Class X Session 2026-27
Subject - Mathematics (Standard)
Sample Question Paper - 10

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

General Instructions:

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 AssertionReason 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 Question 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 wherever required if not stated.
11. Use of calculators is not allowed.

Section A

1. $(2-5\sqrt{3})^2$ is **[1]**

   a) a rational number b) a negative integer

   c) an irrational number d) a positive integer

2. HCF of $(2^3 \times 3^2 \times 5)$, $(2^2 \times 3^3 \times 5^2)$ and $(2^4 \times 3 \times 5^3 \times 7)$ is **[1]**

   a) 105 b) 30

   c) 60 d) 48

3. If one root of the polynomial f(x) = $5x^2$ + 13x + k is reciprocal of the other, then the **[1]**

value of k is

a) $\frac{1}{6}$ b) 0

c) 5 d) 6

4. A quadratic polynomial having zeroes 7 and 0 is: **[1]**

a) $x(x^2 - 7)$ b) $7x^2 - 1$

c) $\frac{1}{7}(x^2 - x)$ d) $7(x^2 - 7x)$

5. The pair of linear equations **[1]**

$9x - 15y + 19 = 0$ and $5y - 3x - 9 = 0$

represents two lines which are:

a) intersecting exactly at two points. b) parallel.

c) intersecting exactly at one point. d) coincident.

6. If $\frac{2x}{3} - \frac{y}{2} + \frac{1}{6} = 0$ and $\frac{x}{2} + \frac{2y}{3} = 3$ then **[1]**

a) x = -2, y = 3 b) x = - 2, y = -3

c) x = 2, y = 3 d) x = 2, y = -3

7. Roots of the quadratic equation $x^2 + x - (a + 1)(a + 2) = 0$ are _____. **[1]**

a) (a + 1), -(a + 2) b) (a + 1), (a + 2)

c) -(a + 1), (a + 2) d) -(a + 1), -(a + 2)

8. The value of k for which the roots of the quadratic equation $6x^2 + 4kx + k = 0$ are real and equal, is **[1]**

a) $\frac{2}{3}$ b) 0

c) $\frac{-3}{2}$ d) $\frac{3}{4}$

9. The 6th term of the AP $\sqrt{27}, \sqrt{75}, \sqrt{147}, \ldots$ is: **[1]**

a) $\sqrt{300}$ b) $\sqrt{507}$

c) $\sqrt{243}$ d) $\sqrt{363}$

10. The sum of first n terms of an AP is $(3n^2 + 6n)$. The common difference of the AP is **[1]**

a) 6 b) 9

c) 15 d) -3

11. Which of the following statements is false? **[1]**

a) Two right triangles are always similar. b) Two circles are always similar.

c) Two equilateral triangles are always similar. d) Two squares are always similar.

12. ABCD is a trapezium such that BC || AD and AB = 4 cm. If the diagonals AC and BD intersect at O such that $\frac{AO}{OC} = \frac{DO}{OB} = \frac{1}{2}$ then, Find DC. **[1]**

a) 8 cm

b) 9 cm

c) 6 cm

d) 7 cm

13. The distance between the points (0, 5) and (-3, 1) is: **[1]**

a) 25 units

b) 8 units

c) 5 units

d) 3 units

14. If the mid-point of the line segment joining A(2a, 4) and B(-2, 3b) is M(1, 2a + 1), then the values of a and b respectively are **[1]**

a) 2, 3

b) 5, 2

c) 2, 2

d) 3, 2

15. If$4\ tan\ \theta\ =\ 3$, then $\frac{4\sin\theta-\cos\theta}{4\sin\theta+\cos\theta}$ is equal to **[1]**

a) $\frac{1}{3}$

b) $\frac{3}{4}$

c) $\frac{1}{2}$

d) $\frac{2}{3}$

16. If 16 cot x = 12, the $\frac{\sin x-\cos x}{\sin x+\cos x}$ equals. **[1]**

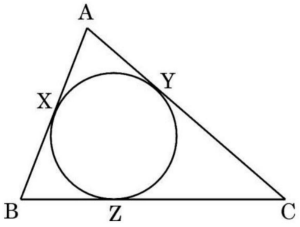
a) $\frac{2}{7}$

b) $\frac{1}{7}$

c) $\frac{3}{7}$

d) 0

17. In the given figure, a circle inscribed in $\triangle ABC$, touches AB, BC and CA at X, Z and Y, respectively. **[1]**



If $AB = 12\ cm, AY = 8\ cm$ and $CY = 6\ cm$, then the length of BC is:

a) 14 cm

b) 10 cm

c) 12 cm

d) 8 cm

18. A cylindrical vessel 32 cm high and 18 cm as the radius of the base, is filled with sand. This bucket is emptied on the ground and a conical heap of sand is formed. If the height of the conical heap is 24 cm, the radius of its base is **[1]**

a) 12 cm

b) 48 cm

c) 36 cm

d) 24 cm

19. **Assertion (A):** If the value of mode and mean is 60 and 66 respectively, then the value of median is 64. **[1]**

Reason (R): Median = (mode + 2 mean)

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):** When two coins are tossed together, the probability of getting no tail **[1]**

is $\frac{1}{4}$.

