Class X Session 2024-25
Subject - Mathematics (Standard)
Sample Question Paper - 14

Time: 3 Hours **Total Marks: 80**

General Instructions:

1. This Question Paper has 5 Sections A - E.
2. Section A has 18 multiple choice questions and 2 Assertion-Reason based questions carrying 1 mark each.
3. Section B has 5 questions carrying 02 marks each.
4. Section C has 6 questions carrying 03 marks each.
5. Section D has 4 questions carrying 05 marks each.
6. Section E has 3 case based integrated units of assessment (04 marks each) with subparts of the values of 1, 1 and 2 marks each respectively.
7. All Questions are compulsory. However, an internal choice in 2 Qs of 5 marks, 2 Qs of 3 marks and 2 Questions of 2 marks has been provided. An internal choice has been provided in the 2 marks questions of Section E.
8. Draw neat figures wherever required. Take π = 22/7 wherever required if not stated.

Section A

Section A consists of 20 questions of 1 mark each.

Choose the correct answers to the questions from the given options. [20]

1. If LCM of 336 and 54 is 3024, then find HCF.

A. 3
B. 6
C. 9
D. 12

2. Find a quadratic polynomial with the given numbers as the sum and product of its zeroes respectively: $\frac{1}{4}, -1$

A. $k(x^2 - x - 4)$
B. $k(x^2 - 4x - 4)$
C. $k(4x^2 - x - 4)$
D. $k(4x^2 - 3x - 4)$

3. If $\frac{4}{5}, a, 2$ are three consecutive terms of an AP, then find the value of a.

A. 14/5
B. 5/7
C. 7/5
D. 4/5

4. If two linear equations in x and y have more than two solutions, then the lines ...

A. are parallel
B. coincide
C. intersect
D. None of these

5. Roots of the quadratic equation $21x^2 + 11x - 2 = 0$ are

A. −1/7 and 2/3
B. 1/7 and −2/3
C. −1/7 and −2/3
D. 1/7 and 2/3

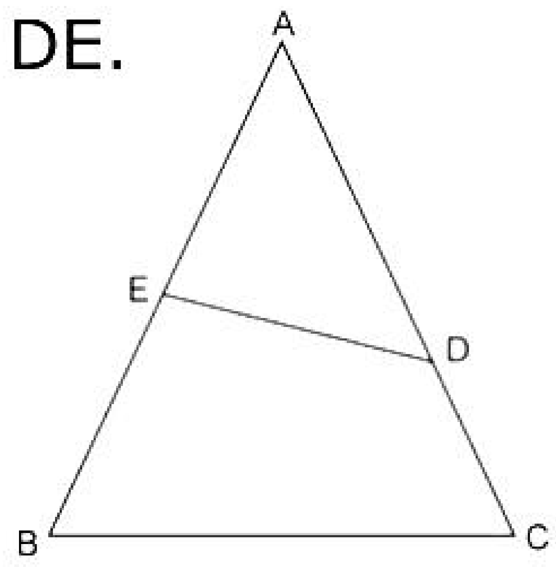
6. The perimeter of the triangle formed by the points (0, 0), (1, 0) and (0, 1) is

A. $\sqrt{2}$
B. $1 + \sqrt{2}$ units
C. $2 + \sqrt{2}$ units
D. $2\sqrt{2}$ units

7. Distance of a point (6, −6) from the origin is

A. $6\sqrt{2}$ units
B. $\sqrt{2}$ units
C. 6 units
D. 12 units

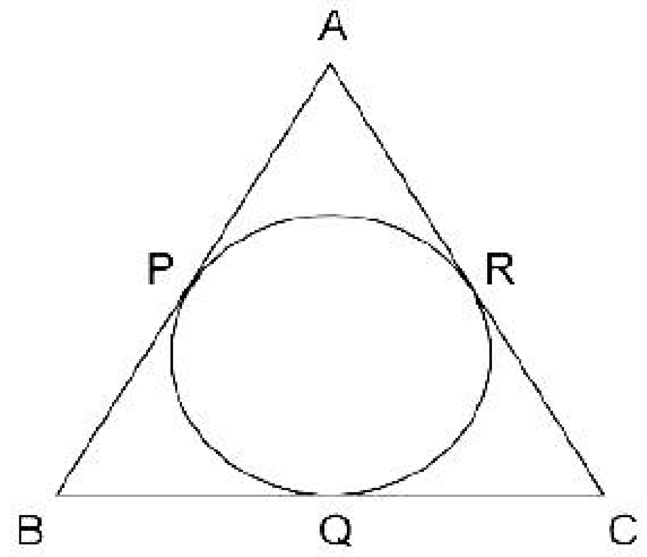
8. In the given figure, if $\angle ADE = \angle B$, show that $\Delta ADE \sim \Delta ABC$. Also, if AD = 3.8 cm, AE = 3.6 cm, BE = 2.1 cm and BC = 4.2 cm, then find DE.



A. 2.2 cm
B. 2.4 cm
C. 2.6 cm
D. 2.8 cm

9. A circle is inscribed in a ΔABC, touching AB, BC and AC at P, Q and R, respectively. If AB = 10 cm, AR = 7 cm and CR = 5 cm, find the length of BC.

A. 2 cm
B. 5 cm
C. 7 cm
D. 8 cm



10. The next term of an A.P. $\sqrt{7}, \sqrt{28}, \sqrt{63}, \ldots$ is

A. $\sqrt{7}$
B. $\sqrt{28}$
C. $\sqrt{112}$
D. $\sqrt{126}$

11. Which of the following is not defined?

A. cosec 0°
B. cos 0°
C. sec 0°
D. tan 0°

12. If $2\sin^2\theta - \cos^2\theta = 2$, then find the value of θ.

A. 30°
B. 60°
C. 90°
D. 120°

13. If $\sqrt{3}\tan\theta - 1 = 0$, find the value of $\sin^2\theta - \cos^2\theta$.

A. $\frac{-1}{2}$
B. $\frac{1}{2}$
C. $\frac{1}{3}$
D. $\frac{-1}{3}$

14. Curved surface area of cone is given by

A. πrh
B. πr^2
C. $2\pi rh$
D. πrl

15. A horse is tethered to one corner of a field which is in the shape of an equilateral triangle of side 12 m. If the length of the rope is 7 m, find the area of the field which the horse can graze.

A. 34.55 m^2
B. 53.57 m^2
C. 25.67 m^2
D. 45.35 m^2

16. Find the mean of the data: 3, 11, 5, 2, 6, 8, 7

A. 7
B. 6
C. 5
D. 5.5

17. Find the mode of the data: 1, 3, 2, 5, 6, 6, 6, 3, 2, 3, 1, 3, 4, 4, 5, 5, 3, 1, 2, 6

A. 2
B. 3
C. 5
D. 6

18. Out of a day's production, which is 1000 machine parts, 100 were found to be sub-standard. The probability that a part selected at random being up to the standard is

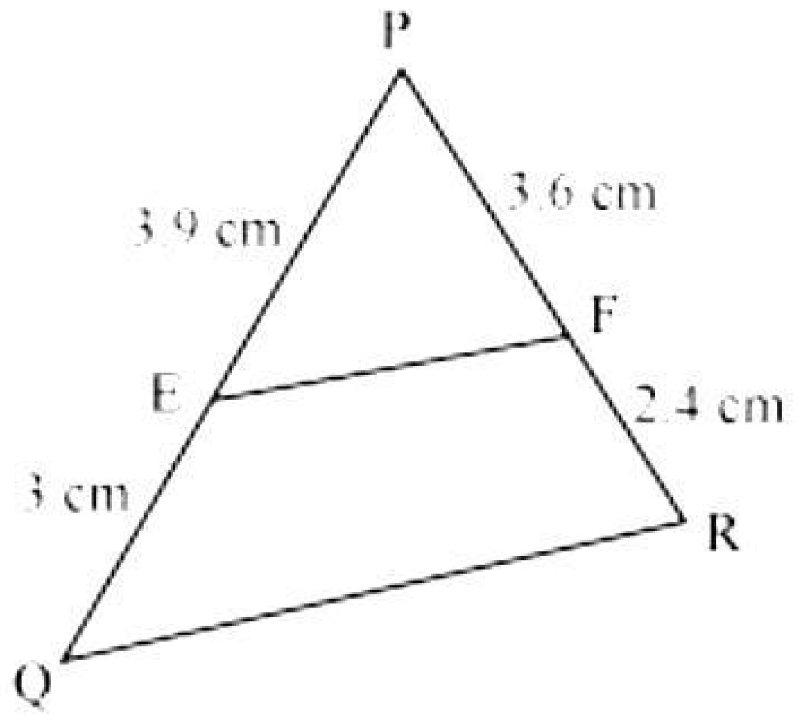
A. $\frac{9}{10}$
B. $\frac{1}{10}$
C. 0
D. None of these

DIRECTION: In the question number 19 and 20, a statement of **Assertion (A)** is followed by a statement of **Reason (R)**. Choose the correct option

19. **Statement A (Assertion):** The length of a chain used as the boundary of a semi-circular park is 90 m. Hence the area of the park will be 481.25 m^2.
Statement R (Reason): If the radius of the circle is 'r', then, $\pi r + 2r = 90°$.

A. Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A)
B. Both assertion (A) and reason (R) are true and reason (R) is not the correct explanation of assertion (A)
C. Assertion (A) is true but reason (R) is false.
D. Assertion (A) is false but reason (R) is true.

20. Statement A (Assertion): In the following figure, EF || QR.



Statement R (Reason): If a line divides any two sides of a triangle in the same ratio, then the line is parallel to the third side.

A. Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A)
B. Both assertion (A) and reason (R) are true and reason (R) is not the correct explanation of assertion (A)
C. Assertion (A) is true but reason (R) is false.
D. Assertion (A) is false but reason (R) is true.

Section B

21. The number of fruits of each kind A, B and C are 50, 90 and 110 respectively. In each basket, the equal number of fruits of same kind are to be kept. Find the minimum number of baskets required to accommodate all fruits. [2]

22. E is a point on the side AD produced of a parallelogram ABCD and BE intersects CD at F. Show that $\Delta ABE \sim \Delta CFB$. [2]

23. A tangent PQ at a point P of a circle of radius 5 cm meets a line through the centre O at a point Q so that OQ = 12 cm. Find the length of PQ. [2]

24. ΔABC is right-angled at B. If $\tan A = \frac{1}{\sqrt{3}}$, find the value of sin A cos C + cos A sin C. [2]

OR

In ΔPQR, right-angled at Q, PR + QR = 25 cm and PQ = 5 cm. Determine the values of sin P, cos P and tan P.

25. Find the area of a quadrant of a circle whose circumference is 22 cm. [2]

OR

The length of the minute hand of a clock is 14 cm. Find the area swept by the minute hand in 5 minutes.

Section C

Section C consists of 6 questions of 3 marks each.

