CENTRAL BOARD OF SECONDARY EDUCATION

CBSE 2026-27

Mathematics (Standard)

Subject Code: 041 | Class X

Question Bank – Set 2

Questions in this Booklet

Ch.	Chapter	MCQs	A-R	VSA	SA	LA	CS	All
01	Real Numbers	5	1	2	1	0	1	**10**
02	Polynomials	3	1	1	1	1	2	**9**
03	Pair of Linear Equations in Two Variables	4	1	1	3	2	2	**13**
04	Quadratic Equations	4	1	1	2	4	1	**13**
05	Arithmetic Progressions	3	1	1	2	1	1	**9**
06	Coordinate Geometry	2	1	1	1	0	2	**7**
07	Triangles	5	0	3	1	2	1	**12**
08	Circles	3	1	2	2	1	1	**10**
09	Introduction to Trigonometry	6	1	4	4	1	1	**17**
10	Some Applications of Trigonometry	1	0	2	2	2	1	**8**
11	Areas Related to Circles	3	1	1	2	1	1	**9**
12	Surface Areas and Volumes	2	1	2	2	3	1	**11**
13	Statistics	3	1	1	1	3	2	**11**
14	Probability	6	1	2	1	1	2	**13**
	Total	**50**	**12**	**24**	**25**	**22**	**19**	**152**

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. The ratio of HCF to LCM of the least composite number and the least prime number is: **[1]**

[Board 2023 30-4-1 Q1; SQP 2021-22 Q1 (= MS 2021-22 Q1, asked as LCM:HCF)]

(a) $1 : 2$ (b) $2 : 1$ (c) $1 : 1$ (d) $1 : 3$

Q2. If $\text{LCM}(x, 18) = 36$ and $\text{HCF}(x, 18) = 2$, then x is: **[1]**

[SQP 2021-22 Q12 (= MS 2021-22 Q12)]

(a) 2 (b) 3 (c) 4 (d) 5

Q3. The LCM of two prime numbers p and q (with $p > q$) is 221. The value of $3p - q$ is: **[1]**

[SQP 2021-22 Q25 (= MS 2021-22 Q25)]

(a) 4 (b) 28 (c) 38 (d) 48

Q4. If $a^2 = \dfrac{23}{25}$, then a is: **[1]**

[SQP 2021-22 Q11 (= MS 2021-22 Q11)]

(a) rational (b) irrational (c) whole number (d) integer

Q5. If $p^2 = \dfrac{32}{50}$, then p is a/an: **[1]**

[Board 2023 30-6-1 Q1]

(a) whole number (b) integer
(c) rational number (d) irrational number

Assertion–Reason

Q6. **Assertion (A):** If the product of two numbers is 5780 and their HCF is 17, then their LCM is 340.
Reason (R): HCF is always a factor of LCM. **[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 2022-23 Q19 (= MS 2022-23 Q19)]

Very Short Answer (VSA)

Q7. Can the number 15^n, where n is a natural number, end with the digit 0? Give reasons. **[2]**

[Board 2023 30-6-1 Q21(A) (6 to the n); Board 2023C 30-C-1 Q21(b) (6 to the n); Board 2024 30-2-1 Q21 (15 to the n)]

Q8. Find the HCF and LCM of 480 and 720 by the prime factorisation method. **[2]**

[SQP 2024-25 Q21(A); SQP 2024-25 VIC Q21(A); Board 2023 30-5-1 Q23 (96, 120); Board 2023 30-6-1 Q21(B) (72, 120)]

Short Answer (SA)

Q9. National Art convention got registrations from students from all parts of the country: 60 are interested in music, 84 in dance and 108 in handicrafts. The organisers wish to keep them in the minimum number of groups such that each group has students of the same art form and every group has the same number of students. Find the number of students in each group, the number of groups in each art form, and the number of rooms required if each group is allotted one room. **[3]**

[SQP 2023-24 Q26 (= MS 2023-24 Q26); Board 2024 30-1-1 Q27; Board 2024C S-1 Q31; SQP 2025-26 Q27 (= MS 2025-26 Q27)]

Case Study

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

[Board 2023C 30-C-1 Q38]

February 14 is celebrated as International Book Giving Day. On this day, some people in India donated books to a public library: History $= 96$ books, Science $= 240$ books and Mathematics $= 336$ books.
The books have to be arranged in the minimum number of stacks such that each stack contains books of only one subject and every stack has the same number of books.

(i) How many books are arranged in each stack? [1]

(ii) How many stacks are used to arrange all the Mathematics books? [1]

(iii) Determine the total number of stacks that will be used for arranging all the books. [2]

OR

(iii) If the thickness of each book of History, Science and Mathematics is 1.8 cm, 2.2 cm and 2.5 cm respectively, find the height of each stack of History, Science and Mathematics books. [2]

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02. Polynomials

Multiple Choice Questions (MCQs)

Q1. If 2 and $\frac{1}{2}$ are the zeroes of $px^2 + 5x + r$, then: **[1]**

[SQP 2021-22 Q38 (= MS 2021-22 Q38)]

(a) $p = r = 2$ (b) $p = r = -2$ (c) $p = 2,\ r = -2$ (d) $p = -2,\ r = 2$

Q2. The zeroes of the polynomial $x^2 - 3\sqrt{2}\,x + 4$ are: **[1]**

[Board 2025 30-3-1 Q17 (adapted: option D replaced; the source's options A and D were the same set)]

(a) $2,\ \sqrt{2}$ (b) $2\sqrt{2},\ \sqrt{2}$ (c) $4\sqrt{2},\ -\sqrt{2}$ (d) $-2\sqrt{2},\ \sqrt{2}$

Q3. If α and β are the zeroes of the polynomial $p(x) = x^2 - ax - b$, then the value of $\alpha + \beta + \alpha\beta$ is: **[1]**

[Board 2025 30-3-1 Q4]

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

Assertion–Reason

Q4. **Assertion (A):** The polynomial $p(x) = x^2 + 3x + 3$ has two real zeroes.
Reason (R): A quadratic polynomial can have at most two 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 2023 30-2-1 Q20; Board 2026 30-1-1 Q20 (near-twin, $y^2 + 4y + 3$; see flag: source key contested)]

Very Short Answer (VSA)

Q5. If α, β are the zeroes of the polynomial $p(x) = x^2 - 3x - 1$, then find the value of $\frac{1}{\alpha} + \frac{1}{\beta}$. **[2]**

[Board 2026 30-1-1 Q21]

Short Answer (SA)

Q6. If α, β are the zeroes of the quadratic polynomial $5x^2 + 5x + 1$, find the values of (i) $\alpha^2 + \beta^2$ and (ii) $\alpha^{-1} + \beta^{-1}$. **[3]**

[SQP 2023-24 Q27 (= MS 2023-24 Q27)]

Long Answer (LA)

Q7. The zeroes α and β of the quadratic polynomial $p(x) = x^2 - 6x + k$ satisfy $\alpha^2 + \beta^2 = 20$.

(a) Find the value of k. [2 marks]

(b) Find the zeroes of $p(x)$ for this value of k. [1 mark]

(c) Hence form a quadratic polynomial whose zeroes are $\frac{1}{\alpha}$ and $\frac{1}{\beta}$. [2 marks] **[5]**

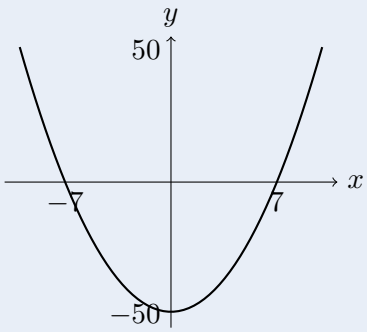
[New]

Case Study

Q8. Read the following passage carefully and answer the questions that follow. **[4]**

[Board 2023C 30-C-1 Q37 (adapted: figure redrawn from the source's description; $y = x^2 - 49$ inferred from zeroes ± 7)]

While playing in a garden, Samaira saw a honeycomb. Her mother told her that it is made by honey bees to store honey, and that its shape is a mathematical structure. The shape of the honeycomb is represented by the graph of a polynomial $y = p(x)$, shown below.



