2.1 Linear Functions & Graphs

Question Paper

Course	DP IB Maths
Section	2. Functions
Topic	2.1 Linear Functions & Graphs
Difficulty	Very Hard

Time allowed: 100

Score: /81

Percentage: /100

Question 1a

A cat breeder is measuring the rate at which a kitten grows by measuring its "back-length", which is the distance from the base of the neck to the base of the tail.
At 1 week old the kitten measured 2.42 cm. 8 weeks later the kitten's back length had doubled.

(a) Using a linear model, find an equation linking y, the kitten's "back-length" in centimetres, to x, the age of the kitten in weeks.

[3 marks]

Question 1b

(b) Find the kitten's "back-length" at birth.

[1 mark]

Question 1c

(c) Use the model to find the age, in weeks, of the kitten that has a "back-length" of 7 cm.

[1 mark]

Question 1d

This breed of cat is fully grown after 50 weeks.

(d) Find the cat's "back-length" at 50 weeks.

[1 mark]

Question 1e

(e) Comment on the suitability of the linear model used.

[2 marks]

Question 2a

Point P has coordinates $(6, -2)$, R has coordinates $(-2, 2)$. The equation of the line PQ is $y = -2$ and the equation of the line QR is $y = 2x + 6$.

(a) Find the coordinates of point Q.

[2 marks]

Question 2b

(b) Find the distance of PQ and QR.

[3 marks]

Question 2c

(c) Find the area of triangle PQR.

[2 marks]

Question 3a

Point P has coordinates (4, 2) and point Q has coordinates (1, 8). l_1 is the perpendicular bisector of [PQ].

(a) Find the equation of l_1, giving your answer in the form $y = mx + c$.

[4 marks]

Question 3b

l_2 passes through Q and has a gradient of -3.

(b) Find the equation of l_2, giving your answer in the form $y = mx + c$.

[2 marks]

Question 3c

Point C lies on l_2 and has a negative x coordinate. The length of QC is 14 units.

(c) Find the coordinates of C.

[4 marks]

Question 4a

Point A has coordinates $(0, y)$, l_1 passes through points A and B and has the equation $4x - 3y - 3 = 0$. The length of [AB] is 10 units.

(a) Find the possible coordinates of point B.

[3 marks]

Question 4b

l_2 passes through points C and D, is parallel to l_1 and crosses the x-axis when $x = 5$.

(b) Write down the equation of l_2. Give your answer in the form $ax + by + d = 0$, where a, b and d are integers.

[2 marks]

Question 4c

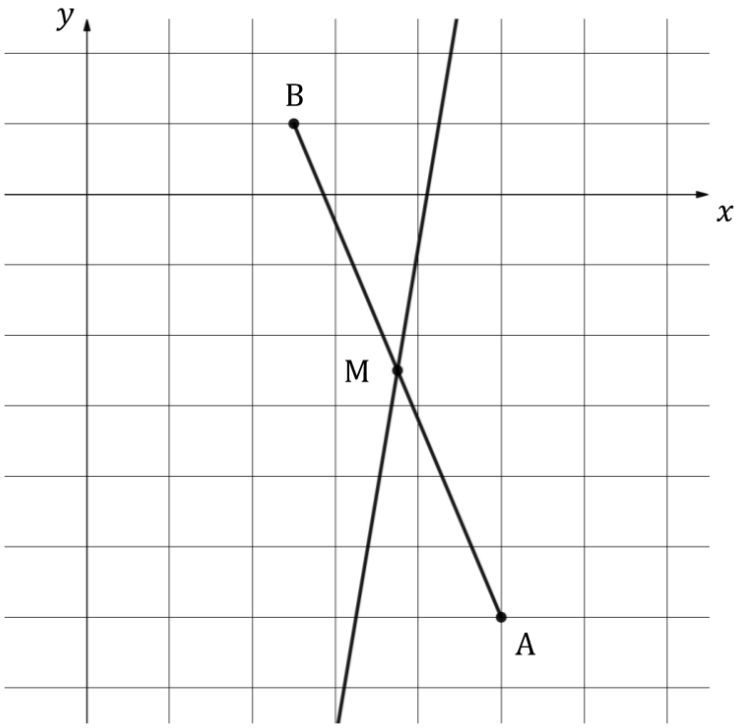
Point C has coordinates $(x, 4)$ and CD is half the length of AB.

(c) Find the possible coordinates of point D.

[3 marks]

Question 5a

The line l_1 passes through $A(10, -12)$ and $B(5, 2)$.



(a) Find the equation of l_1. Give your answer in the form $ax + by + d = 0$, where a, b and d are integers.

[2 marks]

Question 5b

The line l_2 passes through M, the midpoint of [AB] and has a gradient of 7.

(b) Find the equation of l_2. Give your answer in the form $ax + by + d = 0$, where a, b and d are integers.

[3 marks]

Question 5c

Point C lies on l_2 such that MC has a length of 12 units.

(c) Find the possible coordinates of C.

[5 marks]

Question 6a

Carpenter A charges a fixed fee of $28 plus $22.50 per hour. The carpenter then charges tax on top of the total cost of 21%.

(a) Defining suitable variables, write down an equation to represent the charges, including tax, made by the carpenter.

[2 marks]

Question 6b

Carpenter B charges a fixed fee of $35 and $26.50 per hour. These prices already account for tax.

(b) Find the number of hours for which both carpenters charge the same amount.

[4 marks]

Question 6c

Tom needs a job doing by a carpenter that he estimates will take 8.5 hours. Carpenter C has given Tom a fixed quote of $250.

(c) Determine which carpenter would be the cheapest option for Tom.

[2 marks]

Question 7a

The line l_1 has equation $6x + 4y - 21 = 0$ and crosses the x-axis at point A$(p, 0)$.

(a) Find the value of p.

[1 mark]

Question 7b

The line l_2 is perpendicular to l_1 and crosses the x-axis at B$(3p, 0)$.

(b) Write down the equation of l_2. Give your answer in the form $ax + by + d = 0$, where a, b and d are integers.

[2 marks]

Question 7c

l_2 crosses the y-axis at point C.

(c) Find the area of the triangle OAC, where O is the origin. Give your answer as a fraction.

[5 marks]

Question 8

The points $A(x, -5)$ and $B(-1, y)$ lie on the line l_1, where $x, y \in \mathbb{Z}$.
AB has a length of 13 units.

Find all the possible x and y values.

[8 marks]

Question 9a

A quadrilateral has four vertices with coordinates $A(-1, -1), B(2, 2), C(4, 2), D(-1, -3)$.

(a) Show that [AB] and [CD] are parallel.

[1 mark]

Question 9b

(b) Calculate the distance of

(i) AB.

(ii) CD.

[3 marks]

Question 9c

(c) Find the area of the quadrilateral ABCD.

[4 marks]

Question 10

The point F$(-2,\ 4)$ lies on the line l_1. l_1 crosses the y-axis at point G.

Another line, l_2, is perpendicular to l_1 at the point F and crosses the y-axis at the point H$(0, -3)$.

Find the area of the triangle GFH. Give your answer as a fraction.

[6 marks]