

**TEST 11****Linear Graphs and Their Applications**

Marks: /80

Time: 1 hour 30 minutes

Name: .....

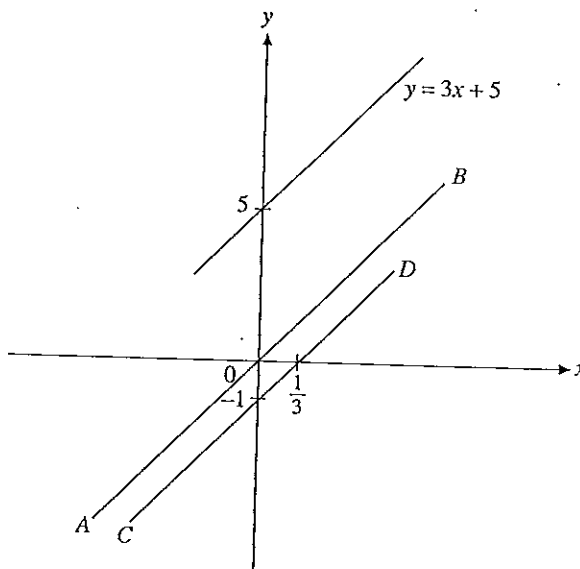
Date: .....

**INSTRUCTIONS TO CANDIDATES****Section A (40 marks)****Time: 45 minutes**

1. Answer all the questions in this section.
2. Calculators may not be used in this section.
3. All working must be clearly shown. Omission of essential working will result in loss of marks.
4. The marks for each question is shown in brackets [ ] at the end of each question.

- 1 The diagram shows the graph of  $y = 3x + 5$ . Given that the lines  $AB$  and  $CD$  are parallel to the line  $y = 3x + 5$ , find the equation of the line

- (a)  $AB$ ,
- (b)  $CD$ .

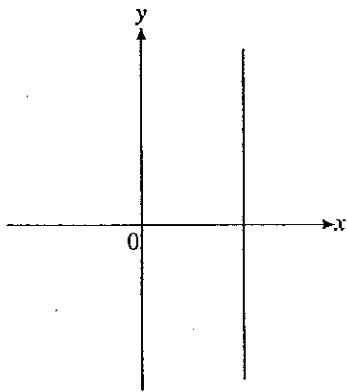


Answer (a) ..... [1]

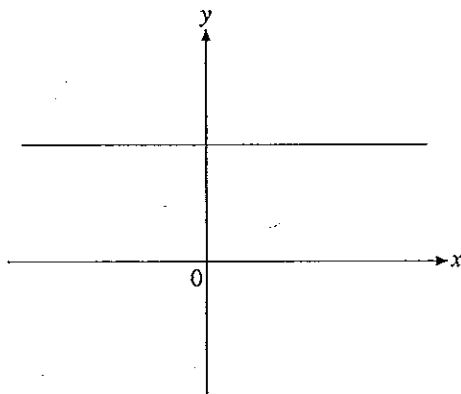
(b) ..... [1]

2. The diagrams below show 4 graphs and 4 equations. Match each graph to the most suitable equation.

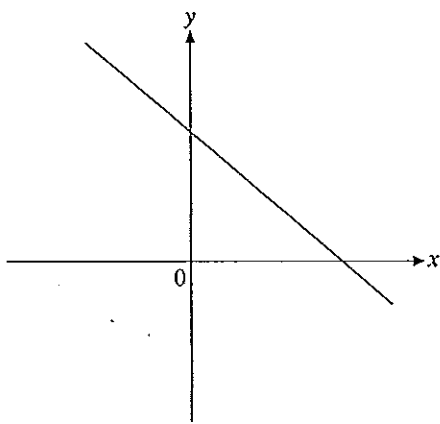
(A)



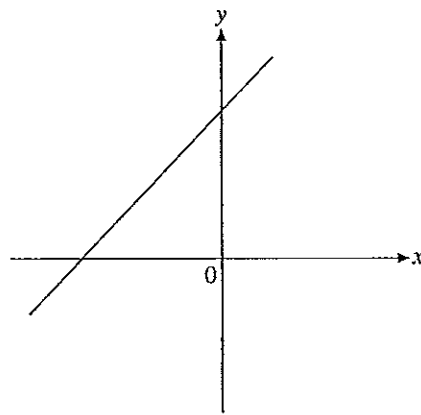
(B)



(C)



(D)



(P)  $y = 3$

(Q)  $y = x + 3$

(R)  $x = 3$

(S)  $y = 3 - x$

Answer (A) .....

