

# 2.1 Linear Functions & Graphs

## Question Paper

Course	DPIB 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**

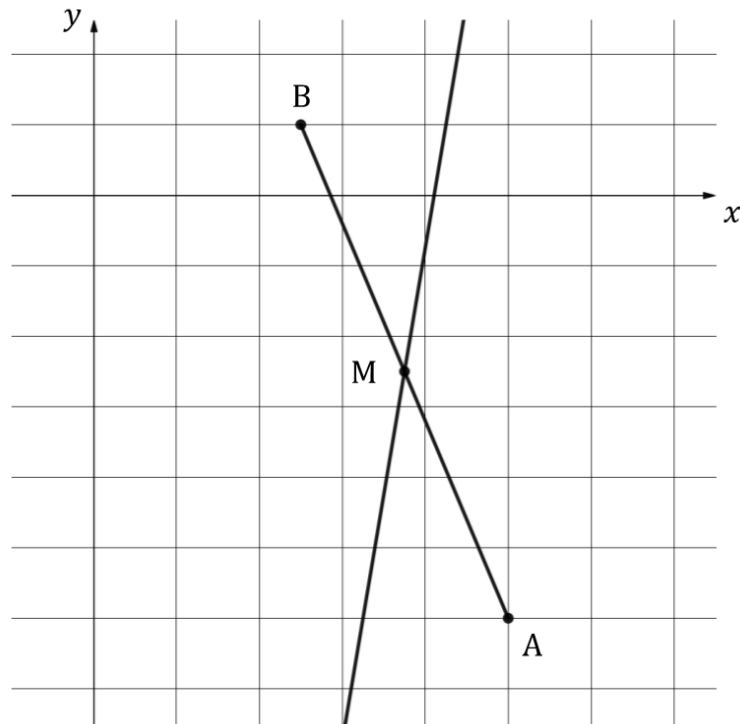
Point C has coordinates  $(x, 4)$  and CD is half the length of AB.

(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]