Reason (R): The probability P(E) of an event E satisfies $0 \leq P(E) \leq 1$.

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 $4 + \sqrt{2}$ is irrational. **[2]**

22. Aftab tells his daughter, **Seven years ago, I was seven times as old as you were then. Also, three years from now, I shall be three times as old as you will be.** (Isn't this interesting?) Represent this situation algebraically and graphically by the method of substitution. **[2]**

23. In what ratio does the point P(2, -5) divide the line segment joining A(-3, 5) and B(4, -9)? **[2]**

OR

If Q(0, 1) is equidistant from P(5, -3) and R(x, 6), find the values of x.

24. Evaluate : $\frac{\cos 45^\circ}{\sec 30^\circ} + \frac{1}{\sec 60^\circ}$. **[2]**

OR

If A = 45°, verify that: $\cos 2A = 2\cos^2 A - 1 = 1 - 2\sin^2 A$

25. A die is thrown once. Find the probability of getting **[2]**

i. a composite number,

ii. a prime number.

Section C

26. Find the zeroes of the polynomial $2x^2 + 7x + 5$ and verify the relationship between its zeroes and co-efficients. **[3]**

OR

Find the zeros of $f(x) = x^2 - 2x - 8$ and verify the relationship between the zeros and its coefficients.

27. If the point Q(0, 1) is equidistant from the points P(5, -3) and R(x, 6); find the value of x. Also, find the distance PR. **[3]**

28. Prove that $\sec\theta(1 - \sin\theta)(\sec\theta + \tan\theta) = 1$ **[3]**

29. The weights (in kg) of 50 wrestlers are recorded in the following table: **[3]**

Weight (in kg)	100-110	110-120	120-130	130-140	140-150
Number of Wrestlers	4	14	21	8	3

Find the mean weight of the wrestlers.

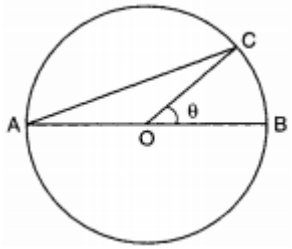
OR

Find the mode of the following frequency distribution:

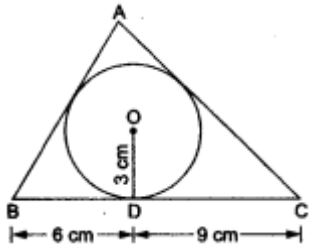
Class:	10 - 14	14 - 18	18 - 22	22 - 26	26 - 30	30 - 34	34 - 38
Frequency:	8	6	11	20	25	22	10

30. AB is the diameter of a circle, centre O. C is a point on the circumference such that **[3]**

$\angle COB = \theta$. The area of the minor segment cut off by AC is equal to twice the area of the sector BOC. Prove that $\sin\frac{\theta}{2}\cos\frac{\theta}{2} = \pi\left(\frac{1}{2} - \frac{\theta}{120}\right)$.



31. In the given figure, a triangle ABC is drawn to circumscribe a circle of radius 3 cm such that the segments BD and DC into which BC is divided by the point of contact D, are of lengths 6 cm and 9 cm respectively. If the area of $\triangle ABC$ = 54 cm then find the lengths of sides AB and AC. **[3]**



Section D

32. A plane left 30 minutes later than the scheduled time and in order to reach its destination 1500 km away on time, it has to increase its speed by 250 km/hr from its usual speed. Find the usual speed of the plane. **[5]**

OR

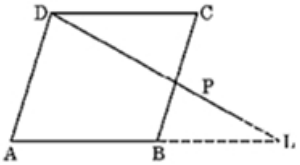
A dealer sells a toy for ₹ 24 and gains as much per cent as the cost price of the toy. Then find the cost price of the toy.38319

33. ABCD is a parallelogram, P is a point on side BC and DP when produced meets AB produced at L. Prove that **[5]**

i. $\frac{DP}{PL} = \frac{DC}{BL}$

ii. $\frac{\text{DL}}{\text{DP}} = \frac{\text{AL}}{\text{DC}}$

iii. If LP : PD = 2 : 3 then find BP : BC.