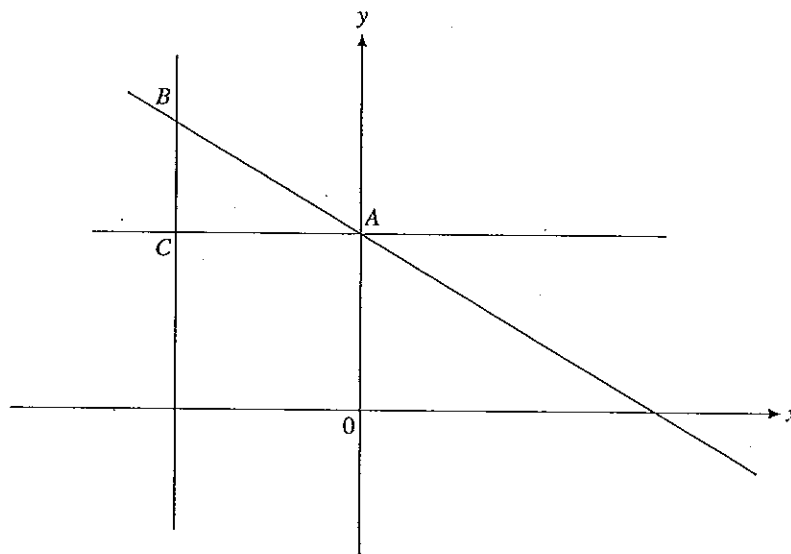
(B) .....

(C) .....

(D) ..... [4]

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- 3 In the diagram, the line  $y = 5 - x$  cuts the  $y$ -axis at  $A$ . The line  $x = -3$  cuts the line  $y = 5 - x$  at  $B$ .
- Write down the coordinates of  $A$  and  $B$ .
  - The line passing through  $A$  and parallel to the  $x$ -axis cuts the line  $x = -3$  at  $C$ . Write down the coordinates of  $C$ .
  - Calculate the area of triangle  $ABC$ .



Answer (a)  $A = \dots\dots\dots$

$B = \dots\dots\dots$  [2]

(b)  $C = \dots\dots\dots$  [1]

(c)  $\dots\dots\dots$  units<sup>2</sup> [2]

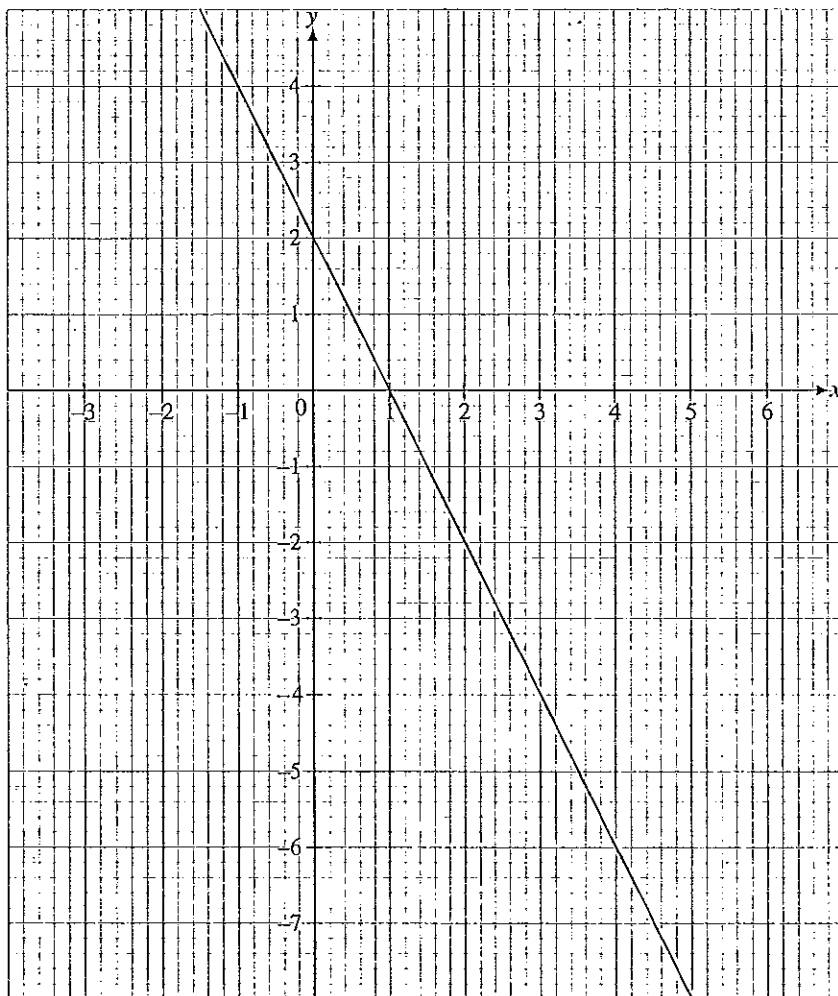
4 The diagram shows the graph of the straight line  $2x + y = 2$ .

