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# FP1: Linear Laws

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Past Paper Questions  
2006 - 2013

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Name:

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**6** [Figure 1 and Figure 2, printed on the insert, are provided for use in this question.]

The variables  $x$  and  $y$  are known to be related by an equation of the form

$$y = kx^n$$

where  $k$  and  $n$  are constants.

Experimental evidence has provided the following approximate values:

$x$	4	17	150	300
$y$	1.8	5.0	30	50

(a) Complete the table in **Figure 1**, showing values of  $X$  and  $Y$ , where

$$X = \log_{10} x \quad \text{and} \quad Y = \log_{10} y$$

Give each value to two decimal places. (3 marks)

(b) Show that if  $y = kx^n$ , then  $X$  and  $Y$  must satisfy an equation of the form

$$Y = aX + b \quad \text{(3 marks)}$$

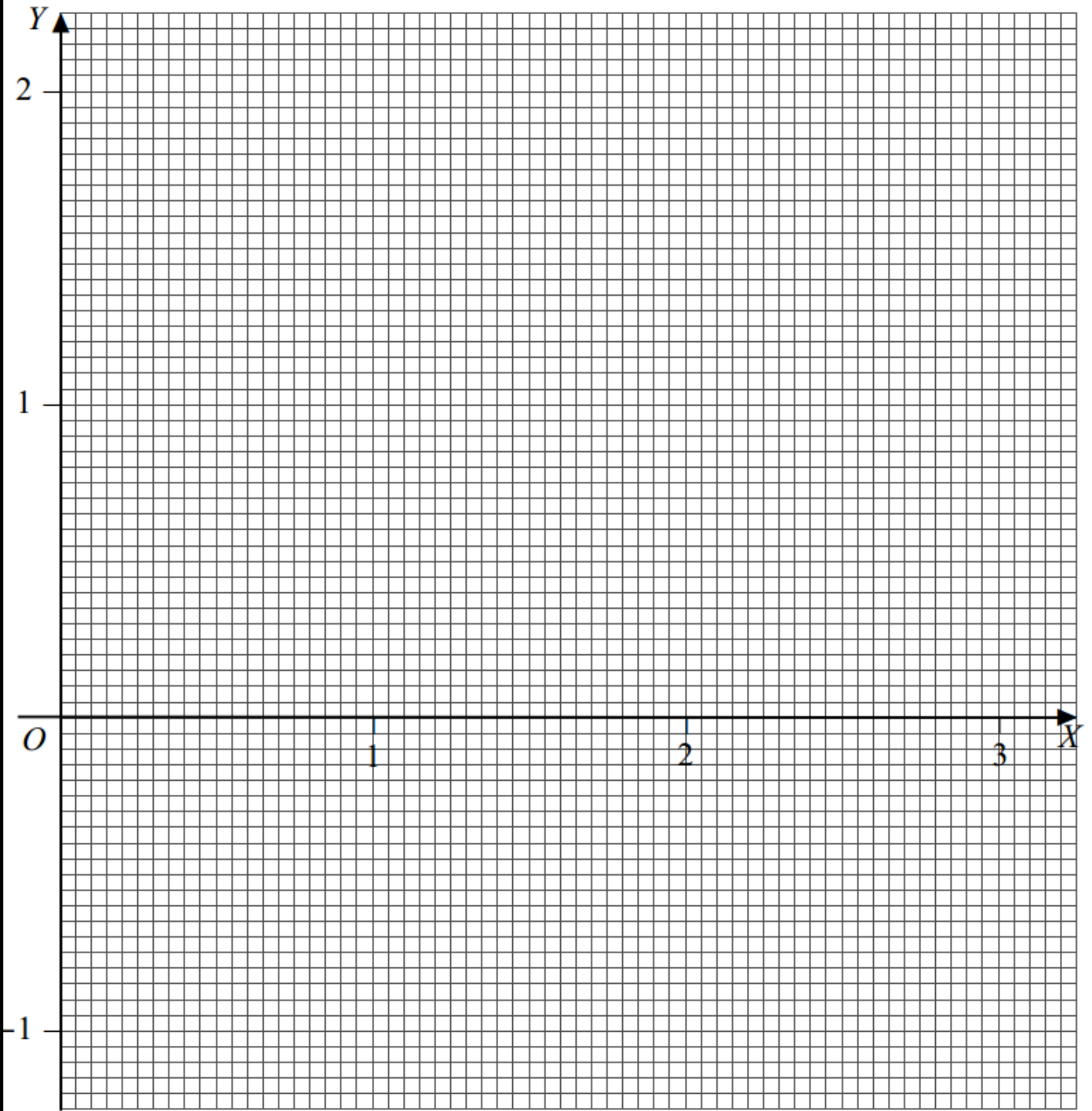
(c) Draw on **Figure 2** a linear graph relating  $X$  and  $Y$ . (3 marks)

