Coordinate Geometry: exam practice

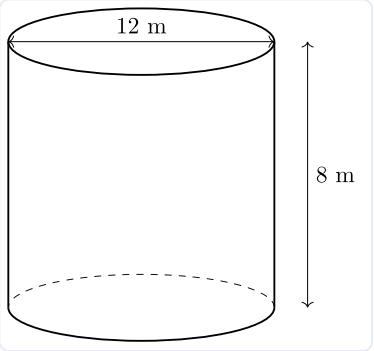
10 questions · 49 marks · worked solutions and markschemes

Name _____ Date _____ Score / 49

- Answer every question before you look at the solutions. They start after the last question, with the marks for each line: M for method, A for accuracy, R for reasoning.
- Online, with more practice: ibmathrevision.com/slai/coordinate-geometry-exam-practice

1. **3 marks · Paper 1 style · calculator allowed**

A water storage tank has a cylindrical shape. The diameter of the base of the tank is $12\ \text{m}$ and the height of the tank is $8\ \text{m}$.



Calculate the exact volume of the tank, giving your answer in terms of π.

2. **4 marks · Paper 1 style · calculator allowed**

The point $P(k, 3)$ is the same distance from $A(1, 1)$ as from $B(5, 7)$.

Find the value of k. **[4]**

3. **4 marks · Paper 1 style · calculator allowed**

The distance between two points with coordinates (x_1, y_1) and (x_2, y_2) is equal to $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$.
Consider the points $A(1, -2)$ and $B(40, -100)$.

1. Calculate the exact distance between points A and B.
2. Find the exact coordinates of the midpoint of the line segment [AB].

4. **4 marks · Paper 1 style · calculator allowed**

Consider the points $A(2, 7)$ and $B(8, -1)$.

(a) Find the coordinates of the midpoint of the line segment $[AB]$.

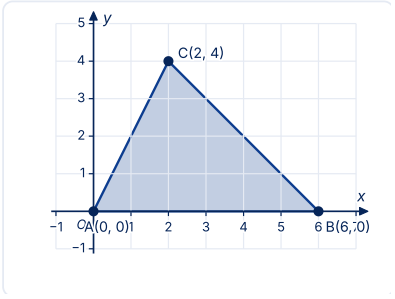
(b) Calculate the exact distance between A and B.

5. **4 marks · Paper 1 style · calculator allowed**

A triangle has vertices $A(0, 0)$, $B(6, 0)$ and $C(2, 4)$.

(a) Find the lengths AC and BC. **[2]**

(b) Find the area of the triangle. **[2]**



A(0, 0), B(6, 0), C(2, 4)

6. **5 marks · Paper 1 style · calculator allowed**

The points P and Q have coordinates $P(-2, 5)$ and $Q(4, 1)$.

1. Find the coordinates of the midpoint, M, of the line segment [PQ].
2. Find the gradient of the line segment [PQ].
3. Find the gradient of a line that is perpendicular to [PQ].

7. **5 marks · Paper 1 style · calculator allowed**

The points $A(-2, 1)$ and $B(4, 9)$ are given.

(a) Find the length of $[AB]$. **[2]**

(b) Find the equation of the perpendicular bisector of $[AB]$ in the form $ax + by + d = 0$. **[3]**

8. **6 marks · Paper 2 style · calculator allowed**

Three towns, A, B and C are represented as coordinates on a map. Town A is located at $(-6, -1)$ and town B is located at $(8, 6)$. A straight highway runs exactly along the perpendicular bisector of the line segment [AB].

1. Find the coordinates of the midpoint of [AB].
2. Find the equation of the line that the highway follows.
3. Town C is located on the highway and has an x-coordinate of -6. Find the y-coordinate of Town C.

9. **7 marks · Paper 2 style · calculator allowed**

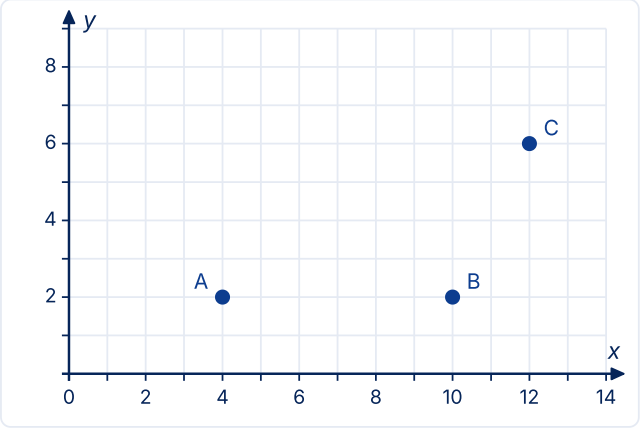
The equation of a straight coastline is modelled by the line $L_1 : 2y - x - 10 = 0$. A boat is anchored at point $M(8, 18)$. The coastguard needs to find the shortest distance from the boat to the coastline.

