CBSE Board
Class X Mathematics

Time: 3 hrs **Total Marks: 80**

General Instructions:
1. **All** questions are **compulsory**.
2. The question paper consists of **30** questions divided into **four sections** A, B, C, and D. **Section A** comprises of **6** questions of 1 mark each, **Section B** comprises of **6** questions of 2 marks each, **Section C** comprises of **10** questions of 3 marks each and **Section D** comprises of **8** questions of 4 marks each.
3. Question numbers **1 to 6** in **Section A** are multiple choice questions where you are to select **one** correct option out of the given four.
4. Use of calculator is **not** permitted.

Section A
(Questions 1 to 6 carry 1 mark each)

1. A kite is flying, attached to a thread which is 165 m long. The thread makes an angle of 30° with the ground. Find the height of the kite from the ground, assuming that there is no slack in the thread.

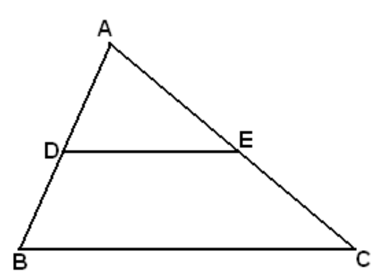
2. Show that the equation $(x^2 + 1)^2 - x^2 = 0$ has no real roots.

3. Five male and three female candidates are available for selection for the post of manager in a company. Find the probability that a male candidate is selected.

4. If $\triangle ABC \sim \triangle RQP$, $\angle A = 80°$, $\angle B = 60°$, then find the value of $\angle P$.

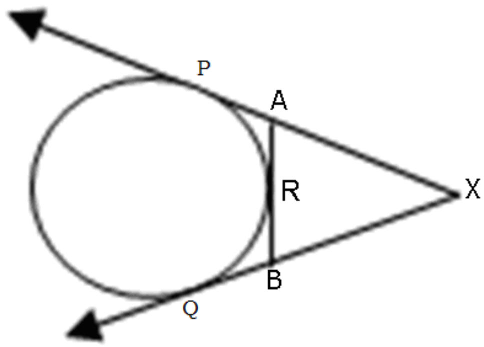
5. The decimal expansion of the rational number $\frac{2^3}{2^2.5}$ will terminate after how many decimal places?

6. In $\triangle ABC$, D and E are points on the sides AB and AC respectively such that $DE \| BC$. If $\frac{AD}{DB} = \frac{2}{3}$ and EC = 4cm, then find AE.



Section B
(Questions 7 to 12 carry 2 marks each)

7. In the given figure, XP and XQ are tangents from X to the circle. R is a point on the circle. Prove that XA + AR = XB + BR.



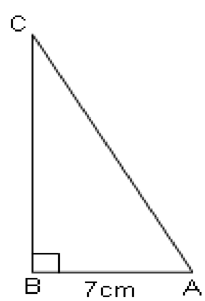
8. Find the roots of the equation $6x^2 - \sqrt{2}x - 2 = 0$ by the factorisation method.

9. Use Euclid's division algorithm to find H.C.F. of 870 and 225.

10. If $\cot\theta = \frac{7}{8}$, find the value of $\frac{(1+\sin\theta)(1-\sin\theta)}{(1+\cos\theta)(1-\cos\theta)}$

11. The perimeter of a sector of a circle of radius 5.2 cm is 16.4 cm. Find the area of the sector.

12. In ΔABC, $m\angle B = 90^\circ$, AB = 7 cm and AC – BC = 1 cm. Determine the values of sin C and cos C.



Section C
(Questions 13 to 22 carry 3 marks each)

13. ABCD is a rectangle formed by joining A(−1, −1), B(−1, 4), C(5, 4) and D(5, −1). P, Q, R and S are the mid points of AB, BC, CD and DA respectively. Is the quadrilateral PQRS a square, a rectangle or a rhombus? Justify your answer.

14. Solve for x: $\frac{x}{x+1}+\frac{x+1}{x}=\frac{34}{15}$

15. For what values of a and b does the following pairs of linear equations have an infinite number of solutions:
$2x + 3y = 7$; $(a - b)x + (a + b)y = 3a + b - 2$

16. If θ and ϕ are acute angles of a right triangle, and if $\frac{\sin^2\theta}{\cos^4\phi}+\frac{\sin^4\phi}{\cos^2\theta}=1$, then prove that
$\frac{\cos^4\theta}{\sin^2\phi}+\frac{\cos^2\phi}{\sin^4\theta}=1$

17. Prove that $\sqrt{5}$ is an irrational number.

18. Solve the given equations for x and y by the method of cross-multiplication.
$7x - 2y = 3$; $11x-\frac{3}{2}y=8$

19. The line segment joining the points A(2, 1) and B(5, −8) is trisected at the points P and Q where P is nearer to A. If point P lies on the line $2x - y + k = 0$, find the value of k.

