P1 Coordinate Geometry: exam questions

10 questions · 44 marks · full mark schemes

Name _____ Date _____ Score / 44

- Straight lines, gradient, midpoint, perpendicular/parallel, equation of a line, distance formula.
- Try every question before you look at the mark schemes. They start after the questions: M marks for method, A marks for accuracy, B marks for a correct result on its own.
- Online, with more practice: alevelmathrevision.com/alevel-frontend/units/p1/coordinate-geometry-questions

1. **3 marks · warm-up**

Three towns are located at coordinate points $A(1, 2)$, $B(5, 4)$, and $C(3, 8)$. A new hospital is built at $H(3, 5)$. Determine mathematically which town is closest to the hospital.

2. **4 marks · warm-up**

The coordinates of a kite $ABCD$ are $A(2, 0)$, $B(0, 4)$, and $C(4, 6)$. The diagonals $[AC]$ and $[BD]$ are perpendicular. Find the exact equation of the line passing through B and D in the form $y = mx + c$.

3. **3 marks · standard**

A line has a gradient of $-\frac{1}{3}$ and passes through the point $(-3, 4)$. Write the equation of the line in the form $ax + by + c = 0$, where a, b, c are integers.

4. 3 marks · standard

Find the exact area of the triangle bounded by the line $3x + 2y - 12 = 0$ and the coordinate axes.

5. 5 marks · standard

Point A has coordinates $(x, 4)$ and point B has coordinates $(9, y)$. M is the midpoint of $[AB]$ and has coordinates $(-2, 7)$.

1. Find the value of x and the value of y.
2. Hence, find the gradient of the line passing through A and B.

6. 6 marks · standard

The line ℓ has equation $3x - 4y + 12 = 0$. The point P has coordinates $(2, k)$ and lies on ℓ. Find the value of k, and find the distance from P to the origin O, giving your answer in the form $a\sqrt{b}$, where a is a rational number and b is an integer.

7. 4 marks · harder

Prove that the points $A(2, 1)$, $B(6, 3)$ and $C(5, 5)$ form the vertices of a right-angled triangle.

8. 4 marks · harder

The points $A(-3, k)$, $B(1, 4)$ and $C(3, 9)$ are collinear (they lie on the same straight line). Find the value of k.

9. 6 marks · harder

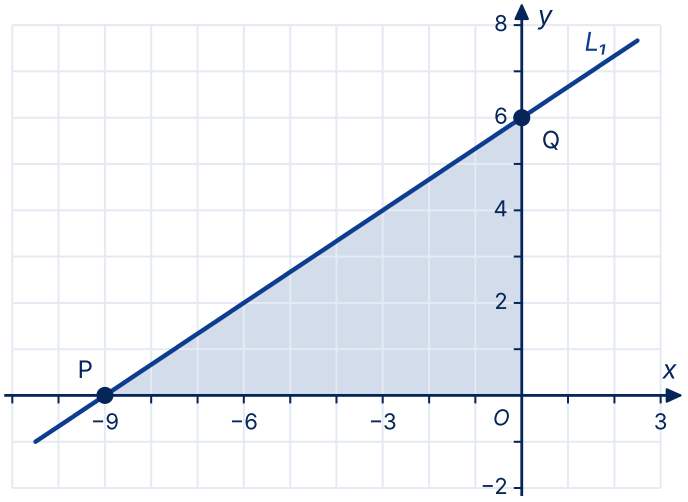
The line L_1 passes through the points $A(-2, 5)$ and $B(4, -7)$.

1. Find the coordinates of the midpoint of $[AB]$.
2. Find the equation of the perpendicular bisector of the line segment $[AB]$. Give your answer in the form $ax + by + d = 0$, where a, b, and d are integers.

10. 6 marks · harder

The diagram below shows the line L_1 with equation $2x - 3y + 18 = 0$. The line intersects the x-axis at point P and the y-axis at point Q.

1. Find the coordinates of P and Q.
2. Calculate the exact area of the triangle OPQ, where O is the origin.
3. A second line L_2 is parallel to L_1 and passes through $(3, 2)$. Find the equation of L_2 in the form $y = mx + c$.



L_1: $2x - 3y + 18 = 0$

Answers and worked solutions

Question 1

3 marks

Answer: Town B ($d_B = \sqrt{5} \approx 2.24$, the smallest distance)

1. M1 for calculating distance to A:
   $d_A = \sqrt{2^2 + 3^2} = \sqrt{13} \approx 3.61$.
2. M1 for calculating distances to B and C:
   $d_B = \sqrt{2^2 + 1^2} = \sqrt{5} \approx 2.24$ and
   $d_C = \sqrt{0^2 + 3^2} = 3$.
3. A1 for concluding that Town B is the closest because $\sqrt{5}$ is the smallest distance.

