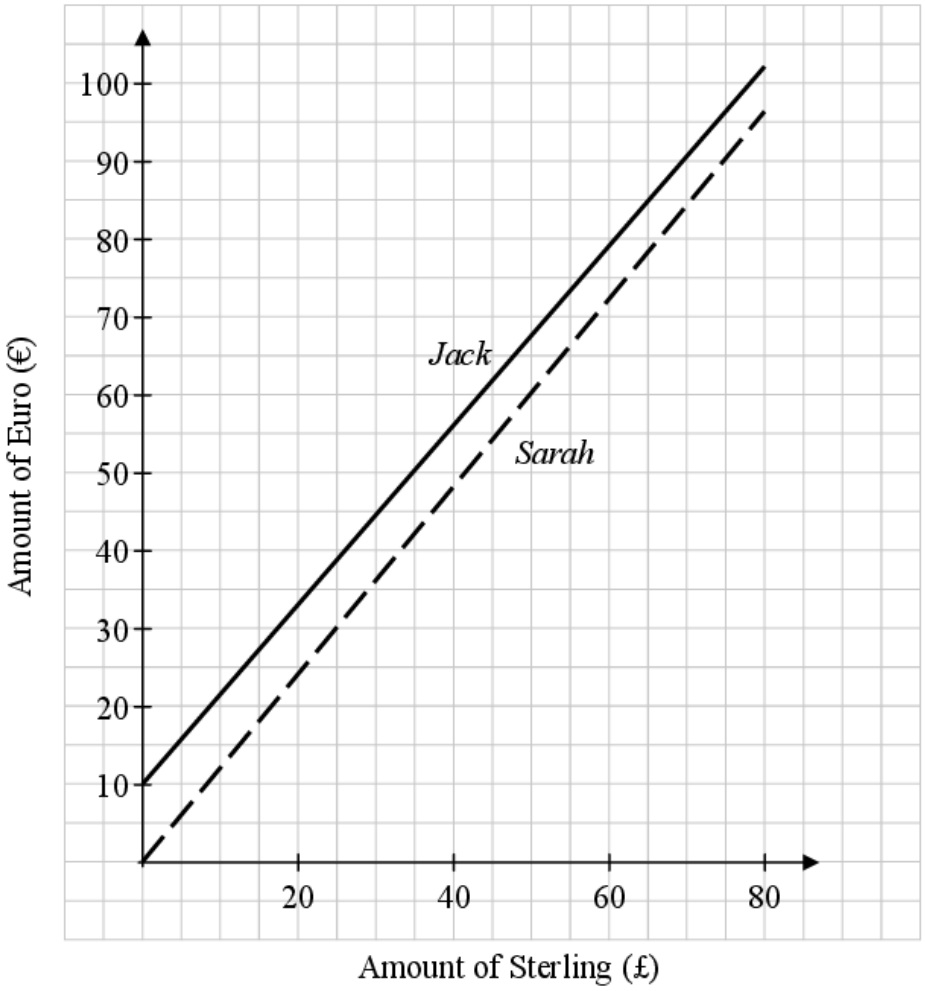
Question 1

(i) On the grid below, draw graphs to show how much the sterling will cost Jack and Sarah, for up to £80.



(ii) Using the table, or your graph, find the slope (rate of change) of Jack's graph.
Explain what this value means. Refer to both euro and sterling in your explanation.

$\text{Slope} = \frac{56-33}{40-20} = \frac{23}{20}$, *or* $1{\cdot}15$.

Explanation: Each extra £1 costs Jack an extra €$1{\cdot}15$.

Or:

Explanation: Each £1 costs Jack €$1{\cdot}15$, after an initial fee of €10.

(iii) Write down a formula to represent what Jack must pay, in euro, for any given amount of sterling. State clearly the meaning of any letters you use in your formula.

$e = 1{\cdot}15s + 10$, where s is the amount, in sterling, and e is the amount, in euro.

(iv) Write down a formula to represent what Sarah must pay, in euro, for any given amount of sterling. State clearly the meaning of any letters you use in your formula.

$\text{Slope} = \frac{48-24}{40-20} = \frac{6}{5}$, *or* $1{\cdot}2$. y-intercept $= 0$

$e = 1{\cdot}2s$, where s is the amount, in sterling, and e is the amount, in euro.

(v) Using your formulas from **(iii)** and **(iv)**, or otherwise, find the amount of sterling Jack and Sarah could buy that would cost them the same amount each in euro.

