Competency Based Practice Questions

Mathematics - X

Co-created by
Board of School Education Haryana
and
Educational Initiatives

HOW TO USE THIS BOOKLET

Dear Teachers and Students,

The **Board of School Education Haryana** is pleased to present the **Competency-Based Practice Questions** booklet. This resource has been thoughtfully designed to help you deepen your understanding of key concepts and enhance your problem-solving skills. It includes **50 exemplar questions** carefully aligned with the curriculum to familiarize students with the format of **Competency-Based Questions**. These questions are intended to support targeted practice and develop the skills necessary to confidently approach a variety of question types in assessments.

Best Ways for Teachers to Utilise This Resource

1. Integrate into Classroom Teaching

- Use these questions to demonstrate how theoretical concepts translate into practical applications.
- Encourage group discussions to explore reasoning and understanding of concepts taught.

2. Scaffold Student Learning

- Start with simpler questions and guide students through the thought process.
- Gradually introduce more complex questions to build confidence and familiarity.

3. Incorporate into Assessments

- Use these questions in classroom quizzes or homework to help students adapt to the format.
- Provide feedback that emphasises reasoning over correctness, encouraging students to refine their understanding.

4. Focus on Skill Development

- Highlight how these questions nurture understanding, analysis and critical thinking.
- Use student responses to identify and address misconceptions effectively.

Best Ways for Students and Parents to Utilise This Resource

1. Focus on Conceptual Understanding

- Approach each question as a way to understand *why* and *how* a concept works, rather than simply finding the correct answer.

2. Practice Purposefully

- Don’t rush—break down the question, identify the concept it addresses, and plan your approach before solving it.

3. Use Feedback to Improve

- Treat mistakes as learning opportunities. Review incorrect answers to understand *what went wrong* and *how to improve*.
- Revisit similar questions to build confidence and mastery over the topic.

Best Ways for Parents to Utilise This Resource

1. Encourage Critical Thinking

- Spend time discussing questions and concepts, asking “Why?” and “How?”.

2. Create a Positive Environment

- Celebrate effort and curiosity, not just grades.
- Help your child view mistakes as opportunities to learn and grow.

3.Collaborate with Teachers

- Stay informed about competency-based assessments through school communications.
- Share observations and work with teachers to address any concerns or challenges.

Final Message

These practice questions are an excellent opportunity to strengthen your conceptual understanding and boost your confidence in solving competency-based questions. For students, each question builds skills that will help you tackle similar challenges with ease. For teachers, this is a chance to mentor students in developing their thinking and problem-solving skills.

Start today—every effort you invest will prepare you not only for exams but for a lifetime of meaningful learning and success. Let’s make this journey toward competency-based education a meaningful and successful one!

Board of School Education, Haryana

Contents

Real Numbers

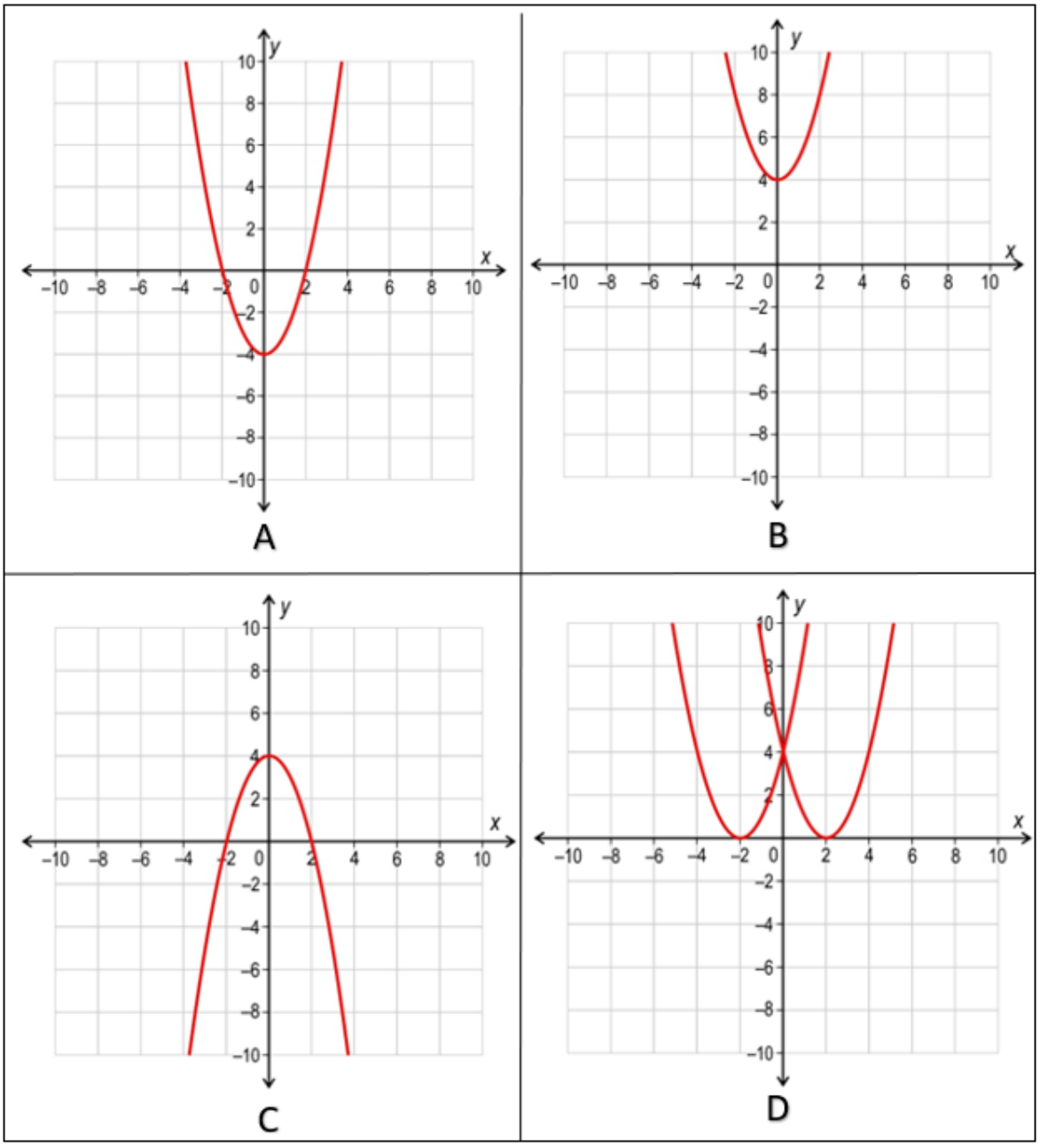
Serial No.	Question	Marks
1	*s* and *t* are two distinct prime numbers. Which one of these is the smallest number that can be divided by both s and t without leaving a remainder? (A) 1 (B) $s \times t$ (C) $s + t$ (D) $\frac{s \times t}{LCM(s,t)}$ [Skill: Understanding]	1
2	A cuboidal warehouse has a length of 9.6 metres, a width of 7.2 metres, and a height of 5.4 metres. What is the length of the longest measuring rod that can exactly measure the three dimensions of the room? [Skill: Application]	2
3	Three numbers P, Q and R are prime factorized as follows: $P = a^2b$ $Q = ab^2c$ $R = a^3bce$ where, *a*, *b*, *c* and *e* are prime numbers. Find HCF (P, Q, R) and LCM (P, Q, R). [Skill: Understanding]	2
4	P and Q are two points on the number line given by $P = 11$ and $Q = \sqrt{2}$. Prove that the distance between them is irrational. [Skill: Understanding]	3