(d) Find an estimate for the value of  $n$ . (2 marks)

**Figure 1 (for use in Question 6)**

$X$	0.60			2.48
$Y$	0.26			1.70

**Figure 2 (for use in Question 6)**

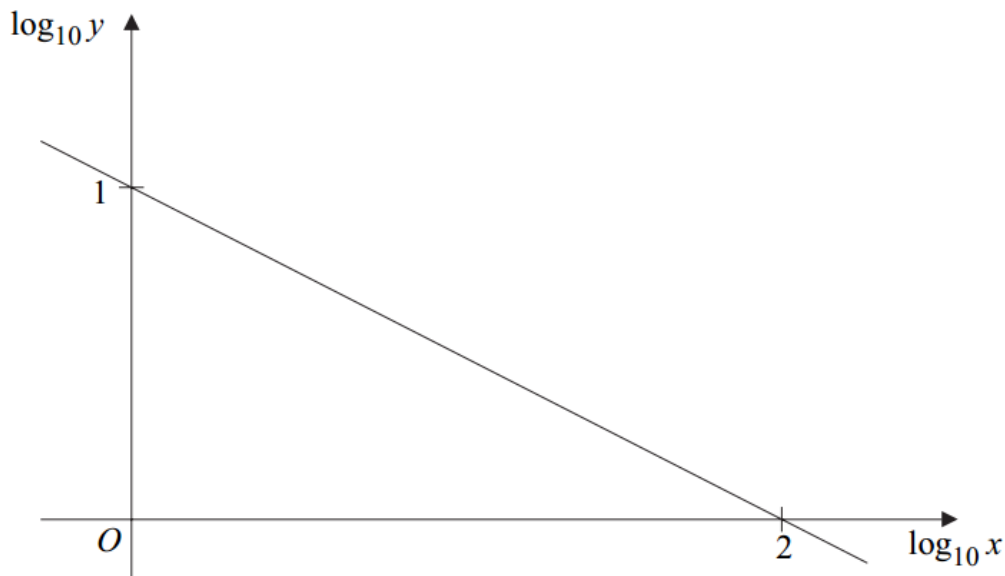


4 The variables  $x$  and  $y$  are related by an equation of the form

$$y = ax^b$$

where  $a$  and  $b$  are constants.

- (a) Using logarithms to base 10, reduce the relation  $y = ax^b$  to a linear law connecting  $\log_{10}x$  and  $\log_{10}y$ . (2 marks)
- (b) The diagram shows the linear graph that results from plotting  $\log_{10}y$  against  $\log_{10}x$ .



Find the values of  $a$  and  $b$ .

(4 marks)

5 [Figure 1 and Figure 2, printed on the insert, are provided for use in this question.]

The variables  $x$  and  $y$  are known to be related by an equation of the form

$$y = ab^x$$

where  $a$  and  $b$  are constants.

The following approximate values of  $x$  and  $y$  have been found.

