1. Mahesh works as a manager in a hotel. He has to arrange seats in hall for a function. A hall has a certain number of chairs. Guests want to sit in different groups like in pairs, triplets, quadruplets, fives and sixes etc. When Mahesh arranges chairs in such pattern like in 2's, 3's, 4's 5's and 6's then 1, 2, 3, 4 and 5 chairs are left respectively. But when he arranges in 11's, no chair will be left.

(i) In the hall, how many chairs are available?

    (a) 407   (b) 143

    (c) 539   (d) 209

Ans :

By dividing all the options by 2, 3, 4, 5, 6 and 11, we will get that 539 is the only option which leaves remainder 1, 2, 3, 4, 5, 0 respectively.

Thus (c) is correct option.

(ii) If one chair is removed, which arrangements are possible now?

    (a) 2   (b) 3

    (c) 4   (d) 5

Ans :

After removing 1 chair, we are left with 538 chairs. On arranging chairs in pair of 3's, 4's, 5's, 6's, 11's ; 1, 2, 3 ,4, 10 chairs are left. So, only pair of 2 chairs is possible now.

Thus (a) is correct option.

(iii) If one chair is added to the total number of chairs, how many chairs will be left when arranged in 11's.

    (a) 1   (b) 2

    (c) 3   (d) 4

Ans :

539 chairs are already arranged in pair of 11's .On adding 1 extra chair, that 1 chair will be left only.

Thus (a) is correct option.

(iv) How many chairs will be left in original arrangement if same number of chairs will be arranged in 7's?

    (a) 0   (b) 1

    (c) 2   (d) 3

Ans :

539 is divisible by 7 and remainder is zero, so arranging chairs in pair of 7's, no chair will be left.

Thus (a) is correct option.

(v) How many chairs will be left in original arrangement if same number of chairs will be arranged in 9's?

(a) 8   (b)   1

(c) 6   (d)   3

Ans :

539 is divisible by 9 and remainder is 8, so arranging chairs in pair of 9's, 8 chair will be left. Thus (a) is correct option.

2. Indian Army is the third biggest military contingent in the World next to USA and China.

However, there are many firsts that make Indian army stand out in the world, making us all Indians very proud. Knowing them, will help you celebrate Republic day with greater vigour and gratitude.

On 71th republic day Parade in Delhi Captian RS Meel is planing for parade of following two group:

(a) First group of Army contingent of 624 members behind an army band of 32 members.

(b) Second group of CRPF troops with 468 soldiers behind the 228 members of bikers.

These two groups are to march in the same number of columns. This sequence of soldiers is followed by different states Jhanki which are showing the culture of the respective states.

(i) What is the maximum number of columns in which the army troop can march?

(a) 8   (b)   16

(c) 4   (d)   32

Ans :

We will find the HCF (624, 32) = 16

Thus (b) is correct option.

(ii) What is the maximum number of columns in which the CRPF troop can march?

(a) 4   (b)   8

(c) 12   (d)   16

Ans :

We will find the HCF (228, 468) = 12.

Thus (c) is correct option.

(iii) What is the maximum number of columns in which total army troop and CRPF troop together can march past?

(a) 2   (b)   4

(c) 6   (d)   8

Ans :

According to the question, we have to find out

HCF(624, 32, 228, 468) = 4

Alternatively we can find,

HCF (16, 12) = 4

Thus (b) is correct option.

(iv) What should be subtracted with the numbers of CRPF soldiers and the number of bikers so that their maximum number of column is equal to the maximum number of column of army troop?

(a) 4 Soldiers and 4 Bikers

(b) 4 Soldiers and 2 Bikers

(c) 2 Soldiers and 4 Bikers

(d) 2 Soldiers and 2 Bikers

Ans :

Maximum number of column of army troop is 16. But 228 and 468 are not divisible by 16. If we subtract 4 from 228 and 468, both(224 and 464) are divisible by 16.

Thus (a) is correct option.

(iv) What should be added with the numbers of CRPF soldiers and the number of bikers so that their maximum number of column is equal to the maximum number of column of army troop?

(a) 4 Soldiers and 4 Bikers

(b) 12 Soldiers and 12 Bikers

(c) 6 Soldiers and 6 Bikers

(d) 12 Soldiers and 6 Bikers

Ans :

Maximum number of column of army troop is 16. But 228 and 468 are not divisible by 16. If we add 12 from 228 and 468, both(240 and 480) are divisible by 16.

Thus (b) is correct option.

3. Shalvi wants to organize her birthday party. She was happy on her birthday. She is very health conscious, thus she decided to serve fruits only.

She has 36 apples and 60 bananas at home and decided to serve them. She want to distribute fruits among guests. She does not want to discriminate among guests so she decided to distribute equally among all.

(i) How many maximum guests Shalvi can invite?
    (a) 12   (b) 120
    (c) 6   (d) 180

Ans :

In this case we need to calculate HCF $(36, 60) = 12$.
Thus fruits will be equally distributed among 12 guests.
Thus (a) is correct option.

(ii) How many apples and bananas will each guest get?
    (a) 3 apple 5 banana   (b) 5 apple 3 banana
    (c) 2 apple 4 banana   (d) 4 apple 2 banana

Ans :

Out of 15 apples, each guest will get $(36 \div 12) = 3$ apples and out of 60 bananas, each guest will get $(60 \div 12) = 5$ bananas.
Thus (a) is correct option.

(iii) Shalvi decide to add 42 mangoes also. In this case how many maximum guests Shalvi can invite ?
    (a) 12   (b) 120
    (c) 6   (d) 180

Ans :

In this case we need to calculate HCF $(36, 42, 60) = 6$.
Thus fruits will be equally distributed among 6 guests.
Thus (c) is correct option.

(iv) How many total fruits will each guest get?
    (a) 6 apple 5 banana and 6 mangoes
    (b) 6 apple 10 banana and 7 mangoes
    (c) 3 apple 5 banana and 7 mangoes
    (d) 3 apple 10 banana and 6 mangoes

Ans :

Out of 36 apples, each guest will get $(36 \div 6) = 6$ apples and out of 42 mangoes, each guest will get $(42 \div 6) = 7$ mangoes, out of 60 bananas, each guest will get $(60 \div 6) = 10$ bananas. Thus each guest will get $6 + 7 + 12 = 25$ fruits.
Thus (b) is correct option.

(v) If Shalvi decide to add 3 more mangoes and instead 6 apple, in this case how many maximum guests Shalvi can invite ?
    (a) 12   (b) 30
    (c) 15   (d) 24

Ans :

Now Shalvi has 30 apples, 60 bananas, and 45 mangoes. HCF $(30, 45, 60) = 15$. Thus Shalvi can invite 15 guest.
Thus (c) is correct option.

4. Amar, Akbar and Anthony are playing a game. Amar climbs 5 stairs and gets down 2 stairs in one turn. Akbar goes up by 7 stairs and comes down by 2 stairs every time. Anthony goes 10 stairs up and 3 stairs down each time. Doing this they have to reach to the nearest point of 100th stairs and they will stop once they find it impossible to go forward. (They have less number of stairs than required forward stairs).

(i) Who reaches the nearest point?

    (a) Amar   (b)   Akbar

    (c) Anthony   (d)   All together reach to the nearest point.

Ans :

Amar will reach up to 93 steps then he will go for 5 steps up and 2 steps down hence covering 96 steps. Since 100 th step is final, so he will not cover more steps. Akbar will reach up to 95 steps, since 100 th step is final, so he will not cover more steps. Anthony will reach up to 91 steps, since 100 th step is final, so she will not cover more steps. Thus akbar reaches the nearest point.

Thus (b) is correct option.

(ii) How many times can they meet in between on same step?

    (a) 3   (b)   4

    (c) 5

    (d) No, they cannot meet in between on same step.

Ans :

      LCM (3, 5, 7) =105 step.

Since, total steps are 100 steps, they cannot meet in between on same step.

Thus (d) is correct option.

(iii) Who takes least number of steps to reach near hundred?

    (a) Amar

    (b) Akbar

    (c) Anthony

    (d) All of them take equal number of steps.

Ans :

Amar will take 32 steps, Akbar will take 19 steps and Anthony will take 13 steps to reach to 96 steps, 95 steps and 91 steps respectively.

Thus (c) is correct option.

(iv) What is the first stair where any two out of three will meet together?

    (a) Amar and Akbar will meet for the first time after 15 steps.

    (b) Akbar and Anthony will meet for the first time after 35 steps.

    (b) Amar and Anthony will meet for the first time after 21 steps.

    (d) Amar and Akbar will meet for the first time after 21 steps.

Ans :

Since LCM(3, 5)=15 ; LCM(5, 7)=35 ; LCM(3, 7)=21. Since, 15 is the smallest so Amar and Akbar will meet for the first time after 15 steps.

Thus (a) is correct option.

(v) What is the second stair where any two out of three will meet together?

    (a) Amar and Akbar will meet after 21 steps.

(b) Akbar and Anthony will meet after 35 steps.

(b) Amar and Anthony will after 21 steps.

(b) Amar and Anthony will after 35 steps.

Ans :

As already calculated in (iii), LCM(3, 7) =21

Thus (b) is correct option.

5. Ashish supplies bread and jams to a hospital and a school. Bread and jam are supplied in equal number of pieces. Bread comes in a bunch of 8 pieces and Jam comes in a pack of 6 pieces. On a particular day, Ashish has supplied x packets of bread and y packets of jam to the school. On the same day, Ashish has supplied $3x$ packets of bread along with sufficient packets of jam to hospital. It is known that the number of students in the school are between 500 and 550.

(i) How many students are there in school?

(a) 508   (b) 504

(c) 512   (d) 548

Ans :

Firstly we will find LCM (8, 6) =24. Now we will find a multiple of 24 in between 500 and 550 i.e., 504 or 528. Thus there 504 students in school.

Thus (b) is correct option.

(ii) How many packets of bread are supplied in the school?

(a) 63 packets   (b) 86 packets

(c) 65 packets   (d) 84 packets

Ans :

For equal distribution of bread among each student, we need 504 pieces of bread. Hence, we need (504/8=63) i.e. 63 packets of bread.

Thus (a) is correct option.

(iii) How many packets of jams are supplied in the school?

(a) 63 packets   (b) 86 packets

(c) 65 packets   (d) 84 packets

Ans :

For equal distribution of jam pieces among each student, we need 504 pieces of jam. Hence, we need (504/6=84) i.e. 84 packets of jam.

Thus (d) is correct option.

(iv) How many packets of bread are supplied in the hospital?

(a) 189 packets   (b) 252 packets

(c) 165 packets   (d) 288 packets

Ans :

For hospital, we need $3x$ packets of bread i.e. $3 \times 63 = 189$ packets of bread.

Thus (a) is correct option.

(v) How many packets of jams are supplied in the hospital?

(a) 248 packets   (b) 252 packets

(c) 165 packets   (d) 288 packets

Ans :

Since, number of bread pieces are $189 \times 8 = 1512$, so we need same number of jam pieces. Hence $\frac{1512}{6} = 252$ packets of jam are distributed in the hospital. Thus (b) is correct option.

6. Underground water sump is popular in India. It is usually used for large water sump storage and can be built cheaply using cement-like materials. Underground water sump are typically chosen by people who want to save space. The water in the underground sump is not affected by extreme weather conditions. The underground sump maintain cool temperatures in both winter and summer.

A builder wants to build a sump to store water in an apartment. The volume of the rectangular sump will be modelled by $V(x) = x^3 + x^2 - 4x - 4$.

(i) He planned in such a way that its base dimensions are $(x+1)$ and $(x+2)$. How much he has to dig ?

    (a) $(x+1)$ (b) $(x-2)$

    (c) $(x-3)$ (d) $(x+2)$

Ans :

We have

$$V(x) = x^3 + x^2 - 4x - 4 = x^2(x+1) - 4(x+1)$$

$$= (x+1)(x^2-4) = (x+1)(x-2)(x+2)$$

If $(x+1)$ and $(x+2)$ are two dimension, 3rd dimension will be $(x-2)$. Thus he has to dig $(x-2)$.

Thus (b) is correct option.

(ii) If $x = 4$ meter, what is the volume of the sump?

    (a) $30\,\text{m}^3$ (b) $20\,\text{m}^3$

    (c) $15\,\text{m}^3$ (d) $60\,\text{m}^3$

Ans :

$$V(x) = (x+1)(x-2)(x+2)$$

$$V(4) = (4+1)(4-2)(4+2) = 5 \times 2 \times 6 = 60\,\text{m}^3$$

Thus (d) is correct option.

(iii) If $x = 4$ and the builder wants to paint the entire inner portion on the sump, what is the total area to be painted ?

    (a) $52\ \text{m}^2$ (b) $96\ \text{m}^2$

(c) 208 m^2 (d)   104 m^2

Ans :

Three dimension of sump are

$$x + 1 = 4 + 1 = 5$$
$$x + 2 = 4 + 2 = 6$$
$$x - 2 = 4 - 2 = 2$$
$$S = 2(5 \times 2 + 2 \times 6 + 6 \times 5)$$
$$= 2(10 + 12 + 30) = 2(52) = 104 \, \text{m}^2$$

Thus (d) is correct option.

(iv) If the cost of paint is Rs. 25/ per square metre, what is the cost of painting ?

  (a) 3900 Rs   (b)   2600 Rs
  (c) 1300 Rs   (d)   5200 Rs

Ans :

$$C = 104 \times 25 = 2600 ₹ \, \text{Rs}$$

Thus (b) is correct option.

(v) What is the storage capacity of this sump ?

  (a) 3000 litre   (b)   6000 litre
  (c) 60000 litre   (d)   30000 litre

Ans :

1 m^3 can store 1000 litre, thus 60 m^3 can store 60000 litre.
Thus (c) is correct option.

7. For the box to satisfy certain requirements, its length must be three meter greater than the width, and its height must be two meter less than the width.

(i) If width is taken as x, which of the following polynomial represent volume of box ?

  (a) $x^2 - 5x - 6$ (b) $x^3 + x^2 - 6x$
  (c) $x^3 - 6x^2 - 6x$ (d) $x^2 + x - 6$

Ans :

$$V(x) = x(x + 3)(x - 2) = x(x^2 + x - 6) = x^3 + x^2 - 6x$$

Thus (d) is correct option.

(ii) Which of the following polynomial represent the area of paper sheet used to make box ?

(a) $x^2 - 5x - 6$ (b) $6x^2 + 4x - 12$

(c) $x^3 - 6x^2 - 6x$ (d) $6x^2 + 3x - 4$

Ans :

$$
\begin{aligned}
S(x) &= 2(LW + WH + HL) \\
&= 2\left[x(x+3) + (x+3)(x-2) + x(x-2)\right] \\
&= 2\left[x^2 + 3x + x^2 + x - 6 + x^2 - 2x\right] \\
&= 2(3x^2 + 2x - 6) \ = 6x^2 + 4x - 12
\end{aligned}
$$

Thus (b) is correct option.

(iii) If it must have a volume of 18 unit, what must be its length ?

(a) 6 unit   (b) 3 unit

(c) 4 unit   (d) 2 unit

Ans :

We have $V(x) = x^3 + x^2 - 6$

$$
\begin{aligned}
18 &= x^3 + x^2 - 6x \\
x^3 + x^2 - 6x - 18 &= 0 \\
x^3 - 3x^2 + 4x^2 - 12x + 6x - 18 &= 0 \\
x^2(x-3) + 4x(x-3) + 6(x-3) &= 0 \\
(x-3)(x^2 + 4x + 6) &= 0
\end{aligned}
$$

Thus width is 3 unit.   Length $= x + 3 = 6$ m

Thus (a) is correct option.

(iv) At a volume of 18 cubic unit, what must be its height ?

(a) 1 unit   (b) 3 unit

(c) 2 unit   (d) 4 unit

Ans :

Height $= x - 2 = 3 - 2 = 1$ m

Thus (a) is correct option.

(v) If box is made of a paper sheet which cost is 100 rs per square unit, what is the cost of paper?

(a) Rs 5400   (b) Rs 10800

(c) Rs 2700   (d) Rs 3400

Ans :

$$
\begin{aligned}
S(x) &= 6x^2 + 4x - 12 \ = 6 \times 3 \times 3 + 4 \times 3 - 12 = 54 \\
S &= 2(LW + WH + HL) = 2(6 \times 3 + 3 \times 1 + 1 \times 6) \\
&= 2 \times (18 + 3 + 6) = 2 \times 27 = 54 \text{ m}^2 \\
C &= 100 \times 54 = 5400 \, ₹
\end{aligned}
$$

Thus (a) is correct option.

8. Pyramid, in architecture, a monumental structure constructed of or faced with stone or brick and having a rectangular base and four sloping triangular (or sometimes trapezoidal) sides meeting at an apex (or truncated to form a platform). Pyramids have been built at various times in Egypt, Sudan, Ethiopia, western Asia, Greece, Cyprus, Italy, India, Thailand, Mexico, South America, and on some islands of the Pacific Ocean. Those of Egypt and of Central and South America are the best known.

The volume and surface area of a pyramid with a square base of area a^2 and height h is given by

$$V = \frac{ha^2}{3} \text{ and } S = a^2 + 2a\sqrt{\left(\frac{a}{2}\right)^2 + h^2}$$

A powerful crystal pyramid has a square base and a volume of $3y^3 + 18y^2 + 27y$ cubic units.

(i) If its height is y, then what polynomial represents the length of a side of the square base ?

    (a) $9(y+3)$ (b) $9(y+3)^2$

    (c) $3(y+3)$ (d) $3(y+3)^2$

Ans :

$$V(y) = 3y^3 + 18y^2 + 27y = 3y(y^2 + 6y + 9) = 3y(y+3)^2$$

If y represent height, then comparing its volume with standard volume, we have

$$h\frac{a^3}{3} = 3y(y+3)^2$$

$$y\frac{a^3}{3} = 3y(y+3)^2$$

$$a^3 = 9(y+3)^2$$

$$a = 3(y+3)$$

Thus (c) is correct option.

(ii) If area of base is 576 square unit, what is the side of base?

    (a) 24 metre   (b)   16 metre

    (c) 13 metre   (d)   12 metre

Ans :

$$a^2 = 576 \Rightarrow a = 24 \text{ unit}$$

Thus (a) is correct option.

(iii) What is the height of pyramid at above area of base ?

    (a) 4 metre   (b)   6 metre

    (c) 5 metre   (d)   12 metre

Ans :

At $a = 24$ meter

$$24 = 3(y+3)$$

$$8 = y+3$$

$$y = 5 \text{ metre}$$

Thus (c) is correct option.

(iv) What is ratio of length of side to the height ?

    (a) $\frac{1}{5}$ (b) $\frac{2}{5}$

    (c) $\frac{5}{24}$ (d) $\frac{5}{3}$

Ans :

We have $a = 24$ and $y = 5$.

$$\frac{a}{y} = \frac{5}{24}$$

Thus (c) is correct option.

