CENTRAL BOARD OF SECONDARY EDUCATION

CBSE 2026-27

Mathematics (Standard)

Subject Code: 041 | Class X

Question Bank – Set 4

Questions in this Booklet

Ch.	Chapter	MCQs	A-R	VSA	SA	LA	CS	All
01	Real Numbers	4	1	1	2	1	1	**10**
02	Polynomials	3	1	1	2	1	1	**9**
03	Pair of Linear Equations in Two Variables	3	1	2	2	2	1	**11**
04	Quadratic Equations	4	1	2	1	3	1	**12**
05	Arithmetic Progressions	3	1	1	2	1	2	**10**
06	Coordinate Geometry	1	2	1	2	1	1	**8**
07	Triangles	4	1	3	1	2	0	**11**
08	Circles	3	1	2	3	2	1	**12**
09	Introduction to Trigonometry	7	1	4	3	1	0	**16**
10	Some Applications of Trigonometry	2	1	1	2	3	2	**11**
11	Areas Related to Circles	3	0	2	2	1	1	**9**
12	Surface Areas and Volumes	3	1	1	2	3	1	**11**
13	Statistics	2	1	1	2	3	1	**10**
14	Probability	7	2	2	1	1	1	**14**
	Total	**49**	**15**	**24**	**27**	**25**	**14**	**154**

MCQs = Multiple Choice; A-R = Assertion–Reason; VSA = Very Short Answer; SA = Short Answer; LA = Long Answer; CS = Case Study / Source-based.

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01. Real Numbers

Multiple Choice Questions (MCQs)

Q1. If x is the LCM of $4, 6, 8$, y is the LCM of $3, 5, 7$, and p is the LCM of x and y, then which of the following is true? **[1]**

[Board 2025 30-3-1 Q2]

(a) $p = 35x$ (b) $p = 4y$ (c) $p = 8x$ (d) $p = 16y$

Q2. If $x = ab^3$ and $y = a^3b$, where a and b are distinct prime numbers, then $[\text{HCF}(x, y) - \text{LCM}(x, y)]$ is equal to: **[1]**

[Board 2025 30-4-1 Q1 (adapted: a and b made distinct primes)]

(a) $1 - a^3b^3$ (b) $ab(1 - ab)$ (c) $ab - a^4b^4$ (d) $ab(1 - ab)(1 + ab)$

Q3. $\left(1 + \sqrt{3}\right)^2 - \left(1 - \sqrt{3}\right)^2$ is: **[1]**

[Board 2025 30-4-1 Q2]

(a) a positive rational number.
(b) a negative integer.
(c) a positive irrational number.
(d) a negative irrational number.

Q4. $\left(\sqrt{3} + 2\right)^2 + \left(\sqrt{3} - 2\right)^2$ is a/an: **[1]**

[Board 2025 30-5-1 Q1]

(a) positive rational number
(b) negative rational number
(c) positive irrational number
(d) negative irrational number

Assertion–Reason

Q5. **Assertion (A):** 4^n ends with the digit 0 for some natural number n.
Reason (R): For a number x having 2 and 5 as its prime factors, x^n ends with the digit 0 for every natural number n. **[1]**

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

[Board 2025 30-4-1 Q19]

Very Short Answer (VSA)

Q6. The HCF of 85 and 238 is expressible in the form $85m - 238$. Find the value of m. **[2]**

[SQP 2024-25 Q21 (OR); SQP 2024-25 VIC Q21 (OR)]

Short Answer (SA)

Q7. Prove that $\sqrt{3}$ is an irrational number. **[3]**

[Board 2023 30-5-1 Q26(a); Board 2024 30-5-1 Q26(a); Board 2025 30-2-1 Q30; Board 2025 30-5-1 Q26(a); Board 2026 30-1-1 Q26; SQP 2024-25 Q31; SQP 2024-25 VIC Q31]

Q8. Prove that $\sqrt{5}$ is an irrational number. **[3]**

[Board 2023 30-1-1 Q27; Board 2023 30-4-1 Q27; Board 2024 30-2-1 Q27]

Long Answer (LA)

Q9. (a) It is given that $\sqrt{5}$ is an irrational number. Prove that $3 + 2\sqrt{5}$ is an irrational number. [3 marks]

(b) Find a rational number lying between $\sqrt{2}$ and $\sqrt{3}$, and justify your answer. [2 marks] **[5]**

[New]

Case Study

Q10. Read the following passage carefully and answer the questions that follow. **[4]**

[New]

Three metro lines start their first trains together from a junction at 6:00 a.m. The Blue line runs trains at intervals of 12 minutes, the Green line at intervals of 18 minutes, and the Red line at intervals of 24 minutes. The station manager uses the times at which trains leave the junction together to plan crowd control. Assume every train runs exactly at its interval.

(i) At what time will the Blue and Green trains next leave the junction together? [1]

(ii) How many times do the Blue and Green trains leave the junction together after 6:00 a.m. and up to 12:00 noon (include 12:00 noon)? [1]

(iii) At what time after 6:00 a.m. will all three lines next leave the junction together? [2]

OR

(iii) Suppose the Red line is changed to run trains at intervals of 20 minutes. At what time after 6:00 a.m. will all three lines next leave the junction together? [2]

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02. Polynomials

Multiple Choice Questions (MCQs)

Q1. If α and β are the zeroes of the polynomial $5x^2 + 3x - 7$, then the value of $\frac{1}{\alpha} + \frac{1}{\beta}$ is: **[1]**

[Board 2024 30-2-1 Q9; Board 2023 30-1-1 Q7 (near-twin, $x^2 + x - 1$); Board 2023 30-4-1 Q17 (near-twin, $4x^2 - 3x - 7$)]

(a) $-\frac{3}{7}$ (b) $\frac{3}{5}$ (c) $\frac{3}{7}$ (d) $-\frac{5}{7}$

Q2. The zeroes of the polynomial $3x^2 + 11x - 4$ are: **[1]**

[Board 2023C 30-C-1 Q5; Board 2024 30-3-1 Q6 (near-twin, $2x^2 - 3x - 9$); Board 2023 30-2-1 Q14 (near-twin, $x^2 + 4x + 3$)]

(a) $\frac{1}{2},\ -4$ (b) $\frac{1}{4},\ -3$ (c) $\frac{1}{3},\ -4$ (d) $\frac{1}{3},\ 4$

Q3. The number of quadratic polynomials having zeroes -3 and 5 is: **[1]**

[Board 2023 30-5-1 Q1; Board 2023 30-6-1 Q3 (near-twin, zeroes $-5, -3$)]

(a) only one (b) infinite (c) exactly two (d) at most two

Assertion–Reason

Q4. **Assertion (A):** If the graph of a polynomial touches the x-axis at only one point, then the polynomial cannot be a quadratic polynomial.
Reason (R): A polynomial of degree n ($n > 1$) can have at most n zeroes. **[1]**
(a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
(b) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).
(c) Assertion (A) is true, but Reason (R) is false.
(d) Assertion (A) is false, but Reason (R) is true.

[Board 2024 30-1-1 Q20]

Very Short Answer (VSA)

Q5. Find the zeroes of the polynomial $p(x) = x^2 + \frac{4}{3}x - \frac{4}{3}$. **[2]**

[Board 2025 30-1-1 Q22]

Short Answer (SA)

Q6. If α and β are the zeroes of the polynomial $6x^2 - 5x + 1$, then form a quadratic polynomial whose zeroes are α^2 and β^2. **[3]**

[SQP 2024-25 Q28; SQP 2024-25 VIC Q28]

Q7. Find the zeroes of the polynomial $4x^2 + 4x - 3$ and verify the relationship between the zeroes and the coefficients of the polynomial. **[3]**

[Board 2024 30-4-1 Q29(a) (OR pair with Q29(b)); near-twins Board 2024 30-3-1 Q27 ($x^2 - 15$) and SQP 2025-26 Q28 ($2x^2 - (1 + 2\sqrt{2})x + \sqrt{2}$)]

Long Answer (LA)

Q8. For the quadratic polynomial $p(x) = x^2 - (k + 6)x + 2(2k - 1)$, let α and β be its zeroes.