26. In a seminar, the number of participants in Hindi, English and Mathematics are 60, 84 and 108, respectively. Find the minimum number of rooms required, if in each room the same number of participants are to be seated and all of them being in the same subject. [3]

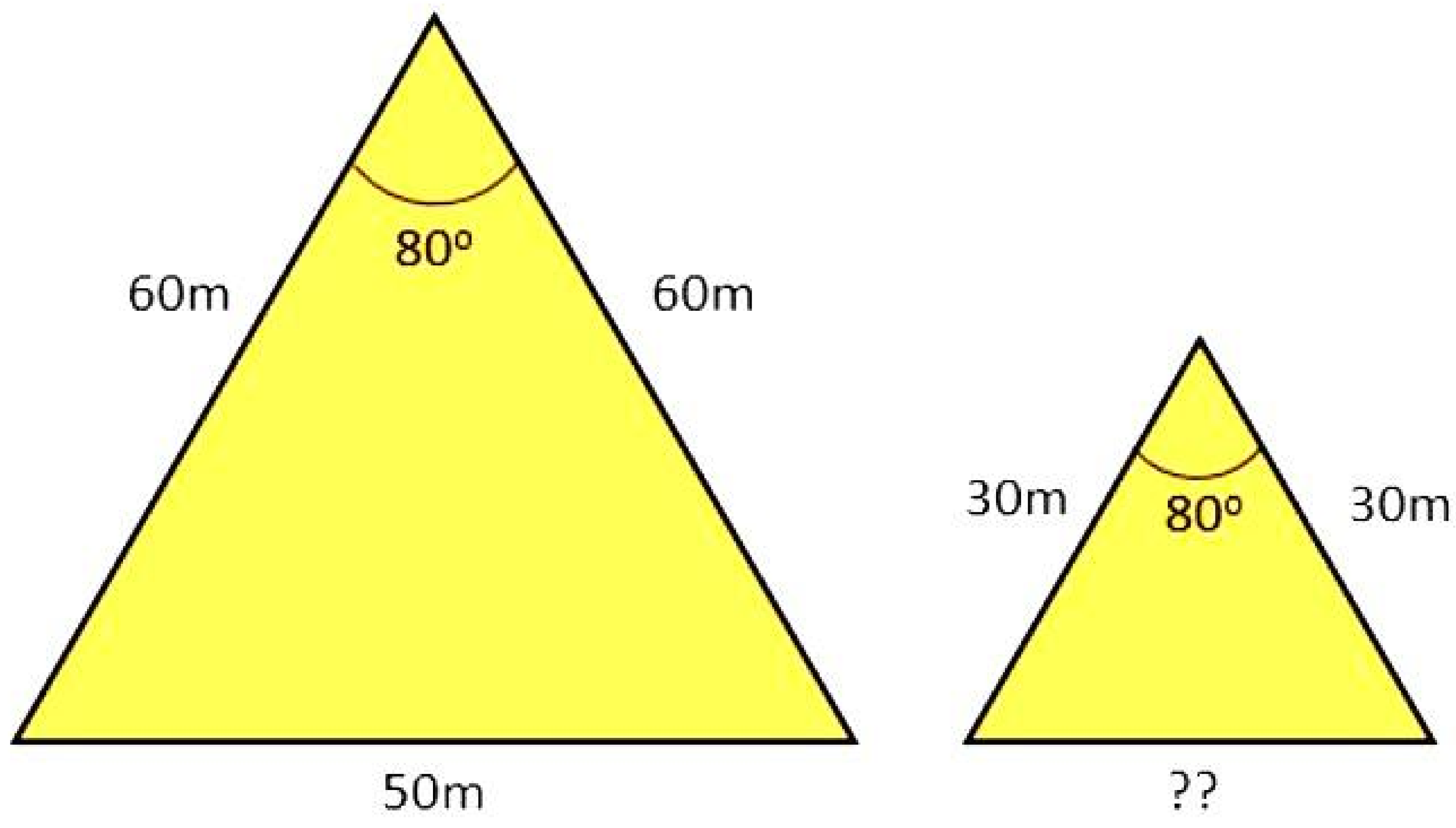
27. Verify the relationship between the zeroes and the coefficients of $t^2 - 15$. [3]

28. A train travels a distance of 480 km at a uniform speed. If the speed had been 8 km/h less, then it would have taken 3 hours more to cover the same distance. Formulate the quadratic equation in terms of speed of the train. [3]

OR

Five years hence, the age of Jacob will be three times that of his son. Five years ago, Jacob's age was seven times that of his son. What are their present ages?

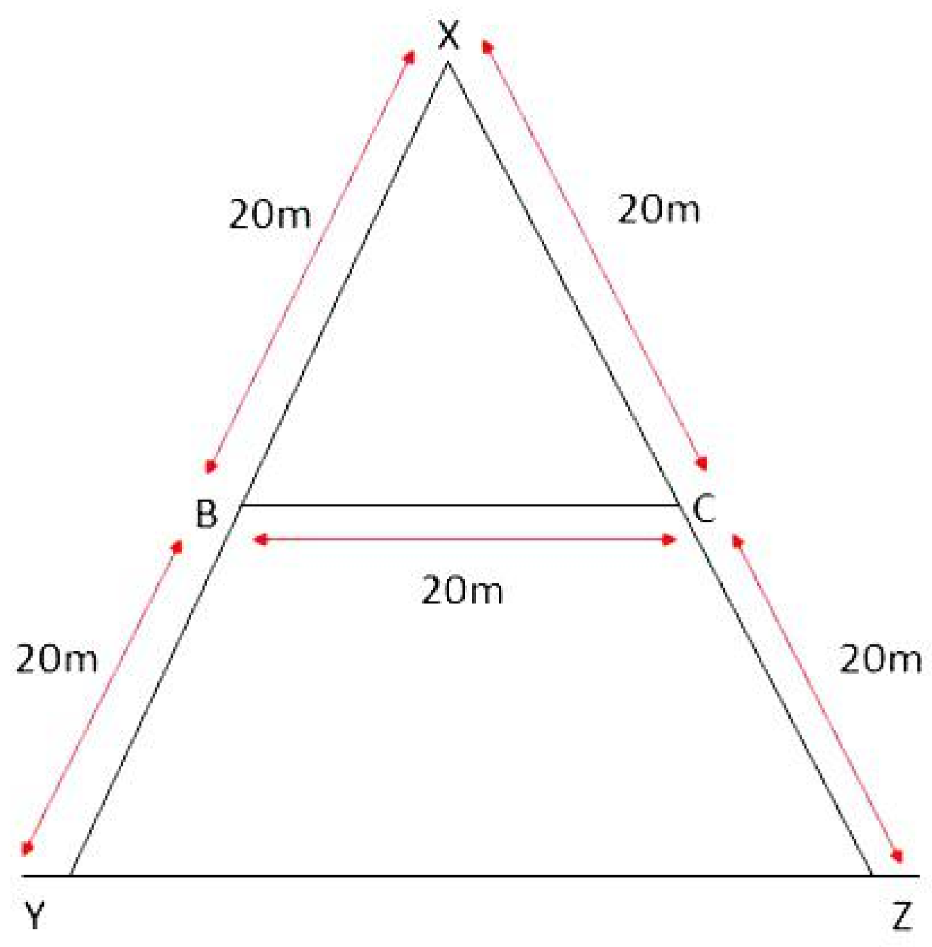
29. Atul went to Egypt to see the pyramids. Now the front side of two adjacent pyramids are as shown in the figure below. [3]



Calculate the base of the smaller pyramid.

OR

A TV tower is erected on the ground as shown in the figure below. Two ends of the tower are XY and XZ, and BC is the support to keep the two ends from falling apart. If BC is parallel to the ground, then find the distance YZ.



30. If $\cos\theta = \frac{7}{25}$, find the values of all T-ratios of θ. [3]

31. A box contains 20 balls bearing numbers 1, 2, 3,..., 20, respectively. A ball is taken out at random from the box. Find the probability that the number on the ball is [3]

i. an even number
ii. divisible by 2 and 3
iii. a prime number

Section D

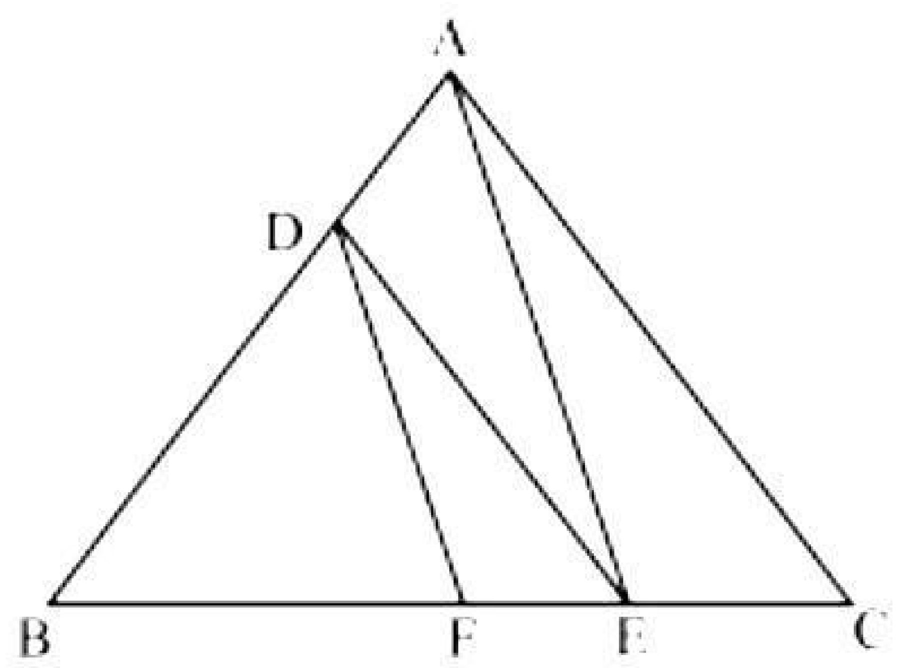
Section D consists of 4 questions of 5 marks each.

32. In a class test, the sum of Kamal's marks in Mathematics and English is 40. Had he got 3 marks more in Mathematics and 4 marks less in English, the product of the marks would have been 360. Find his marks in two subjects separate. [5]

OR

A passenger train takes 2 hours less for a journey of 300 km if its speed is increased by 5 km/hr from its usual speed. Find its usual speed.

33. In figure, DE || AC and DF || AE. Prove that $\frac{BF}{FE} = \frac{BE}{EC}$ [5]



34. A tent is in the shape of a right circular cylinder up to a height of 3 m and conical above it. The total height of the tent is 13.5 m, and the radius of its base is 14 m. Find the cost of cloth required to make the tent at the rate of Rs. 80 per square metre. Take π = 22/7. [5]

OR

A toy is in the form of a cone of radius 3.5 cm mounted on a hemisphere of same radius. The total height of the toy is 15.5 cm. Find the total surface area of the toy.