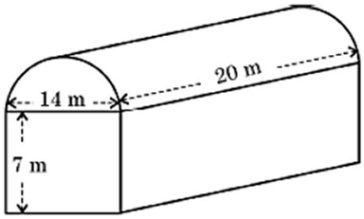


34. On a horizontal plane there is a vertical tower with a flag pole on the top of the tower. At a point 9 metres away from the foot of the tower the angles of elevation of the top and bottom of the flag pole are 60° and 30° respectively. Find the height of the tower and flag pole mounted on it. ($\sqrt{3}$= 1.732) **[5]**

OR

The angle of elevation of an airplane from point A on the ground is 60°. After a flight of 10 seconds, on the same height, the angle of elevation from point A becomes 30°. If the airplane is flying at the speed of 720 km/hr, find the constant height at which the airplane is flying.

35. [5]



A textile industry runs in a shed. This shed is in the shape of a cuboid surmounted by a half cylinder. If the base of the industry is of dimensions 14 m $\times$ 20 m and the height of the cuboidal portion is 7 m, find the volume of air that the industry can hold. Further, suppose the machinery in the industry occupies a total space of 400 m^3. Then, how much space is left in the industry?

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]

Gurpreet is very fond of doing research on plants. She collected some leaves from different plants and measured their lengths in mm.



The data obtained is represented in the following table:

Length (in mm):	70-80	80-90	90-100	100-110	110-120	120-130	130-140
Number of leaves:	3	5	9	12	5	4	2

Based on the above information, answer the following questions:

i. Write the median class of the data.

ii. How many leaves are of length equal to or more than 10 cm?

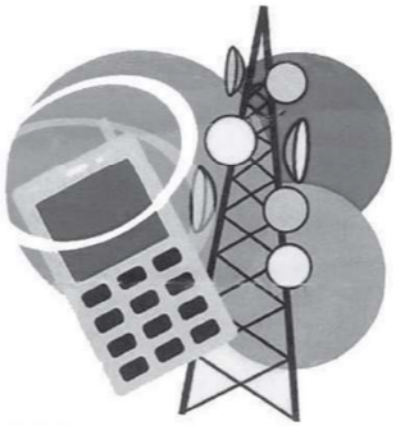
iii. a. Find median of the data.

OR

b. Write the modal class and find the mode of the data.

38. A telecommunication company came up with two plans- plan A and plan B for its customers. [4]

The plans are represented by linear equations where 't' represents the time



(in minutes) bought and 'C' represents the cost. The equations are:

Plan A: $3C = 20t$

Plan B: $3C = 10t + 300$

Based on above information, answer the following questions:

i. If you purchase plan B, how much initial amount you have to pay? **(1)**

ii. Charu purchased plan A. How many minutes she bought for ₹ 250? **(1)**

iii. a. At how many minutes, do both the plans charge the same amount? What is that amount? **(2)**

OR

b. Which plan is better if you want to buy 60 minutes? Give reason for your answer. **(2)**

Solution

Section A

1.

(c) an irrational number
Explanation:
an irrational number

2.

(c) 60
Explanation:
HCF = $(2^3 \times 3^2 \times 5, 2^2 \times 3^3 \times 5^2, 2^4 \times 3 \times 5^3 \times 7)$
HCF = Product of smallest power of each common prime factor in the numbers
$= 2^2 \times 3 \times 5 = 60$

3.

(c) 5
Explanation:
The Given polynomial is $f(x) = 5x^2 + 13x + k$.
Product of roots = k/5
$1 = \frac{k}{5}$
$\Rightarrow$ k = 5

4.

(d) $7(x^2 - 7x)$
Explanation:
$7(x^2 - 7x)$

5.

(b) parallel.
Explanation:
parallel.

6.

(c) x = 2, y = 3
Explanation:
We have,
$\frac{2x}{3} - \frac{y}{2} = -\frac{1}{6}$ ...(i)
$\frac{x}{2} + \frac{2y}{3} = 3$ ...(ii)
Now, multiplying (i) and (ii) by 6 we get:
4x - 3y = - 1 ...(iii)
3x + 4y = 18 ...(iv)
Now, multiplying (iii) by 4 and (iv) by 3 and adding them we get:
16x + 9x = - 4 + 54
x = $\frac{50}{25}$ = 2
Putting the value of x in (iv) we get:
3×2 + 4y = 18

$y = \frac{18-6}{4}$

$y = 3$

7. **(a)** (a + 1), -(a + 2)

Explanation:

Given equation is $x^2 + x - (a + 1)(a + 2) = 0$

$\Rightarrow x^2 + (a + 2)x - (a + 1)x - (a + 1)(a + 2) = 0$

$\Rightarrow x(x + (a + 2)) - (a + 1)(x + (a + 2)) = 0$

$\Rightarrow (x - (a + 1))(x + (a + 2)) = 0$

$\Rightarrow x = (a + 1)$ or $x = -(a + 2)$

8.

(b) 0

Explanation:

0

9.