(a) Find $\alpha + \beta$ and $\alpha\beta$ in terms of k. [1 mark]

(b) If the sum of the zeroes is half of their product, find the value of k. [2 marks]

(c) Write $p(x)$ for this value of k, and verify that the sum of its zeroes is half their product. [2 marks] **[5]**

[New]

Case Study

Q9. Read the following passage carefully and answer the questions that follow. **[4]**

[Board 2026 30-3-1 Q36 (adapted: sub-parts reordered to the 1+1+2 format; the source has 1+2+1)]

During a theatre drama, a backdrop of building arches was used. The shape of the arch curve is represented by the polynomial $p(x) = -x^2 + 2x + 8$, where x is the length (in feet) on the stage level. The highest point of the arch is $C(1, y)$ and the curve meets the stage level at the points A and B.

(i) Determine the height of the arch. [1]

(ii) Write the coordinates of the point where the curve intersects the y-axis. [1]

(iii) Find the zeroes of the polynomial $p(x)$. Which points on the graph represent the zeroes? [2]

OR

(iii) Find the span of the arch on the stage floor. [2]

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03. Pair of Linear Equations in Two Variables

Multiple Choice Questions (MCQs)

Q1. The pair of linear equations $x + 2y + 5 = 0$ and $-3x = 6y - 1$ has: **[1]**

[Board 2024 30/3/1 Q1]

(a) unique solution (b) exactly two solutions

(c) infinitely many solutions (d) no solution

Q2. If $ax + by = a^2 - b^2$ and $bx + ay = 0$, with $a^2 \neq b^2$, then the value of $x + y$ is: **[1]**

[Board 2024 30/4/1 Q1 (condition $a^2 \neq b^2$ added, needed for a unique solution)]

(a) $a^2 - b^2$ (b) $a + b$ (c) $a - b$ (d) $a^2 + b^2$

Q3. Two lines are parallel. The equation of one of them is $5x - 3y = 2$. The equation of the second line can be: **[1]**

[Board 2024 30/4/1 Q11]

(a) $-15x - 9y = 5$ (b) $15x + 9y = 5$ (c) $9x - 15y = 6$ (d) $-15x + 9y = 5$

Assertion–Reason

Q4. **Assertion (A):** The pair of linear equations $3x - 5y = 7$ and $6x - 10y = k$ has no solution when $k \neq 14$.
Reason (R): If $\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$, then the lines represented by the pair of equations are parallel and the pair has no solution. **[1]**
(a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
(b) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).
(c) Assertion (A) is true, but Reason (R) is false.
(d) Assertion (A) is false, but Reason (R) is true.

[New]

Very Short Answer (VSA)

Q5. The cost of 2 kg apples and 1 kg grapes on a day is Rs 320, and the cost of 4 kg apples and 2 kg grapes is Rs 600. If the cost of 1 kg apples is Rs x and of 1 kg grapes is Rs y, represent the situation algebraically as a pair of linear equations and check whether the system is consistent. **[2]**

[Board 2025 30/5/1 Q21(a)]

Q6. Solve the pair of linear equations $x = 3$ and $y = -4$ graphically. **[2]**

[Board 2023 30/1/1 Q21(a)]

Short Answer (SA)

Q7. If the system of linear equations $2x + 3y = 7$ and $2ax + (a + b)y = 28$ has infinitely many solutions, find the values of a and b. **[3]**

[Board 2023 30/2/1 Q30(a) (OR)]

Q8. Half of the difference between two numbers is 2. The sum of the greater number and twice the smaller number is 13. Find the numbers. **[3]**

[Board 2023 30/1/1 Q26]

Long Answer (LA)

Q9. Places A and B are 180 km apart on a highway. One car starts from A and another car starts from B at the same time. If the two cars travel in the same direction at different speeds, they meet in 9 hours. If they travel towards each other at the same speeds as before, they meet in 1 hour. Find the speeds of the two cars. **[5]**

[SQP 2024-25 Q32(B); SQP 2024-25 VIC Q32(B) (identical)]

Q10. Tara scored 40 marks in a test, getting 3 marks for each right answer and losing 1 mark for each wrong answer. Had 4 marks been awarded for each correct answer and 2 marks deducted for each wrong answer, Tara would have scored 50 marks. Assuming that Tara attempted all the questions, find the total number of questions in the test. **[5]**

[Board 2024 30/2/1 Q32(b)]

Case Study

Q11. Read the following passage carefully and answer the questions that follow. **[4]**

[Board 2024 30/5/1 Q36, adapted (sub-parts rebalanced to 1 + 1 + 2 with 2-mark OR)]

The ticket charges at an amusement park are Rs 150 per child and Rs 250 per adult. On a particular day, 300 tickets were sold and Rs 55000 was collected. Let x be the number of children and y the number of adults who visited that day.
Based on the above information, answer the following questions:

(i) Represent the given situation algebraically in terms of x and y. [1]

(ii) How many children visited the park that day? [1]

(iii) Find the amount that will be collected if 250 children and 100 adults visit the park. [2]

OR

(iii) How many adults visited the park that day? [2]

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04. Quadratic Equations

Multiple Choice Questions (MCQs)

Q1. If the quadratic equation $ax^2 + bx + c = 0$, $a \neq 0$, has two real and equal roots, then which of the following relations is true? **[1]**

[Board 2023 30/6/1 Q9; Board 2024 30/1/1 Q3]

(a) $a = \dfrac{b^2}{c}$ (b) $b^2 = ac$ (c) $ac = \dfrac{b^2}{4}$ (d) $c = \dfrac{b^2}{a}$

Q2. The roots of the quadratic equation $x^2 + x - 1 = 0$ are **[1]**

[SQP 2024-25 Q11; SQP 2024-25 (VIC) Q11]

(a) Irrational and distinct (b) Not real

(c) Rational and distinct (d) Real and equal

Q3. The values of k for which the equation $4x^2 + kx + 9 = 0$ has real and equal roots are: **[1]**

[Board 2023 (30/C/1) Q1]

(a) ± 11 (b) ± 12 (c) ± 6 (d) ± 3

Q4. The value of k for which the equation $kx^2 - 6x - 4 = 0$ has real and equal roots, is **[1]**

[Board 2026 30/5/1 Q1]

(a) $\dfrac{9}{4}$ (b) -4 (c) $-\dfrac{9}{4}$ (d) -2

Assertion–Reason

Q5. **Assertion (A):** The quadratic equation $2x^2 - 3x + 5 = 0$ has two distinct real roots.
Reason (R): The quadratic equation $ax^2 + bx + c = 0$ has no real roots when $b^2 - 4ac < 0$. **[1]**

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

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

(c) Assertion (A) is true, but Reason (R) is false.

(d) Assertion (A) is false, but Reason (R) is true.

[New]

Very Short Answer (VSA)

Q6. Solve for x by the quadratic formula: $9x^2 - 6px + (p^2 - q^2) = 0$. **[2]**

[SQP 2021-22 Term 2 Q6 (OR)]

Q7. Find the sum and the product of the roots of the quadratic equation $2x^2 - 9x + 4 = 0$. **[2]**

[Board 2023 30/4/1 Q23(A) (OR)]

Short Answer (SA)

Q8. The roots α and β of the quadratic equation $x^2 - 5x + 3(k - 1) = 0$ are such that $\alpha - \beta = 1$. Find the value of k. **[3]**

[SQP 2020-21 Q28 (OR)]

Long Answer (LA)

Q9. The age of a man is twice the square of the age of his son. Eight years hence, the age of the man will be 4 years more than three times the age of his son. Find their present ages. **[5]**

[Board 2024 30/5/1 Q32(b)]

Q10. At present, Sourav's age is 3 years more than the square of his son Ravi's age. When Ravi grows to his father's present age, Sourav's age would be 6 years less than 13 times the present age of Ravi. Find the present ages of Ravi and Sourav. **[5]**

[Board 2025C (30/S/1) Q34 (OR)]

Q11. Find the value(s) of p for which the quadratic equation $(p+4)x^2 - (p+1)x + 1 = 0$ has real and equal roots. Also, find the roots of the equation(s) so obtained. **[5]**

[Board 2025 30/5/1 Q32(b) (OR)]

Case Study

Q12. Case Study: Garden walkway **[4]**

[Board 2025 30/3/1 Q36 (adapted: parts restructured to 1+1+2+2 with the perimeter question moved to part ii; Rs used for the rupee sign)]

