QUANTITATIVE ABILITY

Concept Tests

CONTENTS

1 Concept Tests

CALCULATION TECHNIQUES

CONCEPT TEST I

1. 37.5% of 14424 + 25% of 14424 = ?

(1) 9020 (2) 8415 (3) 10,345 (4) 9015

2. 3.7% of 729 + 2.7% of 1369 is approximately equal to?

(1) 48.5 (2) 64 (3) 76.34 (4) 37.5

3. 34634 + 45785 – 36457 – 125 = ?

(1) 43837 (2) 43737 (3) 53837 (4) 43817

4. Find the product of 10013 and 10007

(1) 100300291 (2) 101001231 (3) 100200091 (4) 100100001

5. 3454345375 × 11 = ?

(1) 37497791025 (2) 37997799125 (3) 43745551245 (4) 3111112225

6. Find the product of 111 and 94.

(1) 10434 (2) 343434 (3) 13334 (4) None of the above.

7. 4577876 × 9999999 = ?

(1) 45778455411124 (2) 43111435123444 (3) 45778755422124 (4) 311111111344

8. $\dfrac{\sqrt[3]{2197} + 44 \div 4 \times 12}{\sqrt{841}}$

(1) 2 (2) 8/5 (3) 1.5 (4) 5

9. $\dfrac{3.4545\ldots \times 198}{171} = ?$

(1) 4.4545 (2) 5.4545 (3) 4 (4) None of these.

10. A number 14 when added to twice its seventh multiple and the resultant when divided by the smallest prime number gives the outcome as -

(1) 105 (2) 70 (3) 98 (4) 1

11. $7 + 3 \times \overline{4-2} \div 2 - 2$ of $2 = ?$

(1) 18 (2) 6 (3) 4 (4) None of these.

12. 14.28% of 2401 = x% of 686. Find x?

(1) 50% (2) 12.5% (3) 33.33% (4) None of these.

13. What percent is 825 of 18345?

(1) 5.1 % (2) 4.1 % (3) 4.5 % (4) 5.7 %

CONCEPT TEST II

1. $\left(3\frac{2}{3}+4\frac{2}{4}-5\frac{2}{12}\right)^2 \times \sqrt[3]{729} = (x)^2$. Find x.

(1) 81 (2) 3 (3) 9 (4) None of these.

2. $0.5\overline{45} \times \frac{1331}{216} = x\%$ of $\frac{121}{36}$

(1) 50 % (2) 100 % (3) 25 % (4) None of these.

3. $10 \times \left(3+\frac{3}{5}\right)^{th}$ of $3.45\overline{6} + \left(5+\frac{3}{5}\right)^{th}$ of $\frac{6}{5}$ =?

(1) $\frac{3452}{25}$ (2) $\frac{658}{5}$ (3) $\frac{456}{5}$ (4) $\frac{3279}{25}$

4. 11.11% of 20 % of 30 + 9.09 % of $\frac{33}{2}$

(1) 13/6 (2) 1 (3) 0 (4) 3/2

5. Find the value of $\frac{2}{2\left[3+\frac{3}{2+\frac{3}{2}}\right]+2} + \frac{1}{1+\frac{2}{2\left[3+\frac{3}{2+\frac{3}{2}}\right]}}$

(1) 2/3 (2) 3/2 (3) 1 (4) 1/3

6. 3434344 – 434343 + 3434343 = ?

(1) 6434343 (2) 6434344 (3) 36434334 (4) 6343334

7. $2+\frac{2+2\div 2-\overline{2+2}\times 2+2+2\times 2}{2\times\overline{2+2}-2\times 2-2\times\overline{2-2}}$ =?

(1) 1/2 (2) 3/2 (3) 1 (4) 9/4

8. Consider the following steps for a positive number

1. Multiply a number with 9/4
2. Divide the outcome of step (1) by $\frac{3}{20}$
3. Add the resultant of step (2) with $\frac{1}{5}^{th}$ of the answer in step (2)

If the final value is B such that $B = x$ times the original value. x = ?

(1) 20 (2) 18 (3) 1/4 (4) Cannot be determined.

9. $58^2 - 50^2 - 38^2 + 70^2$ = ?

(1) 41350 (2) –980 (3) 4320 (4) –4870

10. 11.11% of 10% of x + 6.67% of 16.67% of x – 11.11% of 20% of x = ?

(1) 1 (2) $x/45$ (3) $2x/25$ (4) 0

11. $\frac{209}{133}-\frac{162}{126}-\frac{33}{231} = x\%$ of 1

(1) 14.28% (2) 16.67% (3) 25% (4) None of these.

12. 456785 – 348543 + 11111 × 9 – 9 × 10101=?

(1) 107342 (2) 117332 (3) 85342 (4) – 41342

AVERAGES

CONCEPT TEST I

1. Average age of 20 students is 9 years. If the age of the teacher is included the average increases by 2. Find the age of the teacher?

(1) 51 years (2) 50 years (3) 52 years (4) 53 years (5) None of these

2. Average age of three brothers is 10 years. If the age of the father and mother is also considered, the average increases by 13 years. If the father is 5 years elder to the mother, what is the age (in years) of the father?

(1) 42 (2) 44 (3) 45 (4) 40 (5) None of these

3. Ram scored 50% marks in an exam consisting of 5 papers. If Ram scored 40% marks in 4 papers, what is the percentage of marks scored by Ram in the fifth paper? All papers had the same total marks?

(1) 80 (2) 60 (3) 70 (4) 90 (5) 75

4. The average age of a couple married five years back was 24 years at the time of their marriage. The average age of the family now is 20 years. It is known that the couple has one child. What is the age of the child in years?

(1) 2 (2) 3 (3) 4 (4) 1 (5) 5

5. Eight years from now Anuradha will be twice as old as she was 6 years ago. What is her present age?

(1) 14 years (2) 8 years (3) 12 years (4) 20 years (5) None of these

6. The ratio of ages of A and B is 11 : 8 and the sum of their ages is 38 years. Find the ratio of ages of A and B after 8 years.

(1) 4 : 3 (2) 6 : 5 (3) 5 : 4 (4) 7 : 5 (5) 3 : 2

7. Eight years ago, Ramesh was twice as old as Suresh. It the ratio of their ages is 3 : 2 now, find Suresh's present age in years.

(1) 8 (2) 15 (3) 16 (4) 24 (5) None of these

8. A batsman's score in an innings was 2.5 times the average of his score in the first two innings. If his average score in the three innings put together was 90, what was his score in the third innings?

(1) 50 (2) 40 (3) 120 (4) 60 (5) 150

9. A person has two sons. Two years ago, the elder son was twice as old as the younger one and two years hence, the father will be twice as old as the elder son. If the younger son is now 14 years old, what is the person's present age (in years)?

(1) 52 (2) 56 (3) 58 (4) 54 (5) None of these

10. A mother is seven times older than her daughter now, but two years hence she will be only five times older. What is the mother's present age (in years)?

(1) 28 (2) 30 (3) 31 (4) Data insufficient (5) None of these

CONCEPT TEST II

1. The average runs scored by 10 players of a cricket team are 26. If the captain's runs are included, the average increases by 4. What is the captain's score?

   (1) 60 (2) 50 (3) 80 (4) 40 (5) 70

2. A class of 25 students took a science test. 10 students had an average score of 80. The other students had an average score of 60. What is the average score of the whole class?

   (1) 66 (2) 68 (3) 70 (4) 64 (5) None

3. The average age of 5 members of a family is 25 years. If the average age of the two members in that family is 13 years, what is the average age (in years) of the other three members of the family?

   (1) 33 (2) 34 (3) 30 (4) 31 (5) None of these

4. A student solved 15 papers each of four subjects and 5 papers each of another six subjects. If she would have reversed the number of papers she solved of each subject, what would be the effect on the earlier average number of papers she solved per subject?

   (1) Increases by 1 (2) Decreases by 2 (3) Increases by 2
   (4) Decreases by 1 (5) None of these

5. If Jason purchased two suits for Rs. 179 each and three suits for Rs. 189 each, what is the average price (in Rs.) that Jason paid for each suit?

   (1) 185 (2) 186 (3) 183 (4) 184 (5) 187

6. Symphony tickets cost Rs. 16 for adults and Rs. 8 for students. A total of 14 tickets worth Rs. 160 were sold. How many adult and student tickets were sold respectively?

   (1) 6 and 10 (2) 7 and 7 (3) 8 and 6 (4) 10 and 6 (5) 6 and 8

7. The average of the test scores of a class of p students is 70, and the average of the test scores of a class of n students is 92. When the scores of both classes are combined, the average is 86. What is the value of (p/n)?

   (1) 4/9 (2) 2/5 (3) 3/8 (4) 3/10 (5) 4/11

8. If the average of three different positive integers is 70, what is the greatest possible value of one of the integers?

   (1) 207 (2) 208 (3) 209 (4) 210 (5) Cannot be determined

9. The average of p numbers is l. If one of the numbers q is replaced by r, the average becomes m. Which of the following is true?

   (1) $p(l-m) = q-r$ (2) $p(l-m) = r-q$ (3) $p(r-q) = l-m$ (4) $p(q-r) = l-m$

10. In a cricket match, the top five batsmen together scored 30 more runs than the bottom six batsmen taken together. What is the difference in the average runs scored by the top five batsmen and the average runs scored by the bottom six batsmen if the total score of the eleven batsmen is 210?

    (1) 6 (2) 8 (3) 10 (4) 9 (5) None of these

PERCENTAGES

CONCEPT TEST I

1. A batsman scored 110 runs which included 3 fours and 8 sixes. A four and six correspond to 4 and 6 runs respectively, and all other runs have to be scored by running between the wickets. What percent of his total score did he make by running between the wickets?

(1) 45% (2) 45.45% (3) 55% (4) 54.63% (5) None of these

2. If $A = x\%$ of y and $B = y\%$ of x, then which of the following is true?

(1) A is smaller than B.
(2) A is greater than B
(3) Relationship between A and B cannot be determined.
(4) If x is smaller than y, then A is greater than B.
(5) None of these

3. What percent of numbers from 1 to 70 have 1 or 9 in the unit's digit?

(1) 1 (2) 14 (3) 20 (4) 21 (5) None of these

4. In an election between two candidates, one got 55% of the total valid votes. 20% of the total votes cast were invalid. If the total number of votes cast was 7500, the number of valid votes that the other candidate got was:

(1) 2700 (2) 2900 (3) 3000 (4) 3100 (5) 3300

5. A student multiplied a number by 3/5 instead of 5/3. What is the percentage error in the calculation?

(1) 34% (2) 44% (3) 54% (4) 64% (5) None of these

6. Ganesh spends 15% of his salary on fuel, 20% on house rent, 40% on other house expenditures and the remaining amount on his children's education. What is the amount spent by him on fuel if his children's education costs him Rs. 5,000?

(1) Rs. 3,000 (2) Rs. 2,000 (3) Rs. 4,000 (4) Rs. 4,500 (5) None of these

7. A's income is 20% more than B's income while B's income is 20% less than C's income. Whose income is the highest among all?

(1) A (2) B (3) C (4) A and C (5) Cannot be determined

8. If the length of a rectangle is increased by 50% and its breadth is increased by 20% what is the net increase in percentage of the area of the rectangle?

(1) 75% (2) 100% (3) 80% (4) 70% (5) None of these

9. Ravi's initial salary was increased by 50% and then reduced by 50%. What is the net increase or decrease in his initial salary?

(1) Decreases by 25% (2) Increases by 20% (3) Decreases by 20%
(4) Decreases by 30% (5) No change

10. When prices are reduced by 40%, the sales increase by 60%. What is the net effect on revenue earned?

(1) No change (2) Decreases by 4% (3) Increases by 4%
(4) Decreases by 6% (5) Increases by 6%

11. In a Chinese city, the population increases in the first year by 10%, increases in the second year by 10% and decreases in the third year by 10%. If the population now is 100000, what is the population after three years?

(1) 98100 (2) 108000 (3) 121000 (4) 108900 (5) None of these

12. In an examination, Raju got 12 out of the first 16 questions correctly. Out of the remaining questions he got only 25% of the questions correctly. All the questions have equal marks and he got 50% marks in all. What is the total number of questions, if there is no negative marking?

(1) 32 (2) 28 (3) 50 (4) 36 (5) 40

13. A shopkeeper gives 20% discount on the printed price of a book. Raju is a good bargainer and he gets 10% discount on the already discounted price of the book. If the shopkeeper still makes 8% profit in the transaction, by what percentage is the printed price more than the cost price of the book?

(1) 40% (2) 48% (3) 45% (4) 50% (5) Cannot be determined.

14. A student must get 40% marks to pass in an exam. A student gets 30 marks and fails by 6 marks. What are the maximum marks of the exam?

(1) 80 (2) 100 (3) 70 (4) 75 (5) 90

15. If we decrease the selling price of milk by 20%, by what percent should the sales be increased so that the total revenue remains the same?

(1) 20% (2) 15% (3) 30% (4) 22% (5) 25%

INTEREST AND GROWTH RATES

CONCEPT TEST I

1. Reena took a loan of Rs. 1,200 at simple interest for as many years as the rate of interest. If she paid Rs. 432 as interest at the end of the loan period, what was the rate of interest (in %)?

(1) 3.6 (2) 6 (3) 18 (4) None (5) Cannot be determined

2. A certain amount earns simple interest of Rs. 1,750 after 7 years. Had the interest been 2% more, how much more interest (in Rs.) would it have earned?

(1) 35 (2) 245 (3) 350 (4) None (5) Cannot be determined

3. There is 60% increase in an amount in 6 years at simple interest. What will be the compound interest of Rs. 12,000 after 3 years at the same rate?

(1) Rs. 2,160 (2) Rs. 3,120 (3) Rs. 3,972 (4) Rs. 6,240 (5) None of these

4. Albert invested an amount of Rs. 8,000 in a fixed deposit scheme for 2 years at compound interest rate of 5%. What amount will Albert get on maturity of the fixed deposit?

(1) Rs. 8,640 (2) Rs. 8,620 (3) Rs. 8,820 (4) Rs. 8,920 (5) None of these

5. If the simple interest on a sum of money for 2 years at 5% per annum is Rs. 50, what is the compound interest on the same sum at the same rate and for the same time?

(1) Rs. 51.25 (2) Rs. 52 (3) Rs. 54.25 (4) Rs. 60 (5) None of these

6. The difference between simple and compound interests compounded annually on a certain sum of money for 2 years at 4% per annum is Re. 1. The sum (in Rs.) is:

(1) Rs. 625 (2) Rs. 630 (3) Rs. 640 (4) Rs. 645 (5) Rs. 650

7. The compound interest on Rs. 30,000 at 7% per annum is Rs. 4,347. The period (in years) is:
(1) 2 (2) 2.5 (3) 3 (4) 3.5 (5) 4

8. A car is bought new at Rs. 3,00,000 and its cost depreciates at 20% per annum. What is the value of the car (in Rs.) after 4 years?
(1) 2,00,000 (2) 2,04,000 (3) 1,23,380 (4) 2,50,000 (5) 1,22,880

9. A colony of bacteria contains 25000 bacteria and it increases at 10% per hour. What is the count of bacteria 3 hours from now?
(1) 33295 (2) 33695 (3) 33475 (4) 33375 (5) None of these

10. The effective annual rate of compound interest corresponding to a compound interest rate of 6% per annum payable half-yearly is:
(1) 6.06% (2) 6.07% (3) 6.08% (4) 6.09% (5) 6.10%

PROFIT LOSS AND DISCOUNT

CONCEPT TEST I

1. The cost price of 20 articles is the same as the selling price of x articles. If the profit is 25%, then the value of x is:
(1) 15 (2) 16 (3) 18 (4) 20 (5) 25

2. On selling 17 balls at Rs. 720, there is a loss equal to the cost price of 5 balls. The cost price of a ball is:
(1) Rs. 45 (2) Rs. 50 (3) Rs. 55 (4) Rs. 60 (5) Rs. 65

3. A trader mixes 26 kg of rice at Rs. 20 per kg with 30 kg of rice of another variety at Rs. 36 per kg and sells the mixture at Rs. 30 per kg. His profit percent is:
(1) No profit, no loss (2) 5% (3) 8% (4) 10% (5) None

4. 100 oranges are bought at the rate of Rs. 350 and sold at the rate of Rs. 48 per dozen. The percentage of profit or loss is:
(1) (100/7)% Gain (2) 15% Gain (3)(100/7)% Loss
(4) 15% Loss (5) None

5. When a plot is sold for Rs. 18,700, the owner loses 15%. At what price must that plot be sold in order to gain 15%?
(1) Rs. 21,000 (2) Rs. 22,500 (3) Rs. 25,300 (4) Rs. 25,800 (5) None of these

6. The percentage profit earned by selling an article for Rs. 1920 is equal to the percentage loss incurred by selling the same article for Rs. 1280. At what price should the article be sold to make 25% profit?
(1) Rs. 2,000 (2) Rs. 2,200 (3) Rs. 2,400 (4) Rs. 1,800 (5) Data insufficient

7. By what percent must the cost of an item be marked up so that even after a discount of 20%, the same amount is realized as before the discount?
(1) 25 (2) 20 (3) 15 (4) None (5) Data insufficient

8. A man saved Rs. 290 when two successive discounts of 10% and 5% were given on a microwave oven. What was the marked price of the microwave oven?

(1) Rs. 1,800 (2) Rs. 2,500 (3) Rs. 2,200 (4) Rs. 2,400 (5) Rs. 2,000

9. Ramesh and Suresh are two shopkeepers. On a plasma TV which has a marked price of Rs. 20,000, Ramesh offers two successive discounts of 20% and 5% respectively and Suresh offers two successive discounts of 15% and 10% respectively. What is the difference between the discounts offered by Ramesh and Suresh?

(1) Nil (2) Rs. 50 (3) Rs. 100 (4) Rs. 500 (5) None of these

10. Raju makes a profit of 8% when he offers two successive discounts of 10% on a particular product. If the total discount offered is Rs. 190, find the cost price of the product.

(1) Rs. 2,000 (2) Rs. 1,500 (3) Rs. 750 (4) Rs. 900 (5) Rs. 800

11. A sells an article to B for Rs. 1,100 at a 10% profit and B sells it back to A at a 10% loss. What is the overall gain or loss for A in the entire transaction?

(1) No gain no loss (2) Loss of 11% (3) Gain of 11%
(4) Loss of 4% (5) Gain of 4%

12. In a certain deal Virat Enterprises got 20% margin on the selling price of the land. If the cost price of the land is Rs. 1,000 per square foot, what is its selling price per square foot?

(1) Rs. 1,200 (2) Rs. 1,250 (3) Rs. 1,400 (4) Rs. 1,300 (5) None of these

13. Ramesh calculates the profit percentage on the selling price instead on the cost price and obtains the profit percentage as 50%. What is the actual profit percentage?

(1) 100% (2) 50% (3) 75% (4) 60% (5) 80%

14. If we increase CP by 20% and keep the SP same, the profit percentage decreases by 25 percentage points. Find the original profit percentage.

(1) 40 (2) 30 (3) 60 (4) 50 (5) None of these

15. Rajat used to buy wheat at Rs. 10 per kg and sell it at a 20% profit. But, in this month, Rajat had to buy the wheat at Rs. 11 per kg and sell it at the original selling price. Find the new profit percentage.

(1) 10% (2) 15% (3) 8% (4) 9.09% (5) None of these

RATIO AND PROPORTION

CONCEPT TEST I

1. A sum of money is to be distributed among A, B, C, D in the proportion of 5 : 2 : 4 : 3. If C gets Rs. 1,000 more than D, what is B's share?

(1) Rs. 500 (2) Rs. 1,500 (3) Rs. 2,000 (4) Rs. 2,500 (5) None of these

2. The sum of three numbers is 98. If the ratio of the first number to the second is 2 : 3 and that of the second to the third is 5 : 8, then the second number is:

(1) 20 (2) 30 (3) 40 (4) 48 (5) 58

3. It is given that: $\frac{a+b}{xa+yb} = \frac{b+c}{xb+yc} = \frac{c+a}{xc+ya}$

Also it is known that : $x + y \neq 0$ and $a + b + c \neq 0$. Each ratio is then equal to:

(1) $1/(x+y)$ (2) 1 (3) $2/(x+y)$ (4) $1/(a+b)$ (5) None of these

4. If $x : y = 3 : 5$, then find the value of $(3x + y) : (5x - y)$.

(1) 49 : 25 (2) 7 : 5 (3) 36 : 25 (4) 49 : 36 (5) 36 : 16

5. A and B invest in a business in the ratio 3 : 2. If 5% of the total profit goes to charity and A's share of the total profit is Rs. 855, the total profit is:

(1) Rs. 1,425 (2) Rs. 1,500 (3) Rs. 1,537.50 (4) Rs. 1,576 (5) None of these

6. A, B and C jointly thought of engaging themselves in a business venture. It was agreed that A would invest Rs. 6,500 for 6 months, B would invest Rs. 8,400 for 5 months and C would invest Rs. 10,000 for 3 months. A wants to be the working member for which he was to receive 5% of the profits. The total profit earned was Rs. 7,400. Calculate the share of B in the profit.

(1) Rs. 1,900 (2) Rs. 2,660 (3) Rs. 2,800 (4) Rs. 2,840 (5) None

7. If $a : b = 3 : 4$ and $b : c = 5 : 8$, what is $a : b : c$?

(1) 15 : 20 : 32 (2) 12 : 16 : 24 (3) 9 : 12 : 20 (4) 6 : 10 : 16 (5) None of these

8. $a/b = 3/8$, $b/c = 5/3$, $c/d = 4/5$, find d/a.

(1) 1/2 (2) 1/3 (3) 2 (4) 3 (5) None

9. A, B, C subscribe Rs. 50,000 for a business. A subscribes Rs. 4,000 more than B and B subscribes Rs. 5,000 more than C. Out of a total profit of Rs. 35,000, A receives:

(1) Rs. 8,400 (2) Rs. 11,900 (3) Rs. 13,600 (5) Rs. 14,700 (5) None of these

10. a, b, c are in continued proportion. b, c, d are also in continued proportion. If $b : c = 2 : 3$ and all the four numbers are positive integers, what is the minimum possible value of $(a + d)$?

(1) 25 (2) 30 (3) 35 (4) None (5) Data insufficient

11. The fourth proportional to 5, 8, 15 is:

(1) 18 (2) 19 (3) 20 (4) 22 (5) 24

12. Two number are in the ratio 3 : 5. If 9 is subtracted from each, the new numbers are in the ratio 12 : 23. The smaller number is:

(1) 27 (2) 33 (3) 39 (4) 50 (5) 55

13. Ram and Shyam select two fractions, 11/76 and 9/62, respectively. Who has selected the larger fraction?

(1) Ram (2) Shyam (3) Both fractions are equal (4) Cannot be determined

14. Ganesh brought two identical pizzas. He cut one pizza into 6 equal parts and the other one into 9 equal parts. Ramesh ate 2 pieces from the first pizza and 5 pieces from the other one. Suresh ate 3 pieces from the first one and 3 pieces from the second one. What is the ratio of pizzas eaten by Ramesh and Suresh?

(1) 16/15 (2) 15/16 (3) 14/15 (4) 15/14 (5) None of these

15. Identify the correct option:

(1) $\frac{4}{5} > \frac{5}{6} > \frac{6}{7}$ (2) $\frac{4}{5} < \frac{5}{6} > \frac{6}{7}$ (3) $\frac{4}{5} > \frac{5}{6} = \frac{6}{7}$ (4) $\frac{4}{5} < \frac{5}{6} < \frac{6}{7}$ (5) None of these

MIXTURES AND ALLIGATIONS

CONCEPT TEST I

1. Find the ratio in which rice at Rs. 7.20 per kg is mixed with rice at Rs. 5.70 per kg to produce a mixture worth Rs. 6.30 per kg.

   (1) 1 : 3 (2) 2 : 3 (3) 3 : 4 (4) 4 : 5 (5) None of these

2. A shopkeeper mixes two varieties of pulses to get a mixture of pulses. He uses 1 kg and 4 kg of pulses costing Rs. 10 and Rs. 20 per kg respectively. What is the cost of the resultant mixture (in Rs. per kg)?

   (1) 11 (2) 1 (3) 17 (4) 25 (5) 18

3. In what ratio should two alloys with zinc and tin in the ratio 3 : 5 and 5 : 3 respectively be mixed to get a new alloy containing zinc and tin in the ratio 1 : 1?

   (1) 1 : 1 (2) 5 : 4 (3) 2 : 3 (4) 1 : 4 (5) 1 : 3

4. A certain heart stimulant is supposed to contain 2% strychnine. It is prepared from two solutions that contain 10% and 0.1% strychnine respectively. If the amount of heart stimulant to be made is 10 ml, what approximate volume (in ml) of the 0.1% solution is to be used in its preparation?

   (1) 1.9 (2) 2.1 (3) 7.9 (4) 8.1 (5) 9

5. 8 litres are drawn from a cask full of wine and replaced by water. This operation is performed three more times. The proportion of wine now left in the cask is 16 : 81. How much wine (in litres) did the cask hold originally?

   (1) 18 (2) 24 (3) 32 (4) 42 (5) None of these

6. A vessel is filled with liquid, 3 parts of which are water and 5 parts are syrup. How much of the mixture must be drawn off and replaced with water so that the mixture is half water and half syrup?

   (1) 1/3 (2) 1/4 (3) 1/5 (4) 1/7 (5) None of these

7. A container contains 40 litres of milk. From this container, 4 litres of milk were taken out and replaced by water. This process was repeated two more times. How much milk (in litres) is now contained by the container?

   (1) 26.34 (2) 27.36 (3) 28 litres (4) 29.16 litres (5) None of these

8. A solution of ethanol is to be made from equal volumes of two existing solutions. The first of these solutions contains 5% ethanol and 95% impurity. If the final solution cannot contain more than 3% ethanol (due to safety reasons), what is the minimum possible percentage of impurity in the second solution?

   (1) 92.5 (2) 95 (3) 99 (4) 1 (5) None of these

9. A vessel is completely filled with a milk and water solution. The capacity of the vessel is 42 litres. 6 litres of this solution is replaced with pure water. The new concentration of milk in the milk and water solution is 30%. What was the concentration of milk in the original solution?

   (1) 25% (2) 35% (3) 40% (4) 30% (5) None of these

10. A can contains a mixture of two liquids, A and B, in the ratio 7 : 5. When 9 litres of mixture are drawn off and the can is filled with liquid B, the ratio of A and B becomes 7 : 9. How many litres of liquid A were present in the can initially?

(1) 10 (2) 15 (3) 21 (4) 24 (5) 36

11. A bag contains only wheat. 5 kg of sand is added to the bag. The resulting mixture has 20% sand by weight. How much sand (in kg) must be added to the bag in order to form a mixture which has 50% wheat by weight?

(1) 12 (2) 12.5 (3) 20 (4) 15 (5) None of these

12. A man mixes oranges and sweet lime to make a juice. He adds 2 oranges and 3 sweet lime pieces to make the juice. Now, if he interchanges the amount of oranges and sweet lime pieces, what is the percentage increase in the concentration of oranges?

(1) 20% (2) 30% (3) 40% (4) 45% (5) 50%

13. 100 employees at Grade I in an organization have an average salary of Rs. 42 per month while 150 employees at Grade II in the same organization have an average salary of Rs. 36 per month. What is the average salary (in Rs.) of one employee in the organization if these are the only grades in this organization?

(1) 36.2 (2) 40 (3) 38.4 (4) 37.8 (5) 39.2

14. A man mixes some quantity of inferior sugar at Rs. 2.4 per kg with superior sugar at Rs. 4 per kg in the ratio 1 : 3? At what price should he sell the rice to get a 25% profit?

(1) Rs. 3.6 (2) Rs. 4.5 (3) Rs. 5 (4) Rs. 4.2 (5) None of the above

15. A scientist mixes 80% sulphuric acid with water to get 60% sulphuric acid. If 9 litres of 80% sulphuric acid was mixed, what was the quantity of water mixed?

(1) 27 litres (2) 3 litres (3) 4.5 litres (4) 6 litres (5) None of the above

VARIATION

CONCEPT TEST I

1. At the rate of 28 lines per page, a book has 300 pages. If the book has to contain only 280 pages, how many lines should a page contain?

(1) 32 (2) 30 (3) 29 (4) 28 (5) 35

2. 24 people can construct a house in 15 days. But the owner would like to finish the work in 12 days. How many more workers should he employ?

(1) 6 (2) 7 (3) 8 (4) 9 (5) 10

3. It is known that current (I) in an electric circuit is inversely proportional to the resistance (R) in the circuit. When the resistance is 3 ohms, the current is 2 amperes. Find the resistance if the current is 5 amperes; and find the current when the resistance is 5 ohms.

(1) 1 ohms and 1 amperes respectively
(2) 2 ohms and 1 amperes respectively
(3) 2 ohms and 1.2 amperes respectively
(4) 1.2 ohms and 1.2 amperes respectively
(5) 1.2 ohms and 1 amperes respectively

4. A diamond weighing 20 decigram costs Rs. 3,600. Find the loss incurred when it breaks into three pieces whose weights are in the ratio 2 : 3 : 5. Note that the cost of the diamond varies as the square of its weight.

(1) Rs. 1,000 (2) Rs. 1,500 (3) Rs. 1,288.90 (4) Rs. 1,200 (5) Rs. 3,258

5. 60 litres of diesel is required to travel 600 km using a 800 cc engine. If the volume of diesel required to cover a distance varies directly as the capacity of the engine, then how many litres of diesel is required to travel 800 km using 1200 cc engine?

(1) 80 (2) 90 (3) 120 (4) 150 (5) 170

6. The length of the shadow of a 5 m high pole at a certain time of the day is 3.6 m. What is the height of another pole, whose shadow at the same time is 54 meters long?

(1) 45 (2) 50 (3) 54 (4) 60 (5) 40

7. Electric field strength is directly proportional to the charge and inversely proportional to square of the distance between the charge and the test charge. When the charge is 1C and the distance between the charge and the test charge is 1m, the field strength is 9×10^9 N/C. Find the field strength when charge is 2C and the distance is 2m.

(1) 18×10^9 N/C (2) 9×10^9 N/C (3) 13.5×10^9 N/C
(4) 4.5×10^9 N/C (5) None of the above.

8. Gravitational force of attraction between two masses is directly proportional to product of their masses and inversely proportional to square of the distance between them. When the masses are 1kg each and the distance between them is 1m, the force of attraction is 5/3 N. Find the distance in meters between two masses of 2kg each and the force of attraction is 5/3 N.

(1) 2 (2) 4 (3) 5/3 (4) 1 (5) 3

9. If y varies directly as x and inversely as z, and $y = 5$ when $x = 2$ and $z = 4$, find y when $x = 3$ and $z = 6$.

(1) 1 (2) 5 (3) 10 (4) 2 (5) 4

10. The maximum load that a cylindrical column with a circular cross section can hold varies directly as the fourth power of the diameter and inversely as the square of the height. A 9 meter high column 2 meters in diameter will support 64 metric tons. How many metric tons can be supported by a column 9 meters high and 3 meters in diameter?

(1) 162 (2) 243 (3) 432 (4) 486 (5) 324

TIME AND DISTANCE

CONCEPT TEST I

1. An airplane covers a certain distance at a speed of 240 km/hr in 5 hours. To cover the same distance in $1\frac{2}{3}$ hours, it must travel at a speed (in km/hr) of:

(1) 300 (2) 360 (3) 480 (4) 600 (5) 720

2. In covering a distance of 30 km, Abhay takes 2 hours more than Sameer. If Abhay doubles his speed, then he would take 1 hour less than Sameer. Abhay's speed is:

(1) 5 km/hr (2) 6 km/hr (3) 6.25 km/hr (4) 7.5 km/hr (5) None of these

3. Robert is travelling on his cycle and has calculated to reach point A at 2 P.M. if he travels at 10 kmph. He will reach there at 12 noon if he travels at 15 kmph. At what speed (in km/h) must he travel to reach A at 1 P.M.?

(1) 8 (2) 11 (3) 12 (4) 12.5 (5) 15

4. It takes eight hours for a 600 km journey, if 120 km is travelled by train and the rest by car. It takes 20 minutes more, if 200 km is travelled by train and the rest by car. The ratio of the speed of the train to that of the car is:

(1) 2 : 3 (2) 3 : 4 (3) 3 : 2 (4) 4 : 3 (5) None of these

5. John drove for 3 hours at a rate of 50 km per hour and for 2 hours at 60 km per hour. What was his average speed for the whole journey?

(1) 52 km/hr (2) 54 km/hr (3) 56km/hr (4) 58 km/hr (5) 55 km/hr

6. Ramesh travels from Andheri to Bandra with a speed of 10 km/h and returns back with a speed of 15km/h. Find the average speed of Ramesh during the whole journey?

(1) 12 km/hr (2) 12.5 km/hr (3) 13km/ hr
(4) None of these (5) Data insufficient

7. If the human ear can clearly recognize the sound made in $1/10^{th}$ of a second, find the minimum distance at what an obstacle should be placed so that sound waves hit the obstacle and come back and the echo can be heard? (Assume speed of sound wave = 340 m/s)

(1) 16 m (2) 20 m (3) 18 m (4) 17 m (5) Cannot be determined

8. A car drove from Town A to Town B without stopping. The car traveled the first 40 miles of its journey at an average speed of 25 miles per hour. What was the car's average speed, in miles per hour, for the remaining 120 miles if the car's average speed (in miles per hour) for the entire trip was 40 miles per hour?

(1) 28 (2) 40 (3) 50 (4) 60 (5) 70

9. A train is moving at speed of 132kmph. If the length of the train is 110 meters, how long will it take to cross a railway platform 165 m long?

(1) 8s (2) 7s (3) 7.5s (4) 9s (5) 10s

10. A goods train runs at the speed of 72 km/hr and crosses a 250 m long platform in 26 seconds. What is the length of the goods train?

(1) 230 m (2) 240 m (3) 250 m (4) 260 m (5) 270 m

CONCEPT TEST II

1. A train passes a station platform in 36 seconds and a man standing on the platform in 20 seconds. If the speed of the train is 54 km/hr, what is the length of the platform?

(1) 120 m (2) 240 m (3) 200 m (4) 300 m (5) 250 m

2. The speed of a motor boat itself is 20 km/hr and the rate of flow of the river is 4 km/hr. Moving with the stream, the boat went 120 km. What distance will the boat cover in the same time if it goes against the stream?

