Class X Session 2025-26
Subject - Mathematics (Standard)
Sample Question Paper - 01

Time Allowed: 3 hours **Maximum Marks: 80**

General Instructions:

Read the following instructions carefully and follow them:

1. This question paper contains 38 questions.
2. This Question Paper is divided into 5 Sections A, B, C, D and E.
3. In Section A, Questions no. 1-18 are multiple choice questions (MCQs) and questions no. 19 and 20 are Assertion-Reason based questions of 1 mark each.
4. In Section B, Questions no. 21-25 are very short answer (VSA) type questions, carrying 02 marks each.
5. In Section C, Questions no. 26-31 are short answer (SA) type questions, carrying 03 marks each.
6. In Section D, Questions no. 32-35 are long answer (LA) type questions, carrying 05 marks each.
7. In Section E, Questions no. 36-38 are case study-based questions carrying 4 marks each with sub-parts of the values of 1,1 and 2 marks each respectively.
8. All Questions are compulsory. However, an internal choice in 2 Questions of Section B, 2 Questions of Section C and 2 Questions of Section D has been provided. An internal choice has been provided in all the 2 marks questions of Section E.
9. Draw neat and clean figures wherever required.
10. Take $\pi = 22/7$ wherever required if not stated.
11. Use of calculators is not allowed.

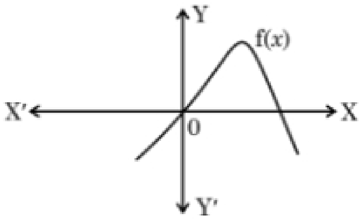
Section A

1. The product of a rational number and an irrational number is **[1]**

a) a rational number only b) an integer

c) an irrational number only d) both rational and irrational number

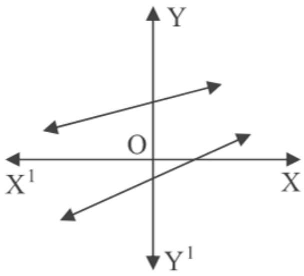
2. In the given figure, graph of a polynomial f(x) is shown. The number of zeroes of polynomial f(x) is: **[1]**



a) 0 b) 2

c) 1 d) 3

3. In the given figure, graphs of two linear equations are shown. The pair of these linear equations is: **[1]**



a) consistent with infinitely many solutions.

b) inconsistent but can be made consistent by extending these lines.

c) consistent with unique solution.

d) inconsistent.

4. The root(s) of the quadratic equation $x^2 - 25 = 0$ is/are: **[1]**

a) -25, 25

b) -5, 5

c) 25

d) 5

5. In an A.P., if d = – 4, n = 7 and a_n = 4, then ‘a’ is **[1]**

a) 28

b) 6

c) 20

d) 7

6. The distance between the points ($\sin\theta$, $\cos\theta$) and ($\cos\theta$, – $\sin\theta$) is **[1]**

a) $\sqrt{2}$ units

b) $\sqrt{\sin\theta + \cos\theta}$ units

c) $2\sqrt{2}$ units

d) 2 units

7. The perpendicular bisector of the line segment joining the points A (1, 5) and B (4, 6) cuts the y-axis at **[1]**

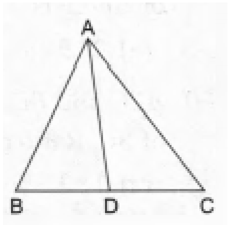
a) (0, 12)

b) (0, 13)

c) (13, 0)

d) (0, -13)

8. In $\triangle$ABC it is given that $\frac{AB}{AC} = \frac{BD}{DC}$. If $\angle B = 70^\circ$ and $\angle$C = 50° then $\angle$BAD = ? **[1]**



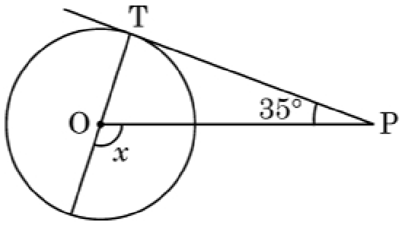
a) 40°

b) 30°

c) 50°

d) 45°

9. In the given figure, if PT is a tangent to a circle with centre O and $\angle \mathrm{TPO} = 35^\circ$, then the measure of $\angle x$ is: **[1]**



a) 115^o

b) 120^o

c) 125^o

d) 110^o

10. Two circles of radii 10 cm and 8 cm intersect each other and the length of common chord is 12 cm. The distance between their centres is ________. **[1]**

a) $4\sqrt{7}$ cm
b) $3\sqrt{7}$ cm
c) $\sqrt{7}$ cm
d) $(8 + 2\sqrt{7})$ cm

11. If sin x + $\sin^2$x = 1, then $\cos^8$x + $2\cos^6$x + cso^4 x = ________. **[1]**

a) -1
b) 2
c) 0
d) 1

12. $\cos^4$A - $\sin^4$A is equal to **[1]**

a) $2\sin^2 A + 1$
b) $2\cos^2 A + 1$
c) $2\sin^2 A - 1$
d) $2\cos^2 A - 1$

13. A plane is observed to be approaching the airport. It is at a distance of 12 km from the point of observation and makes an angle of elevation of 30° there at. Its height above the ground is **[1]**

a) 10 km
b) 8 km
c) 12 km
d) 6 km

14. The area of the sector of a circle of radius 12 cm is 60π cm^2. The central angle of this sector is: **[1]**

a) 6^o
b) 150^o
c) 75^o
d) 120^o

15. The difference of the areas of a minor sector of angle 120^o and its corresponding major sector of a circle of radius 21 cm, is **[1]**

a) 346.5 cm^2
b) 231 cm^2
c) 462 cm^2
d) 693 cm^2

16. One card is drawn at random from a well shuffled deck of 52 playing cards. The probability that it is a red king is: **[1]**

a) $\frac{1}{26}$
b) $\frac{2}{13}$
c) $\frac{2}{26}$
d) $\frac{1}{52}$

17. A girl calculates that the probability of her winning the first prize in a lottery is 0.08. If 6000 tickets are sold, how many tickets has she bought? **[1]**

a) 750
b) 480
c) 40
d) 240

18. The annual rainfall record of a city for 66 days is given in the following table: **[1]**

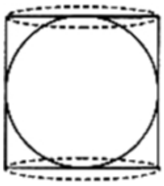
Rainfall (in cm):	0 - 10	10 - 20	20 - 30	30 - 40	40 - 50	50 - 60
Number of days:	22	10	8	15	5	6

