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- Multiple Choice Questions
- Case Study Questions
- Assertion-Reason Questions
- Subjective Type Questions

SURE SHOT QUESTIONS FOR 2027 BOARD EXAMS

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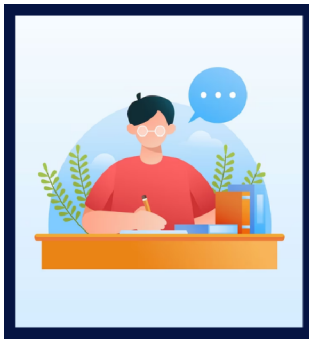
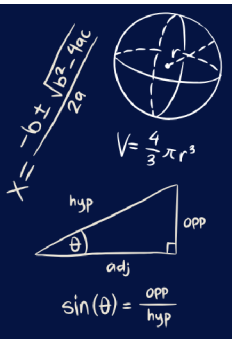


For CBSE 2027 Board Exams - Class 10 (Basic)

SAMPLE PAPER

issued by CBSE on 21 September, 2026

MATHEMATICS (241)



Time Allowed : 180 Minutes **Max. Marks : 80**

General Instructions :

1. This Question paper contains **five sections** - A, B, C, D and E.
2. Section A has **20 MCQs** of **1 mark** each.
   Section B has **05 questions** (Very Short Answer type) carrying **2 marks** each.
   Section C has **06 questions** (Short Answer type) carrying **3 marks** each.
   Section D has **04 questions** (Long Answer type) carrying **5 marks** each.
   Section E has **03 Case study-based questions** carrying **4 marks** each.
3. Each section is compulsory. However, there are internal choices in some questions.
   The **internal choice** has been provided in
   - **02 Questions of Section B**
   - **02 Questions of Section C**
   - **02 Questions of Section D**
   - **03 Questions of Section E** in all the sub-parts having 2 marks questions.

   You have to attempt only one of the alternatives in all such questions.
4. Draw neat figures wherever required. Take $\pi=\frac{22}{7}$ wherever required if not stated.

SECTION A

*(Question numbers 01 to 20 carry **1 mark** each.)*

*Followings are **multiple choice questions**. Select the correct option in each one of them.*

01. If HCF$(2520, 6600) = 40$ and LCM$(2520, 6600) = 252 \times k$, then the value of k is
(a) 165 (b) 1600 (c) 1625 (d) 1650

02. If α and β are the zeroes of the polynomial $2x^2-4x-5$, the value of $(\alpha-\beta)^2$ is
(a) 4 (b) 6 (c) 14 (d) 56

03. For what value of p does the pair of linear equations $4x+py+8=0$ and $2x+2y+2=0$ has a unique solution?
(a) $p=4$ only (b) $p=2$ only (c) $p\neq 4$ (d) $p\neq 2$

04. The sum of the numerator and denominator of a fraction is 11. If the denominator is increased by 1, the fraction becomes $\frac{1}{2}$, then the fraction is
(a) $\frac{2}{9}$ (b) $\frac{3}{8}$ (c) $\frac{4}{7}$ (d) $\frac{5}{6}$

05. If one root of the quadratic equation $ax^2+bx+c=0$ is the reciprocal of the other, then
(a) $b=c$ (b) $a=b$ (c) $ac=1$ (d) $a=c$

06. The first term of A.P. is p and the common difference is q, then its 10^{th} term is
(a) $q+10p$ (b) $p-9q$ (c) $p+9q$ (d) $p+10q$

07. Which term of the A.P. : 21, 42, 63, 84, … is 210?
(a) 9^{th} (b) 10^{th} (c) 11^{th} (d) 12^{th}

08. If the point P(5, 2) divides the line segment joining A(8, 5) and B(4, y) in the ratio 3:1, then the value of y is

(a) 4 (b) 3 (c) 2 (d) 1

09. A letter from the word INDEPENDENCE is selected at random. What is the probability that the letter selected is a vowel which occurs the maximum number of times in the given word?

(a) $\frac{1}{12}$ (b) $\frac{1}{4}$ (c) $\frac{1}{3}$ (d) $\frac{5}{12}$

10. Refer the following distribution.

Class	0-5	5-10	10-15	15-20	20-25
Frequency	10	15	12	20	9

The lower limit of the median class is

(a) 5 (b) 10 (c) 15 (d) 20

11. The length of a tangent drawn from a point at a distance of 10 cm from the centre of the circle is 8 cm. The radius of the circle is

(a) 4 cm (b) 5 cm (c) 6 cm (d) 7 cm

12. Mean and median of certain data are 32 and 30 respectively. Using empirical formula, the value of mode is

(a) 36 (b) 26 (c) 30 (d) 20

13. A ladder 15 m long reaches a window 12 m above the ground. The distance of the foot of the ladder from the base of the wall is

(a) 8 m (b) 9 m (c) 10 m (d) 13 m

14. The value of $\sin^2 60^\circ - 2\tan^2 45^\circ - \cos^2 30^\circ$ is

(a) –2 (b) –1 (c) 1 (d) 2

15. The perimeter of two similar triangles is 28 cm and 35 cm respectively. If one side of the first triangle is 8 cm, then the corresponding side of the second triangle is

(a) 10 cm (b) 12 cm (c) 14 cm (d) 16 cm

16. If in ΔABC and ΔPQR, $\angle B = \angle Q$, $\angle R = \angle C$ and $AB = 2PQ$, then the two triangles are

(a) congruent but not similar (b) similar but not congruent
(c) neither congruent nor similar (d) congruent as well as similar

17. If tangents PA and PB from a point P to a circle with centre O and respective point of contacts as A and B, are inclined to each other at angle of 80°, then $\angle AOB$ is equal to

(a) 60° (b) 70° (c) 80° (d) 100°

18. Two cubes each of volume 64 cm^3 are joined end to end to form a cuboid. The total surface area of the resulting cuboid is

(a) 128 cm^2 (b) 160 cm^2 (c) 176 cm^2 (d) 192 cm^2

*Followings are **Assertion-Reason based questions**.*

In the following questions, a statement of Assertion (A) is followed by a statement of Reason (R). Choose the correct answer out of the following choices.

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

19. **Assertion (A) :** The probability of getting number 8 on rolling a die is zero (0).
Reason (R) : The probability of an impossible event is zero (0).

20. **Assertion (A) :** If a line divides any two sides of a triangle in the same ratio, then the line is parallel to the third side.
Reason (R) : Line drawn from midpoint of one side of triangle parallel to another will bisect the third side.