(v) What is surface area of pyramid ?

    (a) 800 square unit   (b)   2400 square unit

    (c) 1200 square unit   (d)   1600 square unit

Ans :

We have $S = a^2 + 2a\sqrt{\left(\frac{a}{2}\right)^2 + h^2}$

We have $a = 24$ and $y = 5$.

Thus $S = 24^2 + 2 \times 24\sqrt{\left(\frac{24}{2}\right)^2 + 5^2} = 2 \times 24\left(12 + \sqrt{12^2 + 5^2}\right)$

                     $= 48(12+13) = 1200$ square unit

9. Maximum profit: An barrels manufacturer can produce up to 300 barrels per day. The profit made from the sale of these barrels can be modelled by the function $P(x) = -10x^2 + 3500x - 66000$ where $P(x)$ is the profit in rupees and x is the number of barrels made and sold.

 Based on this model answer the following questions:

(i) When no barrels are produce what is a profit loss?

    (a) 22000   (b)   66000

    (c) 11000   (d)   33000

Ans :

When no barrels are produced, $x = 0$

$$P(x) = 0 + 0 - 6000$$

$$P(x) = -66000$$

Thus (b) is correct option.

(ii) What is the break even point ? (Zero profit point is called break even)

(a) 10 barrels   (b)   30 barrels

(c) 20 barrels   (d)   100 barrels

Ans :

At break-even point $P(x) = 0$, thus

$$0 = -10x^2 + 3500x - 66000$$

$$x^2 + 350x + 6600 = 0$$

$$x^2 - 330x - 20x + 6600 = 0$$

$$x(x - 330) - 20(x + 330) = 0$$

$$(x - 330)(x - 20) = 0$$

$$x = 20, \, 330$$

Thus (c) is correct option.

(iii) What is the profit/loss if 175 barrels are produced

(a) Profit 266200   (b)   Loss 266200

(c) Profit 240250   (d)   Loss 240250

Ans :

$$P(175) = -10(175)^2 + 3500(175) - 66000 = 240250$$

Thus (c) is correct option.

(iv) What is the profit/loss if 400 barrels are produced

(a) Profit 266200   (b)   Loss 266200

(c) Profit 342000   (d)   Loss 342000

Ans :

$$P(400) = -10(400)^2 + 3500(400) - 66000 = -266000$$

Thus (b) is correct option.

(v) What is the maximum profit which can manufacturer earn?

(a) Rs 240250   (b)   Rs 480500

(c) Rs 680250   (d)   Rs 240250

Ans :

Rearranging the given equation we have

$$P(x) = -10x^2 + 3500x - 66000 = -10(x^2 - 350x + 6600)$$

$$= -10[(x - 175)^2 - 30625 + 6600] = -10[(x - 175)^2 - 24025]$$

$$= -10(x - 175)^2 + 240250$$

From above equation it is clear that maximum value of $P(x)$ is 240250.

Thus (a) is correct option.

10. Dipesh bought 3 notebooks and 2 pens for Rs. 80. His friend Ramesh said that price of each notebook could be Rs. 25. Then three notebooks would cost Rs.75, the two pens would cost Rs. 5 and each pen could be for Rs. 2.50. Another friend Amar felt that Rs. 2.50 for one pen was too little. It should be at least Rs. 16. Then the price of each notebook would also be Rs.16.

Lokesh also bought the same types of notebooks and pens as Dipesh. He paid 110 for 4 notebooks and 3 pens

(i) Let the cost of one notebook be x and that of pen be y. Which of the following set describe the given problem ?

(a)	$2x+3y=80$ and $3x+4y=110$	(b)	$3x+2y=80$ and $4x+3y=110$
(c)	$2x+3y=80$ and $4x+3y=110$	(d)	$3x+2y=80$ and $3x+4y=110$

Ans :

According to the statement, we have

$3x+2y=80$ and $4x+3y=110$

Thus (b) is correct option.

(ii) Whether the estimation of Ramesh and Amar is applicable for Lokesh?

   (a) Ramesh's estimation is wrong but Amar's estimation is correct.

   (b) Ramesh's estimation is correct but Amar's estimation is wrong.

   (c) Both estimation are correct.

   (b) Ramesh's estimation is wrong but Amar's estimation is also wrong.

Ans :

Consider the prices mentioned by Ramesh.

If the price of one notebook is Rs. 25 and the price of one pen is Rs. 2.50 then,

The cost of 4 notebooks would be : $4 \times 25 = 100$ Rs

And the cost for 3 pens would be : $3 \times 2.5 = 7.5$ Rs

Lokesh should have paid $100 + 7.5 = 107.5$ Rs.

But he paid Rs. 110, thus Ramesh's estimation is wrong.

Now, consider the prices mentioned by Amar.

The cost of 4 notebooks, if one is for Rs.16, would be : $4 \times 16 = 64$ Rs

And the cost for 3 pens, if one is for Rs. 16, would be : $3 \times 16 = 64$ Rs

Lokesh should have paid $64 + 48 = 112$ Rs but this is more than the price he paid.

Therefore, Amar's estimation is also wrong.

Thus (d) is correct option.

(iii) What is the exact cost of the notebook?

(a)	Rs 10	(b)	Rs 20
(c)	Rs 16	(d)	Rs 24

Ans :

Solving $3x+2y=80$ and $4x+3y=110$ we get

$x=20$ and $y=10$

Thus cost of 1 notebook is 20 Rs and cost of 1 pen is 10 Rs

Thus (b) is correct option.

(iv) What is the exact cost of the pen?

(a) Rs 10   (b)   Rs 20

(c) Rs 16   (d)   Rs 24

Ans :

Cost of 1 pen = Rs. 10

Thus (a) is correct option.

(v) What is the total cost if they will purchase the same type of 15 notebooks and 12 pens.

(a) Rs 410   (b)   Rs 200

(c) Rs 420   (d)   Rs 240

Ans :

Total cost $15 \times 20 + 12 \times 10 = 420$ Rs

Thus (c) is correct option.

11. Mr. RK Agrawal is owner of a famous amusement park in Delhi. Generally he does not go to park and it is managed by team of staff. The ticket charge for the park is Rs 150 for children and Rs 400 for adults.

One day Mr Agrawal decided to random check the park and went there. When he checked the cash counter, he found that 480 tickets were sold and Rs 134500 was collected.

(i) Let the number of children visited be x and the number of adults visited be y. Which of the following is the correct system of equation that model the problem ?

(a) $x + y = 480$ and $3x + 8y = 2690$

(b) $x + 2y = 480$ and $3x + 4y = 2690$

(c) $x + y = 480$ and $3x + 4y = 2690$

(d) $x + 2y = 480$ and $3x + 8y = 2690$

Ans :

Since 480 people visited thus $x + y = 480$.

Collected amount is Rs 134500 thus

$150x + 400y = 134500$ $\Rightarrow$ $3x + 8y = 2690$

Thus (a) is correct option.

(ii) How many children attended?

(a) 250   (b)   500

(c) 230   (d)   460

Ans :

Solving the equations $x + y = 480$ and $3x + 8y = 2690$ we get $x = 230$ and $y = 250$

Number of children attended $= 230$

Number of adults attended $= 250$

Thus (c) is correct option.

(iii) How many adults attended?

    (a) 250   (b) 500

    (c) 230   (d) 460

Ans :

Number of adults attended $= 250$

Thus (a) is correct option.

(iv) How much amount collected if 300 children and 350 adults attended?

    (a) Rs 225400   (b) Rs 154000

    (c) Rs 112500   (d) Rs 185000

Ans :

Amount $= 150 \times 300 + 400 \times 350 = 185000$ Rs

Thus (d) is correct option.

(v) One day total attended children and adults together is 750 and the total amount collected is Rs 212500. What are the number of children and adults attended ?

    (a) (700, 800)   (b) (350, 400)

    (c) (800, 700)   (d) (400, 350)

Ans :

Solving the equations $x + y = 750$ and $150x + 400y = 212500$ $\Rightarrow$ $3x + 8y = 4250$ we have $x = 350$ and $y = 400$

i.e Number of children $= 350$

Number of adults $= 400$.

Thus (b) is correct option.

12. In the 1961–1962 NBA basketball season,Wilt Chamberlain of the Philadelphia Warriors made 30 baskets. Some of the baskets were free throws (worth 1 point each) and some were field goals (worth 2 points each). The number of field goals was 10 more than the number of free throws.

(i) How many field goals did he make ?

    (a) 10 Goals   (b) 20 Goals

    (c) 15 Goals   (d) 18 Goals

Ans :

Let x be the free throw and y be the fixed goal.

As per question

$$x + y = 30$$

$$y = x + 10$$

Solving $x = 10$, $y = 20$

Thus he made 20 fixed goal.

Thus (b) is correct option.

(ii) How many free throws did he make?

(a)	10 Goals	(b)	20 Goals
(c)	15 Goals	(d)	18 Goals

Ans :

Free throw $x = 10$

Thus (a) is correct option.

(iii) What was the total number of points scored?

(a)	50	(b)	80
(c)	60	(d)	45

Ans :

Point scored $= 10 + 2 \times 20 = 50$

Thus (a) is correct option.

(iv) If Wilt Chamberlain played 5 games during this season, what was the average number of points per game?

(a)	5	(b)	8
(c)	10	(d)	4

Ans :

Average point $\dfrac{50}{5} = 10$

Thus (c) is correct option.

(v) If Wilt Chamberlain played 10 games during this season, what was the average number of points per game?

(a)	6	(b)	8
(c)	4	(d)	5

Ans :

Average point $\dfrac{50}{10} = 5$

Thus (d) is correct option.

13. Riya has a field with a flowerbed and grass land. The grass land is in the shape of rectangle while flowerbed is in the shape of square. The length of the grassland is found to be 3 m more

than twice the length of the flowerbed. Total area of the whole land is 1260 m².

(i) If the length of the flowerbed is x m then what is the total length of the field ?

(a) $(2x+3)$ m   (b) $(3x+3)$ m

(c) $6x$ m   (d) $(2x+5)$ m

Ans :

The length of the grassland is 3 m more than twice the length of the flowerbed. Thus it will be $2x+3$. Now the total length of field is $2x+3+x = 3x+3$.

Thus (b) is correct option.

(ii) What will be the perimeter of the whole field?

(a) $(8x+6)$ m   (b) $(6x+8)$ m

(c) $(4x+3)$ m   (d) $(4x+3)$ m

Ans :

  Perimeter $= 2(3x+3+x)$ $= 2(4x+3) = (8x+6)$

Thus (a) is correct option.

(iii) What is the value of x if the area of total field is 1260 m².

(a) 21 m   (b) 10 m

(c) 20 m   (d) 15 m

Ans :

We have $A = (3x+3)x$

                  $1260 = 3x^2 + 3x$

                  $420 = x^2 + x$

        $x^2 + x - 420 = 0$

    $(x+21)(x-20) = 0$

Thus, $x = 20$ is only possible value.

Thus (c) is correct option.

(iv) What is the area of grassland ?

(a) 180 m²   (b) 360 m²

(c) 400 m²   (d) 860 m²

Ans :

Area of grassland, $A_g = (2x+3)x$ $= (2 \times 20 + 3)20$ $= 860\,\text{m}^2$

Thus (c) is correct option.

(v) What is the ratio of area of flowerbed to area of grassland ?

(a) $\dfrac{20}{43}$ (b) $\dfrac{23}{40}$

(c) $\dfrac{26}{43}$ (d) $\dfrac{23}{46}$

Ans :

Area of flowerbed,

$$A_f = x^2 = 20^2 = 400 \text{ m}^2$$

$$\text{Ratio} = \frac{400}{860} = \frac{20}{43}$$

Thus (a) is correct option.

14. John and Priya went for a small picnic. After having their lunch Priya insisted to travel in a motor boat. The speed of the motor boat was 20 km/hr. Priya being a Mathematics student wanted to know the speed of the current. So she noted the time for upstream and downstream. She found that for covering the distance of 15 km the boat took 1 hour more for upstream than downstream.

   (i) Let speed of the stream be x km/hr. then speed of the motorboat in upstream will be
       (a) 20 km/hr   (b) $(20 + x)$ km/hr
       (c) $(20 - x)$ km/hr   (d) 2 km/hr

   Ans :

   In this case speed of the motorboat in upstream will be $(20 - x)$ km/hr.
   Thus (c) is correct option.

   (ii) What is the relation between speed distance and time?
        (a) speed = (distance)/time   (b) distance = (speed)/time
        (c) time = speed × distance   (d) none of these

   Ans :

   distance = (speed)/time

   Thus (b) is correct option.

   (iii) Which is the correct quadratic equation for the speed of the current ?
         (a) $x^2 + 30x - 200 = 0$ (b) $x^2 + 20x - 400 = 0$
         (c) $x^2 + 30x - 400 = 0$ (d) $x^2 - 20x - 400 = 0$

   Ans :

   As per question,

   $$\frac{15}{20 - x} = \frac{15}{20 + x} + 1$$

   $$15(20 + x) = 15(20 - x) + (20 - x)(20 + x)$$

   $$15x = -15x + (20^2 - x^2)$$

   $$30x = -x^2 + 400$$

   $$x^2 + 30x - 400 = 0$$

   Thus (c) is correct option.

   (iv) What is the speed of current ?
        (a) 20 km/hour   (b) 10 km/hour
        (c) 15 km/hour   (d) 25 km/hour

Ans :

We have $x^2 + 30x - 400 = 0$

$$x^2 + 40x - 10x - 400 = 0$$

$$x(x + 40) - 10x(x + 40) = 0$$

$$(x + 40)(x - 10) = 0$$

$$x = 10, -40$$

Here $x = 10$ is only possible.

Thus (c) is correct option.

(v) How much time boat took in downstream ?

    (a) 90 minute   (b) 15 minute

    (c) 30 minute   (d) 45 minute

Ans :

In downstream speed of boat $= 20 + 10 = 30$ km/hr
Time take to cover distance 15 km will be 30 minutes.
Thus (c) is correct option.

15. Nidhi and Ria are very close friends. Nidhi's parents own a Maruti Alto. Ria's parents own a Toyota Liva. Both the families decide to go for a picnic to Somnath temple in Gujrat by their own cars.

Nidhi's car travels x km/h while Ria's car travels 5 km/h more than Nidhi's car. Nidhi's car took 4 hrs more than Ria's car in covering 400 km.

(i) What will be the distance covered by Ria's car in two hour?

    (a) $2(x + 5)$ km   (b) $(x - 5)$ km

    (c) $2(x + 10)$ km   (d) $(2x + 5)$ km

Ans :

Nidhi's car travels x km/h while Ria's car travels 5 km/h more than Nidhi's car. Thus Ria's car speed is $x + 5$ km/hour. Distance covered in two hour is $2(x + 5)$.
Thus (a) is correct option.

(ii) Which of the following quadratic equation describe the speed of Nidhi's car?

    (a) $x^2 - 5x - 500 = 0$ (b) $x^2 + 4x - 400 = 0$

    (c) $x^2 + 5x - 500 = 0$ (d) $x^2 - 4x + 400 = 0$

Ans :

As per question,

$$\frac{400}{x} = \frac{400}{x+5} + 4$$

$$400\,(x+5) = 400x + 4x(x+5)$$

$$2000 = 4x^2 + 20x$$

$$500 = x^2 + 5x$$

$$x^2 + 5x - 500 = 0$$

Thus (c) is correct option.

(iii) What is the the speed of Nidhi's car?

    (a) 20 km/hour   (b)   15 km/hour

    (c) 25 km/hour   (d)   10 km/hour

Ans :

We have $x^2 + 5x - 500 = 0$

$$x^2 + 25x - 20x - 500 = 0$$

$$x(x+25) - 20\,(x+25) = 0$$

$$(x+25)(x-20) = 0$$

$$x = 20, -25$$

Since $x = -25$ is not possible, we get $x = 20$

Thus () is correct option.

(iv) How much time took Ria to travel 400 km?

    (a) 20 hour   (b)   40 hour

    (c) 25 hour   (d)   16 hour

Ans :

$$\text{Rias car speed} = 20 + 5 = 25 \text{ km/hour}$$

$$\text{Time Taken} = \frac{400}{25} = 16 \text{ hour}$$

16. In an auditorium, seats are arranged in rows and columns. The number of rows were equal to the number of seats in each row. When the number of rows were doubled and the number of seats in each row was reduced by 10, the total number of seats increased by 300.

(i) If x is taken as number of row in original arrangement which of the following quadratic

equation describe the situation ?

(a) $x^2 - 20x - 300 = 0$ (b) $x^2 + 20x - 300 = 0$

(c) $x^2 - 20x + 300 = 0$ (d) $x^2 + 20x + 300 = 0$

Ans :

Since number of rows were equal to the number of seats in each row in original arrangement, total seats are x^2.

In new arrangement row are $2x$ and seats in each row are $x - 10$. Total seats are 300 more than previous seats so total number of seats are $x^2 + 300$.

Thus $2x(x - 10) = x^2 + 300$

$$2x^2 - 20x = x^2 + 300$$

$$x^2 - 20x - 300 = 0$$

Thus (a) is correct option.

(ii) How many number of rows are there in the original arrangement?

(a) 20   (b) 40

(c) 10   (d) 30

Ans :

We have $x^2 - 20x - 300 = 0$

$$x^2 - 30x + 10x - 300 = 0$$

$$x(x - 30) + 10(x - 30) = 0$$

$$(x - 30)(x + 10) = 0$$

$$x = 30, -10$$

Thus (d) is correct option.

(iii) How many number of seats are there in the auditorium in original arrangement ?

(a) 725   (b) 400

(c) 900   (d) 680

Ans :

Number of seats in original arrangement, $x^2 = 30^2 = 900$

Thus (c) is correct option.

(iv) How many number of seats are there in the auditorium after re-arrangement.

(a) 860   (b) 990

(c) 1200   (d) 960

Ans :

Total seats in rearrangement $= 30^2 + 300 = 900 + 300 = 1200$

Thus (c) is correct option.

(v) How many number of columns are there in the auditorium after re-arrangement?

(a) 42   (b) 20

(c) 25   (d) 32

Ans :

Number of Column after rearrangement,

$$= \frac{\text{Total seats}}{\text{Row}} = \frac{1200}{60} = 20 \text{ Column}$$

Thus (b) is correct option.

17. Some students planned a picnic. The total budget for picnic was Rs 2000 but 5 students failed to attend the picnic and thus the contribution for each student is increased by Rs 20.

S. No.	Article	Cost per student
1	Entry ticket	Rs 5
2	Coffee	Rs 10
3	Food	Rs 25
4	Travelling cost	Rs 50
5	Ice-cream	Rs 15

(i) If x is the number of students planned for picnic, which is the correct quadratic equation that describe the situation.

