Time : 3 Hours
Maximum Marks : 80

MATHEMATICS

CBSE
Sample Question Paper 2020-21
(Issued by CBSE)

Sample Question Paper 1

Solved

General Instructions :

1. *This question paper contains two parts A and B.*
2. *Both Part A and Part B have internal choices.*

Part – A :

1. *It consists two sections- I and II.*
2. *Section I has 16 questions of 1 mark each. Internal choice is provided in 5 questions.*
3. *Section II has 4 questions on case study. Each case study has 5 case-based sub-parts. An examinee is to attempt any 4 out of 5 sub-parts.*

Part – B :

1. *Question No. 21 to 26 are Very short answer Type questions of 2 mark each.*
2. *Question No. 27 to 33 are Short Answer Type questions of 3 marks each.*
3. *Question No. 34 to 36 are Long Answer Type questions of 5 marks each.*
4. *Internal choice is provided in 2 questions of 2 marks, 2 questions of 3 marks and 1 question of 5 marks.*

PART-A

Section-I

Section I has 16 questions of 1 mark each. Internal choice is provided in 5 questions.

1. If $xy = 180$ and HCF $(x, y) = 3$, then find the LCM (x, y).

OR

The decimal representation of $\frac{14587}{2^1 \times 5^4}$ will terminate after how many decimal places?

2. If the sum of the zeroes of the quadratic polynomial $3x^2 - kx + 6$ is 3, then find the value of k.
3. For what value of k, the pair of linear equations $3x + y = 3$ and $6x + ky = 8$ does not have a solution.
4. If 3 chairs and 1 table costs ₹ 1500 and 6 chairs and 1 table costs ₹ 2400. Form linear equations to represent this situation.

5. Which term of the A.P. 27, 24, 21,…..is zero?

OR

In an Arithmetic Progression, if $d = -4$, $n = 7$, $a_n = 4$, then find a.

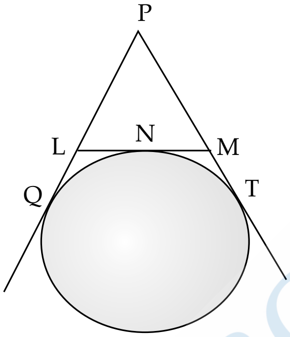
6. For what values of k, the equation $9x^2 + 6kx + 4 = 0$ has equal roots ?

7. Find the roots of the equation $x^2 + 7x + 10 = 0$.

OR

For what value(s) of 'a' quadratic equation $3ax^2 - 6x + 1 = 0$ has no real roots ?

8. If PQ = 28 cm, then find the perimeter of ΔPLM.



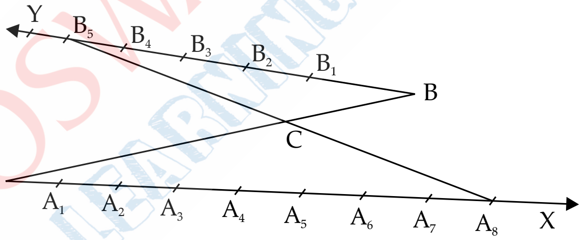
9. If two tangents are inclined at 60° are drawn to a circle of radius 3 cm, then find length of each tangent.

OR

PQ is a tangent to a circle with centre O at point P. If ΔOPQ is an isosceles triangle, then find $\angle$OQP.

10. In the ΔABC, D and E are points on side AB and AC respectively such that DE || BC. If AE = 2 cm, AD = 3 cm and BD = 4.5 cm, then find CE.

11. In the figure, if B_1, B_2, B_3,….. and A_1, A_2, A_3,….. have been marked at equal distances. In what ratio C divides AB?



12. sin A + cos B = 1, A = 30° and B is an acute angle, then find the value of B.

13. If $x = 2\sin^2\theta$ and $y = 2\cos^2\theta + 1$, then find $x + y$.

14. In a circle of diameter 42 cm,if an arc subtends an angle of 60° at the centre where $\pi = \frac{22}{7}$, then what will be the length of arc.

15. 12 solid spheres of the same radii are made by melting a solid metallic cylinder of base diameter 2 cm and height 16 cm. Find the diameter of the each sphere.

16. Find the probability of getting a doublet in a throw of a pair of dice.

OR

Find the probability of getting a black queen when a card is drawn at random from a well-shuffled pack of 52 cards.

Section-II

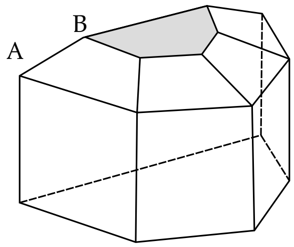
Case study based questions are compulsory. Attempt any four subparts of each question. Each subpart carries 1 mark.

17. Case Study Based-1

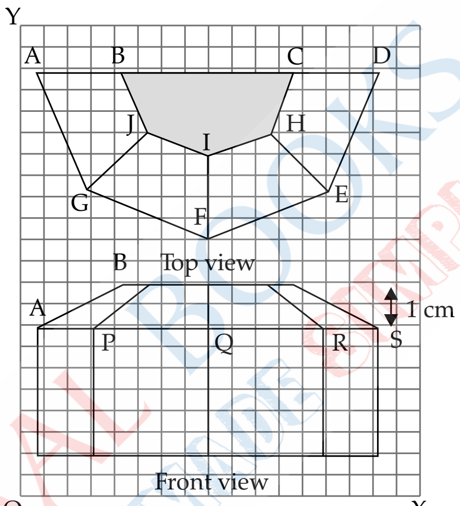
SUN ROOM

The diagrams show the plans for a sun room. It will be built onto the wall of a house. The four walls of the sunroom are square clear glass panels. The roof is made using

- Four clear glass panels, trapezium in shape, all the same size
- One tinted glass panel, half a regular octagon in shape



Not to scale



Scale 1 cm = 1 m

(i) Refer to Top View

Find the mid-point of the segment joining the points J (6, 17) and I (9, 16).