Based on the above information, answer the following questions:

(i) How many zeroes does the polynomial represented by the graph have? [1]

(ii) Write the zeroes of the polynomial. [1]

(iii) If the zeroes of the polynomial $x^2 + (a+1)x + b$ are 2 and -3, find the values of a and b. [2]

OR

(iii) If the square of the difference of the zeroes of the polynomial $x^2 + px + 45$ is 144, find the value of p. [2]

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

[Board 2026 30-5-1 Q36 (adapted: exact zeroes used; endpoints not rounded; no photo)]

An arch of a railway bridge, built across the Chenab riverbed, connects two hills at points P and Q. The arch is a parabola whose shape is represented by the polynomial $p(x) = -0.0025x^2 - 0.025x + 136$, where x and $p(x)$ are measured in metres. The apex A of the arch lies on the y-axis, and the ends P and Q are the zeroes of $p(x)$, on the x-axis at riverbed level.
Based on the above information, answer the following questions:

(i) Write the coordinates of the apex A. [1]

(ii) Find the span of the arch, that is, the distance PQ, correct to the nearest metre. [1]

(iii) Find the zeroes of $p(x)$ correct to one decimal place, and verify that their sum equals $-\frac{b}{a}$. [2]

OR

(iii) Find the values of $p(100)$ and $p(-100)$. Are they the same? [2]

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03. Pair of Linear Equations in Two Variables

Multiple Choice Questions (MCQs)

Q1. If the pair of linear equations $a_1x + b_1y + c_1 = 0$ and $a_2x + b_2y + c_2 = 0$ is consistent and dependent, then: **[1]**

[Board 2026 30/2/1 Q6]

(a) $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$ (b) $\frac{a_1}{a_2} \neq \frac{b_1}{b_2} = \frac{c_1}{c_2}$
(c) $\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$ (d) $\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$

Q2. For which value(s) of p will the lines represented by $3x - y - 5 = 0$ and $6x - 2y - p = 0$ be parallel? **[1]**

[SQP 2019-20 Q4 (MS 2019-20 Q4)]

(a) all real values except 10 (b) 10
(c) $\frac{5}{2}$ (d) $\frac{1}{2}$

Q3. If the system of equations $3x + y = 1$ and $(2k - 1)x + (k - 1)y = 2k + 1$ is inconsistent, then $k =$ **[1]**

[SQP 2022-23 Q4 (MS 2022-23 Q4)]

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

Q4. The lines representing a given pair of linear equations are non-intersecting. Which statement is true? **[1]**

[SQP 2023-24 Q3; Board 2024 30/1/1 Q18 (figure of two parallel lines, same idea)]

(a) $\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$ (b) $\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$
(c) $\frac{a_1}{a_2} \neq \frac{b_1}{b_2} = \frac{c_1}{c_2}$ (d) $\frac{a_1}{a_2} \neq \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$

Assertion–Reason

Q5. **Assertion (A):** The system of linear equations $3x - 5y + 7 = 0$ and $-6x + 10y + 14 = 0$ is inconsistent.
Reason (R): When two linear equations do not have a unique solution, they always represent parallel lines. **[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 30/5/1 Q19]

Very Short Answer (VSA)

Q6. Using the graphical method, find whether the system of linear equations $x = 0$ and $y = -7$ is consistent or not. **[2]**

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

Short Answer (SA)

Q7. Solve the pair of linear equations $62x + 43y = 167$ and $43x + 62y = 148$. **[3]**

[Board 2024C 30/S/1 Q30(b); Board 2023 30/2/1 Q30(b) and SQP 2021-22 Q24 (same symmetric structure; numbers $217, 131$ and $913, 827$; answer $x + y = 5$)]

Q8. The sum of the digits of a two-digit number is 12. Seven times the number is equal to four times the number obtained by reversing its digits. Find the number. **[3]**

[Board 2024C 30/S/1 Q30(a); SQP 2017-18 Q15 (near-twin: digit difference 3 instead of sum 12, answer 36)]

Q9. Two people are 16 km apart on a straight road and start walking at the same time. If they walk towards each other, they meet in 2 hours. If they walk in the same direction at the same speeds as before, they meet in 8

hours. Find their walking speeds. **[3]**

[Board 2023 30/5/1 Q29; SQP 2018-19 Q15 (80 km version of the same template)]

Long Answer (LA)

Q10. Using the graphical method, solve the pair of linear equations $3x + y + 4 = 0$ and $3x - y + 2 = 0$. **[5]**

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

Q11. Vijay invested money in two schemes A and B, which offer simple interest at 8% and 9% per annum respectively. He received Rs 1860 as total annual interest. Had he interchanged the amounts invested in the two schemes, he would have received Rs 20 more as annual interest. How much did he invest in each scheme?**[5]**

[Board 2025 30/1/1 Q32]

Case Study

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

[SQP 2026-27 Q36 (MS 2026-27 Q36)]

A student entrepreneur started a company that manufactures sanitizers in two sizes, small and large. The cost of a small bottle is Rs 10 and that of a large bottle is Rs 15. In June the company sold 1000 bottles and recorded a total sale of Rs 12750. Seeing the increased demand, the company increased the price of both sizes by Rs 2 each. In July it sold 2500 bottles and recorded a total sale of Rs 34250.
Let x and y denote the numbers of small and large bottles sold in a month.
Based on the above information, answer the following questions:

(i) Form a linear equation in two variables representing the sale for June. [1]

(ii) Form a linear equation in two variables representing the sale for July. [1]

(iii) Find how many sanitizer bottles of each type were actually sold in June. [2]

OR

(iii) Find how many sanitizer bottles of each type were sold in July. [2]

Q13. Read the following passage carefully and answer the questions that follow. **[4]**

[Board 2023 30/4/1 Q36, adapted (sub-parts rebalanced to 1 + 1 + 2 with 2-mark OR)]

Two schools P and Q award prizes to their students for two games, Hockey (Rs x per student) and Cricket (Rs y per student). School P awards a total of Rs 9500 to 5 hockey players and 4 cricket players, while school Q awards a total of Rs 7370 to 4 hockey players and 3 cricket players.
Based on the above information, answer the following questions:

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

(ii) Find the prize amount for one hockey player. [1]

(iii) Find the total prize amount if 2 students each from hockey and cricket receive the prize. [2]

OR

(iii) Which game gets the larger prize per student, and by how much? [2]

04. Quadratic Equations

Multiple Choice Questions (MCQs)

Q1. If $(1-p)$ is a root of the quadratic equation $x^2+px+1-p=0$, then its roots are: **[1]**

[SQP 2026-27 Q4]

(a) $0,\ 1$ (b) $-1,\ 1$ (c) $0,\ -1$ (d) $-1,\ 2$

Q2. The value of k for which $x=5$ is a solution of $2x^2+(k-1)x+10=0$ is: **[1]**

[Board 2024C (30/S/1) Q1]

(a) 11 (b) -11 (c) 13 (d) -13

Q3. Which one of the following is not a quadratic equation? **[1]**

[SQP 2025-26 Q6]

(a) $(x+2)^2=2(x+3)$
(b) $x^2+3x=(-1)(1-3x)^2$
(c) $x^3-x^2+2x+1=(x+1)^3$
(d) $(x+2)(x+1)=x^2+2x+3$

Q4. If the zeroes of the quadratic polynomial ax^2+bx+c $(a,c\neq 0)$ are equal, then **[1]**

[SQP 2025-26 Q12]

(a) c and b must have opposite signs
(b) c and a must have opposite signs
(c) c and b must have same signs
(d) c and a must have same signs