The difference of upper limits of modal and median classes is:

a) 15
b) 10

c) 30 d) 20

19. **Assertion (A):** In the given figure, a sphere is inscribed in a cylinder. The surface area of the sphere is not equal to the curved surface area of the cylinder. **[1]**



Reason (R): Surface area of sphere is $4\pi r^2$

a) Both A and R are true and R is the correct explanation of A.
b) Both A and R are true but R is not the correct explanation of A.
c) A is true but R is false.
d) A is false but R is true.

20. **Assertion (A):** The 11th term of an AP is 7, 9, 11, 13 is 67. **[1]**

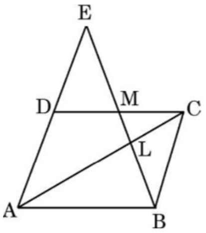
Reason (R): If s_n is the sum of first n terms of an AP then its nth term an is given by $a_n = s_n + s_{n-1}$.

a) Both A and R are true and R is the correct explanation of A.
b) Both A and R are true but R is not the correct explanation of A.
c) A is true but R is false.
d) A is false but R is true.

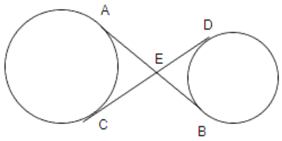
Section B

21. Prove that $6+\sqrt{2}$ is irrational. **[2]**

22. In the given figure, ABCD is a parallelogram. BE bisects CD at M and intersects AC at L. Prove that EL = 2BL. **[2]**



23. In the given figure, common tangents AB and CD to two circles intersect at E. Prove that AB = CD. **[2]**



24. Prove that: $(\sec A-\tan A)^2=\frac{1-\sin A}{1+\sin A}$ **[2]**

OR

Express the trigonometric ratio of sec A and tan A in terms of sin A.

25. A horse is tethered to one corner of a rectangular field of dimensions 70 m $\times$ 52 m, by a rope of length 21 m. How much area of the field can it graze? **[2]**

OR

The long and short hands of a clock are 6 cm and 4 cm long respectively. Find the sum of distances travelled by their tips in 24 hours, (use π = 3.14).

Section C

26. Shekar wants to plant 45 corn plants, 81 tomato plants, and 63 ginger plants. If he plants them in such a way that each row has the same number of plants and each row has only one type of plant, what is the greatest number of plants he can plant in a row? **[3]**

27. Find the zeroes of quadratic polynomial x^2 - 2x - 8 and verify the relationship between the zeroes and their **[3]**

coefficients.

28. Solve the pair of linear equations x + y = 5 and 2x - 3y = 4 by elimination and substitution method. **[3]**

OR

Find two numbers such that the sum of twice the first and thrice the second is 92, and four times the first exceeds seven times the second by 2.

29. From an external point P, a tangent PT and a line segment PAB is drawn to a circle with centre O. ON is perpendicular on the chord AB. Prove that. **[3]**

i. $PA.PB = PN^2 - AN^2$

ii. $PN^2 - AN^2 = OP^2 - OT^2$

iii. $PA.PB = PT^2$

OR

A point P is at a distance of 29 cm from the centre of a circle of radius 20 cm. Find the length of the tangent drawn from P to the circle.

30. Given that 16 cot A = 12; find the value of $\frac{\sin A+\cos A}{\sin A-\cos A}$. **[3]**

31. Calculate the median for the following data: **[3]**

Classes	20 - 40	40 - 60	60 - 80	80 - 100	100 - 120	120 - 140	140 - 160
Frequency	12	18	23	15	12	12	8

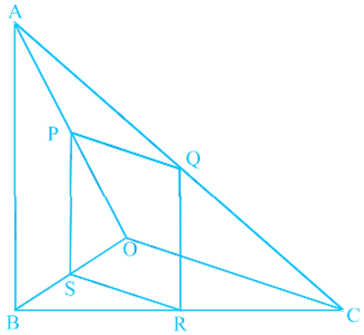
Section D

32. The length of the hypotenuse of a right triangle exceeds the length of its base by 2 cm and exceeds twice the length of altitude by 1 cm. Find the length of each side of the triangle. **[5]**

OR

A truck covers a distance of 150 km at a certain average speed and then covers another 200 km at an average speed which is 20 km per hour more than the first speed. If the truck covers the total distance in 5 hours, then find the first speed of the truck.

33. In the figure, if PQRS is a parallelogram and AB || PS, then prove that OC || SR. **[5]**



34. A student was asked to make a model shaped like a cylinder with two cones attached to its ends by using a thin aluminium sheet. The diameter of the model is 3 cm and its total length is 12 cm. If each cone has a height of 2 cm, find the volume of air contained in the model. **[5]**

OR

In a cylindrical vessel of radius 10 cm, containing some water, 9000 small spherical balls are dropped which are completely immersed in water which raises the water level. If each spherical ball is of radius 0·5 cm, then find the rise in the level of water in the vessel.