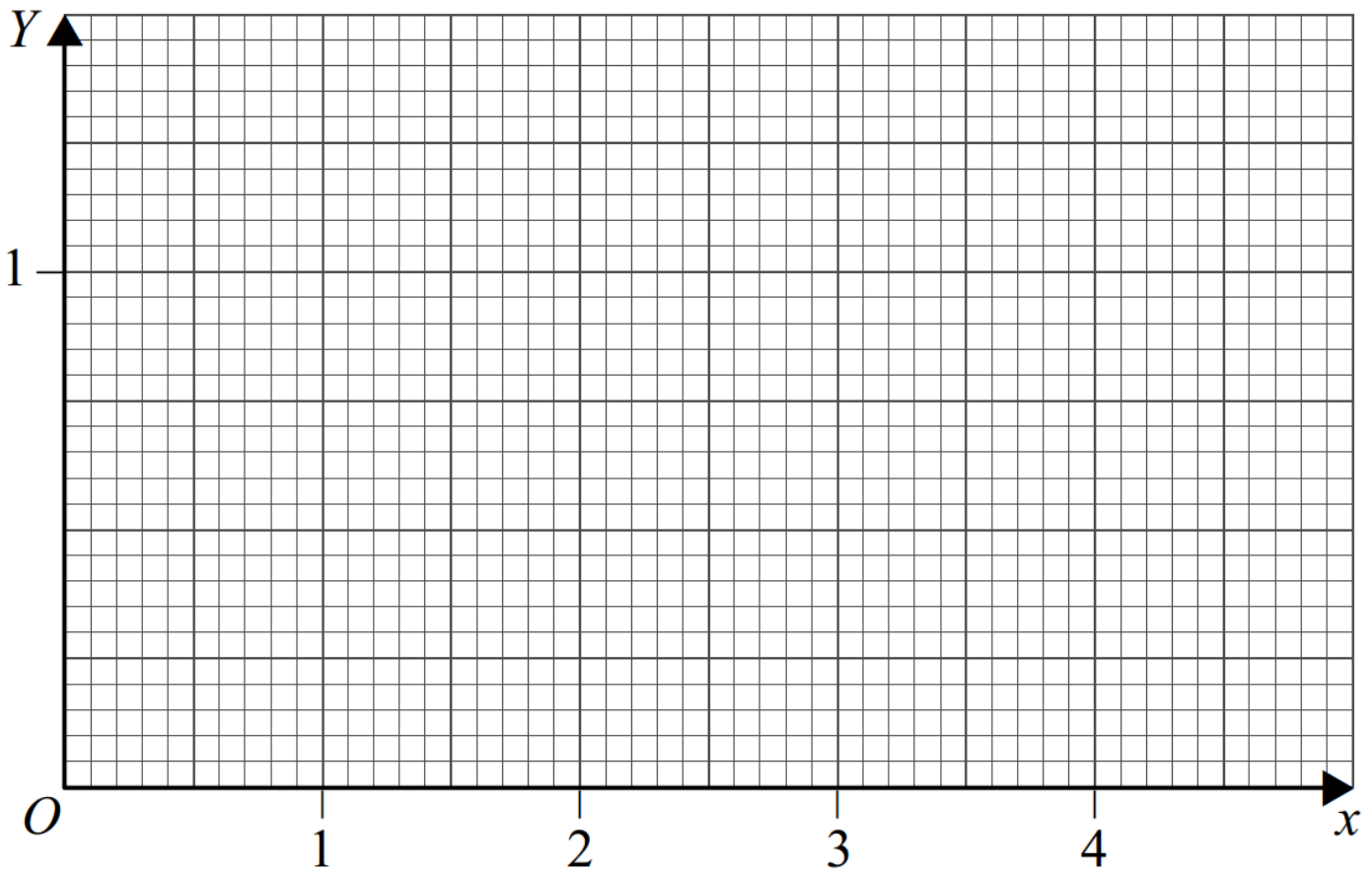
$x$	1	2	3	4
$y$	3.84	6.14	9.82	15.7

- (a) Complete the table in **Figure 1**, showing values of  $x$  and  $Y$ , where  $Y = \log_{10}y$ . Give each value of  $Y$  to three decimal places. (2 marks)
- (b) Show that, if  $y = ab^x$ , then  $x$  and  $Y$  must satisfy an equation of the form
- $$Y = mx + c \quad (3 \text{ marks})$$
- (c) Draw on **Figure 2** a linear graph relating  $x$  and  $Y$ . (2 marks)
- (d) Hence find estimates for the values of  $a$  and  $b$ . (4 marks)

**Figure 1 (for use in Question 5)**

$x$	1	2	3	4
$Y$	0.584			

**Figure 2 (for use in Question 5)**



**4** [Figure 1 and Figure 2, printed on the insert, are provided for use in this question.]

The variables  $x$  and  $y$  are related by an equation of the form

$$y = ax + \frac{b}{x+2}$$

where  $a$  and  $b$  are constants.

- (a) The variables  $X$  and  $Y$  are defined by  $X = x(x+2)$ ,  $Y = y(x+2)$ .

Show that  $Y = aX + b$ .