(1) 80 km (2) 180 km (3) 60 km (4) 100 km (5) None of these

3. A man goes from city A to city B situated 60 km apart by a boat. His onward journey was with the stream while the return journey was an upstream journey. It took him four and half hours to complete the round trip. If the speed of the stream is 10 km/hr, how long did it take him to complete the onward journey?

(1) 3 hours (2) 3.5 hours (3) 2.25 hours (4) 1.5 hours (5) None of these

4. If a boat is moving upstream with a speed of 14 km/hr and goes downstream with a speed of 40 km/hr, then what is the speed of the stream?

(1) 13 km/hr (2) 14 km/hr (3) 27 km/hr (4) 20 km/hr (5) Data insufficient

5. Two cars travel in the same direction at 40km/hr at a regular distance. A car comes in the opposite direction at 60km/hr. It meets each car in a gap of 9 seconds. What is the distance between the two cars?

(1) 300 m (2) 200 m (3) 225 m (4) 275 m (5) 250 m

6. On a straight highway, 2 cars start from the same point in opposite directions. Each travels for 8 km, takes a left turn and then travels for 6 km. What is the distance between them now?

(1) 16 km (2) 20 km (3) 25 km (4) 10 km (5) Data insufficient

7. A and B start moving in opposite directions from the same point on a circular track with speeds of 5 km/h and 10 km/h. Find the time after which they first meet if the length of the circular track is 15 km.

(1) 1 hour (2) 2 hours (3) 1.5 hours (4) 3 hours (5) None of these

8. There is a circular track with perimeter 300 meters. Two joggers, A and B, start from the same point and run at 5 m/s and 10 m/s respectively in the same direction. After what time will they meet again for the first time?

(1) 4 min (2) 3 min (3) 2 min (4) 1 min (5) None of these

9. A, B, C participate in a 200 m race, where A beats B by 20 m and C by 40 m. If B beats C by 24 m, what is the ratio of speeds of B and C?

(1) 5 : 4 (2) 4 : 3 (3) 4 : 5 (4) 9 : 8 (5) Data inconsistent

10. A, B, C participate in a 100m race, in which A beats B by 20m and B beats C by 25m. What is the ratio of speeds of A and C if all three run with a constant speed throughout the race?

(1) 5 : 4 (2) 6 : 5 (3) 5 : 2 (4) 5 : 3 (5) Cannot be determined

CLOCKS

CONCEPT TEST I

1. At what time between 7 and 8 o'clock will the hands of a clock be in the same straight line but, not together?

(1) 5 min past 7 (2) $5\left(\frac{2}{11}\right)$ min past 7 (3) $5\left(\frac{5}{11}\right)$ min past 7 (4) $5\left(\frac{3}{11}\right)$ min past 7

2. The angle in degrees between the minute hand and the hour hand of a clock when the time is 4:20, is:

(1) 0 (2) 5 (3) 10 (4) 15 (5) 20

3. How many times do the hands of a clock coincide in a day?

(1) 22 (2) 20 (3) 21 (4) 23 (5) 24

4. A watch which gains uniformly is 2 minutes slow at noon on Monday and is 4 minutes and 48 seconds fast at 2 p.m. on the following Monday. When was it correct?

(1) 2 p.m. on Tuesday (2) 2 p.m. on Wednesday (3) 3 p.m. on Thursday
(4) 1 p.m. on Friday (5) None of the above

5. At what angle(in degrees) are the hands of a clock inclined at 15 minutes past 5?

(1) $58\left(\frac{1}{2}\right)$ (2) 58 (3) 64 (4) $67\left(\frac{1}{2}\right)$ (5) 70

6. At what time between 9 and 10 o'clock will the hands of a watch be together?

(1) 45 minutes past 9 (2) 50 minutes past 9 (3) $49\left(\frac{1}{11}\right)$ minutes past 9

(4) $48\left(\frac{2}{11}\right)$ minutes past 9 (5) None of the above

7. At what time between 4 and 5 o'clock will the hands of a watch point in opposite directions?

(1) 45 minutes past 4 (2)40 minutes past 4 (3) $50\left(\frac{4}{11}\right)$ minutespast 4

(4) $54\left(\frac{6}{11}\right)$ minutespast 4 (5) None of the above

8. The angle between the minute hand and the hour hand of a clock when the time is 8.30, is:

(1) 60° (2) 70° (3) 75° (4) 80° (5) 105°

9. At what time between 5.30 and 6 will the hands of a clock be at right angles?

(1) $43\left(\frac{5}{11}\right)$ minutes past 5 (2) $43\left(\frac{7}{11}\right)$ minutes past 5 (3) 40 minutes past 5

(4) 45 minutes past 5 (5) None

10. Between 4:00 and 5:00, hour hand and minute hand form a right angle twice. What is the time difference (in minutes) between these two timings?

(1) $32\left(\frac{8}{11}\right)$ (2) $34\left(\frac{5}{11}\right)$ (3) 35 (4) $33\left(\frac{9}{11}\right)$ (5) None of these

TIME AND WORK

CONCEPT TEST I

1. A and B can together do some work in 12 days while B and C together can do it in 15 days and A and C together can do it in 20 days. Find the number of days taken by A alone to finish it.

(1) 25 (2) 30 (3) 35 (4) 40 (5) 60

2. A is twice as good a workman as B. Together they finish a piece of work in 18 days. In how many days can A alone finish the work?

(1) 24 (2) 25 (3) 27 (4) 30 (5) 36

3. 3 men can complete a piece of work in 6 days. Two days after they started the work, 3 more men joined them. How many days will they take to complete the remaining work, if all the men work at the same rate?

(1) 1 (2) 2 (3) 3 (4) 4 (5) 5

4. Two persons, A and B, working together can dig a trench in 8 hours while A alone can dig it in 12 hours. In how many hours B alone can dig such a trench?

(1) 8 (2) 12 (3) 16 (4) 18 (5) 24

5. A can finish a work alone in 18 days while B can finish it alone in 15 days. B worked alone for 10 days and then left the job. In how many days can A alone finish the remaining work?

(1) 5 (2) 4 (3) 7 (4) 6 (5) None of these

6. A is 30% more efficient than B. How much time will they, working together, take to complete a job which B alone could have done in 23 days?

(1) 13 (2) 15 (3) 10 (4) 17 (5) None of these

7. A can do a work in 20 days and B can do the same work in 40 days. If both A and B work with 80% efficiency, find the number of days required for both of them to finish the work, working together.

(1) 20 (2) 30 (3) 18 (4) 50/3 (5) 15

8. A does 80% of a work in 20 days. He then calls in B and they together finish the remaining work in 3 days. How many days would B alone take to do the whole work?

(1) 27 (2) 37 (3) 37.5 (4) 40 (5) None of these

9. A tank is filled in 5 hours by three pipes A, B and C. Pipe C is twice as fast as B and pipe B is twice as fast as A. How much time will pipe A alone take to fill the tank?

(1) 20 (2) 25 (3) 35 (4) None of these (5) Cannot be determined

10. Two pipes A and B can individually fill a tank in 15 minutes and 20 minutes respectively. Both the pipes are opened together but after 4 minutes, pipe A is turned off. What is the total time required to fill the tank?

(1) 10 min. 20 sec. (2) 11 min. 45 sec. (3) 12 min. 30 sec.
(4) 14 min. 40 sec. (5) None of these

11. One pipe can fill a tank three times as fast as another pipe. If together the two pipes can fill the tank in 36 minutes, then the slower pipe will be able to fill the tank alone in how many minutes?

(1) 81 (2) 108 (3) 144 (4) 192 (5) None of these

12. Three pipes A, B and C can fill a tank in 6 hours. After filling the tank together for 2 hours, C is closed and A and B can fill the remaining part in 7 hours. The number of hours taken by C alone to fill the tank is:

(1) 10 (2) 12 (3) 14 (4) 16 (5) 20

13. Twenty women can do a work in sixteen days. Sixteen men can complete the same work in fifteen days. What is the ratio of the capacity of a man and a woman?

(1) 3 : 4 (2) 4 : 5 (3) 5 : 4 (4) 4 : 3 (5) None of these

14. A does a work in 15 days and B does the same work in 10 days. What is the efficiency of the work if both of them are working together?

(1) 1/6 (2) 2/3 (3) ½ (4) 5/9 (5) None of these

15. Ajay does a work in 15 days and Abhay does a work in 20 days which Ajay can do in 18 days. Choose the correct statement:

(1) Abhay is more efficient than Ajay. (2) Ajay is more efficient than Abhay.
(3) Abhay and Ajay are both equally efficient. (4) None of these
(5) Data insufficient

NUMBER SYSTEM

CONCEPT TEST I

1. The smallest natural number n, for which $2n + 1$ is not a prime number is,

(1) 3 (2) 5 (3) 4 (4) 6 (5) None of these

2. Find the sum of all prime numbers between 60 and 75.

(1) 199 (2) 201 (3) 211 (4) 272 (5) 276

3. What is the value of $3 + 6 \div 3 \times 2$?

(1) 7 (2) 6 (3) 4 (4) 1.5 (5) None of these

4. Find the value of: $\frac{[2^4 + (16 - 3 \times 4)]}{[(6 + 3^2) \div (7 - 4)]}$

(1) 2.4 (2) 4 (5) 5 (4) 13.6 (5) 6.8

5. What is the value of $(7 - \sqrt{9}) \times (4^2 - 3 + 1)$?

(1) 62 (2) 60 (3) 56 (4) 48 (5) 42

6. What is the value of $(33 - 2 \times 7) + (5 \times 3 - 22)$?

(1) 8 (2) 24 (3) 186 (4) 536 (5) None of these

7. What is the value of $(15 \div 3 + 4) - (3^2 - 7 \times 2)$?

(1) 4 (2) 14 (3) 5 (4) 15 (5) 25

8. What is the value of $(3 + 2)^2 - 5 \times 3 + 2^3$?

(1) 2 (2) 6 (3) 18 (4) 38 (5) None of these

9. If 123 yields a remainder of 13 when divided by a certain natural number n, what will be the remainder when 492 is divided by $4n$ assuming that the quotient in both cases is the same?

(1) 13 (2) 26 (3) 39 (4) 52 (5) 65

10. When a certain number is divided by 13, the remainder left is 3. However, when the same number is divided by 18, the remainder left is 4. Find one such number.

(1) 94 (2) 44 (3) 29 (4) 104 (5) 192

NUMBER THEORY

CONCEPT TEST I

1. Find the greatest number that divides 43, 91 and 183 so as to leave the same remainder in each case.

(1) 4 (2) 7 (3) 9 (4) 13 (5) 14

2. The least multiple of 7, which leaves a remainder of 4, when divided by 6, 9, 15 and 18 is:

(1) 74 (2) 94 (3) 184 (4) 364 (5) None of these

3. The least number which should be added to 2497 so that the sum is exactly divisible by 5, 6, 4 and 3 is:

(1) 3 (2) 13 (3) 23 (4) 33 (5) 43

4. A, B and C start at the same time in the same direction to run around a circular stadium. A completes a round in 252 seconds, B in 308 seconds and C in 198 seconds, all starting at the same point. After what time will they again at the starting point?

(1) 26 minutes and 18 seconds (2) 42 minutes and 36 seconds (3) 45 minute
(4) 46 minutes and 12 seconds (5) None of these

5. Three numbers are in the ratio of 3 : 4 : 5 and their L.C.M. is 2400. Their H.C.F. is:

(1) 40 (2) 80 (3) 120 (4) 160 (5) 200

6. The greatest number which on, dividing 1657 and 2037, leaves a remainder of 6 and 5 respectively is:

(1) 123 (2) 127 (3) 235 (4) 305 (5) None of these

7. The L.C.M. of two numbers is 48. The numbers are in the ratio 2 : 3. So, the sum of the numbers is:

(1) 28 (2) 32 (3) 40 (4) 64 (5) 72

8. If the sum of two numbers is 55 and the H.C.F. and L.C.M. of these numbers are 5 and 120 respectively, then the sum of the reciprocals of the numbers is equal to:

(1) $\frac{55}{601}$ (2) $\frac{601}{55}$ (3) $\frac{11}{120}$ (4) $\frac{120}{11}$ (5) None of these

9. Find the highest common factor of 36 and 84.

(1) 2 (2) 3 (3) 6 (4) 12 (5) 24

10. The product of two numbers is 2028 and their H.C.F. is 13. The number of such pairs is:

(1) 1 (2) 2 (3) 3 (4) 4 (5) 5

11. The product of two numbers is 4107. If the H.C.F. of these numbers is 37, then the greater number is:

(1) 101 (2) 107 (3) 111 (4) 185 (5) 193

12. The G.C.D. of 1.08, 0.36 and 0.9 is:

(1) 0.03 (2) 0.9 (3) 0.18 (4) 0.36 (5) 0.09

13. When the integer n is divided by 8, the remainder is 3. What is the remainder when $6n$ is divided by 8?

(1) 0 (2) 1 (3) 2 (4) 3 (5) 4

14. If an integer n is divisible by 3, 5 and 12, what is the next larger integer divisible by all these numbers?

(1) $n + 3$ (2) $n + 5$ (3) $n + 12$ (4) $n + 60$ (5) $n + 15$

15. Mr. Brackett works in a factory with his two sons. He is allowed to take a break every 140 minutes while his two sons are allowed to take breaks every 210 minutes and 280 minutes. How many minutes will they have to wait after their first break together to get together again?

(1) 12 hours (2) 13 hours (3) 14 hours (4) 15 hours (5) 16 hours

CALENDARS

CONCEPT TEST I

1. It was Sunday on Jan 1, 2006. What was the day of the week on Jan 1, 2010?
   (1) Sunday (2) Saturday (3) Friday (4) Thursday (5) Wednesday

2. Today is Monday. The 61st day after today will be a:
   (1) Tuesday (2) Wednesday (3) Thursday (4) Friday (5) Saturday

3. If 6th March, 2005 is a Monday, what was the day of the week on 6th March, 2004?
   (1) Saturday (2) Sunday (3) Monday (4) Tuesday (5) Wednesday

4. How many days are there in x weeks x days?
   (1) $7x^2$ (2) $7x$ (3) $14x$ (4) $8x$ (5) None of these

5. The last day of any century cannot be (provided 1st January, 1 AD was a Monday)
   (1) Tuesday (2) Wednesday (3) Monday (4) Friday (5) Cannot be determined

6. What day of the week was 20th June 1837, if the first day of the calendar was a Sunday?
   (1) Monday (2) Tuesday (3) Thursday (4) Friday (5) Saturday

7. Today is 3rd November. The day of the week is Monday. This is a leap year. What will be the day of the week on this date in the third year from now?
   (1) Monday (2) Tuesday (3) Wednesday (4) Thursday (5) Friday

8. How many times does the 29th day of the month occur in 400 consecutive years?
   (1) 4497 (2) 4498 (3) 4499 (4) 4500 (5) 4501

9. Find the day of the week on 16th July, 1776.(Assuming that 1-1-1 is Monday)
   (1) Monday (2) Tuesday (3) Wednesday (4) Thursday (5) Friday

10. If February 1 is a Monday, how many Mondays occur in that particular month?
    (1) 5 (2) 4 (3) 3 (4) Cannot be determined (5) None of these

ALGEBRAIC FORMULAE AND OPERATIONS

CONCEPT TEST I

1. Find the 4th term of the polynomial $\left(4x^2+\frac{5}{x^3}\right)^7$
   (1) $32x^5$ (2) $\frac{4800}{x^2}$ (3) $\frac{1120000}{x}$ (4) $\frac{900000}{x^3}$

2. Which term is independent of x in the polynomial $\left(8x^8+\frac{7}{x^7}\right)^{15}$?
   (1) 10th term (2) 8th term (3) 11th term (4) 9th term

3. What is the remainder when $x^4 + 3x^3 - 20$ is divided by $(x - 2)$?
   (1) 25 (2) - 40 (3) 20 (4) - 45

4. $\frac{24^2 + 144 + 6^2}{24^3 - 6^3} = ?$

(1) 18 (2) 30 (3) 1200 (4) None of the above

5. What is the value when $3(x^3 + 5x^2 + 7x + 3)$ is divided by $(x^3 + 2x^2 - 5x - 6)$?

(1) $3(x + 1)/(x - 2)$ (2) $3/(x + 1)$ (3) $6(x + 1)$ (4) $12(x + 3)/(x + 1)$

6. The degree of the polynomial $\frac{4xy^2}{z^3} - \frac{8x^{10}y^2}{z^8} + \frac{14x^{14}y^8}{x^{12}}$ is?

(1) 0 (2) 4 (3) 10 (4) Cannot be determined.

7. If $a + b = 13$ and $ab = 25$. Find $a^3 + b^3$?

(1) 1332 (2) 942 (3) 1222 (4) 46

8. If $a = 80$, $b = -43$, $c = -37$; then $80^3 - 43^3 - 37^3$ is equal to:

(1) 240 (2) 48 (3) 0 (4) None of the above.

9. When the polynomial $\frac{5x^3}{c} + \frac{5x}{c} - 10c$ is divided by $(x - c)$; the remainder is 5.

What of these could be the value of c?

(1) 2 (2) -4 (3) 10 (4) 7.5

10. If $x^a = y$; $y^b = z$; $z^c = x$; then abc = ?

(1) 0 (2) 1 (3) xyz (4) None of these.

CONCEPT TEST II

1. If $a + b = b + c = c + a$, then the expression

$$\frac{1}{1 + x^{a-b} + x^{b-c}} + \frac{1}{1 + x^{b-c} + x^{c-a}} + \frac{1}{1 + x^{c-a} + x^{a-b}} \text{ equals?}$$

(1) $\frac{3}{1 + x^{a-b}}$ (2) $3(1 + xa - b + xb - c + xc - a)$ (3) 1 (4) None of the above.

2. If $3^a = 5^b = 45^c$; then $\frac{2}{a} + \frac{1}{b} - \frac{1}{c} = ?$

(1) 1 (2) 0 (3) -1 (4) None of these.

3. $\frac{[x^2 + 5x + 4][x^2 + 8x + 15]}{[x^2 + 9x + 20]} = ?$

(1) 1 (2) $x^2 + 4x + 3$ (3) $(x + 3)(x + 4)$ (4) None of these.

4. Add $4x^2 + 12xy + 6y^2$ and $2(x + y)^2$

(1) $(2x + 3y)(2x + 4y)$ (2) $(3x + 2y)(2x + 3y)$ (3) $(3x + 2y)(2x + 4y)$
(4) $(3x + 2y)(4x + 2y)$ (5) None of these

5. Addition of $x^2 + 4x + 3$ and $x^2 + 6x + 5$ = ?

(1) $(x + 1)(x + 4)$ (2) $(x + 1)(2x + 6)$ (3) $(x + 1)(2x + 4)$
(4) $(x + 1)(2x + 8)$ (5) $2(x + 1)(x + 8)$

6. Subtract $2x + 1$ from $2x^2 - 5x - 3$.

(1) $(2x + 1)(x - 5)$ (2) $(2x + 1)(x - 4)$ (3) $(2x + 3)(x - 4)$
(4) $(2x + 1)(x - 2)$ (5) $(2x + 1)(3x - 4)$

7. Subtract $4xy + 2y^2$ from $3x^2 + 9xy + 4y^2$

(1) $(x + y)(3x + 2y)$ (2) $(x + y)(3x + 4y)$ (3) $(2x + y)(x + 4y)$
(4) $(x + 2y)(3x + 2y)$ (5) $(x + y)(2x + 3y)$

8. If $a + b = 11$ and $ab = 30$ then the value of $(a - b)$ could be:

(1) 1 (2) 2 (3) 3 (4) 4 (5) 0

9. If $a + b = 7$ and $ab = 12$ then find $a^3 + b^3$

(1) 111 (2) 81 (3) 91 (4) 135 (5) None of these

10. Multiply $(3x + 4y - 12)$ and $(4x + 7y + 2)$

(1) $12x^2 + 37xy + 28y^2 - 42x + 76y + 24$ (2) $12x^2 + 37xy + 28y^2 - 42x + 76y - 24$
(3) $12x^2 + 37xy + 28y^2 + 42x + 76y - 24$ (4) $12x^2 + 37xy + 28y^2 - 42x - 76y - 24$
(5) $12x^2 + 37xy + 28y^2 + 42x - 76y - 24$

SURDS AND INDICES

CONCEPT TEST I

1. Rationalize $\dfrac{\sqrt{3} + \sqrt{5}}{\sqrt{5} - \sqrt{3}}$

(1) $8 + 2\sqrt{15}$ (2) $4 + \sqrt{15}$ (3) $6 + \sqrt{15}$ (4) $8 + 4\sqrt{15}$ (5) None of these

2. Simplify $3\sqrt{7} + \sqrt{28} - \sqrt{63}$

(1) $\sqrt{7}$ (2) $3\sqrt{7}$ (3) $2\sqrt{7}$ (4) 0 (5) $4\sqrt{7}$

3. Simplify $\sqrt{6} + 1/\sqrt{5} + \sqrt{5}$

(1) $\dfrac{6\sqrt{5} + 5\sqrt{6}}{5}$ (2) $\dfrac{6\sqrt{6} + 5\sqrt{5}}{5}$ (3) $\dfrac{2\sqrt{5} + 5\sqrt{6}}{5}$ (4) $\dfrac{4\sqrt{5} + 5\sqrt{6}}{5}$ (5) None of these

4. Compare $2^{\frac{1}{3}}$ and $3^{\frac{1}{4}}$

(1) $3^{\frac{1}{4}} \leq 2^{\frac{1}{3}}$ (2) $3^{\frac{1}{4}} \geq 2^{\frac{1}{3}}$ (3) $3^{\frac{1}{4}} < 2^{\frac{1}{3}}$ (4) $3^{\frac{1}{4}} > 2^{\frac{1}{3}}$ (5) None of these

5. The pure surd form of $2\sqrt{23}$ will be;

(1) $\sqrt{92}$ (2) $\sqrt{23}$ (3) 2 (4) $\sqrt{46}$ (5) None of these

6. If $3^x \times 2^{(x+2)} = 5184$, find x.

(1) 3 (2) 4 (3) 5 (4) 2 (5) 6

7. If $5^{2x} \times 3^x + 5^x = 5650$, find x.

(1) 1 (2) 2 (3) 3 (4) 4 (5) None of these

8. Rationalise $\dfrac{\sqrt{17} + 4}{\sqrt{17} - 4}$

(1) $32 + 8\sqrt{17}$ (2) $33 + 8\sqrt{17}$ (3) $35 + 8\sqrt{17}$ (4) $33 + 4\sqrt{17}$ (5) $16 + 4\sqrt{17}$

9. What is the value of $x^{(a2+3a+2)} \times x^{(-3-4a)} \times x^{(2-a-a2)}$?

(1) x^a (2) x^{2a} (3) 1 (4) 0 (5) None of the above

10. What is the value of $\sqrt{20} - \sqrt{180} + \sqrt{245} - \sqrt{45}$

(1) $\sqrt{20}$ (2) $2\sqrt{20}$ (3) 1 (4) 0 (5) None of the above

LOGARITHMS

CONCEPT TEST I

1. Find $\log_{12}36 + \log_{12}48$

(1) 4 (2) 3 (3) 5 (4) 2 (5) 3.5

2. If $\log_6 3 = 0.61$ then find $\log_6 2$.

(1) 0.41 (2) 0.62 (3) 0.39 (4) 0.29 (5) None of these

3. If $\log_9 x + \log_9 27 = 3$, then find x.

(1) 27 (2) 45 (3) 9 (4) 81 (5) None of these

4. If $(\log x)^2 - 2(\log x) + 1 = 0$, then find x.

(1) 10 (2) 100 (3) 1 (4) 1000 (5) None of these

5. If $511^{(3\log_{511} x)} = 8$ then find x.

(1) 8 (2) 511^2 (3) 2 (4) 511 (5) 4

6. Find value of $\log_{15}45 + \log_{15}5$.

(1) 2 (2) 3 (3) 4 (4) 1.5 (5) None of these

7. Which of the following is the smallest?

(1) log 23 + log 21 (2) log 121 + log 4 (3) 2log 22
(4) log 44 + log 11 (5) All are equal

8. If $\log_{15}5 = 0.59$ then find $\log_{15}9$.

(1) 0.84 (2) 1.18 (3) 0.41 (4) 0.82 (5) None of these

9. If $\log_6(x+3) + \log_6(x+8) = 2$, then find x.

(1) 1 (2) -12 (3) -1 (4) 12 (5) More than one of the above

10. If $\log(x^2 - 4x - 12) - \log(x-6) = 2$, find x.

(1) 96 (2) 98 (3) 102 (4) 108 (5) 8

LINEAR EQUATIONS

CONCEPT TEST I

1. Find the value of x, if $7x + 8(2-x) + 10 = 4x - 4$

(1) 5 (2) 6 (3) 7 (4) 8 (5) 9

2. Suresh wins one million in a lottery. He spends half the money to buy a house, half of the remaining amount to buy a car and 20% of the remaining amount to buy a motorcycle. Find the amount left with Suresh.

(1) 1.5 lakhs (2) 2.5 lakhs (3) 2 lakhs (4) 1 lakhs (5) 4 lakhs

3. Ramesh travelled 60% of a journey by train and the remaining by road, thus taking 8 hours to complete the journey. If he travels 30% of the journey by train and 70% by road, he requires 12 hours to complete the same journey. If the average speed of the train journey and the road journey remains constant, find the ratio of the average speed of the train journey to the average speed of the road journey.

(1) 1 : 6 (2) 6 : 1 (3) 3 : 1 (4) 1 : 3 (5) Cannot be determined

4. A two digit number when reversed becomes one less than thrice the original number. Find the original number.

(1) 15 (2) 27 (3) 39 (4) 14 (5) More than one number is possible

5. Solve the following linear equation;

$11a + 17b = 73$
$17a + 11b = 67$

(1) $a = 3, b = 2$ (2) $a = 3, b = 3$ (3) $a = 2, b = 3$
(4) $a = 2, b = 2$ (5) None of these

6. In a management test, 3 marks are awarded for a correct answer and 1 mark is deducted for an incorrect one. There is no negative marking. Suresh attempted 70 out of 100 questions and managed to score 170 marks. Find the number of questions correctly answered by Suresh.

(1) 60 (2) 50 (3) 55 (4) 65 (5) 59

7. How many two digit numbers are 72 less than the number obtained by reversing the digits of the original number?

(1) 1 (2) 5 (3) 3 (4) 2 (5) None of these.

8. If $7a + 4b + c = 51$ and $3a + 4b + 5c = 15$ then find $a + b + c$

(1) 5 (2) 6 (3) 4 (4) 3 (5) 1

9. On a certain island, there are coins available in only two denominations – Rs. 2 and Rs. 5. Suresh has 100 coins with him, such that the total amount is Rs. 350. How many Rs. 2 coins does Suresh have?

(1) 50 (2) 55 (3) 60 (4) 65 (5) 70

10. A two digit number when reversed becomes three less than the four times the original value. Find the original number.

(1) 15 (2) 17 (3) 16 (4) 19 (5) None of these

11. The units digit of a certain two digit number is three more than the tens digit. Find the difference between the number and the number obtained by reversing the number.

(1) 18 (2) 9 (3) 3 (4) 27 (5) None of these

12. Solve the following linear equation;

$3a + 4b = 40,$
$7a + 3b = 49$

(1) $a = 4, b = 6$ (2) $a = 5, b = 6$ (3) $a = 4, b = 7$
(4) $a = 3, b = 8$ (5) More than one solution is possible

13. Ramesh had twice as many 2 rupee coins as 5 rupee coins. Had the number of coins been interchanged, he would have had 30 rupees extra. How many coins did Ramesh have in all?

(1) 12 (2) 6 (3) 18 (4) 21 (5) 30

14. Find a if a, b and c satisfy the following equations;

$a - 3b + 3c = -4$
$2a + 3b - c = 15$
$4a - 3b - c = 19$

(1) 1 (2) 2 (3) 3 (4) 4 (5) 5

15. Find x if x, y and z satisfy the following equations;

$4x + y - 2z = 0$
$3x - 3y + 3z = 9$
$6x - 2y + z = 0$

(1) 1 (2) 6 (3) 9 (4) 3 (5) Not defined

QUADRATIC AND HIGHER ORDER EQUATIONS

CONCEPT TEST I

1. Find the roots of the equation $x^2 + 7x - 60 = 0$

(1) 12, –5 (2) 12, 5 (3) –12, 5 (4) –12, –5 (5) None of these

2. If equation $ax^2 + 4x + 2 = 0$ has real roots, find the largest value of a.

(1) 4 (2) 2 (3) 3 (4) –2 (5) None of the above

3. If one of the roots of the equation $x^2 + 2x + a = 0$ is 3, find the value of a.

(1) –15 (2) 15 (3) 25 (4) –25 (5) None of the above

4. If the equation $x^2 + ax + 9 = 0$ has equal roots, find the value of a if $a > 0$.

(1) –6 (2) 3 (3) 4 (4) 6 (5) 8

5. Find the roots of the equation $(x - 5)(x - 7) = 8$

(1) 3, 6 (2) 5, 7 (3) 6, 9 (4) 3, 9 (5) 5, 9

6. Find the roots of the equation $(x - 6)(x - 5) = (x - 5)(8 - x)$

(1) 5, 7 (2) 5, –7 (3) 6, 8 (4) 5, 8 (5) 5, 6

7. Find the nature of the roots of the equation $x^2 + 4x + a = 0$ if $a < 2$.

(1) Both the roots must be real
(2) Both the roots may be real
(3) Both the roots must be complex
(4) Both the roots may be complex
(5) More than one of the above

8. If α and β are the roots of the equation $x^2 - 7x + 8 = 0$, then find $\alpha^2 + \beta^2$

(1) 32 (2) 33 (3) 34 (4) 35 (5) None of these

9. If α and β are the roots of the equation $x^2 - 7x + 8 = 0$, then find $\alpha^2 - \beta^2$

(1) $\pm \sqrt{15} \times 7$ (2) $\pm \sqrt{19} \times 7$ (3) $\pm \sqrt{21} \times 7$
(4) $\pm \sqrt{33} \times 7$ (5) $\pm \sqrt{17} \times 7$

10. If the roots of the equation $x^2 - ax + a = 0$ are positive integers, find the value of a.

(1) 1 (2) 2 (3) 3 (4) 4 (5) More than one value is possible

INEQUALITIES

CONCEPT TEST I

1. If $x^2 + 9x - 112 < 0$; then

(1) $x > 7$ or $x < -16$ (2) $x > 7$ or $x > -16$ (3) $-16 < x < 7$ (4) Cannot be determined.

2. If $3x^2 - 3x - 18 > 0$; then

(1) $-2 < x < 3$ (2) $x < 3$ or $x > -2$ (3) $x > 3$ or $x < -2$ (4) None of these.

3. If $15x^2 - 34x + 15 \le 0$; then

(1) $\frac{3}{5} \le x \le \frac{5}{3}$ (2) $\frac{3}{5} < x < \frac{5}{3}$ (3) $x \ge \frac{3}{5}$ or $x \ge \frac{5}{3}$ (4) $x \ge \frac{5}{3}$ or $x \le \frac{3}{5}$

4. If $m = \left(\frac{3}{5}\right)^x \times \left(\frac{4}{7}\right)^x$ then which of the following is definitely true if x is an integer

(1) $m \le 0$ (2) $m < 0$ (3) $m \ge 0$ (4) $m > 0$

5. If $m > n$; which of the following is definitely true? (m & n are real numbers.)

(1) $am > an$; $a \in$ Real numbers. (2) $\frac{m}{a} > \frac{n}{a}$; $a \in$ Real numbers.

(3) $\frac{1}{m} < \frac{1}{n}$ (4) None of these

6. If $|3x + 9| < 3$; then.

(1) $x > 4$ or $x < -2$ (2) $-4 < x < -2$ (3) $x > -4$ or $x < -2$ (4) Cannot be determined.

7. $3x + 2y \le 24$; $x \ge 5$ & $y \ge 2$; then which of the following is a valid range?

(1) $2 \le y \le 9/2$ (2) $5 \le x \le 20/3$
(3) $6 \le x \le 8$ (4) More than one of the above

8. If $(x - 16)^2 \ge 0$ & $x \in R$; then which of the following is definitely true?

(1) $x < 16$ (2) $x = 16$ (3) $16 \le x \le \infty$ (4) None of these.

9. If $|3x| + 9 = 3$; then the value of 'x' could be?

(1) $x = -2$ (2) $x = 2$ (3) $x = 1$ (4) Data Inconsistent.

10. If $\left|\frac{4x + 5}{10}\right| \le 7$; then.

(1) $x \ge -\frac{75}{4}$ & $x \ge \frac{65}{4}$ (2) $-\frac{75}{4} \le x \le \frac{65}{4}$

(3) $15 \le x \le 16$ (4) None of these.

BASICS OF GEOMETRY

CONCEPT TEST I

1. $\angle A = 60°$. Find the complementary angle of $\angle A$.

   (1) 40° (2) 30° (3) 20° (4) 60° (5) 120°

2. $\angle A + \angle B + \angle C = 240°$, $\angle A = 80°$ and $\angle A$ and $\angle C$ are supplementary. Find $\angle C$ and $\angle B$.

   (1) 80°, 60° (2) 60°, 100° (3) 100°, 60° (4) 60°, 80° (5) None of these

3. L1, L2 and L3 are three parallel lines. Line T1 intersects L1, L2 and L3 at A, B and C, and line T2 intersects L1, L2 and L3 at E, F and G. If AB = 6, BC = 8 and EG = 28. Find FG.

   (1) 12 (2) 16 (3) 14 (4) 10 (5) 15

4. L1 and L2 are parallel lines. Let line T intersect L1 and L2. Let the smallest angle between L1 and T be 60°. Find the obtuse angle between line L2 and T.

   (1) 60° (2) 120° (3) 30° (4) 150° (5) 90°

5. ABCD is a square. E is some point out side the square such that ABE is an equilateral triangle. Find $\angle DEA$.

   (1) 60° (2) 50° (3) 45° (4) 30° (5) None of the above

6. ABCD is a trapezium such that AB || CD and AB < CD. Let E be some point on CD such that, AE = EB. Find $\angle EAB$ if $\angle AEB = 50°$.