SECTION B

*(Question numbers 21 to 25 carry **2 marks** each.)*

21. (A) Find the smallest number which when increased by 17 is exactly divisible by both 520 and 468.

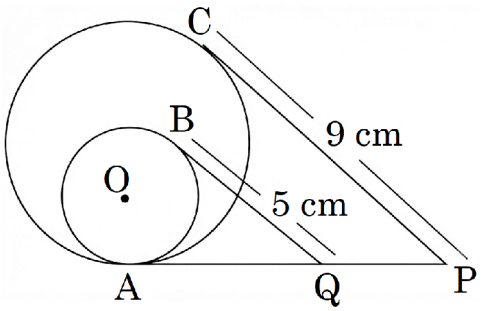
OR

(B) Show that $(25)^n$ will never end with digit zero for any natural number n.

22. If $3\sin\theta = 4\cos\theta$, find the value of $\sin\theta + \cos^2\theta - 1;\ 0^\circ < \theta < 90^\circ$.

23. If one zero of the quadratic polynomial $2x^2 - 3x + p$ is 3, find the value of p. Also find the other zero.

24. In the given figure, PA is a common tangent and QB and PC are the tangents from Q and P to the smaller and larger circle respectively. If $QB = 5$ cm and $PC = 9$ cm, then evaluate length of PQ.



FOR VISUALLY IMPAIRED STUDENTS

Two concentric circles are of radii 5 cm and 3 cm. Find the length of the chord of the larger circle which touches the smaller circle.

25. (A) Points A(3, 1), B(5, 1), C(a, b) and D(4, 3) are vertices of a parallelogram ABCD. Find the values of a and b.

OR

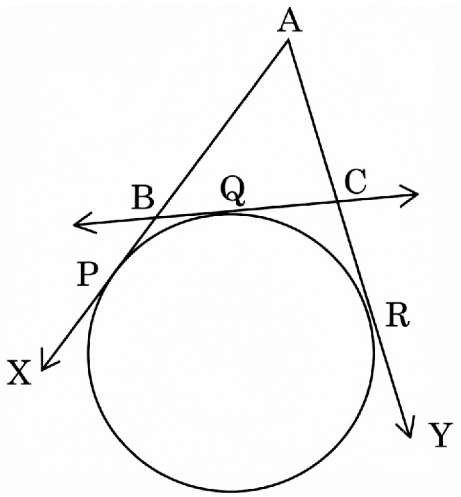
(B) Find a linear relation between x and y such that P(x, y) is equidistant from the points A(1, 4) and B(–1, 2).

SECTION C

*(Question numbers 26 to 31 carry **3 marks** each.)*

26. Given that $\sqrt{5}$ is irrational, prove that $2 + 3\sqrt{5}$ is irrational.

27. (A) In the given figure, AX, AY and BC are tangents to the circle with P, R and Q respective point of contacts. Prove that $AP = \frac{1}{2}(AB + BC + CA)$.



FOR VISUALLY IMPAIRED STUDENTS

Prove that a parallelogram circumscribing a circle is a rhombus.

OR

(B) Two tangents PA and PB are drawn to a circle with centre O from an external point P. Prove that $\angle APB = 2\angle OAB$.

28. Determine the ratio in which the point $(-6, y)$ divides the line segment joining the points $A(-3, -1)$ and $B(-8, 9)$. Also, find the value of y.

29. Consider ΔACB, right-angled at C, in which $AB = 29$ units, $BC = 21$ units and $\angle ABC = \theta$. Determine the values of - i. $1 + \tan^2\theta$ ii. $\cos^2\theta - \sin^2\theta$.

30. (A) The mean of the following distribution is 48 and sum of all the frequencies is 50. Find the missing frequencies x and y.

Class	20-30	30-40	40-50	50-60	60-70
Frequency	8	6	x	11	y

OR

(B) The distribution below gives the weight of 50 students of class X. Find the modal weight of the students.

Weight (in kg)	35-45	45-55	55-65	65-75	75-85
Number of students	5	10	20	12	3

31. The sum of the digits of a two-digit number is 9. Also, nine times this number is twice the number obtained by reversing the order of the digits. Find the number.

SECTION D

*(Question numbers 32 to 35 carry **5 marks** each.)*

32. Prove that if a line is drawn parallel to one side of a triangle intersecting the other two sides in distinct points, then the other two sides are divided in the same ratio.

33. (A) A train travels a distance of 360 km at a uniform speed. If the speed had been 5 km/h more, then it would have taken 1 hour less to cover the same distance. Find the speed of the train.

OR

(B) John and Jivanti together have 45 marbles. Both of them lost 5 marbles each, and the product of the number of marbles they now have is 124. Find the number of marbles they had with them in the beginning.

34. The largest possible hemisphere is drilled out of a wooden cubical block of side 21 cm such that the base of the hemisphere is on one of the faces of the cube. Then find

i. the volume of the wood left in the block.

ii. the total surface area of the remaining solid.

35. (A) To assist an ambulance, a drone is hovering over an accident site at a constant height on a highway. The angle of depression of the ambulance, approaching the accident site, observed from drone is 30°. Twelve minutes later, the angle of depression of the ambulance is found to be 60°. If the ambulance is moving at a constant speed, then find the total time taken by the ambulance to reach the site of accident.

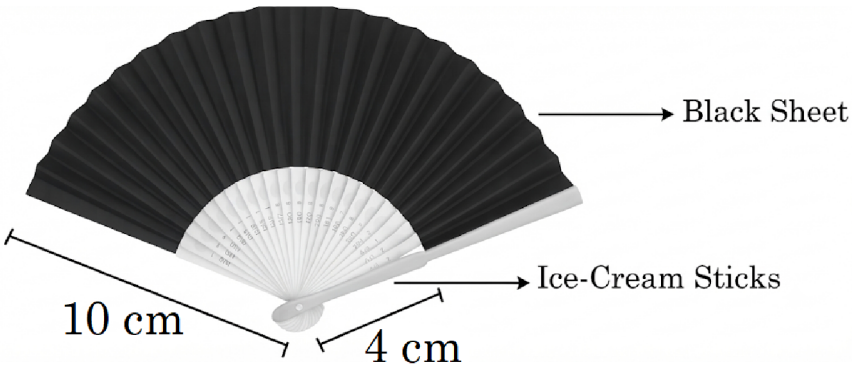
OR

(B) A statue standing on a pedestal, is 1.6 m tall. From a point on the ground, the angles of elevation of the top and bottom of the statue are 60° and 45° respectively. Find the height of the pedestal.