(a) $\frac{33}{2}, \frac{15}{2}$ **(b)** $\frac{3}{2}, \frac{1}{2}$ **(c)** $\frac{15}{2}, \frac{33}{2}$ **(d)** $\frac{1}{2}, \frac{3}{2}$

(ii) Refer to Top View

The distance of the point P from the y-axis is

(a) 4 **(b)** 15 **(c)** 19 **(d)** 25

(iii) Refer to Front View

The distance between the points A and S is

(a) 4 **(b)** 8 **(c)** 16 **(d)** 20

(iv) Refer to Front View

Find the co-ordinates of the point which divides the line segment joining the points A and B in the ratio 1:3 internally.

(a) (8.5, 2.0) **(b)** (2.0, 9.5) **(c)** (3.0, 7.5) **(d)** (2.0, 8.5)

(v) Refer to Front View

If a point (x, y) is equidistant from the Q(9, 8) and S(17, 8), then

(a) $x + y = 13$ **(b)** $x - 13 = 0$ **(c)** $y - 13 = 0$ **(d)** $x - y = 13$

18. Case Study Based- 2

SCALE FACTOR AND SIMILARITY

SCALE FACTOR

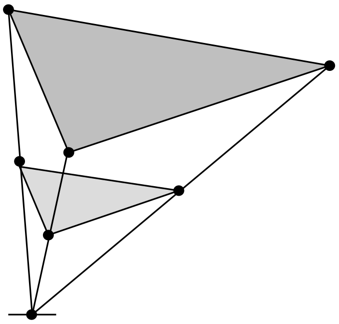
A scale drawing of an object is the same shape as the object but a different size.

The scale of a drawing is a comparison of the length used on a drawing to the length it represents. The scale is written as a ratio.

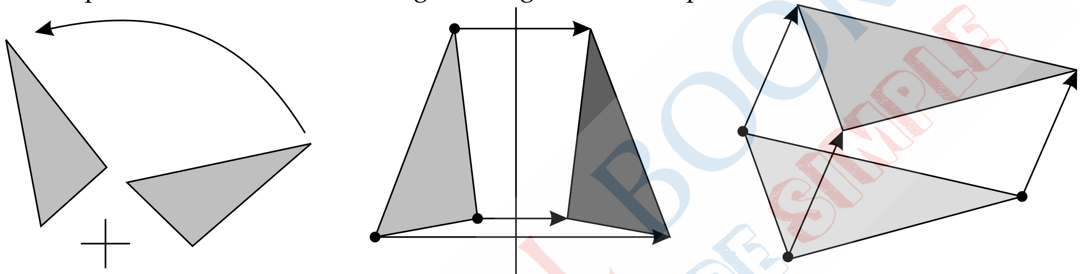
SIMILAR FIGURES

The ratio of two corresponding sides in similar figures is called the scale factor.

$$\text{Scale factor} = \frac{\text{length in image}}{\text{corresponding length in object}}$$



If one shape can become another using Resizing then the shapes are **Similar**



Rotation or Turn

Reflection or Flip

Translation or Slide

Hence, two shapes are **Similar** when one can become the other after a resize, flip, slide or turn.

(i) A model of a boat is made on the scale of 1 : 4. The model is 120 cm long. The full size of the boat has a width of 60 cm. What is the width of the scale model?

(a) 20 cm **(b)** 25 cm **(c)** 15 cm **(d)** 240 cm

(ii) What will effect the similarity of any two polygons?

(a) They are flipped horizontally **(b)** They are dilated by a scale factor

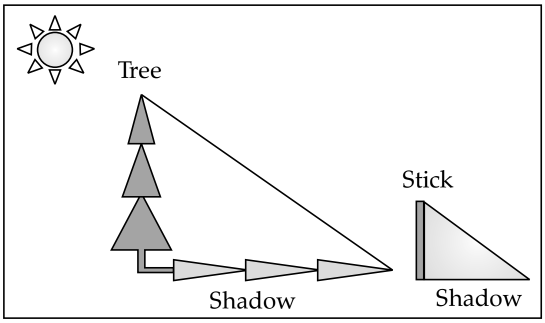
(c) They are translated down **(d)** They are not the mirror image of one another

(iii) If two similar triangles have a scale factor of $a : b$. Which statement regarding the two triangles is true ?

(a) The ratio of their perimeters is $3a : b$ **(b)** Their altitudes have a ratio $a : b$

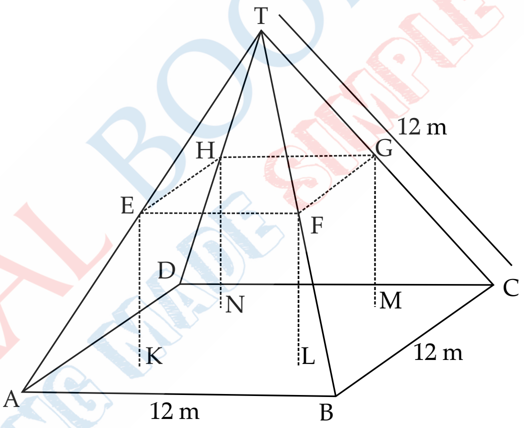
(c) Their medians have a ratio $\frac{a}{2} : b$ **(d)** Their angle bisectors have a ratio $a^2 : b^2$

(iv) The shadow of a stick 5 m long is 2 m. At the same time the shadow of a tree 12.5 m high is



(a) 3 m **(b)** 3.5 m **(c)** 4.5 m **(d)** 5 m

(v) Below you see a student's mathematical model of a farmhouse roof with measurements. The attic floor, ABCD in the model, is a square. The beams that support the roof are the edges of a rectangular prism, EFGHKLMN. E is the middle of AT, F is the middle of BT, G is the middle of CT, and H is the middle of DT. All the edges of the pyramid in the model have length of 12 m.