35. Find the mean of the following frequency distribution: **[5]**

Class Interval	50-70	70-90	90-110	110-130	130-150	150-170

Frequency	18	12	13	27	8	22

Section E

36. **Read the following text carefully and answer the questions that follow:** **[4]**

Suman is celebrating his birthday. He invited his friends. He bought a packet of toffees/candies which contains 360 candies. He arranges the candies such that in the first row there are 3 candies, in second there are 5 candies, in third there are 7 candies and so on.

i. Find the total number of rows of candies. (1)
ii. How many candies are placed in last row? (1)
iii. If Aditya decides to make 15 rows, then how many total candies will be placed by him with the same arrangement? (2)

OR

Find the number of candies in 12th row. (2)

37. **Read the following text carefully and answer the questions that follow:** **[4]**

To raise social awareness about the hazards of smoking, a school decided to start a ‘No smoking’ campaign. 10 students are asked to prepare campaign banners in the shape of a triangle. The vertices of one of the triangles are P(-3, 4), Q(3, 4) and R(-2, -1).

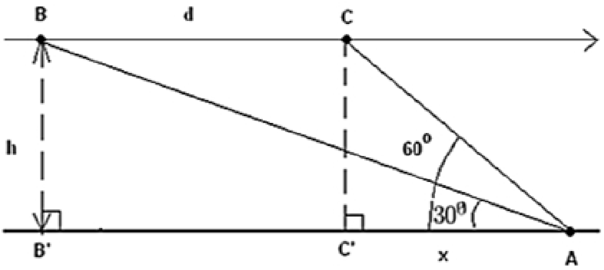
i. What are the coordinates of the centroid of $\triangle PQR$? (1)
ii. If T be the mid-point of the line joining R and Q, then what are the coordinates of T? (1)
iii. If U be the mid-point of line joining R and P, then what are the coordinates of U? (2)

OR

What are the coordinates of centroid of $\triangle STU$? (2)

38. **Read the following text carefully and answer the questions that follow:** **[4]**

Mr. Vinod is a pilot in Air India. During the Covid-19 pandemic, many Indian passengers were stuck at Dubai Airport. The government of India sent special aircraft to take them. Mr. Vinod was leading this operation. He is flying from Dubai to New Delhi with these passengers. His airplane is approaching point A along a straight line and at a constant altitude h. At 10:00 am, the angle of elevation of the airplane is 30^{o} and at 10:01 am, it is 60^{o}.



i. What is the distance **d** is covered by the airplane from 10:00 am to 10:01 am if the speed of the airplane is constant and equal to 600 miles/hour? (1)
ii. What is the altitude **h** of the airplane? (round answer to 2 decimal places) (1)

iii. Find the distance between passenger and airplane when the angle of elevation is 30^o. (2)

OR

Find the distance between passenger and airplane when the angle of elevation is 60^o. (2)

Solution

Section A

1.

(d) both rational and irrational number

Explanation:

The product of a rational number and an irrational number can be either a rational number or an irrational number.

e.g $\sqrt{5} \times \sqrt{2} = \sqrt{10}$ which is irrational

but $\sqrt{8} \times \sqrt{2} = \sqrt{16} = 4$ which is a rational number

Thus, the product of two irrational numbers can be either rational or irrational

similarly, the product of rational and irrational numbers can be either rational or irrational

$5 \times \sqrt{2} = 5\sqrt{2}$ which is irrational.

but $0 \times \sqrt{3} = 0$ which is rational.

2.

(b) 2

Explanation:

No. of zeros = no. of times the graph cuts the x-axis. Here the graph cuts the x-axis two times so no. of zero's = 2

3.

(c) consistent with unique solution.

Explanation:

Since the lines in the graph are not parallel, they will be consistent, also they are not coinciding, that means they have unique solution.

4.

(b) -5, 5

Explanation:

$x^2 - 25 = 0$

$x^2 = 25$

$x = \pm 5$

Roots are +5, -5

5. **(a)** 28

Explanation:

Given: d = – 4, n = 7 and a_n = 4

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

$\Rightarrow 4 = a + (7-1) \times (-4)$

$\Rightarrow$ 4= a+6 $\times$-4

$\Rightarrow 4 = a - 24$

$\Rightarrow a = 28$

6. **(a)** $\sqrt{2}$ units

Explanation:

Distance between $(\sin\theta, \cos\theta)$ and $(\cos\theta, -\sin\theta)$

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

= $\sqrt{\cos^2\theta + \sin^2\theta - 2\cos\theta\sin\theta + \cos^2\theta + \sin^2\theta + 2\cos\theta\sin\theta}$

= $\sqrt{2\cos^2\theta + 2\sin^2\theta}$

= $\sqrt{2\left(\cos^2\theta + \sin^2\theta\right)}$

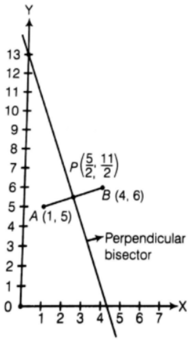
$\left[\because \cos^2\theta + \sin^2\theta = 1\right]$
= $\sqrt{2}$ units

7.

(b) (0, 13)

Explanation:

First, we have to plot the points of the line segment on the paper and join them.



As we know that the perpendicular bisector of line segment AB, perpendicular at AB and passes through the mid-point of AB.

