

FP1 Linear Laws Questions

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

$$Y = aX + b$$

(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)

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

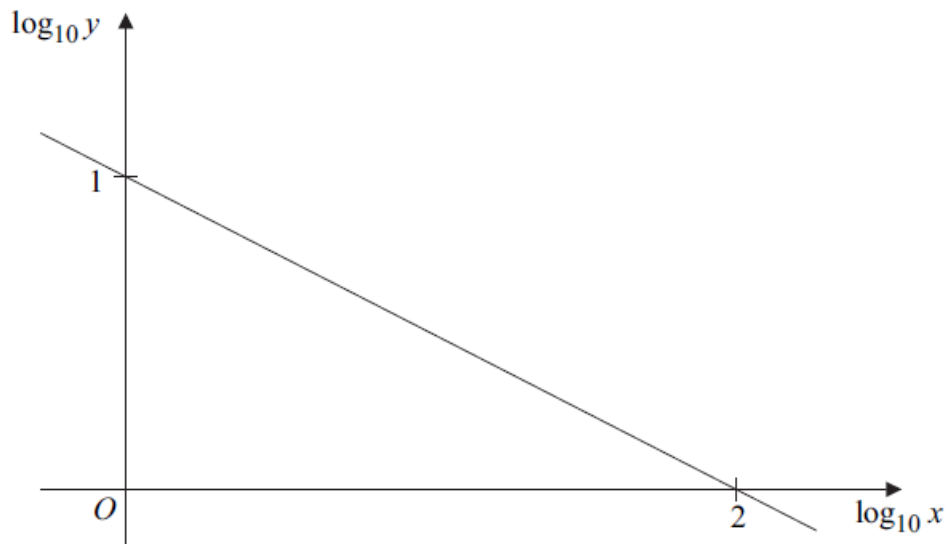
$$y = ax^b$$

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 6)

X	0.60			2.48
Y	0.26			1.70

Figure 2 (for use in Question 6)

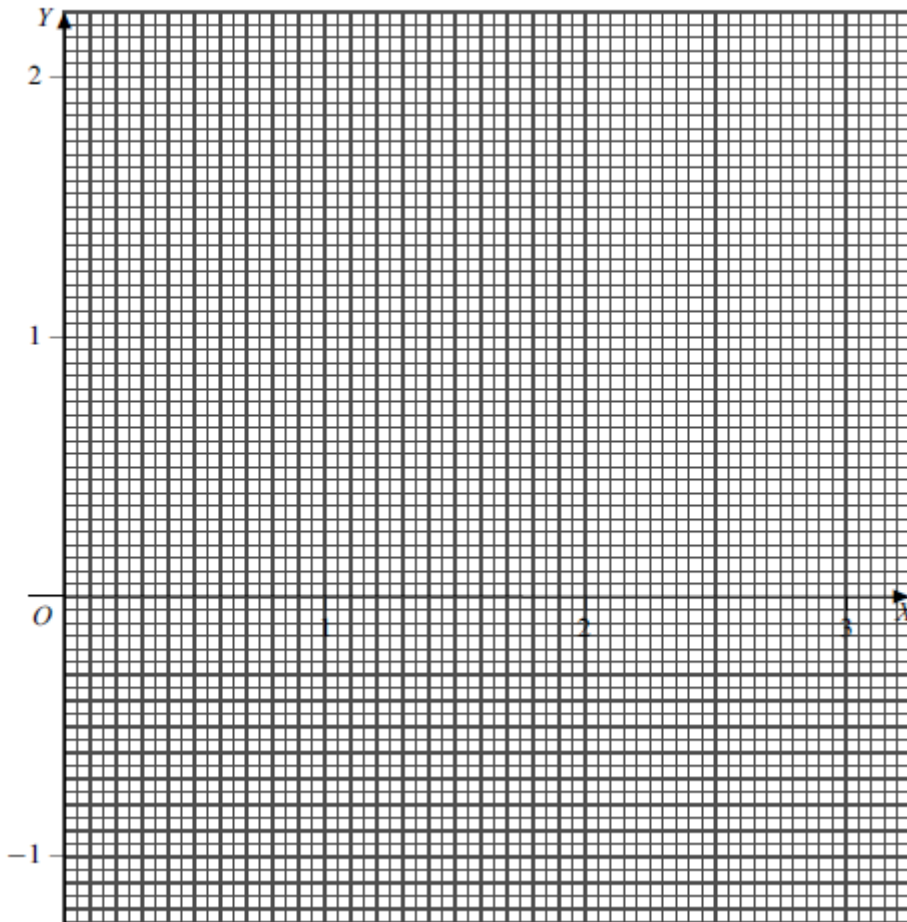
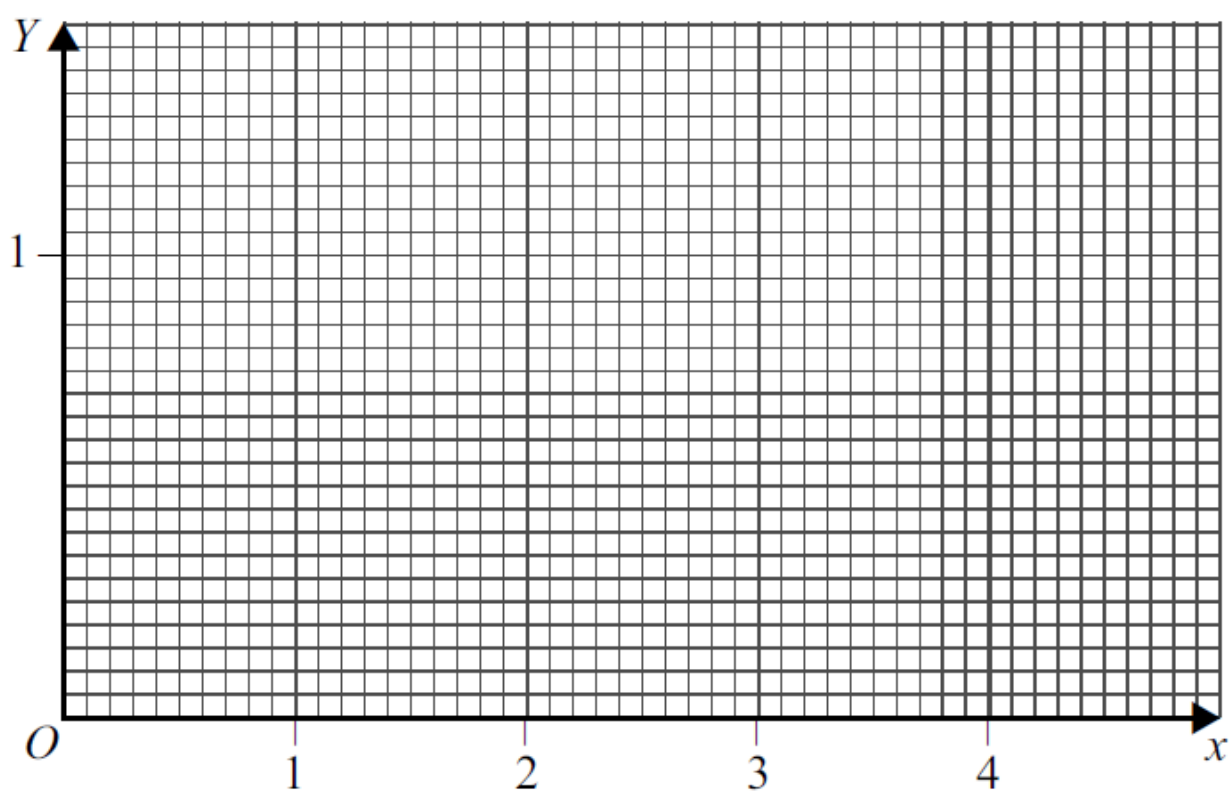