35. Consider the following distribution of daily wages of 50 workers in a factory. [5]

Daily wages (in Rs)	100 – 120	120 – 140	140 –160	160 – 180	180 – 200
Number of workers	12	14	8	6	10

Find the mean daily wages of the factory workers using an appropriate method.

Section E

Case study based questions are compulsory.

36. Rukhsar is celebrating her birthday. She invited her friends. She bought a packet of chocolates which contains 120 chocolates. She arranges the chocolates such that in the first row there are 3 chocolates, in second there are 5 chocolates, in third there are 7 chocolates and so on.

i. Find the total number of rows of chocolates. [1]

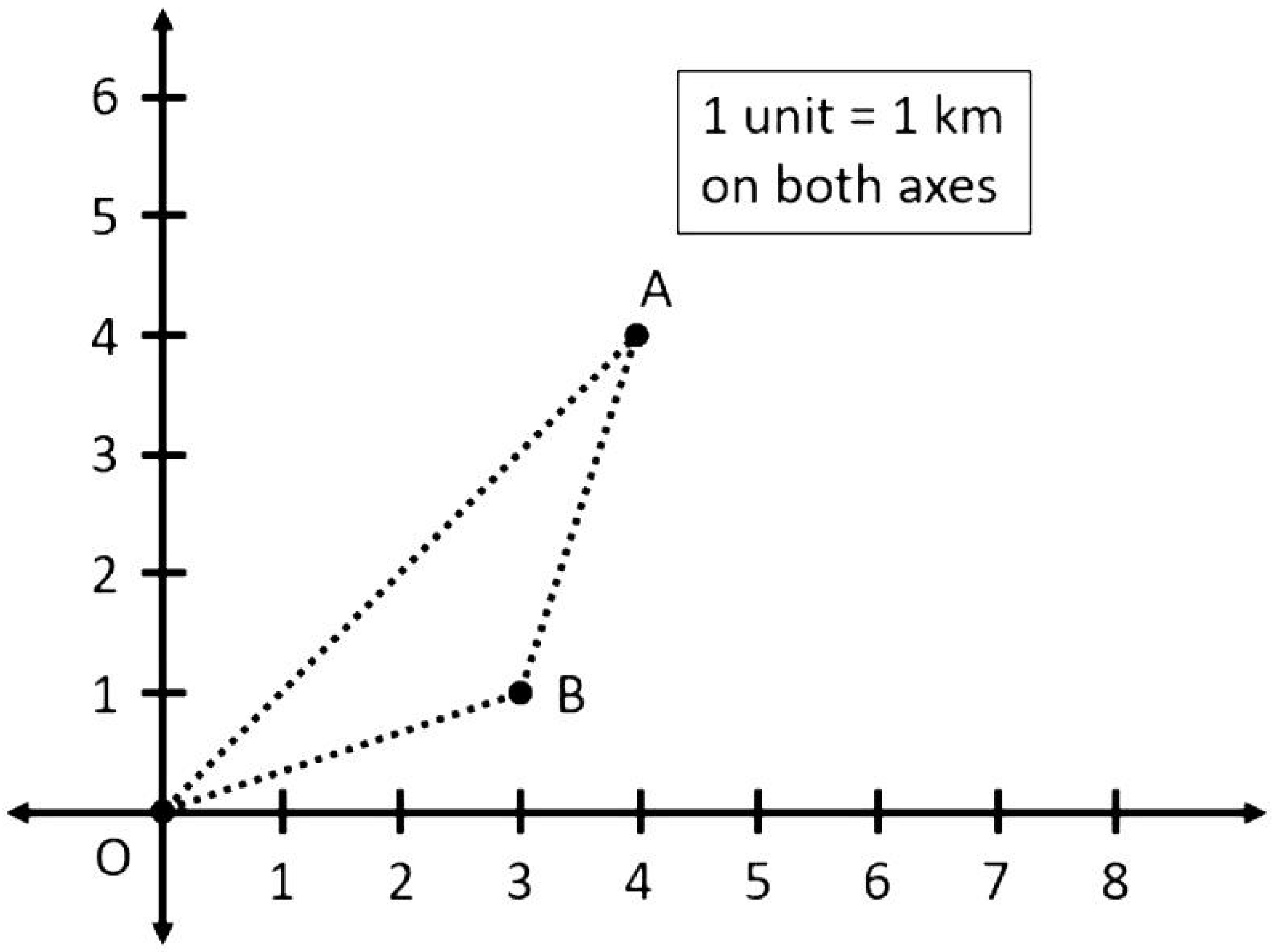
ii. How many chocolates are placed in last row? [2]

OR

Find the difference in number of chocolates placed in 7^{th} and 3^{rd} row. [2]

iii. If Rukhsar decides to make 15 rows, then how many total chocolates will be placed by her with the same arrangement? [1]

37. Bus number 735 travels from source O to A, and Bus number 736 travels from Source O to B, then reaches A. The routes taken by both the buses are shown below. Using the details given, answer the following questions.



i. Find the distance covered by Bus No. 735. [1]

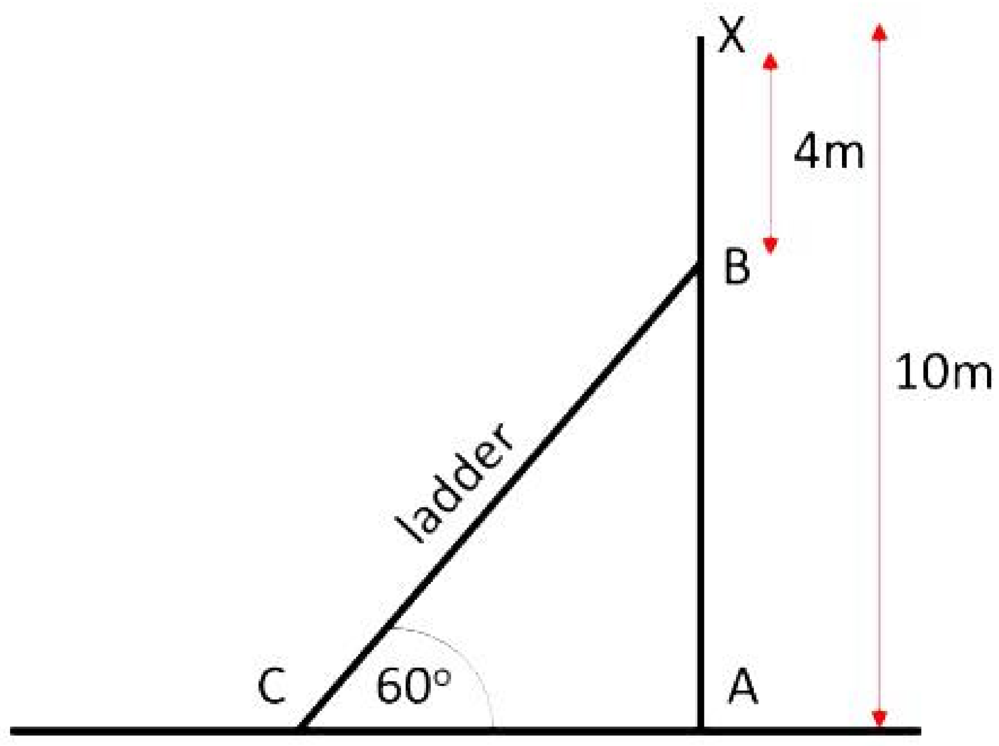
ii. Find the distance between locations B and A. [2]

OR

Find the distance between locations O and B. [2]

iii. Find the distance covered by Bus No. 736. [1]

38. Vinod, an electrician, has to repair an electric wire on the pole AX which is of height 10 m. For the repair, he needs to reach a point B which is 4 m below the top of the pole, using a ladder from the point C. The ladder makes an angle of 60° with the ground. Based on the above information, answer the following questions.



i. Find the length of AB. [1]

ii. If the ladder makes an angle of 60° with the ground, what is the distance between the foot of the ladder and the pole? [2]

OR

If the ladder makes an angle of 60° with the ground, then the length of ladder will be? [2]

iii. If AB = AC, what angle should the ladder make with the ground? [1]

Solution

Section A

1. Correct option: B

Explanation:

HCF × LCM = product of two numbers

⇒ HCF × 3024 = 336 × 54

⇒ HCF = 18144 ÷ 3024 = 6

2. Correct Option: C

Explanation:

Let the required polynomial be $ax^2 + bx + c$.

Suppose its zeroes be α and β.

$$\alpha + \beta = \frac{1}{4} = \frac{-b}{a}$$

$$\alpha\beta = -1 = \frac{c}{a}$$

If a = 4k, then b = −k, c = −4k

Therefore, the quadratic polynomial is $k(4x^2 - x - 4)$, where k is a real number.

3. Correct Option: C

Explanation:

$\frac{4}{5}, a, 2$ are in AP

$$\therefore \quad a - \frac{4}{5} = 2 - a \text{ or } 2a = 2 + \frac{4}{5} = \frac{14}{5}$$

$$\Rightarrow \quad a = \frac{7}{5}$$

4. Correct option: B

Explanation:

If two linear equations in x and y have more than two solutions, then the lines coincide.

5. Correct Option: B

Explanation:

$21x^2 + 11x - 2 = 0$

$21x^2 + 14x - 3x - 2 = 0$

$7x(3x + 2) - (3x + 2) = 0$

$(3x + 2)(7x - 1) = 0$

$x = -2/3$ or $x = 1/7$

6. Correct option: C

Explanation:

Let O(0, 0), A(1, 0) and C(0, 1).

d(OA) = $\sqrt{(1-0)^2 + 0} = 1$

d(AC) = $\sqrt{(1-0)^2 + (0-1)^2} = \sqrt{2}$

d(OC) = $\sqrt{0 + (1-0)^2} = 1$

Perimeter of triangle AOC = 1 + 1 + $\sqrt{2}$ = 2 + $\sqrt{2}$ units

7. Correct Option: A

Explanation:

Origin is O(0, 0) and A(6, −6)

Hence, OA = $\sqrt{(6-0)^2 + (-6-0)^2} = \sqrt{72} = 6\sqrt{2}$ units

8. Correct Option: D

Explanation:

In ΔADE and ΔABC,

$\angle$A = $\angle$A (common)

$\angle$ADE = $\angle$B (Given)

$\therefore$ ΔADE ~ ΔABC (AA criterion)

$\Rightarrow \frac{AD}{AB} = \frac{DE}{BC}$

$\Rightarrow \frac{3.8}{(3.6 + 2.1)} = \frac{DE}{4.2}$

$\Rightarrow \frac{3.8}{5.7} = \frac{DE}{4.2}$

$\Rightarrow DE = \frac{3.8 \times 4.2}{5.7} = 2.8$ cm

9. Correct option: D

Explanation:

AR and AP are the tangents to the circle from a same point.