Let P be the mid-point of AB

Now find the mid-point,

Mid-point of AB = $\frac{1+4}{2}, \frac{5+6}{2}$

$\because$ Mid-point of line segment passes through the points (x_1, y_1) and (x_2, y_2)

= $\left[\frac{(x_1+x_2)}{2}, \frac{(y_1+y_2)}{2}\right]$

$\Rightarrow P = \frac{5}{2}, \frac{11}{2}$

Find the slope of the bisector:

Slop of the given line = $\frac{(y_1-y_2)}{(x_1-x_2)}$

Slope = $\frac{5-6}{1-4} = \frac{1}{3}$

Slope of given line multiplied by slope of bisector = - 1

Slope of bisector = $\frac{-1}{\frac{1}{3}} = \frac{-3}{1}$

= - 3

Now, we find the bisector's formula by using the point slope form;

Which is;

$-3 = \frac{\frac{11}{2}-y}{\frac{3}{2}-x} = \frac{5.5-y}{2.5-x}$

- 3(2.5 – x) = 5.5 - y

- 7.5 + 3x = 5.5 - y3x + y - 13 = 0

Transform the formula into slope - intercept form

3x + y - 13 = 0y = - 3x + 13

because, slope - intercept form is y = mx + c,

Where, m is the slope and c is the y - intercept

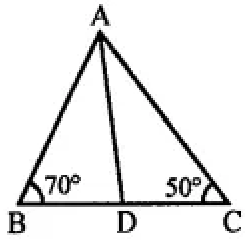
Thus, perpendicular bisector cuts the y - axis at (0, 13)

So, the required point is (0, 13).

8.

(b) 30°

Explanation:



$\frac{AB}{AC} = \frac{BD}{DC}$

$\angle B = 70° \ \angle C = 50°$

But $\angle A + \angle B + \angle C = 180°$ (Angles of a triangle)

$\angle A = 180° - (\angle B + \angle C)$

$= 180° - (70° + 50°)$

$= 180° - 120° = 60°$

$\frac{AB}{AC} = \frac{BD}{DC}$

AD is the bisector of $\angle A$

$\angle BAD = \frac{60}{2} = 30°$

9.

(c) 125^o

Explanation:

In $\triangle OTP$

$\angle O + \angle T + \angle P = 180^\circ$

$\angle O + 90^\circ + 35^\circ = 180^\circ$

$\angle O = 55^\circ$

Now

$\angle 0 + x = 180^\circ$

$55^\circ + x = 180^\circ$

$x = 180^\circ - 55^\circ$

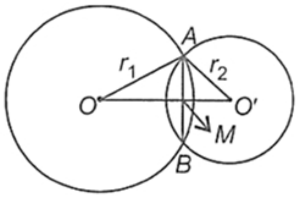
$x = 125^\circ$

10.

(d) $(8 + 2\sqrt{7})$ cm

Explanation:

Since, M is the mid-point of AB.



$\therefore$ AM = 6 cm

$AO(r_1) = 10$ cm, $AO'(r_2) = 8$ cm

AB is perpendicular to OO', then

In $\triangle$AOM, using Pythagoras theorem, $100 = 36 + OM^2$

$\Rightarrow$ OM = 8 cm;

In $\triangle$AMO', $64 = 36 + O'M^2$

$\Rightarrow \sqrt{28} = O'M \Rightarrow 2\sqrt{7} = O'M$

$\therefore OO' = (2\sqrt{7} + 8)$ cm

11.

(d) 1

Explanation:

$\sin x + \sin^2 x = 1$ (Given)

$\Rightarrow \sin x = 1 - \sin^2 x \Rightarrow \sin x = \cos^2 x$

Now, $\cos^8 x + 2\cos^6 x + \cos^4 x = \sin^4 x + 2\sin^3 x + \sin^2 x$

$= (\sin^2 x + \sin x)^2 = 1 \ [\because (\sin x + \sin^2 x) = 1]$

12.

(d) 2 $\cos^2$ A - 1

Explanation:

We have, $\cos^4$ A - $\sin^4$ A = ($\cos^2$ A + $\sin^2$ A) ($\cos^2$ A - $\sin^2$ A)

= 1 ($\cos^2$ A - $\sin^2$ A) = $\cos^2$ A - (1 - $\cos^2$ A)

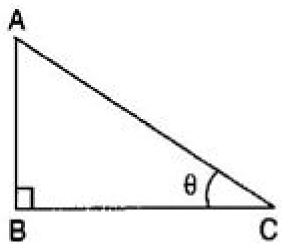
= $\cos^2$ A - 1 + $\cos^2$ A

= 2 $\cos^2$ A - 1

13.

(d) 6 km

Explanation:



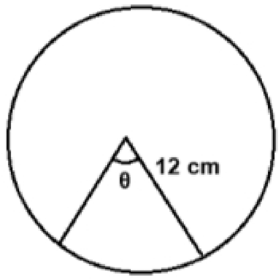
Let the height of the flying plane be AB = h meters, distance from the poisnt of observation AC = 12 m and angle of elevation $\theta=30^{\circ}$

$\therefore \sin 30^{\circ}=\frac{\mathrm{AB}}{\mathrm{AC}} \Rightarrow \frac{1}{2}=\frac{h}{12}$ ⇒h = 6 meters

14.

(b) 150^o

Explanation:



area of sector = 60 π cm^2

Let centre angle = θ

area $=\frac{\theta}{360} \times \pi r^2$

$\frac{60 \times 360^{\circ}}{12 \times 12}=\theta$

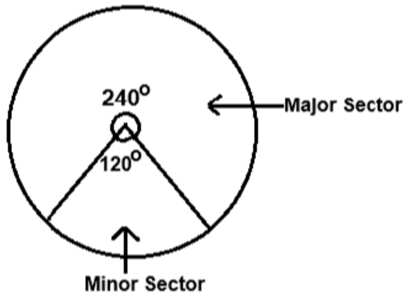
= 150^o = θ

Central angle = 150^o

15.

