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HIGHER

3.15H Drawing Linear Graphs: Higher Tier Practice

EDEXCEL 1MA1 · Calculator allowed · about 70 minutes

Total Marks

Name: ________________________________ Date: ____ / ____ / ______

Answer ALL questions. Show all your working.

1 Plot the point with coordinates (3, -2) on a pair of axes.

(Total for Question 1 is 1 mark)

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2 Write down the equation of the straight line passing through the points (0, 5) and (2, 1).

(Total for Question 2 is 2 marks)

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3 A line has equation $y = 3x - 4$.
Work out the coordinates of the point where this line crosses the y-axis and the x-axis.

(a) Work out the y-intercept. **(1)**

....

(b) Work out the x-intercept. **(2)**

....

(Total for Question 3 is 3 marks)

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4 The graph of a line through (1, 2) has gradient -1/2.
Find the equation of this line in the form $y = mx + c$.

(Total for Question 4 is 3 marks)

5 Two lines L1 and L2 are given by L1: $y = 2x + 1$ and L2: $y = -x + 7$.
Find the coordinates of their point of intersection.

(Total for Question 5 is 4 marks)

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6 The line L has equation $y = ax + 4$ and passes through the point (6, -2).
Find the value of a. Then state the equation of the line perpendicular to L that passes through (6, -2).

(a) Find the value of a. **(2)**

....

(b) State the equation of the line perpendicular to L through (6, -2). **(3)**

(Total for Question 6 is 5 marks)

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7 A company charges a fixed booking fee and a constant hourly rate for hiring equipment. A graph of cost C (pounds) against hours h is a straight line. The graph passes through (0, 18) and (5, 58).
(a) Find the booking fee and the hourly rate. (b) Write down the equation connecting C and h.

(a) Find the booking fee and the hourly rate. **(3)**

....

(b) Write down the equation connecting C and h. **(3)**

....

(Total for Question 7 is 6 marks)

8 Show that the family of lines with equation $y = mx + (3 - 2m)$ all pass through a single fixed point independent of m. Find the coordinates of that point.

(a) Show that all lines of the form $y = mx + (3 - 2m)$ pass through a fixed point, and find its coordinates. **(8)**

(Total for Question 8 is 8 marks)

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9 A cyclist travels at a steady speed along a straight path. Her distance d (metres) from the start after t minutes is modelled by $d = 350t + 120$.

(a) Interpret the numbers 350 and 120 in this context. (b) Another cyclist starts at the same start but 6 minutes later. For $t \geq 6$, her distance is modelled by $d = 450(t - 6)$, where t is minutes since the original start. Find the time (in minutes since the original start) when the second cyclist catches the first.

(a) Interpret the numbers 350 and 120 in context. **(2)**

(b) Find the time since the original start when the second cyclist catches the first. **(8)**

....

(Total for Question 9 is 10 marks)

10 Given the line L1: $4x - 2y + 6 = 0$, (a) rearrange to the form $y = mx + c$. (b) Sketch L1 and the line L3 which is the image of L1 after a translation of 3 units right and 2 units up. Give the equation of L3.

(a) Rearrange $4x - 2y + 6 = 0$ to $y = mx + c$. **(3)**

(b) Give the equation of L3, the image of L1 under translation 3 units right and 2 units up. Include a brief sketch showing both lines labelled. **(5)**

(Total for Question 10 is 8 marks)

Mark scheme · 3.15H Drawing Linear Graphs: Higher Tier Practice

Question 1

- **B1** point plotted at (3, -2) within tolerance (correct quadrant and position) oe
- **Answer: (3, -2)**

Question 2

- **M1** find gradient m = (1 - 5) / (2 - 0) = -4/2 = -2 or equivalent method
- **A1** y = -2x + 5 cao
- **Answer: y = -2x + 5**

Question 3

- (a) **B1** y-intercept (0, -4) cao
- **(a) Answer: (0, -4)**
- (b) **M1** set y = 0 and solve 0 = 3x - 4, showing method
- (b) **A1** x = 4/3, so x-intercept (4/3, 0) cao
- **(b) Answer: (4/3, 0)**

