IB MATHS AA SL · UNIT 2

Equations of straight lines: exam practice

10 questions · 50 marks · worked solutions and markschemes

Name _____ Date _____ Score / 50

- 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/slaa/equations-of-straight-lines-exam-practice

1. **5 marks · Paper 1 style · no calculator**

Line L_1 has the equation $3x - 4y + 12 = 0$. Line L_2 is perpendicular to L_1 and intersects L_1 exactly at its y-intercept. Find the exact area of the triangle bounded by L_1, L_2, and the x-axis.

2. **4 marks · Paper 1 style · no calculator**

The line passing through the points $A(k, 4)$ and $B(6, k)$ has a gradient of 3. Find the exact value of k.

3. **5 marks · Paper 1 style · no calculator**

The lines $L_1 : 2x + ky = 5$ and $L_2 : (k-1)x + 3y = 2$ are parallel.

Find the possible values of k. **[5]**

4. **4 marks · Paper 1 style · no calculator**

The equation of a line L_1 is $3x + 4y - 12 = 0$.

1. Find the gradient of L_1.
2. Find the coordinates of the x-intercept and the y-intercept of L_1.

5. **4 marks · Paper 1 style · no calculator**

A line passes through the points $(-1, 5)$ and $(3, -3)$.

a. Find the gradient of the line. **[2]**

b. Find the equation of the line in the form $y = mx + c$. **[2]**

6. **4 marks · Paper 1 style · no calculator**

A line L_1 has the equation $y = 5x - 2$. A second line, L_2, is parallel to L_1 and passes through the point $(0, 7)$.

1. Write down the equation of L_2.
2. A third line, L_3, is perpendicular to L_1 and passes through the origin. Find the equation of L_3.

7. **5 marks · Paper 1 style · no calculator**

A line L passes through $(-2, 5)$ and has gradient $-\frac{3}{4}$.

(a) Find the equation of L in the form $ax + by + d = 0$, where $a, b, d \in \mathbb{Z}$. **[3]**

(b) Find the x-intercept of L. **[2]**

8. **6 marks · Paper 1 style · no calculator**

The points $A(2, -1)$ and $B(6, 7)$ are the ends of a line segment.

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

(b) Find the gradient of $[AB]$. **[1]**

(c) Find the equation of the perpendicular bisector of $[AB]$, giving your answer in the form $ax + by + d = 0$, where $a, b, d \in \mathbb{Z}$. **[3]**

9. **6 marks · Paper 1 style · no calculator**

The points $P(1, 2)$, $Q(5, 4)$ and $R(k, -2)$ are such that angle $P\hat{Q}R$ is a right angle.

(a) Find the value of k. **[3]**

(b) Find the area of triangle PQR. **[3]**

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

The line L_1 has equation $3x - 2y = 7$. The line L_2 passes through $P(1, 4)$ and is perpendicular to L_1.

(a) Find the equation of L_2 in the form $ax + by = d$. **[3]**

(b) Find the coordinates of the point Q where L_1 and L_2 meet. **[2]**

(c) Hence find the shortest distance from P to L_1. **[2]**

Answers and worked solutions

Question 1

5 marks

Answer: $75/8$

Intercepts of L_1: $x-$intercept $(-4, 0)$ and $y-$intercept $(0, 3)$. A1

Gradient of L_1 is $\frac{3}{4}$, so the gradient of L_2 is $-\frac{4}{3}$; L_2 passes through $(0, 3)$: $y = -\frac{4}{3}x + 3$. M1

$x-$intercept of L_2: $0 = -\frac{4}{3}x + 3 \implies x = \frac{9}{4}$. A1

Base $= \frac{9}{4} - (-4) = \frac{25}{4}$, height $= 3$: area $= \frac{1}{2} \times \frac{25}{4} \times 3$. M1

Area $= \frac{75}{8}$. A1

Question 2

4 marks

Answer: $k = 11/2$

$m = \frac{k-4}{6-k} = 3$. (M1)A1

$k - 4 = 3(6 - k) \implies k - 4 = 18 - 3k$. (M1)