Using formulas:

$e = 1{\cdot}15s + 10$ and $e = 1{\cdot}2s$, so $1{\cdot}15s + 10 = 1{\cdot}2s$,

i.e. $s = 200$ and $e = 240$.

Amount of sterling: £200.

From table:

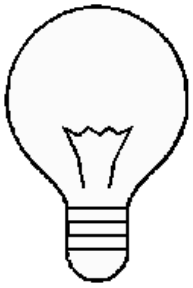
Each time the amount of sterling goes up by 20, the difference between the costs decreases by €1.

This difference is €9 for £20.

So after 9 increases, i.e. increase of $9 \times 20 = £180$, the costs are the same, i.e. for £200.

Question 2

Lisa is on a particular payment plan called "Plan A" for her electricity. She pays a standing charge each month even if no electricity is used. She also pays a rate per unit used. The table shows the cost, including the standing charge, of using different amounts of units, in a month.

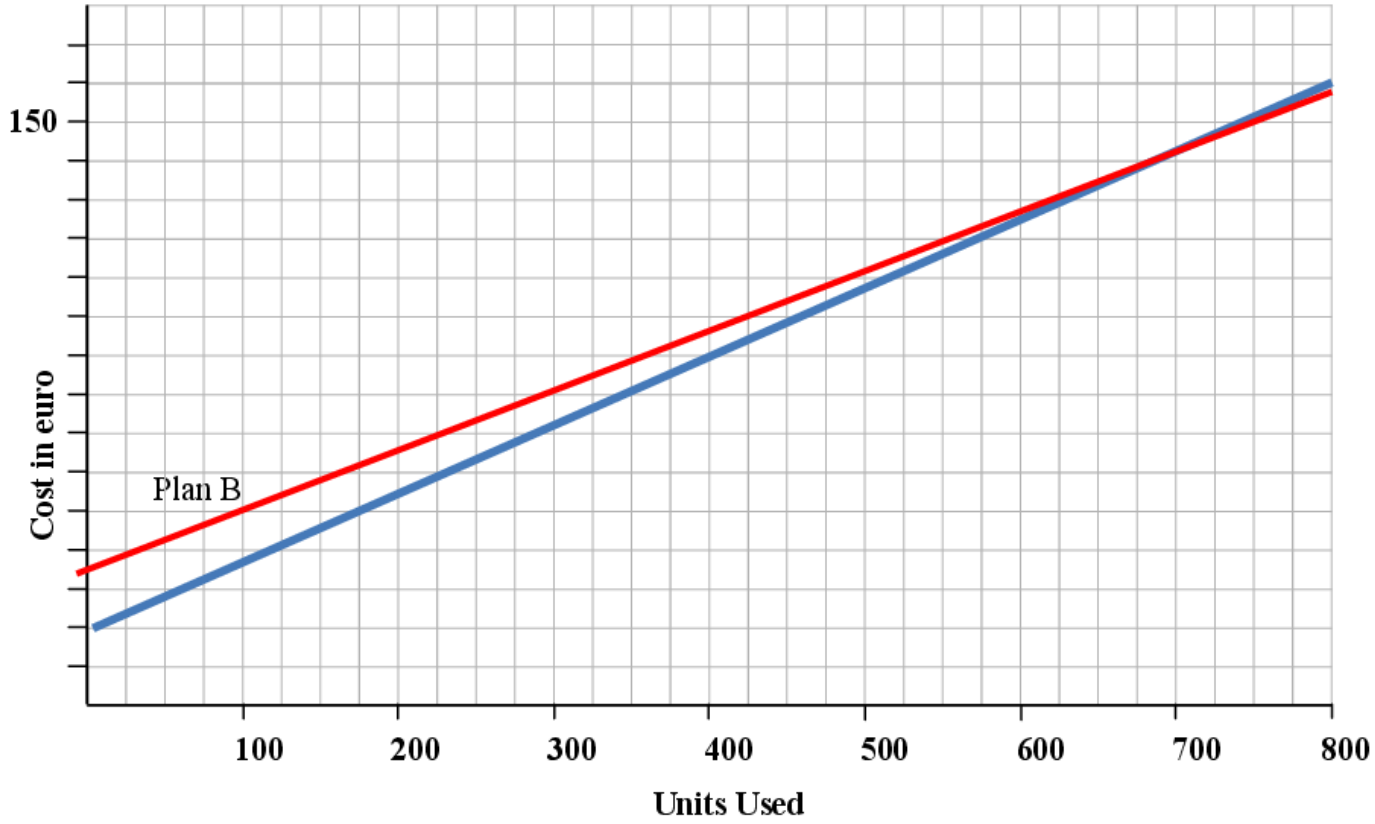


Units Used	Plan A Cost in euro
100	38
200	56
300	74
400	92
500	110
600	128
700	146
800	164

(a) Use the data in the table to show that the relationship between the number of units used and the cost is linear.