Question 4

- **M1** substitute point into y = (-1/2)x + c and solve for c: 2 = (-1/2)(1) + c
- **A1** c = 5/2 or 2.5
- **A1** y = -1/2 x + 5/2 cao
- **Answer: y = -1/2 x + 5/2**

Question 5

- **M1** set 2x + 1 = -x + 7 and form equation 3x = 6 or equivalent
- **A1** x = 2 cao
- **M1** substitute x = 2 into one equation to find y
- **A1** y = 5, intersection (2, 5) cao
- **Answer: (2, 5)**

Question 6

- (a) **M1** substitute (6, -2) into y = ax + 4: -2 = 6a + 4 and form 6a = -6
- (a) **A1** a = -1 cao
- **(a) Answer: a = -1**
- (b) **M1** use perpendicular gradient product = -1: gradient of L is -1 so perpendicular gradient = 1
- (b) **M1** use point (6, -2) to form equation y = 1x + c and solve for c: -2 = 6 + c
- (b) **A1** y = x - 8 cao
- **(b) Answer: y = x - 8**

Question 7

- (a) **B1** booking fee identified as C when h = 0 is 18 pounds
- (a) **M1** find gradient (58 - 18) / (5 - 0) = 40 / 5 = 8
- (a) **A1** hourly rate 8 pounds per hour cao
- **(a) Answer: Booking fee = 18 pounds; hourly rate = 8 pounds/hour**
- (b) **M1** use C = mh + c with m = 8 and c = 18
- (b) **A1** C = 8h + 18 cao
- (b) **A1** units consistent: C in pounds and h in hours (communication) oe
- **(b) Answer: C = 8h + 18**

Question 8

- (a) **M1** recognise rearrangement or set up to eliminate m: write y - mx = 3 - 2m
- (a) **M1** collect m terms: y - mx = 3 - 2m => bring m terms together: y - 3 = m(x - 2) or equivalent
- (a) **M1** argument that for a fixed point (x0, y0) independent of m, coefficient of m must be zero: require x - 2 = 0 so x = 2
- (a) **M1** substitute x = 2 into original to find y: y = m*2 + (3 - 2m) => simplify
- (a) **A1** y = 2m + 3 - 2m = 3, so fixed y = 3 cao
- (a) **A1** conclude fixed point is (2, 3) cao
- (a) **M1** give a clear statement that for any m the point (2, 3) satisfies y = mx + 3 - 2m
- (a) **A1** (2, 3) is on every line in the family cao
- **(a) Answer: (2, 3)**

Question 9

- (a) **B1** 350 is speed in metres per minute oe
- (a) **B1** 120 is initial distance from the start in metres at t = 0 (a head start) oe
- **(a) Answer: 350 metres per minute; 120 metres initial head start**
- (b) **M1** set 350t + 120 = 450(t - 6), correctly using the second cyclist's delayed start
- (b) **M1** expand and rearrange to 2820 = 100t
- (b) **A1** t = 28.2 minutes cao
- (b) **M1** check second cyclist has actually started: confirm t = 28.2 is greater than 6, so the model d = 450(t - 6) applies
- (b) **A1** state that catching occurs at t = 28.2 minutes since original start cao
- (b) **B1** units stated: minutes oe
- (b) **M1** sanity check: distances equal: 350*28.2 + 120 = 9990 and 450*(28.2 - 6) = 9990
- (b) **A1** final value 28.2 minutes cao
- **(b) Answer: 28.2 minutes**

Question 10

- (a) **M1** isolate term -2y = -4x -6 or equivalent
- (a) **M1** divide by -2 to get y = 2x + 3
- (a) **A1** y = 2x + 3 cao
- **(a) Answer: y = 2x + 3**
- (b) **M1** understand translation shifts every point: use general point (x, y) on L1 and map to (x + 3, y + 2) or shift intercepts
- (b) **M1** substitute x' = x + 3, y' = y + 2 into y = 2x + 3 or transform intercept: y' - 2 = 2(x' - 3) + 3
- (b) **M1** simplify to find equation in y' and x': y' = 2x' - 1 or equivalent correct algebra
- (b) **B1** sketch shows two parallel lines with correct relative shift (L3 above and right of L1) oe
- (b) **A1** final equation L3: y = 2x - 1 cao
- **(b) Answer: y = 2x - 1**