   (1) 50° (2) 60° (3) 65° (4) 55° (5) None of these

7. The angles of a triangle are in A.P. If one of the angles is 30° then find the measure of the largest angle.

   (1) 60° (2) 80° (3) 90° (4) 120° (5) None of these

8. ABCD is a parallelogram. If ΔABC is an equilateral triangle, find $\angle BCD$.

   (1) 60° (2) 120° (3) 90° (4) 150° (5) 80°

9. In ΔABC, E is some point on BC such that BE = AE and EC = AE. Find $\angle A$.

   (1) 60° (2) 120° (3) 90° (4) 80° (5) Cannot be determined

10. Which of these is a reflex angle?

    (1) 90° (2) 120° (3) 180° (4) 225° (5) None of the above

TRIGONOMETRY

CONCEPT TEST I

1. If $\tan x = 4/3$, then find $2\cos^2 x + \cos x + 2$. (Assume $\cos x$ is positive)

   (1) 78/25 (2) 83/25 (3) 81/25 (4) 87/25 (5) 77/25

2. If $2\sin^2 x - 3\sin x + 1 = 0$, what is the value of the acute angle x (in degrees)?

   (1) 45 (2) 30 (3) 60 (4) 90 (5) 0

3. If the length of the shadow of two poles - pole A and pole B - is 15 and 12 meters respectively, what is the ratio of the height of pole A and pole B, if the shadow of both the poles falls on the same straight line?

(1) 3/5 (2) 2/5 (3) 4/5 (4) 5/4 (5) 5/3

4. The difference between the lengths of the shadow of two poles is 30. If the ratio of the heights of these poles is 3 : 2, what is the length of the shadow of the largest pole?

(1) 30 (2) 50 (3) 60 (4) 90 (5) 120

5. From a certain point, Ajit observes that the angle of elevation of a certain tower is 30°. He then walks 20 m towards the tower and observes that the angle of elevation increases to 60°. Find the height of the tower.

(1) $10\sqrt{3}$ (2) $20\sqrt{3}$ (3) 10 (4) 20 (5) None of these

6. Sushil is standing 25 m away from a tower. If the angle of elevation of the tower from this point is 45°, find the height (in m) of the tower.

(1) 25 (2) $25\sqrt{2}$ (3) 50 (4) 40 (5) None of these

7. Rohit was standing on a bridge of height 20 m. He observed a train coming towards the bridge. He noticed that the angle of depression changed from 45° to 90° in 10 seconds. Find the speed of the train in m/s. (Neglect the height of the train)

(1) 2 m/s (2) 4 m/s (3) 3 m/s (4) 0.5 m/s (5) Cannot be determined

8. A man was standing on a tower and observed a manhole with an angle of depression 30°. If the height of the tower is $20\sqrt{3}$ m, what is the distance of the manhole from the base of the tower?

(1) 30 m (2) 20 m (3) 20/3 m (4) 60 m (5) 40 m

9. Find cosec x if, $\cos^2 x - 3 = 3\sin x$ and $\cos^2 x + \sin^2 x = 1$

(1) 1 (2) −1 (3) $2/\sqrt{3}$ (4) 2 (5) Not defined

10. If $2\tan x = 1 + \tan^2 x$ then find $\sin x$, if x is in the first quadrant.

(1) 1 (2) $1/\sqrt{2}$ (3) 1/3 (4) 2/3 (5) None of these

11. Find $\cos^2 x$ if $\sec^2 x + 1 = 2\tan^2 x$ and $\tan^2 x + 1 = \sec^2 x$.

(1) 1/2 (2) 1/4 (3) 1/3 (4) 3/4 (5) 1

12. A straight tree breaks due to a storm and the broken part bends so that the top of the tree touches the ground making an angle of 30° with the ground. If the original height of the tree was 90 m, find the length of the bent part.

(1) 30 m (2) $90(\sqrt{2} - 1)$ m (3) 60 m (4) 75 m (5) Cannot be determined

13. An airplane flying horizontally is observed at an angle of elevation of 60°. After 10 seconds, it was observed at an angle of elevation of 30°. If the speed of the plane is 100 m/s, find the height at which the plane is flying.

(1) $\frac{500}{\sqrt{3}}$ (2) 1000 (3) $1000\sqrt{3}$ (4) $1000/\sqrt{3}$ (5) $500\sqrt{3}$

14. The angle of elevation of a ladder leaning against a wall is 60° and the foot of the ladder is 4.6 m away from the wall. The length of the ladder (in meters) is:

(1) 2.3 (2) 4.6 (3) 7.8 (4) 6.9 (5) 9.2

15. From a point P on a level ground, the angle of elevation of the top of a tower is 30°. If the tower is 100 m high, the distance of point P from the foot of the tower is:

(1) 149 (2) 156 (3) 173 (4) 200 (5) None of these

MENSURATION

CONCEPT TEST I

1. A mosquito is flying in a room having dimensions 8 ft × 6 ft × 10 ft. It has to fly from one corner to the farthest opposite corner of a room to collect food. It collects the food and returns to its original spot. Find the minimum possible distance covered by the mosquito?

(1) $20\sqrt{2}$ ft. (2) 20 ft. (3) $4\sqrt{47}$ ft. (4) None of these

2. A house made of cardboard has 4 walls, a base and a roof top each of dimension 6 m. A metal rod is to be placed inside the house for its stability such that the rod should touch of two farthest vertices. Find the length of the rod.?

(1)6 m. (2) $6\sqrt{3}$ m. (3) 36 m. (4) None of these

3. For a house having a square flooring of area 25 m^2 and wall height 8 m, what is the area that gets painted, if only the 4 walls are to be painted?

(1) 210 m^2 (2) 180 m^2 (3) 100 m^2 (4) None of these

4. How many litres of milk can be filled in a spherical tank of outer diameter of 10 m, with the thickness of the tank being 2 m?

(1) 48π m^3 (2) 96π m^3 (3) 36π m^3 (4) None of these

5. A conical cup with a lid is to be painted. The cost of the paint is Rs 70 perm^2. The radius of the cup is 3 m and the vertical height is 4 m. Find the total cost of painting the cup?

(1) Rs. 4,360 (2) Rs. 4,280 (3) Rs. 5,280 (4) Rs. 4,340

6. What is the total surface area of a rectangular parallelopiped. of volume 225 cm^3 and the base area of 25 cm^2 which is also the length of the cuboid

(1) 518 cm^2 (2) 320 cm^2 (3) 468 cm^2 (4) None of these

7. Find the length of a circular ring that could be embedded in a spherical ball of volume $\left(\frac{539}{3}\right)cm^2$

(1) 44 cm (2) 176 cm (3) 84 cm (4) 22 cm

8. A cylindrical vessel of radius 21 m and height 5 m is 60% filled with water. How many pebbles of diameter 2 m are approximately required to fill the vessel?

(1) 540 (2) 340 (3) 662 (4) 750

9. Find the percentage change in the volume of a cuboid if two of its dimensions change by 20% and the third dimension changes by 25%?

(1) 80% (2) 120% (3) 40% (4) 160%

10. A distemper used in painting a cylindrical box of radius and height of 2 cm and having a top and base is now used to paint a spherical ball of the same radius. What percentage of the spherical ball would be painted if the same amount of distemper is used?

(1) 80% (2) 67.67% (3) 100% (4) Cannot be determined

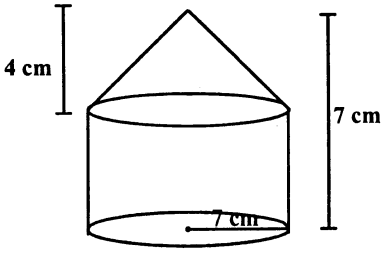
11. A rectangular cuboid has length, breadth and height in the ratio 1 : 2 : 4. A rod of length 28 m equivalent to the body diagonal is placed inside the cuboid. If due to decay, the length of the body diagonal reduces by 25%, how much does the length of the cuboid become if the dimensions are in the same ratio as before?

(1) 3.45 m (2) 4.5 m (3) 6.35 m (4) 8.5 m

12. A gold solid cylinder of radius 7 cm and 4 cm and a gold spherical ball of radius 7 cm is melted. An aluminium sheet of length 31 cm and breadth 11 cm is plated with the liquid gold. Find the height of the gold plated on the aluminium sheet?

(1) 14 cm (2) 18 2/3 cm (3) 19 cm (4) None of these

13. Find the cost of painting the figure below externally at the rate of Rs. 4/m^2



(1) Rs. 5,000 (2) Rs. 6,500 (3) Rs. 14,384 (4) None of these

14. A hemisphere of total surface area 1,848 cm^2 is dropped in a vessel containing water to the brim. Find the amount of water displaced (in cm^3)

(1) 5749 1/3 cm^3 (2) 5849 2/3 cm^3 (3) 1437 cm^3 (4) None of these

15. A cube of side 'a' cm is painted on all its sides. A total of 'n' Rs. is spent in painting all of its sides. If 3 cuts (one each parallel to the three axes) divides the cube into smaller cubes of equal sizes and if the smaller cubes are painted, 'y' amount is spent. $y = bn$. Find b.

(1) 1 (2) 2.5 (3) 2 (4) 3

SEQUENCES, PROGRESSIONS & SERIES

CONCEPT TEST I

1. The ratio of the 5th term of an A.P. to the 7th term of the same A.P. is 0.Find the ratio of the 12th term to 13th term of the A.P.?

(1) 3/4 (2) 4/5 (3) 7/8 (4) Cannot be determined.

2. The sides of a quadrilateral are in A.P. The semi perimeter of the quadrilateral is 40. The second largest side of the quadrilateral is three times the smallest side. How much will the largest side measure?

(1) 28 (2) 32 (3) 40 (4) None of these.

3. Sum of all the multiples of 7 in the range 1 - 491 is?

(1) 17402 (2) 14395 (3) 21347 (4) 17395

4. The 1st term of an A.P is 17 and the product of the 2nd and 4th term equals the product of the 5th and 6th term of the A.P. Find the 3rd term of the A.P.?

(1) 7 (2) -14 (3) -35 (4) Cannot be determined.

5. The least number of terms for which the sum of the series $3 \times 4 + 3 \times 4^2 + 3 \times 4^3 \ldots$ is 4000 is?

(1) 2 (2) 6 (3) 8 (4) 5

6. If w, x, y, z are in A.P ; then,

(1) $2w - 3x + z = 0$ (2) $3w - 4z + 2x = 0$
(3) $2z + 3y + x - 2w = 0$ (4) $4y - 3w + 3y = 0$

7. My travelling expenses are Rs. 1,875, my meal costs Rs. 300 & Rs. 1,450 is the cost of my stay. I decided to borrow the entire amount from Amit. I would return the amount to Amit in 'n' installments, with each installment to be paid at the end of each month. Also, I do not have to pay any interest. Find n, if I pay Rs. 25 at the end of the first month and pay Rs. 75 more than the previous installments for each successive installment?

(1) 7 (2) 8 (3) 13 (4) None of these.

8. Rajesh plans to save money for gifting his friend. He puts Rs.150 in the piggy bank and then puts Rs.25 more than the previous instance, each time he puts in money. If he regularly puts in money each month, how much money (in Rs.) would be accumulated after 3 years?

(1) 12350 (2) 21150 (3) 41325 (4) None of these.

9. The fifth term of a G.P. is 64 times the second term. If the fourth term is – 320, find the sixth term of the G.P.

(1) –5120 (2) 1280 (3) –1280 (4) None of these.

10. A ball is thrown up. It reaches to a height of 3000m and comes back to the ground. It bounces to $2/3^{rd}$ of the height each time it touches ground. Find the approximate vertical distance travelled by the ball before it comes to rest.

(1) 9000m (2) 18000m (3) 6000m (4) None of these.

11. The sum upto infinity of the series $\frac{4}{5}+\frac{3}{4}+\frac{4}{25}+\frac{3}{16}+\frac{4}{125}+\frac{3}{64}\ldots$ is?

(1) 25/16 (2) 16/25 (3) 1 (4) 2

12. The product of 3 terms of an G.P is 1728. If the 3^{rd} term is 4 times the 1^{st} term, find the 3^{rd} term?

(1) 6 (2) 3 (3) –8 (4) Cannot be determined.

13. The ratio of the sum of the first six terms of a G.P. to that of the sum of the first three terms of the G.P.is 217 : 1.Find the common ratio.

(1) 5 (2) 3/2 (3) 6 (4) Cannot be determined.

14. If you save Rs. 7 on 1^{st} May, Rs.14 on 2^{nd} May, and Rs.28 on 3^{rd} May, how much would you save by 15^{th} May?

(1) 229369 (2) 4163335 (3) 11345 (4) 30945345

15. If x, y, z are in G.P; $\log x$, $\log y$, $\log z$ are in?

(1) A.P. (2) G.P. (3) H.P. (4) Cannot be determined.

PERMUTATIONS & COMBINATIONS

CONCEPT TEST I

1. There are 5 flights ($F1$, $F2$, $F3$, $F4$, $F5$) connecting Mumbai-Kolkata and 3 roads ($R1$, $R2$, $R3$) connecting Kolkata-Nepal. In how many ways can a person travel from Mumbai to Nepal such that road $R2$ is accessible only for flight $F3$?

   (1) 15 (2) 12 (3) 10 (4) 11 (5) None of these.

2. How many 4-digit odd numbers can be formed using the digits 0, 1, 3, 4, 5?

   (1) ${}^5P_4$ (2) ${}^5C_4$ (3) 300 (4) 240 (5) None of these.

3. A baggage is locked with a 3-digit lock containing the digits 0 to 9. A traveller forgets the unique code but remembers that all the digits of the code are not similar. What is the maximum number of trials needed before the traveller definitely gets the code?

   (1) ${}^{10}P_3$ (2) 10! (3) 990 (4) 10^3 (5) None of these.

4. There are 10 politicians on a dias. Each politician presents a bouquet to every other member on the dias including himself or herself. A politician may also present a received bouquet to other politicians. What is the minimum number of unique bouquets are required?

   (1) 55 (2) 45 (3) 40 (4) 200 (5) None of these.

5. In how many ways can a committee of 5 be formed from 3 boys and 4 girls if a particular boy is always selected?

   (1) 21 (2) 15 (3) ${}^3C_1 \times {}^6C_4$ (4) ${}^6C_4$ (5) None of these.

6. In how many ways can the letters of the word MYSTERIOUS be arranged?

   (1) 11! / (2! 2!) (2) 10! / 2! (3) 10! (4) 10! 2! (5) None of these.

7. There are 8 different coloured balls in a basket. In how many ways can the selection be done such that the balls are picked up in a group of multiples of 2?

   (1) 256 (2) 128 (3) 127 (4) 64 (5) None of these.

8. There are 5 similar red balloons and 4 similar yellow balloons filled with helium gas. If we have the option to release them in air, how many different combinations of balloons can be seen flying if atleast 1 balloon of each colour is released?

   (1) $2^9 - 1$ (2) 30 (3) 20 (4) 29

9. There are 5 DGPs and 3 IGPs sitting around a circular table for a discussion. In how many ways can they be seated such that 2 particular IGPs are never together?

   (1) 7! (2) $7! - {}^3C_2$ (3) $7! - 6! \times 2!$ (4) $4! \times 2!$

10. Salim makes a necklace for Rajesh. The necklace has only the alphabets present in Rajesh's name. How many different necklaces can he use if all the available alphabets are to be used in each necklace?

    (1) 720 (2) 120 (3) 24 (4) 60

CONCEPT TEST II

1. ${}^{14}C_{10} + {}^{14}C_{11} = ?$

   (1) 1345 (2) 2165 (3) 1930 (4) 1365

2. The number of ways of selecting 2 people out of n people is 5 more than selecting 3 people out of 5. What is the value of n?

   (1) 3 (2) 4 (3) 5 (4) 6

3. There are 7 parallel horizontal lines perpendicularly placed on 4 parallel vertical lines. The number of rectangles formed is?

   (1) 126 (2) 144 (3) 55 (4) 720

4. There are 10 different fruits in a basket. In how many ways can the fruits be selected?

   (1) 1 (2) 10! (3) 1024 (4) 1023

5. 4 boys and 3 girls sit around a circular table to have a sip of coffee. In how many ways can they be seated such that no 2 girls are together?

   (1) 120 (2) 144 (3) 4! × 4! (4) 3! × 2!

6. Sunita has six identical pens, four identical pencils and three different erasers. In how many can sunita arrange these in a row?

   (1) 3! (2) 13! (3) $\frac{12!}{10!}$ (4) $\frac{13!}{6!\,4!}$ (5) $\frac{12!}{6!\,4!\,3!}$

7. There are 17 registrations for 15 vacancies. Out of these 17 registrations, 5 are from a reserved category. If three positions are reserved for this reserved category and the remaining positions are open for all candidates, find the number of ways in which the candidates can be selected.

   (1) ${}^{5}C_{3}$ (2) ${}^{5}C_{3} \times {}^{12}C_{12}$ (3) ${}^{5}C_{3} \times {}^{14}C_{12}$ (4) ${}^{17}C_{15}$ (5) None of these

8. Pristine is considering 12 scientists to form an 8-member team. Out of these twelve scientists, three are theoretical physicists. In how many way they Pristine form the team is there have to be exactly two theoretical physicists in the team?

   (1) 252 (2) 336 (3) 495 (4) 165 (5) None of these

9. City A is connected with 3 cities. Each of these 3 cities is connected to 5 different cities. Now, City is B is connected to all 15 cities. Find the number of different paths possible to reach city B from city A.

   (1) 15 (2) 225 (3) 45 (4) 53 (5) 35

10. Find the number of ways in which the letter of CONNUNDRUM can be arranged.

    (1) 10! (2) 7! (3) $\frac{10!}{3!\,2!}$ (4) $\frac{10!}{5!}$ (5) None of these

PROBABILITY

CONCEPT TEST I

1. Five friends go for a movie at a suburban theatre. On the way Suresh and Ramesh have a tiff and are now not on talking terms with each other. What is the probability that they are not seated together?

   (1) 2/5 (2) 6!7! (3) 3/5 (4) 1/10

Directions for questions 2 to 4: A showroom is conducting an exhibition for its employees. It has 3 Dell, 5 Asus and 6 IBM laptops.

2. What is the probability of choosing 4 laptops from the same company?

(1) 21/1001 (2) 20/1001 (3) 45/361 (4) None of these.

3. What is the probability of selecting 3 laptops such that no two are of the same company?

(1) 42/125 (2) 2/51 (3) 1/26 (4) None of these.

4. What is the probability of selecting 3 laptops such that at least 2 of them are of the same company?

(1) $\frac{273}{2184}$ (2) $\frac{3}{4}$ (3) $\frac{14}{33}$ (4) None of these.

5. If 3 coins are tossed, find the probability

(i) All 3 coins show the same result.
(ii) The first & second coins show the same result.
(iii) The first & third coins show a different result.

(1) $\frac{1}{2},\frac{1}{2},\frac{1}{2}$ (2) $\frac{1}{4},\frac{1}{3},\frac{2}{3}$ (3) $\frac{1}{4},\frac{1}{2},\frac{1}{2}$ (4) None of these.

6. 7 sherbets are to be filled in 7 bottles corresponding to their colours. Out of these, 6 are filled in the bottles corresponding to their colour bottles. What is the probability of all the sherbets not being in their respective bottles?

(1) 1 (2) 1/6 (3) 1/7 (4) 0

7. The odds in favour of A speaking the truth are 2 : 3. The odds against B speaking the truth is 3 : 4. When they lie, they speak the same lie. What are the chances of them contradicting each other?

(1) 8/35 (2) 9/35 (3) 17/35 (4) 18/35

8. $P(A)=\frac{2}{3}$; $P(B)=\frac{1}{4}$; $P(A\cup B)=\frac{8}{15}$. Find (i) $P(A\cap B)$ (ii) $P(A'\cup B')$

(1) $\frac{23}{60},\frac{37}{60}$ (2) $\frac{23}{60},\frac{7}{15}$ (3) $\frac{23}{60},\frac{13}{60}$ (4) None of these.

9. In a box, there are 8 red, 7 blue and 6 green balls. One ball is picked up randomly. What is the probability that it is neither red nor green?

(1) 1/3 (2) 3/4 (3) 7/19 (4) 8/21 (5) 9/21

10. Three unbiased coins are tossed. What is the probability of getting at most two heads?

(1) 3/4 (2) 1/4 (3) 3/8 (4) 7/8 (5) None of these

11. Two dice are thrown simultaneously. What is the probability of getting two numbers whose product is even?

(1) 1/2 (2) 3/4 (3) 3/8 (4) 5/16 (5) 4/9

12. In a class, there are 15 boys and 10 girls. Three students are selected at random. The probability that 1 girl and 2 boys are selected is:

(1) 21/46 (2) 25/117 (3) 1/50 (4) 3/25 (5) None of these

13. A box contains 20 electric bulbs, out of which 4 are defective. Two bulbs are chosen at random from this box. The probability that at least one of these is defective is

(1) 4/19 (2) 12/19 (3) 21/95 (4) 7/19 (5) 23/95

14. An unbiased die is rolled and a coin is tossed. Find the probability that the die shows an odd number and the coin shows a head.

(1) 1/4 (2) 3/4 (3) 1/6 (4) 2/7 (5) 2/9

15. What is the probability of getting all three heads in three consecutive throws of a coin?

(1) 1/2 (2) 1/4 (3) 1/3 (4) 1/6 (5) 1/8

DATA SUFFICIENCY

CONCEPT TEST I

Instructions for all questions: Select your answer as

1. if the question can be answered using statement A alone, but cannot be answered using statement B alone.
2. if the question can be answered using statement B alone, but cannot be answered using statement A alone.
3. if the question can be answered using each of the statements independently
4. if the question can be answered using both the statements together but not by using either statement alone.
5. if the question cannot be answered on the basis of both the statements

1. How long will it take for two pipes A and B to fill an empty cistern if they work alternately for an hour each?

(A) Working alone, Pipe A can fill the cistern in 40 hours
(B) Pipe B is one third as efficient as Pipe A

2. What is the value of X, if X and Y are two distinct integers and their product is 30?

(A) X is an odd integer
(B) $X > Y$

3. The set S of numbers has the following properties:

I. If x is in S, then $1/x$ is in S.
II. If both x and y are in S, then so is $x + y$. Is 3 in S?

(A) 1/3 is in S
(B) 1 is in S.

4. Is $x = y$?

(A) $(x + y)\left(\frac{1}{x} + \frac{1}{y}\right) = 4$

(B) $(x - 50)^2 = (y - 50)^2$

5. Is the smallest of five consecutive integers even?

(A) The product of the five integers is 0
(B) The arithmetic mean of the five integers is 0.

6. Is X a prime number, given that X is a positive integer?

(A) $X^4 > 3000$
(B) $X^4 < 10000$

7. Is m divisible by 6?

   (A) m is divisible by 3
   (B) m is divisible by 4

8. What is the value of x?

   (A) The square of x is 36
   (B) $x(x - 6) = 0$

9. Is $x > 0$?

   (A) $-2x < 0$
   (B) $x^3 > 0$

10. A certain straight corridor has four doors, A, B, C and D (in that order) leading off from the same side. How far apart are doors B and C?

    (A) The distance between doors B and D is 10 meters.
    (B) The distance between A and C is 12 meters.

11. Are the integers x, y and z consecutive?

    (A) The arithmetic mean (average) of x, y and z is y.
    (B) $y - x = z - y$

12. Books numbered 1, 2, 3, 4 are placed in racks 1, 2, 3, 4 not necessarily in that order, such that there is one book in each rack and every even numbered book is in an odd numbered rack. What is the exact order in which the books are placed?

    (A) Rack number 3 has book 2.
    (B) Rack number 2 has book 3.

13. Is the length of the side of an equilateral triangle E less than the length of a side of square F?

    (A) The perimeter of E and the perimeter of F are equal.
    (B) The ratio of the height of triangle E to the diagonal of square F is 1 : 1.

14. A bucket was placed under a dripping tap which was dripping at a uniform rate. At what time was the bucket full?

    (A) The bucket was put in place at 2 pm.
    (B) The bucket was half full at 6 pm and three-quarters full at 8 pm on the same day.

15. Is $xy > 150$?

    (A) $2x - 3y > -5$
    (B) $2x - 5y < -27$

2 Concept Test Solutions

CALCULATION TECHNIQUES

CONCEPT TEST I

1. Before calculating directly, have a look at the percentages and see if they can be represented as fractions. That helps simplify calculations. Here, 37.5% corresponds to 3/8 and 25% corresponds to 1/4.

$\therefore$ 37.5 of 14424 + 25% of 14424

$$= \frac{3}{8} \times 14424 + \frac{1}{4} \times 14424$$

$$\left(\frac{3}{8} + \frac{1}{4}\right) \times 14424$$

$$= \frac{5}{8} \times 14424 = 9015$$

Hence, **option 4.**

2. First calculate 3% of 729 and 2% of 1369; and find their sum.

3% of 729 = 0.03 × 729 = 21.87

2% of 1369 = 27.38

21.87 + 27.38 = 49.25

3.7% of 729 and 2.7% of 1369 will definitely be greater than the numbers above. So, the required sum has to be greater than 49.25.

Hence, options 1 and 4 can be eliminated.

Now, we want to calculate 0.7% of 729 and 0.7% of 1369. This is equivalent to finding 0.7% of (729 + 1369) i.e. 0.7% of 2098

0.7% of 2098 = 0.007 × 2098 = 14.69

$\therefore$ 3.7 % of 729 + 2.7 % of 1369 = 49.25 + 14.69 = 63.94 $\approx$ 64

Hence, **option 2.**

3. 34634 + 45785 − 36457 − 125

= 80419 − 36582 = 43837

Hence, **option 1.**

4. 10013 × 10007

= (10000 + 13) × (10000 + 7)

= 100000000 + 130000 + 70000 + 91

= 100200091

Hence, **option 3.**

5. 3454345375 × 11

= 3454345375 × (10 + 1)

= 34543453750 + 3454345375

= 37997799125

Hence, **option 2.**

6. Here, 111 and 94 need not be spilt in terms of 100 + 11 and 100 − 6 only. They can split in other ways also.

111 × 94 = (110 + 1) × (90 + 4)

= 9900 + 90 + 440 + 4

= 10434

Hence, **option 1.**

7. 4577876 × 9999999

= 4577876 × (10000000 − 1)

= 45778760000000 − 4577876

= 45778755422124

Hence, **option 3.**

8. $$\frac{\sqrt[3]{2197} + 44 \div 4 \times 12}{\sqrt{841}} = \frac{13 + 11 \times 12}{29}$$

$$= \frac{13 + 132}{29} = \frac{145}{29} = 5$$

Hence, **option 4.**

9. 3.4545 ... is also denoted as $3.\overline{45}$ and this implies that the decimal 45 keeps repeating till infinity.

Let x Let $x = 3.\overline{45}$ ... (i)

$\therefore 100x = 345.\overline{45}$ ... (ii)

Subtracting (i) from (ii) we get,

$99x = 342$

$$\therefore x = \frac{342}{99}$$

$$\therefore 3.\overline{45} = \frac{342}{99}$$

$$\therefore \frac{3.\overline{45} \times 198}{171} = \frac{\frac{342}{99} \times 198}{171} = \frac{342 \times 198}{99 \times 171} = 4$$

Hence, **option 3.**

10. The smallest prime number is 2.

Hence the expression is

$$\frac{14 + 2(14 \times 7)}{2} = \frac{14 + 2(98)}{2} = 105$$

Hence, **option 1.**

11. As per the rules of BODMAS, terms of BODMAS need to be calculated first.

$7 + 3 \times \overline{4 - 2} \div 2 - 2$ of 2

$= 7 + 3 \times 2 \div 2 - 2 \times 2$

$= 7 + 3 \times 1 - 4 = 7 + 3 - 4 = 6$

Hence, **option 2.**

12. Knowing the percentage to fraction conversion helps in such a case.

14.28% corresponds to 1/7

$\therefore$ 14.28% of 2401

$= \frac{1}{7} \times 2401 = 343$

$\therefore 343 = x\%$ of 686

$\therefore 343 = \frac{x}{100} \times 686$

$\therefore x = \frac{343 \times 100}{686} = 50\%$

Hence, **option 1.**

13. 1% of 18345=183.45

Find 4% and 5% of 18345 to eliminate answer options.

$\therefore$ 4% of 18345 = 183.45 × 4 = 733.8

$\therefore$ 5 % of 18345 = 183.45 × 5 = 917.25

825 is between these two values.

Hence, options 1 and 4 can be eliminated.

Now, calculate 0.1% and 0.5% of 18345

0.1% of 18345 = 18.345

0.5% of 18345 = 183.45/2 = 91.725

(4% + 0.1%) of 18345 = 733.8 + 18.345 = 752.145

(4% + 0.5%) of 18345 = 733.8 + 91.725 = 825.525

Option 3 is the closest to this value.

Hence, **option 3.**

CONCEPT TEST II

1. $\left(3\frac{2}{3} + 4\frac{2}{4} - 5\frac{2}{12}\right)^2 \times \sqrt[3]{729}$

$= \left(\frac{11}{3} + \frac{18}{4} - \frac{62}{12}\right)^2 \times 9$

$= \left(\frac{44 + 54 - 62}{12}\right)^2 \times 9$

$= 3^2 \times 9 = 9 \times 9 = 81$

$\therefore 81 = x^2$

$\therefore x = \pm 9$

Only, +9 is given in the options.

Hence, **option 3.**

2. $0.5\overline{45} \times \frac{1331}{216}$

$= \frac{545 - 5}{990} \times \frac{1331}{216}$

$= \frac{540}{990} \times \frac{1331}{216} = \frac{121}{36}$

$\therefore \frac{121}{36} = x\% \frac{121}{36}$

$\therefore x = 100\%$

Hence, **option 2.**

3. $10 \times \left(3 + \frac{3}{5}\right)^{th}$ of $3.45\bar{6} + \left(5 + \frac{3}{5}\right)^{th}$ of $\frac{6}{5}$

$= 10 \times \frac{18}{5} \times \frac{3456 - 345}{900} + \frac{28}{5} \times \frac{6}{5}$

$= \frac{3111}{25} + \frac{168}{25} = \frac{3279}{25}$

Hence, **option 4.**

4. 11.11% of 20% of 30 + 9.09% of $\frac{33}{2}$

$= \frac{1}{9} \times \frac{1}{5} \times 30 + \frac{1}{11} \times \frac{33}{2}$

$= \frac{30}{45} + \frac{33}{22} = \frac{2}{3} + \frac{3}{2} = \frac{4+9}{6} = \frac{13}{6}$

Hence, **option 1.**

5. $\frac{2}{2\left[3 + \frac{3}{2+\frac{3}{2}}\right] + 2} + \frac{1}{1 + \frac{2}{2\left[3+\frac{3}{2+\frac{3}{2}}\right]}}$

Let $3 + \frac{3}{2 + \frac{3}{2}} = x$. Therefore, we get

$= \frac{2}{2x+2} + \frac{1}{1 + \frac{2}{2x}}$

$= \frac{2}{2x+2} + \frac{2x}{2x+2} = \frac{2x+2}{2x+2} = 1$

Hence, **option 3.**

6. 3434344 – 434343 + 3434343

= 3000001 + 3434343 = 6434344

Hence, **option 2.**

7. $2 + \frac{2 + 2 \div 2 - \overline{2+2} \times 2 + 2 + 2 \times 2}{2 \times \overline{2+2} - 2 \times 2 - 2 \times \overline{2-2}}$

$= 2 + \frac{2 + 1 - 4 \times 2 + 2 + 4}{2 \times 4 - 4 - 2 \times 0}$

$= 2 + \frac{3 - 8 + 6}{8 - 4} = 2 + \frac{1}{4} = \frac{9}{4}$

Hence, **option 4.**

8. Let the number be A.

1) $A \times \frac{9}{4}$

2) $\frac{9A}{4} \div \frac{3}{20} = \frac{9A}{4} \times \frac{20}{3} = 15A$

3) $15A + \frac{1}{5}(15A) = 18A$

4) B=18A

Hence, x=18.