(a) On the same axes, draw the graph of  $y = \frac{1}{3}x - 5$ .

(b) Use your graph to solve the simultaneous equations  $2x + y = 2$ ,  $y = \frac{1}{3}x - 5$  graphically.

Answer (a)

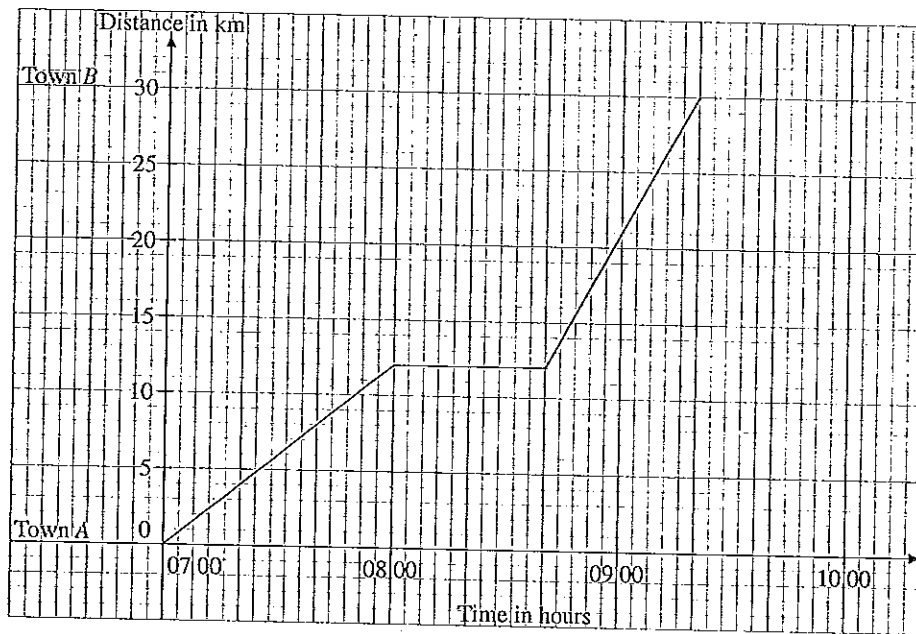
[3]



Answer (b)  $x = \dots\dots\dots$

$y = \dots\dots\dots$  [2]

- 5 The diagram shows a cyclist's journey from Town A to Town B which is 30 km away. On the way, the cyclist stopped at a petrol station to take a break before continuing his journey to Town B.
- How far is the petrol station from Town B?
  - Find the cyclist's average speed for the whole journey.
  - If the cyclist travelled at the initial constant speed throughout the journey without stopping for a break, what time would he have arrived at Town B?



Answer (a) ..... km [1]

(b) ..... km/h [2]

(c) ..... [1]

- 6 Diagram I shows the exchange rates between Canadian dollars (C\$) and the Singapore dollars (S\$).
- (a) Use the graph to estimate the amount of Singapore dollars that can be exchanged for C\$19.