(b) $\sqrt{507}$

Explanation:

$\sqrt{507}$

10. **(a)** 6

Explanation:

Given $S_n = (3n^2 + 6n)$

$\therefore T_1 = S_1 = (3 \times 1^2 + 6 \times 1) = 9,$

Also, $S_2 = (3 \times 2^2 + 6 \times 2) = 24.$

$\therefore T_2 = S_2 - S_1 = (24 - 9) = 15.$

Hence, $d = (T_2 - T_1) = 15 - 9 = 6.$

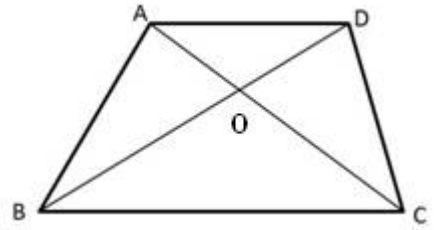
11. **(a)** Two right triangles are always similar.

Explanation:

Two right triangles are always similar.

12. **(a)** 8 cm

Explanation:



In ΔAOB and ΔCOD,

∠ AOB = ∠COD (Vertically opposite angles)

$\frac{AO}{OC} = \frac{DO}{OB}$ (Given)

Therefore according to SAS similarity criterion, we have

ΔAOB ∼ ΔCOD

$\frac{AO}{OC} = \frac{BO}{OD} = \frac{AB}{DC}$ [corresponding sides of similar triangles are proportional]

$\Rightarrow \frac{1}{2} = \frac{4}{DC}$

⇒ DC = 8 cm

13.

(c) 5 units

Explanation:

Let be point A(0, 5) and B(-3, 1)

$x_1 = 0, y_1 = 5, x_2 = -3, y_2 = 1$

Distance between the points

AB = $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

AB = $\sqrt{(-3-0)^2 + (1-5)^2}$

$= \sqrt{9+16}$

$= \sqrt{25}$

= 5 units

14.

(c) 2, 2

Explanation:

Coordinates of mid-point of AB are

$\left(\frac{2a-2}{2}, \frac{4+3b}{2}\right)$ i.e., $\left(a-1, \frac{4+3b}{2}\right)$

But M(1, 2a + 1) is the mid-point of AB. [Given]

$\therefore$ a - 1 = 1 $\Rightarrow$ a = 2 ...(i)

and $\frac{4+3b}{2}$ = 2a + 1 $\Rightarrow$ 4 + 3b = 4a + 2

$\Rightarrow$ 4 + 3b = 4(2) + 2 [Using (i)]

$\Rightarrow$ 4 + 3b = 10 $\Rightarrow$ b = $\frac{10-4}{3} = \frac{6}{3}$ = 2

$\therefore$ a = 2, b = 2

15.

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

Explanation:

Given" $4\tan\theta = 3$

Dividing all terms of $\frac{4\sin\theta - \cos\theta}{4\sin\theta + \cos\theta}$ by $\cos\theta$,

= $\frac{4\tan\theta - 1}{4\tan\theta + 1} = \frac{3-1}{3+1} = \frac{2}{4} = \frac{1}{2}$

16.

(b) $\frac{1}{7}$

Explanation:

16 cot x = 12 $\Rightarrow \cot x = \frac{12}{16} = \frac{3}{4}$

Now, $\frac{\sin x - \cos x}{\sin x + \cos x} = \frac{\frac{\sin x}{\sin x} - \frac{\cos x}{\sin x}}{\frac{\sin x}{\sin x} + \frac{\cos x}{\sin x}}$

$= \frac{1 - \cot x}{1 + \cot x}$ (Dividing by sin x)

= $\frac{1 - \frac{3}{4}}{1 + \frac{3}{4}} = \frac{\frac{1}{4}}{\frac{7}{4}}$

= $\frac{1}{4} \times \frac{4}{7} = \frac{1}{7}$

17.

(b) 10 cm

Explanation:

10 cm

18.

(c) 36 cm

Explanation:

Radius of a cylindrical vessel (r_1) = 18 cm

and height (h_1) = 32 cm

$\therefore$ Volume of sand filled in it = $\pi r_1^2 h_1$

= $\pi\,(18)^2 \times 32 = \pi \times 324 \times 32$ cm^3

= 10368π cm^3

Now height of the conical heap (h_2) = 24 cm

Let r_2 be the its radius, then

$\frac{1}{3}\pi r_2^2 h_2$ = 10368π

$\Rightarrow \frac{1}{3}\pi r_2^2 \times 24 = 10368\pi$

$\Rightarrow 8\pi r_2^2 = 10368\pi$

$r_2^2 = \frac{10368\pi}{8\pi}$ = 1296

$\therefore r_2 = \sqrt{1296}$ = 36

Hence radius of the base of the heap = 36 cm

19.

(c) A is true but R is false.