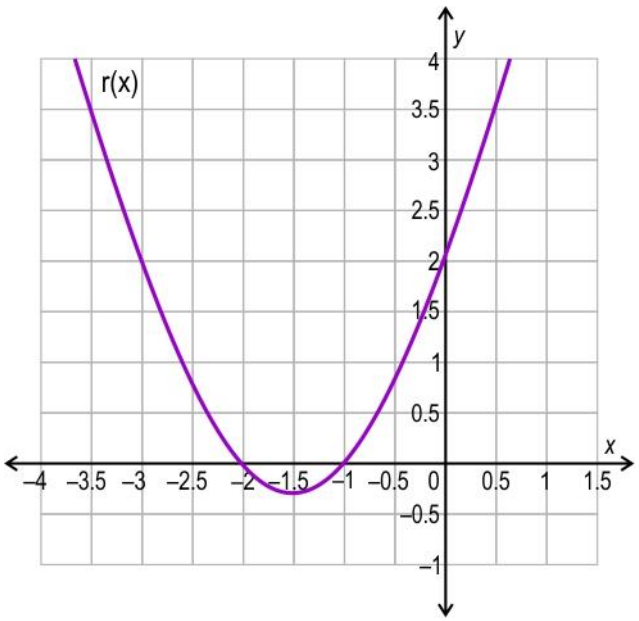
Marking Scheme

Q No.	Rubric	Marks
1	**Correct Answer:** B LCM of any two prime numbers is the product of those numbers.	1
	A: Students selecting this option find HCF.	
	C: Students selecting this option have not understood the concept.	
	D: Students selecting this option find HCF.	
2	**Evaluation Criteria:** Identifies the length of the longest rod as HCF of 9.6 m, 7.2 m and 5.4 m or HCF of 960 cm, 720 cm, 540 cm. Finds the prime factorisation as: Prime factorization of 960 = $2^6 \times 3 \times 5$ Prime factorization of 720 = $2^4 \times 3^2 \times 5$ Prime factorization of 540 = $2^2 \times 3^3 \times 5$ (Award full marks if any other method is used to find HCF.)	1
	Deduces HCF from prime factorisation as follows, Highest Common Factor (HCF) = $2^2 \times 3 \times 5 = 60$ The length of the longest measuring rod that can exactly measure the three dimensions is 60 cm or 0.6 m. (Award 0.5 marks if the length is correct but the unit is incorrect).	1
3	**Evaluation Criteria:** Finds HCF as *ab*.	1
	Finds LCM as a^3b^2ce.	1
4	**Evaluation Criteria:** Identifies the distance between P and Q as $11-\sqrt{2}$.	0.5
	Uses the contradictory method and assumes $\left(11-\sqrt{2}\right)$ is rational. Takes co-primes *a* and *b*, $(b \neq 0)$ such that $11-\sqrt{2} = \frac{a}{b}$. $\Longrightarrow \sqrt{2} = 11 - \frac{a}{b}$	1.5
	Writes that since *a* and *b* are integers, $11 - \frac{a}{b}$ is a rational number and so, √2 is rational. But recognizes that √2 is irrational. Writes that the assumption was wrong.	1

	Hence, proves that $\left(11-\sqrt{2}\right)$ is an irrational number.	

Polynomials

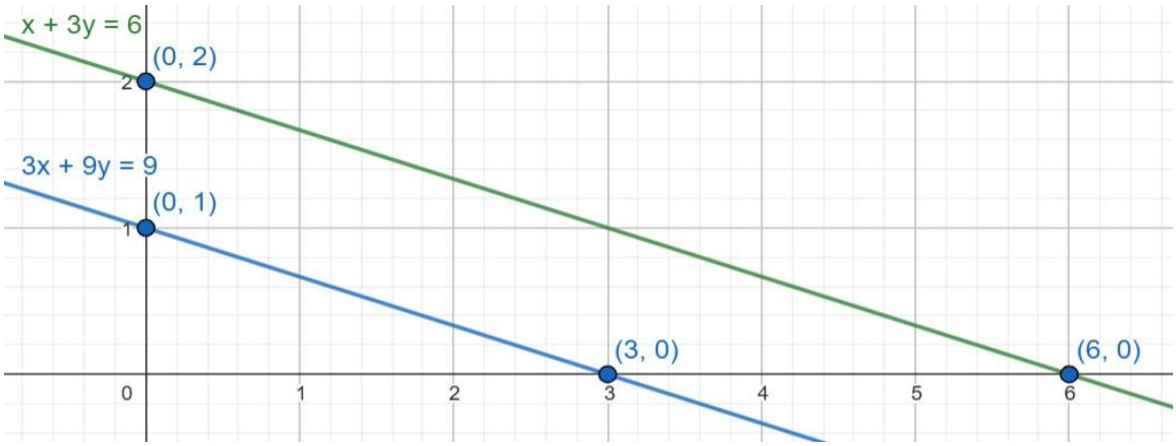
Serial No.	Question	Marks
5	Given is an equation: $y = x^2 + 4$ Which one of the following represents the graph of this equation?  [Skill: Understanding]	1

6	Shown below is the graph of a polynomial, y = r(x).  (i) Find all zeroes of the polynomial. (ii) Write the equation for this polynomial using relationship with coefficients and roots. [Skill: Understanding]	2
7	Shown is the image of a yoga wheel pose.  Based on the image answer the following questions. i) Write one possible equation that represents the path traced by the shape of the person's body in this pose. ii) Solve the quadratic equation written in (i). [Skill: Application]	3

Marking Scheme

Q No.	Rubric	Marks
5	**Correct Answer:** B Finds the that the polynomial has no zeroes, hence does not touch x axis.	1
	A: Students selecting this option take the root of -4 as 2 and -2.	
	C: Students selecting this option do not know that a<0 for an inverted parabola.	
	D: Students selecting this option think that two distinct roots are represented by 2 distinct parabolas.	
6	**Evaluation Criteria:** (i) Finds the zeroes of the polynomial as (-1) and (-2).	1
	(ii) Writes, α = -1 β = -2 $\alpha + \beta = \left(-\frac{b}{a}\right)$ and $\alpha \times \beta = \frac{c}{a}$ (-1) + (-2) = (-3) = $\left(-\frac{b}{a}\right)$ (-1) $\times$ (-2) = 2 = $\frac{c}{a}$ Considers a = 1 and finds that b = 3, c = 2. Writes the polynomial as $x^2 + 3x + 2$. Then verifies it for $r(0)$ = 2 and concludes that equation of the graph given is $x^2 + 3x + 2$.	1
7	**Evaluation Criteria:** (i) Writes any quadratic polynomial of the form $y = ax^2 + bx + c$, where $a < 0$. For example, $y = -5x^2 + 4x + 3$.	1
	(ii) Solves the quadratic equation written in (i) using any method. (Award 1 mark if the quadratic polynomial corresponding to part (i) is incorrect but its solution is correct.)	2

Pair of Linear Equations in Two Variables

Serial No.	Question	Marks
8	The graph below shows the lines representing the equations $x + 3y = 6$ and $3x + 9y = 9$.  Which of the following point(s) is/are solution of both the equations? (i) (-9, 0) (ii) (0, 1) (iii) (3, 0) (iv) (6, 0) (A) only (i) (B) only (ii) (C) only (iii) and (iv) (D) (None of the points on the coordinate plane is a solution to both equations.) [Skill: Understanding]	1
9	A bakery specializes in two types of cupcakes: chocolate and vanilla. To pack these cupcakes, the bakery uses two types of boxes: small boxes and large boxes. • Each small box can hold 3 chocolate cupcakes and 2 vanilla cupcakes. • Each large box can hold 5 chocolate cupcakes and 8 vanilla cupcakes. On Saturday: The bakery baked 115 chocolate cupcakes and 100 vanilla cupcakes. These cupcakes were packed into small and large boxes. On Sunday: The bakery baked 20 less chocolate cupcakes than vanilla cupcakes. These cupcakes were packed into small and large boxes such that the number of small boxes used was double the number of large boxes. Find how many small boxes and large boxes the bakery needed on each day. [Skill: Application]	5

Marking Scheme

Q No.	Rubric	Marks
8	**Correct Answer:** D Students selecting this option know that there is no solution to the system of equations because the two lines represented by the equations are parallel and never intersect.	1
	A: Students selecting this option do not know that there is no solution to the given system of equations. [They might have solved the equations as (3x +9y = 9) - (3x + 9y =18), to find -9.]	
	B: Students selecting this option might think that this point cuts y-axis, hence it is solution to both the equations.	
	C: Students selecting this option might think that these points that cuts x-axis, hence they are the solution to both the equations.	
9	**Evaluation Criteria:** Assumes the number of small and large boxes they need on Saturday as x and y respectively. Frames the equations for Saturday as, Chocolate cupcakes: $3x + 5y = 115$ -----(i) Vanilla cupcakes: $2x + 8y = 100$ -----(ii)	1
	Solves equation (i) and (ii) using any method to find the values of x and y as 30 and 5 respectively. Writes that, on Saturday 30 small boxes and 5 large boxes were needed.	1
	For Sunday, assumes the number of small and large boxes needed as $2p$ and p respectively. Frames the equations for Sunday as, The number of chocolate cupcakes baked = $3(2p) + 5p = 11p$ The number of vanilla cupcakes baked = $2(2p) + 8p = 12p$	1.5
	The bakery baked 20 less chocolate cupcakes than vanilla cupcakes. So, 11p + 20 = 12p and finds the value of p as 20.	1
	Writes that, on Sunday 40 small boxes and 20 large boxes were needed.	0.5