SECTION E

*(Question numbers 36 to 38 carry **4 marks** each.)*
*This section contains **three Case-study / Passage based questions**.*
*Each question has **three sub-parts** (i), (ii) and (iii). Two sub-parts are of **1 mark each** while the remaining third sub-part (with internal choice) is of **2 marks**.*

36. An art and craft teacher prepared a fan which looked like the sector of a circle.



Using ice-cream sticks and black sheet as shown in the given figure.

(i) The angle subtended at the centre of the sector is 60°. Find the area of one face of the fan.

(ii) With the given sector angle of 60° at the centre, find area of black sheet used in the fan.

(iii) (A) The boundary of the black sheet region on one face is to be covered by a designer tape. What length of tape is required?

OR

(iii) (B) If 29.6 cm of designer tape is required to cover the boundary of the black sheet region on one face of the fan, then evaluate the central angle of the sector.

FOR VISUALLY IMPAIRED STUDENTS

A motion sensor (or motion detector) is an electronic device that is designed to detect and measure movement. The motion detector can detect movement over a sector of angle $\theta = 70^\circ$ to a distance of 24 m.

(i) Derive a relation between length of arc (l) and the area of the sector (A) enclosed by it?

(ii) How much area is monitored by motion detector?

(iii) (A) To increase the area to be monitored by 50% with same range of distance covered, what should be the angle?

OR

(iii) (B) For $\theta = 91^\circ$, what range of distance is required for the detector to monitor 30% more area?

37. Delhi's pollution is a severe, often seasonal issue caused by a combination of factors like high vehicular and industrial emissions, dust from construction, and crop burning in surrounding states. In a school, students of classes I to XII thought of planting trees in and around the school to reduce air pollution.

It was decided that the number of trees that each section of each class will plant be three more than the double of the class in which they are studying, e.g., a section of class IV will plant 11 trees. If in the given school, there are two sections of each class, then answer the following questions.

(i) If number of trees planted by students class-wise follow arithmetic progression, then find the common difference.

(ii) What is the number of trees planted by students of class VI?

(iii) (A) What is the total number of trees planted by the students of given school?

OR

(iii) (B) Identify the class that planted 34 trees.

38. A labourer prints 400 T-shirts in a day. The supervisor checked the T-shirts and found that 312 prints were good, 54 prints were with minor defects and rest of the prints were of major defects.

Harish, a customer will buy a T-shirt only if it is good but a trader will buy, if it has no major defect. If a random T-shirt is picked, then

(i) find the probability that Harish will buy a T-shirt.

(ii) find the probability that a trader will buy the T-shirt.

(iii) (A) find the probability that the T-shirt is not good.

OR

(iii) (B) find the probability that neither Harish nor trader buy the T-shirt.

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SECTION A

01. (d) $\because$ HCF $\times$ LCM = Product of two numbers

$\therefore\ 40\times 252\times k = 2520\times 6600$

$\Rightarrow k = \dfrac{2520\times 6600}{40\times 252}$

$\Rightarrow k = \dfrac{6600}{4}$

$\therefore k = 1650$.

02. (c) For $2x^2-4x-5$, $\alpha+\beta = -\left(\dfrac{-4}{2}\right) = 2$, $\alpha\beta = -\dfrac{5}{2}$.

$\therefore (\alpha-\beta)^2 = \alpha^2+\beta^2-2\alpha\beta = (\alpha+\beta)^2-4\alpha\beta = 2^2-4\left(-\dfrac{5}{2}\right) = 4+10 = 14$.

03. (c) For unique solution, $\dfrac{a_1}{a_2} \neq \dfrac{b_1}{b_2}$

$\Rightarrow \dfrac{4}{2} \neq \dfrac{p}{2}$

$\Rightarrow p \neq 4$

04. (c) Let numerator be x and denominator be y.

Given $x+y=11$ and $\dfrac{x}{y+1} = \dfrac{1}{2}$

Solving these equations, we get $x=4,\ y=7$

$\therefore$ Fraction $= \dfrac{4}{7}$.

05. (d) Let the roots be α and $\dfrac{1}{\alpha}$.

Product of roots $= \alpha\times\dfrac{1}{\alpha} = \dfrac{c}{a}$ $\Rightarrow 1 = \dfrac{c}{a}$ $\therefore\ a = c$.

06. (c) $a_{10} = a+(10-1)d = p+9q$

07. (b) Let n^{th} term be 210.

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

$\Rightarrow 210 = 21+(n-1)\times 21$

$\Rightarrow 10 = 1+(n-1)$

$\therefore n = 10$

Hence, 210 is the 10^{th} term in the A.P.

08. (d) $P(5,\ 2) = P\left(\dfrac{3\times 4+1\times 8}{3+1}, \dfrac{3\times y+1\times 5}{3+1}\right)$

$\Rightarrow P(5,\ 2) = P\left(5, \dfrac{3y+5}{4}\right)$

On comparing the y-coordinate on both the sides, we get $2 = \dfrac{3y+5}{4}$

$\Rightarrow 8 = 3y+5$

$\therefore y = 1$.

09. (c) Given word is INDEPENDENCE, which has 12 letters.

Number of I's = 1; number of E's = 4.

$\therefore$ P(most occurig vowel E) $= \frac{4}{12} = \frac{1}{3}$.

10. (b) $\frac{N}{2} = \frac{66}{2} = 33$, which lies in the interval 10-15.

	Class	Frequency	Cumulative frequency
	0-5	10	10
	5-10	15	25
Median class $\rightarrow$	10-15	12	37
	15-20	20	57
	20-25	9	66

Median class is 10-15.
Therefore lower limit of the median class is 10.

11. (c) (Distance of point from the centre)^2 = (Length of tangent)^2 + (Radius)^2
$\therefore 10^2 = 8^2 + (\text{Radius})^2$
$\Rightarrow (\text{Radius})^2 = 10^2 - 8^2$
$\Rightarrow (\text{Radius})^2 = 100 - 64 = 36$
$\Rightarrow$ Radius = 6 cm

12. (b) $\because$ Mode = 3 Median − 2 Mean
$\therefore$ Mode $= 3 \times 30 - 2 \times 32$
$\Rightarrow$ Mode $= 90 - 64$
$\Rightarrow$ Mode $= 26$.