1. Find the gradient of the coastline L_1.
2. Find the equation of the line L_2, which passes through M and is perpendicular to L_1.
3. Find the coordinates of point D, the intersection of L_1 and L_2.
4. Calculate the shortest distance from the boat to the coastline.

10. **7 marks · Paper 2 style · calculator allowed**

There are three stations used by fire wardens in a national forest, located at $A(4, 2)$, $B(10, 2)$, and $C(12, 6)$ on a coordinate plane. The region is partitioned into a Voronoi diagram.

1. Write down the equation of the perpendicular bisector of [AB].
2. Find the equation of the perpendicular bisector of [BC].
3. A central command post is to be built at the Voronoi vertex V where the boundaries meet. Determine the exact coordinates of V.



Answers and worked solutions

Question 1

3 marks

Answer: 288π

Find the radius from the diameter:
$r = \frac{12}{2} = 6\text{ m}$ (A1)
Substitute into the cylinder volume formula: $V = \pi r^2 h = \pi(6^2)(8)$ M1
Simplify:
$V = 36 \times 8 \times \pi = 288\pi\text{ m}^3$ A1

Question 2

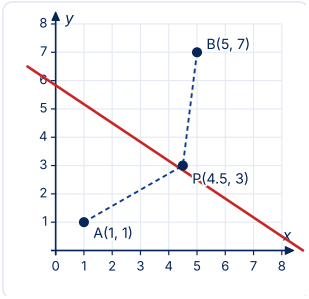
4 marks

Answer: $k = 4.5$

$(k-1)^2 + 4 = (k-5)^2 + 16$ $M1$ A1

$8k = 36$ (A1)

$k = 4.5$ A1



P lies on the perpendicular bisector of AB

Question 3

4 marks

Answer: (a) $5\sqrt{445}$; (b) $(20.5, -51)$

1. Use the distance formula:
   $d = \sqrt{(40-1)^2 + (-100-(-2))^2}$.
   (M1)
   Simplify:
   $d = \sqrt{39^2 + (-98)^2} = \sqrt{1521 + 9604} = \sqrt{11125}$.
   Simplify the surd:
   $d = \sqrt{11125} = 5\sqrt{445}$
   (≈ 105.5). A1
2. Use the midpoint formula:
   $M = \left(\frac{1+40}{2}, \frac{-2-100}{2}\right)$. (M1)
   $M = \left(\frac{41}{2}, \frac{-102}{2}\right) = (20.5, -51)$. A1

Question 4

4 marks

Answer: (a) $(5, 3)$; (b) 10

1. Substitute into the midpoint formula: $\left(\frac{2+8}{2}, \frac{7+(-1)}{2}\right)$ M1
   Midpoint $= (5, 3)$ A1
2. Substitute into the distance formula:
   $AB = \sqrt{(8-2)^2 + (-1-7)^2}$ M1
   $AB = \sqrt{36+64} = \sqrt{100} = 10$ A1

Question 5

4 marks

Answer: (a) $AC = 4.47$, $BC = 5.66$; (b) 12

(a)

$AC = \sqrt{20} = 4.47$ A1

$BC = \sqrt{32} = 5.66$ A1

(b)

$\frac{1}{2} \times 6 \times 4$ (M1)

12 A1

Question 6

5 marks

Answer: (a) $(1, 3)$; (b) $-2/3$; (c) $3/2$

1. $M = \left(\frac{-2+4}{2}, \frac{5+1}{2}\right) = \left(\frac{2}{2}, \frac{6}{2}\right) = (1, 3)$.
   (M1)A1
2. $m = \frac{1-5}{4-(-2)} = \frac{-4}{6} = -\frac{2}{3}$.
   (M1)A1
3. Perpendicular gradient
   $m_\perp = \frac{3}{2}$ (or 1.5). A1

Question 7

5 marks

Answer: (a) 10; (b) $3x + 4y - 23 = 0$

(a)