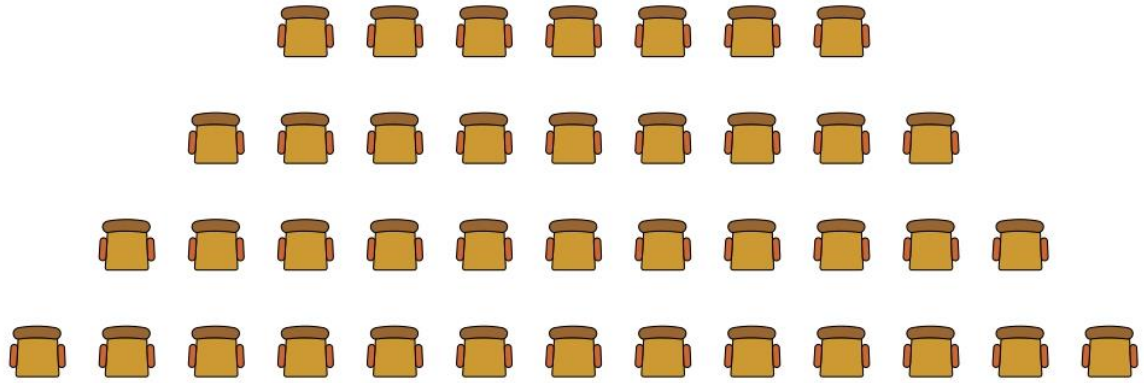
Quadratic Equations

Serial No.	Question	Marks
10	A point P lies on the *x*-axis. The *x*-coordinate of the point P satisfies the quadratic equation $x^2 - 5x + 6 = 0$. Find the possible coordinates of P. [Skill: Application]	2
11	A stone is dropped from the edge of a cliff into the water below. The height *h* of the stone above the water at time *t* seconds is modelled by the equation: $h = 45 - 5t^2$ where, *h* denotes height in meters at *t* seconds. (i) Determine the time it takes for the stone to hit the water. (ii) Determine the height from where the stone is thrown. (iii) Determine the shape of the graph of this equation. [Skill: Application]	2
	Answer the following 3 questions based on the given information. In the historic 1983 Cricket World Cup, India secured its first title under the leadership of Kapil Dev. Two key bowlers for the Indian team were Kapil Dev and R. M. H. Binny. Notably, Kapil Dev took 6 wickets fewer than Binny during the tournament. The product of the wickets taken by these two bowlers is 216. *(Note: A tournament is a competition where teams play multiple matches against each other to find out which team is the best.)*	
12	Frame the quadratic equation to find the wickets taken by Kapil and Binny. [Skill: Application]	1
13	If the equation in the previous question is represented on a graph, how many times will it cut the *x*-axis? Justify your answer based on the nature of its roots. [Skill: Understanding]	1
14	How many wickets did Kapil Dev take in the 1983 World Cup tournament? [Skill: Understanding]	2

Marking Scheme

Q No.	Rubric	Marks
10	**Evaluation Criteria:** Solves $x^2 - 5x + 6 = 0$ by any method to find the values of *x* as 2 and 3.	1.5
	Finds possible coordinates of P as (2, 0) and (3, 0).	1
11	**Evaluation Criteria:** (i) Equates *h* to 0 to get time as 3 seconds.	1
	(ii) Finds the height from where the stone is thrown by equating *t* to 0 to get height as 45m.	0.5
	(iii) Writes that the equation represents an inverted parabola. (Award 0.25 marks if only parabola is mentioned.)	0.5
12	**Evaluation Criteria:** Assumes the number of wickets taken by Binny as *x* or wickets taken by Kapil as *x*. Writes the number of wickets taken by Kapil as (*x* - 6) or wickets taken by Binny as (*x* + 6).	0.5
	Frames the quadratic equation as $x^2 - 6x - 216 = 0$ or $x^2 + 6x - 216 = 0$.	0.5
13	**Evaluation Criteria:** Writes that the graph will cut the *x*-axis at two distinct places.	0.5
	Justifies the answer. For example, since $0 > b^2 - 4ac > 0$, the graph will have two real and distinct roots.	0.5
14	**Evaluation Criteria:** Solves $x^2 - 6x - 216 = 0$ using any method to get *x* = 18. Alternatively solves $x^2 + 6x - 216 = 0$ to get *x* = 12 and hence finds wickets taken by Kapil as 12. Award full marks if done this way.	1.5
	Finds the number of wickets taken by Kapil as (*x* - 6) = 12.	0.5

Arithmetic Progressions

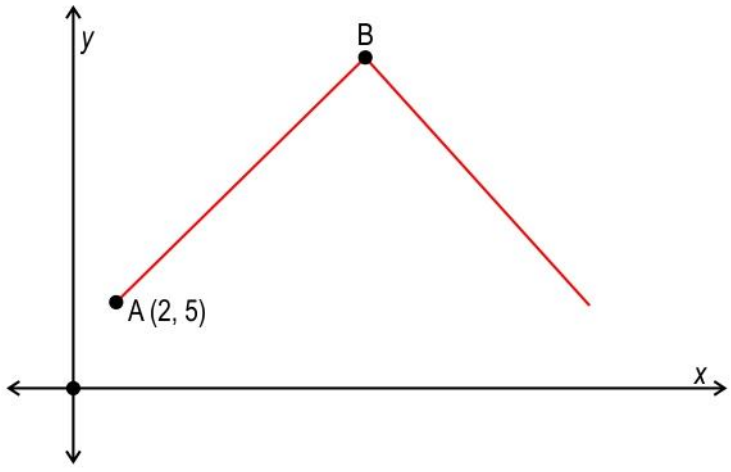
Serial No.	Question	Marks
15	Shown below is the seating pattern for a concert.  If 160 people are attending this concert, how many rows of seats will be required? (A) 10 (B) 20 (C) 40 (D) 78 [Skill: Application]	1
16	The first and last terms of an Arithmetic Progression with 5 terms is 15 and -13. x, y and z are three consecutive terms that belong to the same AP. Find, (i) the common difference of the AP. (ii) the values of x, y and z. [Skill: Understanding]	3
17	A water tank is leaking, with the leakage rate decreasing by a constant amount each minute. After the first minute, the amount of water leaked is 100 ml. (i) If after 10 minutes, the total water leaked altogether is 550 ml, find the amount of water leaked in the 10th minute. (ii) If the leak started at 6:00 AM, at what time will the leakage stop? [Skill: Understanding]	5

Marking Scheme

Q No.	Rubric	Marks
15	**Correct Answer:** A Here, $a_1 = 7$, d = 2 as the seats increase by 2 after each row and $S_n = 160$. Therefore, 160 = n2[2 × 7 + (n - 1)2] n = 10 Hence, we need 10 rows to seat 160 participants.	1
	B: Students selecting this option may have made an error in simplifying the quadratic equation.	
	C: Students selecting this option has divided the total people by 4 rows given in the image.	
	D: Students selecting this option have equated 160 to a_n.	
16	**Evaluation Criteria:** (i) Frames the AP as 15, *x*, *y*, *z*, -13 or 15, *z*, *y*, *x*, -13.	0.5
	Writes that, $a_5 = a + 4d$ $-13 = 15 + 4 \times d$ Finds d as -7.	1
	(ii) Writes that, $a_2 = a + d = 15 - 7 = 8$ $a_3 = a + 2d = 15 - 14 = 1$ $a_4 = a + 3d = 15 - 21 = -6$	1
	Frames the AP as 15, 8, 1, -6, -13. Concludes that $x = 8$ or -6 $y = 1$ $z = -6$ or 8.	0.5
17	**Evaluation Criteria:** (i) Sets up the sum equation for the arithmetic sequence, substitutes $n = 10$, $a = 100$, and $S_{10} = 550$ and solves for d as follows, $550 = \frac{10}{2}(2\times100 + 9d)$ $d = -10$ (Award 0.5 marks if the equation is set up correctly but makes an error in substitution or calculation.)	1.5

	Uses the formula $a + 9d$ to find the amount of water leaked during the 10th minute as $a_{10} = 100 + 9 \times (-10) = 10$ ml. (Award 0.5 marks if the equation is set up correctly but makes an error in substitution or calculation.)	1
	(ii) Sets up the equation as, $a + (n - 1) \times d = 0$ and substitutes the values as follows, $100 + (n - 1) \times (-10) = 0$	1
	Solves the equation to find $n = 11$ and writes that the leakage will stop by the 11th minute.	0.5
	Writes that, 6:00 AM + 11 minutes = 6:11 AM and concludes that the leakage stops by 6:11 AM.	1