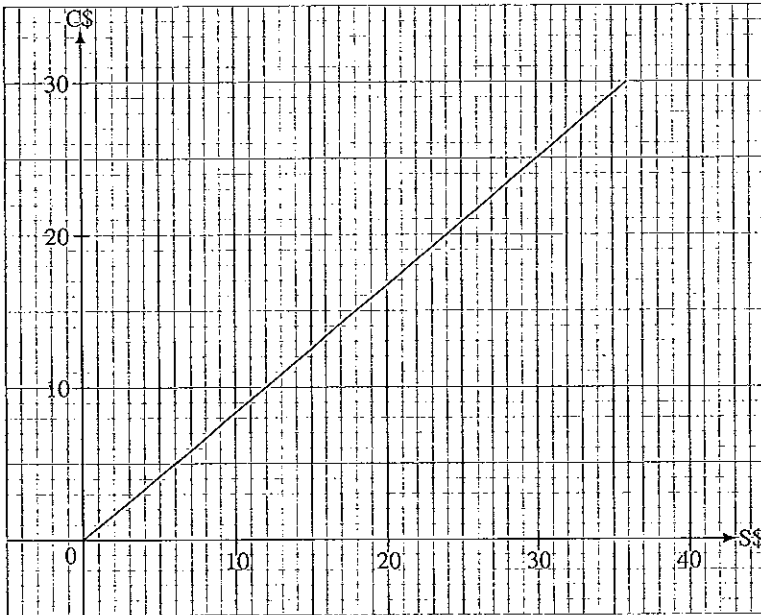


Diagram I

- Diagram II shows the exchange rates between British pounds (£) and the Singapore dollars (S\$).
- (b) Use the graph to estimate the equivalent amount of Singapore dollars to £12.

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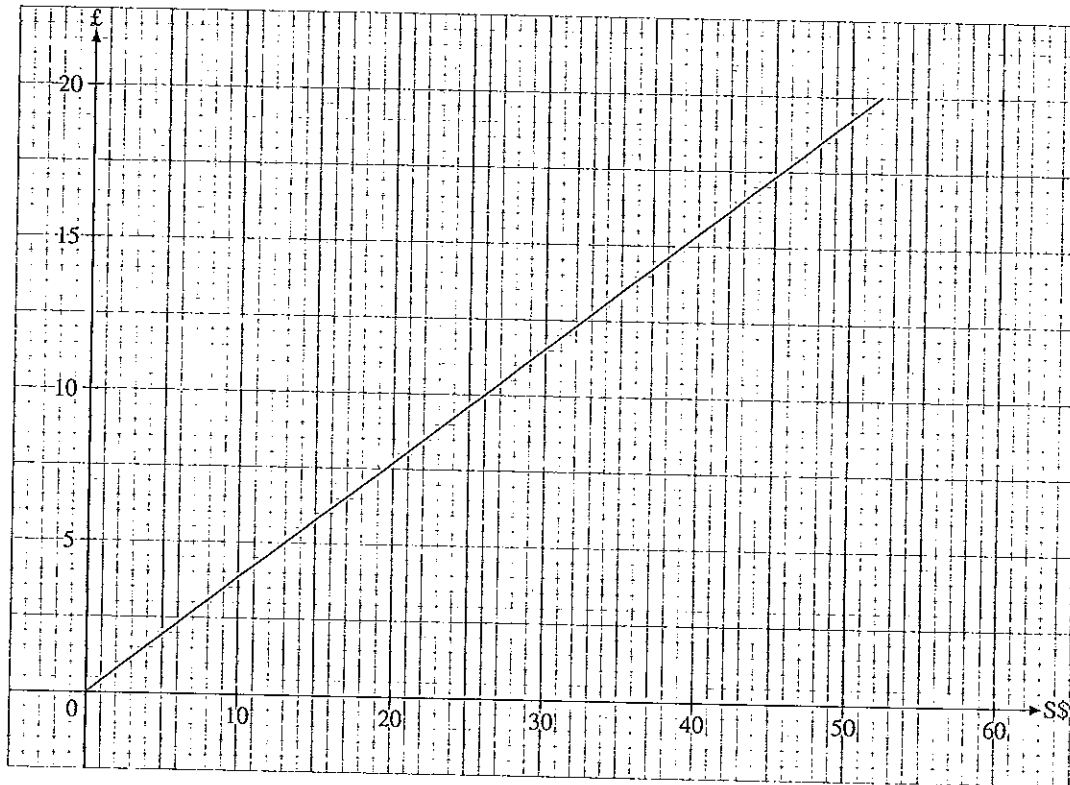


Diagram II

(c) Hence, use the two graphs to estimate the equivalent amount of C\$ for £12.