Assertion–Reason

Q5. **Assertion (A):** If $5+\sqrt{7}$ is a root of a quadratic equation with rational coefficients, then its other root is $5-\sqrt{7}$.
Reason (R): Surd roots of a quadratic equation with rational coefficients occur in conjugate pairs. **[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 30/6/1 Q19]

Very Short Answer (VSA)

Q6. Find the value(s) of k for which the quadratic equation $4x^2+kx+1=0$ has real and equal roots. **[2]**

[Board 2025 30/3/1 Q24(a) (OR)]

Short Answer (SA)

Q7. The sum of two numbers is 18 and the sum of their reciprocals is $\frac{9}{40}$. Find the numbers. **[3]**

[SQP 2024-25 Q27; SQP 2024-25 (VIC) Q27; Board 2023 30/6/1 Q29(A) (near-twin, different numbers)]

Q8. A train travelling at a uniform speed for 360 km would have taken 48 minutes less to travel the same distance if its speed were 5 km/h more. Find the original speed of the train. **[3]**

[SQP 2017-18 Q23 (OR; adapted: 4-mark trimmed to 3); SQP 2019-20 Q37 (OR; adapted: 4-mark trimmed to 3)]

Long Answer (LA)

Q9. Find the value of c, where $c\neq -1$, for which the quadratic equation $(c+1)x^2-6(c+1)x+3(c+9)=0$ has real and equal roots. **[5]**

[Board 2024 30/4/1 Q34(b); Board 2024 30/5/1 Q32(a) (k in place of c; near-identical)]

Q10. To fill a swimming pool two pipes are used. If the pipe of larger diameter is used for 4 hours and the pipe of smaller diameter for 9 hours, only half of the pool can be filled. Find how long it would take for each pipe to fill the pool separately, if the pipe of smaller diameter takes 10 hours more than the pipe of larger diameter to fill the pool. **[5]**

[SQP 2022-23 Q32 (main question)]

Q11. A motor boat whose speed is 18 km/h in still water takes 1 hour more to go 24 km upstream than to return downstream to the same spot. Find the speed of the stream. **[5]**

[SQP 2023-24 Q32]

Q12. Two water taps together can fill a tank in $9\frac{3}{8}$ hours. The tap of larger diameter takes 10 hours less than the smaller one to fill the tank separately. Find the time in which each tap can separately fill the tank. **[5]**

[SQP 2023-24 Q32 (OR)]

Case Study

Q13. Case Study: Enlarging a school photo **[4]**

[Board 2023 30/1/1 Q36]

While designing the school year book, a teacher asked a student to increase the length and the width of a particular photo by x units each, so that the area of the photo doubles. The original photo is 18 cm long and 12 cm wide.
Based on the above information, answer the following questions:

(i) Write an algebraic equation depicting the above information. [1]

(ii) Write the corresponding quadratic equation in standard form. [1]

(iii) What should be the new dimensions of the enlarged photo? [2]

OR

(iii) Can any rational value of x make the new area equal to 220 cm^2? [2]

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05. Arithmetic Progressions

Multiple Choice Questions (MCQs)

Q1. The number of multiples of 4 lying between 12 and 250 is: **[1]**

[Board 2026 30/3/1 Q6; Board 2024 30/5/1 Q11 (near-twin, $3, 6, \ldots, 111$)]

(a) 59 (b) 59.5 (c) 60 (d) 61

Q2. The next (4th) term of the A.P. $\sqrt{18}, \sqrt{50}, \sqrt{98}, \ldots$ is: **[1]**

[Board 2024 30/5/1 Q1; Board 2025C 30-S-1 Q4 (near-twin, $\sqrt{27}, \sqrt{75}, \sqrt{147}$)]

(a) $\sqrt{128}$ (b) $\sqrt{140}$ (c) $\sqrt{162}$ (d) $\sqrt{200}$

Q3. If the sum of the first n terms of an A.P. is $2n^2 + 5n$, then its common difference is: **[1]**

[Board 2025C 30-S-1 Q11; Board 2025 30/1/1 Q11 (near-twin, second term from $S_m = 2m^2 + 3m$)]

(a) 2 (b) 4 (c) 5 (d) 7

Assertion–Reason

Q4. **Assertion (A):** The common difference of the A.P. $5, 1, -3, -7, \ldots$ is 4.
Reason (R): The common difference of an A.P. $a_1, a_2, \ldots, a_n$ is $d = a_n - a_{n-1}$. **[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 2025 30/2/1 Q19]

Very Short Answer (VSA)

Q5. In an A.P., the first term is 32 and the last term is -10. If the common difference is -2, then find the number of terms and their sum. **[2]**

[Board 2026 30/3/1 Q22(a) (OR)]

Short Answer (SA)

Q6. If the p^{th} term of an A.P. is q and the q^{th} term is p, then prove that its n^{th} term is $(p + q - n)$. **[3]**

[Board 2023 30/5/1 Q27]

Q7. Find the sum of all integers between 50 and 500 which are divisible by 7. **[3]**

[Board 2023C 30-C-1 Q29(a) (OR)]

Long Answer (LA)

Q8. In an A.P. of 40 terms, the sum of the first 9 terms is 153 and the sum of the last 6 terms is 687. Find the first term and the common difference of the A.P. Also find the sum of all the terms of the A.P. **[5]**

[Board 2024 30/1/1 Q33(b) (OR)]

Case Study

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

[Board 2025 30/1/1 Q36]

A school is organising a charity run to raise funds for a local hospital. The run is a series of rounds around a track. The first round is 300 m, and each subsequent round is 50 m longer than the previous one: the second round is 350 m, the third 400 m, and so on. The total number of rounds planned is 10.
Based on the above information, answer the following questions:

(i) Write the fourth, fifth and sixth terms of the A.P. formed by the lengths of the rounds. [1]

(ii) Find the distance of the 8^{th} round. [1]

(iii) Find the total distance run after completing all 10 rounds. [2]

OR

(iii) If a runner completes only the first 6 rounds, what is the total distance run by the runner? [2]

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06. Coordinate Geometry

Multiple Choice Questions (MCQs)

Q1. In what ratio does the x-axis divide the line segment joining the points $A(3, 6)$ and $B(-12, -3)$? **[1]**

[Board 2023 30-1-1 Q4; SQP 2023-24 Q6 (near-twin, different numbers)]

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

Q2. The distance between the points $(0, 2\sqrt{5})$ and $(-2\sqrt{5}, 0)$ is: **[1]**

[Board 2023 30-1-1 Q13]

(a) $2\sqrt{10}$ units (b) $4\sqrt{10}$ units (c) $2\sqrt{20}$ units (d) 0

Assertion–Reason

Q3. **Assertion (A):** The point which divides the line segment joining the points $A(1, 2)$ and $B(-1, 1)$ internally in the ratio $1 : 2$ is $\left(-\frac{1}{3}, \frac{5}{3}\right)$.

Reason (R): The coordinates of the point which divides the line segment joining $A(x_1, y_1)$ and $B(x_2, y_2)$ in the ratio $m_1 : m_2$ are $\left(\frac{m_1x_2 + m_2x_1}{m_1 + m_2}, \frac{m_1y_2 + m_2y_1}{m_1 + m_2}\right)$. **[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 Q19]

Very Short Answer (VSA)

Q4. Find the ratio in which the point $P(-4, 6)$ divides the line segment joining the points $A(-6, 10)$ and $B(3, -8)$.**[2]**

[Board 2024 30-5-1 Q24(a) (OR)]

Short Answer (SA)

Q5. P(x, y), Q$(-2, -3)$ and R$(2, 3)$ are the vertices of a right triangle PQR, right angled at P. Find the relationship between x and y. Hence, find all possible values of x for which $y = 2$. **[3]**

[Board 2025 30-4-1 Q28]

Case Study

Q6. Read the following passage carefully and answer the questions that follow. **[4]**

[New]

A village panchayat has a square playground $ABCD$ with corners at $A(2, 3)$, $B(8, 3)$, $C(8, 9)$ and $D(2, 9)$, measured in metres on a survey map. A solar lamp is fixed at each corner. The panchayat also plans a water tank at a point T on the side BC such that $BT : TC = 1 : 2$. The centre of the playground is the point where the diagonals meet.