$\therefore$ AP = AR = 7 cm

Since, AB = 10 cm

$\therefore$ BP = AB − AP = (10 − 7) = 3 cm

Also, BP and BQ are tangents to the circle from the same point.

$\therefore$ BP = BQ = 3 cm

Further, CQ and CR are tangents to the circle from the same point.

$\therefore$ CQ = CR = 5 cm

Now, BC = BQ + QC = (3 + 5) cm = 8 cm

10. Correct option: C

Explanation:

$\sqrt{7}, \sqrt{28}, \sqrt{63}, \ldots$

$a_1 = \sqrt{7}$, $a_2 = \sqrt{28} = 2\sqrt{7}$, $a_3 = \sqrt{63} = 3\sqrt{7}$

$d = a_2 - a_1 = 2\sqrt{7} - 2\sqrt{7} = \sqrt{7}$

Therefore, next term, $a_4 = a_3 + d = 3\sqrt{7} + \sqrt{7} = 4\sqrt{7} = \sqrt{112}$

11. Correct option: A

Explanation:

The value of sin 0° is 0.

Thus, cosec 0° = 1/sin 0° is not defined.

12. Correct option: C

Explanation:

$2\sin^2\theta - \cos^2\theta = 2$

$\Rightarrow 2(1-\cos^2\theta) - \cos^2\theta = 2$

$\Rightarrow 2 - 2\cos^2\theta - \cos^2\theta = 2$

$\Rightarrow 2 - 3\cos^2\theta = 2$

$\Rightarrow 3\cos^2\theta = 0$

$\Rightarrow \cos^2\theta = 0$

$\Rightarrow \cos^2\theta = \cos^2 90^\circ$

$\Rightarrow \theta = 90^\circ$

13. Correct option: A

Explanation:

$\sqrt{3}\tan\theta - 1 = 0 \Rightarrow \sqrt{3}\tan\theta = 1$

$\Rightarrow \tan\theta = \frac{1}{\sqrt{3}}$

$\Rightarrow \tan\theta = \tan 30^\circ$

$\Rightarrow \theta = 30^\circ$

Now,

$\sin^2\theta - \cos^2\theta$

$= \sin^2 30 - \cos^2 30$

$= \left(\frac{1}{2}\right)^2 - \left(\frac{\sqrt{3}}{2}\right)^2 = \frac{1}{4} - \frac{3}{4} = \frac{-2}{4} = \frac{-1}{2}$

14. Correct option: D

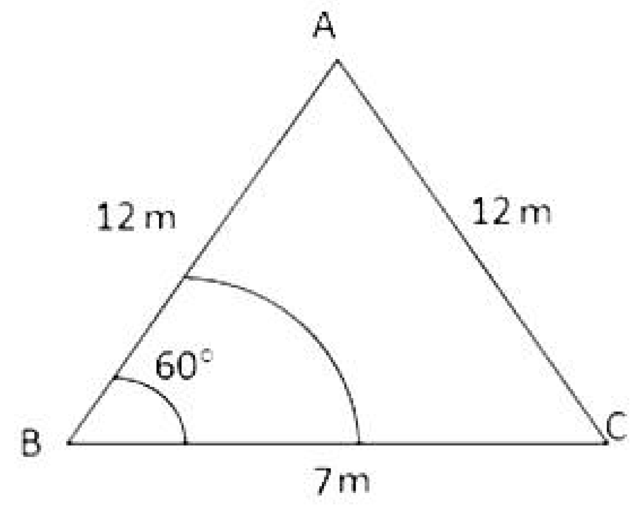
Explanation:

Curved surface area of cone = πrl

15. Correct option: C

Explanation:

Each angle of an equilateral triangle is 60°.



Area which can be grazed = area of the sector with r = 7 m, $\theta = 60^\circ$

$= \left[\frac{22}{7} \times (7)^2 \times \frac{60}{360}\right]$ m^2

$= 25.67$ m^2

16. Correct Option: B

Explanation:

Mean $= \left(\frac{\text{sum of observations}}{\text{no. of observations}}\right) = \left(\frac{3+11+5+2+6+8+7}{7}\right) = 6$

Hence, 6 is the mean.

17. Correct option: B

Explanation:

The most repeated number will be the mode; hence mode is 3 (repeated 5 times).

18. Correct Option: A

Explanation:

Total number of parts of a machine = 1000

Sub-standard parts = 100

Standard parts = 1000 − 100 = 900

Probability of getting standard part = $\frac{900}{1000} = \frac{9}{10}$

19. Correct Option: A

Explanation:

Let the radius of the park be r metres.

Thus, $\pi r + 2r = 90^\circ \Rightarrow \frac{22r}{7} + 2r = 90^\circ$

Hence, the reason (R) is true.

$\Rightarrow \frac{36r}{7} = 90 \Rightarrow r = \frac{90 \times 7}{36} = 17.5$ m

Area of semicircle $= \frac{1}{2}\pi r^2 = \left(\frac{1}{2} \times \frac{22}{7} \times 17.5 \times 17.5\right) m^2 = 481.25\ m^2$

Hence, both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).

20. Correct Option: D

Explanation:

Given that PE = 3.9, EQ = 3, PF = 3.6, FR = 2.4

Now,

$$\frac{PE}{EQ} = \frac{3.9}{3} = 1.3$$

$$\frac{PF}{FR} = \frac{3.6}{2.4} = 1.5$$

Since $\frac{PE}{EQ} \neq \frac{PF}{FR}$

By the converse of BPT, we know that if a line divides any two sides of a triangle in the same ratio, then the line is parallel to the third side.

Therefore, EF is not parallel to QR.

Thus, the assertion is false but reason is true.

Section B

21. To find minimum number of baskets, we need to first find the maximum and equal number of fruits of same kind to be kept in each basket.

That is, HCF of 50, 90 and 110.

$50 = \mathbf{2} \times 5 \times \mathbf{5}$

$90 = \mathbf{2} \times 3 \times 3 \times \mathbf{5}$

$110 = \mathbf{2} \times \mathbf{5} \times 11$

Therefore, HCF(50, 90, 110) = $2 \times 5 = 10$

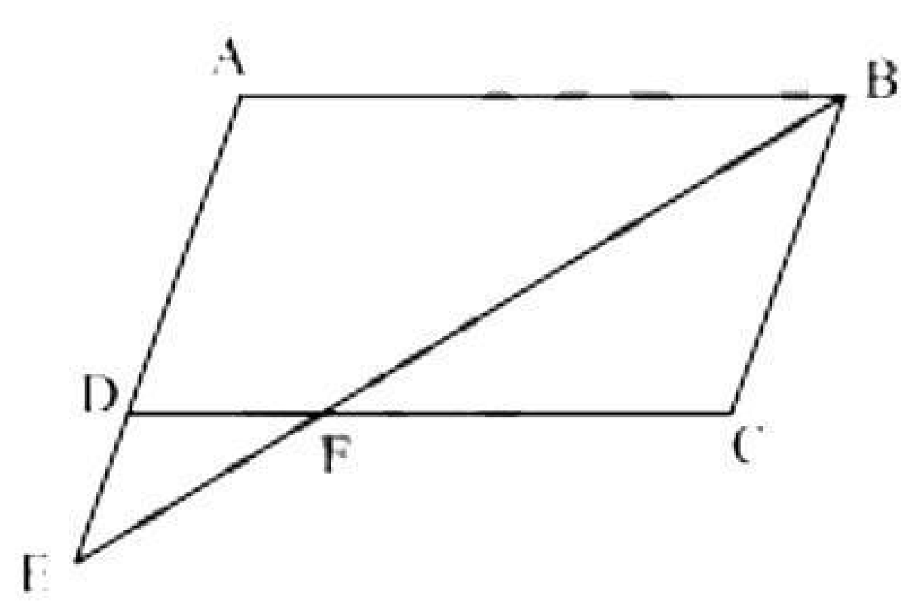
So, minimum number of baskets required to accommodate all fruits

$= \frac{50 + 90 + 110}{10}$

$= \frac{250}{10}$

$= 25$

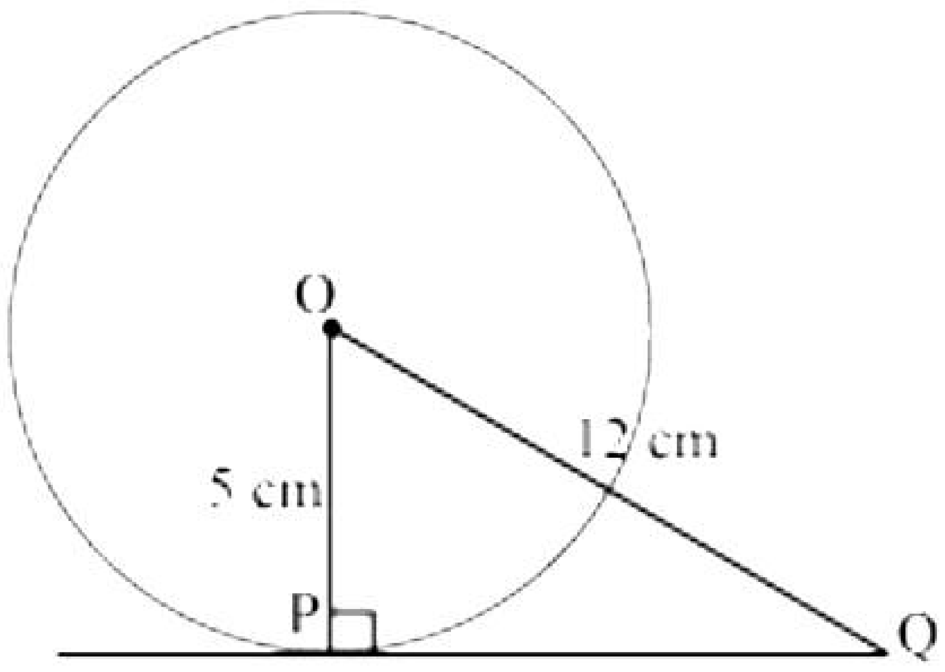
22.