Coordinate Geometry

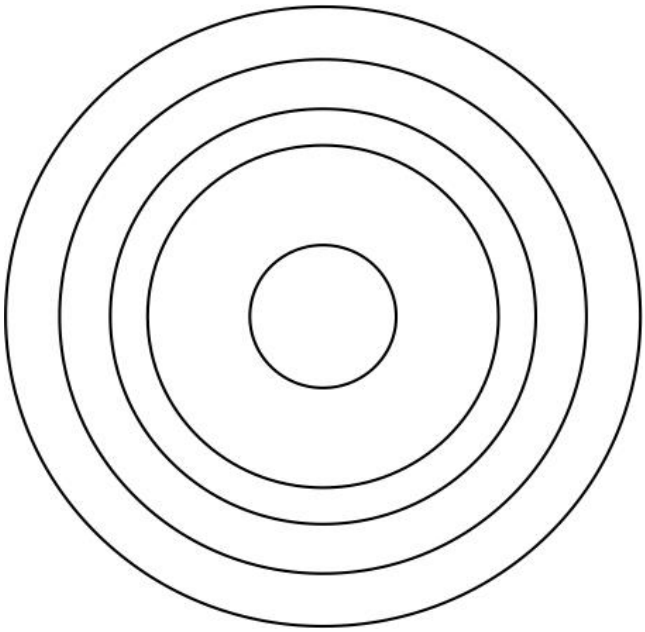
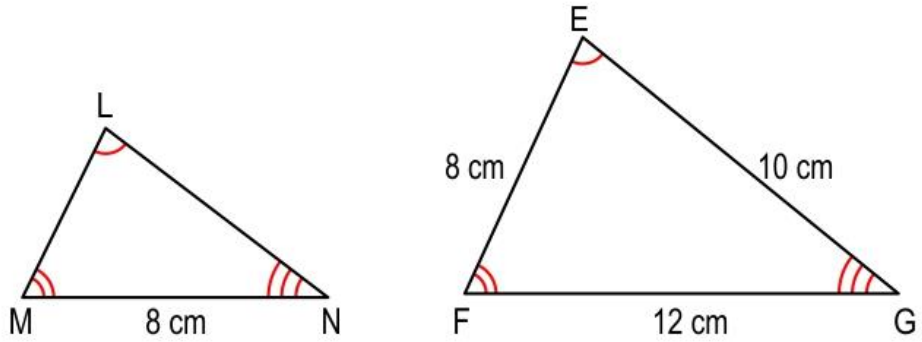
Serial No.	Question	Marks
18	Two cities, City X and City Y, are located at coordinates (10, 30) and (20, 40) respectively. City Z is located on the straight highway that connects City X and City Y. If distance from X to Z is half the distance from X to Y, where is City Z located? (A) (13, 33) (B) (15, 35) (C) (20, 30) (D) (5, 5) [Skill: Understanding]	1
19	Given are the equations of two lines, L_1: $3x + 4y - 12 = 0$ L_2: $3x + 4y + 6 = 0$ Find the distance between one point on L_1 and one point on L_2. [Skill: Application]	2
20	Points A(2, 4) and B(8, 7) lie on a straight line. The line given by the equation $x + y = 9$, intersects the line segment AB at point P(x, y). Find the ratio in which point P divides the line segment AB. [Skill: Understanding]	2
21	A mountain is mapped on a Cartesian plan as shown below. A group of mountaineers starts at the base of the mountain at point A(2, 5) and follows a straight path towards the peak at point B(6, 9). After climbing one-fourth of this path, they decide to camp at a resting point situated along the path AB.  (i) Where is the resting point located? (ii) How much distance have they travelled so far? [Skill: Application]	3

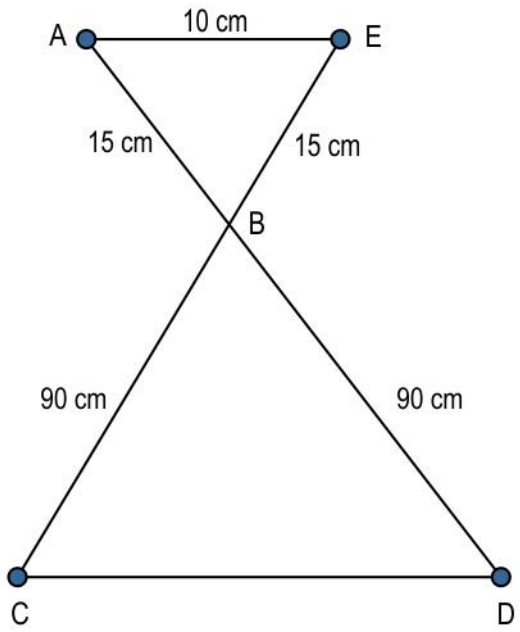
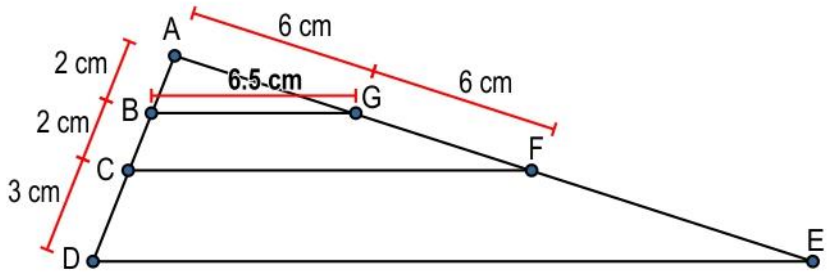
Marking Scheme

Q No.	Rubric	Marks
18	**Correct Answer:** B Since City C lies midway of A and B, we use midpoint formula to find the coordinates of C as $(\frac{10+20}{2}, \frac{30+40}{2})$ = (15, 35) Hence Option C is the correct answer.	1
	A: Students selecting this option might think that Z cuts XY in the ratio 1:2.	
	C: Students selecting this option have incorrectly used midpoint formula as, $(\frac{10+30}{2}, \frac{20+40}{2})$ = (20, 30).	
	D: Students selecting this option have incorrectly used midpoint formula as $(\frac{20-10}{2}, \frac{40-30}{2})$ = (5, 5).	
19	**Evaluation Criteria:** Finds one point for each line as follows: On L_1: (4, 0) On L_2: (2, -3) (Award full marks for any other correct points.)	1
	Finds the distance between the two points as follows: $\sqrt{(4-2)^2+(0+3)^2} = \sqrt{13}$ units (Award full marks for any other correct answer corresponding to the points found in step 1.)	1
20	**Evaluation Criteria:** Assumes that the point P divides AB in the ratio m : n. Uses section formula to write the co-ordinates of P as: $(x,\ y) = \left(\frac{m.8+n.2}{m+n}, \frac{m.7+n.4}{m+n}\right)$	0.5
	Writes that the point P lies on the line $x + y = 9$, hence should satisfy the equation. Replaces (x, y) from the previous step in the equation $x + y = 9$ as:	0.5

	$\frac{8m+2n}{m+n}+\frac{7m+4n}{m+n}=9$	
	Solves the above equation to find *m* : *n* as 1 : 2.	1
21	**Evaluation Criteria:** (i) Writes that the point that divides the segment AB is in the ratio 1:3. (since the remaining distance after climbing one-fourth is three-fourths.)	0.5
	Uses section formula and finds, $P=\left(\frac{1\times 6+3\times 2}{1+3},\frac{1\times 9+3\times 5}{1+3}\right)=(3,6)$ Writes that resting point is located at (3, 6).	1.5
	(ii) Uses distance formula to find the distance between (2, 5) and (3, 6) as, D = $\sqrt{(3-2)^2+(6-5)^2}$ = $\sqrt{2}$ units. Concludes that they have travelled a distance of $\sqrt{2}$ units so far.	1

Triangles

Serial No.	Question	Marks
22	Shown is the image of 5 concentric circles.  Which of these statements about the concentric circles is true? (A) They are similar and congruent. (B) They are congruent but not similar. (C) They are similar but not congruent. (D) They are neither congruent nor similar. [Skill: Mechanical]	1
23	ΔLMN and ΔEFG have equal corresponding angles.  Which of these is the perimeter of ΔLMN? (A) 30 cm (B) 24 cm (C) 20 cm (D) 18 cm [Skill: Application]	1

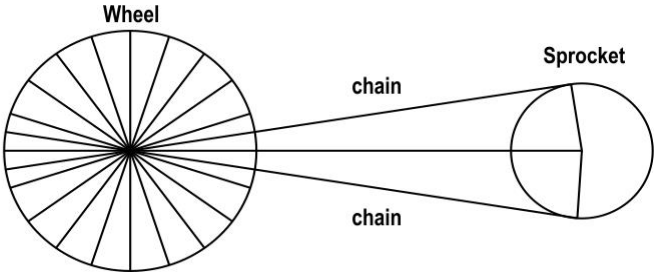
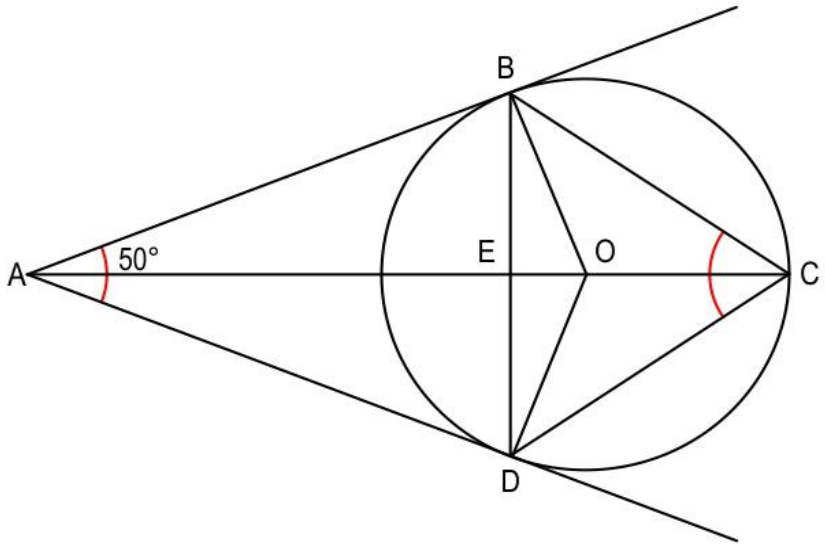
24	In the figure below, the line segments AD and CE intersect at point B. Find the length of CD.  [Skill: Understanding]	3
25	In the ΔADE given below, BG || CF and CF || DE. AB = BC = 2 cm, CD = 3 cm, AG = GF = 6 cm and BG = 6.5 cm.  (*Note: The figure is not to scale.*) (i) Find the measure of FE. (ii) Find the measure of CF. [Skill: Understanding]	5