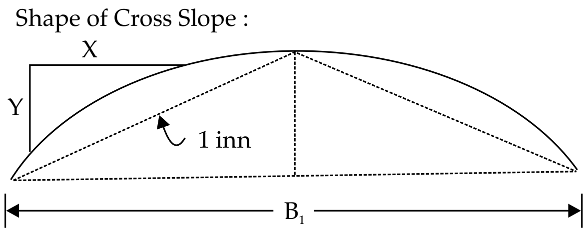
What is the length of EF, where EF is one of the horizontal edges of the block?

(a) 24 m **(b)** 3 m **(c)** 6 m **(d)** 10 m

19. Case Study Based- 3

Applications of Parabolas-Highway Overpasses/Underpasses

A highway underpass is parabolic in shape.



a. Paraboilc camber

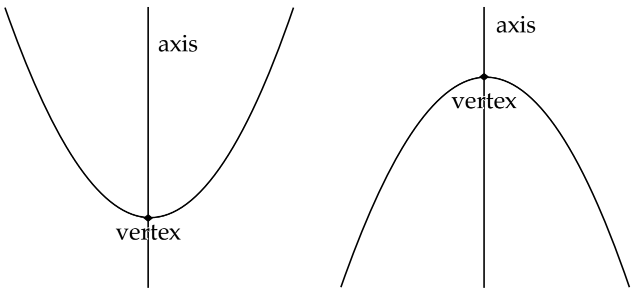
$y = 2x^2/nw$

Parabola

A parabola is the graph that results from $p(x) = ax^2 + bx + c$.

Parabolas are symmetric about a vertical line known as the **Axis of Symmetry.**

The Axis of Symmetry runs through the maximum or minimum point of the parabola which is called the vertex.



(i) If the highway overpass is represented by $x^2 - 2x - 8$. Then its zeroes are
(a) $(2, -4)$ **(b)** $(4, -2)$ **(c)** $(-2, -2)$ **(iv)** $(-4, -4)$

(ii) The highway overpass is represented graphically.
Zeroes of a polynomial can be expressed graphically. Number of zeroes of polynomial is equal to number of points where the graph of polynomial
(a) Intersects x-axis **(b)** Intersects y-axis
(c) Intersects y-axis or x-axis **(d)** None of the above

(iii) Graph of a quadratic polynomial is a
(a) straight line **(b)** circle **(c)** parabola **(d)** ellipse

(iv) The representation of Highway Underpass whose one zero is 6 and sum of the zeroes is 0, is
(a) $x^2 - 6x + 2$ **(b)** $x^2 - 36$ **(c)** $x^2 - 6$ **(d)** $x^2 - 3$

(v) The number of zeroes that polynomial $f(x) = (x - 2)^2 + 4$ can have is :
(a) 1 **(b)** 2 **(c)** 0 **(d)** 3

20. Case Study Based-4
100 m RACE
A stopwatch was used to find the time that it took a group of students to run 100 m.

Time (in sec)	0-20	20-40	40-60	60-80	80-100
No. of students	8	10	13	6	3

(i) Estimate the mean time taken by a student to finish the race.
(a) 54 **(b)** 63 **(c)** 43 **(d)** 50

(ii) What will be the upper limit of the modal class ?
(a) 20 **(b)** 40 **(c)** 60 **(d)** 80

(iii) The construction of cummulative frequency table is useful in determining the
(a) Mean **(b)** Median **(c)** Mode **(d)** All of the above

(iv) The sum of lower limits of median class and modal class is
(a) 60 **(b)** 100 **(c)** 80 **(d)** 140

(v) How many students finished the race within 1 minute?
(a) 18 **(b)** 37 **(c)** 31 **(d)** 8

PART-B

Section-III

All questions are compulsory. In case of internal choices, attempt any one.

21. 3 bells ring at an interval of 4, 7 and 14 minutes. All three bells rang at 6 am, when the three bells will the ring together next?

22. Find the point on x-axis which is equidistant from the points (2, – 2) and (– 4, 2).

OR

P(–2, 5) and Q (3, 2) are two points. Find the co-ordinates of the point R on PQ such that PR = 2QR.

23. Find a quadratic polynomial whose zeroes are $5-3\sqrt{2}$ and $5+3\sqrt{2}$.

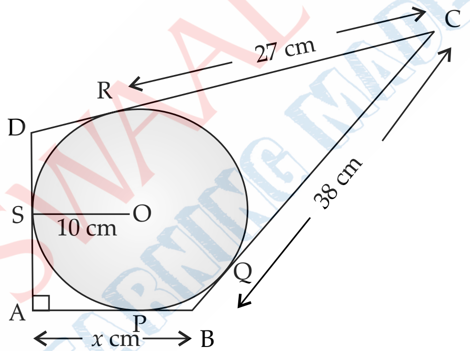
24. Draw a line segment AB of length 9 cm. With A and B as centres, draw circles of radius 5 cm and 3 cm respectively. Construct tangents to each circle from the centre of the other circle.

25. If $\tan A = \frac{3}{4}$, find the value of $\frac{1}{\sin A}+\frac{1}{\cos A}$.

OR

If $\sqrt{3}\sin\theta - \cos\theta = 0$ and $0^\circ < \theta < 90^\circ$, find the value of θ.

26. In the figure, quadrilateral ABCD is circumscribing a circle with centre O and AD ⊥ AB. If radius of incircle is 10 cm, then find the value of x.