(c) 462 cm^2

Explanation:



ar. major sector $\frac{240^{\circ}}{360^{\circ}} \times \pi \times (21)^2$

$= \frac{2}{3} \times \frac{22}{7} \times 21 \times 21$

$= 44 \times 21$

= 924 cm^2

ar. minor sector

$= \frac{120^{\circ}}{360^{\circ}} \times \frac{22}{7} \times 21 \times 21$

$= \frac{1}{3} \times \frac{22}{7} \times 21 \times 21$

= 462 cm^2

difference between area = 924 - 462

= 462 cm^2

16. **(a)** $\frac{1}{26}$

Explanation:

Probability = $\frac{Number\ of\ favorable\ outcomes}{Total\ number\ of\ possible\ outcomes}$

Number of favorable outcomes = 2 (red kings)

Total number of possible outcomes = 52 (total cards in the deck)

Probability = $\frac{2}{52} = \frac{1}{26}$

Therefore, the probability of drawing a red king is $\frac{1}{26}$.

17.

(b) 480

Explanation:

Given, the total number of sold tickets = 6000

Let she bought x tickets.

Then, the probability of her winning the first prize is given as,

$\Rightarrow \frac{x}{6000} = 0.08$ [given]

$\Rightarrow x = 0.08 \times 6000$

$\therefore x$ = 480

Hence, she bought 480 tickets.

18.

(d) 20

Explanation:

Rain fall	**Day**	**Cf**
0-10	22	22
10-20	10	32
20-30	8	40 $\leftarrow$ 33 lies here
30-40	15	55
40-50	5	60
50-60	6	66

Highest frequency = 22
Modal class $\Rightarrow$ 0 - 10
upper limit $\rightarrow$ 10
Median class $\rightarrow$ 20 - 30
upper limit = 30
difference = 30 - 10
= 20

19.
(d) A is false but R is true.
Explanation:
A is false but R is true.

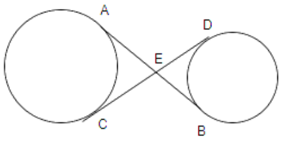
20.
(c) A is true but R is false.
Explanation:
A is true but R is false.

Section B

21. Let us assume that 6 + √2 is a rational number.
So we can write this number as
6 + √2 = a/b
Here a and b are two co-prime numbers and b is not equal to 0
Subtract 6 both side we get
√2 = a/b – 6
√2 = (a-6b)/b
Here a and b are integers so (a-6b)/b is a rational number. So √2 should be a rational number. But √2 is an irrational number. It is a contradiction.
Hence result is 6 + √2 is a irrational number

22. ΔALE $\sim$ ΔCLB
$\Rightarrow \frac{AL}{CL} = \frac{EL}{BL}$ ...(i)
Also $\triangle$CLM $\sim$ ΔALB
$\Rightarrow \frac{AL}{CL} = \frac{AB}{CM}$
$\Rightarrow \frac{AL}{CL} = \frac{CD}{CM}$ {AB = CD} ...(ii)
Using (i) and (ii)
$\frac{EL}{BL} = \frac{2CM}{CM}$
$\Rightarrow$ EL = 2BL

23. Common tangents AB and CD to two circles intersect at E.
As we know that , the tangents drawn from an external point to a circle are equal in length.
$\therefore$ EA = EC....(i)
and EB = ED...(ii)
On adding Eqs (i) and (ii), we get
EA + EB = EC + ED
$\Rightarrow$ AB = CD



24. LHS = (Sec A - tan A)^2
$$= \left(\frac{1}{\cos A} - \frac{\sin A}{\cos A}\right)^2 \left[\because \sec A = \frac{1}{\cos A}, \tan A, = \frac{\sin A}{\tan A}\right]$$
$$= \frac{(1-\sin A)^2}{\cos^2 A}$$

$= \frac{(1-\sin A)(1-\sin A)}{1-\sin^2 A}$ $[\because \cos^2 A = 1 - \sin^2 A]$

$= \frac{(1-\sin A)(1-\sin A)}{(1-\sin A)(1+\sin A)}$ $[\because a^2 - b^2 = (a+b)(a-b)]$

$= \frac{1-\sin A}{1+\sin A}$

= RHS

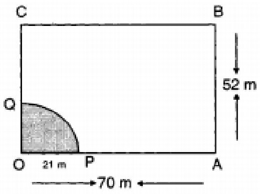
Hence proved.

OR

$secA = \frac{1}{\cos A} = \frac{1}{\sqrt{1-\sin^2 A}}$ $(cos^2 A = 1 - sin^2 A)$

$tanA = \frac{\sin A}{\cos A} = \frac{\sin A}{\sqrt{1-\sin^2 A}}$

25. Shaded portion indicates the area which the horse can graze. Clearly, shaded area is the area of a quadrant of a circle of radius r - 21 m.



$\therefore$Required Area = $\frac{1}{4}\pi r^2$

$\therefore$Required Area = $\left\{\frac{1}{4} \times \frac{22}{7} \times (21)^2\right\}$ cm^2 $=$ $\frac{693}{2}$cm^2 = 346.5 cm^2

OR

Long hand makes 24 rounds in 24 hours

Short hand makes 2 round in 24 hours

radius of the circle formed by long hand = 6 cm.

and radius of the circle formed by short hand = 4 cm.

Distance travelled by long hand in one round = circumference of the circle = $2 \times \pi \times r$

= $2 \times 6 \times \pi$

= 12π cm

Distance travelled by long hand in 24 rounds$= 24 \times 12\pi$

$= 288\pi$

Distance travelled by short hand in a round = $2 \times \pi \times r$

=$2 \times 4\pi$

= 8π cm

Distance travelled by short hand in 2 round

$= 2 \times 8\pi$

$= 16\pi$ cm

Sum of the distances = $288\pi + 16\pi = 304\pi$

$= 304 \times 3.14$

$= 954.56$ cm.

Thus, the sum of distances travelled by their tips in 24 hours is 954.56 cm.