13. (b) $\because$ (Hypotenuse)^2 = (Base)^2 + (Perpendicular)^2
$\therefore 15^2 = (\text{Base})^2 + 12^2$
$\Rightarrow 225 - 144 = (\text{Base})^2$
$\Rightarrow (\text{Base})^2 = 81$
$\therefore$ (Base) = 9 m.

14. (a) $\sin^2 60^\circ - 2\tan^2 45^\circ - \cos^2 30^\circ = \left(\frac{\sqrt{3}}{2}\right)^2 - 2(1)^2 - \left(\frac{\sqrt{3}}{2}\right)^2 = -2$.

15. (a) $\because \frac{\text{Perimeter of first triangle}}{\text{Perimeter of second triangle}} = \frac{\text{Side of first triangle}}{\text{Side of second triangle}}$
$\therefore \frac{28}{35} = \frac{8}{\text{Side of second triangle}}$
$\Rightarrow$ Side of second triangle $= 8 \times \frac{35}{28}$
$\Rightarrow$ Side of second triangle $= 8 \times \frac{5}{4}$
$\therefore$ Side of second triangle = 10 cm.

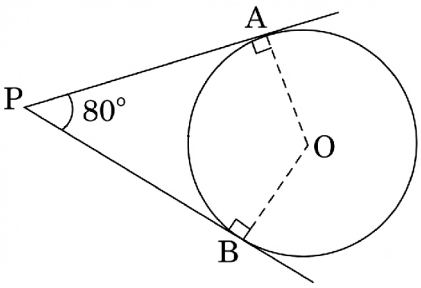
16. (b) In ΔABC and ΔPQR, $\angle B = \angle Q$, $\angle R = \angle C$; $\frac{AB}{PQ} = \frac{2}{1}$
$\therefore \Delta ABC \sim \Delta PQR$
Hence, the triangles are similar but not congruent because $AB \neq PQ$.

17. (d) $\angle APB = 80^\circ$

Join OA and OB.

$\angle OAP = \angle OBP = 90^\circ$

(Radius through the point of contact is $\perp$ to tangent)



In quadrilateral AOBP,

$\angle APB + \angle OAP + \angle AOB + \angle OBP = 360^\circ$

$\Rightarrow 80^\circ + 90^\circ + \angle AOB + 90^\circ = 360^\circ$

$\Rightarrow \angle AOB = 100^\circ$.

18. (b) Volume of cube, $a^3 = 64$

$\Rightarrow a = 4$ cm

On joining two cubes of side $= 4$ cm, we shall get a cuboid whose length $(l) = 8$ cm, breadth $(b) = 4$ cm and height $(h) = 4$ cm.

Surface area of resulting cuboid $= 2(lb + bh + hl)$

$= 2(8\times4 + 4\times4 + 4\times8) = 2(32 + 16 + 32)$

$= 160 \text{ cm}^2$.

19. (a) $\because$ P(getting 8 on rolling a die) $= \frac{0}{8} = 0$

Clearly, this is an impossible event as the numbers on the faces of a die are 1, 2, 3, 4, 5, 6.

$\therefore$ Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

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

SECTION B

21. (A) $\because 520 = 2^3\times5\times13,\ 468 = 2^2\times3^2\times13$

$\therefore$ LCM $= 2^3\times3^2\times5\times13 = 4680$

$\therefore$ The required number is $4680 - 17 = 4663$.

OR

(B) It is evident that any positive integer ending with the digit zero has to be divisible by 5 and 2 so, its prime factorization must contain the primes 5 and 2 both.

We have, $(25)^n = (5^2)^n = 5^{2n}$.

It is clear that the prime factorization of $(25)^n$ contains only 5 and this factorization is unique.

So by uniqueness of the Fundamental theorem of Arithmetic, there is no other prime in the factorization of $(25)^n$.

$\Rightarrow$ 2 does not occur in the prime factorization of $(25)^n$ for any value of n.

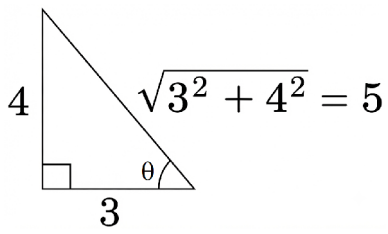
$\Rightarrow$ $(25)^n$ does not end with the digit zero for any natural number n.

22. $3\sin\theta = 4\cos\theta$

$\Rightarrow \frac{\sin\theta}{\cos\theta} = \frac{4}{3}$

$\Rightarrow \tan\theta = \frac{4}{3}$

$\therefore \sin\theta = \frac{4}{5},\ \cos\theta = \frac{3}{5}$



Now $\sin\theta + \cos^2\theta - 1 = \frac{4}{5} + \frac{9}{25} - 1 = \frac{20+9-25}{25} = \frac{4}{25}$.

23. Since 3 is a zero of $2x^2-3x+p$ so, $2(3)^2-3(3)+p=0$

$\Rightarrow 2\times 9-9+p=0$

$\Rightarrow 18-9+p=0$

$\Rightarrow p=-9$

Let the other zero be β.

Then sum of zeroes $=\alpha+\beta=-\left(\frac{-3}{2}\right)$

$\Rightarrow 3+\beta=\frac{3}{2}$

$\Rightarrow \beta=\frac{3}{2}-3$

$\therefore\ \beta=-\frac{3}{2}$.

24. Since the lengths of tangents from an external point to a circle are equal.

$QB=QA=5$ cm

$PC=PA=9$ cm

$\therefore PQ=AP-AQ$

$\Rightarrow PQ=9-5=4$ cm.

FOR VISUALLY IMPAIRED STUDENTS

Join OC and OA.

$\angle ACO=90^\circ$

(Radius through the point of contact is $\perp$ to tangent

In right angled ΔACO, $AC=\sqrt{OA^2-OC^2}$

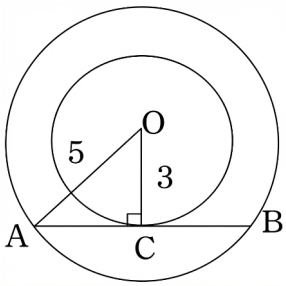
$\Rightarrow AC=\sqrt{5^2-3^2}=\sqrt{25-9}=\sqrt{16}$

$\Rightarrow AC=4$ cm.

$\therefore AB=2(AC)$

(Perpendicular from centre bisects the chord

$\Rightarrow AB=2\times 4$ cm $=8$ cm.



25. (A) Since the diagonals of parallelogram bisect each other.