Section-IV

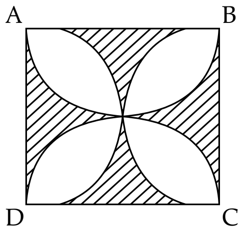
27. Prove that $2-\sqrt{3}$ is irrational, given that $\sqrt{3}$ is irrational.

28. If one root of the quadratic equation $3x^2 + px + 4 = 0$ is $\frac{2}{3}$, then find the value of p and the other root of the equation.

OR

The roots α and β of the quadratic equation $x^2 - 5x + 3(k-1) = 0$ are such that $\alpha - \beta = 1$. Find the value k.

29. In the figure, ABCD is a square of side 14 cm. Semi-circles are drawn with each side of square as diameter. Find the area of the shaded region.



30. The perimeters of two similar triangles are 25 cm and 15 cm respectively. If one side of the first triangle is 9 cm, find the length of the corresponding side of the second triangle.

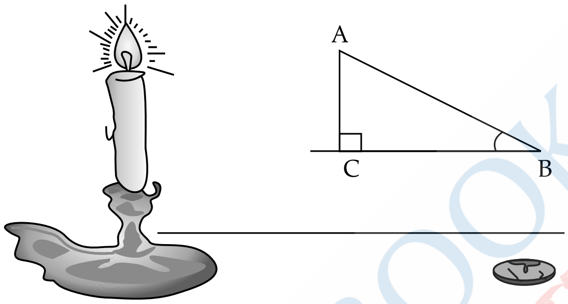
OR

In an equilateral triangle ABC, D is a point on side BC such that BD = $\frac{1}{3}$ BC. Prove that $9\,AD^2 = 7\,AB^2$.

31. The median of the following data is 16. Find the missing frequencies *a* and *b*, if the total of the frequencies is 70.

Class	0-5	5-10	10-15	15-20	20-25	25-30	30-35	35-40
Frequency	12	*a*	12	15	*b*	6	6	4

32.



If the angles of elevation of the top of the candle from two coins distant '*a*' cm and '*b*' cm ($a > b$) from its base and in the same straight line from it are 30° and 60°, then find the height of the candle.

33. The mode of the following data is 67. Find the missing frequency *x*.

Class	40-50	50-60	60-70	70-80	80-90
Frequency	5	*x*	15	12	7

Section-V

34. The two palm trees are of equal heights and are standing opposite each other on either side of the river, which is 80 m wide. From a point O between them on the river the angles of elevation of the top of the trees are 60° and 30°, respectively. Find the height of the trees and the distances of the point O from the trees.

OR

The angles of depression of the top and bottom of a building 50 meters high as observed from the top of a tower are 30° and 60° respectively. Find the height of the tower, and also the horizontal distance between the building and the tower.

35. Water is flowing through a cylindrical pipe of internal diameter 2 cm, into a cylindrical tank of base radius 40 cm at the rate of 0.7 m/sec. By how much will the water rise in the tank in half an hour ?

36. A motorboat covers a distance of 16 km upstream and 24 km downstream in 6 hours. In the same time it covers a distance of 12 km upstream and 36 km downstream. Find the speed of the boat in still water and that of the stream.

■■■

Time : 3 Hours
Maximum Marks : 80

MATHEMATICS

CBSE Solutions With CBSE Marking Scheme

Solutions of Question Paper 1

PART-A

Section-I

1. "LCM × HCF = Product of two numbers" ½

$$(\text{LCM})\,(3) = 180$$

$$\text{LCM} = 60 \quad ½$$

OR

Four decimal places 1

(CBSE Marking Scheme 2020)

Detailed Solution :

$$\frac{14587}{2\times5^4} = \frac{14587}{2\times5^4}\times\frac{2^3}{2^3}$$

$$= \frac{14587\times(2)^3}{10^4} = \frac{116696}{10000}$$

$$= 11.6696$$

Thus the given rational number terminates after four decimal places. 1

2. $$\alpha + \beta = \frac{k}{3} \quad ½$$

$$3 = \frac{k}{3}$$

$$k = 9 \quad ½$$

3. System has no solution if

$$\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$$

$$\frac{3}{6} = \frac{1}{k} \neq \frac{3}{8} \quad ½$$

$$\frac{3}{6} = \frac{1}{k}$$

$$k = 2 \quad ½$$

4. Let the cost of 1 chair = ₹x ½

and the cost of 1 table = ₹y

According to question,

$$3x + y = 1500 \quad ½$$

and $$6x + y = 2400$$

5. $$a_n = a + (n-1)d$$

$$0 = 27 + (n-1)(-3) \quad ½$$

$$30 = 3n$$

$$n = 10 \quad ½$$

OR

$$a_n = a + (n-1)d$$

$$4 = a + 6 \times (-4) \quad ½$$

$$a = 28 \quad ½$$

6. $$9x^2 + 6kx + 4 = 0$$

For equal roots $b^2 - 4ac = 0$

$$(6k)^2 - 4 \times 9 \times 4 = 0 \quad ½$$

$$36k^2 = 144$$

$$k^2 = 4$$

$$k = \pm 2 \quad ½$$

7. $$x^2 + 7x + 10 = 0$$

$$x^2 + 5x + 2x + 10 = 0 \quad ½$$

$$(x+5)(x+2) = 0$$

Either $x = -5$

or $x = -2$ ½

OR

$$3ax^2 - 6x + 1 = 0$$

For no real roots $b^2 - 4ac < 0$ ½

$$(-6)^2 - 4(3a)(1) < 0$$

$$12a > 36$$

$$a > 3 \quad ½$$

8. $\because$

$$PQ = PT$$
$$PL + LQ = PM + MT$$
$$PL + LN = PM + MN$$

Perimeter(ΔPLM)

$= PL + LM + PM$ ½

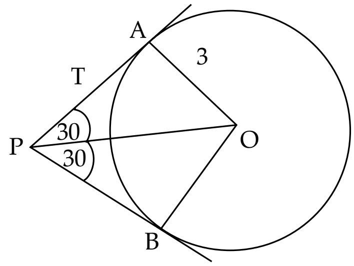
$= PL + LN + MN + PM$

$= 2(PL + LN)$

$= 2(PL + LQ)$

$= 2 \times 28 = 56$ cm ½

9.