Explanation:

Median = $\frac{1}{3}(mode + 2\text{mean})$

= $\frac{1}{3}(60 + 2 \times 66)$ = 64

20.

(b) Both A and R are true but R is not the correct explanation of A.

Explanation:

Both A and R are true but R is not the correct explanation of A.

Section B

21. Let us assume that $4 + \sqrt{2}$ is rational. Then, there exist positive co-primes a and b such that

$4 + \sqrt{2} = \frac{a}{b}$

$\sqrt{2} = \frac{a}{b} - 4$

$\sqrt{2} = \frac{a-4b}{b}$

As a - 4b and b are integers.

So, $\frac{a-4b}{b}$ is a rational number .

But $\sqrt{2}$ is not rational number .

Since a rational number cannot be equal to an irrational number . Our assumption that $4 + \sqrt{2}$ is a rational number is wrong .

Hence, $4 + \sqrt{2}$ is irrational.

22. Let the present age of Aftab and his daughter be x and y years respectively. Then, the pair of linear equations that represent the situation is

x - 7 = 7(y - 7), i.e., x - 7y + 42 = 0 ...(1)

and x + 3 = 3(y + 3), i.e., x - 3y = 6 ...(2)

from equation (2), we get x = 3y + 6

By putting this value of x in equation (1), we get

(3y + 6) -7y + 42 = 0,

i.e., -4y = -48, which gives y = 12

Again by putting this value of y in equation (2), we get

$x = 3 \times 12 + 6 = 42$

So, the present age of Aftab and his daughter are 42 and 12 years respectively.

23. Let the required ratio be k:1.

Then, by the section formula, the coordinates of P are

$P\left(\frac{4k-3}{k+1}, \frac{-9k+5}{k+1}\right)$

$\therefore \quad \frac{4k-3}{k+1} = 2$ and $\frac{-9k+5}{k+1} = -5$ [$\because$ P(2, 5) is given]

$\Rightarrow$ 4k - 3 = 2k + 2 and -9k + 5 = -5k - 5

$\Rightarrow$ 2k = 5 and 4k = 10

$\Rightarrow k = \frac{5}{2}$ in each case.

So, the required ratio is $\frac{5}{2} : 1$, which is 5:2

Hence, P divides AB in the ratio 5:2.

OR

As given Q(0, 1) is equidistant from P(5, -3) and R(x, 6)

$\Rightarrow$ PQ = QR

$\Rightarrow \sqrt{(0-5)^2 + (1-(-3))^2} = \sqrt{(x-0)^2 + (1-6)^2}$ [By using distance formula = $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$]

$\Rightarrow 25 + 16 = x^2 + 25$

$\Rightarrow 41 = x^2 + 25$

$\Rightarrow x^2 = 16$

$\Rightarrow x = 4$

24. $\frac{\cos 45^\circ}{\sec 30^\circ} + \frac{1}{\sec 60^\circ}$

$= \frac{\frac{1}{\sqrt{2}}}{\frac{2}{\sqrt{3}}} + \frac{1}{2}$

$= \frac{1}{\sqrt{2}} \times \frac{\sqrt{3}}{2} + \frac{1}{2}$

$= \frac{\sqrt{3}}{2\sqrt{2}} + \frac{1}{2}$

Rationalise the denominator,

$= \frac{\sqrt{3}}{2\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}} + \frac{1}{2}$

$= \frac{\sqrt{6}}{4} + \frac{1}{2}$

OR

To show: $\cos 2A = 2\cos^2 A - 1 = 1 - 2\sin^2 A$

A = 45°

$\therefore$ We show: $\cos 90^\circ = 2\cos^2 45^\circ - 1 = 1 - 2\sin^2 45^\circ$

Consider $2\cos^2 45^\circ - 1 = 1 - 2\sin^2 45^\circ$

$= 2 \times (1/\sqrt{2})^2 - 1$

$= 1 - 1$

= 0

= cos 90° = R.H.S.

Consider $1 - 2\sin^2 45^\circ = 1 - 2(1/2)$

$= 1 - 1$

= 0

= cos 90° = R.H.S.

∴ L.H.S. = R.H.S.

Hence, verified.

25. Total outcomes =(1, 2,3,4,5,6)

i. Composite numbers on a die are 4 and 6

∴ P(composite number) = $\frac{2}{6} = \frac{1}{3}$

ii. outcomes which are prime = (2,3,5)

Probability of gettting a prime number = $\frac{number\ of\ outcomes\ where\ prime\ number\ comes}{Total\ number\ of\ outcomes}$

= $\frac{3}{6} = \frac{1}{2}$

Section C

26. $p(x) = 2x^2 + 7x + 5$

$= (x + 1)(2x + 5)$

Zeroes of $p(x)$ are -1 and $\frac{-5}{2}$

Sum of zeroes $= -1 - \frac{5}{2} = \frac{-7}{2} = -\frac{\text{coefficient of } x}{\text{coefficient of } x^2}$

Product of zeroes $= (-1)\left(\frac{-5}{2}\right) = \frac{5}{2} = \frac{\text{constant term}}{\text{coefficient of } x^2}$

OR

f(x) = x^2 - 2x - 8

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

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

= (x + 2) (x - 4)

f(x) = 0 if x+2 = 0 or x-4 = 0

x = -2 or 4

So the zeroes of the polynomials are -2 and 4.