$\therefore$ Midpoint of $AC=$ Midpoint of BD

$\Rightarrow\left(\frac{3+a}{2},\frac{1+b}{2}\right)=\left(\frac{5+4}{2},\frac{1+3}{2}\right)$

$\Rightarrow\left(\frac{3+a}{2},\frac{1+b}{2}\right)=\left(\frac{9}{2},2\right)$

On comparing both the coordinates, we get $3+a=9,\ 1+b=4$

$\Rightarrow a=6,\ b=3$.

OR

(B) Since $PA=PB$

$\Rightarrow PA^2=PB^2$

$\Rightarrow (x-1)^2+(y-4)^2=(x+1)^2+(y-2)^2$

$\Rightarrow x^2-2x+1+y^2-8y+16=x^2+2x+1+y^2-4y+4$

$\Rightarrow -2x-8y+16=2x-4y+4$

$\Rightarrow -4x-4y+12=0$

$\Rightarrow x + y - 3 = 0$

$\therefore x + y = 3$.

SECTION C

26. Let us assume that $2 + 3\sqrt{5}$ is a rational number.

Then there must exist co-prime positive integers a and b such that $2 + 3\sqrt{5} = \frac{a}{b}$

$\Rightarrow 3\sqrt{5} = \frac{a}{b} - 2$

$\Rightarrow \sqrt{5} = \frac{a - 2b}{3b}$

Since a and b are integers so, $\frac{a - 2b}{3b}$ is rational.

That implies, $\sqrt{5}$ is rational.

This contradicts the fact that $\sqrt{5}$ is an irrational number. So, our assumption is wrong.

Hence, $2 + 3\sqrt{5}$ is an irrational number.

27. (A) $AB + BC + CA = AB + BQ + CQ + AC$

$\Rightarrow AB + BC + CA = AB + BP + CR + AC$

$\because BQ = BP$ and $CQ = CR$

[Lengths of tangents drawn from an external point to a circle are equal

$\Rightarrow AB + BC + CA = AP + AR$

$\Rightarrow AB + BC + CA = 2AP$ [$\because AP = AR$, tangents from an external point

Hence, $AP = \frac{1}{2}(AB + BC + CA)$.

FOR VISUALLY IMPAIRED STUDENTS

ABCD is a parallelogram.

Therefore, opposite sides are equal.

That is, $AB = CD$ and $BC = AD$.

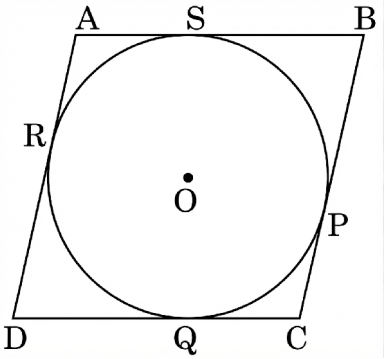
Since the lengths of tangents drawn from an external point to a circle are equal.

Therefore, $BP = BQ$ (Tangents from point B) …(i)

$CR = CQ$ (Tangents from point C) …(ii)

$DR = DS$ (Tangents from point D) …(iii)

$AP = AS$ (Tangents from point A) …(iv)



Adding (i), (ii), (iii) and (iv), we get

$BP + CR + DR + AP = BQ + CQ + DS + AS$

That is, $BP + AP + CR + DR = BC + AD$

$\Rightarrow AB + CD = BC + AD$

Substitute $CD = AB$ and $AD = BC$, then we get

$AB + AB = BC + BC$

$\Rightarrow 2 \times AB = 2 \times BC$

$\Rightarrow AB = BC$

Hence, $AB = BC = CD = DA$.

This implies that all the four sides are equal.

Therefore, the parallelogram circumscribing a circle is a rhombus.

OR

(B) In ΔAPB, $\angle APB + \angle BAP + \angle ABP = 180^\circ$

$\Rightarrow \angle APB + 2\angle BAP = 180^\circ$ [$\because \angle BAP = \angle ABP$

…(i)

$\because$ Tangent is $\perp$ to the radius at the point of contact.

So, $\angle OAB + \angle BAP = 90^\circ$

$\Rightarrow \angle BAP = 90^\circ - \angle OAB$

…(ii)

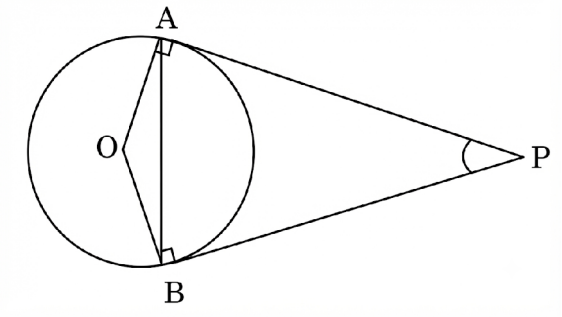
Substituting $\angle BAP$ in (i), we get

$\angle APB + 2(90^\circ - \angle OAB) = 180^\circ$

$\Rightarrow \angle APB + 180^\circ - 2\angle OAB = 180^\circ$

$\Rightarrow \angle APB = 180^\circ - 180^\circ + 2\angle OAB$

$\Rightarrow \angle APB = 2\angle OAB$.



28. Let the point $(-6, y)$ divides the line segment joining the points $A(-3, -1)$ and $B(-8, 9)$ in the ratio $k:1$.

Then $\left(\frac{k\times(-8)+1\times(-3)}{k+1}, \frac{k\times 9+1\times(-1)}{k+1}\right) = (-6, y)$

On comparing the x-coordinates, we get $\frac{k\times(-8)+1\times(-3)}{k+1} = -6$

$\Rightarrow -8k - 3 = -6k - 6$

$\Rightarrow -8k + 6k = -6 + 3$

$\Rightarrow -2k = -3$

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

$\therefore$ The required ratio is $3:2$.

For y-coordinate : $y = \frac{9k-1}{k+1} = \frac{9\left(\frac{3}{2}\right)-1}{\frac{3}{2}+1} = \frac{27-2}{3+2} = \frac{25}{5} = 5$.