20. Find the modal age of 100 residents of a colony from the following data:

Age in yrs. (more than or equal to)	0	10	20	30	40	50	60	70
No. of Persons	100	90	75	50	28	15	5	0

21. In ΔPQR, PD $\perp$ QR such that D lies on QR. If PQ = a, PR = b, QD = c and DR = d and a, b, c and d are positive units, prove that $(a + b)(a - b) = (c + d)(c - d)$.

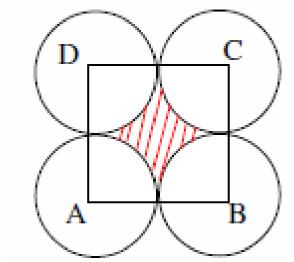
22. One card is drawn from a pack of 52 cards, each of the 52 cards being equally likely to be drawn. Find the probability that the card drawn is:
    i. Either a red card or a king
    ii. A red faced card
    iii. '10' of a black suit

Section D
(Questions 23 to 30 carry 4 marks each)

23. The interior angles of a polygon are in A.P. The smallest angle is 52° and the common difference is 8°. Find the number of sides of the polygon.

24. In a right-angled triangle, the square of the hypotenuse is equal to the sum of squares of the other two sides.

25. In the given figure, points A, B, C and D are the centres of four circles, each having a radius of 1 unit. If a point is chosen at random from the interior of square ABCD, what is the probability that the point will be chosen from the shaded region?



26. Solve the equations $2x - y + 6 = 0$ and $4x + 5y - 16 = 0$ graphically. Also determine the coordinate of the vertices of the triangle formed by these lines and the x-axis.

27. A solid toy is in the form of a hemisphere surmounted by a right circular cone. The height of the cone is 4 cm and the diameter of its base is 8 cm. Determine the volume of the toy. If a cube circumscribes the toy, then find the difference of the volumes of cube and the toy. Also, find the total surface area of the toy.

28. Two circles with centre O and O' of radii 3 cm and 4 cm respectively, intersect at two points P and Q such that OP and O'P are tangents to the two circles. Find the length of the common chord PQ.

29. For the data given below draw less than ogive curve.

Marks	0 - 10	10 - 20	20 – 30	30 - 40	40 - 50	50 – 60
Number of students	7	10	23	51	6	3

30. A tent is of the shape of a right circular cylinder upto a height of 3 metres and conical above it. The total height of the tent is 13.5 metres above the ground. Calculate the cost of painting the inner side of the tent at the rate of Rs. 2 per square metre, if the radius of the base is 14 metres.

CBSE Board
Class X Mathematics
Solution

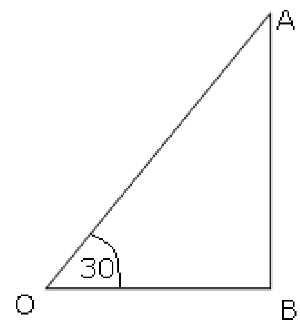
Time: 3 hrs **Total Marks: 80**

Section A

1. Let A be the position of the kite. Let O be the observer and OA be the thread.

Given, OA = 165 m, m$\angle$BOA = 30° and let AB = h m.

In right ΔOBA,



$$\sin 30° = \frac{AB}{OA}$$

$$\Rightarrow \frac{1}{2} = \frac{h}{165}$$

$$\Rightarrow h = \frac{165}{2} = 82.5 \text{ m}$$

Thus, the height of the kite from the ground is 82.5 m.

2. $(x^2 + 1)^2 - x^2 = 0$

$\Rightarrow x^4 + 2x^2 + 1 - x^2 = 0$

$\Rightarrow x^4 + x^2 + 1 = 0$

Let $x^2 = y$

$\Rightarrow y^2 + y + 1 = 0$

Here, Discriminant, $D = b^2 - 4ac = 1 - 4 = -3 < 0$

So, the equation does not have real roots.

3. Number of male candidates available = 5

Number of female candidates available = 3

Total number of candidates = 5 + 3 = 8

Probability that male candidate is selected = $\frac{5}{8}$

4. Since ΔABC ~ ΔRQP,

$\angle A = \angle R = 80°$

$\angle B = \angle Q = 60°$

Therefore, using the angle sum property in ΔRQP, we have

$\angle P = 180° - (80° + 60°) = 40°$

5. If the denominator of a rational number is of the form $2^n 5^m$, then it will terminate

After n places if n > m or after m places if m > n.