$4k = 22 \implies k = 5.5$ (or $\frac{11}{2}$). A1

Question 3

5 marks

Answer: $k = 3$ or $k = -2$

gradients $-\dfrac{2}{k}$ and $-\dfrac{k-1}{3}$ A1A1

$\dfrac{2}{k} = \dfrac{k-1}{3}$, so $k^2 - k - 6 = 0$ M1

$k = 3$ or $k = -2$ A1A1

Question 4

4 marks

Answer: (a) $-3/4$; (b) $(4, 0), (0, 3)$

1. Rearrange $3x + 4y - 12 = 0$ into $y = mx + c$:
   $4y = -3x + 12 \implies y = -\frac{3}{4}x + 3$. (M1)
   Gradient $m = -\frac{3}{4}$. A1
2. $y-$intercept is $c = 3$, so $(0, 3)$. A1
   $x-$intercept occurs when $y = 0 \implies 3x - 12 = 0 \implies x = 4$.
   So $(4, 0)$. A1

Question 5

4 marks

Answer: (a) -2; (b) $y = -2x + 3$

a. $\dfrac{-3-5}{3-(-1)}$ (M1)
$= -2$ A1

b. $y - 5 = -2(x + 1)$ (M1)
$y = -2x + 3$ A1

Question 6

4 marks

Answer: (a) $y = 5x + 7$; (b) $y = -x/5$

1. Parallel lines have the same gradient.
   $m_1 = m_2 = 5$. (M1)
   Passes through $(0, 7) \implies y-$intercept is 7.
   $y = 5x + 7$. A1
2. Perpendicular gradient $m_3 = -\frac{1}{m_1} = -\frac{1}{5}$. (M1)
   Passes through origin $(0, 0)$.
   $y = -\frac{1}{5}x$ (or $y = -0.2x$). A1

Question 7

5 marks

Answer: (a) $3x + 4y - 14 = 0$; (b) $\frac{14}{3}$

(a)

$y - 5 = -\dfrac{3}{4}(x + 2)$ M1

$4y - 20 = -3x - 6$ (A1)

$3x + 4y - 14 = 0$ A1

(b)

$3x = 14$ (M1)

$x = \dfrac{14}{3}$ A1

Question 8

6 marks

Answer: (a) $(4, 3)$; (b) 2; (c) $x + 2y - 10 = 0$

(a)

$\left(\dfrac{2+6}{2}, \dfrac{-1+7}{2}\right)$ (M1)

$(4, 3)$ A1

(b)

$\dfrac{7-(-1)}{6-2} = 2$ A1

(c)

perpendicular gradient $-\frac{1}{2}$ **(A1)**

$y-3=-\frac{1}{2}(x-4)$ **(M1)**

$x+2y-10=0$ **A1**

Question 9

6 marks

Answer: (a) 8; (b) 15

(a)

gradient $PQ=\frac{1}{2}$ **A1**

gradient $QR=\frac{-6}{k-5}=-2$ **M1**

$k=8$ **A1**

(b)

$PQ=\sqrt{20}$, $QR=\sqrt{9+36}=\sqrt{45}$ **A1**

area $=\frac{1}{2}\sqrt{20}\sqrt{45}$ **M1**

$=15$ **A1**

Question 10

7 marks

Answer: (a) $2x+3y=14$; (b) $\left(\frac{49}{13},\frac{28}{13}\right)$; (c) 3.33

(a)

gradient of L_1 is $\frac{3}{2}$ **(A1)**

gradient of L_2 is $-\frac{2}{3}$, $y-4=-\frac{2}{3}(x-1)$ **(M1)**

$2x+3y=14$ **A1**

(b)

solving simultaneously **(M1)**

$Q\left(\frac{49}{13},\frac{28}{13}\right)$ $(3.77,\ 2.15)$ **A1**

(c)

$PQ=\sqrt{\left(\frac{36}{13}\right)^2+\left(\frac{24}{13}\right)^2}$ **(M1)**

3.33 $\left(\frac{12}{\sqrt{13}}\right)$ **A1**

Every solution is also on ibmathrevision.com/slaa/equations-of-straight-lines-exam-practice
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