  (a) $x^2 - 5x - 500 = 0$ (b) $x^2 + 4x - 400 = 0$

  (c) $x^2 + 5x - 500 = 0$ (d) $x^2 - 4x + 400 = 0$

Ans :

We have
$$\frac{2000}{x} + 20 = \frac{2000}{x - 5}$$

$$2000\,(x - 5) + 20x(x - 5) = 2000x$$

$$-10000 + 20x^2 - 100x = 0$$

$$x^2 - 5x - 500 = 0$$

Thus (a) is correct option.

(ii) What is the number of students planned for picnic ?

  (a) 30   (b) 40

  (c) 25   (d) 20

Ans :

We have
$$x^2 - 5x - 500 = 0$$

$$x^2 - 25x + 20x - 500 = 0$$

$$x(x-25) + 20(x-25) = 0$$
$$(x-25)(x+20) = 0$$
$$x = 25, -20$$

Thus (c) is correct option.

(iii) What is the number of students who attended the picnic?

    (a) 20   (b) 40

    (c) 15   (d) 25

Ans :

Thus, $x = 25 - 5 = 20$ Students attended picnic

Thus (a) is correct option.

(iv) What is the total expanse for this picnic ?

    (a) Rs 1500   (b) Rs 2000

    (c) Rs 1000   (d) Rs 2100

Ans :

$$\text{Expanse per Student} = 5 + 10 + 25 + 50 + 15 = 105$$

Total expanse, $105 \times 20 = 2100$

Thus (c) is correct option.

(v) How much money they spent for travelling ?

    (a) Rs 500   (b) Rs 1000

    (c) Rs 800   (d) Rs 3750

Ans :

Expanse on travelling $50 \times 20 = 1000$

Thus (b) is correct option.

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18. The director of the Blue Rose club must decide what to charge for a ticket to the club's performance of The Music Man. If the price is set too low, the club will lose money; and if the price is too high, people won't come. From past experience she estimates that the profit P from sales (in hundreds) can be approximated by $P(x) = -x^2 + 22x - 40$ where x is the cost of a ticket and $0 \le x \le 25$ thousand rupees.

(i) What is the lowest cost of a ticket that would allow the club to break even.

    (a) Rs 3 thousand   (b) Rs 4 thousand

    (c) Rs 2 thousand   (d) Rs 1 thousand

Ans :

At break even $P(x) = 0$, thus

$$-x^2 + 22x - 40 = 0$$

$$x^2 - 22x + 40 = 0$$

$$(x - 2)(x - 20) = 0$$

$$x = 2,\ 20$$

Thus (c) is correct option.

(ii) What is the highest cost that the club can charge to break even?

    (a) Rs 16 thousand   (b) Rs 14 thousand

    (c) Rs 4 thousand   (d) Rs 20 thousand

Ans :

Club can charge Rs 20 thousand also. This is also break even point.

Thus (d) is correct option.

(iii) If club charge Rs 4 thousand for each ticket, what is the profit/loss ?

    (a) Loss Rs 16 thousand   (b) Profit Rs 16 thousand

    (c) Loss Rs 32 thousand   (a) Profit Rs 32 thousand

Ans :

At, $x = 4$, we have

$$P(2) = -(4)^2 + 22 \times 4 - 40 = 32$$

Thus (d) is correct option.

(iv) If club charge Rs 25 thousand for each ticket, what is the profit/loss ?

    (a) Loss Rs 115 thousand   (b) Profit Rs 85 thousand

    (c) Loss Rs 85 thousand   (d) Profit Rs 115 thousand

Ans :

At, $x = 25$, we have $P(5) = -(25)^2 + 22 \times 25 - 40 = -115$

Thus (a) is correct option.

(v) What is the maximum profit which can be earned by club ?

    (a) Rs 40 thousand   (b) Rs 81 thousand

    (c) Rs 61 thousand   (d) Rs 42 thousand

Ans :

We have $P(x) = -x^2 + 22x - 40$

Rearranging the profit equation we have

$$P(x) = -(x^2 - 22x + 121 - 81) = -(x - 11)^2 + 81$$

From above equation it is clear that maximum value of above equation is 81.

Thus (b) is correct option.

19. The Kendriya Vidyalaya Sangathan is a system of premier central government schools in India that are instituted under the aegis of the Ministry of Education (MHRD), Government of India. As of October 2020, it has a total of 1239 schools. It is one of the world's largest chains of schools. The system came into being in 1963 under the name 'Central Schools'. Later, the name was changed to Kendriya Vidyalaya. It is a non profit organisation. Its schools are all affiliated to the Central Board of Secondary Education (CBSE). The objective of KVS is to cater to the educational needs of the children of transferable Central Government employees including Defence and Para-Military personnel by providing a common programme of education.

Commissioner of Regional office Jaipur preapare a table of the marks obtained of 100 students which is given below

Marks obtained	0-20	20-40	40-60	60-80	80-100
Number of students	15	18	21	29	p

He was told that mean marks of a student is 53.

(i) How many students got marks between 80-100?

(a) 21   (b) 38

(c) 17   (d) 26

Ans :

Since numbers of students are 100,

$$14 + 19 + 21 + 29 + p = 100$$

$$83 + p = 100$$

$$p = 100 - 83 = 17$$

Thus (c) is correct option.

(ii) What is the lower limit of model class ?

(a) 20   (b) 40

(c) 60   (d) 80

Ans :

Class 60-80 has the maximum frequency 29, therefore this is model class. Lower limit of this class is 60.

Thus (c) is correct option.

(iii) What is the value of model marks ?

(a) 58   (b) 62

(c) 65   (d) 68

Ans :

Here, $l = 60$, $f_1 = 29$, $f_0 = 21$, $f_2 = 17$ and $h = 20$

Mode, $\qquad M_o = l + h\left(\dfrac{f_1 - f_0}{2f_1 - f_0 - f_2}\right) = 60 + \dfrac{8}{58 - 38} \times 20$

$$= 60 + 8 = 68$$

Thus (d) is correct option.

(iv) What is the value of median marks ?

    (a) 58   (b) 62

    (c) 65   (d) 72

Ans :

Now $\qquad 3M_d = M_o + 2M = 68 + 2 \times 53$

$$M_d = \frac{174}{3} = 58$$

Hence median is 58.

Thus (a) is correct option.

(v) What is the upper limit of median class ?

    (a) 20   (b) 40

    (c) 60   (d) 80

Ans :

Since median is 58 and corresponding class is 40-60. Upper limit of this class is 60.

Thus (c) is correct option.

20. In the following frequency distribution, find the median class.

Height (in cm)	104-145	145-150	150-155	155-160	160-165	165-170
Frequency	5	15	25	30	15	10

(i) What is the upper limit of median class ?

    (a) 150   (b) 160

    (c) 155   (d) 165

Ans :

We prepare following cumulative frequency table to find median class.

Height	Frequency	c.f.
140-145	5	5
145-150	15	20
150-155	25	45
155-160	30	75
160-165	15	90
165-170	10	100
	$N = 100$	

We have $\qquad N = 100 \; ; \; \dfrac{N}{2} = 50$

Cumulative frequency just greater than $\frac{N}{2}$ is 75 and the corresponding class is 155-160. Thus median class is 155-160 and upper limit is 160.

Thus (b) is correct option.

(ii) What is the value of median height ?

    (a) 145.67   (b) 157.67

    (c) 155.83   (d) 159.67

Ans :

Median, $\qquad M_d = l + \left(\dfrac{\frac{N}{2} - F}{f} \right) h = 155 + \dfrac{50 - 45}{30} \times 5 = 155 + \dfrac{5}{6} = \dfrac{935}{6} = 155.83$

Thus (c) is correct option.

(iii) What is the lower limit of model class ?

    (a) 150   (b) 160

    (c) 155   (d) 165

Ans :

Class 155-160 has the maximum frequency 30, therefore this is model class. Lower limit of this class is 155. Thus (c) is correct option.

(iv) What is the value of model marks ?

    (a) 155.25   (b) 156.25

    (c) 157.25   (d) 159.25

Ans :

Here, $l = 155$, $f_1 = 30$, $f_0 = 25$, $f_2 = 15$ and $h = 5$

Mode, $\qquad M_o = l + h \left(\dfrac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) = 155 + \dfrac{30 - 25}{60 - 25 - 15} \times 5$

$$= 155 + \dfrac{5}{20} \times 5$$

$$= 155 + 1.25 = 156.25$$

Thus (b) is correct option.

(v) What is the value of mean height ?

    (a) 155.625   (b) 156.250

    (c) 158.500   (d) 159.275

Ans :

Now $\qquad\qquad 3M_d = M_o + 2M$

$$\dfrac{3 \times 935}{6} = 156.25 + 2M$$

$$2 \times 935 = 4 \times 156.25 + 8M$$

$$1870 = 625 + 8M$$

$$8M = 1870 - 625 = 1245$$

$$M = \dfrac{1245}{8} = 155.625$$

Thus (a) is correct option.

21. Amul, is an Indian dairy cooperative society, based at Anand in the Gujarat. Formed in 1946, it is a cooperative brand managed by a cooperative body, the Gujarat Co-operative Milk Marketing Federation Ltd. (GCMMF), which today is jointly owned by 36 lakh (3.6 million) milk producers in Gujarat. Amul spurred India's White Revolution, which made the country the world's largest producer of milk and milk products.

Survey manager of Amul dairy has recorded monthly expenditures on milk in 100 families of a housing society. This is given in the following frequency distribution :

Monthly expenditure (in Rs.)	0- 175	175-350	350-525	525-700	700-875	875-1050	1050-1125
Number of families	10	14	15	x	28	7	5

(i) How many families spend between Rs 525- Rs 700 on milk ?
   (a) 21   (b) 38
   (c) 17   (d) 26

Ans :

Since number of families is 100,

$10 + 14 + 15 + x + 28 + 7 + 5 = 100$

$$79 + x = 100$$

$$x = 100 - 79 = 21$$

Thus (a) is correct option.

(ii) What is the upper limit of median class ?
   (a) 1225   (b) 875
   (c) 1050   (d) 700

Ans :

We prepare following cumulative frequency table to find median class.

C.I.	f	c.f.
0-175	10	10
157-350	14	24
350-525	15	39
525-700	21	60

700-875	28	88
875-1050	7	95
1050-1225	5	100
	$N = 100$	

We have $\qquad N = 100 \ ; \ \frac{N}{2} = 50$

Cumulative frequency just greater than $\frac{N}{2}$ is 60 and the corresponding class is 525-700. Thus median class is 525-700 and upper limit is 700.

Thus (d) is correct option.

(iii) What is the median expenditure on milk?

    (a) 601.4   (b) 636.5

    (c) 616.6   (d) 624.5

Ans :

Median, $\qquad M_d = l + \left(\frac{\frac{N}{2} - F}{f} \right) h = 525 + \frac{50 - 39}{21} \times 175 = 525 + \frac{11}{21} \times 175$

$$= 525 + 91.6 = 616.6$$

Thus (d) is correct option.

(iv) What is the lower limit of model class ?

    (a) 1225   (b) 875

    (c) 1050   (d) 700

Ans :

Class 700-875 has the maximum frequency 28, therefore this is model class and lower limit is 700.

Thus (d) is correct option.

(v) What is the model expenditure on milk?

    (a) 734.25   (b) 743.74

    (c) 801.25   (d) 820.25

Ans :

Here $l = 700$, $f_0 = 21$, $f_1 = 28$ $f_2 = 7$, $h = 175$

Mode, $\qquad M_o = l + h \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right)$

$$= 700 + \left(\frac{28 - 21}{2 \times 28 - 21 - 7} \right) \times 175$$

$$= 700 + \frac{7}{28} \times 175$$

$$= 700 + 43.75 = 743.75$$

Thus (a) is correct option.

22. Cards on which numbers 1, 2, 3 .... 100 are written (one number on one card and no number is repeated), put in a bag and are mixed thoroughly. A card is drawn at random from the bag. Find the probability that card taken out has

Ans :

(i) What is the probability that card taken out has a odd number ?

(a) 0.25 (b) 0.49

(c) 0.50 (d) 0.51

Ans :

There are 100 cards in bags. Thus we have 100 possible outcomes for all cases.

$$n(S) = 100$$

Odd numbers 1 to 100 are 50.

Number of favourable outcomes,

$$n(E_1) = 50$$

P(an odd number),

$$P(E_1) = \frac{n(E_1)}{n(S)} = \frac{50}{100} = \frac{1}{2}$$

Thus (c) is correct option.

(ii) What is the probability that card taken out has a two digit odd number ?

(a) 0.23 (b) 0.45

(c) 0.56 (d) 0.34

Ans :

Total odd number are 50 and 5 numbers are one digit odd number. Hence two digit odd number are 45. Thus favourable outcomes,

$$n(E_2) = 50 - 5 = 45$$

P(Two digit odd number),

$$P(E_2) = \frac{n(E_2)}{n(S)} = \frac{45}{100} = 0.45$$

Thus (b) is correct option.

(iii) What is the probability that card taken out has a odd number which is multiple of 11?

(a) 0.05 (b) 0.10

(c) 0.12 (d) 0.06

Ans :

Favourable outcomes are {11, 33, 55, 77, 99}. Number of favourable outcomes is 5. Therefore

$$n(E_3) = 5$$

P(odd number multiple of 11),

$$P(E_3) = \frac{n(E_3)}{n(S)} = \frac{5}{100} = 0.05$$

Thus (a) is correct option.

(iv) What is the probability that card taken out has an odd number which is not less than 70 ?

(a) 0.13 (b) 0.14

(c) 0.12   (d) 0.15

Ans :

Favourable outcomes are 71, 73, 75, ...99.

Number of favourable outcomes, $n(E_4) = 15$

P(odd number not less than 70),

$$P(E_4) = \frac{n(E_4)}{n(S)} = \frac{15}{100} = 0.15$$

Thus (d) is correct option.

(v) What is the probability that card taken out has an odd number which is not multiple of 11 ?

    (a) 0.25   (b)   0.50

    (c) 0.40   (d)   0.45

Ans :

Total odd number are 50 and out of which $\{11, 33, 55, 77, 99\}$ are multiple of 11. Thus $50 - 5 = 45$ numbers are not multiple of 11.

Therefore $n(E_5) = 45$

P(odd number not multiple of 11),

$$P(E_5) = \frac{n(E_5)}{n(S)} = \frac{45}{100} = 0.45$$

Thus (d) is correct option.

23. In two dice game, the player take turns to roll both dice, they can roll as many times as they want in one turn. A player scores the sum of the two dice thrown and gradually reaches a higher score as they continue to roll. If a single number 1 is thrown on either die, the score for that whole turn is lost. Two dice are thrown simultaneously.

(a) What is the probability of getting the sum as an even number ?

    (i) $\frac{3}{4}$ (ii) $\frac{1}{2}$

    (iii) $\frac{1}{4}$ (iv) $\frac{5}{8}$

Ans :

All possible outcome are given as below:

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

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

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

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

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

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

Number of all possible outcomes in all case,

$$n(S) = 6 \times 6 = 36$$

Favourable outcome are $\{2, 4, 6, 8, 10, 12\}$. We may get as follows

$\{(1, 1), (1, 3), (3, 1), (2, 2), (1, 5), (5, 1), (2, 4), (4, 2), (3, 3), (2, 6), (6, 2), (3, 5), (5, 3), (4, 4), (6, 4), (4, 6), (5, 5), (6, 6)\}$

Thus number of favourable outcomes,

$$n(E_1) = 18$$

P(sum as an even number),

$$P(E_1) = \frac{n(E_1)}{n(S)} = \frac{18}{36} = \frac{1}{2}$$

Thus (d) is correct option.

(b) What is the probability of getting the sum as a prime number ?

    (i) $\frac{5}{12}$ (ii) $\frac{1}{6}$

    (iii) $\frac{7}{12}$ (iv) $\frac{11}{12}$

Ans :

Favourable outcome are $\{2, 3, 5, 7, 11\}$, which may be as follows

$\{(1, 1), (1, 2), (2, 1), (1, 4), (4, 1), (2, 3), (3, 2), (1, 6), (6, 1), (2, 5), (5, 2), (3, 4), (4, 3), (6, 5), (5, 6)\}$

Thus number of favourable outcomes,

$$n(E_1) = 15$$

P(sum as a prime number),

$$P(E_2) = \frac{n(E_2)}{n(S)} = \frac{15}{36} = \frac{5}{12}$$

Thus (a) is correct option.

(c) What is the probability of getting the sum of atleast 10?

    (i) $\frac{5}{12}$ (ii) $\frac{5}{6}$

    (iii) $\frac{1}{6}$ (iv) $\frac{7}{12}$

Ans :

Favourable outcomes are $\{(5, 5), (6, 4), (4, 6), (6, 5), (5, 6), (6, 6)\}$

Thus number of favourable outcomes,

$$n(E_3) = 6$$

P(sum of atleast 10),

$$P(E_3) = \frac{n(E_3)}{n(S)} = \frac{6}{36} = \frac{1}{6}$$

Thus (c) is correct option.

(d) What is the probability of getting a doublet of even number ?

    (i) $\frac{1}{12}$ (ii) $\frac{5}{12}$

    (iii) $\frac{11}{12}$ (iv) $\frac{7}{12}$

Ans :

Favourable outcomes are $\{(2, 2), (4, 4), (6, 6)\}$

Thus number of favourable outcomes, $n(E_3) = 3$

P (doublet of even number),

$$P(E_4) = \frac{n(E_4)}{n(S)} = \frac{3}{36} = \frac{1}{12}$$

Thus (c) is correct option.

(e) What is the probability of getting a product of numbers greater than 16?

   (i) $\dfrac{7}{36}$ (ii) $\dfrac{2}{9}$

   (iii) $\dfrac{1}{4}$ (iv) $\dfrac{11}{36}$

Ans :

Favourable outcomes are $\{(3, 6), (4, 5), (4, 6),(5, 4), (5, 5), (5, 6), (6, 6),\}$

Thus number of favourable outcomes,

$$n(E_5) = 7$$

P (product of numbers greater than 16),

$$P(E_5) = \frac{n(E_5)}{n(S)} = \frac{7}{36}$$

Thus (c) is correct option.

24. A survey was taken at a high school, and the results were put in a circle graph. The students were asked to list their favourite colours. The measurement of each central angle is shown. If a person is chosen at random from the school, find the probability of each response.
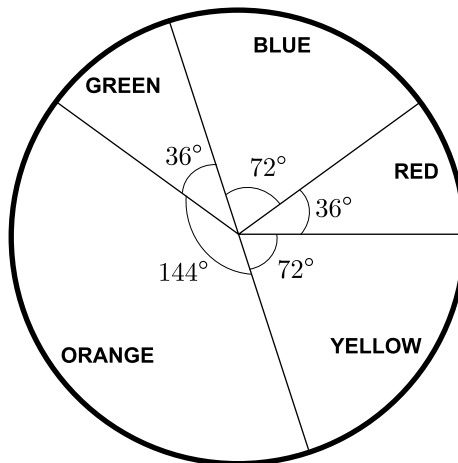
(i) What is the probability of favourite colour being red ?