A garden designer is planning a rectangular lawn of 12 m by 10 m. The lawn is to be surrounded by a walkway of uniform width x m on all sides. The total area of the lawn and the walkway together is 360 m^2.
Based on the above information, answer the following questions:

(i) Formulate the quadratic equation representing the total area of the lawn and the walkway, taking the width of the walkway as x m. [1]

(ii) Find the perimeter of the lawn. [1]

(iii) Solve the quadratic equation to find the width x of the walkway. [2]

OR

(iii) If the cost of paving the walkway at the rate of Rs 50 per square metre is Rs 12000, calculate the area of the walkway. [2]

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05. Arithmetic Progressions

Multiple Choice Questions (MCQs)

Q1. The common difference of an A.P. in which $a_{15} - a_{11} = 48$, is **[1]**

[Board 2024 30/2/1 Q3]

(a) 12 (b) 16 (c) -12 (d) -16

Q2. Three numbers in A.P. have the sum 30. What is its middle term? **[1]**

[Board 2024 30/4/1 Q12]

(a) 4 (b) 10 (c) 16 (d) 8

Q3. Which term of the A.P. $-29, -26, -23, \ldots, 61$ is 16? **[1]**

[Board 2024 30/2/1 Q16]

(a) 11th (b) 16th (c) 10th (d) 31st

Assertion–Reason

Q4. **Assertion (A):** $-5, \frac{-5}{2}, 0, \frac{5}{2}, \ldots$ is in Arithmetic Progression.
Reason (R): The terms of an Arithmetic Progression cannot have both positive and negative rational numbers. **[1]**

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

[SQP 2023-24 Q20]

Very Short Answer (VSA)

Q5. Find the middle term of the A.P. $6, 13, 20, \ldots, 230$. **[2]**

[SQP 2025-26 Q21 (OR)]

Short Answer (SA)

Q6. Ridhi drew a polygon with n sides. The smallest exterior angle is 8° and each subsequent exterior angle is 4° more than the previous one. Find the number of sides of the polygon. **[3]**

[SQP 2026-27 Q28(A) (OR)]

Q7. Find the sum of the integers between 1 and 400 that are multiples of 4 as well as of 5. **[3]**

[SQP 2026-27 Q28(B) (OR)]

Long Answer (LA)

Q8. An A.P. consists of 37 terms. The sum of the three middle-most terms is 225 and the sum of the last three terms is 429. Find the A.P. and the sum of all its terms. **[5]**

[SQP 2017-18 Q24 (adapted: added a sum part to make 5 marks)]

Case Study

Q9. Read the following passage carefully and answer the questions that follow. **[4]**

[SQP 2021-22 Term 2 Q14 (adapted: 2+2 rebalanced to 1+1+2 with 2-mark OR)]

Push-ups are a fast and effective exercise for building strength. They are helpful in almost all sports, including athletics. Nitesh wants to take part in a push-up challenge. He can currently make 3000 push-ups in one hour, but his target is 3900 push-ups in one hour. With each day of practice, he is able to make 5 more push-ups in one hour than on the previous day. On the first day of practice he makes 3000 push-ups, and he continues to practise regularly till his target is achieved.
Based on the above information, answer the following questions:

(i) Write the first three terms of the A.P. formed by the number of push-ups per day, and its common difference. [1]

(ii) On which day of practice will Nitesh first make 3900 push-ups in one hour? [1]

(iii) Find the total number of push-ups he makes in one hour on all days from day 1 up to the day his target is achieved. [2]

OR

(iii) Find the total number of push-ups he makes in one hour on the first 30 days of practice. [2]

Q10. Read the following passage carefully and answer the questions that follow. **[4]**

[SQP 2023-24 Q36 (adapted: 1+2+1 rebalanced to 1+1+2 with 2-mark OR; the 11.16 m alternative was dropped as ambiguous)]

Manpreet Kaur is the national record holder for women in the shot-put discipline; her throw of 18.86 m at the Asian Grand Prix in 2017 is the maximum distance for an Indian female athlete. Sanjitha wants to earn a gold medal at the Olympics one day. Initially her throw reached only 7.56 m. She practises in the mornings and evenings and improves her throw distance by 9 cm every week. During a special camp of 15 days, she starts

with 40 throws on the first day and increases the number of throws by 12 every day.
Based on the above information, answer the following questions:

(i) How many throws did Sanjitha practise on the 11^{th} day of the camp? [1]

(ii) What would be her throw distance at the end of 6 weeks? [1]

(iii) How many throws did she do during the entire camp of 15 days? [2]

OR

(iii) How many throws did she do during the first 10 days of the camp? [2]

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06. Coordinate Geometry

Multiple Choice Questions (MCQs)

Q1. The point on the x-axis nearest to the point $(-4, -5)$ is: **[1]**

[SQP 2024-25 Q15; SQP 2024-25 VIC Q15]

(a) $(0, 0)$ (b) $(-4, 0)$ (c) $(-5, 0)$ (d) $(\sqrt{41}, 0)$

Assertion–Reason

Q2. **Assertion (A):** If three vertices of a parallelogram taken in order are $(-1, -6)$, $(2, -5)$ and $(7, 2)$, then its fourth vertex is $(4, 1)$.
Reason (R): Diagonals of a parallelogram bisect each other. **[1]**
(a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
(b) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).
(c) Assertion (A) is true, but Reason (R) is false.
(d) Assertion (A) is false, but Reason (R) is true.

[SQP 2026-27 Q19; MS 2026-27 Q19]

Q3. **Assertion (A):** Point $P(0, 2)$ is the point of intersection of the y-axis with the line $3x + 2y = 4$.
Reason (R): The distance of point $P(0, 2)$ from the x-axis is 2 units. **[1]**
(a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
(b) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).
(c) Assertion (A) is true, but Reason (R) is false.
(d) Assertion (A) is false, but Reason (R) is true.

[Board 2023 30-1-1 Q19]

Very Short Answer (VSA)

Q4. If the points $A(4, 5)$, $B(m, 6)$, $C(4, 3)$ and $D(1, n)$ taken in this order are the vertices of a parallelogram $ABCD$, then find the values of m and n. **[2]**

[Board 2026 30-2-1 Q23]

Short Answer (SA)

Q5. $P(-2, 5)$ and $Q(3, 2)$ are two points. Find the coordinates of the point R on the line segment PQ such that $PR = 2QR$. **[3]**

[Board 2024 30-3-1 Q29(b) (OR); SQP 2020-21 Q22 (OR, option 2) (near-twin)]

Q6. In what ratio does the x-axis divide the line segment joining the points $(-4, -6)$ and $(-1, 7)$? Also, find the coordinates of the point of division. **[3]**

[SQP 2026-27 Q30; MS 2026-27 Q30; SQP 2017-18 Q16 (identical question)]

Long Answer (LA)

Q7. The vertices of a quadrilateral $ABCD$ are $A(1,7)$, $B(4,2)$, $C(-1,-1)$ and $D(-4,4)$. (a) Prove that $ABCD$ is a square. (b) Show that the mid-points of the diagonals AC and BD coincide. (c) Find the point on the x-axis which is equidistant from B and C. **[5]**

[New]

Case Study

Q8. Case Study: Seema and Aditya travelling to hometowns **[4]**

[SQP 2019-20 Q31 (adapted: part (iii) area-of-triangle question replaced by a distance question; parts restructured to 1+1+2)]

Two friends Seema and Aditya work in the same office in Delhi. In the Christmas vacations, both decided to go to their hometowns, represented by Town A and Town B respectively in the figure. Town A and Town B are connected by trains from the same station C in Delhi. On the map's coordinate grid, Station C is at $(-4,4)$, Town A at $(1,7)$ and Town B at $(4,2)$, in kilometres.
Based on the above information, answer the following questions:

(i) Who travels more distance, Seema or Aditya, to reach their hometown? [1]

(ii) Seema and Aditya planned to meet at a location D, the mid-point of the line joining Town A and Town B. Find the coordinates of point D. [1]

(iii) Find the distance between Town A and Town B. [2]

OR

(iii) Find the point on the y-axis which is equidistant from Town A and Town B. [2]

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07. Triangles

Multiple Choice Questions (MCQs)