(2 marks)

- (b) The following approximate values of  $x$  and  $y$  have been found:

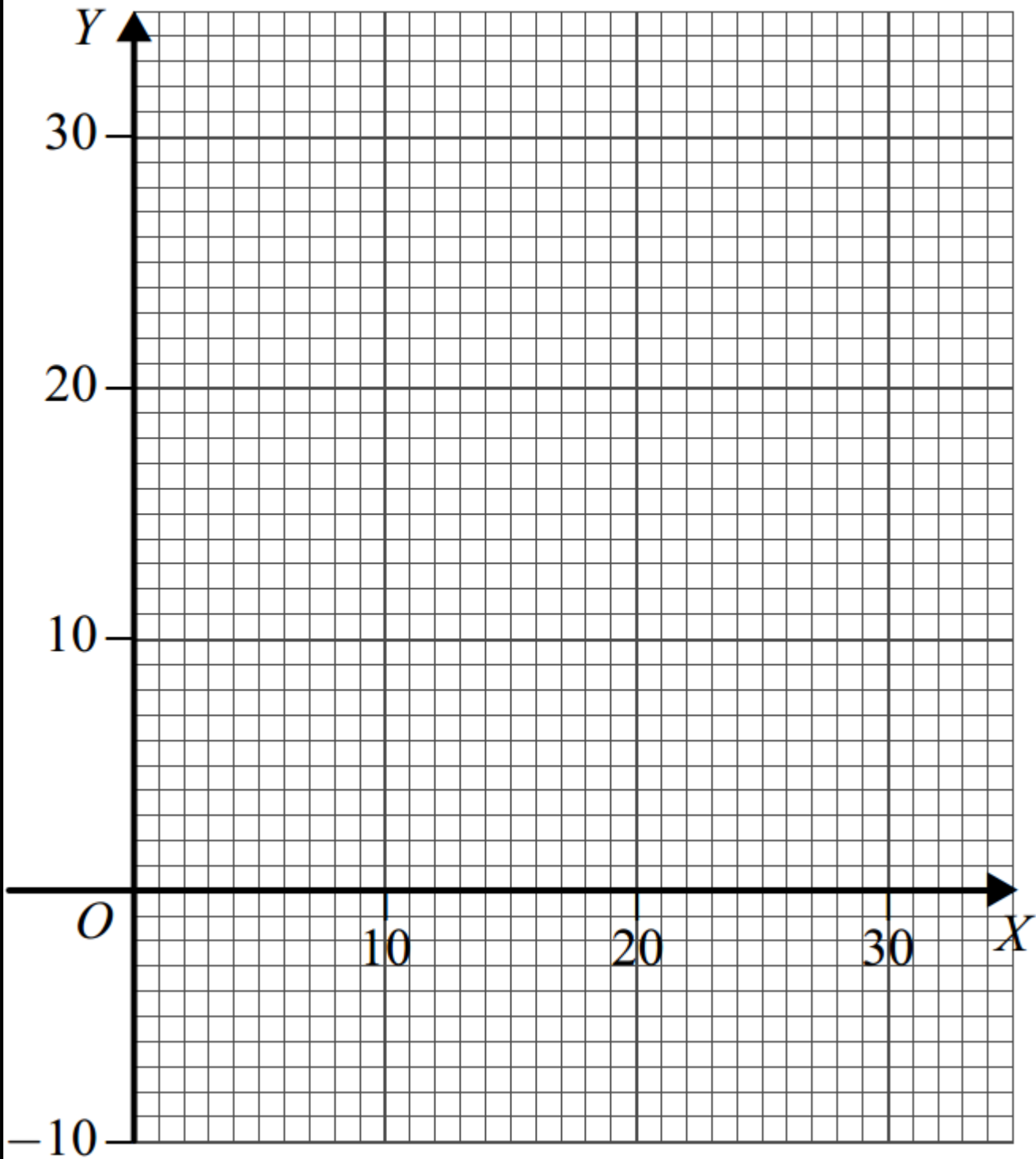
$x$	1	2	3	4
$y$	0.40	1.43	2.40	3.35

- (i) Complete the table in **Figure 1**, showing values of  $X$  and  $Y$ . (2 marks)
- (ii) Draw on **Figure 2** a linear graph relating  $X$  and  $Y$ . (2 marks)
- (iii) Estimate the values of  $a$  and  $b$ . (3 marks)