   (a) 0.1   (b) 0.2

   (c) 0.3   (d) 0.4

Ans :

$$\text{Probability} = \frac{\text{Area of region}}{\text{Area of circle}} = \frac{\text{Total Angle in region}}{360°}$$

$$P(\text{red}) = \frac{36°}{360°} = \frac{1}{10} = 0.1$$

Thus (a) is correct option.

(ii) What is the probability of favourite colour being blue or green ?

   (a) 0.1   (b)   0.2

   (c) 0.3   (d)   0.4

Ans :

$$P(\text{blue of green}) = \frac{72^\circ + 36^\circ}{360^\circ} = \frac{108^\circ}{360^\circ} = \frac{3}{10} = 0.3$$

Thus (c) is correct option.

(iii) What is the probability of favourite colour not being red or blue?

   (a) 0.35   (b)   0.70

   (c) 0.15   (d)   0.50

Ans :

$$P(\text{not red or blue}) = 1 - P(\text{red or blue})$$

$$= 1 - \frac{36^\circ + 72^\circ}{360^\circ} = 1 - \frac{108^\circ}{360^\circ}$$

$$= 1 - \frac{3}{10} = 1 - 0.3 = 0.7$$

Thus (b) is correct option.

(iv) What is the probability of favourite colour not being orange or green ?

   (a) 0.65   (b)   0.75

   (c) 0.25   (d)   0.50

Ans :

$$P(\text{not orange or green}) = 1 - P(\text{orange or green})$$

$$= 1 - \frac{144^\circ + 36^\circ}{360^\circ} = 1 - \frac{180^\circ}{360^\circ} \quad = 1 - \frac{1}{2} = 0.5$$

Thus (d) is correct option.

(v) What is the probability of favourite colour being red or blue?

   (a) 0.2   (b)   0.3

   (c) 0.1   (d)   0.4

Ans :

$$P(\text{red or blue}) = 1 - P(\text{not red or blue}) = 1 - 0.7 = 0.3$$

Thus (b) is correct option.

25. Jawaharlal Nehru Stadium is a multi-purpose sports stadium and a very popular sports stadium of Delhi. It has a capacity to seat 60,000 people. It is the third largest multi-purpose stadium in India and owned by the Indian Olympic Association. In 2010, the Jawaharlal Nehru Stadium was the main stadium for XIX Commonwealth Games; a major sporting

event.

Jawaharlal Nehru Stadium is conducting the annual sports competition soon. The curator of the stadium is tasked to figuring out the dimensions for carving out some areas allotted for a hockey court and a shooting range, as shown in the figure below.
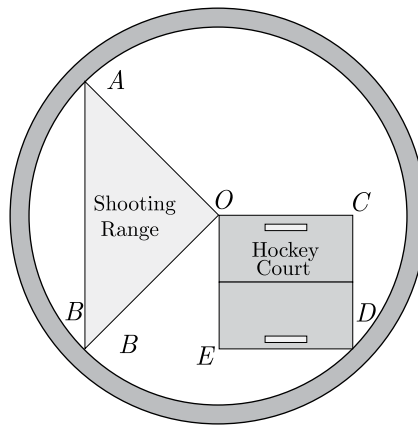
The shapes of the hockey court and the shooting range are square and triangle respectively. Both of the courts have a common edge that touches the centre of stadium. The construction of the shooting range is such that the angle to centre is $90°$. The radius of the stadium is 180 metres.

On the basis of the above information, answer any four of the following questions:

(i) What is the area allotted to shooting range ?

(a) 12, 600 m^2 (b) 22, 000 m^2

(c) 20, 000 m^2 (d) 16, 880 m^2

Ans :

Here $\Delta\, AOB$ is a right-angled triangle in which AB is a hypotenuse.

Now $\qquad\qquad AO = OB$

$$= \text{radius of circle} = 200\,\text{m}$$

Thus area of $\Delta\, AOB$,

$$= \frac{1}{2} \times OA \times OB$$

$$= \frac{1}{2} \times 200 \times 200 = 20{,}000\,\text{m}^2$$

Thus (c) is correct option.

(ii) What is the area allotted to hockey court ?

(a) 12, 600 m^2 (b) 22, 000 m^2

(c) 20, 000 m^2 (d) 16, 880 m^2

Ans :

Here $OCDE$ is a square whose diagonal is equal to the radius of the circle. Let a be side of square.

Now
$$a^2 + a^2 = (200)^2$$
$$2a^2 = 200 \times 200$$
$$a = \sqrt{100 \times 100 \times 2} = 100\sqrt{2} \text{ cm}$$

Area of square $\quad a^2 = \left(100\sqrt{2}\right)^2 = 20{,}000 \text{ m}^2$

Area of hockey court is equal to area of shooting court.

Thus (c) is correct option.

(iii) If the team of the curators managing the stadium, likes to allot space for some more sports, how much area is available to them?

(a) 85, 600 m^2 (b) 95, 800 m^2

(c) 60, 040 m^2 (d) 76, 980 m^2

Ans :

Unoccupied area of stadium,

$$= \text{Area of circle} - (\text{Area of hockey court} + \text{area of shooting court})$$
$$= \pi r^2 - (20{,}000 + 20{,}000)$$
$$= 40{,}000\pi - 40{,}000$$
$$= 40000(\pi - 1)$$
$$= 40{,}000 \times 2.14 = 85{,}600 \text{ m}^2$$

Thus (a) is correct option.

(iv) If the boundaries of the hockey court and shooting range are to be fenced, then what is the required length of the fence ?

(a) $200(2 + 5\sqrt{3})$ m   (b) $200(2 + 3\sqrt{2})$ m

(c) $200(2 + 5\sqrt{2})$ m   (d) $200(2 + 3\sqrt{3})$ m

Ans :

Boundaries need to be fenced

$$= \text{perimeter of triangle} + \text{perimeter of square}$$

For triangle, length of AB,

$$AB = \sqrt{OA^2 + OB^2} = \sqrt{200^2 + 200^2} = 200\sqrt{2} \text{ cm}$$

Perimeter of triangle,

$$OA + OB + AB = 200 + 200 + 200\sqrt{2} = 400 + 200\sqrt{2}$$

Perimeter of square,

$$4a = 4 \times 100\sqrt{2} = 400\sqrt{2}$$

Boundary need to be fenced

$$= 400 + 200\sqrt{2} + 400\sqrt{2}$$
$$= 400 + 600\sqrt{2} \ = 200(2 + 3\sqrt{2}) \ \text{m}$$

Thus (b) is correct option.

(v) If the cost of fencing is Rs 6 per metre, what is the total cost of fencing ?

    (a) Rs $2400(2 + 3\sqrt{2})$ (b) Rs $1200(2 + 5\sqrt{2})$

    (c) Rs $1200(2 + 3\sqrt{2})$ (d) Rs $2400(2 + 3\sqrt{2})$

Ans :

    Cost of Fencing $=$ Length of Fence $\times$ Rate

$$= 200(2 + 3\sqrt{2}) \times 6 \ = 1200(2 + 3\sqrt{2})$$

Thus (c) is correct option.

26. Due to ongoing Corona viruse outbreak, Raj Medical store has started selling masks of decent quality. The store is selling two types of masks currently type A and type B. The cost of one type A mask is Rs. 15 and of one type B mask is Rs. 20. In the month of April, 2020, the store sold 100 masks for total sales of Rs. 1650.

Due to great demand and short supply, the store has increased the price of each type by Rs. 5 from May 1, 2020. In the month of May, 2020, the store sold 310 masks for total sales of Rs. 6875.

₹ 15   ₹ 20

On the basis of the above information, answer any four of the following questions:

(i) How many masks of each type were sold in the month of April?

    (a) 40 masks of type A, and 60 masks of type B

    (b) 60 masks of type A, and 40 masks of type B

    (c) 70 masks of type A, and 30 masks of type B

    (d) 30 masks of type A, and 70 masks of type B

Ans :

Let x be the mask of type A sold and y be the type of mask B sold in April.

Now $x + y = 100$ ...(1)

and $15x + 20y = 1650$ ...(2)

Multiplying equation (1) by 15 and subtracting from (2) we obtain,

$$5y = 150 \Rightarrow y = 30$$

$$x = 100 - 30 = 70$$

Hence 70 masks of type A, and 30 masks of type B were sold.

Thus (c) is correct option.

(ii) If the store had sold 50 masks of each type, what would be its sales in the month of April?

    (a) Rs 550   (b) Rs 560

    (c) Rs 1050   (d) Rs 1750

Ans :

$$\text{Total Sales} = 50 \times 15 + 50 \times 20 = 1750$$

Thus (d) is correct option.

(iii) How many masks of each type were sold in the month of May?

    (a) 175 masks of type A, and 135 masks of type B

    (b) 200 masks of type A, and 110 masks of type B

    (c) 110 masks of type A, and 200 masks of type B

    (d) 135 masks of type A, and 175 masks of type B

Ans :

Let x be the mask of type A sold and y be the type of mask B were sold in April.

Now, $x + y = 310$ ...(1)

and $20x + 25y = 6875$ ...(ii)

Multiplying equation (1) by 20 and subtracting it from equation (2), we obtain

$$5y = 675 \Rightarrow y = 135$$

$$x = 310 - 135 = 175$$

Thus (a) is correct option.

(iv) What percent of masks of each type sale was increased in the month of May, compared with the sale of month April?

    (a) 110 % in type A and 180 % in type B

    (b) 180 % in type A and 110 % in type B

    (c) 350 % in type A and 150 % in type B

    (d) 150 % in type A and 350 % in type B

Ans :

$$\text{Increase in type } A = \frac{175 - 70}{70} \times 100 = 150\,\%$$

Increase in type $B = \dfrac{105 - 30}{30} \times 100 = 350\%$

Thus (d) is correct option.

(v) What extra profit did he earned by increasing price in May month.

    (a) Rs 1550   (b) Rs 3100

    (c) Rs 1650   (d) Rs 1825

Ans :

Total sale value in May at old price $= 175 \times 15 + 135 \times 20 = 5325$

Total sale value in May at new price $= 6875$

Extra Profit $= 6875 - 5325 = 1550$

Alternative :

Since extra profit is Rs 5 on per mask and total mask sold are 310, thus extra profit $= 310 \times 5 = 1550$. Thus (a) is correct option.

27. A game at a stall in new year carnival involves spinning a wheel first as a first step to complete the game with certain rules. If the wheel stops at a particular number, then the player is allowed to roll a 6 faced unbiased dice.

Rules of Game:

1. If the wheel stops at a particular number, then the player is allowed to roll a unbiased dice.
2. If the wheel stops at any other number, player get to try again and only one extra try allowed.

    If player reach the next stage and roll a dice, he may get a prize depending on the number on dice.

On the basis of the above information, answer any four of the following questions:

(i) What is the probability of getting an even number on the wheel?

    (a) $\dfrac{1}{4}$ (b) $\dfrac{1}{2}$

    (c) $\dfrac{1}{8}$ (d) $\dfrac{1}{16}$

Ans :

Total outcomes $n(S) = 8$

Favourable outcome are $\{2, 4, 6, 8\}$, therefore $n(E) = 4$

Probability of getting an even number on the wheel,

$$P(E) = \frac{n(E)}{n(S)} = \frac{4}{8} = \frac{1}{2}$$

Thus (b) is correct option.

(ii) If getting an odd number on the wheel allows a player to roll the die, then what is the probability of his rolling the die ?

  (a) $\frac{1}{4}$ (b) $\frac{1}{2}$

  (c) $\frac{1}{8}$ (d) $\frac{1}{16}$

Ans :

Total outcomes $n(S) = 8$

Favourable outcome are $\{3, 5, 7, 9\}$, therefore $n(E) = 4$

Probability of getting an odd number on the wheel, $P(E) = \frac{n(E)}{n(S)} = \frac{4}{8} = \frac{1}{2}$

Thus (b) is correct option.

(iii) If the player is allowed to roll the die and getting a number greater than 4 entitles him to get prize, then the probability of his winning the prize is

  (a) $\frac{3}{4}$ (b) $\frac{1}{6}$

  (c) $\frac{1}{3}$ (d) $\frac{2}{3}$

Ans :

Dice has total six outcome, thus total outcome

$$n(S) = 6$$

Number greater than 4 on dice are $\{5, 6\}$, therefore

$$n(E) = 2$$

Probability of getting a number greater than 4,

$$P(E) = \frac{n(E)}{n(S)} = \frac{2}{6} = \frac{1}{3}$$

Thus (c) is correct option.

(iv) If getting a square number on the wheel allows a player to roll the die, then what is the probability of his rolling the die ?

  (a) $\frac{1}{4}$ (b) $\frac{1}{2}$

  (c) $\frac{1}{3}$ (d) $\frac{2}{3}$

Ans :

Total outcomes $n(S) = 8$

Favourable outcome are $\{4, 9\}$, therefore $n(E) = 2$

Probability of getting a square number on the wheel,

$$P(E) = \frac{n(E)}{n(S)} = \frac{2}{8} = \frac{1}{4}$$

Thus (a) is correct option.

(v) If the player is allowed to roll the die and getting a prime number on die entitles him to get prize, then what is the probability of his winning the prize?

(a) $\frac{1}{4}$ (b) $\frac{1}{2}$

(c) $\frac{1}{3}$ (d) $\frac{1}{6}$

Ans :

Dice has total six outcome, thus total outcome

$$n(S) = 6$$

Prime number on dice are $\{2, 3, 5\}$, therefore

$$n(E) = 3$$

Probability of getting a prime number on dice,

$$P(E) = \frac{n(E)}{n(S)} = \frac{3}{6} = \frac{1}{2}$$

Thus (b) is correct option.

28. Radio towers are used for transmitting a range of communication services including radio and television. The tower will either act as an antenna itself or support one or more antennas on its structure, including microwave dishes. They are among the tallest human-made structures. There are 2 main types: guyed and self-supporting structures.

On a similar concept, a radio station tower was built in two sections A and B. Tower is supported by wires from a point O. Distance between the base of the tower and point O is 36 m. From point O, the angle of elevation of the top of section B is $30°$ and the angle of elevation of the top of section A is $45°$.
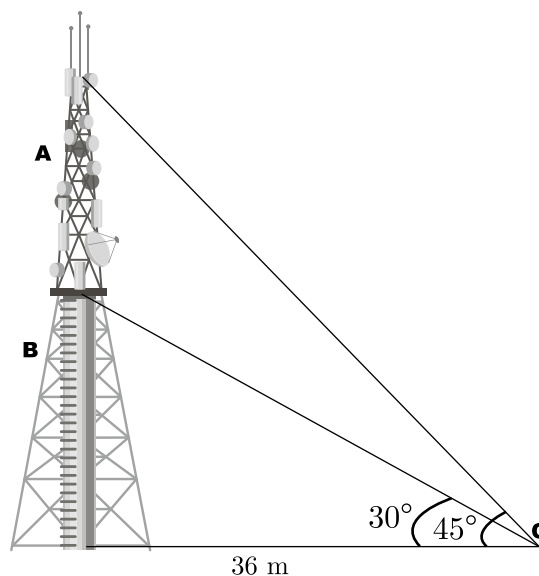
36 m

On the basis of the above information, answer any four of the following questions:

(i) What is the height of the section B ?

    (a) $12\sqrt{3}$ m   (b) $12\sqrt{2}$ m

    (c) $8\sqrt{3}$ m   (d) $4\sqrt{2}$ m

Ans :

We make the following diagram as per given information.
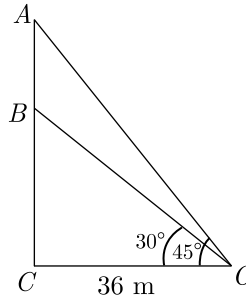
In $\Delta\,BCO$ $\tan 30° = \dfrac{BC}{OC}$

$$BC = OC\tan 30°$$

$$BC = 36 \times \frac{1}{\sqrt{3}} = 12\sqrt{3}\ \text{m}$$

Thus (a) is correct option.

(ii) What is the height of the section A ?

    (a) $12\,(2 - \sqrt{2})$ (b) $24\,(2 - \sqrt{2})$

    (c) $12\,(3 - \sqrt{3})$ (d) $24\,(3 - \sqrt{3})$

Ans :

In $\Delta\,ACO,$ $\tan 45° = \dfrac{AC}{OC} = 1$

Thus $AC = OC = 36$ m

Now, $AB = AC - BC = 36 - 12\sqrt{3} = 12\,(3 - \sqrt{3})$ m

Thus (c) is correct option.

(iii) What is the length of the wire structure from the point O to the top of section A ?

    (a) $32\sqrt{2}$ m   (b) $24\sqrt{3}$ m

    (c) $28\sqrt{3}$ m   (d) $36\sqrt{2}$ m

Ans :

In $\Delta\,ACO,$ $\cos 45° = \dfrac{OC}{OA}$

$$\frac{1}{\sqrt{2}} = \frac{36}{OA}$$

$$OA = 36\sqrt{2}\ \text{m}$$

Thus (d) is correct option.

(iv) What is the length of the wire structure from the point O to the top of section B ?

(a) $12\sqrt{3}$ m

(b) $24\sqrt{3}$ m

(c) $28\sqrt{3}$ m

(d) $16\sqrt{3}$ m

Ans :

In $\Delta\, BCO, \quad \cos 30° = \dfrac{OC}{OB}$

$$\dfrac{\sqrt{3}}{2} = \dfrac{36}{OB}$$

$$OB = \dfrac{72}{\sqrt{3}} \times \dfrac{\sqrt{3}}{\sqrt{3}} = 24\sqrt{3}\ \text{m}$$

Thus (b) is correct option.

(v) What is the angle of depression from top of tower to point O ?

(a) 30°

(b) 45°

(c) 15°

(d) 75°

Ans :

It is clear from figure that angle of elevation from point O to top of tower is 45°. This is equal to the angle of depression from top of tower to point O.

Thus (b) is correct option.

29. RK Fabricators has got a order for making a frame for machine of their client. For which, they are using a AutoCAD software to create a constructible model that includes the relevant information such as dimensions of the frame and materials needed.
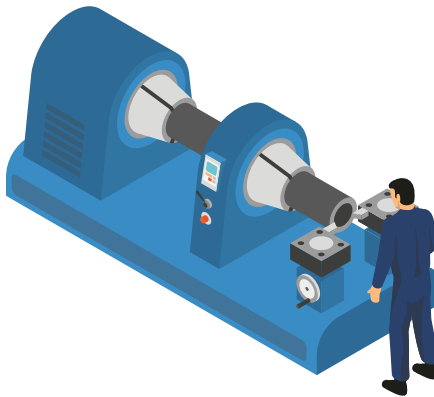
The frame will have a solid base and will be cut out of a piece of steel The final area of the frame should be 54 sq m. The digram of frame is shown below.