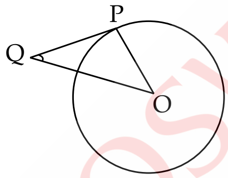
In ΔPAO,

$$\tan 30° = \frac{AO}{PA}$$ ½

$$\frac{1}{\sqrt{3}} = \frac{3}{PA}$$

$$PA = 3\sqrt{3} \text{ cm}$$ ½

OR



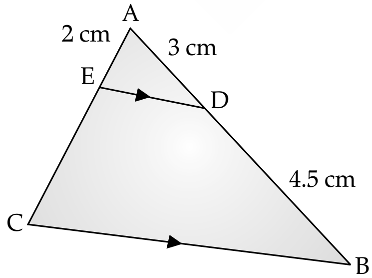
In ΔOPQ,

$$\angle P + \angle Q + \angle O = 180°$$
$$2\angle Q + \angle P = 180°$$
$$2\angle Q + 90° = 180°$$
$$2\angle Q = 90°$$
$$\angle Q = 45°$$

make angle sign before P and Q = 180° 1

make angle sign before Q

10.



$$\frac{AD}{BD} = \frac{AE}{CE}$$ [By using BPT] ½

$$\frac{3}{4.5} = \frac{2}{CE}$$

$$CE = 3 \text{ cm}$$ ½

11. C divides AB internally in the ratio 8 : 5 **1**

12.

$$\sin 30° + \cos B = 1$$

$$\frac{1}{2} + \cos B = 1$$ ½

$$\cos B = \frac{1}{2} = \cos 60°$$

$$B = 60°$$ ½

13.

$$x + y = 2\sin^2\theta + 2\cos^2\theta + 1$$ ½

$$= 2(\sin^2\theta + \cos^2\theta) + 1$$

$$= 3$$ ½

14.

$$\text{Length of arc} = \frac{\theta}{360°}(2\pi r)$$ ½

$$= \frac{60°}{360°}\left(2 \times \frac{22}{7} \times 21\right)$$

$$= 22 \text{ cm}$$ ½

15.

$$\pi R^2 H = 12 \times \frac{4}{3}\pi r^3$$

$$1 \times 1 \times 16 = \frac{4}{3} \times r^3 \times 12$$ ½

$$r^3 = 1$$

$$r = 1$$

$$d = 2 \text{ cm.}$$ ½

16. Probability of getting a doublet $= \frac{1}{6}$ **1**

(CBSE Marking Scheme 2020)

Detailed Solution :

The outcomes when two dice are thrown together are :

(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)

Total number of outcomes $= n(S) = 36$

Favourable outcomes are : (1, 1), (2, 2), (3, 3), (4, 4), (5, 5) and (6, 6) *i.e.*, $n(E) = 6$

$$\text{Required Probability} = \frac{n(E)}{n(S)} = \frac{6}{36} = \frac{1}{6}$$

OR

$$\text{Probability of getting a black queen} = \frac{2}{52} = \frac{1}{26}$$

(CBSE Marking Scheme 2020)

Detailed Solution :

Total no. of cards = 52

No. of black queens = 2

So, Probability of black queen = $\frac{2}{52} = \frac{1}{26}$

Section-II

17. (i) (c) Mid- point of J(6, 17) and I(9, 16) is

$$x = \frac{6+9}{2} \text{ and } y = \frac{17+16}{2}$$

$$x = \frac{15}{2} \text{ and } y = \frac{33}{2}$$

(ii) (a) 4

(iii) (c) 16

(iv) (d) (2.0, 8.5)

(v) (b) $x - 13 = 0$ **1×4=4**

(CBSE Marking Scheme 2020)

Detailed Solution :

Let point be P(x, y)

$$PQ^2 = PS^2$$

or, $(x-9)^2 + (y-8)^2 = (x-17)^2 + (y-8)^2$

or, $x - 13 = 0$

18. (i) (c) 15 cm **(CBSE Marking Scheme 2020)**

Detailed Solution :

width of the scale model = 60/4 = 15 cm

(ii) (d) They are not the mirror image of one another

(iii) (b) Their altitudes have a ratio $a : b$

(iv) (d) 5 m **(CBSE Marking Scheme 2020)**

Detailed Solution :

Let shadow of the tree be x.

By the property of similar triangle

we have $5/2 = 12.5/x$

or, $x = (12.5 \times 2)/5 = 5$ cm

(v) (c) 6 m **(CBSE Marking Scheme 2020)**

Detailed Solution :

Length of the horizontal edge EF

= half of the edge of pyramid

= 12/2 = 6 cm

(as E is the mid point of AT)

19. (i) (b) (4, – 2) **(CBSE Marking Scheme 2020)**

Detailed Solution :

$$x^2 - 2x - 8 = 0$$

or, $x^2 - 4x + 2x - 8 = 0$

or, $x(x-4) + 2(x-4) = 0$

or, $(x-4)(x+2) = 0$

or, $x = 4, x = -2$

(ii) (a) Intersects x-axis

(iii) (c) parabola

(iv) (b) $x^2 - 36$ **(CBSE Marking Scheme 2020)**

Detailed Solution :

$$x^2 - 36 = 0$$

or, $x = 6, -6$

(v) (c) 0

20. (i) (c) 43 **(CBSE Marking Scheme 2020)**

Detailed Solution :