29. Using Pythagoras theorem,

$AC = \sqrt{AB^2 - BC^2}$

$\Rightarrow AC = \sqrt{29^2 - 21^2}$

$\Rightarrow AC = \sqrt{841 - 441}$

$\Rightarrow AC = \sqrt{400}$

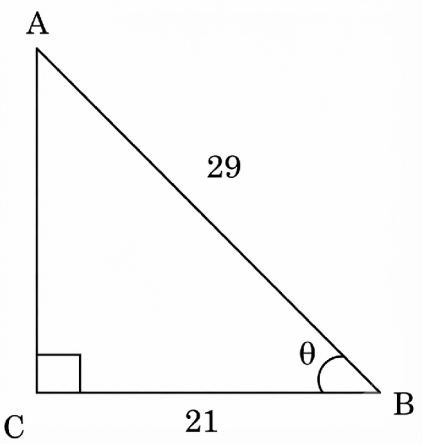
$\Rightarrow AC = 20$ units

$\therefore \sin\theta = \frac{AC}{AB} = \frac{20}{29}$;

$\cos\theta = \frac{BC}{AB} = \frac{21}{29}$ and $\tan\theta = \frac{\sin\theta}{\cos\theta} = \frac{20}{21}$.

i. $1 + \tan^2\theta = 1 + \left(\frac{20}{21}\right)^2 = 1 + \frac{400}{441} = \frac{841}{441}$

ii. $\cos^2\theta - \sin^2\theta = \frac{441}{841} - \frac{400}{841} = \frac{41}{841}$



30. (A) Refer the table given below.

Class Interval	f_i	x_i	$u_i = \frac{x_i - 45}{h}$	$f_i u_i$
20-30	8	25	–2	–16
30-40	6	35	–1	–6
40-50	x	45	0	0
50-60	11	55	1	11
60-70	y	65	2	2y
Total	$25+x+y$			$2y-11$

Assumed mean $(A) = 45$, width of the interval $(h) = 10$.

$$\sum f_i = 25 + x + y = 50$$

$$\Rightarrow x + y = 25 \quad \ldots(i)$$

$$\text{Mean} = 45 + \frac{2y-11}{50} \times 10$$

$$\Rightarrow 48 = 45 + \frac{2y-11}{5}$$

$$\Rightarrow 3 = \frac{2y-11}{5}$$

$$\Rightarrow 15 = 2y - 11$$

$$\Rightarrow 15 + 11 = 2y$$

$$\Rightarrow y = \frac{26}{2} = 13$$

Put value of $y = 13$ in (i), we get $x = 12$.

OR

(B) Refer the table given below.

	Weight (in kg)	Number of students
	35-45	5
	45-55	10 (f_0)
Modal class $\rightarrow$	55-65	20 (f_1)
	65-75	12 (f_2)
	75-85	3

Here modal class is 55-65, $l = 55$, $h = 10$.

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

$$\Rightarrow \text{Mode} = 55 + \left(\frac{20-10}{2\times 20 - 10 - 12}\right) \times 10$$

$$\Rightarrow \text{Mode} = 55 + \left(\frac{10\times 10}{40-22}\right) = 55 + \frac{100}{18} = 55 + 5.555\ldots = 60.555\ldots \text{ or } 60.56 \text{ (approx.)}$$

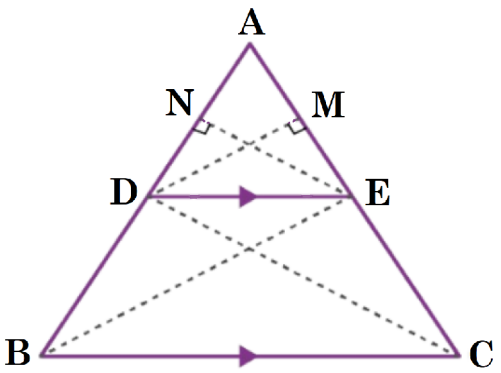
Hence, the modal weight of students is 60.56 kg (approx.).

31. Let the 10's place digit be x and 1's place digit be y.
Number $= 10x + y$, reversed number $= 10y + x$.
According to the question, $x + y = 9$ …(i)
$9(10x + y) = 2(10y + x)$
$\Rightarrow 88x - 11y = 0$
$\Rightarrow 8x - y = 0$ …(ii)
Solving (i) and (ii), we get $x + 8x = 9 \quad \Rightarrow 9x = 9 \quad \therefore x = 1,\ y = 8$
Required number $= 10x + y = 10 \times 1 + 8 = 18$.

SECTION D

32. **GIVEN:** A ΔABC in which $DE \| BC$, and DE intersects AB in D and AC in E.
TO PROVE: $\frac{AD}{DB} = \frac{AE}{EC}$.
CONSTRUCTION: Join BE and CD. Also draw $EN \perp BA$ and $DM \perp CA$.
PROOF: As $EN \perp BA$, therefore EN is the height of the triangles ADE and DBE.

$\because$ Area of $\Delta = \frac{1}{2}(\text{Base} \times \text{Height})$



Now, $ar(ADE) = \frac{1}{2}(AD \times EN)$

and, $ar(DBE) = \frac{1}{2}(DB \times EN)$

$$\Rightarrow \quad \frac{ar(ADE)}{ar(DBE)} = \frac{\frac{1}{2}(AD \times EN)}{\frac{1}{2}(DB \times EN)} = \frac{AD}{DB} \qquad \ldots(i)$$

Similarly, $ar(ADE) = \frac{1}{2}(AE \times DM)$ and $ar(DEC) = \frac{1}{2}(EC \times DM)$

$$\Rightarrow \quad \frac{ar(ADE)}{ar(DEC)} = \frac{\frac{1}{2}(AE \times DM)}{\frac{1}{2}(EC \times DM)} = \frac{AE}{EC} \qquad \ldots(ii)$$

Since ΔDBE and ΔDEC are on the same base DE and between the same parallels DE and BC.
Therefore, $ar(DEC) = ar(DBE)$ …(iii)
By (i), (ii) and (iii), we get $\frac{AD}{DB} = \frac{AE}{EC}$.

33. (A) Let the speed of the train be x km/h.
Then the increased speed of the train be $(x + 5)$ km/h.
According to the question, $\frac{360}{x} - \frac{360}{x+5} = 1$

$$\Rightarrow \frac{360x + 1800 - 360x}{x(x+5)} = 1$$

$$\Rightarrow \frac{1800}{x^2 + 5x} = 1$$

$$\Rightarrow x^2 + 5x = 1800$$

$\Rightarrow x^2 + 5x - 1800 = 0$

$\Rightarrow x^2 + 45x - 40x - 1800 = 0$

$\Rightarrow (x + 45)(x - 40) = 0$

$\because x \neq -45 \ \therefore x = 40$

$\therefore$ Speed of the train $= 40$ km/h .