In order to input the right values in the AutoCAD software, the engineer needs to calculate some basic things. On the basis of the above information, answer any four of the following questions:

(i) What are the dimensions of the outer frame ?

   (a) $(10+x)$ and $(5+x)$ (b) $(10-x)$ and $(5-x)$

   (c) $(10+2x)$ and $(5+2x)$ (d) $(10-2x)$ and $(5-2x)$

Ans :

$$\text{Length} = (10+x+x) = (10+2x)$$

$$\text{Breadth} = (5+x+x) = (5+2x)\,\text{cm}$$

Thus (c) is correct option.

(ii) A metal sheet of minimum area is used to make the frame. What should be the minimum area of metal sheet before cutting ?

   (a) $4x^2+30x+50$ (b) $x^2+27x+55$

   (c) $5x^2+30$ (d) $4x^2+50$

Ans :

Length of steel plate, $l = (10+2x)$

Breadth of steel plate, $b = (5+2x)$

Area of steel plate, $A = lb$

$$= (10+2x)(5+2x)$$

$$= 50+10x+20x+4x^2$$

$$= 50+30x+4x^2$$

$$A = 4x^2+30x+50$$

Thus (a) is correct option.

(iii) What is the area of required final metal frame ?

   (a) $4x^2+30x+50$ m^2 (b) $x^2+27x+55$ m^2

   (c) $4x^2+50x$ m^2 (d) $4x^2+30$ m^2

Ans :

$$\text{Area of frame to be cut} = 10 \times 5 = 50 \text{ m}^2$$

$$\text{Area of frame left} = 4x^2+30x+50-50$$

$$= 4x^2+30x \text{ m}^2$$

Thus (d) is correct option.

(iv) If the area of the frame is 54 sq m, what is the value of x ?

   (a) 0.75 m   (b) 3.0 m

   (c) 1.5 m   (d) 1.8 m

Ans :

Here,   area of frame $= 54 \text{ m}^2$

$$4x^2 + 30x = 54$$
$$2x^2 + 15x - 27 = 0$$
$$2x^2 + 18x - 3x - 27 = 0$$
$$(x + 9)(2x - 3) = 0$$
$$x = 1.5 \text{ or} - 9$$

Thus (c) is correct option.

(v) What is the perimeter of the frame?

    (a) 36 m   (b)   42 m

    (c) 45 m   (d)   39 m

Ans :

Perimeter of frame=Perimeter of Outside Rectangle

$$= 2(10 + 2x + 5 + 2x) = 2(15 + 4x) = 2(15 + 4 \times 1.5) = 42 \text{ m}$$

Thus (b) is correct option.

30. The law of reflection states that when a ray of light reflects off a surface, the angle of incidence is equal to the angle of reflection.
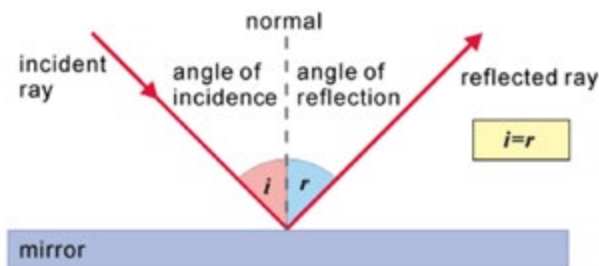
Ramesh places a mirror on level ground to determine the height of a pole (with traffic light fired on it). He stands at a certain distance so that he can see the top of the pole reflected from the mirror. Ramesh's eye level is 1.5 m above the ground. The distance of Ramesh and the pole from the mirror are 1.8 m and 6 m respectively.
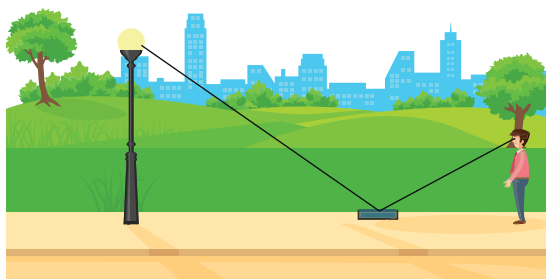
On the basis of the above information, answer any four of the following questions:

(i) Which criterion of similarity is applicable to similar triangles?

    (a) SSA   (b) ASA

    (c) SSS   (d) AA

Ans :

Since angle of incidence and angle of reflection are the same, we draw the figure as given below.
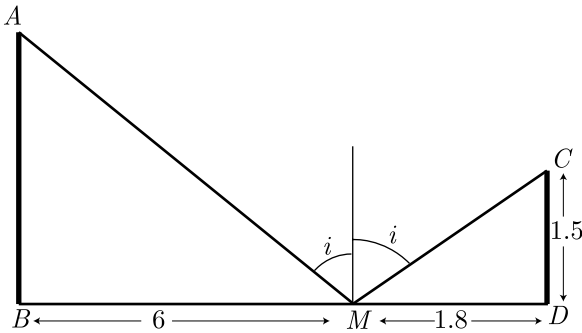
Now $\angle AMB = \angle CMD$

Also, $\angle ABM = \angle CDM = 90°$

So, by AA similarity criterion,

$$\Delta\, AMB \sim \Delta\, CDM$$

Thus (d) is correct option.

(ii) What is the height of the pole?

(a) 6 metres   (b)   8 metres

(c) 5 metres   (d)   4 metres

Ans :

As $\Delta\, ABM \sim \Delta\, CDM$ we obtain,

$$\frac{AB}{CD} = \frac{BM}{DM}$$

$$\frac{AB}{1.8} = \frac{5}{1.5}$$

$$AB = \frac{6}{1.8} \times 1.5 = 5 \text{ m}$$

Thus, the height of the pole is 5 metres.

Thus (c) is correct option.

(iii) If angle of incidence is i, which of the following is correct relation?

(a) $\tan i = \frac{5}{6}$ (b) $\tan i = \frac{6}{5}$

(c) $\tan i = \frac{3}{5}$ (d) $\tan i = \frac{5}{3}$

Ans :

From the geometry of diagram we have

$$\angle MCD = i$$

$$\tan \angle MCD = \frac{MD}{CD}$$

$$\tan i = \frac{1.8}{1.5} = \frac{6}{5}$$

Thus (b) is correct option.

Now Ramesh move behind such that distance between pole and Ramesh is 13 meters. He place mirror between him and pole to see the reflection of light in right position.

(iv) What is the distance between mirror and Ramesh ?

    (a) 7 metres   (b) 3 metres

    (c) 5 metres   (d) 4 metres

Ans :

On the basis of given information we have drawn the figure as follows:
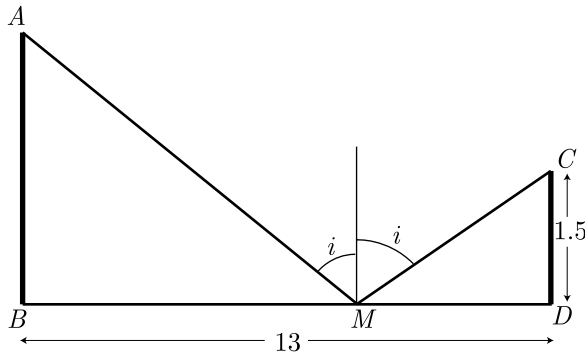
Once again due to AA similarity criterion,

$$\Delta\, AMB \sim \Delta\, CDM$$

$$\frac{5}{13 - x} = \frac{1.5}{x}$$

$$\frac{1}{13 - x} = \frac{0.3}{x}$$

$$x = 3.9 - 0.3x$$

$$1.3x = 3.9 \;\Rightarrow\; x = 3$$

Thus (b) is correct option.

(v) What is the distance between mirror and pole?

    (a) 9 metres   (b) 8 metres

    (c) 12 metres   (d) 10 metres

Ans :

Distance between mirror and pole, $= 13 - x = 13 - 3 = 10$ m

Thus (d) is correct option.

31. Five friends and one of their mother are having a picnic. The mother deicide to play card game. 17 cards numbered 1, 2, 3 ... 17 are put in a box and mixed thoroughly. The mother asks each boy to draw a card and after each draw she shows some magic tricks based on card

number.
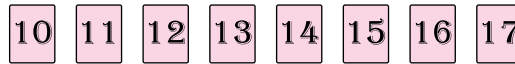
On the basis of the above information, answer any four of the following questions:

(i) What is the probability of drawing an odd number card in the first draw by the first boy ?

(a) $\frac{8}{17}$ (b) $\frac{9}{17}$

(c) $\frac{10}{17}$ (d) $\frac{11}{17}$

Ans :

Total outcomes $n(S) = 17$

Favourable outcome are $\{1, 3, 5, 7, 9, 11, 13, 15, 17\}$, therefore

$$n(E) = 9$$

Probability of drawing an odd number card in the first draw by the first boy,

$$P(E) = \frac{n(E)}{n(S)} = \frac{9}{17}$$

Thus (b) is correct option.

(ii) Now in second draw, card drawn in first draw is replaced. What is the probability of drawing a prime number card by the second boy?

(a) $\frac{6}{17}$ (b) $\frac{9}{17}$

(c) $\frac{7}{17}$ (d) $\frac{11}{17}$

Ans :

Total outcomes $n(S) = 17$

Favourable outcome are $\{2, 3, 5, 7, 11, 13, 17\}$, therefore

$$n(E) = 7$$

Probability of drawing prime number card by the second boy,

$$P(E) = \frac{n(E)}{n(S)} = \frac{7}{17}$$

Thus (c) is correct option.

(iii) If in second draw, boy got number 2 and the card is not replaced, what is the probability of drawing a card bearing a multiple of 3 greater than 5 by the third boy?

(a) $\frac{1}{4}$ (b) $\frac{1}{3}$

(c) $\frac{2}{3}$ (d) $\frac{5}{6}$

Ans :

If the card drawn is not replaced, then total number of cards remaining are 16.

Total outcomes $n(S) = 16$

Favourable outcome are $\{6, 9, 12, 15\}$, therefore

$$n(E) = 4$$

Probability of drawing a number multiple of 3 and greater than 5 by the third boy is,

$$P(E) = \frac{n(E)}{n(S)} = \frac{4}{16} = \frac{1}{4}$$

Thus (a) is correct option.

(iv) If the card is replaced after the third draw, what is the probability of drawing a card bearing a number greater than 17 by the fourth boy ?

    (a) 0.25   (b) 0.2

    (c) 0   (d) 1

Probability of getting number greater than 17 is zero because there is no card having number 17.

Thus (c) is correct option.

(v) If the card is replaced after the fourth draw, what is the probability of drawing a card bearing a multiple of 3 or 7 by the fifth boy?:

    (a) $\frac{6}{16}$ (b) $\frac{7}{16}$

    (c) $\frac{8}{17}$ (d) $\frac{9}{17}$

Ans :

Here we must note that we have 16 card because we have not replaced card in third draw.

Total outcomes $n(S) = 16$

Favourable outcome are $\{3, 6, 7, 9, 12, 14, 15\}$, therefore

$$n(E) = 7$$

Probability of drawing a number multiple of 3 or 7 by the fifth boy,

$$P(E) = \frac{n(E)}{n(S)} = \frac{7}{16}$$

Thus (b) is correct option.

32. A road roller (sometimes called a roller-compactor, or just roller) is a compactor-type engineering vehicle used to compact soil, gravel, concrete, or asphalt in the construction of roads and foundations. Similar rollers are used also at landfills or in agriculture. Road rollers

are frequently referred to as steamrollers, regardless of their method of propulsion.

RCB Machine Pvt Ltd started making road roller 10 year ago. Company increased its production uniformly by fixed number every year. The company produces 800 roller in the 6th year and 1130 roller in the 9th year.

On the basis of the above information, answer any four of the following questions :

(i) What was the company's production in first year ?

    (a) 150   (b) 200

    (c) 250   (d) 290

Ans :

Let a be the production in first year and d be the increase every year in production.

We have $\qquad\qquad a_6 = 800$

$\qquad\qquad\qquad\quad a_9 = 1130$

Now, $\quad a + (6-1)\,d = 800$

$\qquad\qquad\quad a + 5d = 800 \qquad\qquad\qquad ...(1)$

Similarly $\qquad a + 8d = 1130 \qquad\qquad ...(2)$

Solving (1) and (2), we get

$\qquad\qquad\qquad d = 110$

$\qquad\qquad\quad a = 800 - 5 \times 110 = 250$

Thus (c) is correct option.

(ii) What was the company's production in the 8th year ?

    (a) 760   (b)   820

    (c) 880   (d)   1020

Ans :

Since, $\qquad\qquad a = 250$ and $d = 110$

$\qquad\qquad a_8 = a + (8-1)\,d = 250 + 7 \times 110 = 1020$

Thus (d) is correct option.

(iii) What roller the company's total production of the first 6 years?

    (a) 3150   (b)   1775

    (c) 2250   (d)   1725

Ans :

Production in 6th year is 800 rollers.

$$S_n = \frac{n}{2}[a + a_n] = \frac{6}{2}[250 + 800] = 3 \times 1050 = 3150$$

Thus (a) is correct option.

(iv) What was the increase in the company's production every year ?

    (a) 160   (b) 130

    (c) 90   (d) 110

Ans :

In part (i), we have calculated $d = 110$ which is the increase every year in production. Hence, the production increases constantly by 110 every year.

Thus (d) is correct option.

(v) In which year the company's production was 1350 rollers ?

    (a) 5th (b) 6th

    (c) 11th (d) 9th

Ans :

Suppose company produce 1350 rollers in n^{th} year.

Then, $a_n = a + (n-1)\,d$

$$1350 = 250 + (n-1) \times 110$$

$$(n-1)\,110 = 1350 - 250 = 1100$$

$$n - 1 = 10 \;\Rightarrow\; n = 11$$

Thus (c) is correct option.

33. A clinometer is a tool that is used to measure the angle of elevation, or angle from the ground, in a right - angled triangle. We can use a clinometer to measure the height of tall things that you can't possibly reach to the top of, flag poles, buildings, trees.

Ravish got a clinometer from school lab and started the measuring elevation angle in surrounding. He saw a building on which society logo is painted on wall of building.
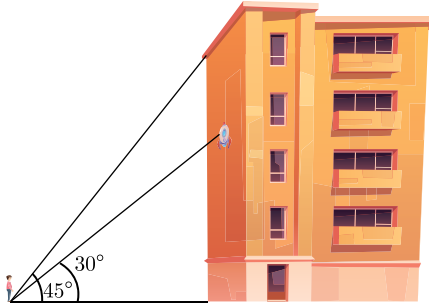
From a point P on the ground level, the angle of elevation of the roof of the building is $45°$. The angle of elevation of the centre of logo is $30°$ from same point. The point P is at a distance of 24 m from the base of the building.

On the basis of the above information, answer any four of the following questions:

(i) What is the height of the building logo from ground ?

    (a) $8\sqrt{2}$ m   (b) $4\sqrt{3}$ m m

    (c) $8\sqrt{3}$ m   (d) $4\sqrt{2}$ m

Ans :

The height of the building logo from ground is AB. Here C is top of building and AC is height of building.
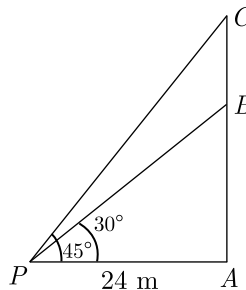
In ΔPAB, $\tan 30° = \dfrac{AB}{PA}$

$$\frac{1}{\sqrt{3}} = \frac{AB}{24}$$

$$AB = \frac{24}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} = 8\sqrt{3} \text{ m}$$

Thus (c) is correct option.

(ii) What is the height of the building from ground ?

    (a) $24(3-\sqrt{3})$ m   (b) $8(3-\sqrt{3})$ m

    (c) 24 m   (d) 32 m

Ans :

The height of the building from ground is AC.

In ΔAPC, $\tan 45° = \dfrac{AC}{AP}$

$$1 = \frac{AC}{24}$$

$$AC = 24 \, \text{m}$$

Thus (c) is correct option.

(iii) What is the aerial distance of the point P from the top of the building (Hint PC)?

(a) $24\sqrt{3}$ m
(b) $24\sqrt{2}$ m

(c) $32\sqrt{3}$ m
(d) $32\sqrt{2}$ m

Ans :

In $\triangle APC$, $\cos 45° = \dfrac{AP}{AC}$

$$\dfrac{1}{\sqrt{2}} = \dfrac{24}{PC}$$

$$PC = 24\sqrt{2} \, \text{m}$$

Thus (b) is correct option.

(iv) If the point of observation P is moved 9 m towards the base of the building, then the angle of elevation θ of the logo on building is given by

(a) $\tan\theta = \sqrt{3}$
(b) $\tan\theta = \dfrac{2}{\sqrt{3}}$

(c) $\tan\theta = \dfrac{1}{2}$
(d) $\tan\theta = \dfrac{8\sqrt{3}}{15}$

Ans :

$$\tan\theta = \dfrac{AB}{AP} = \dfrac{8\sqrt{3}}{24-9} = \dfrac{8\sqrt{3}}{15}$$

Thus (d) is correct option.

(v) In above case the angle of elevation ϕ of the top of building is given by

(a) $\tan\phi = 1.6$
(b) $\tan\phi = 1.5$

(c) $\tan\phi = 0.75$
(d) $\tan\phi = 0.8$

Ans :

$$\tan\phi = \dfrac{AC}{AP} = \dfrac{24}{24-9} = \dfrac{8}{5} = 1.6$$

Thus (a) is correct option.

34. In a toys manufacturing company, wooden parts are assembled and painted to prepare a toy. For the wood processing activity center, the wood is taken out of storage to be sawed, after which it undergoes rough polishing, then is cut, drilled and has holes punched in it. It is then fine polished using sandpaper. For the retail packaging and delivery activity center, the

polished wood sub-parts are assembled together, then decorated using paint.
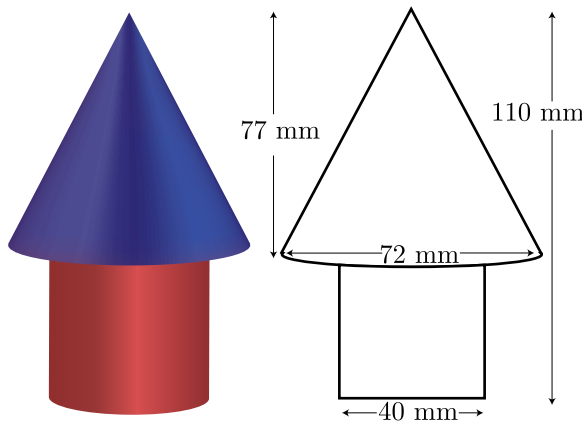
One specific toy is in the shape of a cone mounted on a cylinder. The total height of the toy is 110 mm and the height of its conical part is 77 mm. The diameters of the base of the conical part is 72 mm and that of the cylindrical part is 40 mm.

