CLASS XI – MATHEMATICS (041)

CHAPTER 11 : INTRODUCTION TO THREE DIMENSIONAL GEOMETRY

PRACTICE PAPER – STEP-BY-STEP SOLUTIONS & MARKING SCHEME

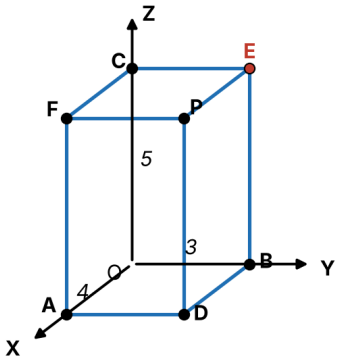
Section A – Answer Key (1 mark each)

Q1	Q2	Q3	Q4	Q5	Q6	Q7
B	C	D	A	B	C	D
Q8	**Q9**	**Q10**	**Q11**	**Q12**	**Q13**	**Q14**
A	B	C	D	A	B	C

SECTION – A (14 × 1 = 14)

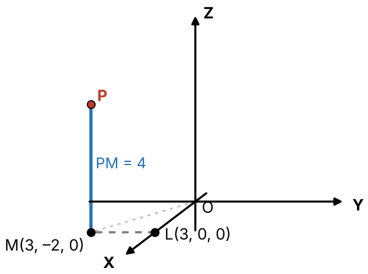
Multiple Choice and Assertion–Reason Questions

Q1. Answer: (B) 1 mark



E lies directly above B(0, 3, 0) at the height OC = 5, so its x-coordinate is 0 (it is in the YZ-plane). The coordinates of E are **(0, 3, 5)**.

Q2. Answer: (C) 1 mark



P is directly above M(3, –2, 0) at height 4, so P = (3, –2, 4): x > 0, y < 0, z > 0.
From Table 11.1, the signs (+, –, +) correspond to **octant IV**.

Q3. Answer: (D) 1 mark

OP = $\sqrt{(x^2 + y^2 + z^2)} = \sqrt{(4 + 9 + 36)} = \sqrt{49} =$ **7**.

Q4. Answer: (A) 1 mark

d = $\sqrt{((5 - 1)^2 + (2 + 2)^2 + (5 - 3)^2)} = \sqrt{(16 + 16 + 4)} = \sqrt{36} =$ **6**.

Q5. Answer: (B) 1 mark

Let P(x, y, z) be such that PA = PB, so $PA^2 = PB^2$: $(x - 2)^2 + y^2 + (z + 3)^2 = (x + 4)^2 + (y - 2)^2 + (z - 1)^2$.
LHS = $x^2 - 4x + y^2 + z^2 + 6z + 13$; RHS = $x^2 + 8x + y^2 - 4y + z^2 - 2z + 21$.
So 12x – 4y – 8z + 8 = 0, i.e. **3x – y – 2z + 2 = 0**.

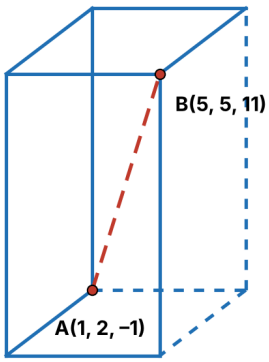
Q6. Answer: (C) 1 mark

Let the point be (0, t, 0). Then $(0 - 2)^2 + (t - 1)^2 + (0 - 3)^2 = (0 + 2)^2 + (t - 5)^2 + (0 + 1)^2$.
$t^2 - 2t + 14 = t^2 - 10t + 30 \Rightarrow 8t = 16 \Rightarrow t = 2$. The point is **(0, 2, 0)**.

Q7. Answer: (D) 1 mark

OA = $\sqrt{(9 + 16)} = 5$, OC = 5 and AC = $\sqrt{(9 + 16 + 25)} = \sqrt{50}$.
OA = OC (isosceles) and $OA^2 + OC^2 = 25 + 25 = 50 = AC^2$ (right angle at O). So it is **right-angled and isosceles**.

Q8. Answer: (A) **1 mark**



AB = $\sqrt{((5-1)^2 + (5-2)^2 + (11+1)^2)} = \sqrt{(16 + 9 + 144)} = \sqrt{169} = \mathbf{13}$.

Q9. Answer: (B) **1 mark**

$PA^2 + PB^2 = [(x-1)^2 + y^2 + z^2] + [(x+1)^2 + y^2 + z^2] = 2x^2 + 2y^2 + 2z^2 + 2$.
Given this equals 20: $2(x^2 + y^2 + z^2) = 18 \Rightarrow \mathbf{x^2 + y^2 + z^2 = 9}$.

Q10. Answer: (C) **1 mark**

Centroid = $((1-3+5)/3, (2+4+0)/3, (3+6-3)/3) = (3/3, 6/3, 6/3) = \mathbf{(1, 2, 2)}$.

Q11. Answer: (D) **1 mark**

Any point on the z-axis is (0, 0, z). Below the XY-plane z is negative, so the point is **(0, 0, –5)**.