$\sqrt{6^2 + 8^2}$ (M1)

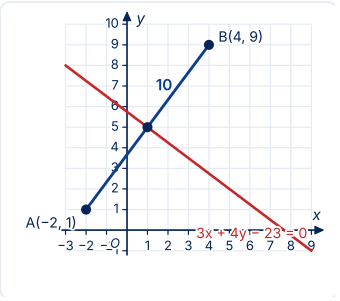
10 A1

(b)

midpoint $(1, 5)$, gradient of $AB = \frac{4}{3}$ (A1)

$y - 5 = -\frac{3}{4}(x - 1)$ (M1)

$3x + 4y - 23 = 0$ A1



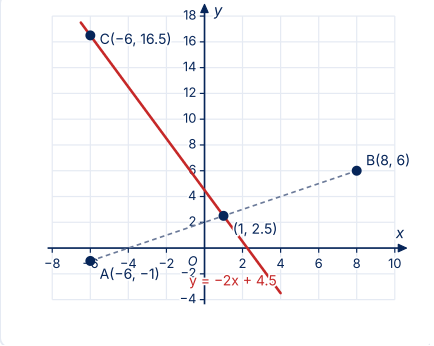
$AB = 10$; perpendicular bisector $3x + 4y - 23 = 0$

Question 8

6 marks

Answer: (a) $(1, 2.5)$; (b) $y = -2x + 4.5$; (c) 16.5

1. Midpoint
   $\left(\frac{-6+8}{2}, \frac{-1+6}{2}\right) = (1, 2.5)$.
   (M1)A1
2. Gradient AB
   $= \frac{6-(-1)}{8-(-6)} = \frac{7}{14} = 0.5$. (A1)
   Perpendicular gradient $= -2$.
   $y - 2.5 = -2(x-1) \implies y = -2x + 2 + 2.5 \implies$
   . (M1)A1
3. Substitute $x = -6$:
   $y = -2(-6) + 4.5 = 12 + 4.5 = 16.5$. A1



Highway: $y = -2x + 4.5$

Question 9

7 marks

Answer: (a) 0.5; (b) $y = -2x + 34$; (c) $(11.6, 10.8)$; (d) 8.05

1. Rearrange to gradient-intercept form:
   $2y = x + 10 \implies y = 0.5x + 5$.
   Gradient is 0.5. A1

2. L_2 is perpendicular, so its gradient is -2.
   Substitute into point-gradient form: $y - 18 = -2(x - 8)$.
   (M1)
   $y = -2x + 16 + 18 \implies y = -2x + 34$. **A1**
3. Substitute L_2 into L_1:
   $2(-2x + 34) - x - 10 = 0 \implies -4x + 68 - x - 10 = 0$
   . **(M1)**
   Solve:
   $5x = 58 \implies x = 11.6$;
   $y = -2(11.6) + 34 = 10.8$.
   Point $D(11.6, 10.8)$. **A1**
4. Distance
   $MD = \sqrt{(11.6 - 8)^2 + (10.8 - 18)^2} = \sqrt{3.6^2 + (-7.2)^2}$
   . **(M1)**
   $MD = \sqrt{12.96 + 51.84} = \sqrt{64.8} \approx 8.05$. **A1**

Every solution is also on ibmathrevision.com/slai/coordinate-geometry-exam-practice
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Question 10

7 marks

Answer: (a) $x = 7$; (b) $y = -0.5x + 9.5$; (c) $(7, 6)$

1. A and B have the same $y-$coordinate, so the perpendicular bisector is the vertical line through the midpoint,
   $x = \frac{4+10}{2} = 7$.
   Equation: $x = 7$. **A1**
2. Midpoint of BC:
   $\left(\frac{10+12}{2}, \frac{2+6}{2}\right) = (11, 4)$. **(A1)**
   Gradient of BC:
   $\frac{6-2}{12-10} = \frac{4}{2} = 2$, so perpendicular gradient $= -0.5$.
   (A1)
   Substitute into point-gradient form: $y - 4 = -0.5(x - 11)$.
   M1
   $y = -0.5x + 9.5$. **A1**
3. Vertex V is the intersection of $x = 7$ and $y = -0.5x + 9.5$.
   (M1)
   Substitute $x = 7$:
   $y = -0.5(7) + 9.5 = -3.5 + 9.5 = 6$.
   Vertex $V(7, 6)$. **A1**