On the basis of the above information, answer any four of the following questions:

(i) If its cylindrical part is to be painted red, the surface area need to be painted is

(a) 2320π mm^2 (b) 1120π mm^2

(c) 1320π mm^2 (d) 1720π mm^2

Ans :

Radius of cylindrical part, $r_{cy} = \frac{40}{2} = 20$ mm

Height of cylindrical part,

$$h_{cy} = 110 - 77 = 33 \text{ mm}$$

$$\text{C.S.A. of cylinder} = 2\pi r_{cy} h_{cy} + \pi r_{cy}^2$$

$$= \pi r_{cy}(2h_{cy} + r_{cy})$$

$$= 20\pi(2 \times 33 + 20)$$

$$= 1720\pi \text{ mm}^2$$

Thus (d) is correct option.

(ii) If its conical part is to be painted blue, the surface area need to be painted is

(a) 4328π mm^2 (b) 1124π mm^2

(c) 3956π mm^2 (d) 3528π mm^2

Ans :

C.S.A. of conical part,

$$\pi r_{co} l_{co} + \pi r_{co}^2 - \pi r_{cy}^2 = \pi r_{co}\sqrt{h_{co}^2 + r_{co}^2} + \pi(r_{co}^2 - r_{cy}^2) = \pi[r_{co}\sqrt{h_{co}^2 + r_{co}^2} + (r_{co}^2 - r_{cy}^2)]$$

$$= \pi[36\sqrt{77^2 + 36^2} + (36^2 - 20^2)] = \pi[36 \times 85 + (36^2 - 20^2)]$$

$$= \pi(3060 + 1296 - 400) = 3956\pi \text{ mm}^2$$

Thus (c) is correct option.

(iii) How much of the wood have been used in making   the toy ?

(a) 56824π mm^3 (b) 46464π mm^3

(c) 84424π mm^3 (d) 64684π mm^3

Ans :

Volume of toy $=$ Volume of cone $+$ Volume of cylinder

$$= \frac{1}{3}\pi r_{co}^2 h_{co} + \pi r_{cy}^2 h_{cy} = \pi\left(\frac{1}{3}\times 36 \times 36 \times 77 + 20 \times 20 \times 33\right)$$

$$= 48\pi(9 \times 77 + 5 \times 5 \times 11) = 46464\pi \text{ mm}^3$$

Thus (b) is correct option.

(iv) If the cost of painting the toy is 2 paise for 8π mm^2, then what is the cost of painting of a box of 100 toys?

(a) 1598 Rs   (b)   2558 Rs

(c) 1419 Rs   (d)   1894 Rs

Ans :

Surface area $=$ S.A. of cone $+$ S.A. of cylinder

$$= 3956\pi + 1720\pi = 5676 \text{ mm}^2$$

Cost of painting is 2 paise for 8π mm^2, thus cost of painting of 1 mm^2 is $\frac{2}{8\pi}$ paise.
Hence cost of painting of a toy of 3956π mm^2,

$$= \frac{2}{8\pi}\times 5676\pi = 1419 \text{ paise}$$

Cost of painting of 100 toys,

$$= 1419 \times 100 = 141900 \text{ paise } = 1419 \text{ Rs}$$

Thus (c) is correct option.

(v) If the toy manufacturer company charge 3 paise for 32π mm^3 of wood, what is the price of a box of 100 toys?

(a) 4356 Rs   (b)   4698 Rs

(c) 4178 Rs   (d)   4898 Rs

Ans :

Cost of toy is 3 paise for 32π mm^3 of wood, thus cost of wood of 1 mm^3 is $\frac{3}{32\pi}$ paise.
Hence cost of a toy of 46464π mm^3,

$$= \frac{3}{32\pi}\times 46464\pi = 4356 \text{ paise}$$

Cost of box of 100 toys,

$$= 4356 \times 100 = 435600 \text{ paise } = 4356 \text{ Rs}$$

Thus (a) is correct option.

35. Underground water tank is popular in India. It is usually used for large water tank storage and can be built cheaply using cement-like materials. Underground water tanks are typically chosen by people who want to save space. The water in the underground tank is not affected by extreme weather conditions. The underground tanks maintain cool temperatures in both winter and summer. Electric pump is used to move water from the underground tank to

overhead tank.
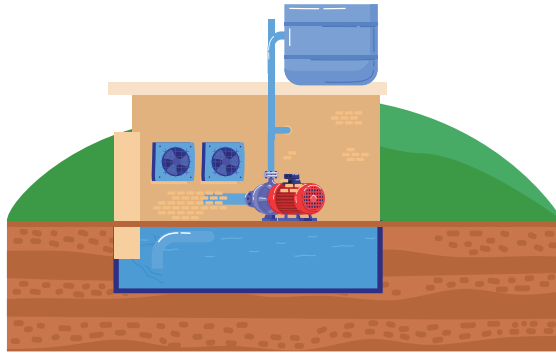
Ramesh has build recently his house ans installed a underground tank and overhead tank. Dimensions of tanks are as follows :

Underground Tank : Base $2\,\text{m} \times 2\,\text{m}$ and Height 1.1 m.

Overhead tank : Radius 50 cm and Height 175 cm

On the basis of the above information, answer the following questions:

(i) What is the capacity of the sump ?

    (a) 2200 litres   (b) 44000 litres

    (c) 4400 litres   (d) 22000 litres

Ans :

Volume of sump,

$$lbh \ = 2 \times 2 \times 1.1 = 4.4 \ \ \text{m}^3$$

Since $1 \ \text{m}^3$ is equal to 1000 litres,

$$4.4 \ \text{m}^3 \ = 4.4 \times 1000 = 4400 \ \ \text{litres}$$

Thus (c) is correct option.

(ii) What is the ratio of the capacity of the sump to the capacity of the overhead tank?

    (a) 1.75   (b) 1.25

    (c) 2.5   (d) 3.2

Ans :

Radius of overhead is 50 cm i.e. $\frac{1}{2}$ meter and height is 175 cm i.e $1.75 = \frac{7}{4}$ metre.

Thus volume of overhead tank,

$$\pi r^2 h_{cy} \ = \frac{22}{7} \times \frac{1}{2} \times \frac{1}{2} \times \frac{7}{4} = \frac{11}{8} \ \text{m}^3$$

$$\frac{\text{Capacity of sump}}{\text{Capacity of Overhead tank}} \ = \frac{lbh}{\pi r^2 h_{cy}} \ = \frac{4.4}{\frac{11}{8}} \ = 3.2$$

Thus (d) is correct option.

(iii) If curved part of overhead tank need to be painted to save it from corrosion, how much area need to be painted?

    (a) $5.5 \ \text{m}^2$ (b) $3.3 \ \text{m}^2$

    (c) $2.5 \ \text{m}^2$ (d) $4.5 \ \text{m}^2$

Ans :

C.S.A. of cylindrical tank

$$2\pi r h_{cy} = 2 \times \frac{22}{7} \times \frac{1}{2} \times \frac{7}{4} = 5.5 \,\text{m}^2$$

Thus (a) is correct option.

(iv) If water is filled in the overhead tank at the rate of 11 litre per minute, the tank will be completely filled in how many time?

(a) 65 minutes   (b) 62.5 minutes

(c) 130 minutes   (d) 125 minutes

Ans :

Volume of water in cylindrical tank is $\frac{11}{8}\,\text{m}^3$.

$$\frac{11}{8}\,\text{m}^3 = \frac{11}{8} \times 1000 \text{ litres}$$

Thus time taken to fill tank,

$$= \frac{11}{8} \times 1000 \times \frac{1}{11} = 125 \text{ minutes}$$

Thus (d) is correct option.

(v) If the amount of water in the sump, at an instant, is 2400 litres , then the water level in the sump at that instant is

(a) 60 cm   (b) 69.3 cm

(c) 70 cm   (d) 60.9 cm

Ans :

Volume of water in sump $= 2400$ litres $= 2.4\,\text{m}^3$

Then, $\qquad\qquad V = lbh_1$

$$2 \times 2 \times h_1 = 2.4$$

$$h_1 = \frac{2.4}{2 \times 2} = 0.6\,\text{m}$$

Thus (a) is correct option.

36. Mr. Colin is a Navy officer who is tasked with planning a coup on the enemy at a certain date. Currently he is inspecting the area standing on top of the cliff. Agent Dev is on a chopper in the sky. When Mr. Colin looks down below the cliff towards the sea, he has Bhawani and Amar in boats positioned to get a good vantage point. Bhawani boat is behind the Amar boat.
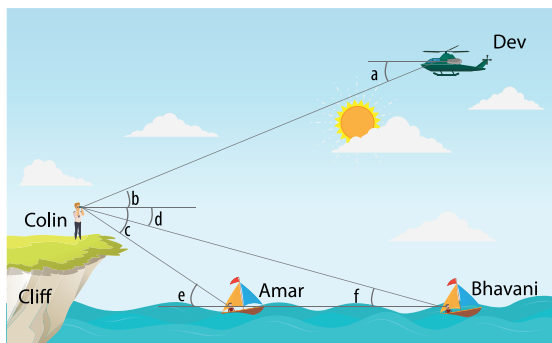
Following angle have been measured :

From Colin to Bhawani : 30°
From Dev to Colin : 60°
From Amar to Colin : 60°

On the basis of the above information, answer any four of the following questions:
(i) Which of the following is a pair of angle of elevation?

(a) $(\angle a°, \angle e°)$ (b) $(\angle b°, \angle e°)$

(c) $(\angle c°, \angle d°)$ (d) $(\angle a°, \angle f°)$

Ans :

The angle of elevation of an object as seen by an observer is the angle between the horizontal and the line from the object to the observer's eye (the line of sight). In our case clearly $(\angle b°, \angle e°)$ are angle of depression.

Thus (b) is correct option.

(ii) Which of the following is a pair of angle of depression?

(a) $(\angle a°, \angle e°)$ (b) $(\angle b°, \angle e°)$

(c) $(\angle c°, \angle d°)$ (d) $(\angle a°, \angle f°)$

Ans :

If the object is below the level of the observer, then the angle between the horizontal and the observer's line of sight is called the angle of depression.
In our case clearly $(\angle c°, \angle d°)$ are angle of depression.

Thus (c) is correct option.

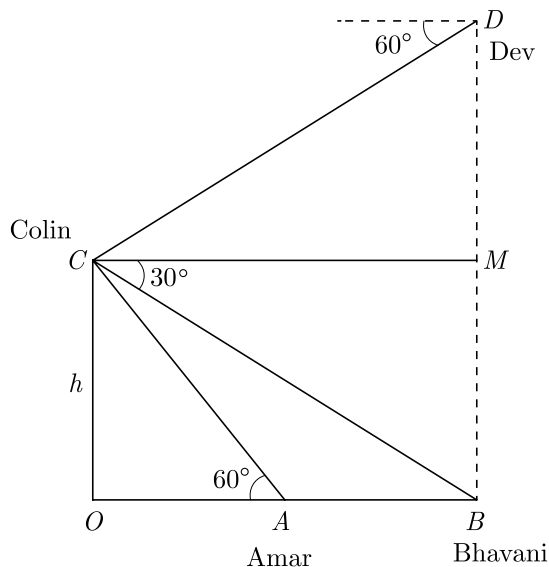(iii) If angle of elevation of Amar to Colin is 60°, what is the distance of Amar boat from the base of hill ?

(a) $\dfrac{\sqrt{3}\, h}{2}$ (b) $\dfrac{h}{\sqrt{3}}$

(c) $\dfrac{2h}{\sqrt{3}}$ (d) $\sqrt{3}\, h$

Ans :

We make the figure as below.
Here $\angle OAC = 60°$ is angle of elevation.

$$\frac{h}{OA} = \tan 60° = \sqrt{3}$$

$$OA = \frac{h}{\sqrt{3}}$$

Thus (b) is correct option.

(iv) If angle of depression of Colin to Bhawani is $30°$, what is the distance of Amar boat from the Bhawani boat?

(a) $\dfrac{\sqrt{3}\,h}{2}$ (b) $\dfrac{h}{\sqrt{3}}$

(c) $\dfrac{2h}{\sqrt{3}}$ (d) $\sqrt{3}\,h$

Ans :

Here $\angle OBC = \angle MCB = 30°$

$$\frac{h}{OB} = \tan 30° = \frac{1}{\sqrt{3}}$$

$$OB = \sqrt{3}\,h$$

$$AB = OB - OA = \sqrt{3}\,h - \frac{h}{\sqrt{3}} = \frac{1}{\sqrt{3}}(3h - h) = \frac{2h}{\sqrt{3}}$$

Thus (c) is correct option.

(v) If angle of depression of Dev to Colin is $60°$, what is the height of Dev from base of hill?

(a) h (b) $2h$

(c) $3h$ (d) $4h$

Ans :

Here $\angle DCM = 60°$

Now, $\dfrac{DM}{CM} = \tan 60° = \sqrt{3}$

$$DM = \sqrt{3}\,CM$$

But $CM = OB = \sqrt{3}\,h$

Thus $DM = \sqrt{3} \cdot \sqrt{3}\,h = 3h$

Height of Dev from Bhawani,

$$= DB = DM + MB = 3h + h = 4h$$

Thus (d) is correct option.

37. The Prime Minister's Citizen Assistance and Relief in Emergency Situations Fund was created on 28 March 2020, following the COVID-19 pandemic in India. The fund will be used for combating, and containment and relief efforts against the coronavirus outbreak and

similar pandemic like situations in the future.

The allotment officer is trying to come up with a method to calculate fair division of funds across various affected families so that the fund amount and amount received per family can be easily adjusted based on daily revised numbers.

The total fund allotted is formulated by the officer is

$x^3 + 6x^2 + 20x + 9$. The officer has also divided the fund equally among families of the village and each family receives an amount of $x^2 + 2x + 2$. After distribution, an amount of $10x + 1$ is left.

On the basis of the above information, answer any four of the following questions:

(i) How many families are there in the village?

    (a) $x + 4$ (b) $x - 3$

    (c) $x - 4$ (d) $x + 3$

Ans :

To get number of families we divide $x^3 + 6x^2 + 20x + 9$ by $x^2 + 2x + 2$.

$$
\begin{array}{r}
x + 4 \\
x^2 + 2x + 2 \overline{)\, x^3 + 6x^2 + 20x + 9} \\
\underline{x^3 + 2x^2 + 2x} \\
4x^2 + 18x + 9 \\
\underline{4x^2 + 8x + 8} \\
10x + 1
\end{array}
$$

Number of families are $x + 4$.

Thus (a) is correct option.

(ii) If an amount of ₹ 1911 is left after distribution, what is value of x?

    (a) 190   (b)   290

    (c) 191   (d)   291

Ans :

$$\text{Amount left} = 10x + 1$$

$$10x + 1 = 1911$$

$$x = \frac{1910}{10} = 191$$

Thus (c) is correct option.

(iii) How much amount does each family receive?

(a) 24490   (b) 34860

(c) 22540   (d) 36865

Ans :

Since, $x = 191$, amount received by each family is

$$x^2 + 2x + 2 = (191)^2 + 2(191) + 2$$
$$= 36865$$

Thus (d) is correct option.

(iv) What is the amount of fund allocated?

(a) Rs 72 72 759   (b) Rs 75 72 681

(c) Rs 69 72 846   (d) Rs 82 74 888

Ans :

Since $x = 191$, allotted fund,

$$x^3 + 6x^2 + 20x + 9 = (x^2 + 2x + 2)(x + 4) + 10x + 1$$
$$= 36865(191 + 4) + 1911 = 69,72,846$$

Thus (c) is correct option.

(v) How many families are there in the village?
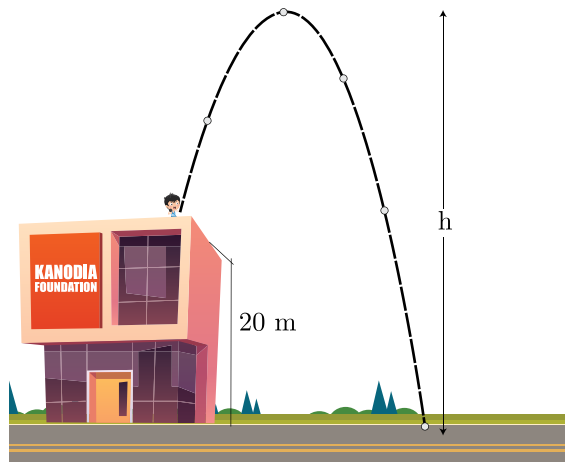
(a) 191   (b) 98

(c) 187   (d) 195

Ans :

No. of families $= x + 4 = 191 + 4 = 195$

Thus (d) is correct option.

38. Lavanya throws a ball upwards, from a rooftop, which is 20 m above from ground. It will reach a maximum height and then fall back to the ground. The height of the ball from the ground at time t is h, which is given by $h = -4t^2 + 16t + 20$.

On the basis of the above information, answer any four of the following questions:

(i) What is the height reached by the ball after 1 second?

    (a) 64 m   (b)   128 m

    (c) 32 m   (d)   20 m

Ans :

Height is given by,

$$h = -4t^2 + 16t + 20$$

At $t = 1$ second,

$$h = -4(1)^2 + 16(1) + 20 = 32 \text{ m}$$

Thus (c) is correct option.

(ii) What is the maximum height reached by the ball?

    (a) 54 m   (b)   44 m

    (c) 36 m   (d)   18 m

Ans :

Rearranging the given equation, by completing the square,

$$h = -4(t^2 - 4t - 5) = -4(t^2 - 4t + 4 - 4 - 5)$$

$$= -4[(t-2)^2 - 9] = -4(t-2)^2 + 36$$

Height is maximum, at $t = 2$, thus

$$h_{\max} = 0 + 36 = 36 \text{ m}$$

Thus (c) is correct option.

(iii) How long will the ball take to hit the ground?

    (a) 4 seconds   (b) 3 seconds

    (c) 5 seconds   (d) 6 seconds

Ans :

When ball hits the ground, $h = 0$, thus

$$-4t^2 + 16t + 20 = 0$$

$$t^2 - 4t - 5 = 0$$

$$(t-5)(t+1) = 0$$

Thus $t = 5$ or $t = -1$. Since, time cannot be negative, the $t = 5$ seconds is correct answer.

Thus (c) is correct option.

(iv) What are the two possible times to reach the ball at the same height of 32 m?

    (a) 1 and 3 seconds   (b) 1.5 and 2.5 seconds

    (c) 0.5 and 2.5 seconds   (d) 1.6 and 2.6 seconds

Ans :

Since,
$$h = -4t^2 + 16t^2 + 20$$

$$32 = -4t^2 + 16t^2 + 20$$

$$8 = -t^2 + 4t^2 + 5$$

$$t^2 - 4t + 3 = 0$$

$$t^2 + 3t - t + 3 = 0$$

$$(t-1)(t-3) = 0 \Rightarrow t = 3, 1$$

Thus (a) is correct option.

(v) Where is the ball after 5 seconds ?