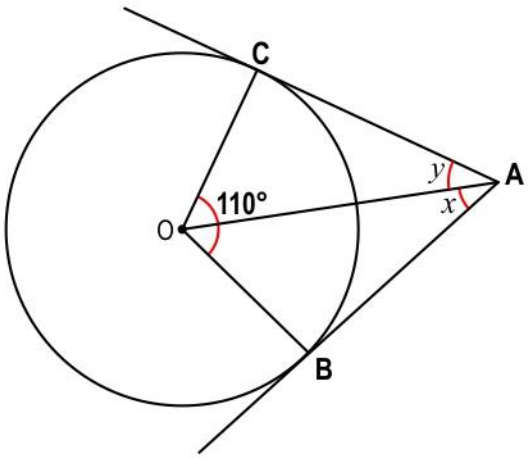
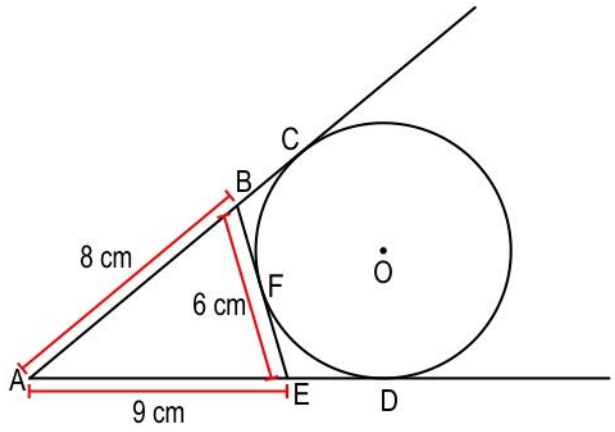
Marking Scheme

Q No.	Rubric	Marks
22	**Correct Answer:** C Since all circles with different radii share the same shape but differ in size, they are similar and not congruent.	1
	A: Students selecting this option think that all circles are similar and congruent since all circles look identical in shape.	
	B: Students selecting this option have not understood the concept of similar and congruent shapes.	
	D: Students selecting this option have not understood the concept of similar and congruent shapes.	
23	**Correct Answer:** C Students who chose this option correctly understood that as $\frac{MN}{FG} = \frac{2}{3}$, then $\frac{LM}{8} = \frac{2}{3} = 5.3cm$ and $\frac{LN}{10} = \frac{2}{3} = 6.6cm$ therefore the perimeter of ΔLMN is 20 cm.	1
	A: Students selecting this option have found the perimeter of ΔEFG.	
	B: Students who chose option 2 appear to have taken MN and EG as corresponding sides to arrive at the ratio of $\frac{4}{5}$.	
	D: Students who chose this option may have seen that MN is 4 cm shorter than FG, so they have subtracted 4 from both 8 and 10 to get a perimeter of 4 + 6 + 8 = 18 cm.	
24	**Evaluation Criteria:** Writes that, $\frac{BE}{BC} = \frac{1}{6}$ $\frac{BA}{BD} = \frac{1}{6}$ $\angle ABE = \angle DBC$ (vertically opposite angles) Hence, using SAS criteria the two triangles are similar.	2
	Writes that, $\frac{EA}{CD} = \frac{1}{6}$ (sides of similar triangles are proportional) CD = 6EA = 6×10 = 60 cm Finds the length of CD as 60 cm.	1

25	**Evaluation Criteria:** (i) Writes that in ΔABG and ΔADE, BG || DE as BG || CF and CF || DE. Hence, using Basic Proportionality theorem writes that $\frac{AB}{AD} = \frac{AG}{AE}$.	1
	Writes that AB = 2 cm and AD = 2 cm + 2cm + 3 cm = 7 cm. Substitutes in the above equation and writes $\frac{2}{7} = \frac{6}{12+FE}$ Hence, FE = 9 cm.	2
	(ii) Writes that according to mid-point theorem, since BG passes through the mid points of AC and AF, CF = 2 × BG = 13 cm.	2

Circles

Serial No.	Question	Marks
26	Given is a cycle wheel with chain and a sprocket. The center of the sprocket lies at a distance of 20 cm from the centre of the wheel.   *(Note: The image is for representation purpose only and is not to scale.)* If the chain makes two tangents with the sprocket with 16 cm length each, what is the circumference of the sprocket? (A) 24π cm (B) 32π cm (C) 40π cm (D) 72π cm [Skill: Application]	1
27	In the following figure, O is the centre of the circle with radius shorter than tangents AB and AD. $\angle BAD = 50°$.  (i) Find the measure of $\angle BCD$. (ii) Kite is a quadrilateral that has two pairs of adjacent sides equal in length. Justify why BADO is a kite. [Skill: Application]	2

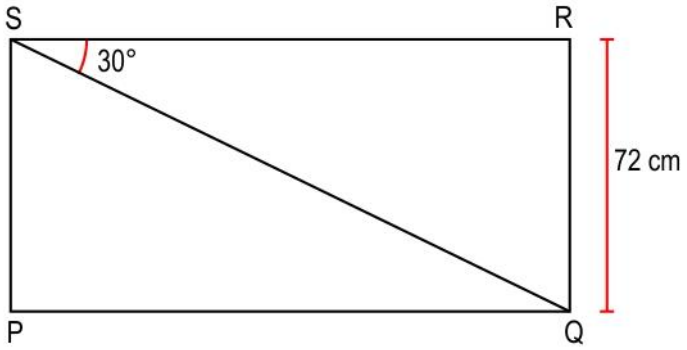
28	In the given figure AC and AB are tangents to the circle with centre O. ∠COB = 110°.  Find *x* and *y*. Give reasons for your answers. [Skill: Understanding]	3
29	In the figure below, AC, AD, BE are tangents to the circle with BE = 6 cm, AE = 9 cm and AB = 8 cm.  Find the length of AC. [Skill: Application]	3

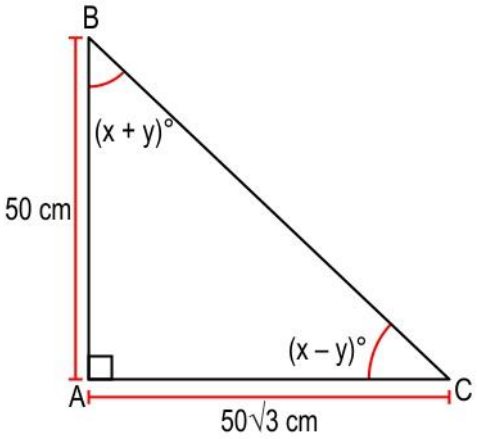
Marking Scheme

Q No.	Rubric	Marks
26	**Correct Answer:** A Using Pythagoras theorem, $20^2 - 16^2 = 12^2$ cm. radius = 12 cm Circumference = $2\pi r = 24\pi$.	1
	B: Students might mistakenly think that the radius is equal to the length of the tangent without considering the Pythagorean relationship.	
	C: Students mistakenly assume the distance from wheel to the center of sprocket (20 cm) as the radius.	
	D: Students might incorrectly add the given lengths (20 cm + 16 cm) to get 36 cm as radius.	
27	**Evaluation Criteria:** (i) Writes that in BADO, $\angle A = 50°$ (given). $\angle OBA = \angle ODA = 90°$ (angle made by tangent). $\angle DOB = 360° - (50° + 90° + 90°) = 130°$ (Interior angles of a quadrilateral). Hence, $\angle BCD = 65°$ (angle on the circumference is double the angle on the center).	1
	(ii) Justifies by writing, AB = AD since tangents from an external point are equal in length. OB = OD (radius) Hence quadrilateral BADO has 2 pairs of adjacent equal-length sides. Concludes that BADO is a kite.	1
28	**Evaluation Criteria:** Writes that, in quadrilateral ACOB, ∠ACO = 90° (angle made by tangent with radius) ∠ABO = 90°(angle made by tangent with radius) Therefore, 90° + 90° + 100° + x + y = 360° (Interior angles of a quadrilateral) Thus, finds $x + y = 70°$.	1.5
	Writes that in ΔAOC and ΔAOB, AC = AB (tangents from an external point) AO = AO (common side) OC = OB (radius) Hence by SSS criteria the two triangles are congruent. Therefore, $x = y = 35°$.	1.5
29	**Evaluation Criteria:**	1

	States the property, tangents from the same external point are equal in length and deduces the relations AC = AD, BC = BF and EF = ED.	
	Writes that AC + AD = AB + BC + AE + ED.	1
	Uses the above steps and the given information to get 2AC = 23 cm. Finds the length of AC as $\frac{23}{2} = 11.5$ cm.	1