Q12. Answer: (A) **1 mark**

The coordinates x, y, z give the perpendicular distances from the YZ, ZX and XY planes respectively (taken without sign).
So the distances are |–4|, |5|, |–3| = **4, 5, 3**.

Q13. Answer: (B) **1 mark**

Assertion: a point on the y-axis has zero distance from the YZ-plane and the XY-plane, so x = 0, z = 0 and the point is (0, y, 0). True.
Reason: the three coordinate planes divide space into eight octants. True, but it does not explain why the points on the y-axis have x = z = 0 → option (B).

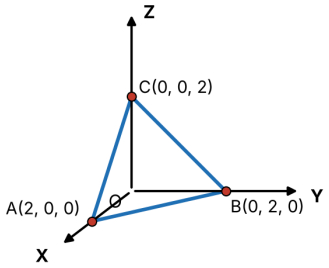
Q14. Answer: (C) **1 mark**

AB = $\sqrt{(1 + 4 + 4)} = 3$, BC = $\sqrt{(4 + 16 + 16)} = 6$ and AC = $\sqrt{(9 + 36 + 36)} = 9$. Since AB + BC = AC, the points are collinear. Assertion is true.
$PQ^2 + QR^2 = PR^2$ is the condition for a *right-angled* triangle, not for collinearity (collinear: PQ + QR = PR). Reason is false → option (C).

SECTION – B (4 × 2 = 8)

Very Short Answer Questions

Q15. 2 marks



(i) AB = $\sqrt{((0-2)^2 + (2-0)^2 + 0^2)} = \sqrt{8} = 2\sqrt{2}$; BC = $\sqrt{(0 + (0-2)^2 + (2-0)^2)} = \sqrt{8} = 2\sqrt{2}$; CA = $\sqrt{((2-0)^2 + 0 + (0-2)^2)} = \sqrt{8} = 2\sqrt{2}$. **[1]**

(ii) All three sides are equal, so ABC is an **equilateral triangle**. **[1]**

Q16. 2 marks

PQ = $\sqrt{((-2-2)^2 + (1+3)^2 + (8-1)^2)}$. **[1]**

= $\sqrt{(16 + 16 + 49)} = \sqrt{81} =$ **9 units**. **[1]**

Q17. 2 marks

(A) AB = $\sqrt{(4 + 4 + 4)} = 2\sqrt{3}$, BC = $\sqrt{(4 + 4 + 4)} = 2\sqrt{3}$. **[½]**

AC = $\sqrt{(16 + 16 + 16)} = 4\sqrt{3}$. **[½]**

Since AB + BC = $2\sqrt{3} + 2\sqrt{3} = 4\sqrt{3}$ = AC, the points A, B, C are **collinear**. **[1]**

OR (B) Let the point be (t, 0, 0). Then $(t+1)^2 + 4 + 4 = (t-4)^2 + 4 + 9$. **[1]**

$2t + 9 = -8t + 29 \Rightarrow t = 2$. The point is **(2, 0, 0)**. **[1]**

Q18. 2 marks

(A) $PA^2 = PB^2$: $(x-1)^2 + y^2 + (z+2)^2 = (x-3)^2 + (y-4)^2 + z^2$. **[1]**

$-2x + 4z + 5 = -6x - 8y + 25 \Rightarrow 4x + 8y + 4z - 20 = 0$, i.e. **x + 2y + z – 5 = 0**. **[1]**

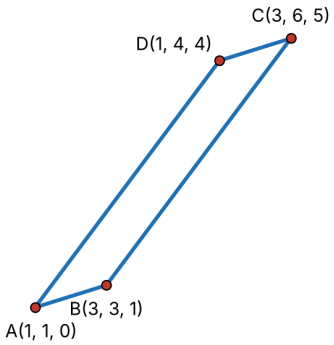
OR (B) Let C = (x, y, z). Centroid: $(2 - 4 + x)/3 = 1$, $(3 + 5 + y)/3 = 2$, $(-1 + 3 + z)/3 = 0$. **[1]**

$x - 2 = 3 \Rightarrow x = 5$; $y + 8 = 6 \Rightarrow y = -2$; $z + 2 = 0 \Rightarrow z = -2$. So C = **(5, –2, –2)**. **[1]**

SECTION – C (3 × 3 = 9)

Short Answer Questions

Q19. 3 marks



(i) AB = √(4 + 4 + 1) = 3; BC = √(0 + 9 + 16) = 5; CD = √(4 + 4 + 1) = 3; DA = √(0 + 9 + 16) = **5**. **[1]**
(ii) AB = CD = 3 and BC = DA = 5: both pairs of opposite sides are equal, so **ABCD is a parallelogram**. **[1]**
(iii) AC = √((3 – 1)² + (6 – 1)² + (5 – 0)²) = √(4 + 25 + 25) = √54; BD = √((1 – 3)² + (4 – 3)² + (4 – 1)²) = √(4 + 1 + 9) = √14. **[½]**
AC ≠ BD, and the diagonals of a rectangle are equal. Hence ABCD is **not a rectangle**. **[½]**