    (a) at the ground   (b) rebounds

   (c) at highest point   (d) fall back

Ans :

From (iii) at $t = 5$ we have $h = 0$. Thus it will hit ground, then after that ball will rebound.

Thus (b) is correct option.

39. Tower cranes are a common fixture at any major construction site. They're pretty hard to miss -- they often rise hundreds of feet into the air, and can reach out just as far. The construction crew uses the tower crane to lift steel, concrete, large tools like acetylene torches and generators, and a wide variety of other building materials.
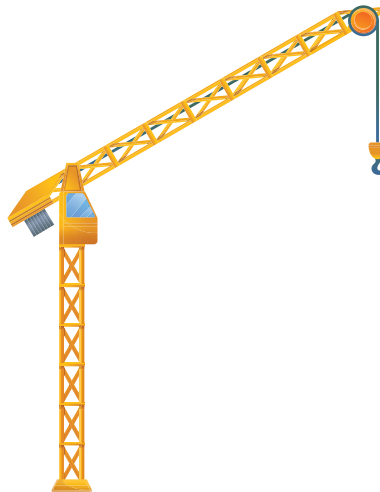
A crane stands on a level ground. It is represented by a tower AB, of height 11 m and a jib BR. The jib is of length 20 m and can rotate in a vertical plane about B. A vertical cable, RS, carries a load S. The diagram shows current position of the jib, cable and load.
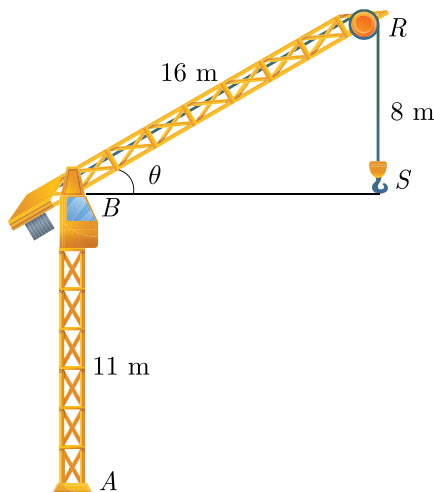
On the basis of the above information, answer any four of the following questions:
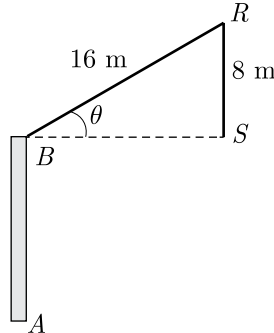
(i) What is the length BS?

(a) $8\sqrt{3}$ m

(b) $4\sqrt{3}$ m

(c) $4\sqrt{2}$ m

(d) $8\sqrt{2}$ m

Ans :

As per information given in question we make the diagram as below.

$$16^2 = 8^2 + BS^2$$

$$BS = \sqrt{16^2 - 8^2} = 8\sqrt{3}$$

Thus (a) is correct option.

(ii) What is the angle that the jib, BR, makes with the horizontal ?

(a) $45°$

(b) $30°$

(c) $60°$

(d) $75°$

Ans :

Let jib make θ with horizontal.

Now, $\sin\theta = \frac{8}{16} = \frac{1}{2} = \sin 30°$

Thus $\theta = 30°$

Thus (b) is correct option.

(iii) What is the measure of the angle BRS?

(a) $60°$

(b) $75°$

(c) $30°$

(d) $45°$

Ans :

$$\theta + 90° + \angle BRS = 180°$$

$$30° + 90° + \angle BSR = 180°$$

$$\angle BSR = 180° - 30° - 90° = 60°$$

Thus (c) is correct option.

(iv) Now the jib BR, has been rotated and the length RS is increased. The load is now on the ground at a point 8 m from A. What is the angle through which the jib has been rotated ?
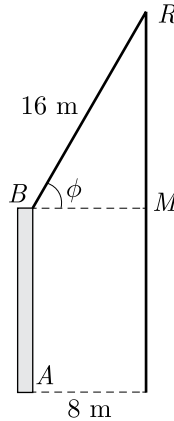
(a) $15°$

(b) $25°$

(c) 30°   (d) 45°

Ans :

We make the digram as below on the information given.

$$\cos\phi \;=\; \frac{8}{16} = \frac{1}{2} \;=\; \cos 60°$$

$$\theta \;=\; 60°$$

$$\phi - \theta \;=\; 60° - 30° = 30°$$

Thus (c) is correct option.

(v) What is the length by which RS has been increased?

    (a) $8\sqrt{3}$ m   (b) $8(\sqrt{3}+1)$ m

    (c) $8(\sqrt{2}+1)$ m   (d) $8(\sqrt{3}+2)$ m

Ans :

$$RT \;=\; 16^2 - 8^2 = 8\sqrt{3}$$

$$RS \;=\; 8\sqrt{3} + 24$$

Increase in length $= 8\sqrt{3} + 24 - 8 = 8\sqrt{3} + 16 = 8(\sqrt{3}+2)$

Thus (c) is correct option.

40. A barn is an agricultural building usually on farms and used for various purposes. In the North American area, a barn refers to structures that house livestock, including cattle and horses, as well as equipment and fodder, and often grain.
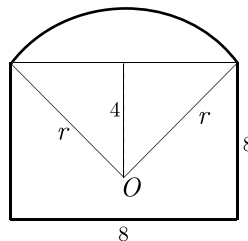
Ramkaran want to build a barn at his farm. He has make a design for it which is above. Here roof is arc of a circle of radius r at centre O.

On the basis of the above information, answer any four of the following questions:

(i) What is the value of radius of arc ?

   (a) $4\sqrt{3}$ m   (b) $4\sqrt{2}$ m

   (c) $4\sqrt{3}$ m   (d) $2\sqrt{2}$ m

Ans :

We redraw the cross section of barn as shown below.
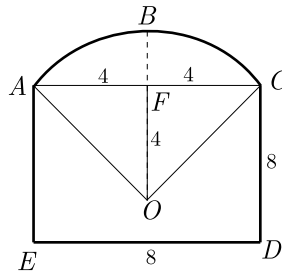
In right triangle $\Delta\,AFO$,

$$AO = \sqrt{AF^2 + FO^2}$$
$$= \sqrt{4^2 + 4^2} = 4\sqrt{2} \text{ m}$$

Thus $AO = 4\sqrt{2}$ which is also radius of curved arc.

(ii) What is the length of BF ?

   (a) $4(\sqrt{3}+1)$ (b) $4(\sqrt{2}+1)$

   (c) $4(\sqrt{3}-1)$ (d) $4(\sqrt{2}-1)$

Ans :

$$BF = BO - FO = r - 4 = 4\sqrt{2} - 4 = 4(\sqrt{2}-1)\,\text{m}$$

(iii) What is the value of angle $\angle AOC$?

   (a) $30°$ (b) $90°$

   (c) $45°$ (d) $60°$

Ans :

In right angle triangle $\Delta\,AFO$ is also isosceles triangle

Thus, $\angle FAO = \angle FOA = 45°$

Similarly, $\angle FOC = 45°$

Thus $\angle AOC = \angle AOF + \angle FOC = 45° + 45° = 90°$

(iv) What is the curved width of roof ?

   (a) $2\pi\sqrt{3}$ m   (b) $4\pi\sqrt{2}$ m

   (c) $2\pi\sqrt{2}$ m   (d) $4\pi\sqrt{3}$ m

Ans :

Curved width

$$\frac{2\pi r\theta}{360°} = \frac{2\pi \times 4\sqrt{2} \times 90°}{360°} = 2\pi\sqrt{2} \text{ m}$$

(v) What is area of cross section of barn ?

   (a) $8(6+\pi)\,\text{m}^2$ (b) $4(6+\pi)\,\text{m}^2$

   (c) $8(3+\pi)\,\text{m}^2$ (d) $4(3+\pi)\,\text{m}^2$

Ans :

Area of cross section

= Area of $AECD$ + Area of section $ABCO$ − Area of triangle ACO

$$= 8 \times 8 + \frac{\pi(4\sqrt{2})^2 \times 90°}{360°} - \frac{1}{2} \times 4 \times 8$$

$$= 64 + 8\pi - 16 = 48 + 8\pi = 8(6 + \pi)$$

41. Apples are most widely planted and are commercially the most important fruit crop in Jammu and Kashmir. The cultivation of apple crop in Jammu and Kashmir shows particular interest for a number of reasons. In terms of both area and production, apple is very beneficial fruit crop. This provides a major source of income and employment in Jammu and Kashmir.

Horticultural department has tasked their statistical officer to create a model for farmers to be able to predict their produce output based on various factors.

A box containing 250 apples was opened and each apple was weighed. The distribution of the masses of the apples is given in the following table:

Mass (in grams)	80-100	100-120	120-140	140-160	160-180
Frequency	20	60	70	x	60

On the basis of the above information, answer any four of the following questions:

(i) How many apples are in the range 140-160 mass ?

    (a) 40   (b) 50

    (c) 60   (d) 70

Ans :

$$20 + 60 + 70 + x + 60 = 250$$

$$210 + x = 250$$

$$x = 250 - 210 = 40$$

Thus (a) is correct option.

(ii) What is the mean mass of the apples?

    (a) 131 grams   (b) 135 grams

    (c) 150 grams   (d) 156 grams

Ans :

We prepare following cumulative frequency distribution table.

Mass	f_i	c.f.	x_i	$f_i x_i$
80-100	20	20	90	1800
100-120	60	80	110	6600
120-140	70	150	130	9100
140-160	40	190	150	6000
160-180	60	250	170	10200
	$\sum f_i = 250$			$\sum f_i x_i = 33700$

$$M = \frac{\sum f x_i}{x_i} = \frac{33700}{250} = 134.8 \text{ gm}$$

Thus (b) is correct option.

(iii) What is the upper limit of the median class?

   (a) 80   (b) 100

   (c) 120   (d) 140

Ans :

Cumulative frequency just greater than $\frac{N}{2} = \frac{250}{2} = 125$ is 150 and the corresponding class is 120-140. Thus median class is 120-140 and upper limit is 140.

Thus (d) is correct option.

(iv) What is the modal mass of the apples?

   (a) 122 grams   (b) 125 grams

   (c) 128 grams   (d) 132 grams

Ans :

Class 120-140 has the maximum frequency 70, therefore this is model class.

Here, $l = 120$, $f_1 = 70$, $f_0 = 60$, $f_2 = 60$ and $h = 20$

Mode, $M_o = l + h\left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2}\right)$

$$= 120 + \frac{70 - 60}{2 \times 70 - 60 - 40} \times 20$$

$$= 120 + \frac{20}{40} \times 10 = 125$$

Thus (b) is correct option.

(v) What is the median mass of the apples?

   (a) 122.33 grams   (b) 128.67 grams

   (c) 131.67 grams   (d) 136.33 grams

Ans :

Now $3M_d = M_o + 2M$

$$3M_d = 125 + 2 \times 135 = 395$$

$$M_d = \frac{395}{3} = 131.67 \text{ grams}$$

Thus (c) is correct option.

42. Formula one Portugese Grand Prix technical team at the Algarve International Circuit are analysing last year data of drivers' performance to provide valuable inferences to commentators on how the drivers can improve this year.

The length of time taken by 80 drivers to complete a journey is given in the table below:

Times (in minutes)

Times (in minutes)	70-80	80-90	90-100	100-110	110-120	120-130
Number of drivers	4	10	14	20	24	8

On the basis of the above information, answer any four of the following questions:

(i) What is the estimate of the mean time (in minutes) taken to complete the journey ?

    (a) 105   (b)   94

    (c) 101   (d)   112

Ans :

We prepare the following table :

C.I.	f_i	c.f.	x_i	$f_i x_i$
70-80	4	4	75	350
80-90	10	14	85	850
90-100	14	28	95	1330
100-110	20	48	105	2100
110-120	24	72	115	2760
120-130	8	80	125	1000
	$\sum f_i = 80$			$\sum f_i x_i = 8390$

$$M = \frac{\sum f_i x_i}{\sum f_i} = \frac{8390}{80} = 104.875$$

Thus (a) is correct option.

(ii) In which interval does the median of the distribution lie?

    (a) 80-90   (b) 90-100

    (c) 100-110   (d) 110-120

Ans :

Cumulative frequency just greater than $\frac{N}{2} = \frac{80}{2} = 40$ is 48 and the corresponding class is 100-110. Thus median class is 100-110.

Thus (c) is correct option.

(iii) In which interval does the mode of the distribution lie?

    (a) 80-90   (b) 90-100

    (c) 100-110   (d) 110-120

Ans :

Class 110-120 has the maximum frequency 24, therefore this is model class.

Thus (d) is correct option.

(iv) What is the model time taken to complete journey ?

    (a) 112   (b) 118

    (c) 101   (d) 108

Ans :

Here, $l = 110$, $f_1 = 24$, $f_0 = 20$, $f_2 = 8$ and $h = 10$

Mode, $\qquad M_o = l + h\left(\dfrac{f_1 - f_0}{2f_1 - f_0 - f_2}\right) = 110 + \dfrac{24 - 20}{2 \times 24 - 20 - 8} \times 10$

$\qquad\qquad\qquad = 110 + \dfrac{4}{20} \times 10 = 112$

Thus (d) is correct option.

(v) What is the median time taken to complete journey ?

    (a) 107   (b) 118

    (c) 98   (d) 103

Ans :

Now $\qquad\qquad 3M_d = M_o + 2M = 112 + 2 \times 104.875 = 321.75$

$\qquad\qquad M_d = \dfrac{321.75}{3} = 107.25$

Thus (a) is correct option.

43. The tunnels are defined as the underground passages that are used for the transportation purposes. These permit the transmission of passengers and freights, or it may be for the transportation of utilities like water, sewage or gas etc. The tunnel engineering is one of the most interesting disciplines in engineering. The work is complex and difficult throughout its course, even though it is interesting.

Earth is excavated to make a road tunnel. The tunnel is a cylinder of radius 7 m and length 450 m.

A level surface is laid inside the tunnel to make road. The Diagram 1 shows the circular cross - section of the tunnel. The level surface is represented by AB, the centre of the circle is O and $\angle AOB = 90°$. The space below AB is filled with rubble (debris from the demolition buildings).
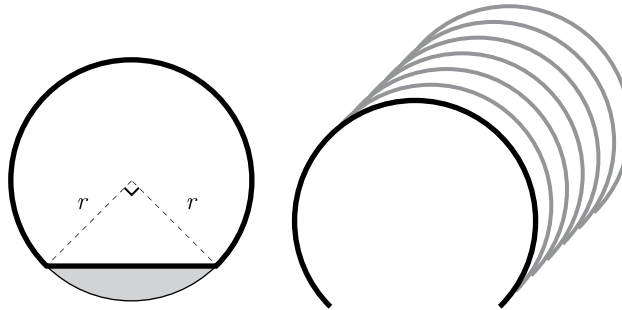
Steel girders are erected above the tracks to strengthen the tunnel. Some of these are shown in Diagram 2. The girders are erected at 6 m intervals along the length of the tunnel, with one at each end.

On the basis of the above information, answer any four of the following questions:

(i) What is the cross section area of tunnel before filling debris on ground plane ?

(a) 154 m²   (b) 140 m²

(c) 155 m²   (d) 145 m²

Ans :

Cross section area of tunnel before filling debris on ground plane,

$$\pi r^2 = \frac{22}{7} \times 7 \times 7 = 154 \ \text{m}^2$$

Thus (a) is correct option.

(ii) What is the area of cross section of tunnel after filling debris on ground plane?

(a) 138 m²   (b) 140 m²

(c) 152 m²   (d) 145 m²

Ans :

The geometry of cross-section is shown below.
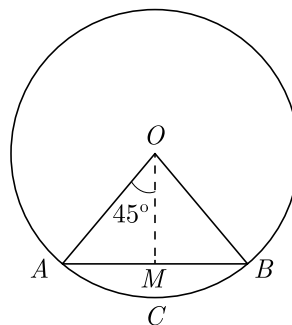
Triangle OAB is isosceles triangle having right angle at O.

Thus area of $\triangle AOB = \frac{r^2}{2}$

Area of circular section $OACB$

$$= \frac{\pi r^2 \theta}{360°} = \frac{\pi r^2 90°}{360°} = \frac{\pi r^2}{4}$$

Area of cross section of tunnel,

$$= \text{Area of circle} - \text{Area } AMBC$$

$$= \text{Area of circle} - (\text{Area of } \Delta\, ACB - \text{Area of } \Delta\, OAB)$$

$$= \pi r^2 - \left(\frac{\pi r^2}{4} - \frac{r^2}{2}\right) = \frac{3\pi r^2}{4} + \frac{r^2}{2} = \frac{r^2}{4}(3\pi + 2)$$

$$= \frac{7 \times 7}{4}\left(\frac{3 \times 22}{7} + 2\right) = 140\,\text{m}^2$$

Thus (b) is correct option.

(iii) What is the length of each girder ?

    (a) 11 m   (b)   22 m

    (c) 33 m   (d)   44 m

Ans :

Length of each girder is length of curved part of cross-section,

$$= \frac{2\pi r(360^\circ - 90^\circ)}{360^\circ} = \frac{2 \times \frac{22}{7} \times 7(360^\circ - 90^\circ)}{360^\circ}$$

$$= \frac{2 \times 22 \times 270^\circ}{360^\circ} = 33\,\text{m}$$

Thus (c) is correct option.

(iv) How many girders are erected ?

    (a) 76   (b) 75

    (c) 74   (d) 73

Ans :

Since 1 girder is placed at every 6 m, total girder required,

$$= \frac{450}{6} + 1 = 75 + 1 = 76 \text{ girder}$$

Thus (a) is correct option.

(v) If the weight of 1 meter girder is 25 kg, how much steel is required ?

    (a) 2508 quintals   (b)   627 quintals

    (c) 2246 quintals   (d)   1646 quintals

Ans :

Total requirement of girder $= 76 \times 33 = 2508$ meter

Total weight of girder $= 2508 \times 25 = 62700\,\text{kg} = 627$ quinte

Thus (b) is correct option.

44. Atal Tunnel (also known as Rohtang Tunnel) is a highway tunnel built under the Rohtang Pass in the eastern Pir Panjal range of the Himalayas on the Leh-Manali Highway in Himachal Pradesh, India. At a length of 9.02 km, it is the longest tunnel above 10,000 feet (3,048 m) in the world and is named after former Prime Minister of India, Atal Bihari Vajpayee. The tunnel reduces the travel time and overall distance between Manali and Keylong on the way to Leh. Moreover, the tunnel bypasses most of the sites that were prone to road blockades,

avalanches, and traffic snarls.