Q1. In the right triangle ABE, the right angle is at B, $AB = 16$ cm and $BE = 8$ cm. The side of the largest square $FDGB$ that can be inscribed in the triangle, with F on AB, G on BE and D on AE, is **[1]**

[SQP 2021-22 Q34]

(a) $\frac{32}{3}$ cm (b) $\frac{16}{3}$ cm (c) $\frac{8}{3}$ cm (d) $\frac{4}{3}$ cm

Q2. The measurements of $\triangle LMN$ and $\triangle ABC$ are: $LM = 45$ cm, $LN = 72$ cm, $MN = 63$ cm, $\angle LMN = 130°$, $\angle LNM = 28°$; and $AB = 5$ cm, $\angle BAC = 22°$, $\angle ABC = 130°$. The length of AC is **[1]**

[Board 2025 (30/3/1) Q11]

(a) 16 cm (b) 7 cm (c) 8 cm (d) 4 cm

Q3. In the right-angled $\triangle ABC$ with $\angle BAC = 90°$, $AD \perp BC$ with D on BC. If $BC = 16$ cm and $DC = 4$ cm, then $AC = x$ cm, where x is **[1]**

[Board 2025 (30/3/1) Q18]

(a) 4 cm (b) 5 cm (c) 8 cm (d) 3 cm

Q4. In the adjoining figure $PQ \parallel XY \parallel BC$, $AP = 2$ cm, $PX = 1.5$ cm, $BX = 4$ cm and $QY = 0.75$ cm, where P, X lie on AB and Q, Y lie on AC. Then $AQ + CY =$ **[1]**

[Board 2025 (30/6/1) Q6]

(a) 6 cm (b) 4.5 cm (c) 3 cm (d) 5.25 cm

Assertion–Reason

Q5. **Assertion (A):** Any two equilateral triangles are similar.
Reason (R): All the angles of an equilateral triangle measure $60°$, so any two equilateral triangles have equal corresponding angles. **[1]**
(a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
(b) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).
(c) Assertion (A) is true, but Reason (R) is false.
(d) Assertion (A) is false, but Reason (R) is true.

[New]

Very Short Answer (VSA)

Q6. The diagonals AC and BD of a quadrilateral $ABCD$ intersect at O such that $\frac{AO}{OC} = \frac{BO}{OD}$. Show that $ABCD$ is a trapezium. **[2]**

[Board 2026 (30/3/1) Q24; Board 2024 (30/3/1) Q11 (MCQ form, see 07-008)]

Q7. In the figure, $\triangle ABC \sim \triangle XYZ$ with $AB = 4$ cm, $BC = 6$ cm, $AC = y$ cm, $XY = x$ cm, $XZ = 6$ cm and $YZ = 7.2$ cm. Find the values of x and y. **[2]**

[Board 2026 (30/1/1) Q22(B) (OR)]

Q8. In the given figure, S lies on side PR of $\triangle PQR$ and QS is joined, with $\angle PQR = \angle QSP$. If $PQ = 6$ cm and $PS = 3$ cm, find PR. **[2]**

[SQP 2026-27 Q22(B) (OR)]

Short Answer (SA)

Q9. Prove that any line parallel to the parallel sides of a trapezium divides the non-parallel sides proportionally. **[3]**

[SQP 2024-25 VIC Q26(A)]

Long Answer (LA)

Q10. In the figure, PA, QB and RC are each perpendicular to the line AC, where A, B, C lie on AC in this order. $PA = x$, $QB = y$ and $RC = z$. The straight lines PC and AR intersect at Q. Prove that $\frac{1}{x} + \frac{1}{z} = \frac{1}{y}$. **[5]**

[Board 2024 (30/1/1) Q34(b) (OR); Board 2025 (30/3/1) Q34(a)]

Q11. In the right triangle CAB with $\angle A = 90°$, $AD \perp CB$ with D on CB. Prove that $\triangle ADB \sim \triangle CDA$. Further, if $BC = 10$ cm and $CD = 2$ cm, find AD. **[5]**

[Board 2025 (30/6/1) Q33(b) (OR); Board 2025 (30/1/1) Q33(b) (OR; converse form: $AD^2 = BD \times DC$ implies $\angle BAC = 90°$)]

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08. Circles

Multiple Choice Questions (MCQs)

Q1. Tangents PA and PB are drawn from an external point P to a circle with centre O, touching it at A and B. If $\angle AOB = 130°$, then $\angle APB$ is equal to: **[1]**

[Board 2026 30/2/1 Q14; near-twins Board 2026 30/1/1 Q12, Board 2025 30/5/1 Q11, Board 2025 30/3/1 Q8, Board 2024 30/5/1 Q16]

(a) $130°$ (b) $50°$ (c) $120°$ (d) $90°$

Q2. PA is a tangent from an external point P to a circle with centre O, touching it at A. The points A, O, B lie on one straight line (AB is a diameter), and $\angle POB = 125°$. Then $\angle APO$ is equal to: **[1]**

[Board 2026 30/1/1 Q13; near-twin Board 2025 30/1/1 Q16 (angle 115 degrees)]

(a) $25°$ (b) $65°$ (c) $90°$ (d) $35°$

Q3. PR is a tangent to a circle with centre O at the point P, and PQ is a chord making an angle of 50° with the tangent PR. The angle subtended by the chord PQ at the centre O is: **[1]**

[SQP 2023-24 Q9 (= MS 2023-24 Q9); near-twins Board 2024 30/3/1 Q18 (70 degrees, giving 140), SQP 2024-25 Q7 (110 degrees, giving 140)]

(a) 130° (b) 100° (c) 50° (d) 30°

Assertion–Reason

Q4. **Assertion (A):** TA and TB are two tangents drawn from an external point T to a circle with centre O. If $\angle TBA = 75^\circ$, then $\angle ABO = 25^\circ$.
Reason (R): The tangent drawn at any point of a circle is perpendicular to the radius through the point of contact. **[1]**
(a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
(b) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).
(c) Assertion (A) is true, but Reason (R) is false.
(d) Assertion (A) is false, but Reason (R) is true.

[Board 2024C 30/S/1 Q20]

Very Short Answer (VSA)

Q5. From a point P, two tangents PA and PB are drawn to a circle with centre O and radius r. If $OP = 2r$, then find $\angle APB$. What type of triangle is APB? **[2]**

[SQP 2021-22 Term2 Q3 (= MS 2021-22 Term2 Q3); near-twin MS 2019-20 Q18 (OP = 2r, 1 mark)]

Q6. PA is a tangent from an external point P to a circle with centre O, touching it at A. BC is a diameter of the circle, and P, B, O, C lie on one straight line with B between P and O. If $\angle AOC = 130^\circ$, find $\angle APB$.**[2]**

[Board 2023 30/6/1 Q24]

Short Answer (SA)

Q7. Prove that the angle between the two tangents drawn from an external point to a circle is supplementary to the angle subtended by the line segment joining the points of contact at the centre. **[3]**

[Board 2023 30/4/1 Q28; Board 2025 30/2/1 Q26(b); SQP 2021-22 Term2 Q12 (4-mark form, adapted to 3 marks)]

Q8. Prove that the opposite sides of a quadrilateral circumscribing a circle subtend supplementary angles at the centre of the circle. **[3]**

[Board 2025 30/1/1 Q26(b) (OR); Board 2025C 30/S/1 Q28; Board 2024 30/2/1 Q28(b)]

Q9. Prove that a parallelogram circumscribing a circle is a rhombus. **[3]**

[Board 2024 30/5/1 Q28; Board 2025 30/2/1 Q26(a); SQP 2022-23 Q30 (= MS 2022-23 Q30); SQP 2026-27 Q29 (= MS 2026-27 Q29)]

Long Answer (LA)

Q10. Prove that the lengths of tangents drawn from an external point to a circle are equal. Using this result, find the length BC of $\triangle ABC$ in which a circle is inscribed touching AB, BC and CA at R, P and Q respectively, given $AB = 10$ cm, $AQ = 7$ cm and $CQ = 5$ cm. **[5]**

[SQP 2024-25 Q33 (= MS 2024-25 Q33)]

Q11. Prove that the lengths of tangents drawn from an external point to a circle are equal. Using this result, prove that if ABC is an isosceles triangle with $AB = AC$ circumscribed about a circle, then the base BC is bisected by the point of contact. **[5]**