Now, $\frac{2^3}{2^2 5} = \frac{2}{5} = \frac{2}{2^{\circ} 5}$ will terminate after 1 decimal place.

6. In ΔABC, DE ∥ BC.

Then, by Basic Proportionality Theorem,

$$\frac{AD}{DB} = \frac{AE}{EC}$$
$$\Rightarrow \frac{2}{3} = \frac{AE}{4}$$
$$\Rightarrow AE = \frac{2 \times 4}{3} = \frac{8}{3} = 2.67 \text{ cm}$$
$$\Rightarrow x^2 - x = x^2 - 4$$
$$\Rightarrow x = 4$$

Section B

7. Since the lengths of tangents from an exterior point to a circle are equal.

Therefore, XP = XQ (tangents from X) ....(i)

AP = AR (tangents from A) ....(ii)

BQ = BR (tangents from B) ....(iii)

Now, XP = XQ

$\Rightarrow$ XA + AP = XB + BQ

$\Rightarrow$ XA + AR = XB + BR [Using (ii) and (iii)]

8. $6x^2 - \sqrt{2}x - 2$

$\Rightarrow 6x^2 - 3\sqrt{2}x + 2\sqrt{2}x - 2$

$\Rightarrow 3x(2x - \sqrt{2}) + \sqrt{2}(2x - \sqrt{2})$

$\Rightarrow (3x + \sqrt{2})(2x - \sqrt{2})$

Now, $6x^2 - \sqrt{2}x - 2 = 0$ gives $(3x + \sqrt{2})(2x - \sqrt{2}) = 0$

i.e., $(3x + \sqrt{2}) = 0$ or $(2x - \sqrt{2}) = 0$

$x = -\frac{\sqrt{2}}{3}$ or $x = \frac{\sqrt{2}}{2} = \frac{1}{\sqrt{2}}$

Therefore, the roots of the given quadratic equation are $-\frac{\sqrt{2}}{3}$ and $\frac{1}{\sqrt{2}}$.

9. $870 = 225 \times 3 + 195$

$225 = 195 \times 1 + 30$

$195 = 30 \times 6 + 15$

$30 = 15 \times 2 + 0$

$\therefore$ HCF (870, 225) = 15

10. $\cot\theta = \frac{7}{8}$ (given)

$$\frac{(1+\sin\theta)(1-\sin\theta)}{(1+\cos\theta)(1-\cos\theta)} = \frac{1-\sin^2\theta}{1-\cos^2\theta}$$

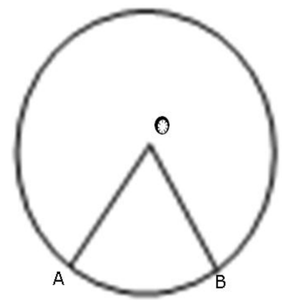
$$= \frac{\cos^2\theta}{\sin^2\theta}$$

$$= \cot^2\theta$$

$$= \left(\frac{7}{8}\right)^2$$

$$= \frac{49}{64}$$

11. Let OAB be the given sector.



Let arc AB = l

Perimeter of sector OAB = 16.4 cm

$\Rightarrow$ OA + OB + arc AB = 16.4

$\Rightarrow$ 5.2 + 5.2 + l = 16.4

$\Rightarrow$ l = 6 cm

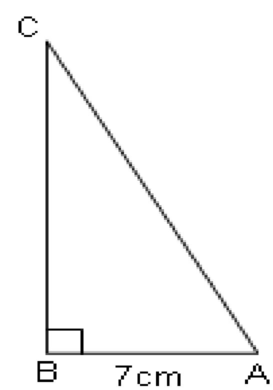
Now, length of an arc $= \frac{\theta}{360} \times 2\pi r$

$\Rightarrow l = \frac{\theta}{360} \times 2\pi r$

$\Rightarrow \frac{6}{2\pi r} = \frac{\theta}{360}$

Area of sector OAB $= \frac{\theta}{360} \times \pi r^2 = \frac{6}{2\pi r} \times \pi r^2 = 3 \times r = 3 \times 5.2 = 15.6\ \text{cm}^2$

12. In ABC, we have



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

$(1 + BC)^2 = BC^2 + AB^2$

$\Rightarrow 1 + BC^2 + 2BC = BC^2 + AB^2$

$\Rightarrow 1 + 2BC = 7^2$

$\Rightarrow$ 2BC = 48

$\Rightarrow$ BC = 24 cm

$\Rightarrow$ AC = 1 + BC = 1 + 24 = 25 cm

Hence, $\sin C = \frac{AB}{AC} = \frac{7}{25}$ and $\cos C = \frac{BC}{AC} = \frac{24}{25}$