Time (in sec)	x	f	cf	fx
0-20	10	8	8	80
20-40	30	10	18	300
40-60	50	13	31	650
60-80	70	6	37	420
80-100	90	3	40	270
Total		**40**		**1720**

$$\text{Mean} = \frac{1720}{40} = 43$$

(ii) (c) 60 **(CBSE Marking Scheme 2020)**

Detailed Solution :

Modal class = 40-60

Upper limit = 60

(iii) (b) Median

(iv) (c) 80 **(CBSE Marking Scheme 2020)**

Detailed Solution :

Median class = 40-60

Modal class = 40-60

Therefore, the sum of the lower limits of median and modal class = 40+40=80

(v) (c) 31 **(CBSE Marking Scheme 2020)**

Detailed Solution :

Number of students are: 8 + 10 + 13 = 31

PART-B

Section-III

21. $4 = 2 \times 2$ ½

$7 = 7 \times 1$ ½

$14 = 2 \times 7$ ½

LCM $= 2 \times 2 \times 7 = 28$ ½

The three bells will ring together again at 6 : 28 am

22. Let P(x, 0) be a point on x-axis

PA = PB ½

$PA^2 = PB^2$ ½

$$(x-2)^2 + (0+2)^2 = (x+4)^2 + (0-2)^2$$
$$x^2 + 4 - 4x + 4 = x^2 + 16 + 8x + 4$$
$$-4x + 4 = 8x + 16 \quad ½$$
$$x = -1 \quad ½$$

P(–1, 0).

OR

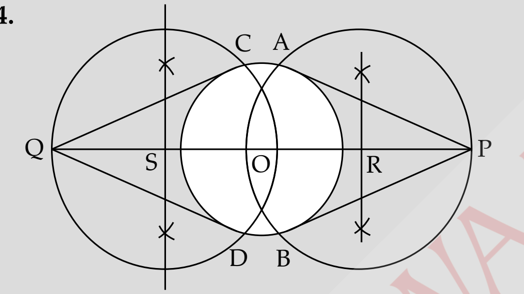
$$PR : QR = 2 : 1 \quad ½$$
$$R(x, y) = \left(\frac{mx_2 + nx_1}{m+n}, \frac{my_2 + ny_1}{m+n}\right)$$
$$R\left(\frac{1(-2)+2(3)}{2+1}, \frac{1(5)+2(2)}{2+1}\right) \quad 1$$
$$R\left(\frac{4}{3}, 3\right). \quad ½$$

23. Sum of zeroes $= 5-3\sqrt{2}+5+3\sqrt{2} = 10$ ½

Product of zeroes $= (5-3\sqrt{2})(5+3\sqrt{2}) = 7$ 1

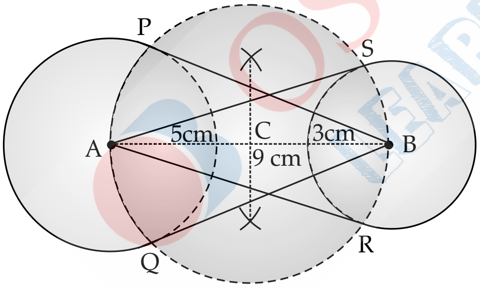
$$P(x) = x^2 - 10x + 7 \quad ½$$

24.



(CBSE Marking Scheme 2020) 2

Detailed Solution :



Steps of Construction :

1. Draw a line segment AB of 9 cm.
2. Taking A and B as centres draw two circles radii of 5 cm and 3 cm respectively.
3. Bisect the line AB. Let mid-point of AB be C.
4. Taking C as centre draw a circle of radius AC which intersects the two circles at point P, Q, R and S.
5. Join BP, BQ, AS and AR.

BP, BQ and AR, AS are the required tangents.

25.
$$\tan A = \frac{3}{4} = \frac{3k}{4k} \quad ½$$
$$\sin A = \frac{3k}{5k} = \frac{3}{5}$$
$$\cos A = \frac{4k}{5k} = \frac{4}{5} \quad ½$$
$$\frac{1}{\sin A} + \frac{1}{\cos A} = \frac{5}{3} + \frac{5}{4} \quad ½$$
$$= \frac{20+15}{12}$$
$$= \frac{35}{12} \quad ½$$

OR

$$\sqrt{3}\sin\theta = \cos\theta \quad ½$$
$$\frac{\sin\theta}{\cos\theta} = \frac{1}{\sqrt{3}} \quad ½$$
$$\tan\theta = \frac{1}{\sqrt{3}} \quad ½$$
$$\theta = 30° \quad ½$$

26. $\angle A = \angle OPA = \angle OSA = 90°$ ½

Hence, $\angle SOP = 90°$

Also, AP = AS

Hence, OSAP is a square.

$$AP = AS = 10 \text{ cm} \quad ½$$
$$CR = CQ = 27 \text{ cm}$$
$$BQ = BC - CQ$$
$$= 38 - 27 = 11 \text{ cm} \quad ½$$
$$BP = BQ = 11 \text{ cm}$$
$$x = AB = AP + BP$$
$$= 10 + 11 = 21 \text{ cm} \quad ½$$

Section-IV

27. Let $2-\sqrt{3}$ be a rational number ½

We can find co-primes a and b ($b \neq 0$) such that

$$2-\sqrt{3} = \frac{a}{b} \quad ½$$
$$2-\frac{a}{b} = \sqrt{3} \quad ½$$

So, we get $\frac{2a-b}{b} = \sqrt{3}$

Since a and b are integers, we get $\frac{2a-b}{b}$ is irrational and so $\sqrt{3}$ is rational. But $\sqrt{3}$ is an irrational number. ½