[SQP 2024-25 VIC Q33 (= MS 2024-25 VIC Q33)]

Case Study

Q12. Read the following passage carefully and answer the questions that follow. **[4]**

[Board 2024 30/1/1 Q38]

A backyard is in the shape of a right-angled triangle ABC with $\angle B = 90°$, $AB = 7$ m and $BC = 15$ m. A circular pit with centre O and radius r has been dug inside it so that it touches the walls AB, BC and AC at R, Q and P respectively, with $AP = x$ m.
Based on the above information, answer the following questions:

(i) Find the length of AR in terms of x. [1]

(ii) Write the type of quadrilateral $BQOR$. [1]

(iii) Find the length PC in terms of x, and hence find the value of x. [2]

OR

(iii) Find x, and hence find the radius r of the circle. [2]

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09. Introduction to Trigonometry

Multiple Choice Questions (MCQs)

Q1. $\dfrac{2\tan 30°}{1+\tan^2 30°}$ is equal to **[1]**

[Board 2023 30/5/1 Q12; near-twin Board 2025 30/5/1 Q12 (the (1 minus tan squared 30) over (1 plus tan squared 30) form)]

(a) $\sin 60°$ (b) $\cos 60°$ (c) $\tan 60°$ (d) $\sin 30°$

Q2. If $x\left(\dfrac{2\tan 30°}{1+\tan^2 30°}\right) = y\left(\dfrac{2\tan 30°}{1-\tan^2 30°}\right)$, then $x : y =$ **[1]**

[Board 2025 30/6/1 Q12]

(a) $1:1$ (b) $1:2$ (c) $2:1$ (d) $4:1$

Q3. $\sec\theta$, when expressed in terms of $\cot\theta$, is equal to **[1]**

[Board 2023 30/4/1 Q10]

(a) $\dfrac{1+\cot^2\theta}{\cot\theta}$ (b) $\sqrt{1+\cot^2\theta}$ (c) $\dfrac{\sqrt{1+\cot^2\theta}}{\cot\theta}$ (d) $\dfrac{\sqrt{1-\cot^2\theta}}{\cot\theta}$

Q4. If $\tan\theta = \dfrac{5}{12}$, then the value of $\dfrac{\sin\theta+\cos\theta}{\sin\theta-\cos\theta}$ is **[1]**

[Board 2023 30/5/1 Q6]

(a) $-\frac{17}{7}$ (b) $\frac{17}{7}$ (c) $\frac{17}{13}$ (d) $-\frac{7}{13}$

Q5. If θ is an acute angle of a right-angled triangle, then which of the following equations is not true? **[1]**

[Board 2023 30/6/1 Q16]

(a) $\sin\theta\cot\theta = \cos\theta$ (b) $\cos\theta\tan\theta = \sin\theta$ (c) $\text{cosec}^2\theta - \cot^2\theta = 1$ (d) $\tan^2\theta - \sec^2\theta = 1$

Q6. If $\sin\theta = \cos\theta$, $(0° < \theta < 90°)$, then the value of $\sec\theta \cdot \sin\theta$ is **[1]**

[Board 2024 30/2/1 Q7]

(a) $\frac{1}{\sqrt{2}}$ (b) $\sqrt{2}$ (c) 1 (d) 0

Q7. If $\dfrac{x}{3} = 2\sin A$ and $\dfrac{y}{3} = 2\cos A$, then the value of $x^2 + y^2$ is **[1]**

[Board 2024 30/5/1 Q2]

(a) 36 (b) 9 (c) 6 (d) 18

Assertion–Reason

Q8. **Assertion (A):** If $\sin A = \frac{1}{3}$ $(0^\circ < A < 90^\circ)$, then the value of $\cos A$ is $\frac{2\sqrt{2}}{3}$.
Reason (R): For every angle θ, $\sin^2\theta + \cos^2\theta = 1$. **[1]**
(a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
(b) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).
(c) Assertion (A) is true, but Reason (R) is false.
(d) Assertion (A) is false, but Reason (R) is true.
[Board 2024 30/2/1 Q19]

Very Short Answer (VSA)

Q9. If $\tan A = \sqrt{3}$, where A is an acute angle, then find the value of $\frac{\sin^2 A}{1+\cos^2 A}$. **[2]**
[Board 2025 30/2/1 Q23]

Q10. If $4k = \tan^2 60^\circ - 2\,\text{cosec}^2 30^\circ - 2\tan^2 30^\circ$, then find the value of k. **[2]**
[Board 2025 30/3/1 Q21]

Q11. Find the value of x for which $(\sin A + \text{cosec } A)^2 + (\cos A + \sec A)^2 = x + \tan^2 A + \cot^2 A$. **[2]**
[Board 2025 30/4/1 Q24(A)]

Q12. Evaluate $\frac{3\sin 30^\circ - 4\sin^3 30^\circ}{2\sin^2 50^\circ + 2\cos^2 50^\circ}$. **[2]**
[Board 2025 30/4/1 Q24(B)]

Short Answer (SA)

Q13. If $\frac{1}{\sin x - \cos x} = \frac{\text{cosec } x}{\sqrt{2}}$, then prove that $\left(\frac{1}{\sin x + \cos x}\right)^2 = \frac{\sec^2 x}{2}$. **[3]**
[SQP 2026-27 Q31(B) (OR); MS 2026-27 Q31 (OR)]

Q14. Prove that $\sqrt{\frac{\sec A - 1}{\sec A + 1}} + \sqrt{\frac{\sec A + 1}{\sec A - 1}} = 2\,\text{cosec } A$. **[3]**
[Board 2025 30/3/1 Q28(a); Board 2023 30/5/1 Q25(b) (2-mark form, same identity); near-twin Board 2025 30/2/1 Q27(b) (cosec form, equal to 2 sec theta)]

Q15. Prove that $\frac{1 + \text{cosec } A}{\text{cosec } A} = \frac{\cos^2 A}{1 - \sin A}$. **[3]**
[Board 2025 30/5/1 Q30(a); near-twin Board 2023 30/6/1 Q30 (secant form: (1 plus sec A) over sec A equals sin squared A over (1 minus cos A))]

Long Answer (LA)

Q16. (a) If $\sec\theta + \tan\theta = p$, find $\text{cosec}\,\theta$ in terms of p. (b) Hence, or otherwise, find $\cos\theta$ in terms of p. **[5]**
[SQP 2018-19 Q30 (4 marks; part (b) of 1 mark added, adapted)]

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10. Some Applications of Trigonometry

Multiple Choice Questions (MCQs)

Q1. A pole 6 m high casts a shadow $2\sqrt{3}$ m long on the ground. The elevation of the Sun is: **[1]**
[SQP 2016-17 Q3 (1-mark VSA, adapted to MCQ); Board 2023 30/4/1 Q9; SQP 2023-24 Q13 (= MS 2023-24 Q13)]
(a) 60° (b) 45° (c) 30° (d) 90°

Q2. From a point on the ground, 30 m away from the foot of a vertical tower, the angle of elevation of the top of the tower is 60°. The height of the tower, in metres, is: **[1]**

[Board 2024 30/3/1 Q7; near-twin Board 2026 30/2/1 Q12 (60 m, 45 degrees)]

(a) $10\sqrt{3}$ (b) $30\sqrt{3}$ (c) 60 (d) 30

Assertion–Reason

Q3. **Assertion (A):** A ladder 12 m long leans against a vertical wall and makes an angle of 30° with the ground. It reaches a height of 6 m on the wall.
Reason (R): A ladder of length L inclined at θ to the ground reaches a height of $L\sin\theta$ on the wall. **[1]**
(a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
(b) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).
(c) Assertion (A) is true, but Reason (R) is false.
(d) Assertion (A) is false, but Reason (R) is true.