In ΔABE and ΔCFB,

$\angle A = \angle C$	(opposite angles of a parallelogram)
$\angle AEB = \angle CBF$	(Alternate interior angles, AE || BC)
$\angle ABE = \angle CFB$	(remaining angle)
Therefore $\Delta ABE \sim \Delta CFB$	(by AAA rule)

23. Radius is perpendicular to the tangent at the point of contact. So, OP $\perp$ PQ.



Now, applying Pythagoras theorem in $\triangle$OPQ,

$OP^2 + PQ^2 = OQ^2$

$5^2 + PQ^2 = 12^2$

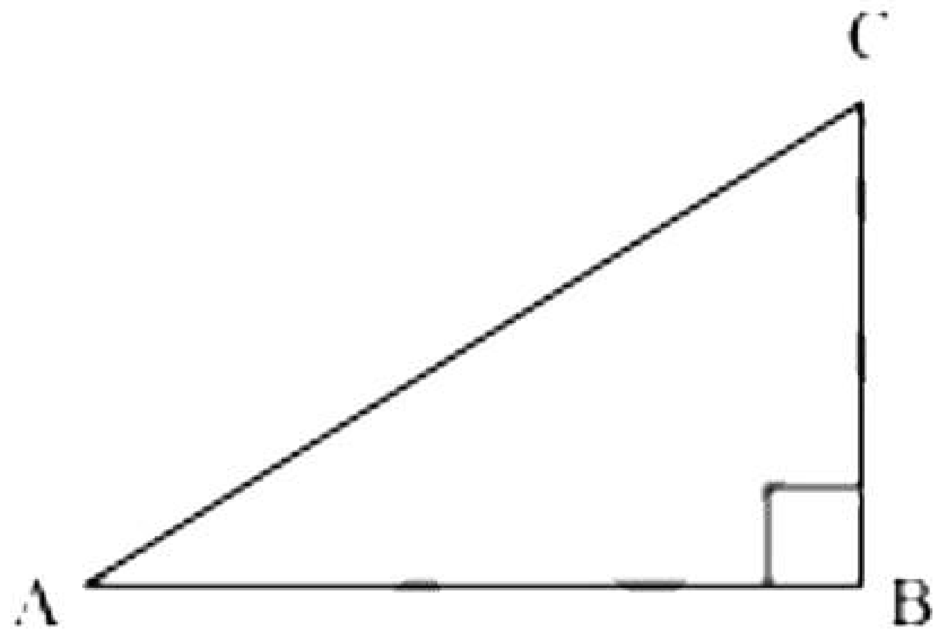
$PQ^2 = 144 - 25$

$PQ = \sqrt{119}$ cm

24.

$\tan A = \frac{1}{\sqrt{3}}$

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



If BC is K, AB will be $\sqrt{3}$ K, where K is a positive integer.

In $\triangle$ABC

$AC^2 = AB^2 + BC^2 = \left(\sqrt{3}\ K\right)^2 + (K)^2 = 3K^2 + K^2 = 4K^2$

AC = 2K

$$\sin A = \frac{\text{Side opposite to } \angle A}{\text{hypotenuse}} = \frac{BC}{AC} = \frac{K}{2K} = \frac{1}{2}$$

$$\cos A = \frac{\text{Side adjacent to } \angle A}{\text{hypotenuse}} = \frac{AB}{AC} = \frac{\sqrt{3}\ K}{2\ K} = \frac{\sqrt{3}}{2}$$

$$\sin C = \frac{\text{Side opposite to } \angle C}{\text{hypotenuse}} = \frac{AB}{AC} = \frac{\sqrt{3}\ K}{2K} = \frac{\sqrt{3}}{2}$$

$$\cos C = \frac{\text{Side adjacent to } \angle C}{\text{hypotenuse}} = \frac{BC}{AC} = \frac{K}{2K} = \frac{1}{2}$$

sin A cos C + cos A sinC

$$= \left(\frac{1}{2}\right)\left(\frac{1}{2}\right) + \left(\frac{\sqrt{3}}{2}\right)\left(\frac{\sqrt{3}}{2}\right)$$

$$= \frac{1}{4} + \frac{3}{4}$$

$$= \frac{4}{4}$$

$$= 1$$

OR

Given that PR + QR = 25

PQ = 5

Let PR be x

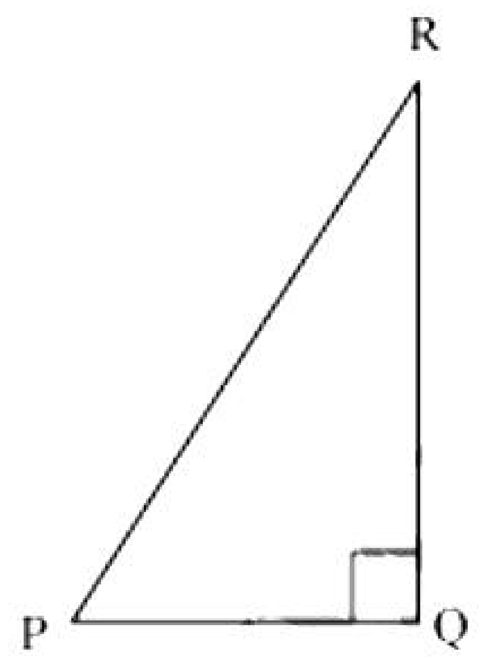
So, QR = 25 − x

Now applying Pythagoras theorem in ΔPQR

$PR^2 = PQ^2 + QR^2$

$x^2 = (5)^2 + (25 - x)^2$

$x^2 = 25 + 625 + x^2 - 50x$



$50x = 650$

$x = 13$

So, PR = 13 cm

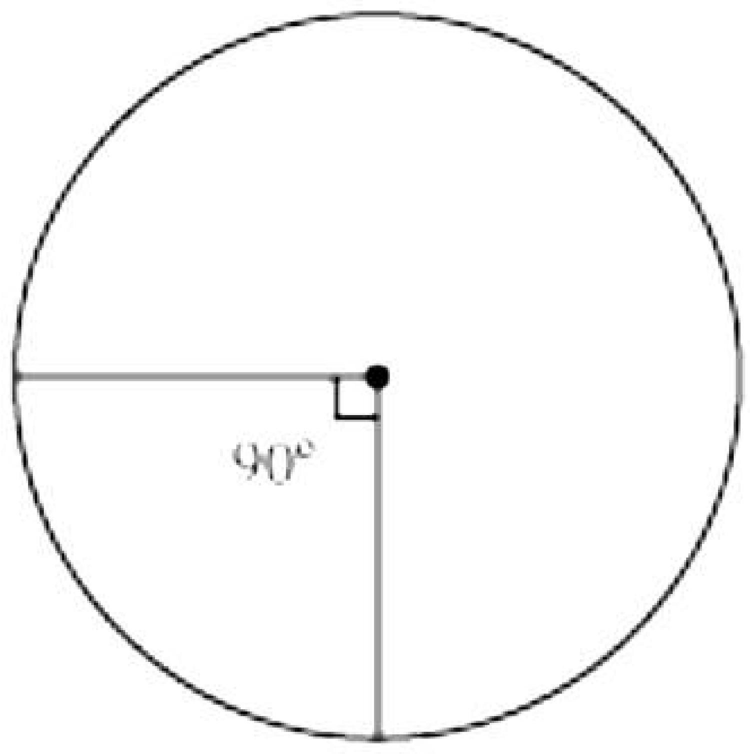
QR = 25 − 13 = 12 cm

$$\sin P = \frac{\text{Side opposite to } \angle P}{\text{hypotenuse}} = \frac{QR}{PR} = \frac{12}{13}$$

$$\cos P = \frac{\text{side adjacent to } \angle P}{\text{hypotenuse}} = \frac{PQ}{PR} = \frac{5}{13}$$

$$\tan P = \frac{\text{Side opposite to } \angle P}{\text{side adjacent to } \angle P} = \frac{QR}{PQ} = \frac{12}{5}$$

25.



Let the radius of a circle be *r*.

Circumference = 22 cm

$2\pi r = 22$

$r = \frac{22}{2\pi} = \frac{11}{\pi}$

Quadrant of circle will subtend 90° angle at the centre of a circle.

So area of such quadrant of circle $= \frac{90^\circ}{360^\circ} \times \pi \times r^2$

$= \frac{1}{4} \times \pi \times \left(\frac{11}{\pi}\right)^2$

$= \frac{121}{4\pi} = \frac{121 \times 7}{4 \times 22}$

$= \frac{77}{8}\ \text{cm}^2$

OR

We know that in 1 hour (i.e. 60 minutes), minute hand rotates 360°.

So in 5 minutes, minute hand will rotate $= \frac{360^\circ}{60} \times 5 = 30^\circ$

So area swept by minute hand in 5 minutes will be the area of a sector of 30° in a circle of 14 cm radius.

Area of sector of angle $\theta = \frac{\theta}{360^\circ} \times \pi r^2$

Area of sector of 30° $= \frac{30^\circ}{360^\circ} \times \frac{22}{7} \times 14 \times 14$

$= \frac{22}{12} \times 2 \times 14$

$= \frac{154}{3}\ \text{cm}^2$

So area swept by minute hand in 5 minutes is $\frac{154}{3}$ cm^2.

Section C

26. To find the minimum number of rooms required, first find the maximum number of participants which can be accommodated in each room such that the number of participants in each room is the same.
This can be determined by finding the HCF of 60, 84 and 108.

$60 = 2^2 \times 3 \times 5$
$84 = 2^2 \times 3 \times 7$
$108 = 2^2 \times 3^3$
$\text{H.C.F.} = 2^2 \times 3 = 12$

So, the minimum number of rooms required

$$= \frac{\text{Total number of participants}}{12}$$
$$= \frac{60 + 84 + 108}{12}$$
$$= 21$$

27. $t^2 - 15 = 0$

$\Rightarrow t - \sqrt{15} = 0 \text{ or } t + \sqrt{15} = 0$

$\Rightarrow t = \sqrt{15} \text{ or } t = -\sqrt{15}$

So, the zeroes of $t^2 - 15$ are $\sqrt{15}$ and $-\sqrt{15}$.

Sum of zeroes $= \sqrt{15} + \left(-\sqrt{15}\right) = 0 = \frac{-0}{1} = \frac{-(\text{Coefficient of t})}{\left(\text{Coefficient of } t^2\right)}$

Product of zeroes $= \left(\sqrt{15}\right)\left(-\sqrt{15}\right) = -15 = \frac{-15}{1} = \frac{\text{Constant term}}{\text{Coefficient of } t^2}$

28. Let the speed of train be x km/h.

Time taken to travel 480 km = $\frac{480}{x}$ hrs

In second condition, let the speed of train = $(x-8)$ km/h

It is also given that the train will take 3 more hours to cover the same distance.

Therefore, time taken to travel 480 km = $\left(\frac{480}{x}+3\right)$ hrs

Speed × Time = Distance

$(x-8)\left(\frac{480}{x}+3\right)=480$

$\Rightarrow 480+3x-\frac{3840}{x}-24=480$

$\Rightarrow 3x-\frac{3840}{x}=24$

$\Rightarrow 3x^2-24x-3840=0$

$\Rightarrow x^2-8x-1280=0$

So, the required quadratic equation is $x^2 - 8x - 1280 = 0$.

OR

Let the age of Jacob be x and the age of his son be y.