Figure 1 (for use in Question 5)

x	1	2	3	4
Y	0.584			

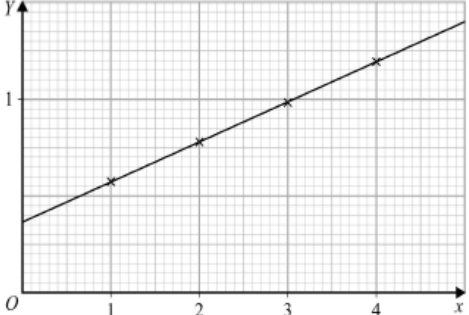
Figure 2 (for use in Question 5)



FP1 Linear Laws Answers

6(a)	X values 1.23, 2.18 Y values 0.70, 1.48	B3,2,1	3	-1 for each error
(b)	$\lg y = \lg k + \lg x^n$ $\lg x^n = n \lg x$ So $Y = nX + \lg k$	M1 M1 A1	3	
(c)	Four points plotted	B2,1 \checkmark		B1 if one error here; ft wrong values in (a) ft incorrect points (approx collinear)
	Good straight line drawn	B1 \checkmark	3	
(d)	Method for gradient Estimate for n	M1 A1 \checkmark	2	Allow AWRT 0.75 - 0.78; ft grad of candidate's graph
Total			11	

4(a)	$\lg y = \lg a + b \lg x$	M1A1	2	M1 for use of one log law
(b)	Use of above result $a = 10$ $b = \text{gradient}$ $\dots = -\frac{1}{2}$	M1 A1 m1 A1	4	
Total			6	OE; PI by answer $\pm \frac{1}{2}$

5(a)	Values 0.788, 0.992, 1.196 in table	B2,1	2	B1 if one correct (or if wrong number of dp given)
(b)	$\lg ab^x = \lg a + \lg b^x$ $\lg b^x = x \lg b$ So $Y = (\lg b)x + \lg a$	M1 M1 A1	3	
(c)		B1F	2	Four points plotted; ft wrong values in (a) Good straight line drawn; ft incorrect points
		B1F	2	
(d)	$a = \text{antilog of } y\text{-intercept}$ $b = \text{antilog of gradient}$	M1A1 M1A1	4	Accept 2.23 to 2.52 Accept 1.58 to 1.62
Total			11	