Q20. 3 marks

(A) AB = √(4 + 4 + 1) = 3; AC = √(4 + 1 + 4) = 3; BC = √(0 + 9 + 9) = 3√2. **[1½]**
AB = AC, so the triangle is isosceles. Also AB² + AC² = 9 + 9 = 18 = BC², so the angle at A is a right angle. **[1]**
Hence ABC is a **right-angled isosceles triangle**. **[½]**
OR (B) PA² + PB² = [(x – 2)² + (y – 1)² + (z + 3)²] + [x² + (y – 3)² + (z – 1)²]. **[1]**
= 2x² + 2y² + 2z² – 4x – 8y + 4z + 24 = 30. **[1]**
Dividing by 2: **x² + y² + z² – 2x – 4y + 2z – 3 = 0**. **[1]**

Q21. 3 marks

(A) Centroid = (0, 1, 2), so (2a + 1 – 5)/3 = 0, (3 + b – 4 + 6)/3 = 1 and (–5 + 7 + 2c)/3 = 2. **[1]**
2a – 4 = 0 ⇒ a = 2; b + 5 = 3 ⇒ b = –2. **[1]**
2c + 2 = 6 ⇒ c = 2. So **a = 2, b = –2, c = 2**. **[1]**
OR (B) PQ = 9 ⇒ PQ² = 81: (x – 1)² + (2 + 2)² + (3 – 7)² = 81. **[1]**
(x – 1)² + 16 + 16 = 81 ⇒ (x – 1)² = 49. **[1]**
x – 1 = ±7 ⇒ **x = 8 or x = –6**. **[1]**

SECTION – D (1 × 5 = 5)

Long Answer Question

Q22. **5 marks**

(A) Given PA = 2PB, where A is the origin O: $PA^2 = 4PB^2$. **[1]**

$x^2 + y^2 + z^2 = 4[(x - 3)^2 + y^2 + z^2]$. **[1]**

$x^2 + y^2 + z^2 = 4x^2 - 24x + 36 + 4y^2 + 4z^2 \Rightarrow 3x^2 + 3y^2 + 3z^2 - 24x + 36 = 0$. **[1]**

The locus is $\mathbf{x^2 + y^2 + z^2 - 8x + 12 = 0}$. **[1]**

Check: (2, 0, 0): 4 – 16 + 12 = 0 ✓ and (6, 0, 0): 36 – 48 + 12 = 0 ✓ (indeed PA = 2, PB = 1 and PA = 6, PB = 3). **[1]**

OR (B) AB = √(4 + 4 + 1) = 3; BC = √(1 + 4 + 4) = 3. **[1]**

CD = √(4 + 4 + 1) = 3; DA = √(1 + 4 + 4) = 3. All four sides are equal, so ABCD is a rhombus. **[1]**

AC = $\sqrt{((4 - 1)^2 + 0 + (2 + 1)^2)} = \sqrt{18} = 3\sqrt{2}$. **[1]**

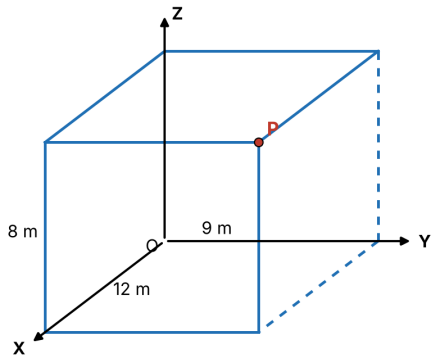
BD = $\sqrt{((2 - 3)^2 + (-2 - 2)^2 + (1 - 0)^2)} = \sqrt{(1 + 16 + 1)} = \sqrt{18} = 3\sqrt{2}$. **[1]**

Equal diagonals make the rhombus a rectangle, so ABCD is a **square**. **[1]**

SECTION – E (1 × 4 = 4)

Case Study Based Question

Q23. **4 marks**



(i) The hall measures 12 m along x, 9 m along y and 8 m along z, so P = **(12, 9, 8)**. **[1]**

(ii) OP = $\sqrt{(12^2 + 9^2 + 8^2)} = \sqrt{(144 + 81 + 64)} = \sqrt{289} =$ **17 m**. **[1]**

(iii)(a) LW = $\sqrt{((6 - 4)^2 + (6 - 3)^2 + (2 - 8)^2)}$. **[1]**

$= \sqrt{(4 + 9 + 36)} = \sqrt{49} =$ **7 m**. **[1]**

OR (b) Let Q(x, y, z) satisfy QO = QP: $x^2 + y^2 + z^2 = (x - 12)^2 + (y - 9)^2 + (z - 8)^2$. **[1]**

$0 = -24x - 18y - 16z + 289 \Rightarrow$ **24x + 18y + 16z = 289**. **[1]**

— End of Solutions —