According to the given information,

$(x+5)=3(y+5)$

$x-3y=10 \quad \dots(1)$

$(x-5)=7(y-5)$

$x-7y=-30 \quad \dots(2)$

From (1), we obtain

$x = 3y + 10 \quad \dots(3)$

Substituting this value in equation (2), we obtain

$3y+10-7y=-30$

$-4y=-40$

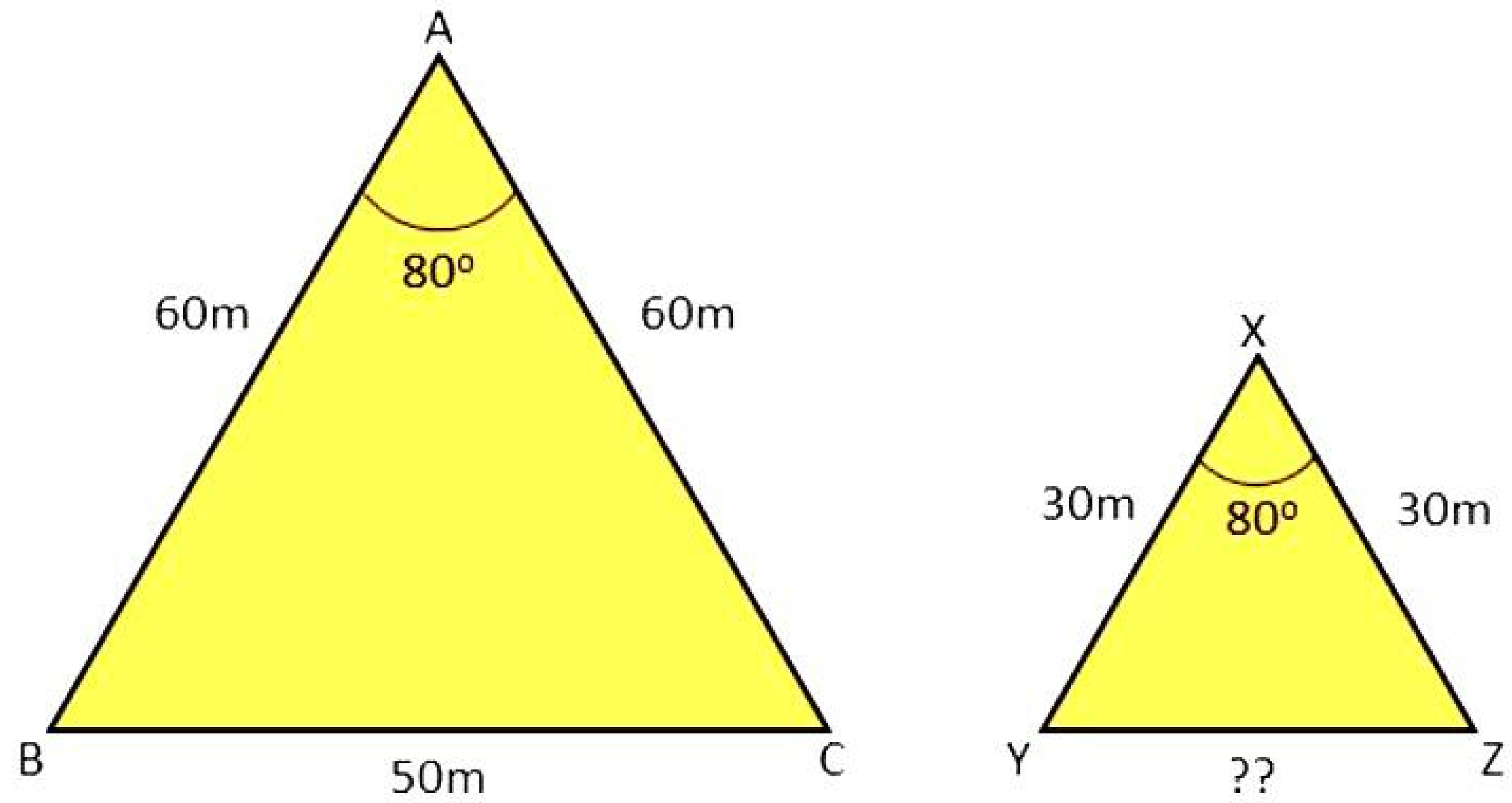
$y=10 \quad \dots(4)$

Substituting this value in equation (3), we obtain

$x = 3\times10 + 10 = 40$

Hence, the present age of Jacob is 40 years whereas the present age of his son is 10 years.

29. We will name the triangles as shown below:



In △ABC and △XYZ, we have

AB/XY = 2

AC/XZ = 2

Also,

∠A = ∠X

∴ △ABC ~ △XYZ … (SAS test)

⇒ BC/YZ = AB/XY … (Corresponding sides of similar triangles)

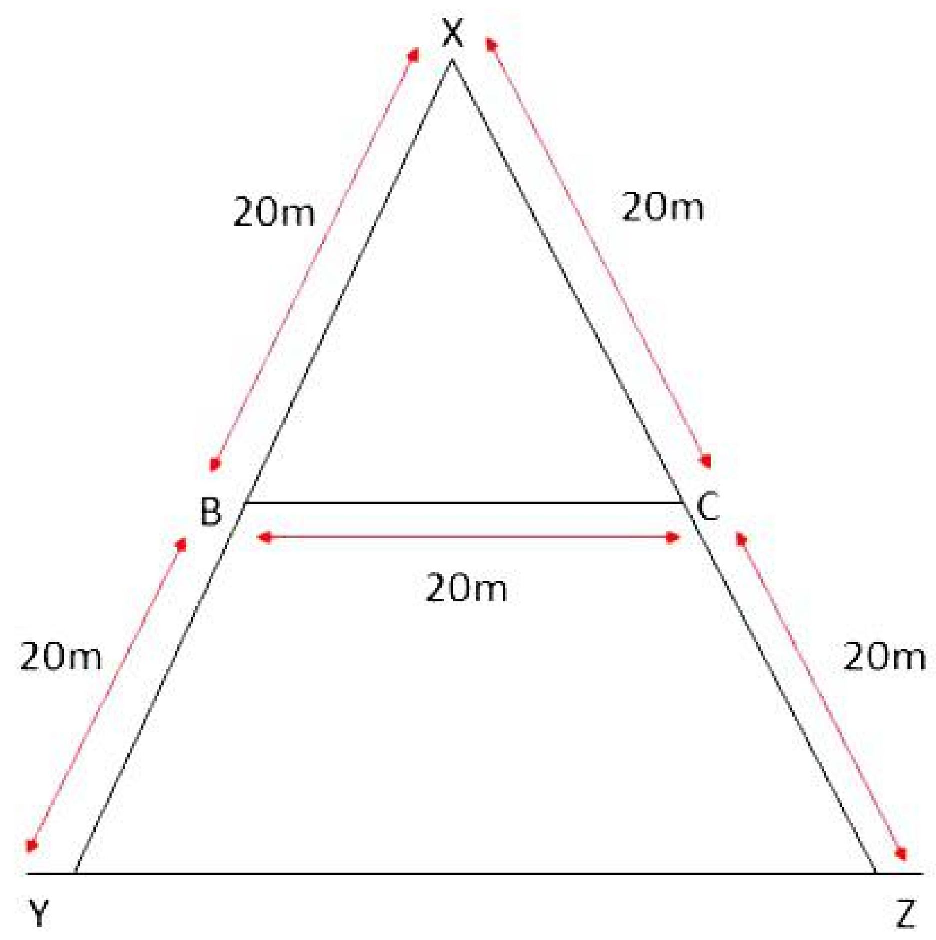
⇒ BC/YZ = 2

∴ YZ = ½ BC

∴ YZ = 25 m

Hence, the base of the smaller pyramid is 25 m.

OR



Here in △XBC and △XYZ, we have

XB/XY = 20/40 = ½

XC/XZ = 20/40 = ½

Also,

∠BXC = ∠YXZ … (common angle)

∴ △XBC ~△XYZ … (SAS test)

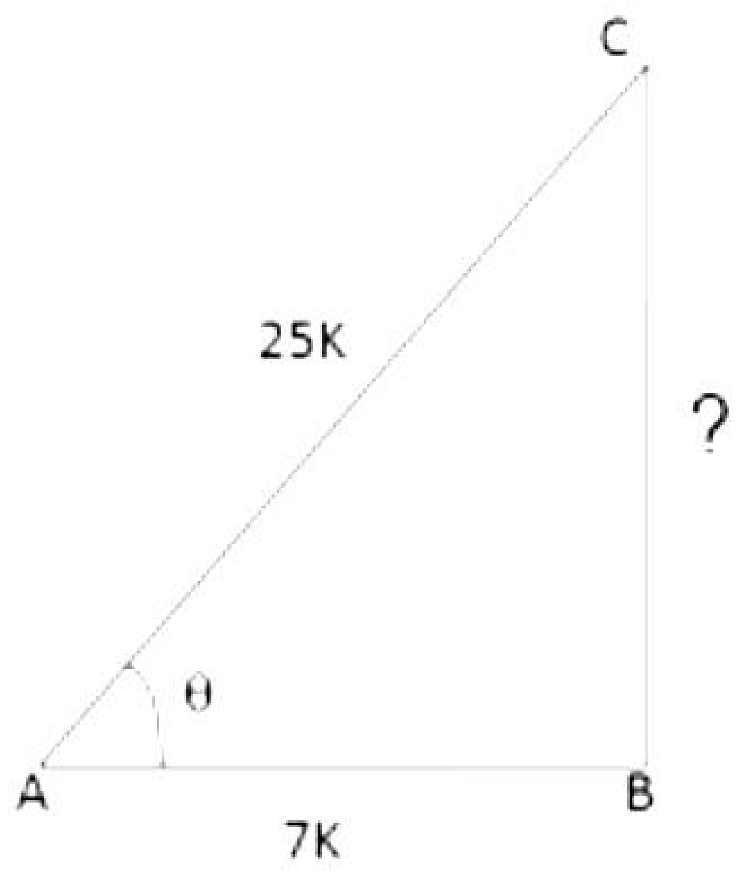
⇒ BC/YZ = XB/XY … (Corresponding sides of similar triangles)

⇒ BC/YZ =½

∴ YZ = 2 × BC = 2 × 20 = 40 m

Hence, the distance YZ is 40 m.

30.



Given : $\cos\theta = \frac{7}{25}$

Let $AB = 7k$ and $AC = 25k$,

where k is positive

Let us draw ΔABC in which $\angle B = 90°$ and $\angle BAC = \theta$.