For the Polynomial f(x)=x^2 - 2x - 8

a=1,b=-2, c=-8

Sum of the zeroes = - 2 + 4 = 2 = -$\frac{b}{a}$

Product of zeros =(-2)(4) = -8 = $\frac{c}{a}$

Hence, the relationship between the zeros and coefficients is verified.

27. PQ = QR $\Rightarrow$ PQ^2 = QR^2

$(5 - 0)^2 + (-3 - 1)^2 = (x - 0)^2 + (6 - 1)^2$

x^2 = 16

x = 4, -4

$\Rightarrow$ R(4, 6) or (-4, 6)

If R(4, 6), PR = $\sqrt{(5-4)^2 + (-3-6)^2}$ = $\sqrt{82}$

If R(-4, 6), PR = $\sqrt{(5+4)^2 + (-3-6)^2}$ = $\sqrt{162}$ or $9\sqrt{2}$

28. LHS = secθ(1 - sinθ)(secθ + tanθ)

$= \left[\sec\theta - \frac{\sin\theta}{\cos\theta}\right] \times (\sec\theta + \tan\theta)$

$= (\sec\theta - \tan\theta)(\sec\theta + \tan\theta)$

= $\sec^2\theta$ - $\tan^2\theta$ = 1 = RHS

29. We first find the class mark x_i, of each class and then proceed as follows

Weight (in kg)	Number of wrestles (f_i)	Class Marks (x_i)	Deviation $d_i = x_i$ - a	$f_i d_i$
100-110	4	105	-20	-80

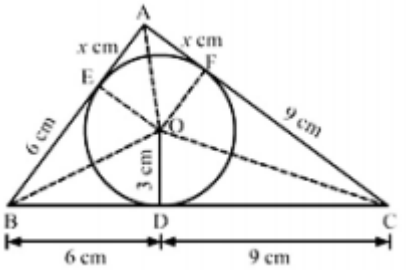
110-120	14	115	-10	-140
120-130	21	a=125	0	0
130-140	8	135	10	80
140-150	3	145	20	60
		$N = \sum f_i = 50$		$\sum f_i d_i = -80$

$\therefore$ Assumed mean, (a) = 125
Class width, (h) = 10
and total observations, (N) = 50
By step deviation method,
Mean $(\bar{x}) = a + \frac{\sum f_d d}{\sum f_i}$
Mean $(\bar{x}) = 125 + \frac{(-80)}{50}$
= 125 - 16
= 123.4kg
Hence, mean weight of wrestlers = 123.4kg

OR

The modal class is 26 - 30, as it has the maximum frequency.
$\therefore$ x_k = 26, h = 4, f_k = 25, f_{k-1} = 20, f_{k+1} = 22
Mode, $M_o = x_k + \left\{h \times \frac{(f_k - f_{k-1})}{(2f_k - f_{k-1} - f_{k+1})}\right\}$
$= 26 + \left(\frac{(25-20)}{(2\times25-20-22)} \times 4\right)$
$= 26 + \frac{5}{2}$
$= 26 + 2.5 = 28.5$

30. Given,
AB is the diameter of the circle
$\angle COB = \theta$
According to question
Area of minor segment cut off by AC = 2 $\times$ Area of sector BOC
$\Rightarrow \quad \frac{\angle AOC}{360^\circ} \times \pi r^2 - \frac{1}{2} r^2 \sin \angle AOC = 2 \times \frac{\theta}{360^\circ} \times \pi r^2$
$\Rightarrow \quad \frac{180-\theta}{360^\circ} \times \pi r^2 - \frac{1}{2} r^2 \sin(180 - \theta) = 2 \times \frac{\theta}{360^\circ} \pi r^2$
$\Rightarrow \quad \frac{180-\theta}{360^\circ} \times \pi r^2 - 2 \times \frac{\theta}{360^\circ} \pi r^2 = \frac{1}{2} r^2 \sin\theta$
$\Rightarrow \quad \pi r^2 \left[\frac{180-\theta}{360^\circ} - \frac{2\theta}{360^\circ}\right] = \frac{1}{2} r^2 \sin\theta$
$\Rightarrow \quad \pi r^2 \left[\frac{180-\theta-2\theta}{360^\circ}\right] = \frac{1}{2} r^2 \sin\theta$
$\Rightarrow \quad \pi \left[\frac{180-3\theta}{360^\circ}\right] = \frac{1}{2} \sin\theta$ [Cancel r^2 from both side]
$\Rightarrow \quad \pi \left[\frac{180}{360^\circ} - \frac{3\theta}{360^\circ}\right] = \frac{1}{2} \times 2 \sin\frac{\theta}{2} \cdot \cos\frac{\theta}{2}$ [We know that $\sin 2\theta = 2\sin\theta\cos\theta$]
$\Rightarrow \quad \pi \left[\frac{1}{2} - \frac{\theta}{120^\circ}\right] = \sin\frac{\theta}{2} \cdot \cos\frac{\theta}{2}$ Hence Proved