Earth is excavated to make a railway tunnel. The tunnel is a cylinder of radius 7 m and length 450 m. A level surface is laid inside the tunnel to carry the railway lines. The Diagram 1 shows the circular cross - section of the tunnel. The level surface is represented by AB, the centre of the circle is O and $\angle AOB = 90°$. The space below AB is filled with rubble (debris from the demolition buildings).
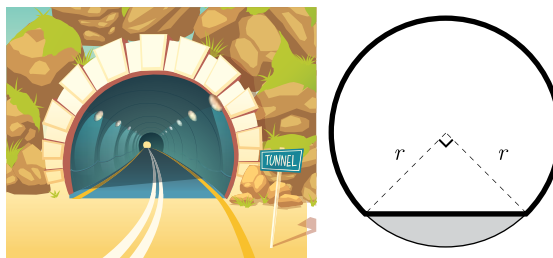
Steel girders are erected above the tracks to strengthen the tunnel. Some of these are shown in Diagram 2. The girders are erected at 6 m intervals along the length of the tunnel, with one at each end.

On the basis of the above information, answer any four of the following questions:

(i) How much volume of earth is removed to make the tunnel ?

    (a) 58700 m^3 (b)   61400 m^3

    (c)   62700 m^3 (d)   69300 m^3

Ans :

Cross-section area of tunnel to be excavated $= \pi r^2$

Volume of earth to be removed,

$$\pi r^2 l = \frac{22}{7} \times 7 \times 7 \times 450 = 69300 \, \text{m}^3$$

Thus (d) is correct option.

(ii) If the cost of excavation of 1 cubic meter is Rs 250, what is the total cost of excavation?

    (a) Rs 17325000   (b)   Rs 34650000

    (c) Rs 8662500   (d)   Rs 12677500

CASE STUDY QUESTIONS CLASS 10TH EXAM 2020-21   V1

Ans :

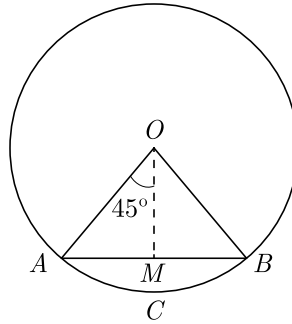Total cost of excavation $= 69300 \times 250 = ₹\,1732500$

Thus (a) is correct option.

(iii) A coating is to be done on the surface of inner curved part of tunnel. What is the area of tunnel to be being coated ?

    (a) 12300 m^2 (b) 14850 m^2

    (c) 15250 m^2 (d) 21200 m^2

Ans :

The geometry of cross-section is shown below.

Triangle OAB is isosceles triangle having right angle at O.

Length of each girder is length of curved part of cross-section,

$$= \frac{2\pi r(360° - 90°)}{360°} = \frac{2 \times \frac{22}{7} \times 7(360° - 90°)}{360°}$$

$$= \frac{2 \times 22 \times 270°}{360°} = 33\,\text{m}$$

Total curved surface area of tunnel

$$= \text{Length of curved part of cross-section} \times \text{Length of tunnel}$$

$$= 33 \times 450 = 14850\,\text{m}^2$$

Thus (b) is correct option.

(iv) Costing of coating is Rs 30 per m^2. What is the total cost of coating ?

    (a) Rs 5588000   (b) Rs 445500

    (c) Rs 339900   (d) Rs 228800

Ans :

(iv) Cost of coating on curved part,

$$= 14850 \times 30$$

$$= ₹\,445500$$

Thus (b) is correct option.

(v) How much volume of debris is required to fill the ground surface of tunnel ?

    (a) 3500 m^3 (b) 14000 m^3

    (c) 7000 m^3 (d) 10500 m^3

Ans :

Cross-section area of debris part of tunnel

$$= \text{Area of } OACB - \text{Area of } \Delta \, OAB$$

$$= \frac{\pi r^2}{4} - \frac{r^2}{2} = \frac{\frac{22}{7} \times 7 \times 7}{4} - \frac{7 \times 7}{2} = \frac{11 \times 7}{2} - \frac{7 \times 7}{2}$$

$$= \frac{4 \times 7}{2} = 14 \text{ m}^2$$

Volume of debris required $= 14 \times 500 = 7000 \text{ m}^3$
Thus (c) is correct option.

45. A bakery is an establishment that produces and sells flour-based food baked in an oven such as bread, cookies, cakes, pastries, and pies. Some retail bakeries are also categorized as cafés, serving coffee and tea to customers who wish to consume the baked goods on the premises.

Tania runs a bakery shop and her bakery is very famous for her tasty biscuits. The amount of mixture required to make one biscuit is 18 cu cm. Before it is cooked, the mixture is rolled into a sphere. After the biscuit is cooked, the biscuit becomes a cylinder of radius 3 cm and height 0.7 cm (The increase in volume is due to air being trapped in the biscuit) Biscuits are packed in a cylindrical card box of height 14 cm. The arrangement of biscuits is shown below

On the basis of the above information, answer any four of the following questions:
(i) What is the volume of the biscuits after it is cooked ?

    (a) 17.8 cu cm   (b) 18.7 cu cm

    (c) 19.8 cu cm   (d) 21.2 cu cm

Ans :

Volume of the biscuits,

$$= \pi r^2 h = \frac{22}{7} \times 3^2 \times 0.7 = 19.8 \text{ cu cm}$$

Thus (b) is correct option.

(ii) What is the volume of air trapped, while cooking the biscuit ?

    (a) 1.8 cu cm   (b) 0.7 cu cm

    (c) 1.5 cu cm   (d) 3.2 cu cm

Ans :

Volume of air trap

$=$ Volume of biscuit $-$ Volume of sphere

$= 19.8 - 18 = 1.8$ cu cm

Thus (a) is correct option.

(iii) How many biscuits will be there in a box ?

    (a) 120   (b)   70

    (c) 140   (d)   60

Ans : (c)

In a layer, 7 biscuits are arranged whose height is 0.7 cm.

Thus total layer in box,

$$= \frac{14}{0.7} = 20 \text{ layer}$$

Total biscuits in box $= 20 \times 7 = 140$ biscuits

Thus (c) is correct option.

(iv) How much space is vacant in box after biscuits are packed ?

    (a) 940 cm^3 (b) 792 cm^3

    (c) 846 cm^3 (d) 912 cm^3

Ans :

$$\text{Volume of box} = \pi R^2 H = \frac{22}{7} \times 9 \times 9 \times 14$$

$$= 22 \times 9 \times 9 \times 2 = 3564 \text{ cm}^3$$

$$\text{Volume of biscuits} = \pi r^2 h \times 140 = 19.8 \times 140 = 2772 \text{ cm}^3$$

$$\text{Vacant volume} = 3564 - 2772 = 792 \text{ cm}^3$$

Thus (b) is correct option.

(v) If weight of 7 biscuits is 50 grams, what will be the weight of box of biscuits?

    (a) 750 gram   (b)   1.4 kg

    (c) 900 gram   (d)   1 kg

Ans :

Weight of 7 biscuits $= 50$ grams

$$\text{Weight of 140 biscuits} = \frac{50}{7} \times 140 = 1000 \text{ grams} = 1 \text{ kg}$$

Thus (d) is correct option.

46. The boiler is essentially a closed vessel inside which water is stored. Fuel (generally coal) is burnt in a furnace and hot gasses are produced. These hot gasses come in contact with water vessel where the heat of these hot gases transfer to the water and consequently steam is produced in the boiler. Then this steam is piped to the turbine of thermal power plant. There are many different types of boiler utilized for different purposes like running a production

unit, sanitizing some area, sterilizing equipment, to warm up the surroundings etc.

Rajesh has been given the task of designing a boiler for NTPC. Boiler consist of a cylindrical part in middle and two hemispherical part its both end. The cross section of boiler is given below. Length of cylindrical part is the 3 times of radius of hemispherical part.
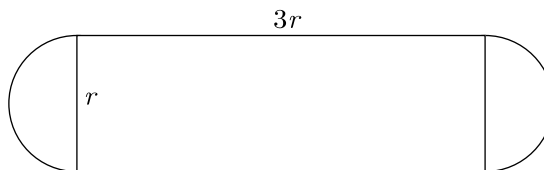
On the basis of the above information, answer any four of the following questions:

Ans :

(i) Which of the following is correct expression for the surface area of cylindrical part of Boiler?

(a) $2\pi r^2$ (b) $6\pi r^2$

(c) $4\pi r^2$ (d) $8\pi r^2$

Ans :

Radius of cylindrical part is equal to the radius of hemispherical part and length of cylindrical part is three times of radius.

Surface area of cylindrical part of boiler $= 2\pi rl$

Since, $l = 3r = 2\pi r \times 3r = 6\pi r^2$

Thus (b) is correct option.

(ii) Which of the following is correct expression for the total surface area of Boiler?

(a) $\dfrac{22}{3}\pi r^2$ (b) $\dfrac{11}{3}\pi r^2$

(c) $6\pi r^2$ (d) $10\pi r^2$

Ans :

Total surface area of boiler

= SA of cylindrical part + SA of two hemisphere

$$= 6\pi r^2 + 2\left(\frac{4\pi r^2}{2}\right) = 6\pi r^2 + 4\pi r^2 = 10\pi r^2$$

Thus (d) is correct option.

(iii) Which of the following is correct expression for the volumes of Boiler?

(a) $\dfrac{15}{4}\pi r^3$ (b) $\dfrac{19}{3}\pi r^3$

(c) $\frac{13}{3}\pi r^3$ (d) $\frac{17}{4}\pi r^3$

Ans :

Volume of boiler,

$=$ Volume of cylinder$+$ Volume of two hemisphere

$$= \pi r^2 l + 2\left(\frac{2\pi}{3} \times r^3\right) = \pi r^2 \cdot 3r + \frac{4\pi}{3} \times r^3 = \left(3 + \frac{4}{3}\right)\pi r^3 = \frac{13}{3}\pi r^3$$

Thus (c) is correct option.

(iv) What is the ratio of volume to the surface area?

(a) $\frac{13}{30}r$ (b) $\frac{3}{10}r$

(c) $\frac{10}{3}r$ (d) $\frac{3}{10}r$

Ans :

Ratio of volume to the surface$= \dfrac{\frac{13}{3}\pi r^3}{10\pi r^2} = \dfrac{13}{30}r$

Thus (a) is correct option.

(v) If $r = 3$ m, what is the volume of Boiler?

(a) 117π m^3 (b) 125π m^3

(c) 231π m^3 (d) 238π m^3

Ans :

At $r = 3$ m volume of boiler,

$$= \frac{13}{3}\pi r^3 = \frac{13}{3} \times \pi \times 3^3 = 13 \times \pi \times 9 = 117\pi \text{ m}^3$$

Thus (a) is correct option.

47. The advantages of cone bottom tanks are found in nearly every industry, especially where getting every last drop from the tank is important. This type of tank has excellent geometry for draining, especially with high solids content slurries as these cone tanks provide a better full-drain solution. The conical tank eliminates many of the problems that flat base tanks have as the base of the tank is sloped towards the centre giving the greatest possible full-

drain system in vertical tank design.

Rajesh has been given the task of designing a conical bottom tank for his client. Height of conical part is equal to its radius. Length of cylindrical part is the 3 times of its radius. Tank is closed from top. The cross section of conical tank is given below.
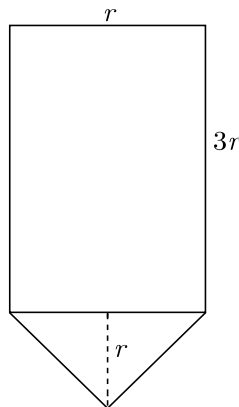
Ans :

On the basis of the above information, answer any four of the following questions:

(i) If radius of cylindrical part is taken as 3 meter, what is the volume of above conical tank ?

    (a) 120π m³   (b) 90π m³

    (c) 60π m³   (d) 30π m³

Ans :

Length of cylindrical part is three times of radius of conical part and height if conical part is equal to its radius.

If we assume r be the common radius of cylindrical part and conical part, height of conical part will be r and length of cylindrical part will be $3r$.

Volume of conical tank= Volume of cylindrical part + Volume of conical part

$$= \pi r^2 l + \frac{1}{3}\pi r^2 h = \pi r^2 \cdot 3r + \frac{1}{3}\pi r^2 \cdot r$$

$$= 3\pi r^3 + \frac{1}{3}\pi r^3 = \frac{10}{3}\pi r^3$$

$$= \frac{10}{3}\pi (3)^3 = 90\,\pi\,\text{m}^3\ \text{m}^3$$

Thus (b) is correct option.

(ii) What is the area of metal sheet used to make this conical tank ? Assume that tank is covered from top.

(a) $27\,(7+\sqrt{2}\,)\pi$ 　　　　　　　(b) $9\,(7+\sqrt{2}\,)\pi$

(c) $27\,(5+\sqrt{2}\,)\pi$ 　　　　　　　(d) $9\,(5+\sqrt{2}\,)\pi$

Ans :

Surface area of tank,

$=$ SA of top $+$ CSA of cylinder $+$ CSA of cone

$$= \pi r^2 + 2\pi rl + \pi r\sqrt{h^2 + r^2}$$

$$= \pi r^2 + 2\pi r \cdot 3r + \pi r\sqrt{r^2 + r^2}$$

$$= \pi r^2 + 6\pi r^2 + \sqrt{2}\,\pi r^2 = (1+6+\sqrt{2}\,)\pi r^2 = (7+\sqrt{2}\,)\pi (3)^2$$

$$= 9\,(7+\sqrt{2}\,)\pi\,\text{m}^2$$

Thus (b) is correct option.

(iii) What is the ratio of volume of cylindrical part to the volume of conical part?

(a) 6 　　　　　　　　　　　　　　　(b) 9

(c) $\frac{1}{6}$ 　　　　　　　　　　　　　(d) 　$\frac{1}{9}$

Ans :

Volume of cylindrical part $= \pi r^2 l = \pi r^2 \cdot 3r = 3\pi r^3$

Volume of conical part $= \frac{1}{3}\pi r^2 h = \frac{1}{3}\pi r^2 r = \frac{1}{3}\pi r^3$

Ratio of volume of cylindrical part to conical part

$$= \frac{3\pi r^3}{\frac{1}{3}\pi r^3} = 9$$

Thus (b) is correct option.

(iv) The cost of metal sheet is Rs 2000 per square meter and fabrication cost is 1000 per square meter. What is the total cost of tank ?

(a) $27000\,(7+\sqrt{2}\,)\pi$ 　　　　　(b) $54000\,(7+\sqrt{2}\,)\pi$

(c) $27000\,(5+\sqrt{2}\,)\pi$ 　　　　　(d) $54000\,(5+\sqrt{2}\,)\pi$

Ans :

Surface area of sheet used $= 9\,(7+\sqrt{2}\,)\pi\,\text{m}^2$

Total cost $=$ Cost of sheet $+$ Fabrication cost

$$= 2000 + 1000 = 3000\ \text{per sq. meter}$$

Total cost of tank $= 9\,(7+\sqrt{2}\,)\pi \times 3000 = 27000\,(7+\sqrt{2}\,)\pi$

Thus (c) is correct option.

(v) A oil is to be filled in the tank. The density of oil is 1050 kg per cubic meter. What is the weight of oil filled in tank ?

(a) 195 Tonne   (b) 200 Tonne

(c) 297 Tonne   (d) 174 Tonne

Ans :

Volume of tank i.e. volume of oil $= 90\,\pi\,\mathrm{m}^3$

Density of oil $= 1050\,\mathrm{kg}$ per cubic meter

Weight of oil $= 90\pi \times 1050$

$$= 90 \times \frac{22}{7} \times 1050$$

$$= 90 \times 22 \times 150 = 297000\,\mathrm{kg} = 297\ \text{Tonne}$$

Thus (c) is correct option.

48. Kumbh Mela is a major pilgrimage and festival in Hinduism. It is celebrated in a cycle of approximately 12 years at four river-bank pilgrimage sites: the Prayagraj (Ganges-Yamuna Sarasvati rivers confluence), Haridwar (Ganges), Nashik (Godavari), and Ujjain (Shipra). The festival is marked by a ritual dip in the waters. The seekers believe that bathing in these rivers is a means to prayascitta for past mistakes, and that it cleanses them of their sins.

Government of UP is planing to procure tent for the pilgrims during Kumbh Mela. The specification of tent is given below.

(i) Lower cylindrical part must have a white colored thick fabric whose cost is ₹ 60 per square meter.

(ii) Top conical part must have PVC coated blue fabric whose cost is ₹ 70 per square meter.

The front viwe section of tent is given below with dimension
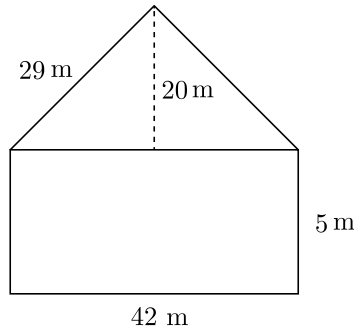
(i) How much white fabric is required ?
- (a) 2640 sq. meter
- (b) 1914 sq. meter
- (c) 1320 sq. meter
- (d) 3828 sq. meter

Ans :

Surface area of conical part of tent

$$= \pi r l = \pi r \sqrt{h^2 + r^2}$$

$$= \frac{22}{7} \times 21 \times \sqrt{(21)^2 + (20)^2}$$

$$= 22 \times 3 \times 29 = 1914 \text{ sq. meter}$$

Thus, 1914 sq. meter of blue PVC coated fabric is required.
Thus (b) is correct option.

(ii) How much blue PVC coated fabric is required?
- (a) 1320 sq. meter
- (b) 330 sq. meter
- (c) 660 sq. meter
- (d) 240 sq. meter

Ans :

Surface area of cylindrical part of tent,

$$= 2\pi r h = 2 \times \frac{22}{7} \times 21 \times 5 = 660 \text{ sq. meter}$$

Thus (c) is correct option.

(iii) If labour charge for the construction of tent is ₹ 15 per sq. meter what is the total cost of tent ?
- (a) ₹ 243100
- (b) ₹ 129800
- (c) ₹ 199650
- (d) ₹ 243800

Ans :

Total cost is sum of material cost and construction cost of both type of fabric.

Total cost = White fabric cost + Blue fabric cost

$$= (60 + 15) \times 1914 + (70 + 15) \times 660$$

$$= 75 \times 1914 + 85 \times 660 = 75(1914 + 17 \times 44) = ₹199650$$

Thus (c) is correct option.

(iv) If space requirement of a pilgrims is 6 sq. meter, how many pilgrims can be accommodate in a tent?
- (a) 142
- (b) 231
- (c) 196
- (d) 346

Ans :

Total floor area of tent,

$$\pi r^2 = \frac{22}{7} \times 21 \times 21$$

$$= 22 \times 3 \times 21 = 1386 \text{ sq. meter}$$

Pilgrims in a tent $= \dfrac{1386}{6} = 231$ pilgrims

Thus (b) is correct option.

(v) If total 50000 pilgrims are expected to visit fair, how many tents are required ?

    (a) 198 tent   (b) 217 tent

    (c) 179 tent   (d) 292 tent

Ans :

Total requirement of tent $= \dfrac{50000}{231} = 216.45$

Thus, 217 tent are required.

Thus (b) is correct option.