Section C

26. The greatest number of plants that can be planted in a row = HCF(81, 45,63)

81 = 3^4

45 =$3^2 \times 5$

63 = $3^2 \times 7$

HCF = 9

9 plants to be planted in a row

27. Let p(x) = x^2 - 2x - 8

By the method of splitting the middle term,

$x^2 - 2x - 8 = x^2 - 4x + 2x - 8$

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

For zeroes of p(x),

p(x) = 0

$\Rightarrow (x-4)(x+2)=0$

$\Rightarrow x-4=0$ or $x+2=0$

$\Rightarrow x=4$ or $x=-2$

$\Rightarrow x=4,-2$

So, the zeroes of p(x) are 4 and -2.

We observe that, Sum of its zeroes

= 4 + (-2) = 2

$=\frac{-(-2)}{1}=\frac{-\text{ (Coefficient of } x)}{\text{Coefficient of } x^2}$

Product of its zeroes

$=4x(-2)=-8=\frac{-8}{1}=\frac{\text{Constant term}}{\text{Coefficient of } x^2}$

Hence, relation between zeroes and coefficients is verified.

28. x + y = 5 .... (1)

2x - 3y=4 .... (2)

I. **<u>Elimination method:</u>**

Multiplying equation (1) by 2, we get equation (3)

2x +2y =10 .... (3)

2x−3y =4 .... (2)

Subtracting equation (2) from (3), we get

5y =6 ⇒ y = $\frac{6}{5}$

Putting value of y in (1), we get

x + $\frac{6}{5}$=5

⇒ x =5− $\frac{6}{5}$= $\frac{19}{5}$

Therefore, x = $\frac{19}{5}$ and y = $\frac{6}{5}$

II. **<u>Substitution method:</u>**

x +y =5 .... (1)

2x−3y =4 .... (2)

From equation (1), we get,

x =5−y

Putting this in equation (2), we get

2(5−y)−3y =4

⇒ 10−2y−3y =4

⇒ 5y =6

⇒ y = $\frac{6}{5}$

Putting value of y in (1), we get

x =5−$\frac{6}{5}$=$\frac{19}{5}$

Therefore, x = $\frac{19}{5}$ and y = $\frac{6}{5}$

OR

Suppose the first and second number be x and y respectively.

According to the question,

$2x+3y=92$ ....(i)

$4x-7y=2$ ....(ii)

Multiplying equation (i) by 7 and (ii) by 3,

$\Rightarrow 14x+21y=644$ ....(iii)

$12x-21y=6$ ....(iv)

Adding equations (iii) and (iv),

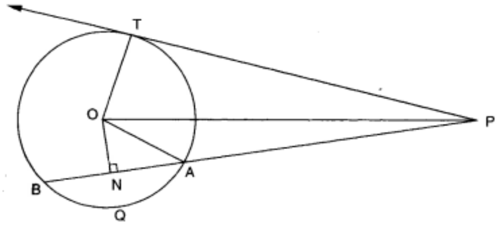
$\Rightarrow 26x=650$

$\Rightarrow x=\frac{650}{26}=25$

Putting $x=25$ in equation (i),

$\Rightarrow 2\times 25+3y=92$

$\Rightarrow 50 + 3y = 92$
$\Rightarrow 3y = 92 - 50$
$y = \frac{42}{3} = 14$
y = 14
$\therefore$ the first number is 25 and second is 14

29. 

i. PA .PB = (PN - AN)(PN + BN)

$= (PN - AN)(PN + AN) \left[\begin{array}{c} \because ON \perp AB \\ \therefore N \text{ is the mid-point of } AB \\ \Rightarrow AN = BN \end{array}\right]$

$= PN^2 - AN^2$

ii. Applying Pythagoras theorem in right triangle PNO, we obtain

$OP^2 = ON^2 + PN^2$

$\Rightarrow PN^2 = OP^2 - ON^2$

$\therefore PN^2 - AN^2 = (OP^2 - ON^2) - AN^2$

$= OP^2 - (ON^2 + AN^2)$

$= Op^2 - OA^2$ [Using Pythagoras theorem in ΔONA]

$= OP^2 - OT^2$ [$\because OA = OT =$ radius]

iii. From (i) and (ii), we obtain

$PA.PB = PN^2 - AN^2$ and $PN^2 - AN^2 = OP^2 - OT^2$

$\Rightarrow PA.PB = OP^2 - OT^2$

Applying Pythagoras theorem in $\triangle OTP$, we obtain

$OP^2 = OT^2 + PT^2$

$\Rightarrow OP^2 - OT^2 = PT^2$

Thus, we obtain

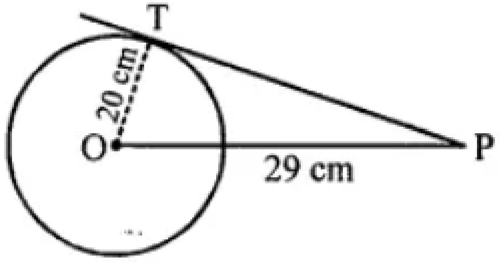
$PA.PB = OP^2 - OT^2$

and $OP^2 - OT^2 = PT^2$

Hence, $PA.PB = PT^2$.

OR

PT is the tangent to the circle with centre O and radius OT = 20 cm.
P is a point 29 cm away from O.