Section C

13. Using mid-point formula, we have

Co-ordinates of P are $(-1, \frac{3}{2})$

Co-ordinates of Q are (2, 4)

Co-ordinates of R are $(5, \frac{3}{2})$

Co-ordinates of S are (2, −1)

Now using distance formula,

$$PQ = \sqrt{(2+1)^2 + \left(4 - \frac{3}{2}\right)^2} = \sqrt{9 + \frac{25}{4}} = \sqrt{\frac{61}{4}} \text{ units}$$

$$QR = \sqrt{(5-2)^2 + \left(\frac{3}{2} - 4\right)^2} = \sqrt{9 + \frac{25}{4}} = \sqrt{\frac{61}{4}} \text{ units}$$

$$RS = \sqrt{(2-5)^2 + \left(-1 - \frac{3}{2}\right)^2} = \sqrt{9 + \frac{25}{4}} = \sqrt{\frac{61}{4}} \text{ units}$$

$$SP = \sqrt{(2+1)^2 + \left(-1 - \frac{3}{2}\right)^2} = \sqrt{9 + \frac{25}{4}} = \sqrt{\frac{61}{4}} \text{ units}$$

And,

$$QS = \sqrt{(2-2)^2 + (4+1)^2} = \sqrt{0+25} = 5 \text{ units}$$

$$PR = \sqrt{(5+1)^2 + \left(\frac{3}{2} - \frac{3}{2}\right)^2} = \sqrt{36+0} = 6 \text{ units}$$

$$\therefore\ PQ = QR = RS = SP = \sqrt{\frac{61}{4}} \text{ units and } QS \neq PR$$

This means that PQRS is a quadrilateral whose sides are equal but diagonals are not equal.

Thus, PQRS is a rhombus.

14. $\frac{x}{x+1}+\frac{x+1}{x}=\frac{34}{15}$

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

Thus, we have

$y+\frac{1}{y}=\frac{34}{15}$

$\Rightarrow \frac{y^2+1}{y}=\frac{34}{15}$

$\Rightarrow 15y^2+15=34y$

$\Rightarrow 15y^2-34y+15=0$

$\Rightarrow 15y^2-9y-25y+15=0$

$\Rightarrow 3y(5y-3)-5(5y-3)=0$

$\Rightarrow (5y-3)(3y-5)=0$

$\Rightarrow 5y-3=0 \text{ or } 3y-5=0$

$\therefore y=\frac{3}{5} \text{ or } y=\frac{5}{3}$

If $y=\frac{5}{3}$ then $\frac{x}{x+1}=\frac{5}{3}$

$\Rightarrow 5x + 5 = 3x$

$\Rightarrow 2x = -5$

$\Rightarrow x=-\frac{5}{2}$

If $y=\frac{3}{5}$ then $\frac{x}{x+1}=\frac{3}{5}$

$\Rightarrow 3x + 3 = 5x$

$\Rightarrow 2x = 3$

$\Rightarrow x=\frac{3}{2}$

Hence, $x=-\frac{5}{2}$ and $x=\frac{3}{2}$

15. Given equations are 2x + 3y = 7; (a – b)x + (a + b)y = 3a + b – 2

The given system of equations will have infinite number of solutions, if

$$\frac{2}{a-b}=\frac{3}{a+b}=\frac{7}{3a+b-2}$$

Consider, $\frac{2}{a-b}=\frac{3}{a+b}$

$\Rightarrow 2a+2b=3a-3b$

$\Rightarrow a=5b$ ....(i)

Consider, $\frac{3}{a+b}=\frac{7}{3a+b-2}$

$\Rightarrow 9a+3b-6=7a+7b$

$\Rightarrow 2a-4b=6$

$\Rightarrow 2(5b)-4b=6$ ....[From (i)]

$\Rightarrow 6b=6 \Rightarrow b=1$

$\Rightarrow a=5b=5\times 1=5$

Hence, $a=5$ and $b=1$

16. The two angles θ and ϕ being the acute angles of a right triangle must be complementary angles.

$\Rightarrow \theta = (90° - \phi)$ and $\phi = (90° - \theta)$ ....(i)