Question 2

4 marks

Answer: $y = -\frac{1}{3}x + 4$

M1 for calculating the gradient of diagonal AC : $m_{AC} = \frac{6-0}{4-2} = \frac{6}{2} = 3$.
M1 for identifying the gradient of the perpendicular diagonal BD : $m_{BD} = -\frac{1}{3}$.
M1 for substituting the point $B(0, 4)$ into the line equation: $y - 4 = -\frac{1}{3}(x - 0)$.
A1 for stating the final equation in the correct form: $y = -\frac{1}{3}x + 4$.

Question 3

3 marks

1. M1 for setting up the equation:
   $y - 4 = -\frac{1}{3}(x - (-3))$.
2. M1 for multiplying by 3 to clear the fraction and expanding: $3y - 12 = -x - 3$.
3. A1 for writing in the final integer form:
   $x + 3y - 9 = 0$.

Question 4

3 marks

1. M1 for finding the intercepts by substituting $x = 0$ and $y = 0$: yielding $(0, 6)$ and $(4, 0)$.
2. M1 for applying the area of a triangle formula:
   $\frac{1}{2} \times \text{base} \times \text{height} = \frac{1}{2} \times 4 \times 6$.
3. A1 for evaluating the area to 12 square units.

Question 5

5 marks

Answer: $m = \frac{3}{11}$

1. Midpoint formula: $\left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$. M1
   $\frac{x+9}{2} = -2 \implies x + 9 = -4 \implies x = -13$
   . A1
   $\frac{4+y}{2} = 7 \implies 4 + y = 14 \implies y = 10$. A1
2. Gradient $m = \frac{10-4}{9-(-13)} = \frac{6}{22}$. M1
   $m = \frac{3}{11}$. A1

Question 6

6 marks

Answer: $k = \frac{9}{2}$; $|OP| = \frac{1}{2}\sqrt{97}$

$3(2) - 4k + 12 = 0 \Rightarrow k = \frac{18}{4} = 4.5$ M1 A1.
$|OP| = \sqrt{2^2 + 4.5^2} = \sqrt{4 + 20.25} = \sqrt{24.25}$; using exact fraction $k = \frac{9}{2}$:
$|OP|^2 = 4 + \frac{81}{4} = \frac{97}{4}$, so $|OP| = \frac{\sqrt{97}}{2}$ M1 A1. Rewritten: $\frac{1}{2}\sqrt{97}$ A1 A1.

Question 7

4 marks

1. M1 for calculating the gradient of AB:
   $m_{AB} = \frac{3-1}{6-2} = \frac{2}{4} = 0.5$.
2. M1 for calculating the gradient of BC:
   $m_{BC} = \frac{5-3}{5-6} = \frac{2}{-1} = -2$.
3. M1 for finding the product of these two gradients: $0.5 \times -2 = -1$.
4. A1 for concluding that since the product is -1, the lines AB and BC are perpendicular, meaning angle ABC is a right angle, hence it is a right-angled triangle.

Question 8

4 marks

1. M1 for calculating the gradient of BC:
   $m = \frac{9-4}{3-1} = \frac{5}{2} = 2.5$.
2. M1 for setting up the gradient expression for AB (or AC) and equating to 2.5:
   $\frac{4-k}{1-(-3)} = 2.5$.
3. M1 for solving the algebraic equation:
   $\frac{4-k}{4} = 2.5 \implies 4 - k = 10$.
4. A1 for finding $k = -6$.

Question 9

6 marks

Answer: $2y + 2 = x - 1 \implies x - 2y - 3 = 0$

1. Midpoint $M = \left(\frac{-2+4}{2}, \frac{5-7}{2}\right) = (1, -1)$. $M1$ **A1**
2. Gradient of $AB = \frac{-7-5}{4-(-2)} = \frac{-12}{6} = -2$. **M1**
   Gradient of perpendicular bisector $m_{\perp} = \frac{1}{2}$. **A1**
   Equation through $(1, -1)$:
   $y - (-1) = \frac{1}{2}(x - 1) \implies y + 1 = 0.5x - 0.5$
   . **M1**
   Multiply by 2:
   $2y + 2 = x - 1 \implies x - 2y - 3 = 0$. **A1**

Question 10 **6 marks**

Answer:

$y - 2 = \frac{2}{3}(x - 3) \implies y = \frac{2}{3}x - 2 + 2 \implies y = \frac{2}{3}x$

1. $x-$intercept (set $y = 0$):
   $2x + 18 = 0 \implies x = -9$. $P(-9, 0)$. **A1**
   $y-$intercept (set $x = 0$):
   $-3y + 18 = 0 \implies y = 6$. $Q(0, 6)$. **A1**
2. Base of triangle $= 9$, Height $= 6$. **M1**
   Area $= \frac{1}{2} \times 9 \times 6 = 27$ sq units. **A1**
3. $2x - 3y + 18 = 0 \implies 3y = 2x + 18 \implies y = \frac{2}{3}x + 6$
   .
   Gradient is $\frac{2}{3}$. **A1**
   Parallel line L_2 has $m = \frac{2}{3}$ through $(3, 2)$.
   $y - 2 = \frac{2}{3}(x - 3) \implies y = \frac{2}{3}x - 2 + 2 \implies y = \frac{2}{3}x$
   . **A1**

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