**Figure 1 (for use in Question 4)**

$x$	1	2	3	4
$y$	0.40	1.43	2.40	3.35
$X$	3			
$Y$	1.20			

**Figure 2 (for use in Question 4)**



- 4** The variables  $x$  and  $y$  are known to be related by an equation of the form

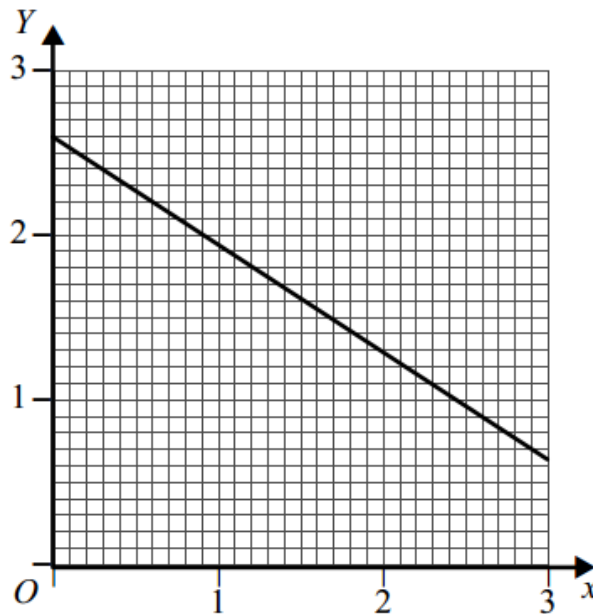
$$y = ab^x$$

where  $a$  and  $b$  are constants.

- (a)** Given that  $Y = \log_{10} y$ , show that  $x$  and  $Y$  must satisfy an equation of the form

$$Y = mx + c \quad (3 \text{ marks})$$

- (b)** The diagram shows the linear graph which has equation  $Y = mx + c$ .



Use this graph to calculate:

- (i)** an approximate value of  $y$  when  $x = 2.3$ , giving your answer to one decimal place;  
**(ii)** an approximate value of  $x$  when  $y = 80$ , giving your answer to one decimal place.

(You are not required to find the values of  $m$  and  $c$ .)

(4 marks)



- 4** The variables  $x$  and  $y$  are related by an equation of the form

$$y = ax^2 + b$$

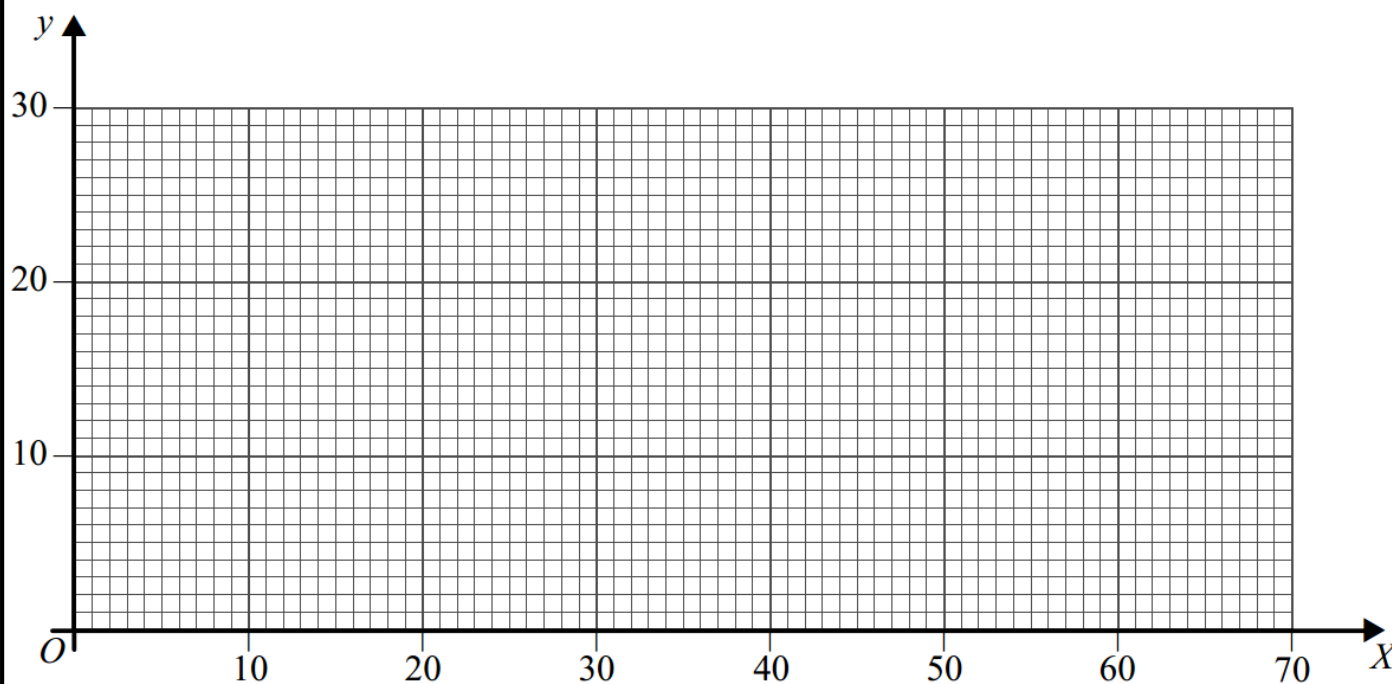
where  $a$  and  $b$  are constants.