Given $\frac{\sin^2\theta}{\cos^4\phi}+\frac{\sin^4\phi}{\cos^2\theta}=1$

$$\Rightarrow \frac{\sin^2(90°-\phi)}{\cos^4(90°-\theta)}+\frac{\sin^4(90°-\theta)}{\cos^2(90°-\phi)}=1$$

$$\Rightarrow \frac{\cos^2\phi}{\sin^4\theta}+\frac{\cos^4\theta}{\sin^2\phi}=1 \quad [\because \sin(90°-A)=\cos A, \cos(90°-A)=\sin A]$$

$$\Rightarrow \frac{\cos^4\theta}{\sin^2\phi}+\frac{\cos^2\phi}{\sin^4\theta}=1$$

17. Let us assume, on the contrary that $\sqrt{5}$ is a rational number.

Then, there exist positive integers a and b such that

$\sqrt{5} = \frac{a}{b}$ where a and b are co-prime

$\Rightarrow \left(\sqrt{5}\right)^2 = \left(\frac{a}{b}\right)^2$

$\Rightarrow 5 = \frac{a^2}{b^2}$

$\Rightarrow 5b^2 = a^2$

$\Rightarrow 5 | a^2$

$\Rightarrow 5 | a$

$\Rightarrow a = 5c$ for some positive integer c

$\Rightarrow a^2 = 25c^2$

$\Rightarrow 5b^2 = 25c^2$

$\Rightarrow b^2 = 5c^2$

$\Rightarrow 5 | b^2$

$\Rightarrow 5 | b$

This implies that a and b have at least 5 as a common factor.

This contradicts the fact that a and b are co-prime.

So, our assumption is wrong.

Hence, $\sqrt{5}$ is an irrational number.

18. Given system of equations are

$$7x-2y-3=0$$

$$11x-\frac{3}{2}y-8=0$$

By cross multification, we have

$$\therefore \frac{x}{\left[(-2)(-8)-\left(\frac{-3}{2}\right)\times(-3)\right]}=\frac{-y}{\left[7\times(-8)-(-3\times11)\right]}=\frac{1}{\left[7\times\left(\frac{-3}{2}\right)-11\times(-2)\right]}$$

$$\Rightarrow \frac{x}{16-\frac{9}{2}}=\frac{-y}{-56+33}=\frac{1}{\frac{-21}{2}+22}$$

$$\Rightarrow \frac{x}{\left(\frac{23}{2}\right)}=\frac{y}{23}=\frac{1}{\frac{23}{2}}$$

$$\Rightarrow \frac{x}{\left(\frac{23}{2}\right)}=\frac{1}{\frac{23}{2}} \text{ and } \frac{y}{23}=\frac{1}{\frac{23}{2}}$$

$$\Rightarrow x=1 \text{ and } y=2$$

Hence, the solution of the given system of equations is x = 1 and y = 2.

19. Since P and Q are trisecting AB and P is nearer to A, so the point P divides AB in the ratio 1 : 2. Let the coordinates of P be (x, y).

Therefore, using section formula, coordinates of P are given by

$$P\left(\frac{1\times5+2\times2}{1+2},\frac{1\times(-8)+2\times1}{1+2}\right)=P(3,-2)$$

Now P(3, −2) lies on the line 2x – y + k = 0

$\Rightarrow$ 2 × 3 – (−2) + k = 0

$\Rightarrow$ 6 + 2 + k = 0

$\Rightarrow$ k = −8

20.

Age in yrs	0-10	10-20	20-30	30-40	40-50	50-60	60-70
No. of Persons	10	15	25	22	13	10	5

From the data given as above we may observe that maximum class frequency is 25 belonging to class interval 20 – 30.

So, modal class = 20 – 30

Lower class limit (l) of modal class = 20

Frequency (f_1) of modal class = 25

Frequency (f_0) of class preceding the modal class = 15

Frequency (f_2) of class succeeding the modal class = 22

Class size (h) = 10

$$\text{Mode} = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2}\right) \times h$$

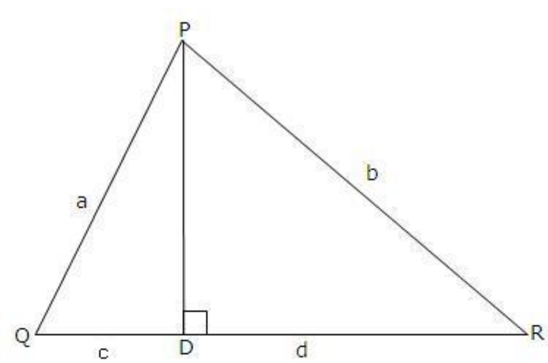
$$= 20 + \left(\frac{25 - 15}{2(25) - 15 - 22}\right) \times 10$$

$$= 20 + \frac{10}{13} \times 10$$

$$= 20 + 7.69$$

$$= 27.69 \text{ years (approx.)}$$

21. In Δ PQD, $\angle$PDQ = 90°



Using Pythagoras Theorem,

$PD^2 = a^2 - c^2$ ....(1)

Similarly, in Δ PDR, $\angle$PDR = 90°

$\therefore$ $PD^2 = b^2 - d^2$ ....(2)

From (1) and (2),

$a^2 - c^2 = b^2 - d^2$

$\Rightarrow a^2 - b^2 = c^2 - d^2$

$\Rightarrow (a + b)(a - b) = (c + d)(c - d)$

22. Out of 52 cards, one card can be drawn in 52 ways.

So, total number of outcomes = 52

i. There are 26 red cards, including two red kings, in a pack of 52 playing cards.