OR

(B) Let the number of marbles John had in the beginning be x.
Then the number of marbles Jivanti had in the beginning $= 45 - x$.
According to the question, $(x - 5)(40 - x) = 124$

$\Rightarrow -x^2 + 45x - 200 = 124$

$\Rightarrow x^2 - 45x + 324 = 0$

$\Rightarrow x^2 - 36x - 9x + 324 = 0$

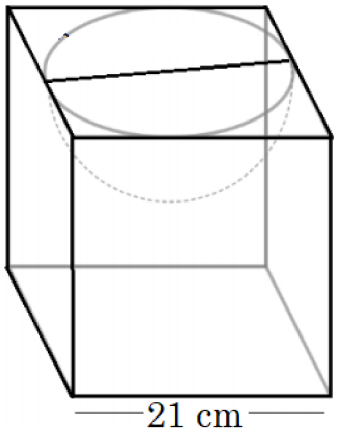
$\Rightarrow (x - 36)(x - 9) = 0$

$\therefore x = 36, 9$

CASE 1 Number of marbles John had in the beginning $= x = 36$.
Number of marbles Jivanti had in the beginning $= 45 - x = 45 - 36 = 9$.
CASE 2 Number of marbles John had in the beginning $= x = 9$.
Number of marbles Jivanti had in the beginning $= 45 - x = 45 - 9 = 36$.

34. Side of cube $(a) = 21$ cm

Radius of hemi-sphere $(r) = \frac{21}{2}$ cm



i. Volume of solid $= V_{cube} - V_{hemisphere}$

$= a^3 - \frac{2}{3}\pi r^3$

$= 21^3 - \frac{2}{3} \times \frac{22}{7} \times \left(\frac{21}{2}\right)^3$

$= 9261 - 11 \times 21 \times \frac{21}{2}$

$= 9261 - \frac{4851}{2} = 9261 - 2425.5$

$= 6835.5 \text{ cm}^3$

ii. Total surface area of wooden block $= 6a^2 - \pi r^2 + 2\pi r^2$

$= 6a^2 + \pi r^2$

$= 6 \times 21^2 + \frac{22}{7} \times \left(\frac{21}{2}\right)^2$

$= 2646 + \frac{22}{7} \times \frac{21}{2} \times \frac{21}{2}$

$= 2646 + 11 \times 3 \times \frac{21}{2}$

$= 2646 + 346.5 = 2992.5 \text{ cm}^2$.

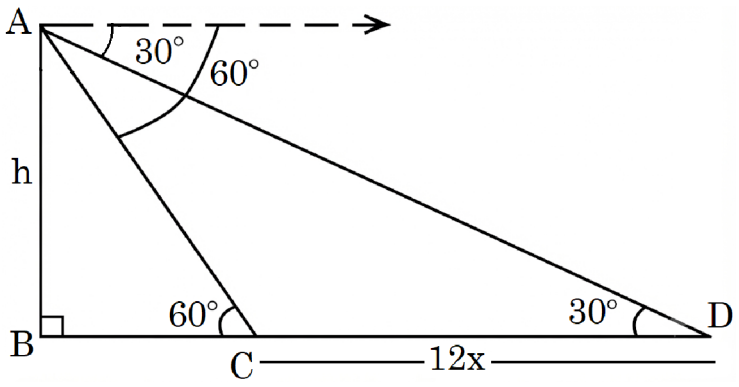
35. (A) Let height of drone (AB) be h m.
Let speed of ambulance be x m/min.
CD $= 12x$ m

In right-angled ΔABC,

$\tan 60^\circ = \dfrac{AB}{BC}$

$\Rightarrow \sqrt{3} = \dfrac{h}{BC}$

$\Rightarrow BC = \dfrac{h}{\sqrt{3}}$ …(i)



In right-angled ΔABD,

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

$\Rightarrow \dfrac{1}{\sqrt{3}} = \dfrac{h}{BD}$

$\Rightarrow BD = h\sqrt{3}$

$\Rightarrow BC + CD = h\sqrt{3}$

By (i), $\dfrac{h}{\sqrt{3}} + 12x = h\sqrt{3}$

$\Rightarrow 12x = h\sqrt{3} - \dfrac{h}{\sqrt{3}}$

$\Rightarrow 12x = \dfrac{2h}{\sqrt{3}}$

$\Rightarrow 6\sqrt{3}\,x = h$

By (i), $BC = \dfrac{6\sqrt{3}\,x}{\sqrt{3}} = 6x$

Time taken from C to B is $\dfrac{6x}{x} = 6$ minutes. $\left[\because \text{Time} = \dfrac{\text{Distance}}{\text{Speed}}\right.$

$\therefore$ Total time taken $= (6+12)$ minutes $= 18$ minutes.

OR

(B) Let height of the pedestal (BC) be h m.

CD = Height of statue = 1.6 m.

In right-angled ΔABC, $\tan 45^\circ = \dfrac{BC}{AB}$

$\Rightarrow 1 = \dfrac{h}{AB}$

$\Rightarrow AB = h$ …(i)

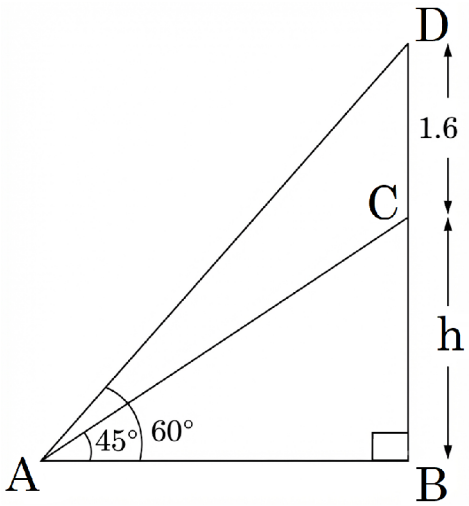
In right-angled ΔABD, $\tan 60^\circ = \dfrac{BD}{AB}$

$\Rightarrow \sqrt{3} = \dfrac{h+1.6}{AB}$

$\Rightarrow AB = \dfrac{h+1.6}{\sqrt{3}}$ …(ii)

By (i) and (ii), $h = \dfrac{h+1.6}{\sqrt{3}}$

$\Rightarrow h\sqrt{3} = h + 1.6$



$\Rightarrow h(\sqrt{3}-1)=1.6$

$\Rightarrow h=\dfrac{1.6}{(\sqrt{3}-1)}\times\dfrac{(\sqrt{3}+1)}{(\sqrt{3}+1)}=\dfrac{1.6(\sqrt{3}+1)}{3-1}=0.8(\sqrt{3}+1)$ m

$\therefore$ Height of the pedestal is $0.8(\sqrt{3}+1)$ m.