Which contradicts our statement ½

Therefore $2-\sqrt{3}$ is irrational. ½

28.
$$3x^2 + px + 4 = 0$$
$$3(2/3)^2 + p(2/3) + 4 = 0$$
$$\frac{4}{3} + \frac{2p}{3} + 4 = 0 \quad ½$$
$$p = -8 \quad ½$$

$$3x^2 - 8x + 4 = 0$$
$$3x^2 - 6x - 2x + 4 = 0 \quad ½$$
$$3x(x-2) - 2(x-2) = 0 \quad ½$$
$$x = 2/3 \text{ or } x = 2 \quad ½$$
Hence, $x = 2$ ½

OR

$$\alpha + \beta = 5 \quad ...(i)\ ½$$
$$\alpha - \beta = 1 \quad ...(ii)\ ½$$
Solving (i) and (ii), we get
$$\alpha = 3 \text{ and } \beta = 2 \quad ½$$
also $\alpha\beta = 6$ ½

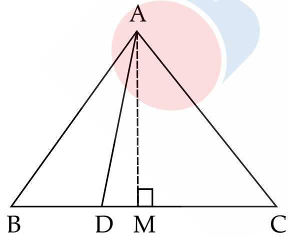
or $3(k-1) = 6$ ½
$$k - 1 = 2$$
$$k = 3 \quad ½$$

29. Area of 1 segment = area of sector – area of triangle ½
$$= \left(\frac{90°}{360°}\right)\pi r^2 - \frac{1}{2} \times 7 \times 7$$
$$= \frac{1}{4} \times \frac{22}{7} \times 7^2 - \frac{1}{2} \times 7 \times 7 \quad ½$$
$$= 14 \text{ cm}^2 \quad ½$$
Area of 8 segments $= 8 \times 14 = 112 \text{ cm}^2$ ½

Area of the shaded region $= 14 \times 14 - 112$ ½
$$= 196 - 112 = 84 \text{ cm}^2 \quad ½$$
(each petal is divided into 2 segments)

30. $\Delta ABC \sim \Delta DEF$
$$\frac{\text{Perimeter } (\Delta ABC)}{\text{Perimeter } (\Delta DEF)} = \frac{AB + BC + CA}{DE + EF + FD} = \frac{AB}{DE} \quad 1$$
$$\frac{25}{15} = \frac{9}{x} \quad ½$$
$$x = 5.4 \text{ cm} \quad ½$$
$$DE = 5.4 \text{ cm} \quad 1$$

OR



½

Construction : Draw $AM \perp BC$ ½
$$BD = \frac{1}{3} BC$$
$$BM = \frac{1}{2} BC$$
In ΔABM, $AB^2 = AM^2 + BM^2$ ½
$$= AM^2 + (BD + DM)^2$$
$$= AM^2 + DM^2 + BD^2 + 2BD.DM$$
$$= AD^2 + BD^2 + 2BD\,(BM - BD) \quad ½$$
$$= AD^2 + \left(\frac{BC}{3}\right)^2 + 2\frac{BC}{3}\left(\frac{BC}{2} - \frac{BC}{3}\right)$$
$$= AD^2 + 2\frac{BC^2}{9} \quad ½$$
$$= AD^2 + 2\frac{AB^2}{9}$$
Hence, $7AB^2 = 9AD^2$ ½

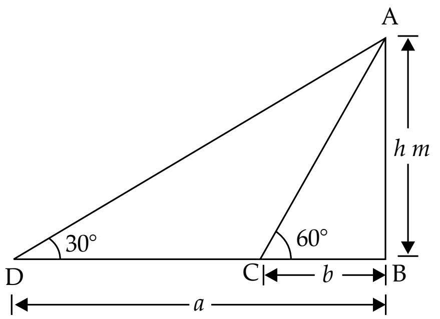
31.

Class	Frequency	Cumulative frequency
0-5	12	12
5-10	a	$12 + a$
10-15	12	$24 + a$
15-20	15	$39 + a$
20-25	b	$39 + a + b$
25-30	6	$45 + a + b$
30-35	6	$51 + a + b$
35-40	4	$55 + a + b$
Total	70	

1

$$55 + a + b = 70$$
$$a + b = 15 \quad ½$$
$$\text{Median} = l + \frac{\frac{N}{2} - cf}{f} \times h \quad ½$$
$$16 = 15 + \frac{35 - 24 - a}{15} \times 5$$
$$1 = (11 - a)/3$$
$$a = 8 \quad ½$$
$$55 + a + b = 70 \quad ½$$
$$55 + 8 + b = 70$$
$$b = 7$$

32.



½

Let AB = candle ½

C and D are coins
$$\tan 60° = \frac{AB}{BD} = \frac{h}{b}$$
$$\sqrt{3} = \frac{h}{b}$$
$$h = b\sqrt{3} \quad ...(i)\ ½$$

$$\tan 30^\circ = \frac{AB}{BD}$$

$$\frac{1}{\sqrt{3}} = \frac{h}{a}$$

$$h = \frac{a}{\sqrt{3}} \qquad \text{...(ii)} \ \tfrac{1}{2}$$

Multiplying (i) and (ii), we get

$$h^2 = b\sqrt{3} \times \frac{a}{\sqrt{3}} \qquad \tfrac{1}{2}$$

$$h^2 = ba$$

$$h = \sqrt{ab} \text{ m} \qquad \tfrac{1}{2}$$

33.

$$\text{Mode} = l + \frac{f_1 - f_0}{2f_1 - f_2 - f_0} \times h \qquad \tfrac{1}{2}$$

$$67 = 60 + \frac{15 - x}{30 - 12 - x} \times 10 \qquad \tfrac{1}{2}$$

$$7 = \frac{15 - x}{18 - x} \times 10 \qquad \tfrac{1}{2}$$

$$7 \times (18 - x) = 10(15 - x) \qquad \tfrac{1}{2}$$

$$126 - 7x = 150 - 10x$$

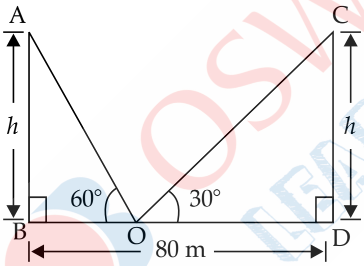
$$3x = 150 - 126 \qquad \tfrac{1}{2}$$

$$3x = 24$$

$$x = 8 \qquad \tfrac{1}{2}$$

Section-V

34.