Also, there are 4 kings, two red and two black.

Therefore, card drawn will be either a red card or a king if it is any one of 28 cards (26 red cards and 2 black kings).

So, favourable number of elementary events = 28

Hence, required probability = $\frac{28}{52} = \frac{7}{13}$

ii. There are 6 red face cards, 3 each from diamonds and hearts.

Out of these 6 red face cards, one card can be chosen in 6 ways.

So, favorable number of elementary events = 6

Hence, required probability = $\frac{6}{52} = \frac{3}{26}$

iii. There are two suits of black cards, viz., spades and clubs.

Each suit contains one card bearing number 10.

So, favorable number of elementary events = 2

Hence, required probability = $\frac{2}{52} = \frac{1}{26}$

Section D

23. Here, a = 52° and d = 8°

Let the polygon have n sides.

Then, the sum of interior angles of the polygon = (n – 2)180°

$\Rightarrow S_n = (n - 2)180$

$\Rightarrow \frac{n}{2}[2a + (n - 1)d] = (n - 2)180$

$\Rightarrow \frac{n}{2}[104 + (n-1)8] = (n - 2)180$

$\Rightarrow n[4n + 48] = (n - 2)180$

$\Rightarrow 4n^2 + 48n = 180n - 360$

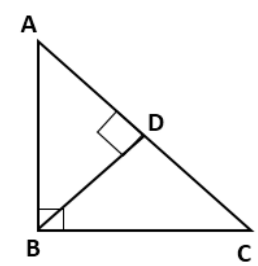
$\Rightarrow n^2 - 33n + 90 = 0$

$\Rightarrow (n - 30)(n - 3) = 0$

$\Rightarrow n = 3, 30$

Hence, the number of sides of the polygon can be either 3 or 30.

24. Given: In ΔABC, $\angle ABC = 90°$



To prove: $AC^2 = AB^2 + BC^2$

Construction: Draw seg $BD \perp$ hypotenuse AC
and $A - D - C$

Proof:

In ΔABC, seg $BD \perp$ hypotenuse AC ....(construction)

$\therefore \Delta ABC \sim \Delta ADB$ ....(Similarity in right angled triangles)

$\therefore \frac{AB}{AD} = \frac{AC}{AB}$ ....(Corresponding sides of similar triangles)

$\therefore AB^2 = AC \times AD$ ....(i)

Similarly, $\Delta ABC \sim \Delta BDC$ ....(Similarity in right angled triangles)

$\therefore \frac{BC}{DC} = \frac{AC}{BC}$ ....(Corresponding sides of similar triangles)

$\therefore BC^2 = AC \times DC$ ....(ii)

$AB^2 + BC^2 = AC \times AD + AC \times DC$ ....[Adding equations (i) and (ii)]

$= AC(AD + DC)$

$= AC \times AC$

$= AC^2$

25. Radius of each circle is 1 unit.

Area of each quadrant of a circle of radius 1 cm $= \frac{1}{4}\pi r^2 = \frac{1}{4}\pi(1)^2 = \frac{1}{4}\pi$ sq. units

$\therefore$ Area of four quadrants $= 4 \times \frac{1}{4}\pi = \pi$ sq. units

Now, side of the square ABCD = 1 + 1 = 2 units

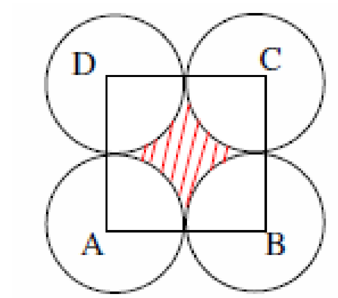
$\therefore$ Area of square = 2 × 2 = 4 sq. units