31. 

We know that tangent segments to a circle from the same external point are congruent
Now, we have
AE = AF,
BD = BE =6 cm and
CD = CF = 9 cm
Now,
$\text{Area}(\triangle ABC)$
$= \text{Area}(\triangle BOC) + \text{Area}(\triangle AOB) + \text{Area}(\triangle AOC)$
$\Rightarrow 54 = \frac{1}{2} \times BC \times OD + \frac{1}{2} \times AB \times OE + \frac{1}{2} \times AC \times OF$
$\Rightarrow 108 = 15 \times 3 + (6 + x) \times 3 + (9 + x) \times 3$
$\Rightarrow$ 36 = 15 + 6 + x + 9 + x
$\Rightarrow$ 36 = 30 + 2x
$\Rightarrow$ 2x = 6
$\Rightarrow$ x = 3cm
$\therefore$ AB = 6 + 3 = 9cm and
AC = 9 + 3 = 12cm.

Section D

32. Let the usual speed of the plane be x km/hr.
Then, time taken to cover 1500 km with the usual speed = $\frac{Distance}{Speed}$ = $\frac{1500}{x} hrs$
Increased speed be (x + 250) km/hr
Time taken to cover 1500 km with the increased speed = $\frac{1500}{x+250} hrs$
According to the question
$\frac{1500}{x} - \frac{1500}{x+250} = 30min = \frac{1}{2}$
$\Rightarrow \frac{1500x+1500\times250-1500x}{x(x+250)} = \frac{1}{2}$
$\Rightarrow \frac{1500\times250}{x^2+250x} = \frac{1}{2}$
$\Rightarrow$ x^2 + 250x - 750000 = 0
$\Rightarrow$ x^2 + 1000x - 750x - 750000 = 0
$\Rightarrow$ x(x + 1000) - 750 (x + 1000) = 0
$\Rightarrow$ (x + 1000) (x - 750) = 0
Either x + 1000 = 0 or x - 750 = 0
$\Rightarrow$ x = -1000, 750
But speed of the plane cannot be negative. So, x = 750.
Hence, the usual speed of the plane is 750 km/hr.

OR

According to question a dealer sells a toy for Rs. 24 and gains as much per cent as the cost price of the toy.
Let the cost price of the toy be Rs. x.
Then, Gain = x%
$\Rightarrow$ Gain = Rs. $\left(x \times \frac{x}{100}\right)$ = Rs. $\frac{x^2}{100}$.
Therefore, S.P. = C.P. + Gain = $x + \frac{x^2}{100}$.
But, S.P. =Rs. 24.
$\therefore \quad x + \frac{x^2}{100} = 24$ [Given]
$\Rightarrow$ 100x + x^2 = 2400
$\Rightarrow$ x^2 + 100x - 2400 = 0
$\Rightarrow$ x^2 + 120x -20x -2400 = 0
$\Rightarrow \quad x(x + 120) - 20(x + 120) = 0$

$\Rightarrow$ (x + 120) (x - 20) = 0

$\Rightarrow$ x = 20, -120

$\Rightarrow$ x = 20 [because x > 0]

Hence, the cost price of the toy is Rs. 20.

33. i. $\triangle$DPC $\sim$ $\triangle$LPB

$\Rightarrow \frac{DP}{PL} = \frac{PC}{PB} = \frac{DC}{BL}$

ii. As BC || AD

$\therefore \Delta$LPB $\sim$ $\triangle$LDA

In $\triangle$DLA, AD || BP

$\Rightarrow \frac{LP}{DP} = \frac{LB}{AB}$

$\Rightarrow \frac{LP}{DP} + 1 = \frac{LB}{AB} + 1$

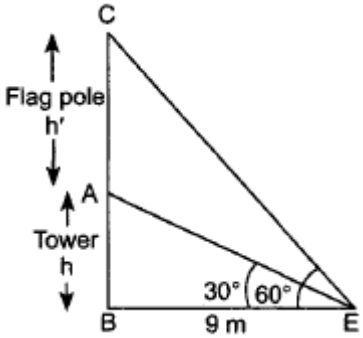
$\Rightarrow \frac{DL}{DP} = \frac{AL}{AB}$

$\Rightarrow \frac{DL}{DP} = \frac{AL}{CD}$ (AB = CD)

iii. $\frac{LP}{LD} = \frac{PB}{AD}$ ($\triangle$LPB $\sim$ $\triangle$LDA)

$\Rightarrow \frac{2}{5} = \frac{PB}{BC}$ (AD = BC)

34.