Introduction to Trigonometry

Serial No.	Question	Marks
30	Shown below is rectangle PQRS.  *(Note: The figure is not to scale.)* What is the length of the rectangle? (A) $\frac{72}{\sqrt{3}}$ cm (B) $72\sqrt{3}$ cm (C) 144 cm (D) $\frac{144}{\sqrt{3}}$ cm [Skill: Mechanical]	1
31	A class 10 student was asked to simplify the expression: $\frac{\cot A}{1+\operatorname{cosec} A}+\frac{1+\operatorname{cosec} A}{\cot A}$ Shown below is her simplification. $=\frac{\cot^2 A+(1+\operatorname{cosec} A)^2}{\cot A(1+\operatorname{cosec} A)}\ldots\ldots(Step\ 1)$ $=\frac{\cot^2 A+1+2\operatorname{cosec} A+\operatorname{cosec}^2 A}{\cot A(1+\operatorname{cosec} A)}\ldots\ldots(Step\ 2)$ $=\frac{(\cot^2 A+\operatorname{cosec}^2 A)+1+2\operatorname{cosec} A}{\cot A(1+\operatorname{cosec} A)}\ldots\ldots(Step\ 3)$ $=\frac{1+1+2\operatorname{cosec} A}{\cot A(1+\operatorname{cosec} A)}=\frac{2+2\operatorname{cosec} A}{\cot A(1+\operatorname{cosec} A)}\ldots\ldots(Step\ 4)$ $=\frac{2(1+\operatorname{cosec} A)}{\cot A(1+\operatorname{cosec} A)}\ldots\ldots(Step\ 5)$ $=\frac{2}{\cot A}\ldots\ldots(Step\ 6)$ i) Identify the step in which the student made an error. ii) Correct the error and simplify the expression accurately. [Skill: Understanding]	2

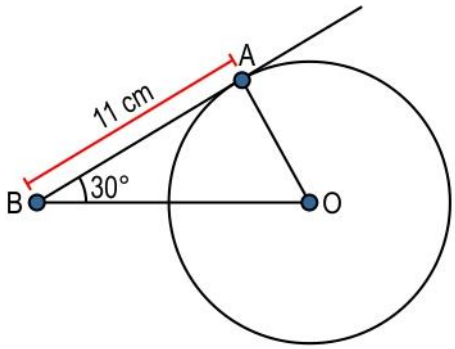
32	Look at the figure given below.  Find the values of *x* and *y*. [Skill: Understanding]	2
33	Given, $5\cot A = 12,$ Evaluate the following: i) $\dfrac{\operatorname{cosec}^2 A + 1}{\operatorname{cosec}^2 A - 1}$ ii) $\dfrac{1 - \sin^2 A}{1 - \cos^2 A}$ [Skill: Mechanical]	3

Marking Scheme

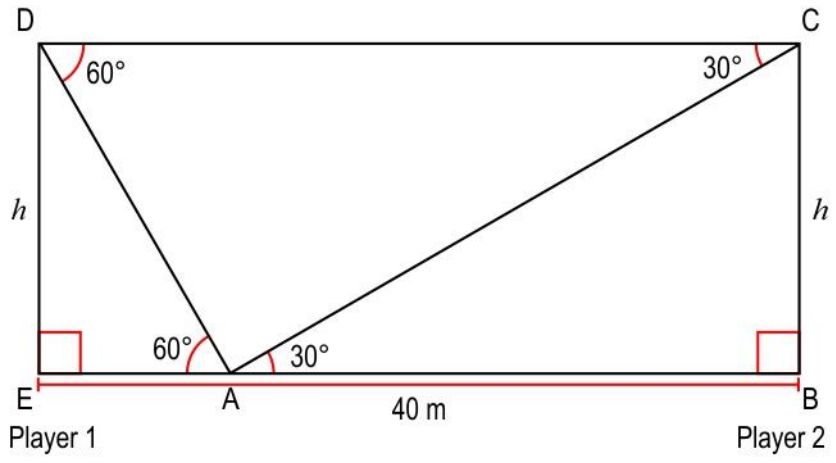
Q No.	Rubric	Marks
30	**Correct Answer:** B Since PQRS is a rectangle, PQ = RS. => tan 30° = QR/SR = 72/SR => $1/\sqrt{3} = 72/SR$ => SR = $72\sqrt{3}$ m	1
	A: Students selecting this option might have taken the angle as 60°.	
	C: Students selecting this option might have considered sin 30 = QR/RS.	
	D: Students selecting this option might have used cos 30° = SR/RQ	
31	**Evaluation Criteria:** i) Writes that the error occurs in Step 4.	1
	ii) Rewrites the correct simplification as: $\frac{cotA}{1+cosecA} + \frac{1+cosecA}{cotA}$ $= \frac{cot^2A + (1+cosecA)^2}{cotA(1+cosecA)}$ $= \frac{cot^2A + 1 + cosec^2A + 2cosecA}{cotA(1+cosecA)}$ $= \frac{2cosec^2A + 2cosecA}{cotA(1+cosecA)}$ $= \frac{2cosecA}{cotA}$ $= 2\ secA$	1
32	**Evaluation Criteria:** Writes that, $\tan(x-y)° = \frac{50}{50\sqrt{3}} = \frac{1}{\sqrt{3}}$ tan(x – y)° = tan 30° Hence concludes that, x – y = 30°-----(i)	0.5
	Finds the third angle as, x + y = 30°-----(ii)	0.5
	Solves equation (i) and (ii) to find x = 45° and y = 15°.	1
33	**Evaluation Criteria:**	1

	Rewrites the expression as, $cot\ A = \frac{12}{5}$ And finds, $cosec\ A\ = \frac{13}{5}$, $sin\ A\ = \frac{5}{13}$ and $cos\ A = \frac{12}{13}$.	
	i) Calculates the expression as $\frac{97}{72}$.	1
	ii) Rewrites the expression as, Substitutes the value to get $\frac{144}{25}$.	1

Some Applications of Trigonometry

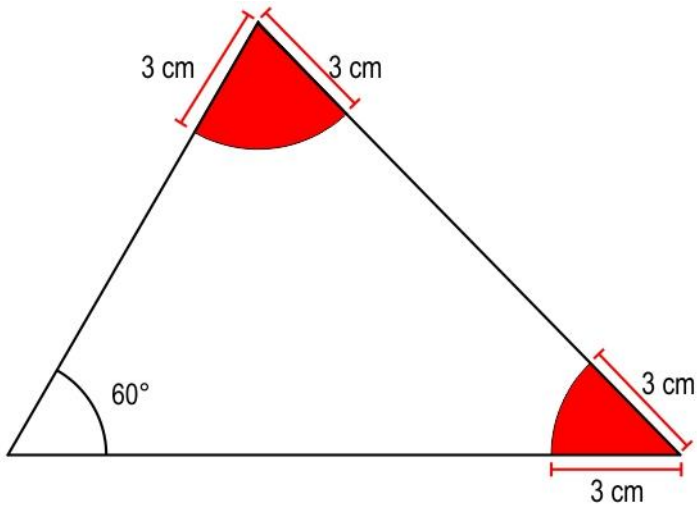
Serial No.	Question	Marks
34	Piya's eye level is 1 metre above the ground. She uses binoculars to observe birds at the top of a 101 metre tall tree. If the angle of elevation from her eye level to the birds is 30°, how many metres is Piya from the base of the tree? (A) $\frac{100}{\sqrt{3}}$ m (B) $\frac{101}{\sqrt{3}}$ m (C) $100\sqrt{3}$ m (D) $101\sqrt{3}$ m [Skill: Application]	1
35	In the figure below, AB is a tangent to the circle at A, with centre O. BA = 11 cm and $\angle ABO = 30°$.  i) Find the length of the radius of this circle. ii) Find the distance from point B to the centre of the circle. [Skill: Understanding]	2
36	During a football match, Player 1 and Player 2, of equal height standing vertically are positioned on opposite sides of a ball on the field, with a distance of 40 m between them. The angles of depression from Player 1 and Player 2 to the ball are 60° and 30°, respectively. (i) Draw a figure to represent the situation. (ii) Find the distance between player 2 and the ball. [Skill: Application]	5

Marking Scheme

Q No.	Rubric	Marks
34	**Correct Answer:** C tan 30° = height of tree - height of Piya distance from base tan 30° = 100/d d = 100√3 Hence Option B is the correct answer.	1
	A: Students selecting this option have incorrectly assumed tan 30 to be √3.	
	B: Students selecting this option have not understood the concept.	
	D: Students selecting this option have not considered the height of the kid.	
35	**Evaluation Criteria:** (i) Writes that tan 30° = $\frac{AO}{11} = \frac{1}{\sqrt{3}}$ Finds that the radius of the circle, AO = $\frac{11}{\sqrt{3}}$ cm.	1
	(ii) Writes that sin 30° = $\frac{\frac{11}{\sqrt{3}}}{OB} = \frac{1}{2}$ Finds that OB = $\frac{22}{\sqrt{3}}$ cm.	1
36	**Evaluation Criteria:** (i) Draws a figure according to the question such that A is the ball between the players E and B. The figure may look as follows:  	1
	(ii) Writes that, in triangle ABC, tan 30° = $\frac{h}{AB}$ and finds h as $\frac{AB}{\sqrt{3}}$.	1