Hence, **option 2.**

9. $58^2 - 50^2 - 38^2 + 70^2$

$= 58^2 - 50^2 + 70^2 - 38^2$

$= (58 + 50)(58 - 50) + (70 + 38)(70 - 38)$

= (108)(8) + (108)(32) = (108)(8 + 32)
= (108)(40) = 4320
Hence, **option 3.**

10. 11.11% of 10% of x + 6.67% of 16.67% of x - 11.11% of 20% of x

$$= \frac{1}{9} \times \frac{1}{10} \times x + \frac{1}{15} \times \frac{1}{6} \times x - \frac{1}{9} \times \frac{1}{5} \times x$$

$$= \frac{x}{90} + \frac{x}{90} - \frac{x}{45} = \frac{x}{45} - \frac{x}{45} = 0$$

Hence, **option 4.**

11. $\frac{209}{133} - \frac{162}{126} - \frac{33}{231}$

$$= \frac{19 \times 11}{19 \times 7} - \frac{18 \times 9}{18 \times 7} - \frac{33 \times 1}{33 \times 7}$$

$$= \frac{11}{7} - \frac{9}{7} - \frac{1}{7} = \frac{1}{7}$$

$\therefore \frac{1}{7} = x$ % of 1

$\therefore \frac{x}{100} = \frac{1}{7}$

$\therefore x = 100/7 = 14.28$ %
Hence, **option 1.**

12. 456785 - 348543 + 99999 - 90909
= 208241 - 90909 = 117332
Hence, **option 2.**

AVERAGES

CONCEPT TEST I

1. Total age of 20 students = 20 × 9 = 180 years.
When the teacher is included, there are 21 people in all.
Thus, after including the teacher's age, average age of the 21 people = 11 years.
So, total age of the 21 persons = 21 × 11 = 231.
∴ Age of the teacher = 231 - 180 = 51.
Hence, **option 1.**

2. Total age of the three brothers = 10 × 3 = 30.
When the father and mother are also considered in this group, the average age increases by 13 i.e. it becomes 10 + 13 = 23
∴ Total age of the 5 family members = 23 × 5 = 115
So, total age of father and mother = 115 - 30 = 85
Let the age of the father be x years.
So, age of the mother = x - 5 years.
∴ $x + x - 5 = 85$
∴ $x = 45$
Thus, the father is 45 years old.
Hence, **option 3.**

3. Let the total marks in each paper be 100.
So, total marks scored by Ram in 5 papers = 50 × 5 = 250.
and, marks scored by Ram in 4 papers = 40 × 4 = 160.
∴ Marks scored by Ram in the fifth paper = 250 - 160 = 90.
Hence, **option 4.**

4. Five years ago, average age of the couple = 24
So, total age of the couple five years ago = 24 × 2 = 48
∴ Total age of the couple at present = 48 + 10 = 58
Here, the age of the child is not considered.
But, present average age of the family of three members = 20
∴ Total age of the family at present = 20 × 3 = 60
∴ Age of the child at present = 60 - 58 = 2 years.
Hence, **option 1.**

5. Let Anuradha's present age = x
∴ $x + 8 = 2(x - 6)$
∴ $x = 20$ years
Hence, **option 4.**

Alternatively,
This can also be solved quickly by using answer options. Since current age is asked, each option corresponds to present age. So, take each option, add 8 to it and also subtract 6 from it separately. See if the former number is double the latter. The answer option that satisfies this condition is the answer. For instance, the age in option 1 is 14.
14 + 8 = 22 and 14 - 6= 8
22/8 ≠ 2
Thus, this is not the present age.
Consider option 4.
20 + 8 = 28 and 20 - 6 = 14
28/14 = 2
Hence, the present age is 20 years.
Hence, **option 4.**

6. The ratio of the age of A and B is 11 : 8 and the sum of their ages is 38
∴ $11x + 8x = 38$
∴ $x = 2$
∴ A = 22 and B = 16
Thus, A is 22 years old and B is 16 years old.
So, after 8 years, A will be 30 years old and B will be 24 years old.
∴ Ratio of ages of A and B = 30 : 24 = 5 : 4.
Hence, **option 3.**

7. Let Suresh's present age be x. So, his age, 8 years ago, was $(x - 8)$ years.
So, Ramesh's age 8 years ago was $2(x - 8)$.
$\therefore$ Ramesh's current age = $2(x - 8) + 8 = 2x - 8$
The current ratio of their ages is 3 : 2.

$$\therefore \frac{2x - 8}{x} = \frac{3}{2}$$

$\therefore 4x - 16 = 3x$
$\therefore x = 16$
So, Suresh's present age is 16 years.
Hence, **option 3.**

8. Let the average score of the batsman in the first two innings be x runs.
So, his total score in the first two innings = $2x$
and his score in the third innings = $2.5x$
His average across all three innings is 90
So, his total score across all three innings = 270
$\therefore 2x + 2.5x = 270$
$\therefore x = 60$.
So, the batsman scored $2.5x = 150$ runs in the third innings.
Hence, **option 5.**

9. Since the age of the younger son is given, the age of the other two people can be easily found without any equations.
Since the younger son is 14 years old right now, two years ago his age was 12 years. Two years ago, since the elder son was twice as old as the younger son, the elder son's age was 12×2 i.e. 24 years.
So, the elder son is 26 years old now and will be 28 years old, two years from now.
At that time, the father will be twice as old as the elder son.
So, the father will be $2 \times 28 = 56$ years old two years from now.
Hence, the father is currently 54 years old.
Hence, **option 4.**

10. Let the daughter's present age be x years.
So, the mother's present age = $7x$ years.
The daughter's age after two years
= $x + 2$ years.
So, the mother's age after two years
= $7x + 2$ years.
$\therefore 7x + 2 = 5(x + 2)$
$\therefore x = 4$ years
$\therefore 7x = 28$ years.
Hence, **option 1.**

CONCEPT TEST II

1. Average score of 10 players = 26
Total score of the 10 players without the captain = $26 \times 10 = 260$
When the captain's score is added, the average increases by 4 i.e. it becomes 30
So, total score of the 11 players including the captain = $30 \times 11 = 330$
$\therefore$ Runs scored by the captain = $330 - 260 = 70$
Hence, **option 5.**

2. 10 students had an average score of 80.
So, their total score = $10 \times 80 = 800$
The remaining 15 students had an average score of 60.
Their total score = $15 \times 60 = 900$
So, total score of the class = $800 + 900 = 1700$
Average score of the class = $1700/25 = 68$
Hence, **option 2.**

Alternatively,
Since the two groups of students have different group sizes (10 and 15), the weighted average of their scores can be taken to get the average score of the whole class.
$\therefore$ Average score of entire class

$$= \frac{(10 \times 80) + (15 \times 60)}{(10 + 15)} = \frac{1700}{25} = 68$$

Hence, **option 2.**

3. The average age of all 5 members of the family is 25 years while the average age of 2 members of this family is 13 years.
$\therefore$ Total age of the 5 members = $25 \times 5 = 125$ years and, total age of the 2 members = $13 \times 2 = 26$ years
$\therefore$ Total age of the remaining 3 members of the family = $125 - 26 = 99$ years
$\therefore$ Average age of the 3 members = $99/3 = 33$ years
Hence, **option 1.**

4. The student solves 15 papers each of 4 subjects and 5 papers each of 6 subjects.
$\therefore$ Total number of papers solved by the student = $(15 \times 4) + (5 \times 6) = 90$
$\therefore$ Average number of papers solved per subject = $90/(4 + 6) = 9$
Now, the student solves 5 papers each of 4 subjects and 15 papers each of 6 subjects.
$\therefore$ Total number of papers solved by the student = $(5 \times 4) + (15 \times 6) = 110$
$\therefore$ Average number of papers solved per subject = $110/(4 + 6) = 11$
Hence, the average number of papers solved increases by 2.
Hence, **option 3.**

5. Since the price of the two groups of suits differs, the average cost of the 5 suits is the weighted average of the two groups.

$$\therefore \text{Average cost} = \frac{(2 \times 179) + (3 \times 189)}{(2 + 3)}$$

$$= \frac{925}{5} = \text{Rs.}185$$

Hence, **option 1.**

6. Let x tickets of Rs.16 and y tickets of Rs.8 be sold.
$\therefore x + y = 14$
And, $16x + 8y = 160$ i.e. $2x + y = 20$
Solving these two simultaneous equations, we get $x = 6$ and $y = 8$.
Hence, **option 5.**

7. The average score of a class of p students is 70 while that of a class of n students is 92.
So, total marks of the students of the first class = $70p$ and, total marks of the students of the second class = $92n$
Average marks obtained by students of these two class

$$= \frac{70p + 92n}{p + n}$$

It is given that this average is equal to 86.

$$\therefore \frac{70p + 92n}{p + n} = 86$$

$\therefore 70p + 92n = 86p + 86n$
$\therefore 16p = 6n$
$\therefore p/n = 6/16 = 3/8$
Hence, **option 3.**

8. Average of three distinct positive integers = 70
$\therefore$ Sum of three integers = $3 \times 70 = 210$.
If the largest of the three integers is 210, the other two integers have to be 0 or negative.
However, it is given that both the other integers are positive and distinct.
So, those two integers have to be the smallest possible integers i.e. 1 and 2.
So, the largest number required = $210 - (1 + 2) = 207$.
Hence, **option 1.**

9. As the average of p numbers is l, their sum is pl.
If one of the numbers q is replaced by r, the average becomes m.
Here, note that the total number of numbers still remains the same i.e. p
So, the new sum is pm.$\therefore pm = pl + r - q$
$\therefore pl - pm = q - r$
$\therefore p(l - m) = q - r$
Hence, **option 1.**

10. Let the total runs scored by the bottom six batsmen = x
$\therefore$ Total runs scored by the top five batsmen = $x + 30$
$\therefore x + x + 30 = 210$
$\therefore x = 90$ and $x + 30 = 120$
So, average runs scored by the top five batsmen = 120/5 = 24.and, average runs scored by the bottom six batsmen = 90/6 = 15.
So, the required difference = 24 - 15 = 9.
Hence, **option 4.**

PERCENTAGES

CONCEPT TEST I

1. A four and six correspond to 4 and 6 runs respectively.
$\therefore$ Runs scored in boundaries = $(3 \times 4) + (8 \times 6) = 12 + 48 = 60$
So, runs scored by running between the wickets = $110 - 60 = 50$
$\therefore$ Percentage of runs scored by running between the wickets = $(50/110) \times 100 = 45.45\%$
Hence, **option 2.**

2. $A = x\%$ of $y = (x/100) \times y = xy/100$
$B = y\%$ of $x = (y/100) \times x = xy/100$
So, $A = B$
This relationship is not given in any of the answer options.
Hence, **option 5.**

3. Between the numbers 1 and 10, there are 2 numbers that have 1 or 9 in the units place i.e. the numbers 1 and 9.
Since, $70 = 7 \times 10$
Each group of 10 numbers between 1 and 70 will have 2 numbers that satisfy this condition.
$\therefore$ Total number of numbers that have units digit 1 in this range = $2 \times 7 = 14$
So, the required percentage = $(14/70) \times 100 = 20\%$
Hence, **option 3.**

4. Total votes cast = 7500, out of which 20% were invalid.
$\therefore$ Number of valid votes = 80% of 7500 = 6000.
One candidate got 55% of the valid votes
$\therefore$ Valid votes polled by other candidate = 45% of 6000 = $(45/100) \times 6000 = 2700$
Hence, **option 1.**

5. Let the number be x.
The original value should have been $(5x/3)$ but it became $(3x/5)$

So, error in the number $= \frac{5x}{3} - \frac{3x}{5} = \frac{16x}{15}$

So, % Error $= \frac{\frac{16x}{15}}{\frac{5x}{3}} \times 100 = 64\%$

Hence, **option 4.**

6. Ganesh spends 15, 20 and 40% respectively of his salary on fuel, house rent and other expenditure.
So, Ganesh spends (100 – 15 – 20 – 40) = 25% of his salary on his children's education.
So, 25% of his salary is equal to Rs. 5,000
But, amount spent by him on his fuel = 15% of his salary.
So, amount spent on fuel = (15/25) × 5000 = Rs. 3,000
Hence, **option 1.**

7. Let us assume that B earns Rs. 100
So, A's income = 20% more than A = 1.2 × 100 = Rs. 120
But B's income is 20% less than that of C.
So, B's income is (100 – 20) i.e 80% of C's income.
So, C's income = (100/80) × B's income
∴ C's income = (100/80) × 100 = Rs.125
Hence, C's income is the highest among the three.
Hence, **option 3.**

8. Let the length and breadth of the rectangle be l and b respectively.
So, original area of the rectangle = lb
Now, the length is increased by 50% and the breadth is increased by 20%.
So, the new length and breadth will be $1.5l$ and $1.2b$ respectively.
∴ New area of the rectangle = $1.8lb$
So, increase in area = $1.8lb - lb = 0.8lb$
∴ % increase in area = $[(0.8lb)/(lb)] \times 100$ = 80%
Hence, **option 3.**

9. Let Ravi's initial salary be Rs. 100.
So, after an increase of 50%, his salary becomes 1.5 × 100 = Rs. 150.
Now, after a decrease of 50%, his salary becomes 0.5 × 150 = Rs. 75
So, reduction in salary = 100 – 75 = Rs. 25
∴ Percentage decrease = (25/100) × 100 = 25%
Hence, **option 1.**

10. Let the initial price be p and initial sales be s.
So, initial revenue = ps
Now, the price reduces by 40% and sales increase by 60%.
So, new price = $0.6p$ and new sales = $1.6s$
∴ New revenue = $0.6p \times 1.6s = 0.96ps$.
So, decrease in revenue = $(1 - 0.96) = 0.04ps$
∴ % decrease in revenue = $(0.04ps/ps) \times 100$ = 4%
Hence, **option 2.**

11. The population now is 100000.
So, after the first year, it becomes (110/100) × 100000 = 110000
After the second year, it becomes (110/100) × 110000 = 121000
Finally, after the third year, it becomes (90/100) × 121000 = 108900
Hence, **option 4.**

Alternatively,
The percentage change in population can be applied simultaneously.
Since the increases by 10%, then increases by 10% and finally decreases by 10%, the population at the end of 3 years = 100000 × 1.1 × 1.1 × 0.9 = 108900
Hence, **option 4.**

12. Raju initially got 12 out of 16 questions correctly.
He then answered 25% of the remaining questions correctly.
Let the remaining number of questions be $4x$ and let Raju get x out of them correctly.
So, total questions in the exam = $16 + 4x$
Total questions answered correctly = $12 + x$
Overall Raju got 50% marks
∴ We get

$$\frac{12 + x}{16 + 4x} = \frac{1}{2}$$

∴ $24 + 2x = 16 + 4x$
∴ $x = 4$
So, number of questions = $16 + 4x = 32$.
Hence, **option 1.**

13. Let the printed price of the book be Rs. x.
So, after the first discount, it becomes Rs. $0.8x$
Now an additional 10% discount on $0.8x$ makes the price $(90/100) \times 0.8x = 0.72x$
But this amount gives 8% profit to the shopkeeper.
So, if the cost price is Rs. y, selling price = Rs. $1.08y$
And, $1.08y = 0.72x$
So, $x/y = 1.5$

Hence, the printed amount is 1.5 times the cost price i.e. 50% more than the cost price.
Hence, **option 4.**

14. The student gets 30 marks and fails by 6 marks.
So, 36 marks are the passing marks for this exam.
Since the passing marks in this exam correspond to 40% of the total marks.
$\therefore$ Total marks = (100/40) × 36 = 90
Hence, **option 5.**

15. Let the initial selling price of milk be x and the sales be s.
So, total revenue = sx
Now, the selling price is made $0.8x$
Total revenue has to remain the same.

$$\therefore \text{New sales} = \frac{sx}{0.8x} = 1.25s$$

Increase in sales = 1.25s − s = 0.25s
$\therefore$ % Increase = (0.25s/s) × 100 = 25%
Hence, **option 5.**

INTEREST AND GROWTH RATES

CONCEPT TEST I

1. Let rate = r% and time = r years.

$$\therefore 432 = 1200 \times r \times \frac{r}{100}$$

$\therefore r^2 = 36$
$\therefore r = 6\%$
Hence, **option 2.**

2. $S.I. = \dfrac{P \times n \times r}{100}$

Here, both P and r are unknown.
Now, we know that the new value of r is 2 greater than the old value. However, in the absence of information on the Principal, the simple interest cannot be found.
Hence, the given data is inadequate.
Hence, **option 5.**

3. Since there is a 60% increase in the amount put at simple interest, the simple interest is 60% of the principal.
Let P = Rs. 100. Then, S.I. = Rs. 60 and N = 6 years.

$$\therefore 60 = 100 \times 6 \times \frac{R}{100}$$

$\therefore R = 10\%$
Now, P = Rs. 12,000. N = 3 years and R = 10% p.a.

$\therefore$Compound Interest

$$= 12000\left[\left(1+\frac{10}{100}\right)^3 - 1\right]$$

$$= 1200 \times \frac{331}{100} = 3972.$$

So, the compound interest is Rs. 3,972
Hence, **option 3.**

4. Using the formula for the amount obtained on compound interest we get:

$$A = 8000\left(1+\frac{5}{100}\right)^2$$

$$\therefore A = 8000 \times \frac{21}{20} \times \frac{21}{20}$$

$\therefore A$ = Rs. 8,820
Hence, **option 3.**

5. Let the sum of money be Rs. P

$$\therefore 50 = \frac{P \times 2 \times 5}{100}$$

$\therefore P$ = Rs. 500
Now, using the formula for compound interest,

$$A = 500\left(1+\frac{5}{100}\right)^2 = 551.25$$

So, the compound interest = $A - P$ = Rs. 51.25
Hence, **option 1.**

6. Let the principle be Rs. x.
Compound interest = Amount − Principle

$$\text{Compound Interest} = x\left(1+\frac{4}{100}\right)^2 - x$$

$$= \frac{676x - 625x}{625} = \frac{51x}{625}$$

$$\text{Now, Simple Interest} = x \times 4 \times \frac{2}{100} = \frac{2x}{25}$$

So, according to given condition:

$$\frac{51x}{625} - \frac{2x}{25} = 1$$

$\therefore x$ = Rs. 625
Hence, **option 1.**

7. Amount at the end of the period = Rs. (30000 + 4347) = Rs. 34,347.
Let the time be n years.

$$\text{Then, } 34347 = 30000\left(1+\frac{7}{100}\right)^n$$

$$\therefore \frac{11449}{10000} = \left(\frac{107}{100}\right)^n$$

Since, $10000 = 100^2$, check the value of 107^2.
It is indeed 11449.
$\therefore n$ = 2 years.
Hence, **option 1.**

8. The value of the car depreciates at 20% every year.
So, its value after 1 year = 300000 × (1 – 0.2)
= 0.8 × 300000
Its value after 2 years
= 0.8 × 300000 × (1 – 0.2) = 0.8^2 × 300000
Similarly its value after 4 years
= 0.8^4 × 300000 = Rs. 1,22,880
Hence, **option 5.**

9. The count of bacteria increases by 10% every hour.
If the count is 25000 now, the count after one hour = 1.1 × 25000.
Similarly, the count after two hours = 1.1^2 × 25000.
And, the count of bacteria after 3 hours = 1.1^3 × 25000 = 33275.
Hence, **option 5.**

10. Let us assume for simplicity the principle to be Rs. 100.
Now we have to take the rate of interest = 6/2 = 3% (because the compounding is done on a half yearly basis)
Also, the number of periods, n = 2 (As we are calculating for one year on half yearly basis)

$$\therefore \text{Amount} = 100\left(1+\frac{3}{100}\right)^2 = 106.09$$

So, the compound interest = 106.09 – 100 = Rs. 6.09
So, if the same amount has to be compounded once a year, it has to be placed at 6.09% compound interest per year.
Hence, **option 4.**

PROFIT LOSS AND DISCOUNT

CONCEPT TEST I

1. Let C.P. of each article be Re. 1
∴ C.P. of x articles = Rs. x
C.P. of 20 articles = Rs. 20
C.P. of 20 articles = S.P. of x articles.
∴ S.P. of x articles = Rs. 20.
∴ Profit = Rs. $(20 - x)$
Also, profit = 25%

$$\therefore \frac{20-x}{x} \times 100 = 25$$

$\therefore x = 16$.
Hence, **option 2.**

2. Loss = C.P. – S.P.
On selling 17 balls, there is a loss equal to the C.P. of 5 balls.
∴ (C.P. of 17 balls) – (S.P. of 17 balls)
= (C.P. of 5 balls)
C.P. of 12 balls = S.P. of 17 balls = Rs.720.

$$\therefore \text{CP of one ball} = \text{Rs.}\frac{720}{12} = \text{Rs. } 60$$

Hence, **option 4.**

3. Total rice purchased = 26 +30 = 56 kg
∴ C.P. of 56 kg rice = (26 ×20 + 30 × 36)
= 520 + 1080 = Rs. 1,600.
He sells the mixture at Rs. 30 per kg.
∴ S.P. of 56 kg rice = (56 × 30) = Rs. 1,680.
Thus, he gains Rs. 80 in the transaction.

$$\therefore \text{Gain} = \frac{80}{1600} \times 100 = 5\%$$

Hence, **option 2.**

4. Since the oranges are sold in dozens, convert the original quantity bought into dozens.
Number of oranges bought in dozens = 100/12.
So, Selling price = (100/12) × 48 = Rs. 400
∴ Profit = 400 – 350 = Rs. 50
%Profit = (50/350) × 100 = 100/7
Hence, **option 1.**

5. Let the cost price of the plot be Rs. x
Now, when it is sold at 15% loss, the SP = 0.85x
∴ 0.85x = 18700
∴ x = 18700/0.85
Now, for profit to be 15% selling price = 1.15x
∴ 1.15x = 1.15 × (18700/0.85) = Rs. 25,300
So, the plot must be sold at Rs. 25,300 to gain 15%
Hence, **option 3.**

6. Let the C.P. of the product be Rs. x.
Profit percent when the product is sold at Rs. 1,920 is the same as the loss percent when the product is sold at Rs. 1,280.

$$\therefore \frac{1920-x}{x} \times 100 = \frac{x-1280}{x} \times 100$$

∴ 1920 – x = x – 1280
∴ x = 1600
For 25% profit, selling price = 1.25x = 1.25 × 1600 = Rs. 2,000
Hence, **option 1.**

7. Let the cost of the item be Rs. x.
Now, the amount that is to be realized i.e. the selling price is not known in this case. The only condition known is that the selling price arrived at after marking up the price and giving a discount is the same as the original selling price.
Let the item be sold at cost price in the original case i.e. at Rs. x

So, the final selling price should also be Rs. x
Now, if the mark up in the cost price is p%.
Marked price = $x + xp/100$
Now, discount offered on this marked price = 20%
So, selling price = $0.8\ (x + xp/100)$
But this selling price is equal to the original selling price i.e. the cost price itself.
$\therefore x = 0.8\ (x + xp/100)$
$\therefore x = 0.8x + (0.8xp)/100$
$\therefore 20x = 0.8xp$
$\therefore p = 25\%$
So, the cost of the item needs to be marked up by 25%.
Hence, **option 1.**

8. Let the marked price of the oven be Rs. x
Since the person gets two successive discounts of 10% and 5%, the final price paid to purchase the oven
$= x \times 0.9 \times 0.96 = 0.855x$
Also, through these two discounts, the person saves Rs. 290
$\therefore$ Final amount paid to purchase the oven $= x - 290$
$\therefore 0.855x = x - 290$
$\therefore 0.145x = 290$
$\therefore x = 2000$
So, the marked price of the oven is Rs. 2,000.
Hence, **option 5.**

9. Ramesh offers consecutive discounts of 20% and 5% respectively on Rs. 20,000.
$\therefore$ Ramesh offers the TV at $20000 \times 0.8 \times 0.95$ = Rs. 15,200
$\therefore$ Ramesh offers discount = 20000 – 15200 = Rs. 4,800
Suresh offers consecutive discounts of 15% and 10% respectively.
$\therefore$ Suresh offers the TV at $20000 \times 0.85 \times 0.9$ = Rs. 15,300
$\therefore$ Suresh offers discount = 20000 – 15300 = Rs. 4,700
$\therefore$ Difference in their discount = 4800 – 4700 = Rs. 100
Hence, **option 3.**

10. Let the marked price of the product be Rs. x.
If Raju gives two successive discounts of 10% each, the selling price of the product $= x \times 0.9 \times 0.9$ i.e. $0.81x$
$\therefore$ Discount offered = $x - 0.81x = 0.19x$
However, it is given that the discount offered is Rs. 190
$\therefore 0.19x = 190$
$\therefore x = 1000$
$\therefore$ selling price = $0.81x$ = Rs. 810
This corresponds to a profit percent of 8%
Let the cost price be Rs. c
$\therefore 1.08c = 810$
$\therefore c = 810/1.08 = 750$
Hence, **option 3.**

11. Let A's initial cost price be Rs. x.
Since A sells to B for Rs. 1,100 at a 10% profit$1.1x = 1100$
$\therefore x = 1000$
Now, B's cost price = Rs. 1,100
Since B sells back to A at a 10% loss, selling price of B = 1100×0.9 = Rs. 990
Now, A gets an article costing Rs. 1000 back at Rs. 990.
$\therefore$ Gain to A = Rs. 10. Also, he has already gained Rs. 100 in the earlier transaction with B.
$\therefore$ Total gain by A = Rs. 10 + Rs. 100 = Rs. 110
% Gain = $(110/1000) \times 100 = 11\%$
Hence, **option 3.**

12. Let the selling price be Rs. x
Since the margin on the selling price is 20%, profit = $0.2x$.
And cost price = selling price – profit $= x - 0.2x = 0.8x$
Cost price is given as Rs. 1,000
$\therefore 0.8x = 1000$
$\therefore x = 1250$
Hence, **option 2.**

13. Let the selling price = Rs. x.
Since the profit is calculated on the selling price, 50% profit corresponds to $0.5x$
$\therefore$ cost price = selling price – profit $= x - 0.5x = 0.5x$

$$\therefore \text{Actual profit \%} = \frac{\text{Profit}}{\text{Cost Price}} \times 100$$

$$= \frac{0.5x}{0.5x} \times 100 = 100$$

Hence, **option 1.**

14. Let the CP be x.
So, after increase the CP becomes $1.2x$
Now, let SP = y
It is given that:

$$\frac{y - x}{x} \times 100 - \frac{(y - 1.2x)}{1.2x} \times 100 = 25$$

$$1.2(y - x) - (y - 1.2x) = 0.25 \times 1.2x$$

$\therefore 0.2y = 0.3x$
So, $y/x = 1.5$
So, the profit percentage is 50%
Hence, **option 4.**

15. Cost price = Rs. 10
Original selling price = 10×1.2 = Rs. 12

New cost price = Rs. 11
New selling price = Rs. 12

$$\% \text{ Profit} = \frac{12-11}{11} \times 100 = 9.09\ \%$$

Hence, **option 4.**

RATIO AND PROPORTION

CONCEPT TEST I

1. Let the share of A, B, C and D be Rs. $5x$, Rs. $2x$, Rs. $4x$ and Rs. $3x$ respectively.
C gets Rs. 1,000 more than D.
$\therefore 4x - 3x = 1000$
$\therefore x = 1000.$
$\therefore$ B's share = Rs. $2x$ = Rs. 2,000.
Hence, **option 3.**

2. Let the three numbers be a, b, c
$a : b = 2 : 3$ and $b : c = 5 : 8$
Since b is the common term being compared in both ratios, we equalize b in both ratios.
$\therefore$ Take the LCM of 3 and 5 i.e. 15.
So, multiply a by 5 and c by 3 to get a consolidated ratio.
$\therefore a : b : c = 10 : 15 : 24$
Let $a = 10x$, $b = 15x$ and $c = 24x$
$a + b + c = 98$
$\therefore 10x + 15x + 24x = 98$
$\therefore 49x = 98$
$\therefore x = 2$
So, the second number is $15x = 15 \times 2 = 30$.
Hence, **option 2.**

3. Let us assume that:

$$\frac{a+b}{xa+yb} = \frac{b+c}{xb+yc} = \frac{c+a}{xc+ya} = k$$

$$\therefore k = \frac{a+b+b+c+c+a}{xa+yb+xb+yc+sc+ya}$$

$$= \frac{2(a+b+c)}{[(x+y)(a+b+c)]} = \frac{2}{x+y}$$

Hence, **option 3.**

4. It is given that:

$$\frac{x}{y} = \frac{3}{5}$$

$$\therefore \frac{3x}{y} = \frac{9}{5}$$

Let us apply componendo

$$\therefore \frac{3x+y}{y} = \frac{9+5}{5} = \frac{14}{5} \quad \text{... (i)}$$

$$\text{Now, } \frac{5x}{y} = \frac{3}{1}$$

$$\therefore \frac{5x-y}{y} = \frac{3-1}{1} = 2 \quad \text{... (ii)}$$

Dividing equation (i) by equation (ii) we get:

$$\frac{3x+y}{5x-y} = \frac{14}{5 \times 2} = \frac{7}{5}$$

Hence, **option 2.**

Alternatively,
Let $x = 3k$ and $y = 5k$
$\therefore 3x + y = 3(3k) + 5k = 14k$
$5x - y = 5(3k) - 5k = 10k$
$\therefore (3x + y) : (5x - y) = 14k : 10k = 7 : 5$
Hence, **option 2.**

5. The profit of A and B are in the same ratio as their investment i.e. 3 : 2
Thus, A's share in the profit is 3 : 5.
A's share of the profit = Rs. 855
$\therefore (3/5) \times x = 855$, where x is the total profit after donating to charity.
$\therefore x = 855 \times (5/3) =$ Rs. 1,425.
This is 95% of the actual profit.
$\therefore$ Actual profit = $1425 \times (100/95)$ = Rs.1,500
Hence, **option 2.**

6. For managing the business, A received 5% of the total profit i.e 5% of Rs. 7400 = Rs. 370.
$\therefore$ Balance profit = 7400 − 370 = Rs. 7,030.
This is divided among A, B and C in the ratio of their investments.
Since they invested money for different periods, the time periods need to be multiplied with the investment values to get their total investments.
$\therefore$ Ratio of their investments
$= (6500 \times 6) : (8400 \times 5) : (10000 \times 3)$
$= 39000 : 42000 : 30000 = 13 : 14 : 10$
$\therefore$ B's share in the profit = $7030 \times (14/37)$
= Rs. 2,660
Hence, **option 2.**

7. $a : b = 3 : 4$ and $b : c = 5 : 8$
Since b is the term common to both ratios, equate it by taking the LCM of 4 and 5 i.e. 20
So, multiply a by 5 and c by 4
So, $a : b = 15 : 20$ and $b : c = 20 : 32$
$\therefore a : b : c = 15 : 20 : 32$
Hence, **option 1.**

8. We know that:

$$\frac{a}{d} = \frac{a}{b} \times \frac{b}{c} \times \frac{c}{d} = \frac{3}{8} \times \frac{5}{3} \times \frac{4}{5} = \frac{1}{2}$$

$$\therefore \frac{d}{a} = \frac{1}{\frac{a}{d}} = 2.$$

Hence, **option 3.**

9. Let the contribution of C = x.
Then, contribution of B = x + 5000 and contribution of A = x + 5000 + 4000 = x + 9000.

So, $x + x + 5000 + x + 9000 = 50000$

$\therefore 3x = 36000$

$\therefore x = 12000$

Hence, A : B : C = 21000 : 17000 : 12000 = 21 : 17 : 12.

A's share will be in the same ratio as the investment.

$\therefore$ A's share = Rs. [35000 × (21/50)] = Rs. 14,700

Hence, **option 4.**

10. a, b, c, d are in continued proportion, so

$a/b = b/c = c/d = 2/3$

$\therefore a = (2/3) \times b, b = (2/3) \times c, c = (2/3) \times d$

$\therefore a = (2/3) \times (2/3) \times (2/3) \times d = (8/27) \times d$

$\therefore d = (27/8) \times a$

As all the four numbers are positive integers, so

The minimum value of a has to be 8 giving a value of $d = 27$

Hence, $a + d = 35$

Hence, **option 3.**

11. Let the fourth proportional be x.

$$\therefore \frac{5}{8} = \frac{15}{x}$$

$$\therefore x = 15 \times \frac{8}{5} = 24.$$

Hence, **option 5.**

12. Let the original numbers be $3x$ and $5x$.

As per the given data:

$$\frac{3x-9}{5x-9} = \frac{12}{23}$$

$\therefore 23(3x - 9) = 12(5x - 9)$

$\therefore 9x = 99$

$\therefore x = 11$

So, the smaller number is $3x = 3 \times 11 = 33$.

Hence, **option 2.**

13. Let us assume:

$$\frac{a}{b} = \frac{11}{76} \text{ and } \frac{c}{d} = \frac{9}{62}$$

We know that $\frac{a}{b} > \frac{c}{d}$ if $ad > bc$ and vice versa

So, $ad = 11 \times 62 = 682$

And $bc = 76 \times 9 = 684$

As $bc > ad$

We get $(c/d) > (a/b)$

Hence, Shyam has selected the larger fraction.

Hence, **option 2.**

14. Ramesh ate 2 out of 6 pieces from the first pizza and 5 out of the 9 from the second one.

$$\text{Ramesh's total share} = \frac{2}{6} + \frac{5}{9} = \frac{16}{18} = \frac{8}{9}$$

$$\text{Similarly Suresh's total share} = \frac{3}{6} + \frac{3}{9} = \frac{15}{18}$$

$$= \frac{5}{6}$$

$$\therefore \text{Ratio of what Ramesh and Suresh ate} = \frac{\frac{8}{9}}{\frac{5}{6}}$$

$$= \frac{16}{15}$$

Hence, **option 1.**

15. Let us assume that:

$$\frac{a}{b} = \frac{4}{5}$$

Now we know that if $a/b < 1$, then

$$\frac{a+1}{b+1} > \frac{a}{b}$$

$$\therefore \frac{5}{6} > \frac{4}{5}$$

Extending the same logic we get:

$$\frac{[(a+1)+1]}{[(b+1)+1]} > \frac{a+1}{b+1}$$

$$\therefore \frac{a+2}{b+2} > \frac{a+1}{b+1}$$

$$\therefore \frac{6}{7} > \frac{5}{6} > \frac{4}{5}$$

Hence, **option 4.**

Alternatively,

For these values, the value of the fraction could have been directly calculated.

4/5 = 0.8

5/6 = 0.833

6/7 = 0.857

0.857 > 0.833 > 0.8

$\therefore$ (6/7) > (5/6) > (4/5)

Hence, **option 4.**

Note that this approach may be time consuming for larger fractions.

MIXTURES AND ALLEGATIONS

CONCEPT TEST I

1. Let a parts of the Rs. 7.2 per kg mixture be mixed with b parts of the Rs. 5.7 per kg mixture.

$\therefore a : b = (6.3 - 5.7) : (7.2 - 6.3) = 0.6 : 0.9 = 2 : 3$

Hence, **option 2.**

2. The shopkeeper uses 1 kg and 4 kg of pulses costing Rs. 10 and Rs. 20 per kg respectively. Cost of resultant mixture

$$= \frac{(10 \times 1) + (20 \times 4)}{(1+4)} = \frac{90}{5} = \text{Rs. } 18 \text{ per kg}$$

Hence, **option 5.**

3. The first alloy has zinc and tin in the ratio 3 : 5.

∴ The amount of zinc in the first alloy is 3/8.

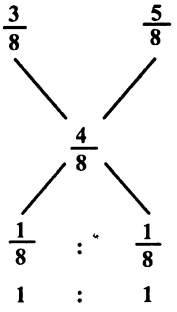
Similarly, the ratio of zinc and tin in the second alloy is 5 : 3.

∴ The amount of zinc in the second alloy is 5/8.

The ratio of zinc and tin in the mixture of the two alloys is 1 : 1

∴ The amount of zinc in the mixture of these two alloys is 1/2 i.e. 4/8.

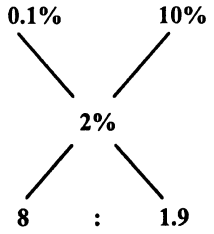
∴ The ratio in which the two alloys should be mixed, to get a resultant mixture of zinc and tin in the ratio 1 : 1 can be found using the diagram given below.



∴ The required ratio is 1 : 1.

Hence, **option 1.**

4.



Using the alligation rule shown above, the ratio of strychnine from the two mixtures is 8 : 1.9.