According to question it is given that AB be the tower and AC the flag pole on top of the tower.

$\angle$CEB = 60°, $\angle$AEB = 30°

To find: Height of the tower and the height of the flag pole. Flag pole.

Let us suppose that h be the height of the tower and height of the flag pole be h'

Now, In right $\triangle$ABE

$\frac{\text{AB}}{\text{BE}} = \tan 30^\circ \Rightarrow \frac{h}{9} = \frac{1}{\sqrt{3}}$

$\Rightarrow$ h = $\frac{9}{\sqrt{3}}$m

$= \frac{9}{\sqrt{3}} = \frac{9\sqrt{3}}{3}m = 3\sqrt{3}$ = 5.196 m .....(i)

In right $\triangle$CBE,

$\frac{CB}{BE} = \tan 60^\circ \Rightarrow \frac{h+h'}{BE} = \tan 60^\circ$

$\Rightarrow \frac{h+h'}{\text{BE}} = \sqrt{3}$

$\Rightarrow h + h' = 9\sqrt{3}$ .....(ii)

From (i) and (ii), we get

$\frac{9}{\sqrt{3}} + h' = 9\sqrt{3} \Rightarrow h' = 9\sqrt{3} - \frac{9}{\sqrt{3}}$

$h' = \frac{27-9}{\sqrt{3}} = \frac{18\times\sqrt{3}}{\sqrt{3}\times\sqrt{3}} = \frac{18\sqrt{3}}{3}\text{m} = 6\sqrt{3}\text{m}$

$= 6 \times 1.732\text{m} = 10.392\text{m}$

Height of flag pole mounted on tower = 10.932 m.

Thus, Height of the tower = $\frac{9}{\sqrt{3}}$m, and

the height of flag pole mounted on tower is 10.932 m

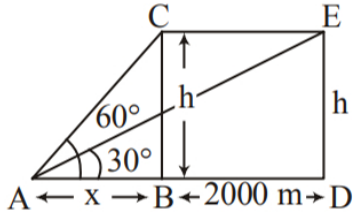
OR

Distance travelled in 10 seconds = 2000 m

Getting x = $\frac{h}{\sqrt{3}}$ (In $\triangle ABC$)

In $\triangle EDA$ $\tan 30^o = \frac{ED}{AD} \Rightarrow \frac{1}{\sqrt{3}} = \frac{h}{x+2000}$

Getting correct value of h = $1000\sqrt{3}$ m.



35. Volume of cuboid = $20 \times 14 \times 7 = 1960$ m^3

For half cylinder: $r = \frac{14}{2}$ m, h = 20 m

Volume of half cylinder = $\frac{1}{2}\pi r^2 h$

$= \frac{1}{2} \times \frac{22}{7} \times 7 \times 7 \times 20 = 1540$ m^3

$\therefore$ Required volume of air = 1960 + 1540 = 3500 m^3

Space occupied by machinery = 400 m^3

$\therefore$ Space left = 3500 - 400

= 3100 m^3

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

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

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

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

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

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

$\Rightarrow n = -20$ reject

n = 18 accept

ii. Since there are 18 rows number of candies placed in last row (18th 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 12th 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. Median class : 100 - 110

ii. No. of leaves equal to or more than 10cm(100 mm) = 23

a.

C.I	f	cf
70-80	3	3
80-90	5	8
90-100	9	17
100-110	12	29
110-120	5	34
120-130	4	38
130-140	2	40 = N

Median $= 100 + \frac{10}{12}(20 - 17) = 102 \cdot 5$

OR

b. Modal class is 100 - 110

Mode $= 100 + 10 \times \frac{12-9}{24-9-5} = 103$

38. i. At $t = 0, 3C = 300 \Rightarrow C = 100$

₹ 100 have to be paid initially.

ii. $3 \times 250 = 20t \Rightarrow t = 37.5$ minutes

iii. a. $20t = 10t + 300 \Rightarrow t = 30$

Both plans charge same amount if a person buys 30 minutes.

$\text{Amount } = \frac{20 \times 30}{3} = ₹200$

OR

b. At $t = 60$, cost under plan $A = ₹400$

At $t = 60$, cost under plan $B = ₹300$

Plan B is better as ₹ 100 are saved.