By Pythagoras' theorem, we have

$$AC^2 = AB^2 + BC^2$$

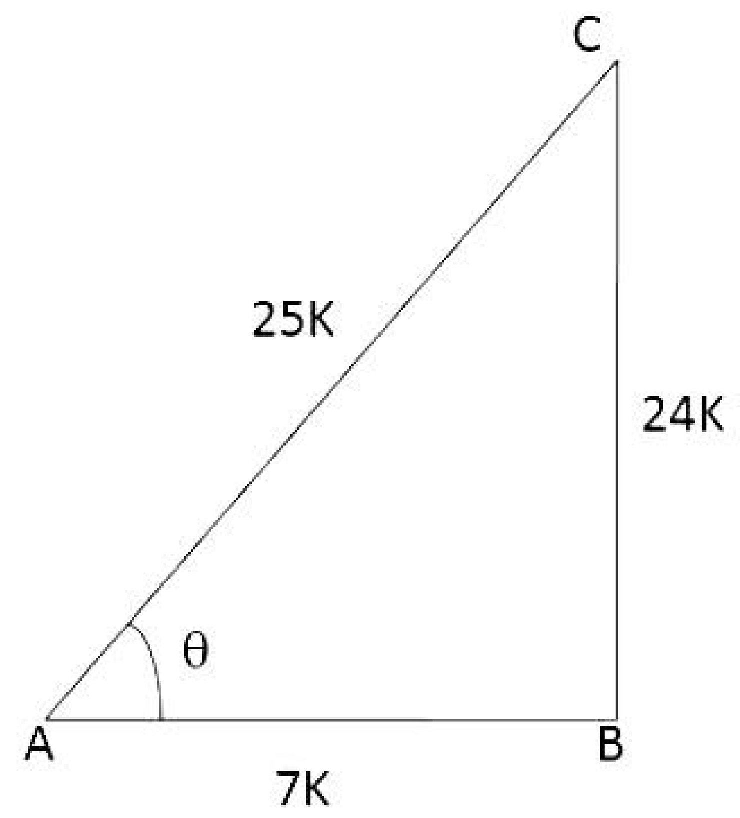
$$\Rightarrow BC^2 = AC^2 - AB^2$$

$$BC^2 = \left[(25k)^2 - (7k)^2\right]$$

$$= \left(625k^2 - 49k^2\right)$$

$$= 576k^2$$

$$\Rightarrow BC = \sqrt{576k^2} = 24k$$



$$\therefore \sin\theta = \frac{BC}{AC} = \frac{24k}{25k} = \frac{24}{25}; \cos\theta = \frac{7}{25}(\text{given})$$

$$\tan\theta = \frac{\sin\theta}{\cos\theta} = \left(\frac{24}{25} \times \frac{25}{7}\right) = \frac{24}{7}$$

$$\operatorname{cosec}\theta = \frac{1}{\sin\theta} = \frac{25}{24}$$

$$\sec\theta = \frac{1}{\cos\theta} = \frac{25}{7}$$

$$\cot\theta = \frac{1}{\tan\theta} = \frac{7}{24}$$

31.

i. Total number of balls = 20

Even numbers are 2, 4, 6, 8, 10, 12, 14, 16, 18, 20.

Total no. of even numbers = 10

P(getting an even number) = $\frac{10}{20} = \frac{1}{2}$

ii. Numbers divisible by 2 and 3 are 6, 12, 18.

Total no. of numbers divisible by 2 and 3 = 3

P(getting a number divisible by 2 and 3) = $\frac{3}{20}$

iii. Prime numbers are 2, 3, 5, 7, 11, 13, 17, 19

Total no. of prime numbers = 8

P(getting a prime number) = $\frac{8}{20} = \frac{2}{5}$

Section D

32. Let the marks obtained by Kamal in Mathematics and English be x and y.

$\therefore x + y = 40 \quad ....(1)$

and $(x+3)(y-4) = 360 \quad ....(2)$

From (1), $y = 40 - x$

Putting value of y in (2)

$(x+3)(40-x-4) = 360$

$\Rightarrow (x+3)(36-x) = 360$

$\Rightarrow 36x - x^2 + 108 - 3x = 360$

$\Rightarrow -x^2 + 33x - 252 = 0$

$\Rightarrow x^2 - 33x + 252 = 0$

$\Rightarrow x^2 - 21x - 12x + 252 = 0$

$\Rightarrow x(x-21) - 12(x-21) = 0$

$\Rightarrow (x-21)(x-12) = 0$

When $x - 21 = 0$, $x = 21$

when $x - 12 = 0$, $x = 12$

For $x = 21$,

$y = 40 - 21 = 19$

For $x = 12$,

$y = 40 - 12 = 28$

The marks obtained by Kamal in Mathematics and English, respectively, are 21 and 19 or 12 and 28.

OR

Let x km/hr be the usual speed of the passenger train.

Then, time taken to travel 300 km $= \frac{300}{x}$ hours

When speed is (x + 5) km/hr, the time taken to travel 300 km $= \frac{300}{x+5}$ hours

$\therefore \frac{300}{x} - \frac{300}{x+5} = 2$

$\Rightarrow \frac{1}{x} - \frac{1}{x+5} = \frac{2}{300} = \frac{1}{150}$

$\Rightarrow \frac{x+5-x}{x(x+5)} = \frac{1}{150}$

$\Rightarrow \frac{5}{x(x+5)} = \frac{1}{150}$

$\therefore x(x+5) = 750$ or $x^2 + 5x - 750 = 0$

$\Rightarrow x^2 + 30x - 25x - 750 = 0$

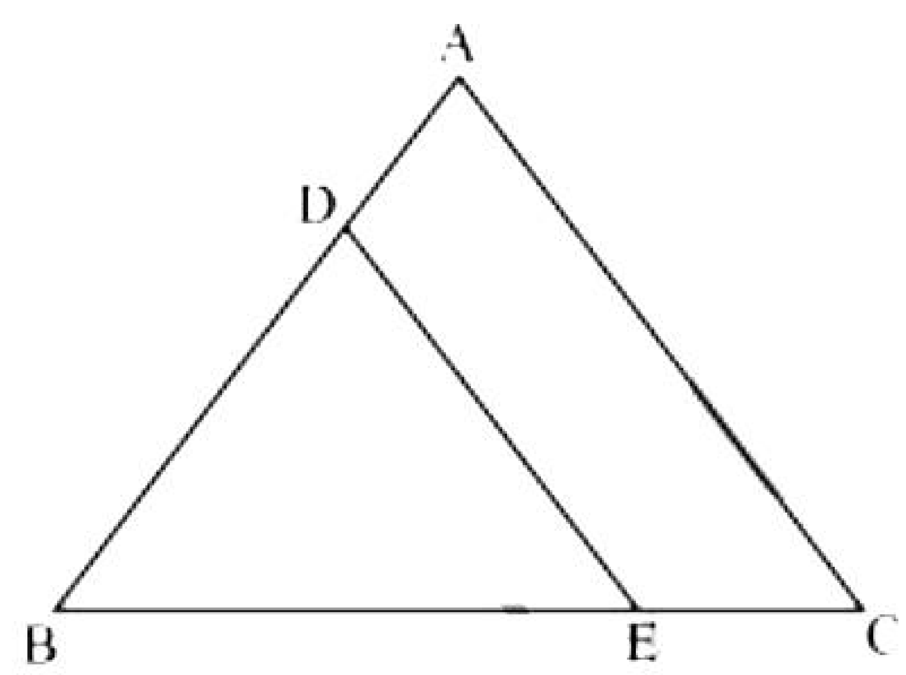
$\Rightarrow x(x+30) - 25(x+30) = 0$ or $(x+30)(x-25) = 0$

$\therefore x + 30 = 0, x = -30,$ but x cannot be negative

$\therefore x - 25 = 0, x = 25$

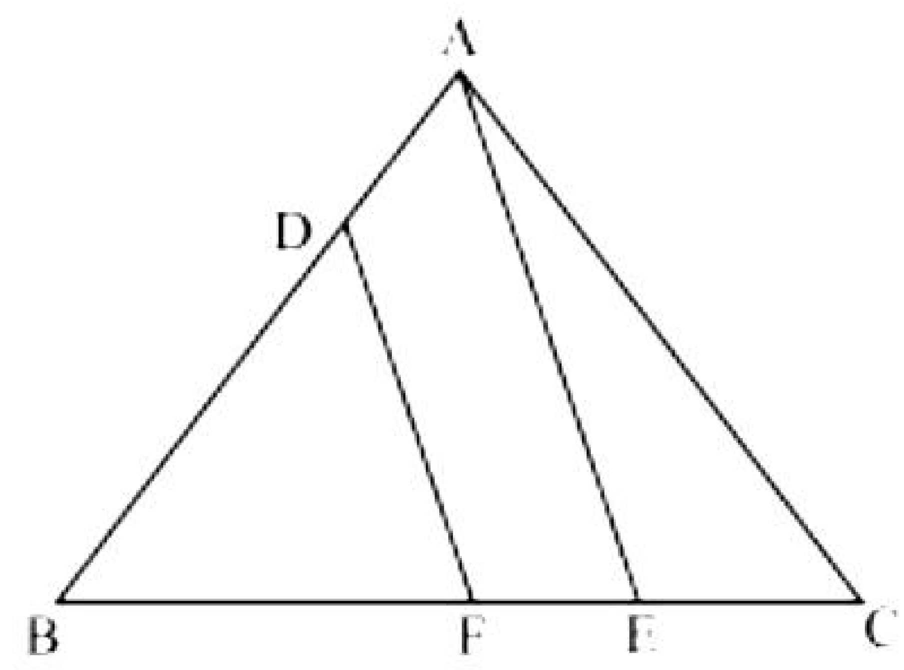
Therefore, the usual speed of the passenger train is 25 km/hr.

33.



In ΔABC, DE || AC.

$\therefore \frac{BD}{DA} = \frac{BE}{EC}$ ....(i)



In ΔBAE, $DF \parallel AE$.

$\therefore \frac{BD}{DA} = \frac{BF}{FE}$ ....(ii)

