1 **Answer part (ii) of this question on the insert provided.**

The proposal for a major building project was accepted, but actual construction was delayed. Each year a new estimate of the cost was made. The table shows the estimated cost, £y million, of the project t years after the project was first accepted.

Years after proposal accepted (t)	1	2	3	4	5
Cost (£y million)	250	300	360	440	530

The relationship between y and t is modelled by $y = ab^t$, where a and b are constants.

(i) Show that $y = ab^t$ may be written as

$$\log_{10} y = \log_{10} a + t \log_{10} b.$$ **[2]**

(ii) **On the insert**, complete the table and plot $\log_{10} y$ against t, drawing by eye a line of best fit. **[3]**

(iii) Use your graph and the results of part **(i)** to find the values of $\log_{10} a$ and $\log_{10} b$ and hence a and b. **[4]**

(iv) According to this model, what was the estimated cost of the project when it was first accepted? **[1]**

(v) Find the value of t given by this model when the estimated cost is £1000 million. Give your answer rounded to 1 decimal place. **[2]**

2 **(i)** Find $\sum_{k=2}^{5} 2^k$. [2]

(ii) Find the value of n for which $2^n = \frac{1}{64}$. [1]

(iii) Sketch the curve with equation $y = 2^x$. [2]

3 You are given that $\log_{10} y = 3x + 2$.

(i) Find the value of x when $y = 500$, giving your answer correct to 2 decimal places. [1]

(ii) Find the value of y when $x = -1$. [1]

(iii) Express $\log_{10}(y^4)$ in terms of x. [1]

(iv) Find an expression for y in terms of x. [1]

4 **(i)** Express $\log_a x^4 + \log_a\left(\frac{1}{x}\right)$ as a multiple of $\log_a x$. [2]

(ii) Given that $\log_{10} b + \log_{10} c = 3$, find b in terms of c. [2]

5 **Answer part (ii) of this question on the insert provided.**

The table gives a firm's monthly profits for the first few months after the start of its business, rounded to the nearest £100.

Number of months after start-up (x)	1	2	3	4	5	6
Profit for this month (£y)	500	800	1200	1900	3000	4800

The firm's profits, £y, for the xth month after start-up are modelled by

$$y = k \times 10^{ax}$$

where a and k are constants.

(i) Show that, according to this model, a graph of $\log_{10} y$ against x gives a straight line of gradient a and intercept $\log_{10} k$. [2]

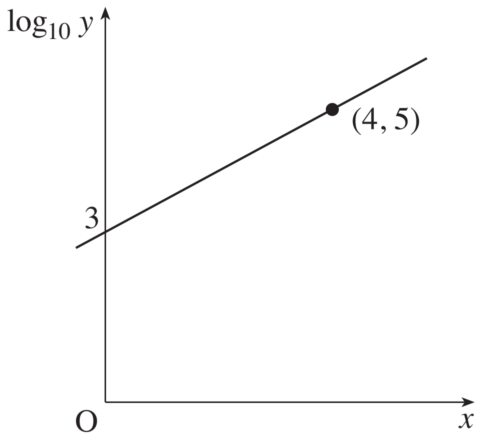
(ii) **On the insert**, complete the table and plot $\log_{10} y$ against x, drawing by eye a line of best fit. [3]

(iii) Use your graph to find an equation for y in terms of x for this model. [3]

(iv) For which month after start-up does this model predict profits of about £75 000? [3]

(v) State one way in which this model is unrealistic. [1]

6



Not to scale

Fig. 9

The graph of $\log_{10} y$ against x is a straight line as shown in Fig. 9.

(i) Find the equation for $\log_{10} y$ in terms of x. [3]

(ii) Find the equation for y in terms of x. [2]

7 **(i)** Granny gives Simon £5 on his 1st birthday. On each successive birthday, she gives him £2 more than she did the previous year.

(*A*) How much does she give him on his 10th birthday? [2]

(*B*) How old is he when she gives him £51? [2]

(*C*) How much has she given him **in total** when he has had his 20th birthday present? [2]

(ii) Grandpa gives Simon £5 on his 1st birthday and increases the amount by 10% each year.

(*A*) How much does he give Simon on his 10th birthday? [2]

(*B*) Simon first gets a present of over £50 from Grandpa on his nth birthday. Show that

$$n > \frac{1}{\log_{10} 1.1} + 1.$$

Find the value of n. [5]