	Writes that, in triangle ADE, $\tan 60° = \frac{h}{EA}$ and finds h as $\sqrt{3} \times EA$.	1
	Uses steps 2 and 3 to write the relation between EA and AB as $AB = 3 \times EA$	1
	Writes that AB + EA = 40 m and concludes that AB = 30 m using step 4. Concludes that the distance between player 2 and the ball is 30 m.	1

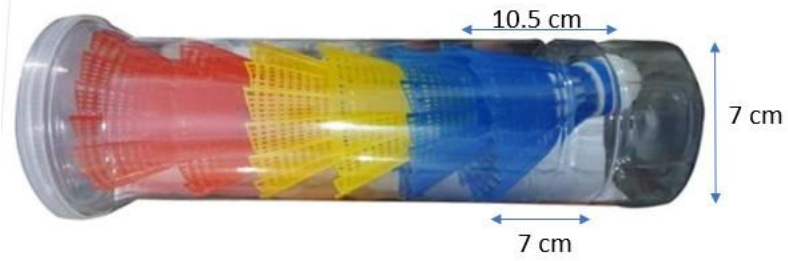
Areas Related to Circles

Serial No.	Question	Marks
37	What is the area of the shaded part of the triangle shown below?  *(Note: The image is not to scale.)* (A) 3π cm^2 (B) 4.5π cm^2 (C) 9π cm^2 (D) (Cannot be calculated with the given information.) [Skill: Application]	1
38	A lawn sprinkler waters a specific area of a park in the shape of a sector. The sprinkler sprays water over a sector with a radius of 1.8 m and an angle of 70°. The sprinkler uses 4 liters of water per square meter per 1 minute. i) Calculate the area watered by the sprinkler. ii) Determine the total amount of water the sprinkler uses in 1 minute. *(Note: Take π as $\frac{22}{7}$.)* [Skill: Application]	2
39	Sector P is part of a circle with a radius of 10 cm and has an angle of 80°. Sector Q is part of a circle with a radius of 20 cm and has an angle of 40°. i) Find the relationship between the areas of sector P and sector Q. ii) A sector Z is drawn in a new circle such that its angle is 4 times that of sector Q, but its area is equal to that of sector Q. Find the radius of sector Z. [Skill: Understanding]	3

Marking Scheme

Q No.	Rubric	Marks
37	**Correct Answer:** A Angles of a triangle add up to 180°. The shaded parts together forms a sector with an angle of 180° - 60° = 120° and radius 3 cm. Hence area of the shaded part = Area of the sector with angle 120° and radius 3 cm = $120/360 \times \pi \times 3^2 = 3\pi$.	1
	B: Students selecting this option might have taken the angle as 180°.	
	C: Students selecting this option might have taken the angle as 360°.	
	D: Students selecting this option might not know that the shaded portion forms a sector.	
38	**Evaluation Criteria:** i) Calculates the area of the sector covered by the sprinkler as: $\frac{70°}{360°} \times \frac{22}{7} \times 1.8 \times 1.8 = 1.98\ m^2$.	1
	ii) Calculates the total amount of water the sprinkler uses in 1 minute as $1.98 \times 4 = 7.92$ liters.	1
39	**Evaluation Criteria:** i) Finds the area of sector P as: $\frac{80°}{360°} \times \pi \times 10 \times 10$ Finds the area of sector Q as: $\frac{40°}{360°} \times \pi \times 20 \times 20$. (Award 0.5 marks for usage of correct formula and 0.5 marks each for correct evaluation.)	1.5
	Writes that the area of sector P is half of that of Q.	0.5
	ii) Writes equation to find radius of sector Z as: $\frac{160°}{360°} \times \pi \times r \times r = \frac{40°}{360°} \times \pi \times 20 \times 20$ Finds the radius of sector Z as 10 cm.	1

Surface Areas and Volumes

Serial No.	Question	Marks
40	Sport Store sells packs of shuttles in cylindrical containers. The shuttles are partially stacked inside one another. Each shuttlecock has a length of 10.5 cm, and approximately 7 cm of each shuttlecock is inside the other. To ensure that the shuttle do not move at all, the container is made such that there is no extra space is left at the top, or at the sides of the container. Each pack contains 6 shuttles. A rough diagram of this is shown below.  *(Note: The figure is not to scale.)* i) A label is to be printed to cover the entire curved surface of a cylindrical container. If there is a 1 cm overlap where the ends of the label meet, find the measures of the label. ii) Seema has an empty container after using all the shuttles. She fills the container to the brim with spherical marbles, each with a radius of 1 cm. If only 60% of the container's volume is occupied by the marbles due to the empty space between them, how many marbles can Seema fit in the container? *(Note: Take π as $\frac{22}{7}$.)* [Skill: Application]	5
	Answer the following 3 questions based on the given information. A housing society is being developed, and the builder must design overhead water tanks for storing water. To ensure the best design, the builder is evaluating two types of water tanks: ♦ Cylindrical tank with radius 2 m and height 3.5 m ♦ Spherical tank with radius 2.1 m. The tanks must hold at least 35,000 litres of water (1 m^3 = 1,000 litres).	
41	The builder is comparing the volumes of two tank designs to see which one meets the water storage requirement of 35,000 litres. Which tank(s) meet the water requirement? *(Note: Take π as* 22/7.*)* [Skill: Mechanical]	1
42	Which of the two tank designs will require the smaller total surface area for construction, thus reducing material costs? *(Note: You can keep the answers in terms of π.)*	1

	[Skill: Understanding]	
43	The housing society prefers the cylindrical tank due to its pragmatic design and ease of construction, but the builder needs to increase its volume by 20% to account for future water demands. To achieve this, they decide to increase the height of the tank. What will be the height of the new tank? *(Note: Take π as 3.)* [Skill: Application]	2

Marking Scheme

Q No.	Rubric	Marks
40	**Evaluation Criteria:** (i) Finds the height of the cylinder as: 10.5 + 5 (3.5) = 10.5 + 17.5 = 28 cm. Writes that this will be the length of the label.	1
	Finds the circumference of the cylinder as as: $2 \times \pi \times 3.5 = 22$ cm. Accounts for the overlap and finds the breadth of the label as 22 + 1 = 23 cm.	1
	ii) Finds the volume of 1 marble ball = $\frac{4}{3} \times \pi \times 1^3 = \frac{4}{3}\pi$ cm^3.	0.5
	Finds the volume of cylinder occupied by the marbles as = $\frac{60}{100} \times \pi \times 3.5 \times 3.5 \times 28 = 205.8\pi$ cm^3.	1
	Finds the number of marbles that can fit in the container as $\frac{205.8\pi}{\frac{4}{3}\pi} = 154.35 \approx 154$.	1
41	**Evaluation Criteria:** Finds the volume of cylindrical tank as: $\frac{22}{7} \times 2 \times 2 \times 3.5 = 44$ m^3 = 44000 litres.	0.5
	Finds the volume of spherical tank as: $\frac{4}{3} \times \frac{22}{7} \times 2.1 \times 2.1 \times 2.1 = 38.808$ m^3 = 38808 litres. Writes that both the tanks meet the water requirement.	0.5
42	**Evaluation Criteria:** Finds the surface area of cylindrical tank as: $2 \times \pi \times 2 \times (2 + 3.5) = 22\pi$. m^2.	0.5
	Finds the surface area of spherical tank as: $4 \times \pi \times 2.1 \times 2.1 = 17.64\pi$ m^2. Writes that the spherical tank has a smaller surface area.	0.5
43	**Evaluation Criteria:** Writes that the volume was = 44 m^3. Finds the new volume as $\frac{120}{100} \times 44 = 52.8$ m^3.	0.5
	Writes the equation to the new height as: $\pi \times 2 \times 2 \times H = 52.8$. Finds the new height as 4.4 m.	1.5

Statistics

<table>
<tr><th>Serial No.</th><th>Question</th><th>Marks</th></tr>
<tr><td>44</td><td>A book distributor ships boxes of books to various bookstores. Each box contains a varying number of books. The table below shows the distribution of the number of books in each box:

<table>
<tr><th>Number of Books</th><th>5 – 15</th><th>15 – 25</th><th>25 – 35</th><th>35 – 45</th><th>45 – 55</th></tr>
<tr><td>Number of Boxes</td><td>20</td><td>40</td><td>50</td><td>20</td><td>10</td></tr>
</table>

Based on this data, Priya calculated the mean number of books in a box to be 27.14.

Which of the following statements about Priya's calculation is definitely true?
(A) The mean number of books per box can never be a decimal, so Priya must have made a mistake.

(B) 27.14 is the exact mean number of books per box because a mean can be a decimal.

(C) 27.14 is an estimate for the mean since the exact number of boxes with a specific number of books is unknown.