[New]

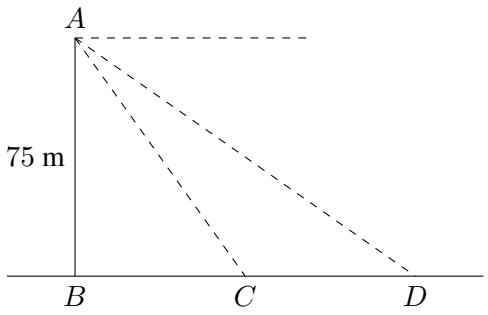
Very Short Answer (VSA)

Q4. Find the length of the shadow on level ground of a pole of height 18 m when the elevation of the Sun is 60°. **[2]**

[Board 2023 30/6/1 Q23 (adapted: the original gave tan(theta) = 6/7, which is not a 30, 45 or 60 degree angle; the sun's elevation is changed to 60 degrees and the problem re-solved)]

Short Answer (SA)

Q5. From the top of a lighthouse 75 m high, the angles of depression of two ships are 45° and 30° respectively. If one ship is directly behind the other on the same side of the lighthouse, find the distance between the two ships.



[3]

[SQP 2016-17 Q13; near-twins Board 2023 30/2/1 Q33(a) and Board 2023 30/4/1 Q32(A) (same structure, 75 m, one car or ship behind the other)]

Q6. Two vertical poles of different heights stand 20 m apart on level ground. The angle of elevation of the top of the first pole from the foot of the second pole is 60°, and the angle of elevation of the top of the second pole from the foot of the first pole is 30°. Find the difference between the heights of the two poles. **[3]**

[SQP 2021-22 Term 2 Q10; MS 2021-22 Term 2 Q10 (MS prints 23.06 m, a rounding slip; exact value used)]

Long Answer (LA)

Q7. A straight highway leads to the foot of a 75 m high tower. A man standing on the top of the tower observes two cars, at angles of depression 30° and 60°, approaching the foot of the tower. If one car is exactly behind the other on the same side of the tower, find the distance between the two cars. (Use $\sqrt{3} = 1.73$.) **[5]**

[Board 2023 30/4/1 Q32(A); Board 2023 30/2/1 Q33(a) (same question); near-twin SQP 2016-17 Q13]

Q8. From a point on the ground, the angles of elevation of the bottom and the top of a transmission tower, fixed at the top of a 20 m high building, are 45° and 60° respectively. Find the height of the tower. (Use $\sqrt{3} = 1.732$.) **[5]**

[Board 2024 30/3/1 Q34; near-twins Board 2023 30/2/1 Q33(b) (30 m building, 30 and 60 degrees) and Board 2023 30/4/1 Q32(B) (7 m building, 60 and

30 degrees); the 2023 30/4 pair is an internal choice with 10-027]

Q9. Two palm trees of equal height stand opposite each other on either side of a river 80 m wide. From a point O on the river between them, the angles of elevation of the tops of the trees are $60°$ and $30°$ respectively. Find the height of the trees and the distances of O from the two trees. (Use $\sqrt{3} = 1.73$.) **[5]**

[SQP 2020-21 Q34 (OR option 1); MS 2020-21 Q34; near-twin Board 2024 30/4/1 Q32 (pillars across a 100 m road)]

Case Study

Q10. Case Study: Amrita and the lighthouse **[4]**

[Board 2025 30/1/1 Q38]

Amrita stood at the point A near the base E of a lighthouse CE on level ground, and found the angle of elevation of its top C to be $60°$. She then climbed an observation deck, at a point B that is 40 m vertically above A. From B the angle of elevation of C is $45°$. Let D be the point of the lighthouse at the level of B, so BD is horizontal and $CD = h$ metres.
Based on the above information, answer the following questions:

(i) If $CD = h$ metres, find BD in terms of h. [1]

(ii) Find BC in terms of h. [1]

(iii) Find the height CE of the lighthouse. (Use $\sqrt{3} = 1.73$.) [2]

OR

(iii) If $AC = 100$ m, find the distance AE. [2]

Q11. Case Study: Lighthouse and the approaching ship **[4]**

[Board 2025 30/3/1 Q37 (adapted: the time from Q to A is changed from 10 minutes to 20 seconds, since 10 minutes gives an unrealistic speed of 0.3 km/h)]

A lighthouse AB of height 50 m stands on the shore, with its base A and top B vertical. A ship approaches the shore along a straight line on the sea. From the top B of the lighthouse, the angles of depression of the ship are $30°$ when it is at P and $45°$ when it is at Q, where P and Q lie on the ground on the same side of A, with P farther away than Q.
Based on the above information, answer the following questions:

(i) Find the distance of the ship from the base of the lighthouse when it is at Q. [1]

(ii) Find the measures of $\angle PBA$ and $\angle QBA$. [1]

(iii) Find the distance travelled by the ship between P and Q. (Use $\sqrt{3} = 1.73$.) [2]

OR

(iii) If the ship takes 20 seconds to travel from Q to A, find its speed in km/h. [2]

11. Areas Related to Circles

Multiple Choice Questions (MCQs)

Q1. Five congruent circles of radius 1 cm are arranged as in the Olympic symbol: three rings in the upper row and two in the lower row, so that each lower ring overlaps two upper rings. There are four overlapping regions, shown dotted. In each overlap the two points where the overlapping circles meet are joined by a chord of length 1 cm. Assuming the thickness of the rings is negligible, the total area of the four dotted regions is **[1]**

[SQP 2025-26 Q7; SQP 2021-22 Q37 (adapted: figure described in words; option unit corrected from cm to cm2)]

(a) $4\left[\frac{\pi}{12}-\frac{\sqrt{3}}{4}\right]$ cm^2 (b) $\left[\frac{\pi}{6}-\frac{\sqrt{3}}{4}\right]$ cm^2 (c) $4\left[\frac{\pi}{6}-\frac{\sqrt{3}}{4}\right]$ cm^2 (d) $8\left[\frac{\pi}{6}-\frac{\sqrt{3}}{4}\right]$ cm^2

Q2. The area (in cm^2) of a sector of a circle of radius 21 cm cut off by an arc of length 22 cm is **[1]**

[SQP 2025-26 Q13]

(a) 441 (b) 321 (c) 231 (d) 221

Q3. The arc of a circle is of length 6π cm and the sector it bounds has an area of 24π cm^2. The radius of the circle is: **[1]**

[SQP 2026-27 Q15]

(a) 4 cm (b) 8 cm (c) 16 cm (d) 18 cm

Very Short Answer (VSA)

Q4. A horse, a cow and a goat are tied, each by ropes of length 14 m, at the corners A, B and C respectively, of a grassy triangular field ABC with sides 35 m, 40 m and 50 m. Find the area of the grass field that can be grazed by them. (Use $\pi = \frac{22}{7}$.) **[2]**

[SQP 2025-26 Q24 (A); SQP 2023-24 Q25 (near-twin: arcs at the three vertices of a triangle)]

Q5. Find the area of the major segment (in terms of π) of a circle of radius 5 cm, formed by a chord subtending an angle of 90° at the centre. **[2]**

[SQP 2025-26 Q24 (B) (OR)]

Short Answer (SA)

Q6. AB is a chord of a circle with centre O such that $\angle AOB = 60^\circ$. If $OA = 14$ cm, find the area of the minor segment. (Take $\sqrt{3} = 1.73$.) **[3]**

[SQP 2024-25 Q30 (B) (OR); Board 2023C 30/C/1 Q31 (b) (near-twin with r = 10 cm)]

Q7. Find the area of the minor sector and the major sector of a circle with radius 6 cm, if the angle subtended by the minor arc at the centre is 60°. (Use $\pi = 3.14$.) **[3]**

[Board 2023C 30/C/1 Q31 (a) (OR); SQP 2024-25 VIC Q30 (B) (near-twin: minor sector with major arc 300 deg)]

Long Answer (LA)

Q8. The perimeter of a certain sector of a circle of radius 5.6 m is 20.0 m. (i) Find the area of the sector. (ii) Find the central angle of the sector in degrees. (Use $\pi = \frac{22}{7}$.) **[5]**

[Board 2024 30/2/1 Q35, adapted: part (ii) (central angle) added]

Case Study

Q9. Read the following passage carefully and answer the questions that follow. **[4]**

[Board 2025 30/5/1 Q36, adapted: shaded area and ratio reworded as segment and fence questions so that no circle-plus-square combination is used]

A farmer has a circular piece of land of radius 35 m. He wishes to build his house in the form of the largest possible square inside the land, so the square is inscribed in the circle. The land outside the house is to be covered with grass. The four parts of the land lying between the sides of the house and the boundary are the grass areas.
Based on the above information, answer the following questions:

(i) Find the length of wire needed to fence the entire circular land. (Use $\pi = \frac{22}{7}$.) [1]

(ii) Find the length of each side of the square house. [1]

(iii) Find the cost of growing grass on the four grass areas at the rate of Rs 50 per square metre. (Use $\pi = \frac{22}{7}$.) [2]

OR

(iii) Find the length of wire needed to fence the four walls of the square house. [2]

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12. Surface Areas and Volumes

Multiple Choice Questions (MCQs)

Q1. The volume of a solid hemisphere is $\frac{396}{7}$ cm^3. The total surface area of the solid hemisphere (in cm^2) is: **[1]**

[SQP 2024-25 Q13; near-twin SQP 2024-25 VIC Q13]

(a) $\frac{396}{7}$ (b) $\frac{594}{7}$ (c) $\frac{549}{7}$ (d) $\frac{604}{7}$

Q2. The radius of the base of a right circular cone and the radius of a sphere are each 5 cm. If the volume of the cone is equal to the volume of the sphere, then the height of the cone is: **[1]**

[SQP 2024-25 Q5; near-twin SQP 2024-25 VIC Q5]

(a) 5 cm (b) 20 cm (c) 10 cm (d) 4 cm

Q3. The area of the base of a right circular cone is 51 cm^2 and its volume is 85 cm^3. The height of the cone is:**[1]**

[SQP 2025-26 Q11 (printed volume unit cm2 corrected to cm3)]

(a) $\frac{5}{6}$ cm (b) $\frac{5}{3}$ cm (c) $\frac{5}{2}$ cm (d) 5 cm

Assertion–Reason

Q4. **Assertion (A):** Two cubes, each of edge 4 cm, are joined end to end to form a cuboid. The total surface area of the cuboid is 160 cm^2.
Reason (R): The surface area of a cuboid of dimensions $l \times b \times h$ is $lb + bh + hl$. **[1]**
(a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
(b) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).
(c) Assertion (A) is true, but Reason (R) is false.
(d) Assertion (A) is false, but Reason (R) is true.

[Board 2026 30/2/1 Q19; near-twins Board 2024 30/2/1 Q20 (edge 10 cm, A false), SQP 2026-27 Q11 (MCQ form)]

Very Short Answer (VSA)

Q5. A building has a cylindrical base of radius 7 m and height 10 m, surmounted by a hemispherical dome of the same radius. Find the total surface area of the building (count the circular top of the cylinder as covered by the dome). (Take $\pi = \frac{22}{7}$.) **[2]**

[New (lead replacement: the original new-block draft was a pouring/conversion problem, a deleted topic; replaced with a direct two-solid TSA question)]

Short Answer (SA)

Q6. A room is in the form of a right circular cylinder surmounted by a hemispherical dome. The base radius of the hemisphere is one-half of the height of the cylindrical part. If the room contains $\frac{1408}{21}$ m^3 of air, find the total height of the room. (Take $\pi = \frac{22}{7}$.) **[3]**

[Board 2023 30/1/1 Q31(a); near-twin Board 2025 30/1/1 Q30 (asks the cylinder height, 4 m)]

Q7. Water flows through a cylindrical pipe of internal diameter 4 cm at the rate of 20 metres per minute. How long will it take to fill a conical tank of base radius 40 cm and depth 72 cm? Give the answer in minutes.**[3]**

[SQP 2016-17 Q17]

Long Answer (LA)

Q8. Water flows at 15 km/h through a pipe of diameter 14 cm into a cuboidal pond which is 50 m long and 44 m wide. (a) In what time will the level of water in the pond rise by 21 cm? (b) What should be the speed of the

water if the rise in the water level is to be attained in 1 hour? **[5]**

[SQP 2018-19 Q21 (OR); SQP 2019-20 Q38 (OR); SQP 2023-24 Q34 (part b is the speed question from SQP 2023-24)]

Q9. From one face of a solid cube of edge 14 cm, the largest possible cone is carved out: its base is a circle inscribed in that face and its vertex touches the centre of the opposite face. Find the volume and the total surface area of the remaining solid. (Use $\pi = \frac{22}{7}$ and $\sqrt{5} = 2.2$.) **[5]**

[SQP 2017-18 Q21 (OR, option 2); Board 2025 30/6/1 Q34 (sqrt(5) = 2.2 as printed) (adapted)]

Q10. A wooden article is made by scooping out a hemisphere from each end of a solid cylinder. The height of the cylinder is 5.8 cm and its base radius is 2.1 cm. (i) Find the total surface area of the article. (ii) Find the volume of the article. (Take $\pi = \frac{22}{7}$.) **[5]**

[SQP 2016-17 Q20; Board 2024 30/5/1 Q35 (merged; volume part added) (adapted)]

Case Study

Q11. Read the following passage carefully and answer the questions that follow. **[4]**

[Board 2025 30/2/1 Q38 (lead fold-in: overruled the 3-cylinders drop — no part computes a 3-solid combination; each part is single-solid or two-identical-solid arithmetic; official 2025 board question)]

A skilled carpenter decided to craft a special rolling pin for the local baker. He carefully joined three cylindrical pieces of wood - two small ones on the ends and one larger in the centre - to create a perfect tool. The length of the bigger cylindrical part is 12 cm and its diameter is 7 cm, and the length of each smaller cylindrical part is 5 cm and its diameter is 2.1 cm.
Based on the above information, answer the following questions:

(i) Find the volume of the bigger cylindrical part. [1]

(ii) Find the curved surface area of the bigger cylindrical part. [1]

(iii) Find the ratio of the volume of the bigger cylindrical part to the total volume of the two smaller (identical) cylindrical parts. [2]

OR

(iii) Find the sum of the curved surface areas of the two identical smaller cylindrical parts. [2]

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13. Statistics

Multiple Choice Questions (MCQs)

Q1. If the maximum number of students has obtained 52 marks out of 80, then: **[1]**

[Board 2025 30/6/1 Q16; near-twin Board 2024 30/2/1 Q18 (the mode is the most frequent value)]

(a) 52 is the mean of the data. (b) 52 is the median of the data.
(c) 52 is the mode of the data. (d) 52 is the range of the data.

Q2. If the difference of mode and median of a data is 24, then the difference of median and mean is: **[1]**

[SQP 2022-23 Q14 (= MS 2022-23 Q14); Board 2024 30/4/1 Q7 (same numbers, different option order)]

(a) 8 (b) 12 (c) 24 (d) 36

Assertion–Reason

Q3. **Assertion (A):** The mean of the first n natural numbers is $\frac{n-1}{2}$.

Reason (R): The sum of the first n natural numbers is $\frac{n(n+1)}{2}$. **[1]**

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

[Board 2026 30/2/1 Q20]

Very Short Answer (VSA)

Q4. The time (in minutes) spent on a mobile game by 20 children is recorded below. Find the mean time by the step-deviation method, taking $a = 35$ and $h = 10$.

Time (minutes)	10–20	20–30	30–40	40–50
Number of children	3	5	8	4

[2]

[New]

Short Answer (SA)

Q5. Find the mode of the following distribution of marks obtained by the students in an examination:

Marks obtained	0–20	20–40	40–60	60–80	80–100
Number of students	15	18	21	29	17

Given that the mean of the above distribution is 53, using the empirical relationship estimate the value of its median. **[3]**

[SQP 2017-18 Q22; MS 2017-18 Q22 (same paper)]

Q6. The table shows the daily expenditure on grocery of 25 households in a locality. Find the modal daily expenditure on grocery by a suitable method.

Daily expenditure (Rs)	100–150	150–200	200–250	250–300	300–350
Number of households	4	5	12	2	2

[3]

[SQP 2018-19 Q22; MS 2018-19 Q22 (same paper)]

Long Answer (LA)

Q7. A student noted the number of cars passing through a spot on a road for 100 periods, each of 3 minutes, and summarised the counts below. Find the mean and median of the following data.

Number of cars	Frequency (periods)
0–10	7
10–20	14
20–30	13
30–40	12
40–50	20
50–60	11
60–70	15
70–80	8

[5]

[Board 2023 30/2/1 Q34]

Q8. The masses of 250 apples in a box were weighed and the distribution is given below.