Final amount of the heart stimulant = 10 ml

∴ Amount of 0.1% solution in the final stimulant = (8/9.9) × 10 ≈ 8.1 ml

Hence, **option 4.**

5. Let the quantity of the wine in the cask originally be x litres.

8 litres of water is replaced with 8 litres of water. This process is repeated 4 times.

∴ Quantity of wine left in cask after 4 operations

$$= \left[x\left(1-\frac{8}{x}\right)^4\right]$$

$$\therefore \frac{x\left(1-\frac{8}{x}\right)^4}{x} = \frac{16}{81}$$

$\therefore x = 24$

Thus, there was initially 24 litres of wine in the cask.

Hence, **option 2.**

6. Suppose the vessel initially contains 8 litres of liquid. So, it has 3 litres of water and 5 litres of syrup.

Let x litres of this liquid be replaced with water.

So, $3x/8$ litres of water and $5x/8$ litres of syrup get reduced from the mixture while x litres of water gets added.

So, quantity of water in the new mixture

$$= 3 - \frac{3x}{8} + x$$

and, quantity of syrup in the new mixture

$$= 5 - \frac{5x}{8}$$

The mixture comprises equal parts water and equal parts syrup.

$$\therefore 3 - \frac{3x}{8} + x = 5 - \frac{5x}{8}$$

$$\therefore x = \frac{8}{5}$$

So, part of the mixture replaced $= \frac{1}{8} \times \frac{8}{5} = \frac{1}{5}$

Hence, **option 3.**

7. 4 litres of milk is replaced with 4 litres of water.

Amount of milk left after 3 operations

$$= 40\left(1-\frac{4}{40}\right)^3 \text{ litres}$$

$$= 40 \times \frac{9}{10} \times \frac{9}{10} \times \frac{9}{10} = 29.16 \text{ litres}$$

Hence, **option 4.**

8. ∵ The volumes of the two solutions are equal, the percentage of ethanol in the final solution is the average of the percentages of ethanol in the two constituent solutions.

Let us denote the maximum possible percentage of ethanol in the second solution by x

$3 = (5 + x)/2$

$\therefore x = 1\%$

So, the minimum possible percentage of impurity in the second solution

= 100 – 1 = 99%
Hence, **option 3.**

9. Let the original concentration of milk be x%.
The concentration of milk after the replacement is 30%.
Since this replacement is done only once,

$$\frac{x}{100} \times \frac{(42-6)}{42} = \frac{30}{100}$$

$$\therefore \frac{36x}{42} = 30$$

$\therefore x = 35\%$
Hence, **option 2.**

10. Suppose the can initially contains $7x$ litres and $5x$ litres of the liquids A and B respectively.

$$\text{Quantity of A in mixture left} = 7x - \frac{7}{12} \times 9$$

$$= 7x - \frac{21}{4}$$

$$\text{Quantity of B in mixture left} = 5x - \frac{5}{12} \times 9$$

$$= 5x - \frac{15}{4}$$

$$\therefore \frac{7x - \frac{21}{4}}{5x - \frac{15}{4} + 9} = \frac{7}{9}$$

$\therefore x = 3$
So, $7x = 21$ litres of liquid A was initially present in the can.
Hence, **option 3.**

11. 5 kg of sand constitutes 20% of the mixture by weight.
$\therefore$ 100% of mixture weighs 25 kg.
Let the quantity of sand which must be further added to the mixture be x kg.
If the weight of wheat is 50% of the mixture, the remaining 50% should be because of the sand.

$$\therefore 5 + x = \frac{50}{100}(25 + x)$$

$\therefore x = 15$ kg
Hence, **option 4.**

12. Initially, number of oranges = 2.
Now, number of oranges = 3
So, percentage increase in oranges = [(3 – 2)/2] × 100 = 50%
Hence, **option 5.**

13. 100 employees at Grade I in an organization have an average salary of Rs. 42 per month while 150 employees at Grade II in the same organization have an average salary of Rs. 36 per month.
So, average salary
= [(100 × 42) + (150 × 36)]/(100 + 150)
= (4200 + 5400)/250 = 9600/250 = Rs. 38.4
Hence, **option 3.**

14. Let the price of the mixture be Rs. x.
So, as per the given ratio,
$(4 - x)/(x - 2.4) = 1/3$
$\therefore 12 - 3x = x - 2.4$
$\therefore 4x = 14.4$
$\therefore x = 3.6$
So, the cost price of the mixture is Rs. 3.6
To make a 25% profit, it should be sold at 3.6 × 1.25 = Rs. 4.5
Hence, **option 2.**

15. A scientist mixes 80% sulphuric acid with water to get 60% sulphuric acid.
Since water contains 0% sulphuric acid, the ratio in which the two solutions are mixed is:
(60 – 0) : (80 – 60) = 60 : 20 = 3 : 1
Since 9 litres of 80% sulphuric acid was used, quantity of water used was (1/3) × 9 = 3 litres.
Hence, **option 2.**

VARIATION

CONCEPT TEST I

1. The book has 300 pages at the rate of 28 lines per page.
Now, if the number of pages has to become only 280. For this to happen, the number of lines per page has to increase.
So, the number of pages and the number of lines per page are inversely proportional to each other.
$\therefore$ Number of pages × Number of lines per page = k
Let the number of lines per page in the second case be p
$\therefore 28 \times 300 = 280p$
$\therefore p = (28 \times 300)/280 = 30$
Thus, if the book is to have 280 pages, it should have 30 lines per page.
Hence, **option 2.**

2. 24 workers can finish the work in 15 days.
Since the work is to be done in 12 days now, the number of workers required has to increase.
Thus, the number of days required is inversely proportional to the number of workers.

∴ Number of workers × Number of days = k
Let the number of workers needed in the second case be x.
∴ $24 \times 15 = x \times 12$
∴ $x = (24 \times 15)/12 = 30$
Thus, the number of additional workers required is 30 – 24 = 6
Hence, **option 1.**

3. Current (I) is inversely proportional to resistance (R)
∴ $I_1R_1 = I_2R_2 = I_3R_3$
Here, I_1 = 2 amperes, R_1 = 3 ohms, I_2 = 5 amperes and R_3 = 5 ohms
∴ $R_2 = (2 \times 3)/5 = 1.2$ ohms
And $I_3 = (2 \times 3)/5 = 1.2$ ohms
Hence, **option 5.**

4. Let the weight of the diamond be w decigrams and the price be Rs. p.
∴ $p \propto w^2$
∴ $p = kw^2$
Now when w = 20 dg, p = 3600
∴ $3600 = k \times 20^2$
∴ $k = 9$
Now, the diamond is broken in three pieces in the ratio 2 : 3 : 5.
So, the weights will be 4 dg, 6 dg and 10 dg respectively.
∴ Total price = $k(2^2 + 3^2 + 5^2) = 38k = 9 \times 38$ = Rs. 342
∴ Loss = 3600 – 342 = Rs. 3258
Hence, **option 5.**

5. 60 litres of diesel is required to travel 600 km using a 800 cc engine.
If the same 80 cc engine were to be used, then the amount of diesel required to travel 800 km would be $(800 \times 60)/600$ = 80 litres
However, the vehicle uses a 1200 cc engine and it is given that the amount of diesel required varies directly as the engine capacity.
i.e., for instance, if the capacity of the engine increases, the diesel requirement also increases.
Therefore, with a 1200 cc engine, quantity of diesel required = $(1200 \times 80)/800$
= 120 litres.
Hence, **option 3.**

6. The greater the height of the pole, the longer is its shadow.
So, the height of the pole and the length of the shadow are directly proportional to each other.
When the height of the pole is 3 m, the length of the shadow is 3.6 m.
So, when the length of the shadow is 54 m, the height of the pole is $(3 \times 54)/3.6$ = 45 m
Hence, **option 1.**

7. Let us denote electric field strength by E, charge by q and distance by r.
It is given that:

$$E \propto \frac{q}{r^2}$$

$$\therefore E = \frac{kq}{r^2}$$

Putting the given values in the above equation we get:

$$9 \times 10^9 = k \times \frac{1}{1^2}$$

$\therefore k = 9 \times 10^9$
Now, we need to find E when q = 2C and r = 2m

$$\therefore E = 9 \times 10^9 \times \frac{2}{2^2} = 4.5 \times 10^9 \text{N/C}$$

Hence, **option 4.**

8. Let us denote gravitational force by F, masses by m_1, m_2 and distance between them be r.
It is given that:

$$F \propto \frac{m_1 m_2}{r^2}$$

$$\therefore F = \frac{k m_1 m_2}{r^2}$$

Now, substituting the given values we get:

$$\frac{5}{3} = k \times 1 \times \frac{1}{1^2}$$

$$\therefore k = \frac{5}{3}$$

Now, F = 5/3 N, $m_1 = m_2$ = 2kg
So, we can find r.

$$\frac{5}{3} = \frac{\left(\frac{5}{3}\right) \times 2 \times 2}{r^2}$$

$\therefore r = \sqrt{2 \times 2} = 2$m
Hence, **option 1.**

9. It is given that:

$$y \propto \frac{x}{z}$$

$$\therefore y = \frac{kx}{z}$$

$$\therefore k = \frac{yz}{x}$$

And hence $\frac{y_1 z_1}{x_1} = \frac{y_2 z_2}{x_2}$

Substituting the values we get:

$$\frac{5 \times 4}{2} = \frac{y \times 6}{3}$$

$\therefore y = 5.$

Hence, **option 2.**

10. Let us denote the weight supported by w, diameter by d and height by h.

It is given that:

$$w \propto \frac{d^4}{h^2}$$

$$\therefore w = \frac{kd^4}{h^2}$$

$$\therefore k = \frac{wh^2}{d^4}$$

$$\therefore \frac{w_1 h_1^2}{d_1^4} = \frac{w_2 h_2^2}{d_2^4}$$

Putting the values we get:

$$\frac{64 \times 9^2}{2^4} = w_2 \times \frac{9^2}{3^4}$$

$\therefore w_2 = 324$ metric ton

Hence, **option 5.**

TIME AND DISTANCE

CONCEPT TEST I

1. When distance is constant, speed and time are inversely proportional to each other.

The distance is covered in 5 hours at a speed of 240 kmph.

For the same distance to be covered in 5/3 hours, speed should be (5 × 240)/(5/3) = 720 km/hr

Hence, **option 5.**

2. Let Abhay's speed be x km/hr and the time taken by Sameer be y hours.

$$\therefore \frac{30}{x} - \frac{30}{2x} = (y + 2) - (y - 1) = 3$$

$$\therefore \frac{30}{2x} = 3$$

$\therefore x = 5$ km/h

Hence, **option 1.**

3. Let the distance travelled by x km. Robert saves 2 hours by increasing his speed by 5 kmph.

$$\therefore \frac{x}{10} - \frac{x}{15} = 2$$

$\therefore x = 60$ km

So, time taken to travel 60 km at 10 km/hr = 60/10 = 6 h

So, Robert started 6 hours before 2 P.M. i.e., at 8 A.M.

Now, Robert wants to reach by 1 P.M. i.e. in 5 hours.

Required speed = 60/5 = 12 km/h

Hence, **option 3.**

4. Let the speed of the train be x km/hr and that of the car be y km/hr.

$$\therefore \frac{120}{x} + \frac{480}{y} = 8$$

$$\therefore \frac{1}{x} + \frac{4}{y} = \frac{1}{15}$$

$$\text{Also, } \frac{200}{x} + \frac{400}{y} = \frac{25}{3},$$

because this mode of transport requires 8 hours,

$$20 \text{ minutes } \therefore \frac{1}{x} + \frac{2}{y} = \frac{1}{24}$$

On solving these we get $x = 60$ and $y = 80$

So, ratio of speed of train to speed of car = 3 : 4

Hence, **option 2.**

5. $$\text{Average speed} = \frac{\text{Total Distacnce}}{\text{Total Time}}$$

$$= \frac{(50 \times 3) + (60 \times 2)}{5} = \frac{270}{5} = 54 \text{ km/hr}$$

Hence, **option 2.**

6. Let the distance be d.

Time required to go from Andheri to Bandra will be $(d/10)$ hours.

Now, time required while coming back = $(d/15)$ hours.

So, using the formula for average speed:

$$\text{Average speed} = \frac{\text{Total Distance}}{\text{Total Time}}$$

$$\text{Average Speed} = \frac{2d}{\frac{d}{10} + \frac{d}{15}} = \frac{2 \times 10 \times 15}{10 + 15}$$

=12km/h

Hence, **option 1.**

7. Since the human ear can clearly hear the sound produced within $1/10^{th}$ of a second, the sound after production will have to travel for $1/10^{th}$ of a second before coming back to its source.

So, sound has to cover (1/10) × 340 = 34 m

$\therefore$ The obstacle must be placed at (34/2) = 17 m.

Hence, **option 4.**

8. The car travels at 25 miles per hour for 40 miles and then at s miles per hour for another 120 miles. So, the total distance covered is

160 miles and the average speed over this distance is 40 miles per hour.
So, we get

$$40 = \frac{160}{\frac{40}{25} + \frac{120}{s}}$$

$$\therefore \frac{120}{s} = 4 - \frac{40}{25} = \frac{60}{25}$$

$$\therefore s = 25 \times \frac{120}{60} = 50 \text{ miles per hour.}$$

Hence, **option 3.**

9. Since the length of the train, length of the platform and the time (in the answer options) are given in terms of metres and seconds, convert the speed of the train to m/s.
Speed of the train = 132 kmph = 132 × (5/18) = (110/3) m/s
Distance covered in passing the platform
= Length of the train + Length of the Platform
= (110 + 165) = 275 m.

$$\text{So, Required time} = \frac{275}{\frac{110}{3}} = 7.5 \text{ sec.}$$

Hence, **option 3.**

10. Length of the train = x m.
Speed of the train = 72 km hr = 72 × (5/18) = 20 m/sec
Time taken = 26 sec.
Length of the Platform = 250 m.
∴ Total Length = (x + 250) m.
∴ (x + 250) = 20 × 26 = 520
∴ x + 250 = 520
∴ x = 270
∴ Length of the train = 270 m.
Hence, **option 5.**

CONCEPT TEST II

1. Let the length of the train be x m.
Speed of the train = 54 km/hr = 54 × (5/18) = 15 m/sec.
Time taken to cross the man = 20 s.
∴ Length of the train = 15 ×20 = 300 m.
Let the length of the platform be y m.
Time taken to cross the platform = 36 s.
∴ Total distance covered
= Length the train + length of the platform
= 300 + y
∴ 300 + y = 15 × 36 = 540
300 + y = 540
∴ y = 240 m
∴ Length of the platform = 240 m.
Hence, **option 2.**

2. The distance travelled by the boat while travelling in the direction of the stream is 120 km.
Let the distance to be covered by the boat when it is travelling against the stream be x km.
The boat goes down the river at a speed of 20 + 4 = 24 km/hr and up the river at a speed of 20 – 4 = 16 km/hr.
Since the time taken is same
∴ 120/24 = x/16
∴ x = 80 km.
Hence, **option 1.**

3. Let the speed of the boat in still water be 'b' km/h.
∴ Downstream speed = b + 10 (As the speed of the stream is 10 km/h).
And upstream speed = b – 10
As per the given condition:

$$\frac{60}{b+10} + \frac{60}{b-10} = 4.5$$

b = 30 km/hr satisfies the above equation
∴ Downstream speed = 30 + 10 = 40 km/h
His onward journey was done at a speed of 40 km/h and the distance covered was 60 kms.
So, the time taken for the onward journey = 1.5 hours.
Hence, **option 4.**

4. Let the speed of the boat be b and speed of the current be f.
∴ $b + f$ = 40 and $b - f$ = 14
Solving these two equations we get:
f = 13 km/hr
Hence, **option 1.**

5. Let the distance between two cars travelling at a speed of 40km/hr be x m.
So, when the car with 60 km/hr crosses the first car, the car and the other car with 40 km/hr will travel relatively with (40 + 60) km/hr = 100 × (5/18) m/s
So, we the distance is

$$x = 100 \times \frac{5}{18} \times 9 = 250 \text{ m}$$

Hence, **option 5.**

6. Before the turn, both cars travel for 8 km each.
So, just before they take the turn, the two cars are (8 + 8) = 16 km apart.
Once they take the turn, they travel 6 km each.
So, after the turn, they are 6 km apart horizontally.
So, actual distance between them = $[(12)^2 + (16)^2]^{1/2}$ = 20 km
Hence, **option 2.**

7. As both the people move in opposite directions, their relative speed = (5 + 10) = 15 km/h
So, time after which they meet each other = (15/15) = 1 hour.
Hence, **option 1.**

8. A will complete one round in 300/5 = 60s.
B will complete one round in 300/10 = 30s.
LCM of 30 and 60 = 60.
Hence, A and B will meet together after 60s.
Hence, **option 4.**

9. A beats B by 20m and A beats C by 40 m.
So, when A covers 200 m, B covers 180 m and C covers 160 m.
So, ratio of speeds of B and C = 180 : 160 = 9 : 8
Now, when B covers 200 m, he beats C by 24 m.
So, C covers 176 m
∴ Ratio of speeds of B and C = 200 : 176 = 25 : 23
Hence, the data is not consistent.
Hence, **option 5.**

10. A beats B by 20m in 100m race.
So, ratio of speeds of A and B = 100 : 80 = 5 : 4.
Now, B beats C by 25m in the same race.
∴ Ratio of speeds of B and C = 100 : 75 = 4 : 3.
Hence, ratio of speeds of A, B, and C = 5 : 4 : 3
∴ ratio of speeds of A and C = 5 : 3.
Hence, **option 4.**

CLOCKS

CONCEPT TEST I

1. When the hands of the clock are in the same straight line but not together, they are 30 minute spaces apart.
At 7 o'clock, the two hands of the clock 25 minute spaces apart.
Minute hand will have to gain only 5 minute spaces.
55 minute spaces are gained in 60 minutes.

5 minute spaces are gained in $\frac{60}{55} \times 5 = \frac{60}{11}$

$= 5\left(\frac{5}{11}\right)$ minutes

Hence, **option 3.**

2. At 4:20, $h = 4$ and $m = 20$.
Let the required angle be θ degrees

$$\theta = 6\left(\frac{11m}{12} - 5h\right)$$

$$\therefore \theta = \left|\left(\frac{(11 \times 20)}{2} - (6 \times 5 \times 4)\right)\right|$$

$= |110 - 120| = 10°$
The angle is actually negative because the hour hand is ahead of the minute hand.
Hence, **option 3.**

3. The hands of a clock coincide 11 times in every 12 hours (Since between 11 and 1, they coincide only once, i.e., at 12 o'clock).
So, in 24 hours, the two hands coincide 11 × 2 = 22 times.
Hence, **option 1.**

4. Time from 12 p.m. on Monday to 2 p.m. on the following Monday = 7 days and 2 hours i.e. 170 hours.
The watch moves from being 2 minutes slow to 4 minutes and 48 seconds fast in this period.
So, the watch gains

$2 + 4\left(\frac{4}{5}\right) = \frac{34}{5}$ minutes in 170 hours.

To be on time, it needs to gain 2 minutes compared to noon on Monday.

∴ 2 minutes are gained in $2 \times \frac{170}{\frac{34}{5}}$

= 50 hours

∴ The watch shows the correct time 2 days and 2 hours after 12 p.m. on Monday i.e., it will be correct at 2 p.m. on Wednesday.
Hence, **option 2.**

5. At 5 : 15, $h = 5$ and $m = 15$.
Let the required angle be θ degrees

$$\theta = 6\left(\frac{11m}{12} - 5h\right)$$

$$\therefore \theta = \left|\left(\frac{(11 \times 15)}{2} - (6 \times 5 \times 5)\right)\right|$$

$= |82.5 - 150| = 67.5°$
The angle is actually negative because the hour hand is ahead of the minute hand.
Hence, **option 4.**

6. At 9 o'clcok, the minute and hour hand are 45 minute spaces apart.
To be together between 9 and 10 o'clock, the minute hand has to gain 45 minute spaces.
55 minute spaces are gained in 60 minutes.

∴ 45 minute spaces are gained in $\left(\frac{60}{55}\right) \times 45$

$= 49\left(\frac{1}{11}\right)$ minutes.

Hence, **option 3.**

7. At 4 o'clock, the hands of the watch are 20 minute spaces apart.
To be in opposite directions, they must be 30 minute spaces apart.
So, the minute hand will have to gain 20 + 30 i.e. 50 minute spaces.
55 minute spaces are gained in 60 minutes.

$\therefore$ 50 minute spaces are gained in $\left(\frac{60}{55}\right) \times 50$

$= 54\left(\frac{6}{11}\right)$ minutes

Hence, **option 4.**

8. At 8:30, $h = 8$ and $m = 30$.
Let the required angle be θ degrees

$$\theta = 6\left(\frac{11m}{12} - 5h\right)$$

$$\therefore \theta = \left|\left(\frac{(11 \times 30)}{2} - (6 \times 5 \times 8)\right)\right|$$

$= |165 - 240| = 75°$
The angle is actually negative because the hour hand is ahead of the minute hand.
Hence, **option 3.**

9. At 5 o'clock, the hands are 25 minutes spaces apart.
To be at right angles and that too between 5.30 and 6, the minute hand has to gain (25 + 15) = 40 minute spaces.
55 minute spaces are gained in 60 minutes.

40 minute spaces are gained in $\frac{60}{55} \times 40$

$= 43\left(\frac{7}{11}\right)$ minutes.

Hence, **option 2.**

10. When first time the two hands make a right angle, minute hand is behind the hour hand by 15 minutes and when this happens for the second time, the minute hand is ahead of the hour hand by 15 minutes.
So, the minute hand effectively covers 30 minutes more than the hour hand.
In an hour the minute hand covers 55 minutes more than the hour hand.
So, the required number = (60/55) × 30 = 32(8/11) minutes.
Hence, **option 1**

TIME AND WORK

CONCEPT TEST I

1. Let the total amount of work be the LCM of 12, 15 and 20 i.e. 60 units.
Let a, b and c be the number of units of work respectively done by A, B and C alone.
$\therefore a + b = 60/12 = 5$ units/day
$b + c = 60/15 = 4$ units/day
$c + a = 60/10 = 60/20 = 3$ units/day
On solving these equations, we get $a = 2$ units/day.
Thus, A working alone can do 2 units of work per day.
So, A working alone can finish the work in 60/2 = 30 days
Hence, **option 2.**

2. Since A is twice as good a worksman as B, A takes half the time as B to complete the work if they are working alone.
Let A working alone finish the work in a days.
So, A does (1/a) of the work in 1 day.
So, B working alone finishes the work in $2a$ days. So, B does $(1/2a)$ of the work in 1 day.
Thus, in 1 day, A and Be together do $(1/a) + (1/2a)$ of the work i.e. $(3/2a)$ of the work.
A and B can together complete the work in 18 days. So, they can do (1/18) of the work in 1 day.

$\therefore \frac{3}{2a} = \frac{1}{18}$

$\therefore a = 27$
Hence, A alone can finish the work in 27 days.
Hence, **option 3.**

3. Assume that 1 man can do 1 unit of work per day.
So, 3 men can do 3 units of work per day.
Since 3 men take 6 days to complete the work, total work = 3 × 6 = 18 units
The 3 men work for 2 days. So, work done in 2 days = 3 × 2 = 6 units
Amount of work left = 18 – 6 = 12 units
Now, there are 3 + 3 = 6 men working on this piece of work.
$\therefore$ Time taken by 6 men to complete the remaining work = 12/6 = 2 days
Hence, **option 2.**

4. A and B can together dig the trench in 8 hours.
So, work done by A and B in one hour = 1/8
A alone can dig the trench in 12 hours.
So, work done by A alone in one hour = 1/12

So, work done by B alone in one hour = (1/8) – (1/12) = 1/24
So, B can dig the trench alone in 24 hours.
Hence, **option 5.**

5. Let the total work be the LCM of 18 and 15 i.e. 90 units.
So, B alone can do 90/15 = 6 units/day
A alone can do 90/18 = 5 units/day
In the first 10 days, B does 10 × 6 = 60 units of work
So, time taken by A to do the remaining 30 units of work = 30/5 = 6 days
Hence, **option 1.**

6. B, working alone, takes 23 days to complete the work.
A is 30% more efficient than B.
So, A is 1.3 times as efficient as B.
So, time taken by A working alone = Time taken by B working alone/1.3 = 23/1.3 = 230/13 days
Let the total work be a common multiple of 23 and 230/13, say 230 units.
So, B does 230/23 = 10 units of work per day and A does 230/(230/13) = 13 units of work per day.
So, A and B working together do 10 + 13 = 23 units of work per day.
So, A and B together complete the work in 230/23 = 10 days.
Hence, **option 3.**

7. Let the total work be 40 units
So, A and B can respectively do 2 units/day and 1 unit/day, if working alone.
Together, they can do 3 units of work per day.
If both work at 80% efficiency, they can do 0.8 × 3 = 2.4 units per day.
So, time taken = 40/2.4 = 50/3 days
Hence, **option 4.**

8. A, working alone, finishes 80% of the work in 20 days.
So, if A is working alone, he can finish the entire work in 25 days.
Let the total work be a multiple of 25, say 150 units.
So, A does 6 units of work per day.
Thus, in 20 days, A completes 120 units of work.
Now, A and B together finish the remaining 30 units of work in 3 days i.e. they do 10 units of work per day.
Since A does 6 out of those 10 units, B does the remaining 4 units per day.
So, time taken by B to do 150 units of work = 150/4 = 37.5 days
Hence, **option 3.**

9. Suppose pipe A alone takes x hours to fill the tank.
Then, pipes B and C will take $x/2$ and $x/4$ hours to fill the tank.

$$\therefore \frac{1}{x}+\frac{2}{x}+\frac{4}{x}=\frac{1}{5}$$

$$\frac{7}{x}=\frac{1}{5}$$

$\therefore x = 35$ hours
Hence, **option 3.**

10. Let the capacity of the tank be 60 units.
So, pipe A and pipe B can individually fill 4 units/min and 3 units/min respectively.
Together, they can fill 7 units per minute.
They work together for 4 minutes and fill 28 units in this time.
So, 32 units are still to be filled.
B can fill this in 32/3 minutes.
So, total time = 4 + (32/3) = 44/3 minutes i.e. 14 minutes and 40 seconds
Hence, **option 4.**

11. Let the slower pipe alone fill the tank in x minutes.
Then, the faster pipe will fill it in $x/3$ minutes.
Together they fill the tank in 36 minutes.

$$\therefore \frac{1}{x}+\frac{3}{x}=\frac{1}{36}$$

$\therefore x = 144$ minutes
Hence, **option 3.**

12. Let the capacity of the tank be 84 units.
So, $A + B + C = 14$ units/hour
In 2 hours, they fill 2 × 14 = 28 units
The remaining 56 units are filled by A and B in 7 hours.
So, number of units filled by A and B in 1 hour = 56/7 = 8 units
$\therefore A + B = 8$
$\therefore C = 14 - 8 = 6$ hours
So, C can fill the tank in 84/6 = 14 hours
Hence, **option 3.**

13. (20 × 16) women can complete the work in 1 day.
∴ 1 woman's 1 day's work = 1/320
(16 × 15) men can complete the work in 1 day.
∴ 1 man's 1 day's work = 1/240

So, required ratio $\frac{1}{240}:\frac{1}{320}=4:3$

Hence, **option 4.**

14. Efficiency is defined as the amount of work done in one day.
Working together A and B can do
$\frac{1}{15}+\frac{1}{10}=\frac{5}{30}=\frac{1}{6}$ amount of work.
So the efficiency is 1/6.
Hence, **option 1.**

15. Abhay does a work in 20 days and Ajay does the same work in 18 days.
So, Abhay does $(1/20)^{th}$ of the work in one day and Ajay does $(1/18)^{th}$ of the work in one day.
We know that: (1/18) > (1/20).
So, Ajay is more efficient than Abhay.
Hence, **option 2.**

NUMBER SYSTEM

CONCEPT TEST I

1. The shortest way to solve such a question is to substitute the value of n using the answer options, and then to see which value of $2n + 1$ is not a prime number.
For $n = 3$, $2n + 1 = 7$
$n = 5$, $2n + 1 = 11$
$n = 4$, $2n + 1 = 9$
$n = 6$, $2n + 1 = 13$
Thus, among the four numbers given in the options, only $n = 4$ yields a non-prime number.
However, because one of the options is "None of these", we also need to check $n = 1$ and $n = 2$
For $n = 1$, $2n + 1 = 3$
$n = 2$, $2n + 1 = 5$
Thus, the smallest value of n for which $2n + 1$ is not prime is $n = 4$
Hence, **option 3.**

2. The prime numbers between 60 and 75 are 61, 67, 71 and 73.
$\therefore$ sum = 61 + 67 + 71 + 73 = 272
Hence, **option 4.**

3. $3 + 6 \div 3 \times 2 = 3 + 2 \times 2 = 3 + 4 = 7$
Hence, **option 1.**

4. $\frac{[2^4+(16-3\times4)]}{[(6+3^2)\div(7-4)]}=\frac{16+(16-12)}{15\div3}$
$=\frac{16+4}{5}$
$=\frac{20}{4}=5$
Hence, **option 3.**

5. $7-\sqrt{9})\times(4^2-3+1)$
$=(7-3)\times(16-3+1)$
$=4\times14=56$
Hence, **option 3.**

6. $(33-2\times7)+(5\times3-22)$
$=(33-14)+(15-22)$
$=19-7=12$
Hence, **option 5.**

7. $(15\div3+4)-(3^2-7\times2)$
$=(5+4)-(9-14)$
$=9-(-5)=14$
Hence, **option 2.**

8. $(3+2)^2-5\times3+2^3$
$=5^2-15+8$
$=25-15+8=18$
Hence, **option 3.**

9. Let the quotient in both the case be q.
Using the first statement,
$\therefore 123 = nq + 13$
$\therefore nq = 110$
Let the remainder when 492 is divided by $4n$ be r.
$\therefore 492 = (4n)q + r = 4(nq) + r$
$\therefore 492 = 4(110) + r$
$\therefore r = 492 - 440 = 52$
Hence, **option 4.**

10. A number which gives a remainder of 3 when divided by 13 can be represented as $(13n + 3)$.
Further, when the same number is divided by 18, the remainder is 4. Hence, this number can also be represented as $18m + 4$
$\therefore 13n + 3 = 18m + 4$
$\therefore 13n - 18m = 1$
$\therefore n = (18m + 1)/13$
Both, n and m have to be integers.
The lowest positive integral value of m for which n is also an integer is $m = 5$
For this value of m, $n = 7$
So, the number is $(13 \times 7) + 3 = 94$
Hence, **option 1.**

NUMBER THEORY

CONCEPT TEST I

1. 43, 91 and 183 when divided by a particular number leave the same remainder, say r.
Let the highest number that satisfies this condition be n.
So, $43 - r$ is divisible by n.
Similarly, $91 - r$ and $183 - r$ are also divisible by n.