(i) Find the length of the diagonal AC. [1]
(ii) Find the coordinates of the centre of the playground. [1]
(iii) Find the coordinates of the water tank T. [2]

OR

(iii) Find the distance between the solar lamp at D and the water tank T. [2]

Q7. Read the following passage carefully and answer the questions that follow. **[4]**

[New]

A straight footpath in a city park joins the points $P(-3, -1)$ and $Q(5, 3)$, with coordinates measured in metres from the park gate at the origin O. A bench is placed at a point R on the footpath such that $PR : RQ = 1 : 3$. A fountain F is placed on the y-axis at a point equidistant from P and Q.

(i) Find the length of the footpath PQ. [1]
(ii) Find the coordinates of the bench R. [1]
(iii) Find the coordinates of the fountain F. [2]

OR

(iii) Find the distance between the bench R and the fountain F. [2]

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07. Triangles

Multiple Choice Questions (MCQs)

Q1. In the given figure, D lies on AB, $AD = 3$ cm, $AC = 8$ cm and $\angle ACB = \angle CDA$. Then BD is **[1]**

[SQP 2021-22 Q30; SQP 2019-20 Q17 (near-twin: same figure, AC = 6 cm, AD = 3 cm, answer AB = 12 cm)]

(a) $\frac{22}{3}$ cm (b) $\frac{26}{3}$ cm (c) $\frac{55}{3}$ cm (d) $\frac{64}{3}$ cm

Q2. In $\triangle OPS$, M lies on side OP and N lies on side OS such that $MN \parallel PS$. Given $MP = 8.5$ cm, $ON = 4.8$ cm and $NS = 6$ cm, the length of OP is **[1]**

[Board 2024C (30-S-1) Q6; Board 2023 (30/2/1) Q18]

(a) 6.8 cm (b) 17 cm (c) 15.3 cm (d) 9.6 cm

Q3. If the diagonals of a quadrilateral divide each other proportionally, then the quadrilateral is a **[1]**

[Board 2024 (30/3/1) Q11]

(a) parallelogram (b) rectangle (c) square (d) trapezium

Q4. In $\triangle ABC$, D lies on AB and E lies on AC with $AD = 6$ cm, $DB = 9$ cm, $AE = 8$ cm, $EC = 12$ cm and $\angle ADE = 48^\circ$. Then $\angle ABC$ is **[1]**

[SQP 2018-19 Q5 (VSA-1 adapted to MCQ; same figure data)]

(a) 48° (b) 84° (c) 132° (d) 42°

Q5. In $\triangle ABC$, D and E lie on AB and AC such that $DE \parallel BC$. If $AE = 2$ cm, $AD = 3$ cm and $BD = 4.5$ cm, then CE is **[1]**

[SQP 2020-21 Q10 (VSA-1 adapted to MCQ)]

(a) 3 cm (b) 2 cm (c) 4.5 cm (d) 1.5 cm

Very Short Answer (VSA)

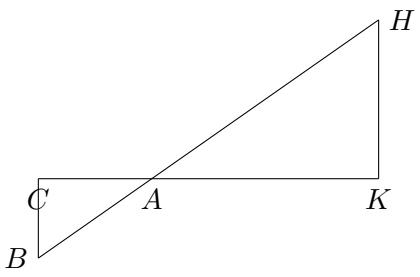
Q6. In $\triangle ABC$, $DE \parallel BC$ with D on AB and E on AC. If $AD = x$, $DB = x-2$, $AE = x+2$ and $EC = x-1$, find the value of x. **[2]**

[Board 2023 (30/6/1) Q25(A); Board 2026 (30/1/1) Q22(A)]

Q7. $ABCD$ is a trapezium in which $AB \parallel DC$, and its diagonals AC and BD intersect at O. Show that $\frac{AO}{BO} = \frac{CO}{DO}$. **[2]**

[SQP 2026-27 Q22(A) (OR); Board 2023 (30/6/1) Q25(B) (OR)]

Q8. In the given figure, $\triangle AHK \sim \triangle ABC$. The points C, A, K lie on one straight line with A between C and K; the points B, A, H lie on one straight line with A between B and H; $BC \perp CK$ and $HK \perp CK$. If $AK = 10$ cm, $BC = 3.5$ cm and $HK = 7$ cm, find AC.



[2]

[Board 2026 (30/2/1) Q22(a) (OR); Board 2024 (30/4/1) Q25 (same figure, different data)]

Short Answer (SA)

Q9. In the given figure $ABCD$ is a parallelogram. BE bisects CD at M and meets AC at L, where E lies on AD produced beyond D. Prove that $EL = 2BL$. **[3]**

[Board 2023 (30/5/1) Q28(b) (OR); see LA 07-078 (5-mark form, Board 2023 (30/2/1) Q35(b))]

Long Answer (LA)

Q10. State the Basic Proportionality Theorem and use it to prove the following. Three parallel lines l, m, n are intersected by transversals q and s: q meets them at A, B, C and s meets them at D, E, F, where A and D lie on l, B and E lie on m, and C and F lie on n. Prove that $\dfrac{AB}{BC} = \dfrac{DE}{EF}$. **[5]**

[Board 2025 (30/4/1) Q33(B) (OR)]

Q11. D is the mid-point of side BC of $\triangle ABC$. CE and BF intersect at O, a point on AD. AD is produced to G such that $OD = DG$. Prove that (i) OBGC is a parallelogram. (ii) EF $\parallel$ BC. (iii) $\triangle AEF \sim \triangle ABC$. **[5]**

[Board 2026 (30/5/1) Q33(A) (adapted by lead: part (ii) re-proved without Ceva, via the parallelogram and AA similarity; parts kept as printed)]

Case Study

Q12. Case Study: Height of a tower from shadows **[4]**

[SQP 2024-25 VIC Q37 (with its OR variant, part (iii)(B))]

A student wants to find the height of a tower near his house by using the properties of similar triangles. At one instant, a building of height 20 m casts a shadow 10 m long on the ground. At the same instant, the tower casts a shadow 50 m long and the student's house casts a shadow 20 m long.
Based on the above information, answer the following questions:

(i) What is the height of the tower? [1]

(ii) What is the height of the student's house? [1]

(iii) What will be the length of the shadow of the tower when the building casts a shadow of 12 m at the same time? [2]

OR

(iii) When the tower casts a shadow of 40 m, what will be the length of the shadow of the student's house at the same time? [2]

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08. Circles

Multiple Choice Questions (MCQs)

Q1. PQ is a tangent to a circle with centre O, touching it at Q, and OP is joined. If $\angle OPQ = x$ and $\angle POQ = y$, then $x + y$ is: **[1]**

[Board 2023 30/4/1 Q14]

(a) $45°$ (b) $90°$ (c) $60°$ (d) $180°$

Q2. AB is a tangent to a circle with centre O, touching it at B. If $OA = 6$ cm and $\angle OAB = 30°$, then the radius of the circle is: **[1]**

[Board 2023 30/5/1 Q11]

(a) 3 cm (b) $3\sqrt{3}$ cm (c) 2 cm (d) $\sqrt{3}$ cm

Q3. PA and PB are tangents from an external point P to a circle with centre C, touching it at A and B. Q is any point on the major arc AB. If $\angle APB = 55°$, then $\angle AQB$ is: **[1]**

[Board 2023 30/6/1 Q14]

(a) $62\frac{1}{2}°$ (b) $125°$ (c) $55°$ (d) $90°$

Assertion–Reason

Q4. **Assertion (A):** Radius is the smallest distance of a tangent from the centre of the circle.
Reason (R): Radius is perpendicular to the tangent. **[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 30/3/1 Q19]