The following approximate values of  $x$  and  $y$  have been found.

$x$	2	4	6	8
$y$	6.0	10.5	18.0	28.2

- (a) Complete the table below, showing values of  $X$ , where  $X = x^2$ . (1 mark)
- (b) On the diagram below, draw a linear graph relating  $X$  and  $y$ . (2 marks)
- (c) Use your graph to find estimates, to two significant figures, for:
- (i) the value of  $x$  when  $y = 15$ ; (2 marks)
- (ii) the values of  $a$  and  $b$ . (3 marks)

$x$	2	4	6	8
$X$				
$y$	6.0	10.5	18.0	28.2



- 4** The variables  $x$  and  $Y$ , where  $Y = \log_{10} y$ , are related by the equation

$$Y = mx + c$$

where  $m$  and  $c$  are constants.

- (a)** Given that  $y = ab^x$ , express  $a$  in terms of  $c$ , and  $b$  in terms of  $m$ . (3 marks)

- (b)** It is given that  $y = 12$  when  $x = 1$  and that  $y = 27$  when  $x = 5$ .

On the diagram opposite, draw a linear graph relating  $x$  and  $Y$ . (3 marks)

- (c)** Use your graph to estimate, to two significant figures:

- (i)** the value of  $y$  when  $x = 3$ ; (2 marks)

- (ii)** the value of  $a$ . (2 marks)

- 7** The variables  $y$  and  $x$  are related by an equation of the form

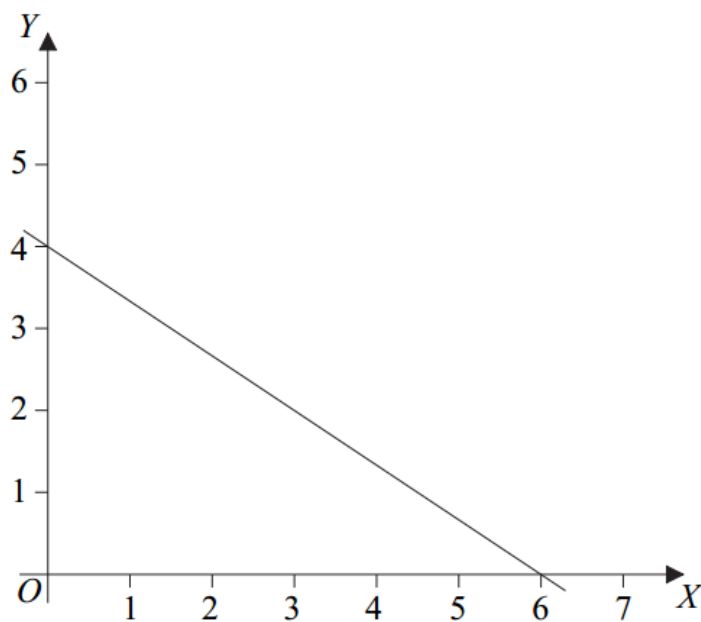
$$y = ax^n$$

where  $a$  and  $n$  are constants.

Let  $Y = \log_{10} y$  and  $X = \log_{10} x$ .

- (a)** Show that there is a linear relationship between  $Y$  and  $X$ . (3 marks)

- (b)** The graph of  $Y$  against  $X$  is shown in the diagram.



Find the value of  $n$  and the value of  $a$ .

(4 marks)