(D) (We cannot determine anything without knowing how Priya calculated the mean.)

[Skill: Understanding]</td><td>1</td></tr>
<tr><td>45</td><td>A city council conducted a survey of residential buildings to analyze the distribution of apartments across different age ranges of buildings. The collected data is shown in the table below:

<table>
<tr><th>Age of Building (in years)</th><th>Number of Buildings (f_i)</th></tr>
<tr><td>0 - 10</td><td>12</td></tr>
<tr><td>10 - 20</td><td>30</td></tr>
<tr><td>20 - 30</td><td>45</td></tr>
<tr><td>30 - 40</td><td>70</td></tr>
<tr><td>40 - 50</td><td>40</td></tr>
<tr><td>50 - 60</td><td>25</td></tr>
<tr><td>60 - 70</td><td>18</td></tr>
</table>

If the assumed mean age of a building is 25 years, what is the deviation of the class mark of the modal class from assumed mean?

(A) (-15)
(B) (-10)
(C) 10
(D) 15

[Skill: Understanding]</td><td>1</td></tr>
<tr><td>46</td><td>A health camp in a locality measured the blood pressure levels of residents to assess their heart health.</td><td>3</td></tr>
</table>

	The following table shows the distribution of blood pressure levels (in mm Hg) among the residents. **Blood Pressure (mm Hg) / Number of Residents** 100 - 110 : 6 110 - 120 : 12 120 - 130 : 20 130 - 140 : 30 140 - 150 : 18 150 - 160 : 10 160 - 170 : 4 Calculate the median blood pressure level for the residents. [Skill: Mechanical]	
47	The table below shows data on the temperatures across all districts of a state. **Temperatures (°C) / Mid-Value (x_i) / Number of districts (f_i) / $f_i x_i$** 20 - 24 : 22 : 6 : 6 × 22 = 132 24 - 28 : 26 : x : x × 26 28 - 32 : 30 : 5 : 5 × 30 = 150 32 - 36 : 34 : 2 : 2 × 34 = 68 Total : : 13 + x : 350 + 26x If the mean of temperature of the state is 26.6 °C, what is the value of x? [Skill: Application]	3

Marking Scheme

<table>
<tr><th>Q No.</th><th>Rubric</th><th>Marks</th></tr>
<tr><td>44</td><td>Correct Answer: C
27.14 is an estimate for the mean because the exact number of boxes with a specific number of books is not known.</td><td>1</td></tr>
<tr><td></td><td>A: Students selecting this option might think that since each box can only contain a whole number of books, the mean must also be a whole number</td><td></td></tr>
<tr><td></td><td>B: Students selecting this option might think that 27.14 is the exact mean and not know that using grouped data only provides an estimate mean.</td><td></td></tr>
<tr><td></td><td>D: Students selecting this option might not be able to interpret the grouped frequency distribution.</td><td></td></tr>
<tr><td>45</td><td>Correct Answer: C
The modal class is 30-40.
Class mark of modal class = 35.

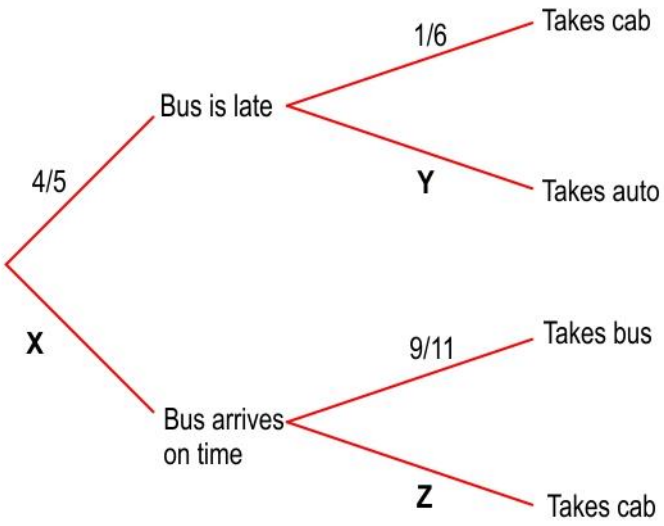
Deviation of assumed mean from the class mark of the modal class = 35 - 25 = 10.</td><td>1</td></tr>
<tr><td></td><td>A: Students selecting this option might have taken class mark as 40 and found the deviation as 25 - 40 = -15.</td><td></td></tr>
<tr><td></td><td>B: Students selecting this option might not know that deviation is always class mark - assumed mean.</td><td></td></tr>
<tr><td></td><td>D: Students selecting this option might have taken class mark as 40.</td><td></td></tr>
<tr><td>46</td><td>Evaluation Criteria:
Makes a cumulative frequency table as,

<table>
<tr><th>Blood Pressure (mm Hg)</th><th>Number of Residents (f_i)</th><th>Cumulative Frequency</th></tr>
<tr><td>100 - 110</td><td>6</td><td>6</td></tr>
<tr><td>110 - 120</td><td>12</td><td>6 + 12 = 18</td></tr>
<tr><td>120 - 130</td><td>20</td><td>18 + 20 = 38</td></tr>
<tr><td>130 - 140</td><td>30</td><td>38 + 30 = 68</td></tr>
<tr><td>140 - 150</td><td>18</td><td>68 + 18 = 86</td></tr>
<tr><td>150 - 160</td><td>10</td><td>86 + 10 = 96</td></tr>
<tr><td>160 - 170</td><td>4</td><td>96 + 4 = 100</td></tr>
</table></td><td>1</td></tr>
<tr><td></td><td>Identifies the median class as 130-140.</td><td>0.5</td></tr>
<tr><td></td><td>Calculates the median as,

$130 + \left(\frac{50 - 38}{30}\right) \times 10 = 134$ mm Hg.</td><td>1.5</td></tr>
<tr><td>47</td><td>Evaluation Criteria:
Makes a table as:</td><td>1.5</td></tr>
</table>

	<table><tr><th>Temperatures (°C)</th><th>Mid-Value (x_i)</th><th>Number of districts (f_i)</th><th>$f_i x_i$</th></tr><tr><td>20 - 24</td><td>22</td><td>6</td><td>6 × 22 = 132</td></tr><tr><td>24 - 28</td><td>26</td><td>x</td><td>x × 26</td></tr><tr><td>28 - 32</td><td>30</td><td>5</td><td>5 × 30 = 150</td></tr><tr><td>32 - 36</td><td>34</td><td>2</td><td>2 × 34 = 68</td></tr><tr><td>Total</td><td></td><td>13 + x</td><td>350 + 26x</td></tr></table>	
	Writes the equation to find mean as: $\frac{350+26x}{13+x} = 26.6$	0.5
	Solves the equation to find the value of x as 7.	1

Probability

Serial No.	Question	Marks
48	Shobha has some letter cards. She used all cards to make the word "TENNESSEE". If she picks 1 card at random, what is the probability that she gets a letter card with E on it? (A) $\frac{1}{9}$ (B) $\frac{1}{4}$ (C) $\frac{4}{9}$ (D) $\frac{4}{5}$ [Skill: Understanding]	1
49	Sarah's daily commute involves different transportation options depending on whether the bus arrives late or on time. The probabilities of each event are shown in the tree diagram. For instance, if the bus arrives late, the probability of Sarah taking a cab is 1/6.  Find the values of *X*, *Y*, and *Z*. Describe what each of these probabilities represents in the context of Sarah's commute. [Skill: Application]	3
50	A school playground is installing three circular flower beds within a rectangular field. The length and breadth of the field is 42 m and 22 m respectively. Area of each circular flower bed is 6.16 m^2. If a gardener randomly throws a seed somewhere on the field, what is the probability that the seed lands within one of the flower beds? [Skill: Application]	3

Marking Scheme

Q No.	Rubric	Marks
48	**Correct Answer:** C Total number of E = 4 Total number of letters = 9 The probability that she gets a letter card with E on it = 4/9.	1
	A: Students selecting this option have considered E as one letter card out of 9 cards.	
	B: Students selecting this option might think that the denominator to find the probability is total number of E's in the word or they considered one E among 4 different letters, T,E,N,S as 1/4.	
	D: Students selecting this option might think that the denominator to find the probability is total number of word - total number of E's in the word.	
49	**Evaluation Criteria:** Finds the value of X as $\frac{1}{5}$.	0.5
	Writes that X represents the probability that the bus arrives on time.	0.5
	Finds the value of Y as $\frac{5}{6}$.	0.5
	Writes that Y represents the probability that Sarah takes an auto when the bus is late.	0.5
	Finds the value of Z as $\frac{2}{11}$.	0.5
	Writes that Z represents the probability that Sarah takes a cab when the bus arrives on time.	0.5
50	**Evaluation Criteria:** Finds the area of 3 flower beds as, $3 \times 6.16 = 18.48$ m^2. Finds the area of the rectangular field as, $42 \times 22 = 924$ m^2.	1.5
	Finds the probability that the seed lands within one of the flower beds as, $\frac{18.48}{924} = \frac{1}{50}$.	1.5

Board of School Education Haryana, Bhiwani