So, $(183 - r) - (91 - r)$ is also divisible by n i.e. 92 is divisible by n.
Similarly, $(183 - r) - (43 - r)$ i.e. 140 is also divisible by n.
Also, $(91 - r) - (43 - r)$ i.e. 48 is also divisible by n.
So, n is the highest number that divides 48, 92 and 140 i.e. n is the H.C.F. of 48, 92 and 140.
$48 = 2^4 \times 3^1$
$92 = 2^2 \times 23^1$
$140 = 2^2 \times 5 \times 7$
Thus, H.C.F. of 48, 92 and 140 is 22 i.e. 4
Hence, **option 1.**

2. Let the least multiple of 7 required by $7n$.
This number when divided by 6, 9, 15 and 18 leave a remainder of 4.
So, $7n - 4$ is divisible by 6, 9, 15 and 18.
So, $7n - 4$ has to be the L.C.M. of 6, 9, 15 and 18.
$6 = 2^1 \times 3^1$
$9 = 3^2$
$15 = 3^1 \times 5^1$
$18 = 2^1 \times 3^2$
So, L.C.M. of 6, 9, 15 and $18 = 2^1 \times 3^2 \times 5^1 = 90$
When 4 is added to it, the number becomes 94
However, 94 is not a multiple of 7.
So, check for further multiples of 90.
We can confirm that 184 and 274 are also not divisible by 7.
However, 364 is divisible by 7.
So, 364 is the smallest such number.
Hence, **option 4.**

3. Let the number to be added be r.
So, $2497 + r$ is divisible by 3, 4, 5 and 6.
This also means that $2497 + r$ is divisible by the L.C.M. of 3, 4, 5 and 6 i.e. by 60.
So, when 2497 is divided by 60, some remainder will be left
This remainder $+ r = 60$
$\therefore r = 60 -$ remainder
On dividing 2497 by 60, the remainder is 37.
$\therefore$ Number to be added $= (60 - 37) = 23$.
Hence, **option 3.**

4. The time at which all the three people meet will be the L.C.M. of the time taken by each person individually to complete one round.
$252 = 2^2 \times 7^1 \times 9^1$
$308 = 2^2 \times 7^1 \times 11^1$
$198 = 2^1 \times 9^1 \times 11^1$
$\therefore$ L.C.M. of 252, 308 and 198 $= 2^2 \times 7^1 \times 9^1 \times 11^1 = 2772$.
So, A, B and C will again meet at the starting point in 2772 seconds i.e. 46 minutes and 12 seconds.
Hence, **option 4.**

5. Since the numbers are in the ratio 3 : 4 : 5, let the numbers be $3x$, $4x$ and $5x$ respectively.
Then, their L.C.M. $= 60x$.
However, their L.C.M. is given to be 2400.
$\therefore 60x = 2400$ i.e. $x = 40$.
So, the numbers are (3×40), (4×40) and (5×40) i.e. 120, 160 and 200.
So, their H.C.F. is 40
Hence, **option 1.**

6. Since the required number leaves a remainder of 6 and 5 when dividing 1657 and 2037 respectively, it divides $(1657 - 6)$ and $(2037 - 5)$ i.e. 1651 and 2032.
So, the required number is the H.C.F. of 1651 and 2032
Since these are relatively larger numbers, divide 2032 by 1651. The remainder when 2032 is divided by 1651 is 381.
Now, divide 1651 by 381. The remainder of this division is 127.
Now, divide 381 by 127. The remainder of this division is 0.
So, 127 is the H.C.F of 1651 and 2032.
So, 127 is the required number.
Hence, **option 2.**

7. Let the numbers be $2x$ and $3x$.
So, their L.C.M. $= 6x$.
However, the L.C.M. is given as 48
$\therefore 6x = 48$
$\therefore x = 8$.
So, the numbers are 16 and 24.
Hence, their sum is 40.
Hence, **option 3.**

8. Let the numbers be a and b.
$\therefore a + b = 55$
H.C.F. $\times$ L.C.M. $= a \times b$
$\therefore ab = 5 \times 120 = 600$.
$\therefore$ Sum of reciprocals $= \frac{1}{a} + \frac{1}{b} = \frac{a+b}{ab} = \frac{55}{600}$
$= \frac{11}{120}$
Hence, **option 3.**

9. $36 = 2^2 \times 3^2$
$84 = 2^2 \times 3 \times 7$
$\therefore$ H.C.F. $= 2^2 \times 3 = 12$.
Hence, **option 4.**

10. Let the numbers be $13a$ and $13b$.
$\therefore 13a \times 13b = 2028$

$\therefore ab = 12$.
Now, the pairs of co-primes with product 12 are (1, 12) and (3, 4).
So, the required numbers are (13 × 1, 13 × 12) and (13 × 3, 13 × 4).
Clearly, there are 2 such pairs.
Hence, **option 2.**

11. Product or two primes = H.C.F. of two numbers × L.C.M. of two numbers
Let the numbers be $37a$ and $37b$.
$\therefore 37a \times 37b = 4107$
$\therefore ab = 3$.
Now, co-primes with product 3 are (1, 3).
So, the required numbers are (37 × 1, 37 × 3) i.e., (37, 111).
∴ The greater number is 111.
Hence, **option 3.**

12. The given numbers are 1.08, 0.36 and 0.90.
These numbers can also be written as (108/100), (36/100) and (90/100)
So, the H.C.F. is the H.C.F. of the numerators and the L.C.M. of the denominators.
Since the denominators are the same in each fraction, L.C.M. of the denominators is 100.
H.C.F. of 108, 36 and 90 is 18.
∴ H.C.F. of given numbers = 18/100 = 0.18.
Hence, **option 3.**

13. It is given that:
$n = 8k + 3$
$\therefore 6n = 6 \times (8k + 3)$
$\therefore 6n = 48k + 18$
Since we want the remainder when $6n$ is divided by 8, express the R.H.S. in terms of a multiple of 8.
$\therefore 6n = 8 \times (6k + 2) + 2$
So, when $6n$ is divided by 8, remainder is 2.
Hence, **option 3.**

14. Since n is divisible by 3, 5 and 12, the next number divisible by 3, 5 and 12 will be n + LCM of (3, 5, 12)
Now, the LCM of (3, 5, 12) = 60
So, the next number after n, which is divisible by 3, 5, 12 is $n + 60$.
Hence, **option 4.**

15. Mr. Brackett and his sons can take a break every 140, 210 and 280 minutes respectively.
So, the three of them will meet each other at the L.C.M. of 140, 210 and 280 minutes.
But, LCM of (140, 210 and 280) = 840 minutes i.e. 14 hours.
So, they can meet each other every 14 hours.
Hence, **option 3.**

CALENDARS

CONCEPT TEST I

1. Since Jan 1, 2006 was a Sunday; December 31, 2005 was a Saturday.
2006, 2007 and 2009 will have 1 odd day each (as they are not leap years) while 2008 will have 2 odd days (as it is a leap year).
∴ Number of odd days from the year 2006 to the year 2009 = (1 + 1 + 2 + 1) = 5 days.
So, December 31, 2009 was a Thursday.
∴ Jan 1, 2010 was a Friday.
Hence, **option 3.**

2. Each day of the week is repeated after 7 days.
Thus, the 7th day after today will also be a Monday.
Thus, every day after today that is a multiple of 7 will be a Monday.
Thus, the 63rd day after today will also be a Monday.
Thus, the 61st day after today will be a Saturday.
Hence, **option 5.**

3. 2004 is a leap year and so it has 2 odd days.
However, the period under consideration is from 6th March 2004 to 6th March 2005.
So, February 2004 (having 29 days) does not come under consideration.
Therefore, the given period has only one odd day.
This implies that the day on 6th March 2004 will be a day prior to 6th March 2005.
Since it is given that 6th March 2005 is a Monday, 6th March 2004 has to be a Sunday.
Hence, **option 2.**

4. x weeks x days = $(7x + x)$ days = $8x$ days.
Hence, **option 4.**

Alternatively,
Substitute suitable values of x.
1 week and 1 day = 7 + 1 = 8 days
2 weeks and 2 days = 14 + 2 = 16 days i.e. 8 × 2 days
3 weeks and 3 days = 21 + 3 = 24 days i.e. 8 × 3 days
Thus, each of these get represented in the form $8x$ days.
Hence, **option 4.**

5. 1st January of 1 A.D. is a Monday.
100 years contain 5 odd days.
So, the last day of the first century will be (5 – 1) days i.e. 4 odd days.
So, the last day of the first century is Friday.
200 years contain 3 odd days.

As per the logic given above, the last day of the second century is Wednesday.
300 years contain 1 odd day.
So, the last day of the third century is Monday.
400 years contain 0 odd days.
So, the last day of the fourth century is Sunday.
This cycle is repeated for every series of four hundred years.
So, the last day of a century cannot be Tuesday, Thursday or Saturday.
Among these, only Tuesday is given in the options.
Hence, **option 1.**

6. 20th June, 1837 means 1836 complete years + the first 5 months of the year 1837 + 20 days of June
1836 = 1600 + 200 + 36
1600 years give 0 odd days.
200 years give 3 odd days.
36 years have 27 non-leap years and 9 leap years
So, they have (27 × 1) + (9 × 2) = 45 odd days i.e. 3 odd days
Thus 1836 years give 0 + 3 + 3 i.e. 6 odd days.
1837 is not a leap year.
The number of odd days in the five completed months of 1837 is 3 + 0 + 3 + 2 + 3 i.e. 11 odd days or 4 odd days.
From 1st June to 20th June, there are 6 odd days.
So, total odd days in the given period = 6 + 4 + 6 = 16. This is equivalent to 2 odd days.
So, the 20th of June will be two days after Sunday i.e. Tuesday.
Hence, **option 2.**

7. This is a leap year.
So, none of the next 3 years will be leap years.
So, each of the next three years will have one odd day.
So, this date in the third year from now will be 3 days after Monday i.e. it will be Thursday.
Hence, **option 4.**

8. In 400 consecutive years there are 97 leap years.
Hence, in 400 consecutive years, February has the 29th day 97 times and the remaining eleven months have the 29th day 400 × 11 i.e. 4400 times. Thus the 29th day of the month occurs 4400 + 97 = 4497 times in 400 consecutive years
Hence, **option 1.**

9. 16th July, 1776 = 1775 years + 6 months from January to June in 1776 + 16 days in July 1776.
1775 = 1600 + 1100 + 75
Now, 1600 years have 0 odd days.
100 years have 5 odd days.
75 years have 18 leap years and 57 non-leap years.
Number of odd days in this 75 years = (57 × 1) + (18 × 2) = 93 odd days.
93 = (13 × 7) + 2
Thus, 75 years have 2 odd days.
Therefore, 1775 years have 0 + 5 + 2 = 7 odd days.
This is nothing but 0 odd days. 1776 is a leap year.
So, the 6 completed months in 1776 have 3 + 1 + 3 + 2 + 3 + 2 = 14 odd days.
Again, this is nothing but 0 odd days.
The 16 days of July 1776 have 2 odd days.
So, total odd days in the given period = 0 + 0 + 2 = 2
The cycle starts with Monday and ends on Sunday
Therefore, the day of the week on the given date was Tuesday (Sunday + 2).
Hence, **option 2.**

10. Since the year is not given, it is not known if it is a leap year or not.
So, there can be 4 Mondays (1, 8, 15, 22) or 5 Mondays (1, 8, 15, 22, 29) in the month depending on whether it is a leap year or not.
Hence, **option 4.**

ALGEBRAIC FORMULAE AND OPERATIONS

CONCEPT TEST I

1. By Binomial Theorem;
$(a + b)^n = {}^nC_0a^nb^0 + {}^nC_1a^{n-1}b^1 + \ldots {}^nC_na^0b^n$
So, the 4th term of an expansion of this form is ${}^nC_3a^{n-3}b^3$:
Here, $a = 4x^2$ and $b = 5/(x^3)$

So, the 4th term of $\left(4x^2 + \frac{5}{x^3}\right)^7$

$= {}^7C_3(4x^2)^{7-3}\left(\frac{5}{x^3}\right)^3 = 35 \times 4^4 \times x^8 \times \frac{5^3}{x^9}$

$= \frac{7^1 \times 5^1 \times 4^4 \times 5^3}{x} = \frac{5^4 \times 4^4 \times 7^1}{x}$

$= \frac{1120000}{x}$

Hence, **option 3.**

2. In the binomial theorem; $(r + 1)^{th}$ term is given by

$T_{r+1} = {}^nC_r a^{n-r} b^r$

Here; $a = 8x^8$

$$b = \frac{7}{x^7}$$

and $n = 15$

$\therefore$ The term independent of 'x' is the term where the power of 'x' gets cancelled out when multiplied across all terms.

i.e. the power of x in $(8x^8)^{15-r}$ cancels the power

of x in $\left(\frac{7}{x^7}\right)^r$

i.e. $8(15 - r) = 7r$

$15r = 120$

$\therefore r = 8$ and $r + 1 = 9$

$\therefore$ The 9th term i.e. T_9 is independent of x.

Hence, **option 4.**

3. When a polynomial $f(x)$ is divided by $(x - a)$, $(x - a)$ is said to be a factor of the polynomial if $f(a)$ is 0. Thus, the remainder when a polynomial $f(x)$ is divided by $(x - a)$ is given by $f(a)$.

Hence $f(2) = 24 + 32^3 - 20 = 16 + 24 - 20 = 20$

Hence, **option 3.**

4. Re-writing the expression, we get

$$\frac{24^2 + (24)(6) + 6^2}{24^3 - 6^3}$$

Comparing with $a^3 - b^3 = (a - b)(a^2 + ab + b^2)$

$$\therefore \frac{a^2 + ab + b^2}{a^3 - b^3} = \frac{1}{(a - b)}$$

$$\therefore \frac{24^2 + (24)(6) + 6^2}{24^3 - 6^3} = \frac{1}{(24 - 6)} = \frac{1}{18}$$

Hence, **option 4.**

Alternatively,

If you do not remember the formula given above, you can solve the question using factorization.

$$\frac{24^2 + 144 + 6^2}{24^3 - 6^3} = \frac{(6 \times 4)^2 + (6 \times 24) + 6^2}{(6 \times 4)^3 - 6^3}$$

$$= \frac{6 \times (96 + 24 + 6)}{6^3 \times (64 - 1)} = \frac{126}{36 \times 63} = \frac{1}{18}$$

Hence, **option 4.**

5. This can be solved by either factorizing the two polynomials or by dividing the numerator by the denominator. However, both these methods are relatively longer. Here, the simplest way is to substitute a value of x in the expression and find the quotient. Then, using that value of x, check which option gives that same value. The only requirement is that the value of x chosen should not make the divisor zero.

Let $x = 1$

$\therefore 3(x^3 + 5x^2 + 7x + 3) = 3(1 + 5 + 7 + 3) = 48$

Also, $(x^3 + 2x^2 - 5x - 6) = 1 + 2 - 5 - 6 = -8$

So, the required quotient is $48/(-8) = -6$

Now, consider each option using $x = 1$ and check which option gives a value equal to -6

Option 1: $3(x + 1)/(x - 2) = (3 \times 2)/(-1) = -6$

Option 2: $3/(x + 1) = 3/2$

Option 3: $6(x + 1) = 6 \times 2 = 12$

Option 4: $12(x + 3)/(x + 1) = (12 \times 4)/2 = 24$

Thus, only the expression in option1 gives the same quotient.

Hence, **option 1.**

6. The degree of a polynomial is the degree of a term having the highest degree.

$$\text{Degree of } \frac{4xy^2}{z^3} = (1 + 2 - 3) = 0$$

$$\text{Degree of } \frac{8x^{10}y^2}{z^8} = (10 + 2 - 8) = 4$$

$$\text{Degree of } \frac{14x^{14}y^8}{x^{12}} = (14 + 8 - 12) = 10$$

Highest $(0, 4, 10) = 10$.

Hence degree of the polynomial is 10.

Hence, **option 3.**

7. First remember that $a^3 + b^3$, ab as well as $a + b$ are all present in the formula for $(a + b)^3$.

$(a + b)^3 = a^3 + b^3 + 3ab(a + b)$

$\therefore a^3 + b^3 = (a+b)^3 - 3ab(a+b)$

$= 13^3 - (3 \times 25 \times 13) = 2197 - 975 = 1222$

Hence, **option 3.**

8. One way to solve this to simply calculate the values of the three cubes and get the answer. However, this is time consuming. Also, note that the values are given in a specific format

i.e. $a^3 + b^3 + c^3$

$a^3 + b^3 + c^3 = (a + b + c)$

$(a^2 + b^2 + c^2 - ab - bc - ac) + 3abc$

Here $a = 80$, $b = -43$, $c = -37$

$\therefore a + b + c = 80 + (-43) + (-37) = 0$

$\therefore a^3 + b^3 + c^3 = 3abc$

$\therefore 80^3 - 43^3 - 37^3 = 3(80)(-43)(-37) = 381840$

Hence, **option 4.**

9. As seen earlier, if the remainder on division of a polynomial $f(x)$ by $(x - c)$ is R; then $f(c) = R$.

Here, $R = 5$

$\therefore f(c) = 5$

$$\therefore \frac{5c^3}{c} + \frac{5c}{c} - 10c = 5$$

$\therefore 5c^2 + 5 - 10c = 5$
$\therefore 5c(c - 2) = 0$
$\therefore c = 0$ or $c = 2$
Hence, **option 1.**

10. $z^c = x$
But $z = y^b$
$\therefore (y^b)^c = x$
But $y = x^a$
$\therefore ((x^a)^b)^c = x$
$\therefore x^{abc} = x^1$
$\therefore abc = 1$
Hence, **option 2.**

CONCEPT TEST II

1. $a + b = b + c$
$\therefore a = c$
Similarly, $b = c$ and $a = b$
$\therefore a = b = c$
$\therefore$ Replace b & c by a in the entire expression

$$\frac{1}{1 + x^{a-a} + x^{a-a}} + \frac{1}{1 + x^{a-a} + x^{a-a}}$$

$$+ \frac{1}{1 + x^{a-a} + x^{a-a}} = \frac{1}{3} + \frac{1}{3} + \frac{1}{3} = 1$$

Hence, **option 3.**

2. Let $3^a = 5^b = 45^c = k$
$\therefore 3^a = k$
$\therefore 3 = k^{1/a}$ ... (i)
$\therefore 5^b = k$
$\therefore 5 = k^{1/b}$ ... (ii)
$\therefore 45^c = k$
$\therefore 45 = k^{1/c}$ ... (iii)
Now $45 = 3 \times 3 \times 5 = k^{1/c}$
Substituting value of 3 and 5 from (i) & (ii); we get
$k^{1/a} \times k^{1/a} \times k^{1/b} = k^{1/c}$

$$\therefore k^{\left[\frac{1}{a} + \frac{1}{a} + \frac{1}{b}\right]} = k^{\frac{1}{c}}$$

$$\therefore \frac{1}{a} + \frac{1}{a} + \frac{1}{b} = \frac{1}{c}$$

$$\therefore \frac{2}{a} + \frac{1}{b} - \frac{1}{c} = 0$$

Hence, **option 2.**

3. $$\frac{[x^2 + 5x + 4][x^2 + 8x + 15]}{[x^2 + 9x + 20]}$$

$$= \frac{[x + 1][x + 4][x + 5][x + 3]}{[x + 5][x + 4]}$$

$= (x + 1)(x + 3)$
$= x^2 + 4x + 3$
Hence, **option 2.**

4. $2(X + Y)^2 = 2(X^2 + 2XY + Y^2) = 2X^2 + 4XY + 2Y^2$
$\therefore 4X^2 + 12XY + 6Y^2 + 2X^2 + 4XY + 2Y^2$
$= 6X^2 + 16XY + 8Y^2$
$6X^2 + 16XY + 8Y^2 = 6X^2 + 4XY + 12XY + 8Y^2$
$= 2X(3X + 2Y) + 4Y(3X + 2Y)$
$= (3X + 2Y)(2X + 4Y)$
Hence, **option 3.**

5. $x^2 + 4x + 3 = (x + 3)(x + 1)$
$x^2 + 6x + 5 = (x + 1)(x + 5)$
$\therefore x^2 + 4x + 3 + x^2 + 6x + 5$
$= (x + 1)(x + 3) + (x + 1)(x + 5)$
$= (x + 1)(x + 3 + x + 5)$
$= (x + 1)(2x + 8)$
Hence, **option 4.**

6. $2x^2 - 5x - 3 = 2x - 6x + x - 3 = (2x + 1)(x - 3)$
$(2x + 1)(x - 3) - (2x + 1) = (2x + 1)(x - 3 - 1)$
$= (2x + 1)(x - 4)$
Hence, **option 2.**

7. $(3x^2 + 9xy + 4y^2) - (4xy + 2y^2)$
$= 3x^2 + 5xy + 2y^2$
$= 3x^2 + 3xy + 2xy + 2y^2$
$= 3x(x + y) + 2y(x + y)$
$= (x + y)(3x + 2y)$
Hence, **option 1.**

8. $(a + b) = 11$
$ab = 30$
Now, $(a - b)^2 = (a + b)^2 - 4ab$
$\therefore (a - b)^2 = 11^2 - (4 \times 30) = 121 - 120 = 1$
$\therefore (a - b) = \pm 1$
Only +1 is among the options.
Hence, **option 1.**

9. $(a + b)^3 = a^3 + b^3 + 3ab(a + b)$
$\therefore 7^3 = (a^3 + b^3) + (3 \times 12 \times 7)$
$\therefore (a^3 + b^3) = 343 - 252 = 91$
Hence, **option 3.**

10. $(3x + 4y - 12) \times (4x + 7y + 2)$
$= 3x(4x + 7y + 2) + 4y(4x + 7y + 2) - 12(4x + 7y + 2)$
$= 12x^2 + 21xy + 6x + 16xy + 28y^2 + 8y - 48x - 84y - 24$
$= 12x^2 + 37xy + 28y^2 - 42x - 76y - 24$
Hence, **option 4.**

SURDS AND INDICES

CONCEPT TEST I

1. $$\frac{\sqrt{3} + \sqrt{5}}{\sqrt{5} - \sqrt{3}} = \frac{\sqrt{3} + \sqrt{5}}{\sqrt{5} - \sqrt{3}} \times \frac{\sqrt{3} + \sqrt{5}}{\sqrt{5} + \sqrt{3}}$$

$$= \frac{(\sqrt{3} + \sqrt{5})^2}{2} = \frac{8 + 2\sqrt{15}}{2}$$

$= 4 + \sqrt{15}$
Hence, **option 2.**

2. $3\sqrt{7} + \sqrt{28} - \sqrt{63} = 3\sqrt{7} + 2\sqrt{7} - 3\sqrt{7} = 2\sqrt{7}$
Hence, **option 3.**

3. $\sqrt{6}+\frac{1}{\sqrt{5}}+\sqrt{5}=\frac{6+\sqrt{30}}{\sqrt{5}}=\frac{6\sqrt{5}+5\sqrt{6}}{5}$

Hence, **option 1.**

4. Since the power of both terms is not the same, we raise them by the same power. So, we multiply the two powers by 12 i.e. LCM of 4 and 3.
So, we get the powers as 2^4 and 3^3
$3^3 > 2^4$
So, the twelvth power of $3^{\frac{1}{4}}$ is greater than the twelvth power of $2^{\frac{1}{3}}$.
$\therefore 3^{\frac{1}{4}} > 2^{\frac{1}{3}}$
Hence, **option 4.**

5. $2\sqrt{23}=\sqrt{4\times 23}=\sqrt{92}$
Hence, **option 1.**

6. To find the value of x, factorise 5184 in terms of the product of the powers of 2 and 3
$5184 = 3^4 \times 2^6$
$\therefore 3^x \times 2^{(x+2)} = 3^4 \times 2^6$
Comparing the two equations, $x = 4$
Hence, **option 2.**

7. $5650 = 5^2 \times 226$
Now, $5^{2x} \times 3^x + 5^x = 5^x \times (15^x + 1) = 5650$
Comparing the two equations, $5^2 \times 226 = 5^x \times (15^x + 1)$
Clearly, x = 2 satisfies the given equation.
Hence, **option 2.**

8. $\frac{\sqrt{17}+4}{\sqrt{17}-4}=\frac{(\sqrt{17}+4)^2}{17-16}=17+16+8\sqrt{17}$
$= 33 + 8\sqrt{17}$
Hence, **option 2.**

9. $x^{(a2+3a+2)} \times x^{(-3-4a)} \times x^{(2-a-a2)} = x^{(1-2a)}$
Hence, **option 5.**

10. $\sqrt{20} - \sqrt{180} + \sqrt{245} - \sqrt{45} = 2\sqrt{5} - 6\sqrt{5} + 7\sqrt{5} - 3\sqrt{5} = 0$
Hence, **option 4.**

LOGARITHMS

CONCEPT TEST I

1. $\log_{12}36 + \log_{12}48 = \log_{12}(36 \times 48)$
$= \log_{12}(12 \times 3 \times 12 \times 4)$
$= \log_{12}(12 \times 12 \times 12)$
$= \log_{12}(12^3)$
$= 3$
Hence, **option 2.**

2. $\log_6 6 = 1$
Now, $\log_6 6 = \log_6(3 \times 2) = \log_6 3 + \log_6 2$
$\therefore \log_6 2 + \log_6 3 = 1$
$\therefore \log_6 2 = 1 - \log_6 3 = 1 - 0.61 = 0.39$
Hence, **option 3.**

3. If $\log_a m = \log_a n$, then $m = n$
$\log_9 x + \log_9 27 = 3$
$\therefore \log_9(27x) = 3$
So, express the RHS in terms of logs with base 9.
$\therefore \log_9(27x) = \log_9(9^3)$
$\therefore 27x = 9^3$
$\therefore x = 9 \times 9 \times 9/27 = 27$
Hence, **option 1.**

4. Let $\log x = y$
Hence, we have,
$y^2 - 2y + 1 = 0$
$\therefore (y-1)^2 = 0$
$\therefore y = 1$
$\therefore \log x = 1$
$\therefore x = 10$
Hence, **option 1.**

5. $511^{(3\log_{511} x)} = \left(511^{(\log_{511} x^3)}\right) = 8$
If $a^{\log_a m} = b$, then $m = b$
$\therefore x^3 = 8$
$\therefore x = 2$
Hence, **option 3.**

6. $\log_{15}45 + \log_{15}5 = \log_{15}(45 \times 5) = \log_{15}225 = \log_{15}(15^2) = 2$
Hence, **option 1.**

7. $\log 23 + \log 21 = \log (23 \times 21) = \log 483$
$\log 121 + \log 4 = \log (121 \times 4) = \log 484$
$2\log 22 = \log (22^2) = \log 484$
$\log 44 + \log 11 = \log (44 \times 11) = \log 484$
Hence, the value in the first option has the least value.
Hence, **option 1.**

8. $\log_{15}15 = 1$
$\log_{15}15 = \log_{15}(5 \times 3) = \log_{15}5 + \log_{15}3$
$\therefore \log_{15}5 + \log_{15}3 = 1$
$\therefore \log_{15}3 = 1 - \log_{15}5 = 1 - 0.59 = 0.41$
$\therefore \log_{15}9 = \log_{15}(3^2) = 2\log_{15}3 = 2 \times 0.41 = 0.82$
Hence, **option 4.**

9. $\log_6(x+3) + \log_6(x+8) = 2$
$\therefore \log_6[(x+3)(x+8) = 2$
$\log_6(x^2 + 11x + 24) = 2$
$\therefore \log_6(x^2 + 11x + 24) = \log_6(6^2) = \log_6 36$
$\therefore x^2 + 11x + 24 = 36$
$\therefore x^2 + 11x - 12 = 0$
$\therefore (x+12)(x-1) = 0$
$\therefore x = -12$ or $x = 1$.
But for $x = -12$, $x + 8$ and $x + 3$ are negative, and logarithms are not defined for negative numbers.
Hence, x cannot be -12.

Hence, $x = 1$.
Hence, **option 1.**

10. Since the base is not mentioned, it is taken as 10
$\log(x^2 - 4x - 12) - \log(x - 6) = 2$
$\therefore \log((x-6)(x+2)/(x-6)) = \log(x+2) = 2$
$\therefore \log(x+2) = \log(10^2) = \log 100$
$\therefore x + 2 = 100$
$\therefore x = 98$
Hence, **option 2.**

LINEAR EQUATIONS

CONCEPT TEST I

1. $7x + 8(2 - x) + 10 = 4x - 4$
$\therefore 7x + 16 - 8x + 10 = 4x - 4$
$\therefore 5x = 16 + 10 + 4 = 30$
$\therefore x = 6$
Hence, **option 2.**

2. Let the total money available be Rs. x.
Amount spent on buying a house = $0.5x$
So, amount left = Rs. $0.5x$
Now, he spends the half the remaining amount to buy a car.
Thus, he spends Rs. $0.25x$ to buy the car and is left with Rs. $0.25x$
He now spends 20% of this amount to buy a motorcycle.
So, he spends $0.2 \times 0.25x$ = Rs. $0.05x$ to buy a motorcycle.
So, he is left with $0.2x$.
$\because x = 1000000$
$\therefore$ The amount that he is left with
$= 0.2 \times 1000000$
= 200000 i.e. Rs. 2 lakhs
Hence, **option 3.**

3. Let the total distance travelled be d km.
Let the average speed of the train journey be t km/hr and the average speed of the road journey be r km/hr.
Hence, the time taken by Ramesh to complete the journey in the first case is;

$$\frac{0.6d}{t} + \frac{0.4d}{r} = 8$$

$$\therefore \frac{0.6}{t} + \frac{0.4}{r} = \frac{8}{d}$$

Let $1/t = t'$ and $1/r = r'$
$\therefore 0.6t' + 0.4r' = 8/d$ ... (I)
Similarly, for the second case, we have;

$$\frac{0.3d}{t} + \frac{0.7d}{r} = 12$$

$\therefore 0.3t' + 0.7r' = 12/d$ ... (II)
Dividing I by II, we have;

$$\frac{0.6t' + 0.4r'}{0.3t' + 0.7r'} = \frac{8}{12}$$

$\therefore 1.8t' + 1.2r' = 0.6t' + 1.4r'$
$\therefore 1.2t' = 0.2r'$
$\therefore t'/r' = 0.2/1.2$
$\therefore t/r = 1.2/0.2 = 6 : 1$
Hence, **option 2.**

4. Let $10a + b$ be the original number.
So, the number when reversed becomes $10b + a$.
Hence, $(10b + a) = 3(10a + b) - 1$
$\therefore 29a = 7b + 1$
$\therefore a = (7b + 1)/29$
a and b have to be single-digit positive integers.
Only $b = 4$ satisfies this condition.
For this value of b, $a = 1$
Hence, $b = 4$ and $a = 1$
Hence, the original number is 14.
Hence, **option 4.**

5. $11a + 17b = 73$ ... (I)
$17a + 11b = 67$ ... (II)
When the coefficients of a and b are interchanged, the equations can be solved faster by first adding them and then subtracting them.
Adding I and II, we get,
$28a + 28b = 140$
$\therefore 14a + 14b = 70$
$\therefore a + b = 5$ ... (III)
Now, II − I is,
$6a - 6b = -6$
$\therefore b - a = 1$ ... (IV)
Solving (III) and (IV), we get
$a = 2$ and $b = 3$
Hence, **option 3.**

6. Let the number of questions correctly attempted by Suresh be a and the number of questions incorrectly attempted be b.
Hence, we have;
$a + b = 70$ ... (I)
$3a - b = 170$ ... (II)
Add I and II to get,
$4a = 240$
$\therefore a = 60$
Thus, Suresh correctly attempted 60 questions.
Hence, **option 1.**

7. Let the original number be $10a + b$. So, the number obtained by reversing the digits of the number is
$10b + a$.

As per the given condition,
$(10b + a) - (10a + b) = 72$
$\therefore 9b - 9a = 72$
$\therefore b - a = 8$
ab be the number.
Hence, we have,
$10b + a = 10a + b + 72$
$\therefore 9(b - a) = 72$
$\therefore b - a = 8$
Both, a and b have to be single-digit numbers.
For $a = 1$, $b = 9$
For $a = 2$, $b = 10$ (which is not possible)
$\therefore a = 1$ and $b = 9$
So, there is only one such number i.e. 19.
Hence, **option 1.**

8. The given equations are:
$7a + 4b + c = 51$ ... (I)
$3a + 4b + 5c = 15$ ... (II)
Since we want to find the value of $a + b + c$, express the 2 equations in the form of $a + b + c$
3(II) + (I) gives,
$16a + 16b + 16c = 96$
$\therefore a + b + c = 6$
Hence, **option 2.**

Alternatively,
The given equations are:
$7a + 4b + c = 51$ ... (I)
$3a + 4b + 5c = 15$ ... (II)
On subtracting the two equations, we get
$4a - 4c = 36$
$\therefore a - c = 9$ ... (III)
Substitute this value in (I)
So, (I) becomes: $7c + 63 + 4b + c = 51$
$\therefore 4b + 8c = -12$
$\therefore b + 2c = -3$ ... (IV)
(I) + (II) gives $a + b + c = 9 + (-3) = 6$
Hence, **option 2.**

9. Let Suresh have x coins of Rs. 2 and y coins of Rs. 5.
$\therefore x + y = 100$ ... (I)
and $2x + 5y = 350$ ... (II)
5 × (I) – II gives
$3x = 150$
$\therefore x = 50$
Thus, Suresh has 50 Rs. 2 coins.
Hence, **option 1.**

10. Let $10a + b$ be the original number.
Thus, the reversed number is $10b + a$.
$\therefore 4(10a + b) = (10b + a) + 3$
$\therefore 39a = 6b + 3$
$$\therefore a = \frac{6b + 3}{39}$$
a and b have to be single digit numbers.
a is a single digit number only for $b = 6$
Now, for only $b = 6$, a is an integer.
For $b = 6$, $a = 1$
Hence, the original number is 16.
Hence, **option 3.**

11. Let $10a + b$ be the number.
Hence, reverse of the number is $10b + a$
Hence, difference between the two numbers is $(10b + a) - (10a + b) = 9b - 9a = 9(b - a)$
It is given that $b = a + 3$
$\therefore b - a = 3$
$\therefore 9(b - a) = 9 \times 3 = 27$
Hence, **option 3.**

12. $3a + 4b = 40$ ... (I)
$7a + 3b = 49$ ... (II)
4 × (II) – 3 × (I) we get,
$19a = 76$
$\therefore a = 4$ and $b = 7$
Hence, **option 3.**

13. Let Ramesh had a 5 rupee coins initially.
Hence, the number of 2 rupee coins with him is $2a$.
Hence, he had Rs. $4a + 5a$ = Rs. $9a$ with him.
Now, if numbers of coins were to be interchanged, i.e. he would have had $2a$ 5 rupee coins. and a 2 rupee coins.
So, the amount of money that he would have had would be $2a + 10a$ = Rs. $12a$.
Hence, the required difference = $12a - 9a = 3a$
This difference is given as Rs. 30
$\therefore 3a = 30$
$\therefore a = 10$
Hence, number of coins = $3a = 3 \times 10 = 30$
Hence, **option 5.**

14. $a - 3b + 3c = -4$ ... (I)
$2a + 3b - c = 15$ ... (II)
$4a - 3b - c = 19$ ... (III)
II + III gives,
$6a - 2c = 34$ ... (IV)
Similarly, I + II gives,
$3a + 2c = 11$ ... (V)
IV + V gives,
$9a = 45$
$\therefore a = 5$
Hence, **option 5.**

15. $4x + y - 2z = 0$ ... (I)
$3x - 3y + 3z = 9$ ... (II)
$6x - 2y + z = 0$ ... (III)
By I + II – III, we get,
$x = 9$
Hence, **option 3.**

QUADRATIC AND HIGHER ORDER EQUATIONS

CONCEPT TEST I

1. $x^2 + 7x - 60 = 0$
$\therefore x^2 + 12x - 5x - 60 = 0$
$\therefore (x + 12)(x - 5) = 0$
$\therefore x = -12$ and $x = 5$
Thus, the roots are 5 and −12
Hence, **option 3.**

2. As the roots of the equation are real, the discriminant of the equation must be greater than 0
i.e. $b^2 - 4ac > 0$
Here, a = a, b= 4, c = 2
$\therefore 4^2 - 4(a)\ 2 > 0$
$\therefore 16 - 8a \geq 0$
$\therefore 16 \geq 8a$
$\therefore 2 \geq a$
Hence, the maximum possible value of a is 2.
Hence, **option 2.**

3. 3 is one of the roots of $x^2 + 2x + a = 0$
So, $x = 3$ satisfies the given equation.
$\therefore 3^2 + 23 + a = 0$
$\therefore 9 + 6 + a = 0$
$\therefore a = -15$
Hence, **option 1.**

4. The equation $x^2 + ax + 9 = 0$ has equal roots.
Since the roots are equal, the discriminant of the equation is 0.
$\therefore a^2 - 41(9) = 0$
$\therefore a^2 = 36$
$\therefore a = \pm 6$
But $a > 0$
$\therefore a = 6$.
Hence, **option 4.**

5. $(x - 5)(x - 7) = 8$
$\therefore x^2 - 12x + 35 = 8$
$\therefore x^2 - 12x + 27 = 0$
$\therefore x^2 - 9x - 3x + 27 = 0$
$\therefore x(x - 9) - 3(x - 9) = 0$
$\therefore (x - 9)(x - 3) = 0$
$\therefore x = 9$ or $x = 3$
Hence, the roots of the equation are 3 and 9.
Hence, **option 4.**

6. $(x - 6)(x - 5) = (x - 5)(8 - x)$
$\therefore (x - 6)(x - 5) - (x - 5)(8 - x) = 0$
$\therefore (x - 5)(x - 6 - 8 + x) = 0$
$\therefore (x - 5)(2x - 14) = 0$
$\therefore 2(x - 5)(x - 7) = 0$
$\therefore (x - 5)(x - 7) = 0$
$\therefore x = 5$ and $x = 7$
So, the roots of the equation are 5 and 7.
Hence, **option 1.**

7. $x^2 + 4x + a = 0$ and $a < 2$
To find the nature of the roots of the equation, find the value of the discriminant.
The discriminant of the equations is:
$4^2 - 41(a)$ i.e. $16 - 4a$
As $a < 2$
$\therefore 4a < 8$
$\therefore 16 - 4a > 8$
Hence, the discriminant of the equation is positive.
Hence, the roots of the equation must be real.
Hence, **option 1.**

8. As α and β are the roots of the equation $x^2 - 7x + 8 = 0$
Hence, $\alpha + \beta = 7$ and $\alpha\beta = 8$
$(\alpha + \beta)^2 = \alpha^2 + \beta^2 + 2\alpha\beta$
$\therefore \alpha^2 + \beta^2 = (\alpha + \beta)^2 - 2\alpha\beta$
$= (7)^2 - 2(8)$
$= 49 - 16 = 33$
Hence, **option 2.**

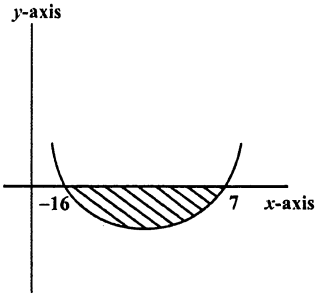
9. As α and β are the roots of the equation $x^2 - 7x + 8 = 0$
Hence, $\alpha + \beta = 7$ and $\alpha\beta = 8$
Hence, $(\alpha - \beta)^2 = (\alpha + \beta)^2 - 4\alpha\beta = 49 - 32 = 17$
$\therefore \alpha - \beta = \pm\sqrt{17}$
$\therefore \alpha^2 - \beta^2 = (\alpha - \beta)(\alpha + \beta) = \pm\sqrt{17} \times 7$
Hence, **option 5.**

10. Let the roots of the equation be α and β.
$\therefore \alpha + \beta = a$ and $\alpha\beta = a$
$\therefore \alpha + \beta = \alpha\beta$
$\therefore \beta = \alpha/(\alpha - 1)$
Now, α and $\alpha - 1$ will be relatively prime to each other unless $\alpha - 1 = 1$
Hence, there is only one solution i.e. $\alpha = 2$
Hence, $\beta = 2/(2 - 1) = 2$
Hence, $a = \alpha + \beta = 2 + 2 = 4$
Hence, **option 4.**

INEQUALITIES

CONCEPT TEST I

1. $f(x) < 0$
$x^2 + 9x - 112 < 0$
$\therefore x^2 + 16x - 7x - 112 < 0$
$\therefore (x + 16)(x - 7) < 0$
Plotting the co-ordinates, we get



Since $f(x)$ = y-axis < 0;
Only shaded portion could be considered.
$\therefore -16 < x < 7$
Hence, **option 3**

Alternatively,
$x^2 + 9x - 112 = 0$
$\therefore (x + 16)(x - 7) < 0$
This is of the form $ab < 0$
This happens when $a < 0$ and $b > 0$ or $a > 0$ and $b < 0$
So, $x + 16 < 0$ and $x - 7 > 0$ i.e. $x < -16$ and $x > 7$
or, $x + 16 > 0$ and $x - 7 < 0$ i.e. $-16 < x < 7$
$x < -16$ and $x > 7$ is not possible simultaneously.
$\therefore -16 < x < 7$
Hence, **option 3.**

2. $f(x) > 0$
$3x^2 - 3x - 18 > 0$
$\therefore 3x^2 - 9x + 6x - 18 > 0$
$\therefore 3x(x - 3) + 6(x - 3) > 0$
$\therefore (3x + 6)(x - 3) > 0$
$\therefore 3x + 6 > 0$ and $x - 3 > 0$
or $3x + 6 < 0$ and $x - 3 < 0$
In the first case we get, $x > -2$ and $x > 3$
Both these conditions get satisfied at $x > 3$
In the second case we get, $x < -2$ and $x < 3$
Both these conditions get satisfied for $x < -2$
$\therefore x < -2$ or $x > 3$
Hence, option 3.