1

Let BD = river ½

AB = CD = palm trees = h

BO = x ½

OD = $80 - x$

In ΔABO,

$$\tan 60^\circ = \frac{h}{x} \qquad \tfrac{1}{2}$$

$$\sqrt{3} = \frac{h}{x} \qquad \text{...(i)} \ \tfrac{1}{2}$$

$$h = \sqrt{3}x$$

In ΔCDO,

$$\tan 30^\circ = \frac{h}{(80 - x)} \qquad \tfrac{1}{2}$$

$$\frac{1}{\sqrt{3}} = \frac{h}{(80 - x)} \qquad \text{...(ii)} \ \tfrac{1}{2}$$

Solving (i) and (ii), we get

$$x = 20$$

$$h = \sqrt{3}x \qquad \text{[From eqn. (i)]}$$

$$= 34.6$$

The height of the trees = h = 34.6 m ½

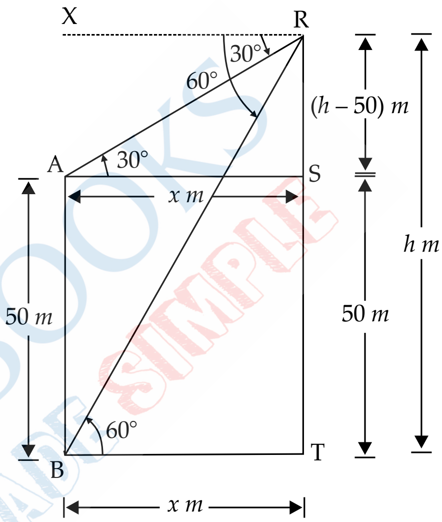
$$BO = x = 20 \text{ m}$$

$$DO = 80 - x$$

$$= 80 - 20$$

$$= 60 \text{ m} \qquad \tfrac{1}{2}$$

OR



1

Let AB = Building of height 50 m

RT = tower of height = h m ½

BT = AS = x m

AB = ST = 50 m ½

RS = TR – TS = $(h - 50)$m

In ΔARS,

$$\tan 30^\circ = \frac{RS}{AS}$$

$$\frac{1}{\sqrt{3}} = \frac{h - 50}{x} \qquad \text{...(i)} \ \tfrac{1}{2}$$

In ΔRBT,

$$\tan 60^\circ = \frac{RT}{BT}$$

$$\sqrt{3} = \frac{h}{x} \qquad \tfrac{1}{2}$$

Solving (i) and (ii), we get

$$h = 75 \qquad \tfrac{1}{2}$$

From (ii),

$$x = \frac{h}{\sqrt{3}} = \frac{75}{\sqrt{3}} \qquad \tfrac{1}{2}$$

$$= 25\sqrt{3}$$

Hence, height of the tower = h = 75 m ½

Distance between the building and the tower

$$= 25\sqrt{3}$$

$$= 43.25 \text{ m} \qquad \tfrac{1}{2}$$

35. For pipe, $r = 1$ cm ½

Length of water flowing in 1 sec, ½

$$h = 0.7 \text{ m} = 7 \text{ cm}$$

Cylindrical Tank, R = 40 cm ½
rise in water level = H
Volume of water flowing in 1 sec

$$= \pi r^2 h = \pi \times 1 \times 1 \times 70$$
$$= 70\pi \quad ½$$

Volume of water flowing in 60 sec $= 70\pi \times 60$ **1**
Volume of water flowing in 30 minutes

$$= 70\pi \times 60 \times 30 \quad ½$$

Volume of water in tank $= \pi r^2 H$

$$= \pi \times 40 \times 40 \times H \quad ½$$

Volume of water in tank
= Volume of water flowing in 30 minutes ½

$$\pi \times 40 \times 40 \times H = 70\pi \times 60 \times 30$$
$$H = 78.75 \text{ cm} \quad ½$$

36. Let speed of the boat in still water = x km/hr, and speed of the current = y km/hr
Downstream speed = $(x+y)$ km/hr ½
Upstream speed = $(x - y)$ km/hr ½

$$\frac{24}{x+y} + \frac{16}{x-y} = 6 \quad \text{...(i) ½}$$

$$\frac{36}{x+y} + \frac{12}{x-y} = 6 \quad \text{...(ii) ½}$$

Let $\frac{1}{x+y} = u$

and $\frac{1}{x-y} = v$ ½

Put in the above equation, we get ½

$$24u + 16v = 6$$
or, $$12u + 8v = 3 \quad \text{...(iii)}$$
$$36u + 12v = 6$$
or, $$6u + 2v = 1 \quad \text{...(iv)}$$

Multiplying (iv) by 4, we get

$$24u + 8v = 4 \quad \text{...(v)}$$

Subtracting (iii) by (v), we get ½

$$12u = 1$$
$$\Rightarrow \quad u = 1/12$$

Putting the value of u in (iv), we get, $v = 1/4$ ½

$$\Rightarrow \quad \frac{1}{x+y} = \frac{1}{12}$$

and $$\frac{1}{x-y} = \frac{1}{4}$$

$$\Rightarrow \quad x + y = 12 \text{ and } x - y = 4$$

Thus, speed of the boat in still water = 8 km/hr, ½
Speed of the current = 4 km/hr ½

●●●