$56-38=18,\ 74-56=18,\ 92-74=18,$
$110-92=18,\ 128-110=18,$
$146-128=18,\ 164-146=18$
Common first difference of 18

(b) Draw a graph to show the relationship between the number of units used and the cost of electricity.



(c) Use your graph to estimate the standing charge. _____€20_____

(d) Write down a different method of finding the standing charge.
Find the standing charge using your method.

Method:

When the units used go down by 100 then the cost goes down by 18.
=> 38 – 18 = 20

$$m = \frac{56-38}{200-100} = 0{\cdot}18 \left(\text{or } \frac{9}{50} \right)$$
$$y - 38 = 0{\cdot}18(x - 100)$$
$$0{\cdot}18x - y + 20 = 0$$
$$sub\ x = 0$$
$$=> y = 20$$

Standing charge:€20

(e) Write down a formula to represent the relationship between the number of units used and the cost for any given number of units.

$$\text{Cost} = 20 + 0{\cdot}18x$$

(f) The table above does not include VAT. One month Lisa used 650 units.
Her total bill for that month, including VAT, was €155·50.
Find the VAT rate on electricity, correct to one decimal place.

$650 \times 0{\cdot}18 + 20 = 137$

$155{\cdot}5 - 137 = 18{\cdot}5$

$\frac{18{\cdot}5}{137} \times 100 = 13{\cdot}5\%$ VAT

$650 \times 18 + 2000 = 13\,700$

$15550 - 13700 = 1850$

$\frac{1850}{13700} \times 100 = 13{\cdot}5\%$ VAT

(g) Lisa is offered a new plan, "Plan B", where the standing charge is €36 and the rate per unit used is 15·5 cent. Complete the following table for Plan B.

Units Used	Plan B Cost in euro
100	€51·50
200	€67·00
300	€82·50
400	€98·00
500	€113·50
600	€129·00
700	€144·50
800	€160·00

(h) Which plan do you think Lisa should choose? Give a reason for your answer.

Scenario 1: Concentrates on 650 units

[36 + 0·155 × 650 = €136·75]
The cost of Plan A and Plan B are very similar therefore it doesn't really matter which plan Lisa chooses
OR
Lisa should choose plan B as it is 25c cheaper

Scenario 2: Concentrates on low and/or high usage

If Lisa tends to use a low number of units on average then plan A is better but if she uses a high number of units on average then Plan B is better.

(i) On your diagram for part **(b)**, draw a graph to show the relationship between the number of units used and the cost of electricity for Plan B. Label this graph "Plan B".

(j) Use your diagram to find the number of units for which both plans have the same cost.

640 units

Question 3

(i) Is the pattern of heights in the table linear, quadratic, or exponential? Explain your answer.

Time (seconds)	0	0·5	1	1·5	2	2·5	3
Height (metres)	0·3	3·4	5·7	7·2	7·9	7·8	6·9

First difference: 3·1 2·3 1·5 0·7 –0·1 –0·9

Second difference: –0·8 –0·8 –0·8 –0·8 –0·8

Answer: Quadratic.

Reason: The first differences are not all the same, but the second differences are.

(ii) Estimate the height of the ball after 3·5 seconds.

5·2 metres.

Second difference: –0·8 –0·8

First difference: –0·1 –0·9 –1·7

Height (m): 7·9 7·8 6·9 5·2

Time (s): 2 2·5 3 3·5

(iii) Estimate the total time the ball spends in the air. Justify your answer.

Continuing the method for **(ii)**:

Second difference: –0·8 –0·8 –0·8 –0·8

First difference: –0·1 –0·9 –1·7 –2·5 –3·3

Height (m): 7·9 7·8 6·9 5·2 2·7 –0·6

Time (s): 2 2·5 3 3·5 4 4·5

Answer: The ball spends roughly 4·4 seconds in the air. Its height is 0 just before 4·5 seconds.

Or, graphically:

From the graph, the ball spends roughly 4·4 seconds in the air