From (i) and (ii),

$\frac{BE}{EC} = \frac{BF}{FE}$

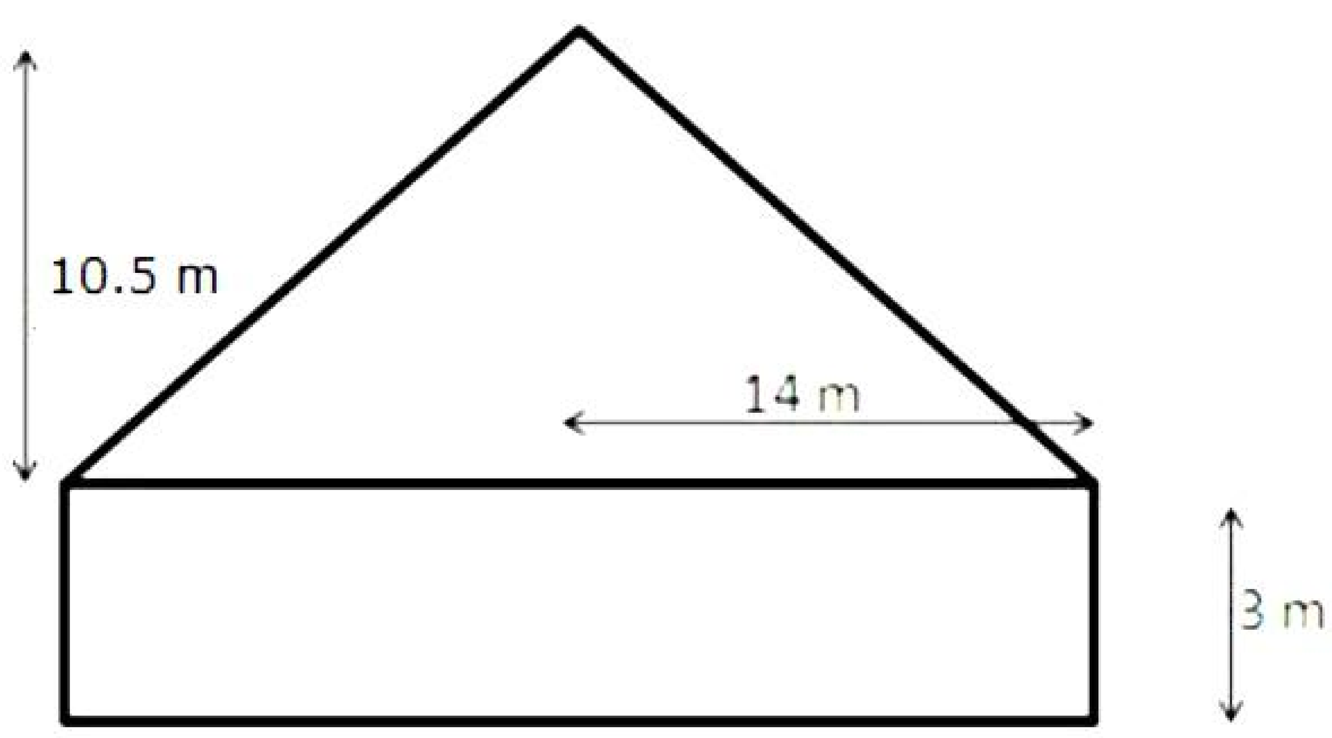
34. For a cylinder,
Radius = 14 m and Height = 3 m
For a cone,
Radius = 14 m and Height = 10.5 m
Let l be the slant height of the cone. Then,

$l = \sqrt{(14)^2 + (10.5)^2}$

$= \sqrt{(196 + 110.25)}$

$= \sqrt{306.25}$

$= 17.5$ m



Now, Curved surface area of the tent
= (curved area of the cylinder + curved surface area of the cone)

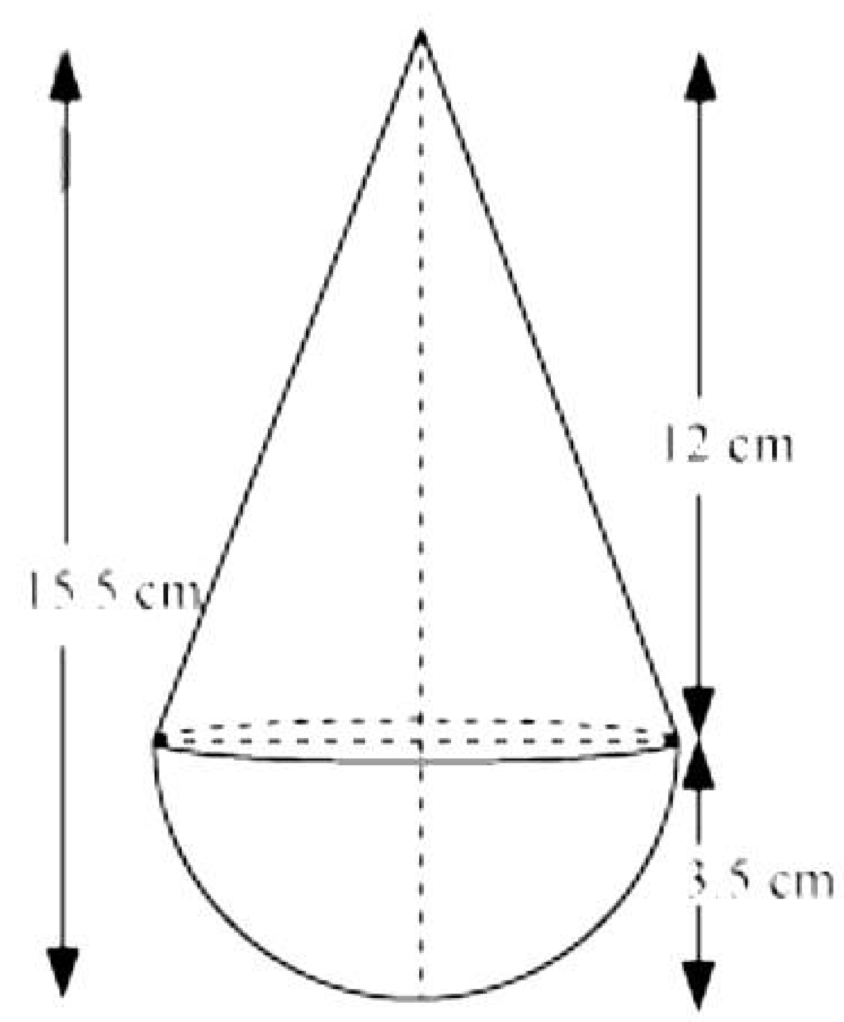
$= \left[\left(2 \times \frac{22}{7} \times 14 \times 3\right) + \left(\frac{22}{7} \times 14 \times 17.5\right)\right] m^2$

$= (264 + 770) m^2$

$= 1034 \ m^2$

Hence, the cost of canvas = Rs. (1034 × 80) = Rs. 82720.

OR



Radius of the conical part and the hemispherical part (r) = 3.5 cm

Height of hemispherical part = radius = 3.5 = $\frac{7}{2}$ cm.

Height of conical part (h) = (15.5 – 3.5) = 12 cm

Slant height (l) of conical part $= \sqrt{r^2 + h^2}$

$$= \sqrt{\left(\frac{7}{2}\right)^2 + (12)^2} = \sqrt{\frac{49}{4} + 144} = \sqrt{\frac{49 + 576}{4}}$$

$$= \sqrt{\frac{625}{4}} = \frac{25}{2}$$

Total surface area of toy = CSA of conical part + CSA of hemispherical part

$= \pi rl + 2\pi r^2$

$= \frac{22}{7} \times \frac{7}{2} \times \frac{25}{2} + 2 \times \frac{22}{7} \times \frac{7}{2} \times \frac{7}{2}$

$= 137.5 + 77$

$= 214.5 \text{ cm}^2$

35. Let us find class mark for each interval by using the relation.

$$x_i = \frac{\text{upper class limit } + \text{ lower class limit}}{2}$$

Class size (h) of this data = 20

Now taking 150 as assured mean (a) we may calculate d_i, u_i and f_iu_i as following:

Daily wages (in Rs)	Number of workers (f_i)	x_i	$d_i = x_i - 150$	$u_i = \frac{x_i - 150}{h}$	f_iu_i
100 –120	12	110	–40	–2	–24
120 – 140	14	130	–20	–1	–14
140 – 160	8	150	0	0	0
160 –180	6	170	20	1	6
180 – 200	10	190	40	2	20
Total	50				–12

Here, $\sum f_i = 50$ and $\sum f_iu_i = -12$

Mean $\bar{x} = a + \left(\frac{\sum f_iu_i}{\sum f_i}\right)h$

$= 150 + \left(\frac{-12}{50}\right)20$

$= 150 - \frac{24}{5}$

$= 150 - 4.8$

$= 145.2$

Therefore, the mean daily wages of the workers in a factory is Rs.145.20

Section E

36.

i. Here, the chocolates are arranged in increasing order of 2.
Thus, it forms an A.P. with a = 3 and d = 2.
Therefore, the required A.P. is 3, 5, 7, …..
Given, S_n = 120

$$S_n = \frac{n}{2}\left[2a + (n-1)d\right]$$

$$\Rightarrow 120 = \frac{n}{2}\left[2 \times 3 + (n-1)2\right]$$

$$\Rightarrow 240 = \left(6n + 2n^2 - 2n\right)$$

$$\Rightarrow n^2 + 2n - 120 = 0$$

$$\Rightarrow (n+12)(n-10) = 0$$

$$\Rightarrow (n+12) = 0 \text{ or } (n-10) = 0$$

$$\Rightarrow n = -12 \text{ or } n = 10$$

Number of rows can't be negative.
Hence, total number of rows of chocolates is 10.

ii. Here, a = 3, d = 2 and n = 10
$a_n = a_{10} = a + (n - 1)d = 3 + (10 - 1)2 = 21$
Hence, 21 chocolates are placed in last row.

OR

We have, d = 2 and $a_n = a + (n - 1)d$
$\Rightarrow a_7 - a_3 = a + 6d - a - 2d = 4d = 4(2) = 8$
Hence, the difference in number of chocolates placed in 7^{th} and 3^{rd} row is 8.

iii. Here, n = 15

$$S_n = \frac{n}{2}\left[2a + (n-1)d\right]$$

$$\Rightarrow S_{15} = \frac{15}{2}\left[2 \times 3 + 14 \times 2\right] = \frac{15 \times 34}{2} = 255$$

Hence, 255 chocolates will be placed by her with the same arrangement.

37.

i. Distance covered by Bus No. 735 = OA

$A(4,4)$ and $O(0,0)$.

$AO = \sqrt{(0-4)^2 + (0-4)^2} = 4\sqrt{2}$ km

ii. Distance between locations B and A = AB

$A(4,4)$ and $B(3,1)$.

$AB = \sqrt{(4-3)^2 + (4-1)^2} = \sqrt{10}$ km

OR

Distance between locations O and B.

$B(3,1)$ and $O(0,0)$

$OB = \sqrt{(0-3)^2 + (0-1)^2} = \sqrt{10}$ km

iii. distance covered by Bus No. 736 = O – B – A

$A(4,4)$, $B(3,1)$ and $O(0,0)$.

$OB = \sqrt{(0-3)^2 + (0-1)^2} = \sqrt{10}$ km

$AB = \sqrt{(4-3)^2 + (4-1)^2} = \sqrt{10}$ km

$O - B - A = 2\sqrt{10}$ km

38.

i. Height of the pole is 10 m which is AX.

AB = AX – XB = 10 – 4 = 6 m

ii. In right-angled ΔBAC,

$\tan 60^\circ = \frac{AB}{AC}$

$\Rightarrow \sqrt{3} = \frac{6}{AC}$

$\Rightarrow AC = 2\sqrt{3}$ m

Hence, the distance between foot of the ladder and the pole is $2\sqrt{3}$ m.

OR

In right-angled ΔBAC,

$\sin 60^\circ = \frac{AB}{BC}$

$\Rightarrow \frac{\sqrt{3}}{2} = \frac{6}{BC}$

$\Rightarrow BC = 4\sqrt{3}$ m

iii. If AB = AC ⇒ ∠ACB = ∠ABC

And, ∠BAC = 90°

Then, in ΔABC,

∠ACB + ∠ABC + ∠BAC = 180°

⇒ 2∠ACB + 90° = 180°

⇒ 2∠ACB = 90°

⇒ ∠ACB = 45°

Thus, the angle made by the ladder with the ground must be 45°.