Mass (g)	Number of apples
80–100	20
100–120	60
120–140	70
140–160	x
160–180	60

(i) Find the value of x and the mean mass of the apples. (ii) Find the modal mass of the apples. **[5]**

[Board 2023 30/6/1 Q35]

Q9. Medical check-up was carried out for 35 students of a class and their weights (in kg) were recorded as follows. Find the difference between the mean weight and the median weight.

Weight (kg)	38–40	40–42	42–44	44–46	46–48	48–50	50–52
Number of students	3	2	4	5	14	4	3

[5]

[Board 2025 30/5/1 Q35]

Case Study

Q10. Case Study: Vocational training **[4]**

[Board 2024 30/3/1 Q37 (adapted: empirical-relation part replaced by a counting part; OR pair kept) (adapted)]

Vocational training complements traditional education by providing practical, job-specific skills and hands-on experience. A teacher made the following frequency table of the participants in vocational training at an institute, by age.

Age (in years)	Number of participants
15–19	62
20–24	132
25–29	96
30–34	37
35–39	13
40–44	11
45–49	10
50–54	4

Based on the above information, answer the following questions:

(i) What is the lower limit of the modal class? [1]

(ii) Write the median class of the above data. [1]

(iii) Find the number of participants of age less than 50 years. [2]

OR

(iii) Find the number of participants of age 30 years or more. [2]

14. Probability

Multiple Choice Questions (MCQs)

Q1. Two fair coins are tossed simultaneously. The probability of getting at most one head is: **[1]**

[SQP 2021-22 Q5; Board 2023C 30/C/1 Q17 (near-twin); Board 2023 30/4/1 Q24 (VSA near-twin)]

(a) $\frac{3}{4}$ (b) $\frac{1}{4}$ (c) $\frac{1}{2}$ (d) $\frac{3}{8}$

Q2. A card is drawn from a well shuffled deck of 52 playing cards. The probability of getting a red face card is: **[1]**

[SQP 2024-25 Q18; SQP 2024-25 VIC Q18; Board 2025 30/1/1 Q13]

(a) $\frac{3}{13}$ (b) $\frac{1}{2}$ (c) $\frac{3}{52}$ (d) $\frac{3}{26}$

Q3. A girl calculates that the probability of her winning the first prize in a lottery is 0.08. If 6000 tickets are sold, how many tickets has she bought? **[1]**

[Board 2023 30/1/1 Q17; Board 2026 30/5/1 Q16 (near-twin, 800 tickets); Board 2024C 30/S/1 Q13 (near-twin, ice creams)]

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

Q4. Two dice are rolled simultaneously. The probability that 6 comes up at least once is: **[1]**

[SQP 2022-23 Q17; SQP 2021-22 Q27 (near-twin, number 5 instead of 6)]

(a) $\frac{1}{6}$ (b) $\frac{7}{36}$ (c) $\frac{11}{36}$ (d) $\frac{13}{36}$

Q5. Two cards of hearts and four cards of spades are missing from a pack of 52 cards. A card is drawn at random from the remaining pack. The probability of getting a black card is: **[1]**

[SQP 2023-24 Q17; MS 2023-24 Q17; SQP 2026-27 Q18 (near-twin: diamonds and spades missing, heart asked, answer 13/46)]

(a) $\frac{22}{52}$ (b) $\frac{22}{46}$ (c) $\frac{24}{52}$ (d) $\frac{24}{46}$

Q6. In a bag containing 24 balls, 4 are blue, 11 are green and the rest are white. One ball is drawn at random. The probability that the drawn ball is white in colour is: **[1]**

[SQP 2024-25 Q14; SQP 2024-25 VIC Q14]

(a) $\frac{1}{6}$ (b) $\frac{3}{8}$ (c) $\frac{11}{24}$ (d) $\frac{5}{8}$

Q7. For an event E, if $P(E) + P(\overline{E}) = q$, then the value of $q^2 - 4$ is: **[1]**

[Board 2024 30/4/1 Q17; Board 2023 30/1/1 Q16 (near-twin: $p + q = 1$)]

(a) -3 (b) 3 (c) 5 (d) -5

Assertion–Reason

Q8. **Assertion (A):** The probability that a leap year has 53 Sundays is $\frac{2}{7}$.
Reason (R): The probability that a non-leap year has 53 Sundays is $\frac{5}{7}$. **[1]**

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

[Board 2023 30/4/1 Q19; Board 2026 30/1/1 Q19 (near-twin, asks about 53 Mondays, same key)]

Q9. **Assertion (A):** In a cricket match, a batsman hits a boundary 9 times out of 45 balls he plays. The probability that in a given ball he does not hit the boundary is $\frac{4}{5}$.
Reason (R): $P(E) + P(\text{not } E) = 1$. **[1]**

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

[Board 2024 30/3/1 Q20]

Very Short Answer (VSA)

Q10. How many positive three-digit integers have the hundreds digit 8 and the units digit 5? Find the probability of selecting one such number out of all three-digit integers. **[2]**

[SQP 2024-25 Q22 (B) OR; SQP 2024-25 VIC Q22 (B) OR (the paper says "hundredths digit"; read as hundreds digit, as the scheme does)]

Q11. The probability of guessing the correct answer of a certain test question is $\frac{x}{12}$. If the probability of not guessing the correct answer is $\frac{5}{6}$, then find the value of x. **[2]**

[Board 2025 30/3/1 Q22; Board 2024 30/3/1 Q4 (MCQ near-twin with $\frac{x}{6}$ and answer 2)]

Short Answer (SA)

Q12. Two dice are thrown at the same time. Determine the probability that (i) the sum of the numbers on the two dice is 5; (ii) the difference of the numbers on the two dice is 3. **[3]**

[Board 2026 30/2/1 Q31]

Long Answer (LA)

Q13. Tickets numbered 1 to 60 are put into a box for a school lucky draw. One ticket is drawn at random. Find the probability that the number on the ticket is (i) a multiple of 6; (ii) a prime number; (iii) a perfect square; (iv) a two-digit number divisible by 8; (v) a multiple of 6 or of 8. **[5]**

[New]

Case Study

Q14. Case Study: Two packs of cards **[4]**

[Board 2026 30/3/1 Q37]

A group of friends wanted to play cards with two identical packs shuffled together. While shuffling, three cards were dropped: the queen of hearts, the ten of spades and the ace of clubs. The remaining cards are shuffled, and one card is drawn at random.
Based on the above information, answer the following questions:

(i) Find the probability that the drawn card is a face card. [1]

(ii) Find the probability that the drawn card is a king or a queen. [1]

(iii) (a) Do you think that the probability of getting a queen was higher if none of the cards had been dropped? Justify your answer. [2]

OR

(iii) (b) Find the probability that the drawn card is a jack. In which case, when cards were dropped or when none were dropped, is the probability of getting a jack higher? [2]

Answer Key (MCQs and Assertion–Reason)

Ch. 01: Q1-(a), Q2-(d), Q3-(c), Q4-(a), Q5-(d)

Ch. 02: Q1-(c), Q2-(c), Q3-(b), Q4-(d)

Ch. 03: Q1-(d), Q2-(c), Q3-(d), Q4-(a)

Ch. 04: Q1-(c), Q2-(a), Q3-(b), Q4-(c), Q5-(d)

Ch. 05: Q1-(a), Q2-(b), Q3-(b), Q4-(c)

Ch. 06: Q1-(b), Q2-(a), Q3-(b)

Ch. 07: Q1-(b), Q2-(c), Q3-(c), Q4-(c), Q5-(a)

Ch. 08: Q1-(b), Q2-(d), Q3-(b), Q4-(d)

Ch. 09: Q1-(a), Q2-(c), Q3-(c), Q4-(a), Q5-(d), Q6-(c), Q7-(a), Q8-(a)

Ch. 10: Q1-(a), Q2-(b), Q3-(a)

Ch. 11: Q1-(d), Q2-(c), Q3-(b)

Ch. 12: Q1-(b), Q2-(b), Q3-(d), Q4-(c)

Ch. 13: Q1-(c), Q2-(b), Q3-(d)

Ch. 14: Q1-(a), Q2-(d), Q3-(c), Q4-(c), Q5-(b), Q6-(b), Q7-(a), Q8-(c), Q9-(a)