Very Short Answer (VSA)

Q5. AB and AC are tangents drawn from an external point A to a circle with centre O, touching it at B and C. If $\angle BAC = 65°$, find $\angle BOC$. **[2]**

[Board 2023 30/2/1 Q25]

Q6. AB and CD are tangents to a circle with centre O, touching it at A and C respectively, and AC is a chord. Is $\angle BAC = \angle DCA$? Justify your answer. Assume the two tangents meet at a point P, with B on ray PA beyond A and D on ray PC beyond C. **[2]**

[Board 2024 30/2/1 Q24]

Short Answer (SA)

Q7. AP is a diameter of a circle with centre O. B is a point on the line AP produced beyond P. The tangent at a point C of the circle meets the line AP at B, and D is a point on this tangent with C between B and D. Prove that $\angle BAC + \angle ACD = 90°$. **[3]**

[Board 2025 30/1/1 Q26(a) (OR)]

Q8. The radii of two concentric circles are 13 cm and 8 cm. AB is a diameter of the bigger circle and BD is a tangent to the smaller circle, touching it at D and meeting the bigger circle again at P on producing. Find AP. **[3]**

[SQP 2018-19 Q18 (= MS 2018-19 Q18); SQP 2016-17 Q29 (adapted: 4 marks trimmed to 3)]

Long Answer (LA)

Q9. There is a circular park of diameter 65 m, where AB is a diameter. An entry gate is to be constructed at a point P on the boundary of the park such that the distance of P from A is 35 m more than the distance of P from B. Find the distance of point P from A and from B respectively. **[5]**

[Board 2025 30/6/1 Q32(a) (lead fold-in: post-rationalization board question; angle in semicircle + Pythagoras, both in-syllabus skills)]

Case Study

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

[MS 2026-27 Q37 (= SQP 2026-27 Q37)]

In a technology park in Hyderabad, a company has installed a circular meditation garden for its employees. Arjun, a designer, stood at a point P outside the garden and drew two tangents PA and PB to the circular boundary, touching it at A and B. The radius of the garden is 9 m and the distance of P from the centre O is 18 m. For preparing safety guidelines, Arjun needed the lengths of the tangents.

Based on the above information, answer the following questions:

(i) What is the measure of $\angle OAP$? [1]

(ii) Calculate the length of the tangent PA. [1]

(iii) Calculate the measure of $\angle AOB$. [2]

OR

(iii) If PA and PB were inclined at 60° (that is, $\angle APB = 60^\circ$), what would be the length of each tangent? [2]

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09. Introduction to Trigonometry

Multiple Choice Questions (MCQs)

Q1. $\tan 2A = 3\tan A$ is true, when the measure of $\angle A$ is **[1]**

[Board 2025 30/4/1 Q8]

(a) 90° (b) 60° (c) 45° (d) 30°

Q2. Which of the following statements is true? **[1]**

[Board 2025 30/4/1 Q9]

(a) $\sin 20^\circ > \sin 70^\circ$ (b) $\sin 20^\circ > \cos 20^\circ$ (c) $\cos 20^\circ > \cos 70^\circ$ (d) $\tan 20^\circ > \tan 70^\circ$

Q3. In a right triangle ABC, right-angled at A, if $\sin B = \dfrac{1}{4}$, then the value of $\sec B$ is **[1]**

[Board 2025 30/6/1 Q18]

(a) 4 (b) $\frac{\sqrt{15}}{4}$ (c) $\sqrt{15}$ (d) $\frac{4}{\sqrt{15}}$

Q4. If $x = p\cos^3\alpha$ and $y = q\sin^3\alpha$, then the value of $\left(\dfrac{x}{p}\right)^{2/3} + \left(\dfrac{y}{q}\right)^{2/3}$ is **[1]**

[Board 2025C 30/S/1 Q9]

(a) 1 (b) 2 (c) p (d) q

Q5. In a right-angled triangle PRQ with the right angle at R, a point S lies on RQ such that $RS : SQ = 1 : 2$. Let $\alpha = \angle PSR$ and $\beta = \angle PQR$. Then $\dfrac{\tan\alpha}{\tan\beta}$ equals **[1]**

[Board 2025C 30/S/1 Q14 (reworded in words; the figure is not reproduced)]

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

Q6. If $\cos A = \dfrac{1}{2}$, then the value of $\sin^2 A + 2\cos^2 A$ is **[1]**

[Board 2026 30/1/1 Q10]

(a) $\frac{3}{2}$ (b) $\frac{5}{4}$ (c) -1 (d) $\frac{1}{2}$

Assertion–Reason

Q7. **Assertion (A):** $\tan 2\theta$ is not defined at $\theta = 45^\circ$.
Reason (R): $\sin 90^\circ \neq \cos 90^\circ$. **[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 30/3/1 Q20]

Very Short Answer (VSA)

Q8. If $2\sin(A+B)=\sqrt{3}$ and $\cos(A-B)=1$, where $0^\circ \le A, B, (A+B) \le 90^\circ$, find the measures of A and B. **[2]**

[Board 2024 30/2/1 Q23(b); near-twin Board 2023 30/4/1 Q25(B) (sin(A-B)=0 and 2cos(A+B)-1=0)]

Q9. Find the value of x if $2\,\text{cosec}^2\,30^\circ + x\sin^2 60^\circ - \frac{3}{4}\tan^2 30^\circ = 10$. **[2]**

[SQP 2023-24 Q24 (OR); near-twin Board 2024C 30/S/1 Q25(b) (same template, answer x = 4 there)]

Q10. If $\sin\alpha = \frac{1}{\sqrt{2}}$ and $\cot\beta = \sqrt{3}$, then find the value of $\text{cosec}\,\alpha + \text{cosec}\,\beta$. **[2]**

[Board 2023 30/1/1 Q23(b)]

Q11. If $4\cot^2 45^\circ - \sec^2 60^\circ + \sin^2 60^\circ + p = \frac{3}{4}$, then find the value of p. **[2]**

[Board 2023 30/2/1 Q22(a)]

Short Answer (SA)

Q12. If $1+\sin^2\theta = 3\sin\theta\cos\theta$, then prove that $\tan\theta = 1$ or $\tan\theta = \frac{1}{2}$. **[3]**

[SQP 2023-24 Q30; SQP 2021-22 Q28 (MCQ form, asking for cot A values 1 and 2); MS 2023-24 Q30]

Q13. If $\cos\theta + \sin\theta = 1$, then prove that $\cos\theta - \sin\theta = \pm 1$. **[3]**

[SQP 2024-25 Q29; SQP 2024-25 VIC Q29]

Q14. If $x = h + a\cos\theta$ and $y = k + b\sin\theta$, then prove that $\left(\frac{x-h}{a}\right)^2 + \left(\frac{y-k}{b}\right)^2 = 1$. **[3]**

[Board 2026 30/1/1 Q28(A)]

Q15. Prove that $\frac{\tan A}{1+\sec A} - \frac{\tan A}{1-\sec A} = 2\,\text{cosec}\,A$. **[3]**

[Board 2026 30/1/1 Q28(B) (OR)]

Long Answer (LA)

Q16. (i) Prove that $\sqrt{\sec^2\theta + \text{cosec}^2\,\theta} = \tan\theta + \cot\theta$. (ii) Evaluate $\frac{\cos 45^\circ}{\sec 30^\circ + \text{cosec}\,30^\circ}$. **[5]**

[Board 2023C 30/C/1 Q35(a) (OR)]

Case Study

Q17. Read the following passage carefully and answer the questions that follow. **[4]**

[New]

An architect designs a sloping ramp that connects the floor of an auditorium to its stage. The ramp is 5 m long and rises vertically by 3 m from the floor to the stage. The ramp makes an angle A with the floor. Before finalising the drawings, the architect wants to check the trigonometric ratios of A using these lengths.
Based on the above information, answer the following questions:

(i) Find the value of $\sin A$. [1]

(ii) Find the value of $\cos A$. [1]

(iii) Find the value of $\frac{\cot A + \text{cosec}\,A}{\tan A}$. [2]

OR

(iii) Verify that $1+\cot^2 A = \text{cosec}^2\,A$ for this angle A. [2]

10. Some Applications of Trigonometry

Multiple Choice Questions (MCQs)

Q1. A kite is flying at a height of 150 m from the ground. It is attached to a string inclined at 30° to the horizontal. The length of the string is: **[1]**

[Board 2025 30/1/1 Q17; near-twin Board 2025C 30/S/1 Q17 (50 m kite at 60 degrees)]

(a) $100\sqrt{3}$ m (b) 300 m (c) $150\sqrt{2}$ m (d) $150\sqrt{3}$ m

Very Short Answer (VSA)

Q2. The angle of elevation of the top of a tower from a point on the ground, which is 30 m away from the foot of the tower, is 30°. Find the height of the tower. **[2]**

[Board 2023 30/2/1 Q24(b)]

Q3. A towing kite is at a vertical height of 200 m above the sea. The rope from the kite to the ship makes an angle of 30° with the horizontal sea level at the ship. Find the length of the rope. **[2]**

[SQP 2019-20 Q24(ii) (2-mark case study cut to a VSA; part (i) deleted, see note); MS 2019-20 Q24]

Short Answer (SA)

Q4. The angle of elevation of the top of a tower 24 m high, seen from the foot of another tower in the same plane, is 60°. The angle of elevation of the top of the second tower, seen from the foot of the first tower, is 30°. Find the distance between the two towers and the height of the second tower. **[3]**

[Board 2023 30/1/1 Q33(a) (5-mark LA cut to 3 marks: the wire-length part is removed because it needs a third right triangle)]

Q5. From a point 60 m above the surface of a lake, the angle of elevation of a cloud is 30°, and the angle of depression of the reflection of the cloud in the lake is 60°. Find the height of the cloud above the surface of the water. **[3]**

[SQP 2018-19 Q27 (option 2) and MS 2018-19 Q27 (OR), 4 marks trimmed to 3 (only the height is asked)]

Long Answer (LA)

Q6. The angle of elevation of an airplane from a point on the ground is 60°. After a flight of 30 seconds, the angle of elevation becomes 30°. If the airplane flies at a constant height of $3000\sqrt{3}$ m, draw a correct figure and find the speed of the airplane in km/h. **[5]**

[SQP 2019-20 Q39; MS 2019-20 Q39; near-twin SQP 2022-23 Q38 and MS 2022-23 Q38 (case study, same aircraft data). Speed in km/h added as part (d) to make 5 marks]

Q7. From the top of a 45 m high lighthouse, the angles of depression of two ships on opposite sides of it are 30° and 60°. If the line joining the ships passes through the foot of the lighthouse, find the distance between the ships. (Use $\sqrt{3} = 1.73$.) **[5]**

[Board 2024 30/2/1 Q34; near-twin Board 2025 30/2/1 Q32(a) (ships on opposite sides of a lighthouse)]

Case Study

Q8. Case Study: Passenger boarding stairs **[4]**

[Board 2025 30/5/1 Q38]

Passenger boarding stairs provide a mobile means of travel between an aircraft door and the ground. Larger aircraft have door sills 5 to 20 feet high (1 foot = 30 cm). An aircraft has a door sill 15 feet above the ground, and a stair car is placed at a horizontal distance of 15 feet from the aircraft.
Based on the above information, answer the following questions:

(i) Find the angle at which the stairs are inclined to reach the door sill. [1]

(ii) Find the length of the stairs used to reach the door sill. [1]

(iii) If 20-feet-long stairs are inclined at 60° to reach the door sill, find the height of the door sill above the ground. (Use $\sqrt{3} = 1.732$.) [2]

OR

(iii) What should be the shortest possible length of stairs to reach a door sill 20 feet above the ground, if the angle of elevation of the stairs cannot exceed 30°? Also find the horizontal distance of the base of the stair car from the aircraft. [2]

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11. Areas Related to Circles

Multiple Choice Questions (MCQs)

Q1. The diameter of a car wheel is 21 cm. The number of complete revolutions it will make in moving 66 km is: **[1]**

[SQP 2026-27 Q10; SQP 2021-22 Q15; SQP 2022-23 Q15; Board 2023C 30/C/1 Q16 (near-twins)]

(a) 10^4 (b) 10^5 (c) 10^6 (d) 10^7

Q2. The length of the arc of a sector of a circle with radius 21 cm and central angle 60° is: **[1]**

[Board 2026 30/1/1 Q14; Board 2023 30/2/1 Q2 (90 deg form); SQP 2020-21 Q14 (1-mark VSA recast as MCQ; diameter 42 cm)]

(a) 22 cm (b) 44 cm (c) 88 cm (d) 11 cm

Q3. The perimeter of a sector of a circle whose central angle is 90° and radius 7 cm is: **[1]**

[Board 2024 30/3/1 Q17; Board 2024 30/5/1 Q8 (60 deg, r 21 cm: perimeter 64 cm); Board 2023C 30/C/1 Q13 (quadrant perimeter)]

(a) 35 cm (b) 11 cm (c) 22 cm (d) 25 cm

Assertion–Reason

Q4. **Assertion (A):** If the circumference of a circle is 176 cm, then its radius is 28 cm.
Reason (R): Circumference $= 2\pi\times$ radius of a circle. **[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 30/4/1 Q20]

Very Short Answer (VSA)

Q5. $ABCD$ is a quadrilateral. Arcs of radius 7 cm are drawn with each of its vertices A, B, C and D as centre, lying inside the quadrilateral, and the four sectors so formed are shaded. Find the total shaded area. (Use $\pi = \frac{22}{7}$.) **[2]**

[SQP 2022-23 Q24 (OR); scheme's triangle angle-sum slip corrected to quadrilateral; figure described in words]

Short Answer (SA)

Q6. Find the area of the sector of a circle of radius 42 cm and central angle 30°. Also find the area of the corresponding major sector. (Use $\pi = \frac{22}{7}$.) **[3]**

[Board 2026 30/2/1 Q30]

Q7. A circle of diameter 20 cm is equally divided into five sectors. Find the area and the perimeter of one of the sectors. (Use $\pi = \frac{22}{7}$.) **[3]**

[Board 2026 30/5/1 Q26]

Long Answer (LA)

Q8. An arc of a circle of radius 21 cm subtends an angle of 60° at the centre of the circle. Find: (i) the length of the arc; (ii) the area of the minor segment of the circle made by the corresponding chord. (Use $\pi = \frac{22}{7}$.) **[5]**

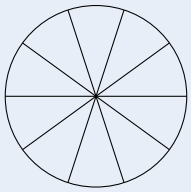
[Board 2024 30/1/1 Q32]

Case Study

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

[Board 2026 30/1/1 Q38; Board 2025 30/1/1 Q37 (near-twin, diameter in mm)]

A brooch is crafted from silver wire in the shape of a circle with a diameter of 35 cm. The wire is also used to make 5 diameters, which divide the circle into 10 equal sectors, as shown in the figure.