Note: In general, if we have an a quadratic expression of the form $ax^2 + bx + c$ with roots as α and β respectively, then the expression can also be represented as $(x - \alpha)(x - \beta) = 0$
Now, if $\alpha < \beta$
$ax^2 + bx + c < 0$ at $\alpha < x < \beta$
$ax^2 + bx + c = 0$ at $x = \alpha$ and $x = \beta$
$ax^2 + bx + c > 0$ at $x < \alpha$ or $x > \beta$
$ax^2 + bx + c \le 0$ at $\alpha \le x \le \beta$
$ax^2 + bx + c \ge 0$ at $x \le \alpha$ or $x \ge \beta$

3. Consider $f(x) = 15x^2 - 34x + 15$
$\therefore 15x^2 - 34x + 15 \le 0$
$\therefore 15x^2 - 25x - 9x + 15 \le 0$
$\therefore 5x(3x - 5) - 3(3x - 5) \le 0$
$\therefore (5x - 3)(3x - 5) \le 0$
So, as explained above,

$$\frac{3}{5} \le x \le \frac{5}{3}$$

Hence, **option 1.**

4. The easiest way to solve such a problem is to substitute suitable value(s) of x and see the range of values that m can take. Since x is an integer, it can be positive, negative or zero.

Case: 1 x is positive, say $x = 1$.

$$\therefore m = \frac{3^1}{5} \times \frac{4^1}{7} = \frac{12^1}{35}$$

$\therefore m > 0$

Case: 2 x is negative, say $x = -1$.

$$\therefore m = \frac{5}{3} \times \frac{7}{4} = \frac{35}{12}$$

$\therefore m > 0$

Case: 3 $x = 0$.

$$\therefore m = \left(\frac{3}{5}\right)^0 \times \left(\frac{4}{7}\right)^0 = 1 \times 1 = 1$$

$\therefore m > 0$
Thus, $m > 0$ in all cases.
Hence, **option 4.**

5. Consider each options.

Option 1: If $m = 5$; $n = 4$ & $a = -2$; we have $m > n$
i.e. $5 > 4$
But $am = -10$ and $an = -8$ $-10 < -8$
$\therefore am < an$
Hence option 1 can be eliminated.

Option 2: If $m = 10$; $n = 8$ & $a = -2$; we get $m > n$
i.e. $10 > 8$
But $m/a = -5$, $n/a = -4$ $-5 < -4$

$$\frac{m}{a} < \frac{n}{a}$$

Hence option 2 can be eliminated

Option 3: If $m = 4$; $n = -5$ $m > n$
$1/m = ¼ = 0.25$ and $1/n = 1/(-5) = -0.2$
$0.25 > -0.2$

$$\text{i.e.} \frac{1}{m} > \frac{1}{n}$$

Hence option 3 can be eliminated.
Hence, **option 4.**

6. $|3x + 9| < 3$
$\therefore -3 < 3x + 9 < 3$
$\therefore 3x + 9 > -3$ or $3x + 9 < 3$
$\therefore 3x > -12$ or $3x < -6$
$\therefore x > -4$ or $x < -2$

$\therefore -4 < x < -2$

Hence, **option 2**

7. The line $3x + 2y \le 24$ cuts the x-axis at $y = 0$

$\therefore 3x + 2(0) \le 24$

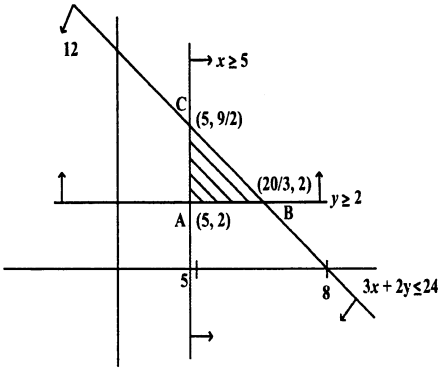
$\therefore x \le 8$

The same line cuts the y-axis at $x = 0$

$\therefore 3(0) + 2y \le 24$

$\therefore y \le 12$

$\therefore$ Plotting the 3 lines on a graph, we get



$\therefore$ Point (A) = Point of Intersection of $x \ge 5$ & $y \ge 12$

$\therefore$ A = (5, 2).

Point (B) = Point of Intersection of $y \ge 2$ & $3x + 2y \le 24$

$\therefore 3x + 22 \le 24$

$\therefore 3x \le 20$

$x \le \frac{20}{3}$,

Point (C) = Point of Intersection of $x \ge 5$ & $3x + 2y \le 24$

$\therefore 3(5) + 2y \le 24$

$\therefore y \le 9/2$

So, the valid range for x is: $-5 \le x \le 20/3$

The valid range for y is: $2 \le y \le 9/2$

Thus, the ranges in options 1 and 2 are valid.

$x = 8$ is outside this range.

So, the range in option 3 is not valid

Hence, **option 4.**

Alternatively,

Such a problem can be solved faster through substitution. Consider each option and substitute it in the two-variable equation. See if the value of the other variable obtained satisfies all the conditions.

Option 1: Consider $y = 9/2$

At $y = 9/2$, $x = 5$

For $y < 9/2$, $x > 5$

This satisfies all the required conditions.

Hence, option1 is valid.

Option 2: Consider $x = 20/3$

For $x = 20/3$, $y = 2$

For $x < 20/3$, $y > 2$

This also satisfies all the required conditions.

Option 3: Consider $x = 8$

For $x = 8$, $y = 0$

This does not satisfy the condition that $y \ge 2$

Hence, option 3 can be eliminated.

Thus, the range in both, options 1 and 2 is valid.

Hence, **option 4.**

8. Consider each options.

Option 1: If $x < 16$ i.e. if $x = 15$; the expression is $(15 - 16)^2 \Rightarrow (-1)^2 = 1 \ge 0$.

Hence the expression is true for $x \le 16$ also.

Hence, option 1 can be eliminated.

Option 2: If $x = 16$ as in the above case; the expression holds true.

Hence, option 2 can also be eliminated.

Option 3: If we take the value of 'x' other than these specified in the range; i.e. $x = 20$; the expression is

$(20 - 16)^2 = 4^2 = 16 \ge 0$.i.e.it holds true.

Hence, option 3 can be eliminated.

Hence, **option 4.**

9. $|3x| + 9 = 3$

$\therefore |3x| = -6$

This is an invalid expression, as the mod of a value can never be negative.

Hence, the data is inconsistent.

Hence, **option 4.**

10. $\left|\frac{4x + 5}{10}\right| \le 7$

$\therefore -7 \le \frac{4x + 5}{10} \le 7$

Case: $(1) -7 \le \frac{4x + 5}{10}$

$\therefore 4x + 5 \ge -70$

$\therefore 4x \ge -75$

$\therefore x \ge -\frac{75}{4}$

Case: $(2) \frac{4x + 5}{10} \le 7$

$\therefore 4x + 5 \le 70$

$\therefore 4x \le 65$

$\therefore x \le \frac{65}{4}$

$\therefore -\frac{75}{4} \le x \le -\frac{65}{4}$

Hence, **option 2.**

BASICS OF GEOMETRY

CONCEPT TEST I

1. The sum of two complementary angles is 90°
∴ Complementary angle of ∠A = 90° – ∠A
= 90° – 60°
= 30°
Hence, **option 2.**

2. As ∠A and ∠C are supplementary, ∠A + ∠C = 180°
Hence, ∠C = 180 – ∠A = 180 – 80 = 100°
As ∠A, ∠B and ∠C are angles of a triangle,
∠A + ∠B + ∠C = 180°
But ∠B = 240 – (∠A + ∠C)
∴ ∠B = 240 – 180 = 60°
Hence, **option 3.**

3. As, L1, L2 and L3 are parallel.
Both T1 and T2 divide the lines L1, L2 and L3 in the same ratio.

$$\therefore \frac{AB}{BC} = \frac{EF}{FG} = \frac{6}{8} = \frac{3}{4}$$

Let EF = 3x and FG = 4x
Also, EG = EF + FG = 28
∴ 3x + 4x = 28
∴ x = 4
∴ FG = 4 × 4 = 16
Hence, **option 2.**

4. Since L1 and L2 are parallel lines and T is the common transversal, T makes the same acute angle with both lines. Similarly, it makes the same obtuse angle with both lines.
∴ Obtuse angle between L2 and T = Obtuse angle between L1 and T = 180° – 60° = 120°
Hence, **option 2.**

5. ΔABE is equilateral triangle.
∴ ∠ABE = ∠EAB = 60°
Because ABCD is a square, ∠DAB = 90°
∴ ∠DAE = ∠EAB + ∠DAB = 90° + 60° = 150°
ABCD is a square and ABE is an equilateral triangle.
∴ AD = AE = AB
∴ In ΔDAE, AD = AE
Hence, ΔDAE is an isosceles triangle.
Hence, ∠ADE = ∠AED
But ∠ADE + ∠DAE + ∠EAD = 180
∴ 2∠DEA + 150 = 180
∴ ∠DEA = 15°
Hence, **option 5.**

6. As AE = EB
∴ ΔAEB is an isosceles triangle.
∴ ∠EAB = ∠EBA
Hence, we have,
∠EAB + ∠EBA + ∠AEB = 180°
∴ 2∠EAB + 50° = 180°
∴ ∠EAB = 65°
Hence, **option 3.**

Note: Here the fact that ABCD is a trapezium is irrelevant. ABCD could have been any quadrilateral but that would not have made any difference to the calculations.

7. As the angles of the triangle are in A.P., let the three angles be $a - r$, a and $a + r$.
∴ $a - r + a + a + r = 180$
∴ $a = 60$
Thus, 30° and 60° are two angles.
∴ Largest angle = 180 – (30 + 60) = 90°
Hence, **option 3.**

8. As ΔABC is an equilateral triangle.
∴ ∠ACB = ∠CBA = ∠BAC = 60°
Now as AB || CD, hence, we have,
∠CAB = ∠ACD
Hence, ∠ACD = 60°
Hence, ∠BCD = ∠BCA + ∠ACD = 60 + 60 = 120°
Hence, **option 2.**

9. As AE = BE
∴ ∠EBA = ∠EAB
Similarly,
∠CAE = ∠ECA
∴ ∠EAB + ∠CAE = ∠ECA + ∠BEA
∴ ∠A = ∠ECA + ∠BEA
= 180 - ∠A
∴ ∠A = 90°
Hence, **option 3.**

10. A reflex angle is greater than 180° but less than 360°.
Only 225° satisfies this condition.
Hence, **option 4.**

TRIGONOMETRY

CONCEPT TEST I

1. tan x = 4/3
In a right angled triangle,
tan x = (opposite)/(adjacent)
Here, let the side opposite to x be 4 units and the side adjacent to x be 3 units.
So, the hypotenuse will be 5 units.
Cos x = adjacent/hypotenuse = 3/5
∴ $2\cos^2 x + \cos x + 2 = 2 \times (3/5)^2 + (3/5) + 2$
= 83/25
Hence, **option 2.**

2. $2\sin^2 x - 3\sin x + 1 = 0$
∴ $2\sin^2 x - 2\sin x - \sin x + 1 = 0$

$\therefore (2\sin x - 1)(\sin x - 1) = 0$
$\therefore \sin x = 1/2$ or $\sin x = 1$
For $\sin x = 1$, $x = 90°$
However, x is an acute angle.
$\therefore \sin x = 1/2$
$\therefore x = 30°$
Hence, **option 2.**

3. Let the height of pole A be a meters and the height of pole B be b meters.
Since we have the two shadows falling on the same straight line, the height of the two poles is in the same ratio as the lengths of the shadows.
Hence, we have,

$$\frac{15}{a} = \frac{12}{b}$$

$$\therefore \frac{a}{b} = \frac{15}{12} = \frac{5}{4}$$

Hence, **option 4.**

4. The length of the shadows of the two poles is proportional to the heights of the two poles.
Let the length of the smaller and larger pole be l_1 and l_2 respectively.
Similarly, let the length of the shadow of these poles be s_1 and s_2 respectively.
Hence, $s_1 = 30 + s_2$

$$\therefore \frac{l_1}{l_2} = \frac{s_1}{s_2} = \frac{(s_2 + 30)}{s_2} = \frac{3}{2}$$

Hence, $s_2 = 60$
Hence, $s_1 = s_2 + 30 = 90$
Hence, length of the shadow of the larger pole is 90 meters.
Hence, **option 4.**

5. Let the height of the pole be h m.
Let the initial distance of Ajit from the base of the tower be x m.
Hence, after Ajit travels 20 m towards the tower, the final distance of Ajit from the base of the tower = $x - 20$ m
Hence, we have;

$$\tan 30 = \frac{h}{x}$$

$$\tan 60 = \frac{h}{x - 20}$$

$$\therefore \frac{\tan 60}{\tan 30} = \frac{x}{x - 20}$$

$$\therefore \frac{\sqrt{3}}{1/\sqrt{3}} = \frac{x}{x - 20}$$

$\therefore 3(x - 20) = x$
$\therefore x = 30$
$\therefore h = (30 - 20) \times \tan 60 = 10\sqrt{3}$
Hence, **option 1.**

6. Let the height of the tower be h m.
$\therefore \tan 45 = h/25$
$\therefore h = 25 \tan 45 = 25 \times 1 = 25$ m
Hence, **option 1.**

7. When Rohit first saw the train, the angle of depression was 45°.
Let the original distance between the train and the bridge be d.
$\therefore d = h/\tan 45 = 20/1 = 20$ m
When the angle of depression was 90°, the train was directly below the bridge.
So, the train moved 20 m in 10 s.
Hence, speed of the train = 20/10 = 2 m/s
Hence, **option 1.**

8. Let the distance between the manhole and the base of the tower be d m.
Since the angle of depression is 30°, the angle from the manhole to the top of the tower is also 30°.
$\therefore \tan 30 = 20\sqrt{3}/d$

$$\therefore d = \frac{20\sqrt{3}}{\frac{1}{\sqrt{3}}} = 20 \times 3 = 60 \text{ m}$$

Hence, **option 4.**

9. Since $\operatorname{cosec} x = 1/\sin x$ and $\cos^2 x + \sin^2 x = 1$, express $\cos x$ in terms of $\sin x$.
$\cos^2 x = 3\sin x + 3$
$\therefore 1 - \sin^2 x = 3\sin x + 3$
$\therefore \sin^2 x + 3\sin x + 2 = 0$
$\therefore \sin^2 x + 2\sin x + \sin x + 2 = 0$
$\therefore (\sin x + 2)(\sin x + 1) = 0$
$\therefore \sin x = -2$ or $\sin x = -1$
However, the sine of an angle cannot be −2.
$\therefore \sin x = -1$
$\therefore \operatorname{cosec} x = 1/(-1) = -1$.
Hence, **option 2.**

10. $2\tan x = 1 + \tan^2 x$
$\therefore \tan^2 x - 2\tan x + 1 = 0$
$\therefore (\tan x - 1)^2 = 0$
$\therefore \tan x = 1$
$\therefore x = 45°$
$\therefore \sin x = 1/\sqrt{2}$
Hence, **option 2.**

11. $\sec^2 x + 1 = 2\tan^2 x$ and $\tan^2 x + 1 = \sec^2 x$
$\therefore \sec^2 x + 3 = 2\tan^2 x + 2$
$\therefore \sec^2 x + 3 = 2\sec^2 x$
$\therefore \sec^2 x = 3$
$\cos x = 1/\sec x$
$\therefore \cos^2 x = 1/3$
Hence, **option 3.**

12. Let the length of the bent part be $2l$ m.
Since the top of the tree makes an angle of 30°, the bent part of the tree is a hypotenuse of a 30-60-90 triangle.
So, the remaining part of the tree is the smallest side of the triangle.
Hence, length of the remaining tree = $2l/2 = l$
Hence, total length of the tree = $2l + l = 3l = 90$
Hence, $l = 30$ and $2l = 60$
Hence, length of the bent portion of the tree is 60 meters.
Hence, **option 3.**

13. Let the height at which plane is flying is h.
Since the original angle of elevation is 60°, the initial horizontal distance of the plane is $h/\sqrt{3}$
Similarly, since the final angle of elevation is 30°, the final horizontal distance of the plane is $\sqrt{3} \times h$
Hence, distance travelled $= \sqrt{3} \times h - h/\sqrt{3}$
$= 2h/\sqrt{3}$
But horizontal distance travelled by the plane
$= 100 \times 10 = 1000$ meters
$\therefore 2h/\sqrt{3} = 1000$
$\therefore h = 500\sqrt{3}$
Hence, **option 5.**

14. The length of the ladder is the hypotenuse of the triangle. Let x be the length of the ladder.
So, length of the ladder = $x = (4.6)/\cos 60$
$= 4.6 \times 2 = 9.2$ m
Hence, **option 5.**

15. Let x be the required distance between the point and the base of the tower.
So, $x = 100/\tan 30$
$\therefore x = 100 \times \sqrt{3}$
$\therefore x = 100 \times 1.73 = 173$ m
Hence, **option 3.**

MENSURATION

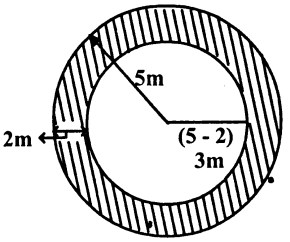
CONCEPT TEST I

1. Since the mosquito is flying from one corner to the opposite corner, it has traverse the body diagonal for the minimum possible distance.
$\therefore$ Body Diagonal distance $= \sqrt{l^2 + b^2 + h^2}$
$= \sqrt{8^2 + 6^2 + 10^2} = 10\sqrt{2}$
Since the mosquito returns to its original spot, the total distance travelled
$= 2 \times 10\sqrt{2} = 20\sqrt{2}$ ft.
Hence, **option 1.**

2. Since only 6m is given as the dimension of the house, the house has to be a cube.
The length of each face of this house is 6 m.
The distance between the farthest vertices is equal to the body diagonal
$\therefore$ length of the body diagonal = $\sqrt{3} \times 6$
$\therefore$ length of the rod = $\sqrt{3}(6) = 6\sqrt{3}$ m.
Hence, **option 2.**

3. The house is a rectangular cuboid with a square base such that area of the base = 25 m^2 and height = 8 m.
$\therefore$ length = breadth of base = 5 m
If only the area of the four walls needs to be found, it means that the lateral surface area is to be found.
LSA of a rectangular cuboid = $2(lh + bh)$ where l, h and b correspond to the length, height and breadth of the wall respectively.
$= 2(5 \times 8 + 5 \times 8) = 160$ m^2
Hence, **option 4.**

4.



The outer diameter of the tank is 10 m.
So, the outer radius is $10/2 = 5$ m
Since the thickness of the tank is 2 m, the inner radius = 5 – 2 = 3 m
Litres of milk to be filled
= Volume of the inner spherical tank.

$= \frac{4}{3}\pi r^3$ where r is the inner radius

of the spherical tank

$\therefore$ Volume of inner spherical tank

$= \frac{4}{3}\pi \times 3^3$

36π m^3
Hence, **option 3.**

5. Since the conical cup has a lid, we need to paint the Total Surface Area of the Cone
$\therefore$ TSA $= \pi r^2 + \pi rl = \pi r(r + l)$
Here $r = 3$ m ; $h = 4$ m, $l = \sqrt{r^2 + h^2}$

$\therefore l^2 = \sqrt{3^2 + 4^2}$ $\quad\quad$ $\therefore l = 5$m

$\therefore$ TSA $= \frac{22}{7} \times 3(3 + 5)$

$= \frac{22}{7} \times 3 \times 8$ m^2

The cost per sq.m is Rs. 70

$\therefore$ Total cost $= \frac{22}{7} \times 24 \times 70 =$ Rs. 5,280

Hence, **option 3.**

6. Volume of Cuboid = lbh.

$\therefore lbh = 225$.

Also the area of base = 25 cm^2 = lb

$\therefore 25 \times h = 225$

$\therefore h = 9$ cm

$\because lb = l$

$\therefore b = 1$ cm

$\therefore$ Total Surface area = $2(lb + bh + lh)$

$= 2(25 \times 1 + 1 \times 9 + 25 \times 9)$

$= 2(25 + 9 + 225) = 518$ cm^2

Hence, **option 1.**

7. Volume of Sphere

$$= \frac{4}{3}\pi r^3$$

$$\therefore \frac{4}{3}\pi r^3 = \frac{539}{3}$$

$$\therefore \frac{4}{3} \times \frac{22}{7} r^3 = \frac{49 \times 11}{3}$$

$$\therefore r^3 = \frac{343}{8} \qquad \therefore r = \frac{7}{2}$$

Length of the Circular ring = Perimeter of a circle = $2\pi r$

$$\therefore \text{Length} = 2\pi \times \frac{7}{2}$$

$$= 2 \times \frac{22}{7} \times \frac{7}{2}$$

= 22 cm

Hence, **option 4.**

8. Since the vessel is 60% full, $\frac{3}{5}$ of the vessel is filled

$$\therefore \text{Height of the unfilled vessel} = \frac{2}{5} \times 5 = 2\text{m}$$

$\therefore$ Volume of water to be filled = $\pi r^2 h$

$$= \frac{22}{7} \times 21 \times 21 \times 2$$

Also, diameter of a pebble = 2m

$\therefore$ Radius = 1m

$$\therefore \text{Volume of pebble} = \frac{4}{3}\pi(r)^3$$

$$= \frac{4}{3} \times \frac{22}{7} \times (1)^3$$

Let the number of pebbles required be n.

$$\therefore \frac{22}{7} \times 21 \times 21 \times 2 = n \times \frac{4}{3} \times \frac{22}{7} \times 1$$

$\therefore n = 661.5$ peddles ≈ 662 peddles

Hence, **option 3.**

9. Volume of a cuboid = lbh.

Suppose l & b change by 20%

$$\therefore \text{New length} = \frac{6}{5}l \text{ ; New breadth}$$

$$= \frac{6}{5}b$$

Suppose h changes by 25%

$$\therefore \text{New height} = \frac{5}{4}h$$

Volume of new cuboid

$$= \frac{6}{5}l \times \frac{6}{5}b \times \frac{5}{4}h = \frac{9}{5}lbh$$

$$\therefore \%\text{ change in volume} = \frac{\frac{9}{5}lbh - lbh}{lbh} \times 100$$

$$= \frac{4}{5} \times 100 = 80\%$$

Hence, **option 1.**

10. Amount of distemper used in painting cylindrical box with a top and a base = Total Surface Area of cylinder

$\therefore$ (TSA) = $2\pi r(r + h) = 2\pi\, 2(2 + 2) = 16\pi$

To paint a spherical ball = Total Surface Area of sphere

TSA = $4\pi r^2 = 4\pi 2^2 = 16\pi$

$\therefore$ % of spherical ball painted by the amount of distemper used in cylinder

$$= \frac{16\pi}{16\pi} \times 100 = 100\%$$

Hence, **option 3.**

11. Length of body diagonal after decay = 75% of 28

$$= \frac{3}{4} \times 28 = 21\text{m}$$

$$\therefore \sqrt{l^2 + b^2 + h^2} = 21\text{m}$$

$l = b = h = 1 : 2 : 4$. Let common multiple be 'n'

$\therefore l = n : b = 2n\ h = 4n$

$$\therefore \sqrt{(n)^2 + (2n)^2 + (4n)^2} = 21$$

$$\therefore \sqrt{21n^2} = 21$$

$\therefore 21n^2 = 441$

$n^2 = 21$

$n \approx 4.5$ m

$\therefore$ Length = $n \approx 4.5$m

Hence, **option 2.**

12. Amount of melted gold = Volume of cylinder = Volume of sphere

$$= \pi r^2 h + \frac{4}{3}\pi r^3$$

$$\pi(7)^2(4) + \frac{4}{3}\pi(7)^3$$

$\pi\left[7^2 \times 4 + \frac{4}{3} \times 7^3\right]$

$= \frac{22}{7} \times 7 \times 7 \times 4 \times \frac{31}{3} \text{cm}^3$

Now the plating is done on the rectangular sheet of dimension 31 cm × 11 cm

∴ Height of the plating could be calculated as

$22 \times 7 \times 4 \times \frac{31}{3} = l \times b \times h$

$22 \times 7 \times 4 \times \frac{31}{3} = 31 \times 11 \times h$

$\therefore h = 18\frac{2}{3}\text{cm}$

Hence, **option 2.**

13. Total Area to be painted = Curved surface area of Cone + Curved Surface Area of Cylinder + Base Area of Circle.

$= \pi rl + 2\pi rh + \pi r^2$

$l = \sqrt{r^2 + h^2} = \sqrt{7^2 + 4^2} = \sqrt{65}$

$= \pi[7 \times \sqrt{65} + 2 \times 7 \times 3 + 7^2]$

$= \pi \times 7[\sqrt{65} + 6 + 7]$

$\approx 22 \times 21$

∴ Total cost of painting = 22 × 21 × 4

= Rs. 1,848

Hence, **option 4.**

14. Total Surface Area of Hemisphere = $3\pi r^2$

$\therefore 3\pi r^2 = 1848$

$\therefore r^2 = 7 \times 28$

$r = 14$ m

∴ Amount of water displaced

= Volume of Hemisphere.

$\therefore v = \frac{2}{3}\pi r^3$

$= \frac{2}{3} \times \frac{22}{7} \times 14 \times 14 \times 14$

$= \frac{17248}{3}$

$= 5749\frac{1}{3}\text{cm}^3$

Hence, **option 1.**

15. Total amount spent in painting a cube = Total surface area

∴ TSA = $6a^2$... (i) .....'n' amount is spent in painting

Now 8 smaller cubes are formed each of side

$\left(\frac{a}{2}\right)$cm

$\therefore$ TSA of 1 cube $= 6 \times \left(\frac{a}{2}\right)^2$

$\therefore$ TSA of 8 cubes $= 8 \times 6 \times \left(\frac{a}{2}\right)^2 = 12a^2$

Since the surface area is doubled, the cost also doubles.

$\therefore y = 2n$

$\therefore b = 2$

Hence, **option 3.**

SEQUENCE, PROGRESSIONS & SERIES

CONCEPT TEST I

1. The n^{th} term of an A.P. is $a + (n - 1)d$

So, the 5th term is $a + 4d$ and the 7th term is $a + 6d$

$\therefore \frac{a + 4d}{a + 6d} = 0$

$\therefore a + 4d = 0 \qquad \therefore a = -4d$

∴ Ratio of 12th term to 13th term

$= \frac{a + 11d}{a + 12d} = \frac{-4d + 11d}{-4d + 12d} = \frac{7d}{8d} = \frac{7}{8}$

Hence, **option 3.**

2. The sides of a quadrilateral are in A.P.

Let the sides of the quadrilateral be

$a - 3d, a - d, a + d, a + 3d$

∴ Semi perimeter

$= \frac{a - 3d + a - d + a + d + a + 3d}{2} = 40$

$\therefore 4a = 80$

$\therefore a = 20$

Now, $a + d = 3(a - 3d)$

$20 + d = 3(20 - 3d)$

$\therefore 20 + d = 60 - 9d$

$\therefore d = 4$

∴ Largest side = $a + 3d = 20 + 34 = 32$

Hence, **option 2.**

3. There are total of 491 numbers in the range.

Since we are looking for multiples of 7, look for the highest multiple of 7 less than or equal to 491

$491 = (70 \times 7) = 1$

Thus, there are 70 multiples of 7 less than 490 Now, the multiples of 7 form an A.P. such that $a = d = 7$ and

$n = 70$

So, the sum of these multiples is given by

$S_n = \frac{n}{2} \times [2a + (n - 1)d]$

$\therefore S_{70} = \frac{70}{2} \times [(2 \times 7) + (69 \times 7)]$

$= 35 \times 71 \times 7 = 17395$

Hence, **option 4.**

4. Here; $a = 17$.

n^{th} term of an A.P is given by $T_n = a + (n - 1)d$

$T_2 = 17 + d$ $T_4 = 17 + 3d$
$T_5 = 17 + 4d$ $T_6 = 17 + 5d$
$\therefore (17 + d)(17 + 3d) = (17 + 4d)(17 + 5d)$
$\therefore 289 + 51d + 17d + 3d^2$
$= 289 + 85d + 68d + 20d^2$
$\therefore 68d + 3d^2 = 153d + 20d^2$
$\therefore 17d^2 = -85d$
$\therefore d = -5$
$\therefore 3^{rd}$ term is $T_3 = a + 2d = 17 + 2(-5) = 7$
Hence, **option 1.**

5. The given series is $3 \times 4 + 3 \times 4^2 + 3 \times 4^3 \ldots$
$= 3 \times 4 (1 + 4 + 4^2 + 4^3 \ldots)$
$\therefore 4000 = 3 \times 4 (1 + 4 + 4^2 + 4^3 \ldots)$
$\therefore$ The terms in the bracket are in G.P. with $a = 1; r = 4$

$$\therefore 4000 = 3 \times 4\left[\frac{a(r^n - 1)}{(r - 1)}\right]$$

$$\therefore \frac{4000}{3 \times 4} = \frac{1(4^n - 1)}{4 - 1}$$

$$\therefore \frac{4000}{3 \times 4} = \frac{4^n - 1}{3}$$

$\therefore 4^n - 1 = 1000$
$\therefore 4^n = 1001$
$\because$ The least number of terms is required
$\therefore 4^n \geq 1001$
$\therefore n \geq 5$
Hence, **option 4.**

6. Since w, x, y, z are in A.P.
$x - w = y - x \;\&\; y - x = z - y$
$\therefore 2x = w + y$ ... (i)
and $2y = x + z$

$$\therefore y = \frac{x + z}{2} \quad \text{... (ii)}$$

Substituting y in equation (i); we get

$$\therefore 2x = w + \frac{x + z}{2}$$

$\therefore 4x = 2w + x + z.$
$\therefore 2w - 3x + z = 0$
Hence, **option 1.**

Alternatively,
Substitute suitable values for w, x, y and z such that they are in A.P. and put them in the answer options. Check which answer option gets satisfied. Let w, x, y, z be 1, 2, 3 and 4 respectively.
Only the equation in option 1 gets satisfied.
Hence, **option 1.**

7. The total amount borrowed is 1875 + 300 + 1450 = Rs. 3,625.
The first installment is Rs. 25. Since the second installment is Rs. 75 more than the first installment, the second installment is Rs. 100. Similarly, the third installment is Rs. 175 and so on.
Thus, the installments form an A.P. with $a = 25$ and
$d = 75$
Since there is no interest paid, the sum of all the installments is Rs. 3625.
$\therefore S_n = 3625$

$$\therefore 3625 = \frac{n}{2}[2(25) + (n - 1)75]$$

$\therefore 7250 = n[50 + 75n - 75]$
$\therefore 7250 = n[75n - 25]$
$\therefore 7250 = 25n[3n - 1]$
$\therefore 290 = 3n^2 - n$
$\therefore 3n^2 - n - 290 = 0$

Solving by formula $\alpha, \beta = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$;

we have $a = 3; b = -1; c = -290$

$$\therefore \alpha, \beta = \frac{1 \pm \sqrt{1 - 4(3)(-290)}}{6} = \frac{-58}{6}; \frac{60}{6};$$

Number of installments cannot be negative.
Hence $n \neq -58/6$
$\therefore n = 10$
Hence, **option 4.**

8. Since Rajesh puts money in the piggy bank for 3 years, he puts in money 36 times.
The first amount put is Rs. 150, the next is Rs. 175, then Rs. 200 and so on. These amounts form an A.P. with
$a = 150$ and $d = 25$

$$S_n = \frac{n}{2}[2a + (n - 1)d]$$

$$\therefore S_{36} = \frac{36}{2}[2(150) + (36 - 1)25]$$

$= 18 [300 + 875] = 21150$
Thus, Rs. 21,150 get accumulated.
Hence, **option 2.**

9. n^{th} term (T_n) in a G.P. is given as $T_n = ar^{n-1}$
$\therefore T_5 = ar^4$ $T_2 = ar$
$\therefore ar^4 = 64(ar)$
$\therefore r^3 = 64$
$\therefore r = 4$
Also, $T_4 = -320$
$\therefore ar^3 = -320$
$\therefore a4^3 = -320$
$\therefore a = -5$
$\therefore T_6 = ar^5 = (-5)4^5 = -5120$
Hence, **option 1.**

10. When the ball goes up and comes down the first time, it has travelled as distance of (3000 + 3000) = 6000 metres.

Now, it bounces to $\frac{2}{3} \times 3000$

= 2000 and comes back

i.e. travels 2000 + 2000 = 4000m on the first bounce.