Thus, area of shaded region

= Area of square ABCD – Area of four quadrants

= 4 – π

$\therefore$ Required probability = $= \frac{(4-\pi)}{4} = 1 - \frac{\pi}{4}$



26. To solve the equations, make the table corresponding to each equation.

$2x - y + 6 = 0$

$\Rightarrow y = 2x + 6$

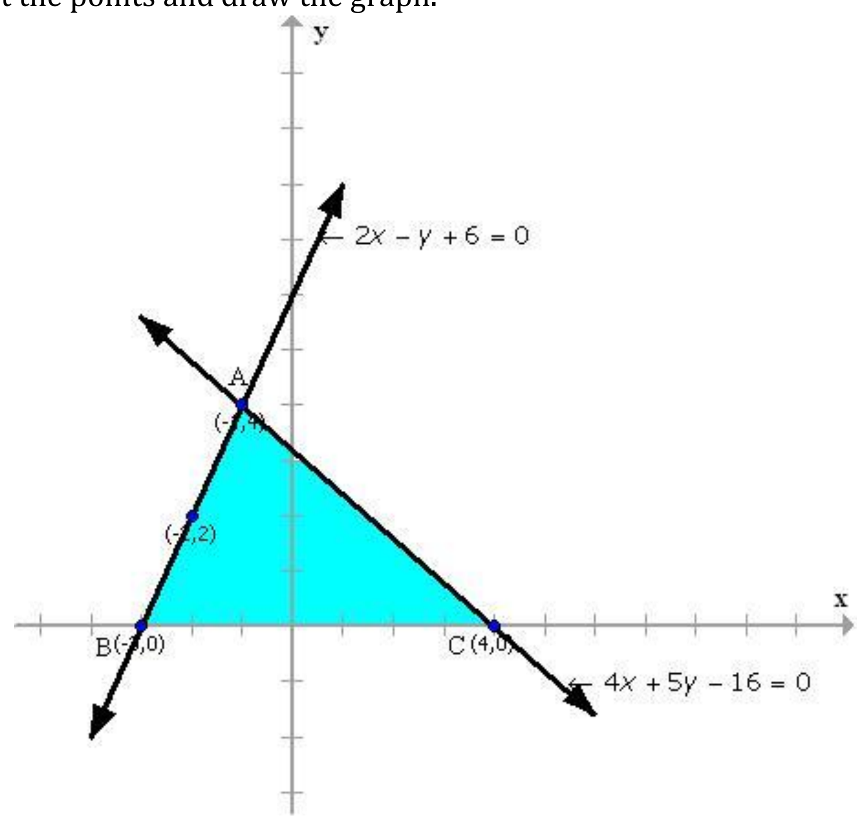
x	-1	-2	-3
y	4	2	0

$4x + 5y - 16 = 0$

$\Rightarrow y = \frac{16-4x}{5}$

x	4	-1
y	0	4

Now plot the points and draw the graph.



Because the lines intersect at the point (-1, 4), x = -1 and y = 4 is the solution. Also, by observation, vertices of triangle formed by lines and x-axis are A (-1, 4), B (-3, 0) and C (4, 0).

27. Radius of the hemisphere = r = 4 cm = Radius of cone

Height of cone = h = 4 cm

Volume of toy = Volume of hemisphere + Volume of the cone

$$= \frac{2}{3}\pi r^3 + \frac{1}{3}\pi r^2 h$$

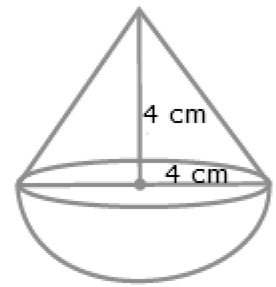
$$= \frac{1}{3}\pi r^2(2r + h)$$

$$= \frac{1}{3} \times \frac{22}{7} \times 4 \times 4(2 \times 4 + 4)$$

$$= \frac{1}{3} \times \frac{22}{7} \times 4 \times 4 \times 12$$

$$= \frac{1408}{7} \text{ cm}^3$$

$$= 201.14 \text{ cm}^3$$



It is given that a cube circumscribes the given toy.

$\Rightarrow$ Edge of the cube $= 8$ cm

$\Rightarrow$ Volume of the cube $= (8)^3 = 512 \text{ cm}^3$

Difference in the volumes of the cube and the toy $= 512 - 201.14 = 310.86 \text{ cm}^3$