Based on the above information, answer the following questions:

(i) What is the radius of the circle? [1]

(ii) What is the circumference of the brooch? (Use $\pi = \frac{22}{7}$.) [1]

(iii) What is the total length of silver wire required? [2]

OR

(iii) What is the area of each sector of the brooch? (Use $\pi = \frac{22}{7}$.) [2]

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12. Surface Areas and Volumes

Multiple Choice Questions (MCQs)

Q1. A cone of height 12 cm and slant height 13 cm is surmounted on a hemisphere whose radius equals the radius of the cone. The entire height of the solid is: **[1]**

[Board 2025 30/5/1 Q15]

(a) 17 cm (b) 18 cm (c) 22 cm (d) 23 cm

Q2. On the top face of a wooden cube of side 7 cm, hemispherical depressions of radius 0.35 cm are to be formed by taking out wood. The maximum number of depressions that can be formed is: **[1]**

[Board 2025 30/4/1 Q11]

(a) 400 (b) 100 (c) 20 (d) 10

Assertion–Reason

Q3. **Assertion (A):** A toy is in the form of a cylinder surmounted by a hemisphere of the same radius. If the radius of the cylinder is 3 cm and its height is 7 cm, then the volume of the toy is 81π cm^3.
Reason (R): The volume of the given solid is the sum of the volume of the cylinder and the volume of the hemisphere. **[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 2025C 30/S/1 Q19]

Very Short Answer (VSA)

Q4. The curved surface area of a right circular cone is 12320 cm^2. If the radius of its base is 56 cm, find its height. (Take $\pi = \frac{22}{7}$.) **[2]**

[SQP 2021-22 Term 2 Q4; MS 2021-22 Term 2 Q4 (same paper)]

Q5. A paper cone used to serve ice-cream has base radius 3 cm and vertical height 4 cm. Take $\pi = 3.14$. (i) Find the volume of ice-cream the cone can hold. (ii) Find the area of paper needed to make the cone, ignoring the overlap and the open top. **[2]**

[New]

Short Answer (SA)

Q6. A solid is in the form of a right circular cylinder surmounted by a hemisphere of the same radius. The total height of the solid is 20 cm and the diameter of the cylinder is 7 cm. Find the total volume of the solid. (Take $\pi = \frac{22}{7}$.) **[3]**

[Board 2026 30/1/1 Q30 (adapted: one hemispherical end instead of two, so that the solid has two solids, not three) (adapted)]

Q7. A dairy sells flavoured milk in mugs of negligible thickness. Each mug is a cylinder of height 14 cm and diameter 7 cm, with a hemispherical bottom of the same radius bulging into the cylinder. Dairy owner A computes the quantity as $\pi r^2 h$ and charges Rs 43.12 for one mug. Owner B says the price should be based on the actual quantity of milk the mug holds. Milk is sold at Rs 80 per litre. (i) Find the actual quantity, in cm^3, that the mug holds. (ii) Find the price owner B would charge for one mug. (iii) Which value does owner B exhibit? (Take $\pi = \frac{22}{7}$.) **[3]**

[SQP 2017-18 Q29 (4-mark value question trimmed to 3 marks) (adapted)]

Long Answer (LA)

Q8. From one face of a solid wooden cube of side 14 cm, hemispheres of diameter 1.4 cm are scooped out, placed side by side without overlapping, so that the maximum number is removed. (i) Find the total number of hemispheres that can be scooped out. (ii) Find the total surface area of the remaining solid. (Take $\pi = \frac{22}{7}$.)**[5]**

[Board 2025 30/5/1 Q34(a)]

Q9. A wooden cubical die of edge 5 cm has hemispherical depressions made on its faces: face 1 has one depression, face 2 has two, and so on up to face 6. The number of depressions on opposite faces always adds up to 7. Each depression is a hemisphere of diameter 1.4 cm. Find the total surface area of the die. (Take $\pi = \frac{22}{7}$.)**[5]**

[Board 2025 30/4/1 Q34]

Q10. From a solid cylinder of height 24 cm and radius 5 cm, two cones, each of height 12 cm and base radius 5 cm, are hollowed out, one from each circular end, so that their vertices meet at the centre of the cylinder. Find the volume and the total surface area of the remaining solid. Give your answers in terms of π. **[5]**

[Board 2025 30/5/1 Q34 (OR)]

Case Study

Q11. Case Study: Golf ball dimples **[4]**

[Board 2023 30/5/1 Q36]

A golf ball is spherical, and its surface has hemispherical dimples that increase its velocity in play. This golf ball has diameter 4.2 cm. Its surface has 315 dimples, each a hemisphere of radius 2 mm (that is, 0.2 cm). Each dimple is a hemispherical hollow cut into the surface of the ball.
Based on the above information, answer the following questions:

(i) Find the surface area of one dimple. (Take $\pi = \frac{22}{7}$.) [1]

(ii) Find the volume of material dug out to make one dimple. [1]

(iii) Find the total surface area exposed to the surroundings. [2]

OR

(iii) Find the volume of the golf ball. [2]

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13. Statistics

Multiple Choice Questions (MCQs)

Q1. The mean and median of the data are 35.5 and 32 respectively. The value of the mode of the data is: **[1]**

[SQP 2026-27 Q16; near-twins Board 2023 30/5/1 Q10, Board 2023C 30/C/1 Q12, Board 2025 30/4/1 Q13, Board 2026 30/2/1 Q17]

(a) 23 (b) 26 (c) 25 (d) 30

Q2. Consider the frequency distribution of 45 observations:

Class	0–10	10–20	20–30	30–40	40–50
Frequency	5	9	15	10	6

The upper limit of the median class is: **[1]**

[SQP 2024-25 Q9; SQP 2024-25 VIC Q9; near-twin SQP 2019-20 Q2]

(a) 20 (b) 10 (c) 30 (d) 40

Q3. Which of the following gives the middle-most observation of the data, when the observations are arranged in order? **[1]**

[SQP 2024-25 Q16; SQP 2024-25 VIC Q16; near-twin Board 2024 30/1/1 Q14]

(a) Median (b) Mean (c) Range (d) Mode

Assertion–Reason

Q4. **Assertion (A):** If each observation of a data set is multiplied by 3, then the mean of the new data is three times the mean of the original data.
Reason (R): If each observation x_i is multiplied by a constant k, then $\sum kx_i = k\sum x_i$, so the mean is also multiplied by k. **[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 mean and mode of the daily water consumption (in litres) of a set of households are 36 and 39 respectively. Using the empirical relation, find the median. **[2]**

[New]

Short Answer (SA)

Q6. The mode of the following data is 67. Find the missing frequency x.

Class	40–50	50–60	60–70	70–80	80–90
Frequency	5	x	15	12	7

[3]

[SQP 2020-21 Q33; MS 2020-21 Q33 (same paper; MS heads it "Section V")]

Long Answer (LA)

Q7. The following table shows the number of patients of different age groups discharged from a hospital in a particular month. Find the mean and the mode of the data.

Age (years)	5–15	15–25	25–35	35–45	45–55	55–65
Number of patients	6	11	21	23	14	5

[5]

[Board 2025 30/4/1 Q35; Board 2024 30/4/1 Q35 (identical table)]

Q8. The median of the following data is 525. Find the values of x and y, if the total frequency is 100.

Class interval	Frequency
0–100	2
100–200	5
200–300	x
300–400	12
400–500	17
500–600	20
600–700	y
700–800	9
800–900	7
900–1000	4

[5]

[SQP 2022-23 Q35 (= MS 2022-23 Q35); SQP 2018-19 Q28 (OR option 1, identical numbers; MS 2018-19 misprints y, see notes)]

Q9. Find the missing frequency f in the following table, if the mean of the given data is 18. Hence find the mode.

Daily allowance (Rs)	Number of children
11–13	7
13–15	6
15–17	9
17–19	13
19–21	f
21–23	5
23–25	4

[5]

[Board 2025 30/1/1 Q35; near-twin SQP 2017-18 Q30 (OR option 1; MS 2017-18 same paper; there the first frequency is 3 and the answer k = 8)]

Case Study

Q10. Case Study: Monsoon rainfall of sub-divisions **[4]**

[Board 2023 30/1/1 Q37 (adapted: count part moved to (ii), median and mean form the (iii) pair)]

The India Meteorological Department observes seasonal and annual rainfall every year in different sub-divisions of the country, so that the results can be compared and analysed. The table below shows the sub-division-wise seasonal (monsoon) rainfall (in mm) in 2018.