Hence the total distance travelled

$$= 2 \times 3000 + 2 \times \frac{2}{3}(3000) + 2 \times \frac{2}{3} \times \frac{2}{3}(3000) \ldots$$

$$S_\infty \approx 2\left[3000 + \frac{2}{3}(3000) + \frac{4}{9}(3000) \ldots\right]$$

$$\approx 2\left[\frac{3000}{1-\frac{2}{3}}\right] = 2\left[\frac{3000 \times 3}{1}\right] \approx 18000 \text{ m}$$

Hence, **option 2.**

11. The given series is made up of two series.

1) Addition of all odd terms i.e.

$$\frac{4}{5} + \frac{4}{25} + \frac{4}{125} + \cdots$$

2) Addition of all even terms i.e.

$$\frac{3}{4} + \frac{3}{16} + \frac{3}{64} + \cdots$$

Series: 1) $\frac{4}{5} + \frac{4}{25} + \frac{4}{125} + \cdots$

$$= 4\left[\frac{1}{5} + \frac{1}{5^2} + \frac{1}{5^3} \ldots\right]$$

$$S_\infty = 4\left[\frac{1/5}{1-\frac{1}{5}}\right] = 4\left[\frac{1}{5} \times \frac{5}{4}\right] = 1$$

Series: 2) $\frac{3}{4} + \frac{3}{16} + \frac{3}{64} + \cdots$

$$= 3\left[\frac{1}{4} + \frac{1}{4^2} + \frac{1}{4^3} \ldots\right]$$

$$= 3\left[\frac{1/4}{1-\frac{1}{4}}\right] = 3\left[\frac{1}{4} \times \frac{4}{3}\right] = 1$$

$S_{\infty 1} + S_{\infty 2} = 1 + 1 = 2$

Hence, **option 4.**

12. Let the 3 terms of the G. P be $\frac{a}{r}, a, ar$

$$\therefore \frac{a}{r} \times a \times ar = 1728$$

$\therefore a^3 = 1728$

$\therefore a = 12$

Also; $ar = 4\left(\frac{a}{r}\right)$

$$12r = \frac{4 \times 12}{r}$$

$\therefore r^2 = 4$

$\therefore r = \pm 2$

$\therefore$ 1st term $= \frac{12}{2}$ or $\frac{12}{-2}$ i.e. (6 or -6)

So, the exact value of the first term cannot be determined.

Hence, **option 4.**

13. In a G.P.;

$$S_6 = \frac{a(r^6-1)}{r-1} \qquad S_3 = \frac{a(r^3-1)}{(r-1)}$$

(Note: The formula: $S_6 = \frac{a(1-r^6)}{1-r}$

$$S_3 = \frac{a(1-r^3)}{(1-r)}$$

(could also be used since the value of r is not known)

$$\therefore \frac{S_6}{S_3} = \frac{a(r^6-1)}{r-1} \div \frac{a(r^3-1)}{(r-1)} = \frac{217}{1}$$

$$\therefore \frac{S_6}{S_3} = \frac{a(r^6-1)}{a(r^3-1)} = 217$$

$$\therefore \frac{r^6-1}{r^3-1} = 217$$

$$\therefore \frac{(r^3)^2-(1)^2}{(r^3-1)} = 217$$

$$\therefore \frac{(r^3+1)(r^3-1)}{(r^3-1)} = 217$$

$\therefore r^3 + 1 = 217$

$\therefore r^3 = 216$

$\therefore r = 6$

Hence, **option 3.**

14. You save Rs. 7 on 1st May, Rs.14 on 2nd May, and Rs.28 on 3rd May

Thus, this is a G.P. $a = 7$ & $r = 2$.

$n = 15$, since the period is upto 15th May.

$$\therefore S_{15} = \frac{7(2^{15}-1)}{(2-1)} = \frac{7[2^{10}.2^5-1]}{1}$$

$$= \frac{7[1024 \times 32 - 1]}{1} = \text{Rs. } 2,26,369$$

Hence, **option 1.**

15. Since x, y, z are in G.P.

$$\frac{y}{x} = \frac{z}{y}$$

$\therefore y^2 = xz$

Taking log on both sides;

$\log y^2 = \log (xz)$

$\therefore 2 \log y = \log x + \log z$

$$\therefore \log y = \frac{\log x + \log z}{2}$$

$\therefore \log y$ is the Arithmetic mean of $\log x$ and $\log z$.
$\therefore \log x, \log y, \log z$ are in A.P.
Hence, **option 1.**

PERMUTATIONS & COMBINATIONS

CONCEPT TEST I

1. For each flight except $F3$, there are 2 connecting roads ($R1$ or $R3$).
So, for all flights apart from $F3$, Total number of ways = $4 \times 2 = 8$
For flight $F3$, all three roads are accessible.
So, for $F3$, total number of ways = $1 \times 3 = 3$
$\therefore$Total number of ways = $8 + 3 = 11$
Hence, **option 4.**

2. Since no condition is given regarding repetition, it can be assumed that repetition of digits is allowed. The digits available are 0, 1, 3, 4, and 5.
Since the number is odd, the last digit can be filled in 3 ways using either 1, 3 or 5.
Also, the first digit can be filled in 4 ways (using any digit except 0).
The remaining two digits can be filled in 5 ways each.
So, total number of numbers that can be formed = $4 \times 5 \times 5 \times 3 = 300$
Hence, **option 3.**

3. Each digit of the 3-digit code can have a value from 0 to 9 i.e. 10 possible values.
So, the total number of codes possible = $10 \times 10 \times 10 = 1000$
However, all the digits of the code are not the same. So, codes such as 000, 111 ... 999 can be excluded. So, 10 codes can be excluded.
$\therefore$ Maximum number of trials required before the traveller gets the code = $1000 - 10 - 1$ = 989 trials.
Hence, **option 5.**

4. Let us number the 10 politicians as P1 to P10.
Assume that P1 is the first person presenting the bouquets. So, he/she will need to present 10 bouquets to the 10 politicians (including himself / herself).
Now, consider P2. P2 already has 1 bouquet received from P1. A politician may also present a received bouquet to other politicians. Since we want to minimize the number of unique bouquets, P2 can present the bouquet given to him/her by P1, back to P1. So, P2 will require 9 unique bouquets (one for P2 and the remaining 8 for P3-P10).
Now, consider P3. P3 has 2 bouquets (one from P1 and one from P2). P3 can return these to P1 and P2 respectively. So, P3 needs 7 unique bouquets
(1 for P3 and the remaining 6 for P4-P10).
Using this logic, the number of bouquets required reduces by 1 such that the last politician P10 receives 1 bouquet.
So, minimum total number of unique bouquets = $10 + 9 + \ldots + 1 = 55$
Hence, **option 1.**

5. Since a particular boy is always selected, we only need to select 4 people from the remaining 6 people i.e. 2 boys and 4 girls
This can be done in ${}^6C_4$ ways.
Hence, **option 4.**

6. Total number of letters in the word MYSTERIOUS = 10.
So, the number of ways in which they can be arranged amongst themselves is ${}^{10}P_{10} = 10!$ ways.
The letter S occurs 2 times;
Hence, the total number of ways in which the letters can be arranged is $10!/2!$
Hence, **option 2.**

7. Since the balls are picked up in a group of multiples of 2, either 2 or 4 or 6 or 8 balls can be selected.
This can be done in ${}^8C_2$ or ${}^8C_4$ or ${}^8C_6$ or ${}^8C_8$ ways.
$\therefore$ Total number of ways = ${}^8C_2 + {}^8C_4 + {}^8C_6 + {}^8C_8$
$= 28 + 70 + 28 + 1 = 127$ ways
Hence, **option 3.**

8. Since balloons of the same colour are similar, the number of red balloons that can be released can be 1, 2, 3, 4 or 5 i.e. 5 possible combinations.
Similarly, number if yellow balloons that can be released can be 1, 2, 3 or 4 i.e. 4 possible combinations.
So, there are $5 \times 4 = 20$ combinations possible.
Hence, **option 3.**

9. Since two particular IGPs are never together, number of ways this can happen = Total number of ways − number of ways of them being together.
Total number of ways 8 people can be seated around a circular table = 7!
Since two particular IGPs are together, consider them as one block. This leaves one IGP alone. Hence there are $5 + 1 + 1 = 7$ blocks. They can be arranged in 6! ways. Also,

the two IGP's can be arranged among themselves in 2! ways.
Hence, total number of ways in which 2 particular IGPs are never together = 7! – 6! × 2!.
Hence, **option 3.**

10. There are 6 letters in the name Rajesh (R, A, J, E, S, H)
∴ The number of circular arrangements (number of names) that could be formed with 6 letters = (6 – 1)! = 5! = 120
Hence, **option 2.**

CONCEPT TEST II

1. ${}^nC_r + {}^nC_{r+1} = {}^{n+1}C_{r+1}$
Hence ${}^{14}C_{10} + {}^{14}C_{11} = {}^{15}C_{11}$
∴ ${}^{15}C_{11} = {}^{15}C_4$ {Since ${}^nC_r = {}^nC_{n-r}$}

$$\therefore {}^{15}C_4 = \frac{15!}{11! \times 4!} = \frac{15 \times 14 \times 13 \times 12}{4 \times 3 \times 2 \times 1}$$

=1365
Hence, **option 4.**

2. The equation for the given condition is:
${}^nC_2 = {}^5C_3 + 5$

$$\therefore \frac{n!}{(n-2)!\,2!} = \frac{5!}{2!\,3!} + 5$$

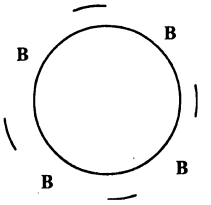
$$\therefore \frac{n(n-1)(n-2)!}{(n-2)!\,2!} = 10 + 5$$

$\therefore n(n-1) = 30$
$\therefore n^2 - n - 30 = 0$
$\therefore n^2 - 6n + 5n - 30 = 0$
$n(n-6) + 5(n-6) = 0$
$(n+5)(n-6) = 0$
$\therefore n = -5$ or $n = 6$
But $n \neq -5$
$\therefore n = 6.$
Hence, **option 4.**

3. There are 7 parallel horizontal lines perpendicularly placed on 4 parallel vertical lines.
To make a rectangle, we need 2 horizontal lines and 2 vertical lines. So, 2 out of 7 horizontal lines and 2 out of 4 vertical lines are to be selected. This can be done in ${}^7C_2$ and ${}^4C_2$ ways respectively.
∴ Number of rectangles = ${}^7C_2 \times {}^4C_2 = 126$
Hence, **option 1.**

4. The number of ways in which fruits can be selected is: 0 fruits; 1 fruit, 2 fruits....or 10 fruits.
This can be done in ${}^{10}C_0 + {}^{10}C_1 + {}^{10}C_2 \ldots {}^{10}C_{10}$ ways.
${}^{10}C_0 + {}^{10}C_1 + {}^{10}C_2 \ldots {}^{10}C_{10} = 2^{10}$ ways
= 1024 ways.
Hence, **option 3.**

5. Since no 2 girls are together, 4 boys can be arranged around the circle in 3! ways.
Now, there are 4 positions between the boys, where these girls can sit as shown I the figure below.



So, the girls can be seated in ${}^4P_3$ ways.
Hence, the total number of ways = 3! × ${}^4P_3$
= 6 × 4! =144
Hence, **option 2.**

6. There are 6 + 4 + 3 = 13 objects in all.
These 13 objects can be arranged in 13! ways.
But out of these 13 objects, six objects of one type (pens) and four objects of another type (pencils) are identical.

Hence, the required number of ways $= \frac{13!}{6! \times 4!}$

Hence, **option 4.**

7. 5 candidates have registered for the 3 reserved category positions.
So, these 3 positions can be filled in ${}^5C_3$ ways.
Now, the remaining 14 seats are open for all candidates.
Hence, these can be filled by the remaining 17 – 3 = 14 candidates.
(Note that the remaining positions can be filled by anyone, so the reserved category candidates are not excluded).
∴ These 12 vacancies can be filled in ${}^{14}C_2$ ways;
Hence, total number of ways = ${}^5C_3 \times {}^{14}C_{12}$
Hence, **option 3.**

8. Two theoretical physicists can be chosen in ${}^3C_2$ ways.
The remaining 6 members can be selected from the remaining 9 scientists.
This can be done in ${}^9C_6$ ways.
Hence, required number of ways = ${}^3C_2 \times {}^9C_6 = 252$
Hence, **option 1.**

9. Each path will contain at least one of the three cities connected with A.
Now, after that there will be 5 paths which will lead to B.

Hence, total number of paths = 3 × 5 = 15
Hence, **option 1.**

10. There are 10 letters in the word CONNUNDRUM. These can be arranged in 10! ways.
Out of these 10 letters, N is repeated thrice and U is repeated twice.
Hence, the required number of ways = 10!/(3!2!)
Hence, **option 3.**

PROBABILITY

CONCEPT TEST I

1. $n(S)$ = Total number of ways in which the friends could be seated.
$n(S) = {}^5P_5 = 5! = 120$ ways.
Let A be the event that Ramesh & Suresh are seated together. So, A' is the event that Ramesh & Suresh are not seated together.
$\therefore P(A') = 1 - P(A)$

$$P(A) = \frac{n(A)}{n(S)}$$

Since Ramesh & Suresh are seated together, they can be considered as one unit.
So, they can be arranged in 4! ways.
Also, Suresh & Ramesh can be mutually arranged in 2! ways.
$\therefore n(A) = 4! \times 2! = 24 \times 2 = 48$ ways
$\therefore P(A) = 48/120$
$\therefore P(A') = 1 - P(A) = 1 - (48/120) = 72/120 = 3/5$
Hence, **option 3.**

2. 4 laptops can be selected out of 14 laptops in ${}^{14}C_4$ ways
$\therefore n(S) = {}^{14}C_4$
Since 4 laptops are to be selected from the same company, we can either select 4 out of 5 Asus laptops or 4 out of 6 IBM laptops.
4 out of 5 Asus laptops can be selected in ${}^5C_4$ ways and 4 out of 6 IBM laptops can be selected in ${}^6C_4$ ways.
$\therefore n(A) = {}^5C_4 + {}^6C_4$

$$\therefore P(A) = \frac{n(A)}{n(S)} = \frac{{}^5C_4 + {}^6C_4}{{}^{14}C_4} = \frac{5 + 15}{\frac{14\times13\times12\times11}{4\times3\times2\times1}}$$

$$= \frac{20 \times 4 \times 3 \times 2}{14 \times 13 \times 12 \times 11} = \frac{20}{1001}$$

Hence, **option 2.**

3. 3 out of 14 laptops could be selected in ${}^{14}C_3$ ways.
$\therefore n(S) = {}^{14}C_3$
Since no two laptops are of the same company, all 3 laptops have to be of different companies.
1 Dell laptop can be selected in ${}^3C_1$ ways.
Similarly, 1 Asus laptop can be selected in ${}^5C_1$ ways and 1 IBM laptop can be selected in ${}^6C_1$ ways.
$\therefore n(A) = {}^3C_1 \times {}^5C_1 \times {}^6C_1$

$$\therefore P(A) = \frac{n(A)}{n(S)} = \frac{{}^3C_1 + {}^5C_1 + {}^6C_1}{{}^{14}C_3} = \frac{3 + 5 + 6}{\frac{14 \times 13 \times 12}{3 \times 2 \times 1}}$$

$$= \frac{90 \times 3 \times 2}{14 \times 13 \times 12} = \frac{45}{182}$$

Hence, **option 4.**

4. 3 Laptops out of 14 can be chosen in 14/3 ways.
$\therefore n(S) = {}^{14}C_3$
Since at least 2 laptops are of the same company, there are 2 cases possible.

Case 1: 2 laptops are of one company and 1 laptop is of another company.

Case 2: All 3 laptops are of the same company.

Case 1: 2 laptops are of one company and 1 laptop is of another company. The number of ways this can be done is:
${}^3C_2 \times {}^{11}C_1 + {}^5C_2 \times {}^9C_1 + {}^6C_2 \times {}^8C_1 = 33 + 90 + 120 = 243$

Case 2: All 3 laptops are of the same company. The number of ways this can be done is:
${}^3C_3 + {}^5C_3 + {}^6C_3 = 1 + 10 + 20 = 31$

$$\therefore P(A) = \frac{243 + 31}{{}^{14}C_3} \approx \frac{3}{4}$$

Hence, **option 2.**

5. When 3 coins are tossed, there are 8 possible outcomes. Thus, S = {HHH, HHT, HTH, HTT, THH, THT , TTH, TTT}. So, $n(S) = 8$

(i) Let A be the event that all three coins show the same result.
$\therefore A$ = {HHH, TTT}
$\therefore n(A) = 2$

$$\therefore P(A) = \frac{n(A)}{n(S)} = \frac{2}{8} = \frac{1}{4}$$

(ii) Let A be the event that the first and second coins show the same result.
A = {HHH, TTT, HHT, TTH}
$\therefore n(A) = 4$

$$\therefore P(A) = \frac{4}{8} = \frac{1}{2}$$

(iii) Let A be the event that the first and third coins show different results.

A = {THH, HTT, HHT, TTH}

$\therefore n(A) = 4$

$$\therefore P(A) = \frac{n(A)}{n(S)} = \frac{2}{4} = \frac{1}{2}$$

Hence, **option 3.**

6. Since 6 of the 7 sherbets are already filled in bottles corresponding to their respective colours, the last sherbet also has to be filled in the bottle corresponding to its colour. Hence all the sherbets are filled in the bottles corresponding to their respective colours.
Hence, the probability of all sherbets not being in their respective bottles is 0.
Hence, **option 4.**

7. Let A = event when A speaks the truth.

$$\therefore P(A) = \frac{2}{5} \text{ and } P(A') = \frac{3}{5}$$

Let B = event when B speaks the truth.

$$\therefore P(B) = \frac{4}{7} \text{ and } P(B') = \frac{3}{7}$$

When A and B contradict each other, the possibilities are:

(i) A speaks the truth & B lies.
(ii) B speaks the truth & A lies.

$\therefore$ Required probability
$= P(A) \times P(B') + P(B) \times P(A')$

$$= \frac{2}{5} \times \frac{3}{7} + \frac{4}{7} \times \frac{3}{5} = \frac{6}{35} + \frac{12}{35} = \frac{18}{35}$$

Hence, **option 4.**

8.

(i) $P(A \cup B) = P(A) + P(B) - P(A \cap B)$

$$\therefore \frac{8}{15} = \frac{2}{3} + \frac{1}{4} - P(A \cap B)$$

$$\therefore P(A \cap B) = \frac{2}{3} + \frac{1}{4} - \frac{8}{15}$$

$$= \frac{11}{12} - \frac{8}{15} = \frac{55 - 32}{60} = \frac{23}{60}$$

(ii) $P(A' \cup B') = P(A \cap B)'$

$$\therefore P(A' \cup B') = 1 - \frac{23}{60} = \frac{37}{60}$$

Hence, **option 1.**

9. Total number of balls in the box = (8 + 7 + 6) = 21.
1 ball can be drawn from 21 balls in $^{21}C_1$ = 21 ways

Let E = event that the ball drawn is neither red nor green i.e. the event that the ball drawn is blue.
1 blue ball can be drawn from 7 blue balls in $^{7}C_1 = 7$ ways
So, the required probability = 7/21 = 1/3
Hence, **option 1.**

10. Here S = {TTT, TTH, THT, HTT, THH, HTH, HHT, HHH}
Let E = event of getting at most two heads.
Then E = {TTT, TTH, THT, HTT, THH, HTH, HHT}.

$$\text{So, required probability} = \frac{n(E)}{n(S)} = \frac{7}{8}$$

Hence, **option 4.**

Alternatively,
If E is the event of getting at most two heads, E' is the event of getting all three heads.
So, E' = {HHH}
So, $n(E') = 1$
$\therefore P(E') = 1/8$
$\therefore P(E) = 1 - P(E') = 1 - 1/8 = 7/8$
Hence, **option 4.**

11. In a simultaneous throw of two dice, we have $n(S) = (6 \times 6) = 36$.
Let E be the event that we get two numbers whose product is even.
Then, E= {(1, 2), (1, 4), (1, 6), (2, 1), (2, 2), (2, 3), (2, 4), (2, 5), (2, 6), (3, 2), (3, 4), (3, 6), (4, 1), (4, 2), (4, 3), (4, 4), (4, 5), (4, 6), (5, 2), (5, 4), (5, 6), (6, 1), (6, 2), (6, 3), (6, 4), (6, 5), (6, 6)}
$\therefore n(E) = 27$

$$\text{So, required probability} = \frac{n(E)}{n(S)} = \frac{27}{36} = \frac{3}{4}$$

Hence, **option 2.**

12. Let S be the sample space and E be the event of selecting 1 girl and 2 boys.
Then, $n(S)$ = Number ways of selecting 3 students out of 25 = $^{25}C_3 = 2300$
But, $n(E) = (^{10}C_1 \times {}^{15}C_2) = 1050$
So, the required probability is:

$$\frac{n(E)}{n(S)} = \frac{1050}{2300} = \frac{21}{46}$$

Hence, **option 1.**

13. Since there are 4 bulbs defective, 16 bulbs are not defective.
Probability of having at least one bulb defective
= 1 – (Probability of having no bulb defective)
$= 1 - [(^{16}C_2)/{}^{20}C_2]$

$= 1 - [(15 \times 16)/(19 \times 20)]$
$= 1 - 12/19 = 7/19$
Hence, **option 4.**

14. When a coin is tossed, there are two possible outcomes – it shows a head or a tail.
So, probability of getting a head = 1/2
When an unbiased die is rolled, there are 6 possible outcomes – 1, 2, 3, 4, 5 and 6.
So, probability of getting an odd number = 3/6 = 1/2
Since both of these are independent events, the required probability = (1/2) × (1/2) = 1/4
Hence, **option 1.**

15. Probability of getting one head in one throw = 1/2
So, probability of getting 3 heads in three throws = (1/2) × (1/2) × (1/2) = 1/8.
Hence, **option 5.**

DATA SUFFICIENCY

CONCEPT TEST I

1. Using Statement A alone:
We know how long pipe A takes but we do not know how long pipe B takes. So, the time cannot be calculated.
Thus, the question cannot be answered using statement A alone.

Using Statement B alone:
Pipe B is one third as efficient as pipe A. However, we do not know the time taken by either pipe A or pipe B to fill the cistern. So, the total time cannot be calculated.
Thus, the question cannot be answered using statement B alone.

Using both the statements together:
Pipe A takes 40 hours to fill the cistern and pipe B is one-third as efficient as pipe A. So, pipe B takes 120 hours to fill the cistern. Though we know the time taken by each pipe individually, we do not know the capacity of the cistern. Because pipes A and B have different efficiencies, the total time taken depends on the capacity of the cistern and on which pipe start first.
Thus, the question cannot be answered on the basis of the two statements.
Hence, **option 5.**

2. X and Y are distinct integers and their product is 30.
Also, it is not mentioned whether the integers are positive or negative.
30 can be obtained as a product of two distinct integers in the following manner:

1 × 30	(−1) × (−30)
2 × 15	(−2) × (−15)
3 × 10	(−3) × (−10)
5 × 6	(−5) × (−6)

Using Statement A alone:
X is odd.
Therefore, X can have one of the following values: 1, −1, 3, −3, 5, −5.
So, a unique value of X cannot be found.
Thus, the question cannot be answered using statement A alone.

Using Statement B alone:
Since $X > Y$, X can take any of the larger values in each combination given above.
Again, a unique value of X cannot be found.
Thus, the question cannot be answered using statement B alone.

Using both the statements together:
X is odd and $X > Y$
Based on these conditions, X could be −1, −3 or −5.
Thus, a unique value of X still cannot be found.
Thus, the question cannot be answered on the basis of the two statements.
Hence, **option 5.**

3. Using Statement A alone:
Since 1/3 is in S, its reciprocal i.e. 3 should also be in S.
So, 3 is in S.
Thus, the question can be answered using statement A alone.

Using Statement B alone:
If x and y are in S, then $x + y$ is also in S.
The given data does not say that x and y need to be distinct.
If $x = y = 1$, then 1 + 1 = 2 is also in S.
Now, if 1 and 2 are in S, then 1 + 2 = 3 is also in S.
Thus, 3 is in S.
Thus, the question can be answered using statement B alone.
Thus, the question can be answered using either statement alone.
Hence, **option 3.**

4. Using Statement A alone:

$$(x+y)\left(\frac{1}{x}+\frac{1}{y}\right) = 4$$

$$\therefore 1 + 1 + \frac{x}{y} + \frac{y}{x} = 4$$

$\therefore \frac{x}{y}+\frac{y}{x}=2$

$\therefore x^2 + y^2 = 2xy$

$\therefore x^2 - 2xy + y^2 = 0$

$\therefore (x-y)^2 = 0$

$\therefore x = y$

Thus, the question can be answered using statement A alone.

Using Statement B alone:

$(x - 50)^2 = (y - 50)^2$

$\therefore x^2 - y^2 = 100(x - y)$

If $x \neq y$, then $x + y = 100$ satisfies this equation.

Thus, x is not necessarily equal to y.

Thus, the question cannot be answered using statement B alone.

Thus, the question can be answered using statement A alone but not by using statement B alone.

Hence, **option 1.**

5. If the smallest of five consecutive integers is even, the first, third and fifth integers have to be even.

Using Statement A alone:

Since the product of the five integers is 0, one of the integers has to be 0.

However, one cannot say which of the five integers is 0.

Thus, the question cannot be answered using statement A alone.

Using Statement B alone:

The arithmetic mean of five consecutive integers is 0. The arithmetic mean of five consecutive integers is the third integer. So, the third integer is 0. So, the first integer is even. So, the smallest integer is even.

Thus, the question can be answered using statement B alone.

Thus, the question can be answered using statement B alone but not by using statement A alone.

Hence, **option 2.**

6. X is a positive integer.

Using Statement A alone:

$X^4 > 3000$

This is satisfied for all $X > 7$

Thus, a unique value of X cannot be found.

Thus, the question cannot be answered using statement A alone.

Using Statement B alone:

$X^4 < 10000$

This is satisfied for $1 \leq X < 10$

Again, a unique value of X cannot be found.

Thus, the question cannot be answered using statement B alone.

Using both the statements together:

The only values of X that satisfy both the conditions are $X = 8$ and $X = 9$

Neither of these numbers is prime.

So, the question can be answered using both the statements together but not by using either statement alone.

Hence, **option 4.**

7. The test of divisibility for 6 is that the number should be divisible by both 3 and 2.

Using Statement A alone:

m is divisible by 3.

However, this does not say whether m is also divisible by 2.

Thus, the question cannot be answered using statement A alone.

Using Statement B alone:

m is divisibly by 4.

If m is divisible by 4, then m is definitely divisible by 2.

However, this does not say whether m is divisible by 3.

Thus, the question cannot be answered using statement B alone.

Using both the statements together:

m is divisible by 3 and 4. So, m is divisible by both 3 and 2. So, m is divisible by 6.

Thus, the question can be answered using both the statements together but not by using either statement alone.

Hence, **option 4.**

8. Using Statement A alone:

The square of x is 36.

$\therefore x = \pm 6$

Thus, a unique value of x cannot be found.

Thus, the question cannot be answered using statement A alone.

Using Statement B alone:

$x(x - 6) = 0$

So, x can be 0 or 6.

Thus, a unique value of x cannot be found.

Thus, the question cannot be answered using statement B alone.

Using both the statements together:

When both statements are combined, we get $x = 6$

Thus, the question can be answered using both the statements together but not by using either statement alone.

Hence, **option 4.**

9. Using Statement A alone:

$-2x < 0$

Divide both sides by -2

$\therefore x > 0$ (The sense of the inequality changes because we divide by a negative number)

Thus, the question can be answered using statement A alone.

Using Statement B alone:

$x^3 > 0$

This is true only when x is greater than 0.

Thus, the question can be answered using statement B alone.

Thus, the question can be answered using either statement alone.

Hence, **option 3.**

10. Using Statement A alone:

Though the distance between doors B and D is known, door C is not mentioned at all. So, the distance between doors B and C cannot be found.

Thus, the question cannot be answered using statement A alone.

Using Statement B alone:

Though the distance between doors A and C is known,

door B is not mentioned at all. So, the distance between

doors B and C cannot be found.

Thus, the question cannot be answered using statement B alone.

Using both the statements together:

Even when both statements are combined, we do not have any definite relationship between doors B and C.

Thus, the question cannot be answered on the basis of the two statements.

Hence, **option 5.**

11. Using Statement A alone:

y is the AM of x and z.

So, $2y = x + z$.

For this to happen, y needs to between x and z but x, y, z need not be consecutive.

Thus, the question cannot be answered using statement A alone.

Using Statement B alone:

$y - x = z - y$

$\therefore 2y = x + z$

This is the same case as that in statement A.

So, the question cannot be answered using statement B alone.

Using both the statements together:

Since both statements are the same case, no further information is obtained when they are combined.

Thus, the question cannot be answered on the basis of the two statements.

Hence, **option 5.**

12. Using Statement A alone:

Rack 3 has book 2. So, Rack 1 has book 4. However, the position of books 1 and 3 cannot be obtained.

So, the question cannot be answered using statement A alone.

Using Statement B alone:

Rack 2 has book 3. However, the position of books 1, 2 and 4 cannot be obtained.

Thus, the question cannot be answered using statement B alone.

Using both the statements together:

Rack 1 has book 4, rack 2 has book 3 and rack 3 has book 2. So, rack 4 has book 1. Thus, the final arrangement is obtained.

Thus, the question can be answered using both the statements together but not by using either statement alone.

Hence, **option 4.**

13. Using Statement A alone:

Let the perimeter of the square and the triangle be p.

So, side of the triangle = $p/3$

and the side of the square = $p/4$

So, the side of the triangle is not less than the side of the square.

Thus, the question can be answered using statement A alone.

Using Statement B alone:

The ratio of the height of triangle E to the diagonal of square F is 1 : 1.

So, side of the triangle = $(\sqrt{3}/2) \times s$

and side of the square = $(1/\sqrt{2}) \times s$

Hence, the side of the triangle is not less than the side of the square.

Thus, the question can be answered using statement B alone. Thus, the question can be answered using either statement alone.

Hence, **option 3.**

14. Using Statement A alone:

Since the rate at which the tap drips is not known, the time at which the bucket will be full is not known.

Thus, the question cannot be answered using statement A alone.

Using Statement B alone:
The bucket was half full at 6 pm and three-quarters full at 8 pm on the same day.
So, it takes 2 hours to fill one-fourth of the bucket.
So, the bucket (that is three-fourths filled at 8 pm) will take 2 more hours to get completely filled and will be full by 10 pm.
Thus, the question can be answered using statement B alone.
Thus, the question can be answered using statement B alone but not by using statement A alone.
Hence, **option 2.**

15. Using Statement A alone:
$2x - 3y > -5$
Consider two different cases.
For $x = 100$ and $y = 10$, we have $2x - 3y = 170$ (≥ 5) and $xy = 1000$ (> 150)
For $x = 10$ and $y = 0$, we have $2x - 3y = 20$ (≥ 5) and
$xy = 0$ (< 150)
So we cannot say if $xy > 150$
Thus, the question cannot be answered using statement A alone.

Using Statement B alone:
$2x - 5y \leq -27$
Consider two different cases.
For $x = 10$ and $y = 100$, we have $2x - 5y = -480$ (≤ 27) and $xy = 1000$ (> 150)
For $x = 0$ and $y = 10$, we have $2x - 5y = -50$ (≤ 27) and $xy = 0$ (< 150)
So we cannot say if $xy > 150$
Thus, the question cannot be answered using statement B alone.

Consider both the statements A and B together:
$2x - 3y > -5$ ... (i)
$-27 > 2x - 5y$ ... (ii)
Adding the above two inequalities, we get
$2x - 3y - 27 > 2x - 5y - 5$
$\therefore 2y > 22$
$\therefore y > 11$ ... (iii)
From (i), we have
$2x > 3y - 5$
$\therefore 2x > 28$
$\therefore x > 14$ ... (iv)
From (iii) and (iv), it is evident that $xy > 154$
Thus, the question can be answered using both the statements together but not by using either statement alone.
Hence, **option 4.**