Total surface area of the toy $=$ CSA of cone $+$ CSA of hemisphere

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

$$= \pi r(l + 2r)$$

Now, $l = \sqrt{h^2 + r^2} = \sqrt{4^2 + 4^2} = \sqrt{32} = 4\sqrt{2}$ cm

$\therefore$ Total surface area of the toy $= \frac{22}{7} \times 4\left(4\sqrt{2} + 2 \times 4\right)$

$$= \frac{22}{7} \times 16\left(1.414 + 2\right)$$

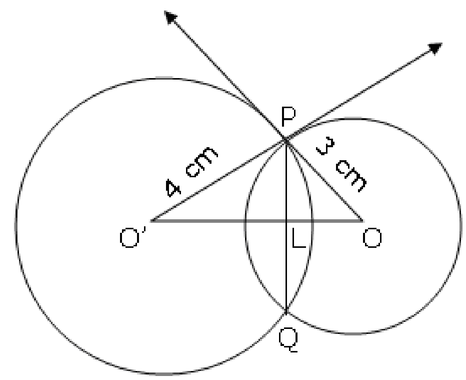
$$= \frac{352}{7} \times 3.414$$

$$= 171.68 \text{ cm}^2$$

28. Since, the radius is perpendicular to the tangent at the point of contact, m∠OPO' = 90°.

O'O = $\sqrt{4^2 + 3^2}$ = 5 cm (Using Pythagoras theorem)

Let O'L = x, then OL = 5 – x



$\therefore PL^2 = 4^2 - x^2 = 3^2 - (5-x)^2$

$\Rightarrow 16 - x^2 = 9 - (25 + x^2 - 10x)$

$\Rightarrow 16 = -16 + 10x$

$\Rightarrow 10x = 32 \Rightarrow x = \frac{32}{10} = 3.2$ cm

$\therefore PL = \sqrt{4^2 - (3.2)^2} = \sqrt{16 - 10.24} = \sqrt{5.76} = 2.4$

$\therefore$ PQ = 2 × 2.4 cm = 4.8 cm

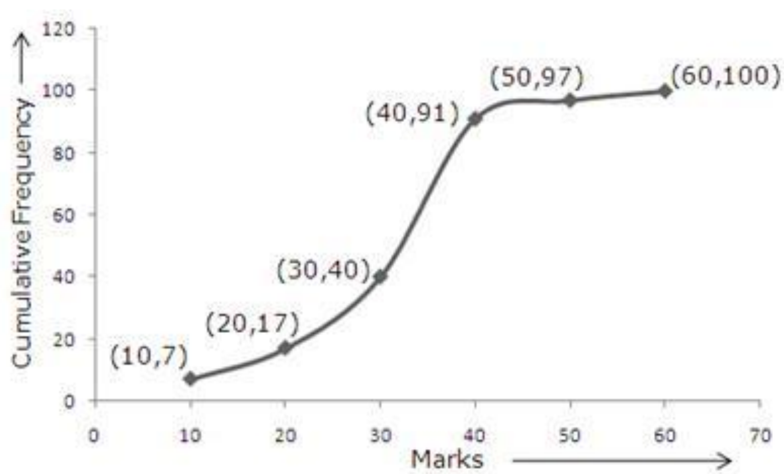
29. We first prepare the cumulative frequency distribution table as given below:

Marks	No. of students	Marks less than	Cumulative frequency
0-10	7	10	7
10-20	10	20	17
20-30	23	30	40
30-40	51	40	91
40-50	6	50	97
50-60	3	60	100

Now, we mark the upper class limits along x-axis by taking a suitable scale and the cumulative frequencies along the y-axis by taking a suitable scale.

Thus, we plot the points (10, 7), (20, 17), (30, 40), (40, 91), (50, 97) and (60, 100).

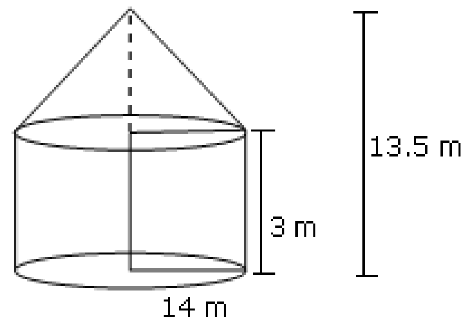
Join the plotted points by a free hand to obtain the required ogive.



30. Radius of conical portion = Radius of cylindrical portion = 14 m

Height of cylindrical portion = 3 m

Height of conical portion = 13.5 m − 3 m = 10.5 m



C.S.A. of tent = C.S.A. of cylinder + C.S.A. of cone

$= 2\pi rh + \pi rl$

$= 2\pi(14)(3) + \pi(14)\sqrt{14^2 + 10.5^2}$

$= 264 + 44\sqrt{306.25}$

$= 264 + 44(17.5)$

$= 264 + 770$

$= 1034 \text{ m}^2$

Cost of painting the inside of tent,

i.e. 1034 m^2 at the rate of Rs. 2 per sq. m = Rs. 1034 × 2 = Rs. 2068