OP = 29 cm, OT = 20 cm
OT is radius and PT is the tangent
$OT \perp PT$
Now, in right $\triangle$OPT,
$OP^2 = OT^2 + PT^2$ (Pythagoras Theorem)
$\Rightarrow (29)^2 = (20)^2 + PT^2$

$\Rightarrow$ 841 = 400 + PT^2

$\Rightarrow$ PT^2 = 841 – 400

$\Rightarrow$ PT^2 = 441 = (21)^2

$\Rightarrow$ PT = 21

Length of tangent, PT = 21 cm

30. We have,$16 \cot A = 12 \Rightarrow \cot A = \frac{12}{16} \Rightarrow \cot A = \frac{3}{4}$

Now, $\frac{\sin A + \cos A}{\sin A - \cos A} = \frac{\frac{\sin A + \cos A}{\sin A}}{\frac{\sin A - \cos A}{\sin A}}$ [Dividing Numerator Denominator by $\sin A$]

$= \frac{\frac{\sin A}{\sin A} + \frac{\cos A}{\sin A}}{\frac{\sin A}{\sin A} - \frac{\cos A}{\sin A}}$ [$\because \frac{cos A}{sin A} = cot A$]

$= \frac{1 + \cot A}{1 - \cot A}$

$= \frac{1 + \frac{3}{4}}{1 - \frac{3}{4}} = \frac{\frac{7}{4}}{\frac{1}{4}} = 7 \ \left[\because \cot A = \frac{3}{4}\right]$

therefore, $\frac{\sin A + \cos A}{\sin A - \cos A} = 7$

31.

C.I.	f	c.f.
20 - 40	12	12
40 - 60	18	30
60 - 80	23	53
80 - 100	15	68
100 - 120	12	80
120 - 140	12	92
140 - 160	8	100
	$\sum f_i = 100$	

$n = 100 \Rightarrow \frac{n}{2} = 50$

Median Class$= 60 - 80$

$l = 60, c.f. = 30, f = 23, h = 20$

we know that, Median = $l + \frac{\frac{n}{2} - cf}{f} \times h$

$= 60 + \frac{50 - 30}{23} \times 20$

$= 77.39$

Section D

32. Let altitude of triangle be x.

$\therefore$ hypotenuse of triangle = 2x + 1 and base of triangle = 2x - 1.

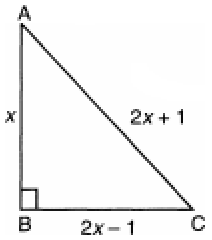
Using Pythagoras theorem,

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

or, $4x^2 + 1 + 4x = x^2 + 4x^2 + 1 - 4x$

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

or, x(x - 8) = 0



either x = 0 or x - 8 = 0

Rejecting x = 0,$\therefore$ x = 8

hypotenuse of triangle 2 $\times$8 + 1 = 17 cm and base of triangle 2 $\times$ 8 - 1 = 15 cm

OR

Let the average speed of truck be x km/h.

$\frac{150}{x}+\frac{200}{x+20}=5$

or, 150x + 3000 + 200x = 5x(x + 20)

or, $x^2-50x-600=0$

or, $x^2-60x+10x-600=0$

or, $x(x-60)+10(x-60)=0$

or, (x-60)(x + 10) = 0

or, x = 60 ; or x = -10

as, speed cannot be negative

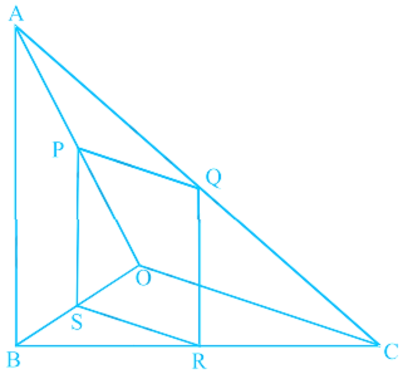
Therefore, x=60 km/h

Hence, first speed of the truck = 60 km/h

33. It is given that PQRS is a parallelogram,

So, PQ || SR and PS || QR.

Also, AB || PS.



To prove OC || SR

In $\triangle$OPS and OAB,

PS || AB

$\angle$POS = $\angle$AOB [common angle]

$\angle$OSP = $\angle$OBA [corresponding angles]

$\therefore$OPS $\sim$ $\triangle$OAB [by AAA similarity criteria]

Then,

$\frac{PS}{AB}=\frac{OS}{OB}$ …(i) [by basic proportionality theorem]

In $\triangle$CQR and ΔCAB,

QR || PS || AB

$\angle$QCR = $\angle$ACB [common angle]

$\angle$CRQ = $\angle$CBA [corresponding angles]

$\therefore$ $\triangle$CQR $\sim$ $\triangle$CAB

Then, by basic proportionality theorem

$=\frac{QR}{AB}=\frac{CR}{CB}$

$\Rightarrow \frac{PC}{AB}=\frac{CR}{CB}$ .....(ii)

[PS $\cong$ QR Since, PQRS is a parallelogram,]

From Equation (i) and (ii),

$\frac{\mathrm{OS}}{\mathrm{OB}}=\frac{\mathrm{CR}}{\mathrm{CB}}$

or $\frac{\mathrm{OB}}{\mathrm{OS}}=\frac{\mathrm{CB}}{\mathrm{CR}}$

On subtracting from both sides, we get,

$\frac{\mathrm{OB}}{\mathrm{OS}}-1=\frac{\mathrm{CB}}{\mathrm{CR}}-1$

$\Rightarrow \frac{\mathrm{OB}-\mathrm{OS}}{\mathrm{OS}}=\frac{(\mathrm{CB}-\mathrm{CR})}{\mathrm{CR}}$

$\Rightarrow \frac{\mathrm{BS}}{\mathrm{OS}}=\frac{\mathrm{BR}}{\mathrm{CR}}$

By converse of basic proportionality theorem, SR || OC

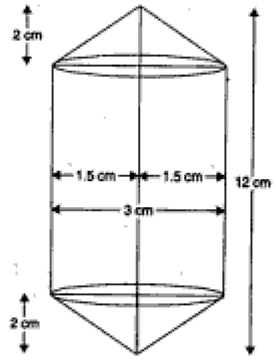
Hence proved.