Rainfall (mm)	Number of sub-divisions
200–400	2
400–600	4
600–800	7
800–1000	4
1000–1200	2
1200–1400	3
1400–1600	1
1600–1800	1

Based on the above information, answer the following questions:

(i) Write the modal class. [1]

(ii) A sub-division having at least 1000 mm rainfall during the monsoon season is considered a good rainfall sub-division. How many sub-divisions had good rainfall? [1]

(iii) Find the median rainfall of the given data. [2]

OR

(iii) Find the mean rainfall in this season. [2]

Q11. Case Study: Seasonal rainfall of sub-divisions **[4]**

[Board 2025 30/3/1 Q38 (adapted: count part moved to (ii), median and mean form the (iii) pair)]

The India Meteorological Department observes seasonal and annual rainfall in the different sub-divisions of the country, to compare and analyse the results. The table below shows the sub-division-wise seasonal (monsoon) rainfall (in mm) in 2023.

Rainfall (mm)	Number of sub-divisions
200–400	3
400–600	4
600–800	7
800–1000	4
1000–1200	3
1200–1400	3

Based on the above information, answer the following questions:

(i) Write the modal class. [1]

(ii) If a sub-division having at least 800 mm rainfall during the monsoon season is considered a good rainfall sub-division, how many sub-divisions had good rainfall? [1]

(iii) Find the median rainfall of the given data. [2]

OR

(iii) Find the mean rainfall in the season. [2]

14. Probability

Multiple Choice Questions (MCQs)

Q1. Two dice are rolled simultaneously. The probability of getting a number less than 4 on each die is: **[1]**

[SQP 2026-27 Q13; MS 2026-27 Q13]

(a) $\frac{1}{4}$ (b) $\frac{1}{9}$ (c) $\frac{1}{36}$ (d) $\frac{1}{6}$

Q2. A letter is chosen at random from the letters of the word PROBABILITY. The probability that it is not a vowel is: **[1]**

[SQP 2016-17 Q1 (adapted)]

(a) $\frac{4}{11}$ (b) $\frac{7}{11}$ (c) $\frac{1}{11}$ (d) $\frac{10}{11}$

Q3. A number is chosen at random from the numbers $-5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5$. The probability that the square of this number is less than or equal to 1 is: **[1]**

[SQP 2019-20 Q15; MS 2019-20 Q15 (adapted)]

(a) $\frac{2}{11}$ (b) $\frac{3}{11}$ (c) $\frac{4}{11}$ (d) $\frac{5}{11}$

Q4. Find the probability of getting a doublet in a throw of a pair of dice. **[1]**

[SQP 2020-21 Q16 (OR option 1) (adapted); MS 2020-21 Q16]

(a) $\frac{1}{6}$ (b) $\frac{1}{36}$ (c) $\frac{1}{12}$ (d) $\frac{5}{36}$

Q5. Find the probability of getting a black queen when a card is drawn at random from a well shuffled pack of 52 cards. **[1]**

[SQP 2020-21 Q16 (OR option 2) (adapted); MS 2020-21 Q16 (OR)]

(a) $\frac{1}{52}$ (b) $\frac{1}{26}$ (c) $\frac{1}{13}$ (d) $\frac{1}{4}$

Q6. A bag contains 100 cards numbered 1 to 100. A card is drawn at random from the bag. The probability that the number on the card is a perfect cube is: **[1]**

[Board 2023 30/2/1 Q7]

(a) $\frac{1}{20}$ (b) $\frac{3}{50}$ (c) $\frac{1}{25}$ (d) $\frac{7}{100}$

Assertion–Reason

Q7. **Assertion (A):** Two players, Sania and Ashnam, play a tennis match. The probability of Sania winning the match is 0.79 and that of Ashnam winning the match is 0.21.
Reason (R): The sum of probabilities of two complementary events is 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 2023C 30/C/1 Q19]

Very Short Answer (VSA)

Q8. In a pack of 52 playing cards one card is lost. From the remaining cards, a card is drawn at random. Find the probability that the drawn card is the queen of hearts, if the lost card is a black card. **[2]**

[Board 2024 30/1/1 Q22]

Q9. One card is drawn at random from a well shuffled deck of 52 cards. Find the probability that the card drawn (i) is the queen of hearts; (ii) is not a jack. **[2]**

[Board 2024 30/3/1 Q21]

Short Answer (SA)

Q10. Three unbiased coins are tossed simultaneously. Find the probability of getting: (a) exactly two tails; (b) at least one head; (c) at most two heads. **[3]**

[Board 2025 30/3/1 Q30]

Long Answer (LA)

Q11. Cards marked with the numbers $1, 3, 5, \ldots, 49$ are placed in a box and mixed thoroughly. One card is drawn at random from the box. Find the probability that the number on the card is (i) divisible by 3; (ii) a composite number; (iii) not a perfect square; (iv) a multiple of 3 and 5; (v) a prime number. **[5]**

[SQP 2016-17 Q23 (4-mark question adapted to LA by adding part (v)) (adapted)]

Case Study

Q12. Case Study: Eight Ball **[4]**

[Board 2023 30/6/1 Q38 (adapted: marks not shown on the scan, split inferred; restructured to the CS pattern, OR part as (iii)-OR)]

"Eight Ball" is a game played on a pool table with 15 numbered balls, numbered 1 to 15, and a solid white cue ball. Of the numbered balls, eight are solid coloured and numbered 1 to 8, and seven are striped and numbered 9 to 15. The 15 numbered balls (the cue ball is not included) are placed in a large bowl and mixed, and one ball is drawn out at random.
Based on the above information, answer the following questions:

(i) What is the probability that the drawn ball bears the number 8? [1]

(ii) What is the probability that the drawn ball is solid coloured and bears an even number? [1]

(iii) What is the probability that the drawn ball bears an even number? [2]

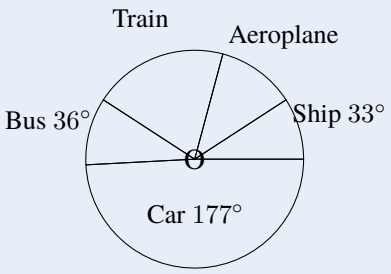
OR

(iii) What is the probability that the drawn ball bears a number which is a multiple of 3? [2]

Q13. Case Study: Modes of transport **[4]**

[Board 2024 30/2/1 Q38 (pie chart redrawn in TikZ; aeroplane and train angles not labelled, as in the original)]

In a survey on holidays, 120 people were asked which type of transport they used on their last holiday. The pie chart below shows the results. Its centre is O. The sectors for Ship, Bus and Car measure $33°$, $36°$ and $177°$ respectively, and the remaining two sectors are Aeroplane and Train.



Observe the pie chart and answer the following questions:

(i) If one person is selected at random, find the probability that he or she travelled by bus or ship. [1]

(ii) Which is the most favourite mode of transport, and how many people used it? [1]

(iii) (a) A person is selected at random. If the probability that he did not use a train is $\frac{4}{5}$, find the number of people who used a train. [2]

OR

(iii) (b) The probability that a randomly selected person used an aeroplane is $\frac{7}{60}$. An air company collects Rs 5000 from each such person. Find the revenue collected by the company. [2]

Answer Key (MCQs and Assertion–Reason)

Ch. 01: Q1-(a), Q2-(c), Q3-(c), Q4-(b), Q5-(c), Q6-(b)

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

Ch. 03: Q1-(d), Q2-(a), Q3-(d), Q4-(b), Q5-(c)

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

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

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

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

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

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

Ch. 10: Q1-(b)

Ch. 11: Q1-(b), Q2-(a), Q3-(d), Q4-(a)

Ch. 12: Q1-(a), Q2-(b), Q3-(a)

Ch. 13: Q1-(c), Q2-(c), Q3-(a), Q4-(a)

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