SECTION E

36. Central angle, $\theta=60^\circ$; $r=4$ cm, $R=10$ cm.

(i) Required area of one face of the fan $=\dfrac{\theta}{360}\pi R^2=\dfrac{60}{360}\times\dfrac{22}{7}\times10^2=52.38$ cm^2.

(ii) Required area of black sheet $=\dfrac{\theta}{360}\pi(R^2-r^2)=\dfrac{60}{360}\times\dfrac{22}{7}(10^2-4^2)=44$ cm^2.

(iii) (A) Boundary length of black sheet region on one face of the fan

$$=2(10-4)+\frac{60}{360}\times2\times\frac{22}{7}(10+4)$$

$$=12+\frac{1}{6}\times2\times\frac{22}{7}\times14=12+\frac{44}{3}=\frac{80}{3}\text{ cm}.$$

OR

(iii) (B) Since $2(10-4)+\dfrac{\theta}{360}\times2\times\dfrac{22}{7}(10+4)=29.6$

$\Rightarrow 12+\dfrac{\theta}{45}\times11=29.6$

$\Rightarrow \dfrac{\theta}{45}\times11=17.6$

$\Rightarrow \theta=17.6\times\dfrac{45}{11}=72^\circ$.

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Radius i.e., range of distance covered $(r)=24$ m; central angle $(\theta)=70^\circ$.

(i) $\dfrac{A}{l}=\dfrac{\dfrac{\theta}{360}\times\pi r^2}{\dfrac{\theta}{360}\times2\pi r}$

$\Rightarrow A=\dfrac{1}{2}\times l r$.

(ii) Area monitored $=\dfrac{\theta}{360}\times\pi r^2=\dfrac{70}{360}\times\dfrac{22}{7}\times24^2=352$ m^2.

(iii) (A) $\dfrac{\theta}{360}\times\pi\times24^2=\dfrac{150}{100}\times352$

$\Rightarrow \theta=\dfrac{3}{2}\times\dfrac{7\times360}{22\times24^2}\times352$

$\therefore \theta=105^\circ$

OR

(iii) (B) $\dfrac{91}{360}\times\pi\times r^2=\dfrac{130}{100}\times352$

$\Rightarrow r^2 = \frac{13}{10} \times \frac{7 \times 360}{22 \times 91} \times 352 = 36 \times 16$

$\Rightarrow r = \sqrt{36 \times 16} = 6 \times 4$

$\therefore r = 24$ m.

37. Number of trees planted by class I $= 2\{2(1)+3\} = 2 \times 5 = 10$

Number of trees planted by class II $= 2\{2(2)+3\} = 2 \times 7 = 14$

Number of trees planted by class III $= 2\{2(3)+3\} = 2 \times 9 = 18$ and so on.

Hence, it follows A.P. : 10, 14, 18, 22, …

(i) Common difference $= 14 - 10 = 4$

(ii) Number of trees planted by class VI $= 2\{2(6)+3\} = 2 \times 15 = 30$

(iii) (A) There are 12 classes (from class I to XII), so $n = 12$.

Total number of trees planted $= S_n = \frac{n}{2}[2a + (n-1)d]$

$= \frac{12}{2}[2 \times 10 + (12-1) \times 4]$

$= 6 \times 64 = 384$.

The total number of trees planted by all students is 384.

OR

(iii) (B) Let the class number be n.

Total trees for that class $= 2\{2(n)+3\} = 34$

$\Rightarrow \{2(n)+3\} = 17$

$\Rightarrow 2(n) = 17 - 3$

$\Rightarrow (n) = \frac{14}{2}$

$\therefore n = 7$.

Hence, the class that planted 34 trees is Class VII.

38. Total number of T-shirts printed $= 400$

Number of T-shirts with good print $= 312$

Number of T-shirts with minor print defect $= 54$

(i) P(Harish buys T-shirt) $= \frac{312}{400} = \frac{39}{50}$

(ii) P(Trader buys T-shirt) $= \frac{312+54}{400} = \frac{366}{400} = \frac{183}{200}$

(iii) (A) P(T-shirt is not good) $= 1 - $ P(T-shirt is good) $= 1 - \frac{312}{400} = \frac{88}{400} = \frac{11}{50}$

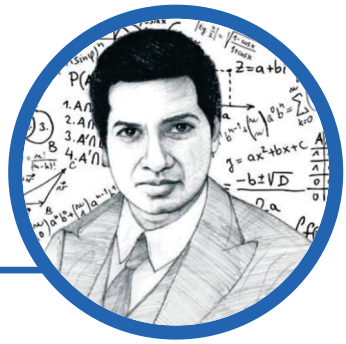
OR

(iii) (B) P(neither Harish nor Trader buys T-shirt) $= \frac{400-54-312}{400} = \frac{34}{400} = \frac{17}{200}$.

“

An equation means nothing to me
unless it expresses a thought of God.

SRINIVASA RAMANUJAN



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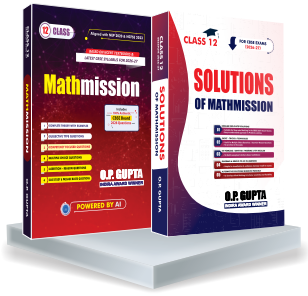

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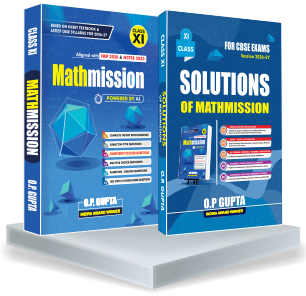

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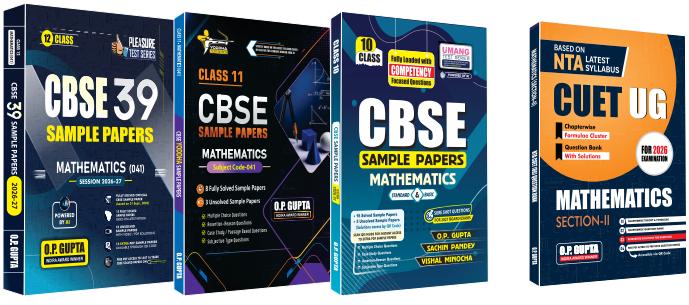

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