34. For upper conical portion

Radius of the base(r) = 1.5 cm

Height (h_1) = 2 cm

$\therefore$ Volume = $\frac{1}{3}\ \pi r^2 h_1 = \frac{1}{3}\pi(1.5)^2(2) = 1.5\pi\ cm^3$



For lower conical portion

Volume = $1.5\pi\ cm^3$

For central cylindrical portion

Radius of the base(r) = 1.5 cm

Height (h_2) = 12 - (2 + 2) = 12 - 4 = 8 cm

$\therefore$ Volume = $\pi r^2 h_2 = \frac{1}{3}\pi(1.5)^2(8) = 18\pi\ cm^3$

Therefore, volume of the model = $1.5\pi + 1.5\pi + 18\pi = 21\pi = 21 \times \frac{22}{7} = 66\ cm^3$

Hence, the volume of the air contained in the model that Rechel made is 66 cm^3.

OR

Volume of raised water in cylinder = Volume of 9000 spherical balls

$\pi(10)^2 H = 9000 \times \frac{4}{3} \times \pi \times (0.5)^3$

$\therefore$ H = 15 cm

35.

Class Interval	Mid-value x_i	$d_i = x_i - 100$	$u_i = \left(\frac{x_i - 100}{20}\right)$	f_i	$f_i u_i$
50 – 70	60	-40	-2	18	-36
70 – 90	80	-20	-1	12	-12
90 – 110	100	0	0	13	0
110– 130	120	20	1	27	27
130– 150	140	40	2	8	16
150– 170	160	60	3	22	66
				N = 100	$\sum f_i u_i = 61$

Let us assumed mean is 100.

a = 100, h = 20

we know that , mean = $\overline{x}$ = a + $\frac{\sum f_i u_i}{N}$

Mean = 100 + 20$\left(\frac{61}{100}\right)$

= 100 + 12.2

= 112.2

Section E

36. i. Let there be 'n' number of rows

Given 3, 5, 7... are in AP

First term a = 3 and common difference d = 2

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

$\Rightarrow$ 360 = $\frac{n}{2}[2 \times 3 + (n-1) \times 2]$

$\Rightarrow$ 360 = n[3 + (n - 1) × 1]

$\Rightarrow$ n^2 + 2n - 360 = 0

$\Rightarrow$ (n + 20) (n - 18) = 0
$\Rightarrow$ n = -20 reject
n = 18 accept

ii. Since there are 18 rows number of candies placed in last row (18^{th} row) is
$a_n = a + (n - 1)d$
$\Rightarrow a_{18} = 3 + (18 - 1)2$
$\Rightarrow a_{18} = 3 + 17 \times 2$
$\Rightarrow a_{18} = 37$

iii. If there are 15 rows with same arrangement
$S_n = \frac{n}{2}[2a + (n-1)d]$
$\Rightarrow S_{15} = \frac{15}{2}[2 \times 3 + (15-1) \times 2]$
$\Rightarrow S_{15} = 15[3 + 14 \times 1]$
$\Rightarrow S_{15} = 255$
There are 255 candies in 15 rows.

OR

The number of candies in 12^{th} row.
$a_n = a + (n - 1)d$
$\Rightarrow a_{12} = 3 + (12 - 1)2$
$\Rightarrow a_{12} = 3 + 11 \times 2$
$\Rightarrow a_{12} = 25$

37. i. We have, P(-3, 4), Q(3, 4) and R(-2, -1).
$\therefore$ Coordinates of centroid of $\triangle$PQR
$= \left(\frac{-3+3-2}{3}, \frac{4+4-1}{3}\right) = \left(\frac{-2}{3}, \frac{7}{3}\right)$

ii. Coordinates of T = $\left(\frac{-2+3}{2}, \frac{-1+4}{2}\right) = \left(\frac{1}{2}, \frac{3}{2}\right)$

iii. Coordinates of U = $\left(\frac{-2-3}{2}, \frac{-1+4}{2}\right) = \left(\frac{-5}{2}, \frac{3}{2}\right)$

OR

The centroid of the triangle formed by joining the mid-points of sides of a given triangle is the same as that of the given triangle.
So, centroid of $\triangle$STU = $\left(\frac{-2}{3}, \frac{7}{3}\right)$

38. i. Time covered 10.00 am to 10.01 am = 1 minute = $\frac{1}{60}$ hour
Given: Speed = 600 miles/hour
Thus, distance d = 600 $\times \frac{1}{60}$ = 10 miles

ii. Now, tan $30^o = \frac{BB'}{B'A} = \frac{h}{10+x}$ ...(i)
And tan $60^o = \frac{CC'}{C'A} = \frac{BB'}{C'A} = \frac{h}{x}$
$x = \frac{h}{\tan 60^o} = \frac{h}{\sqrt{3}}$
Putting the value of x in eq(1), we get,
$\tan 30^o = \frac{h}{10+\frac{h}{\sqrt{3}}} = \frac{\sqrt{3}h}{10\sqrt{3}+h}$
$\tan 30^0 = \frac{\sqrt{3}h}{10\sqrt{3}+h}$
$\Rightarrow \frac{1}{\sqrt{3}} = \frac{\sqrt{3}h}{10\sqrt{3}+h}$
$\Rightarrow 3h = 10\sqrt{3} + h$
$\Rightarrow 2h = 10\sqrt{3}$
$\Rightarrow h = 5\sqrt{3}$ = 8.66 miles
Thus, the altitude 'h' of the airplane is 8.66 miles.

iii. The distance between passenger and airplane when the angle of elevation is 30^o.
In $\triangle$ABB'

$\sin 30^o = \frac{BB'}{AB}$

$\Rightarrow \frac{1}{2} = \frac{8.66}{AB}$

$\Rightarrow$ AB = 17.32 miles

OR

The distance between passenger and airplane when the angle of elevation is 60^o.

In $\triangle$ACC'

$\sin 60^o = \frac{CC'}{AC}$

$\Rightarrow \frac{\sqrt{3}}{2} = \frac{5\sqrt{3}}{AC}$

$\Rightarrow$ AC = 10 miles