Answer (a) S\$ ..... [1]

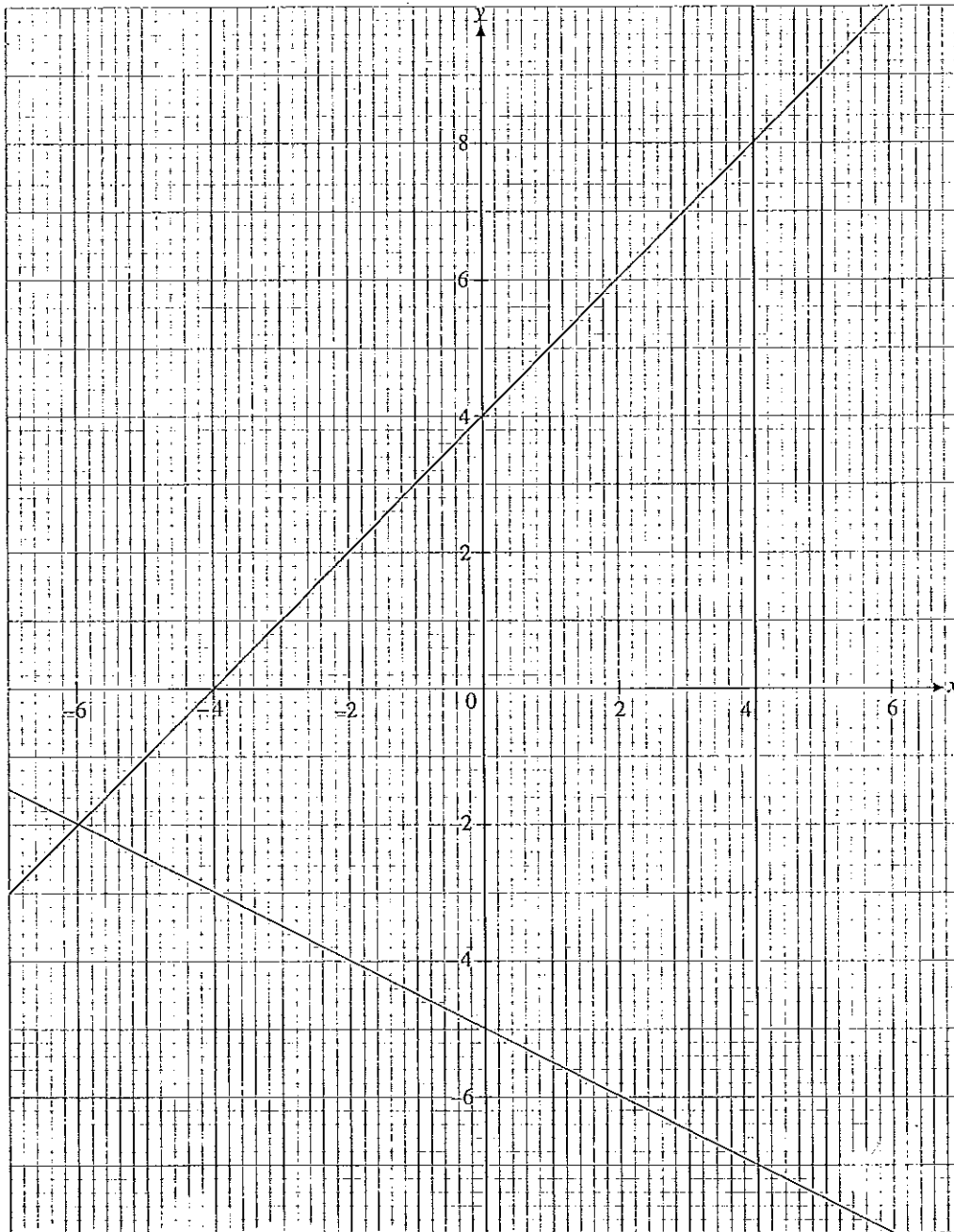
(b) S\$ ..... [1]

(c) C\$ ..... [2]

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7 The  
of t  
(a)  
(b)

- 7 The diagram shows three lines,  $l_1$ ,  $l_2$  and  $l_3$ . The equation of the line  $l_1$  is  $y = x + 4$  and the equation of the line  $l_2$  is  $2y + x = -10$ .
- (a) Use the graphs to solve the simultaneous equations  $y = x + 4$  and  $2y + x = -10$ .
- (b) Write down the equation of the line  $l_3$ .



Answer (a)  $x = \dots\dots\dots$

$y = \dots\dots\dots$  [2]

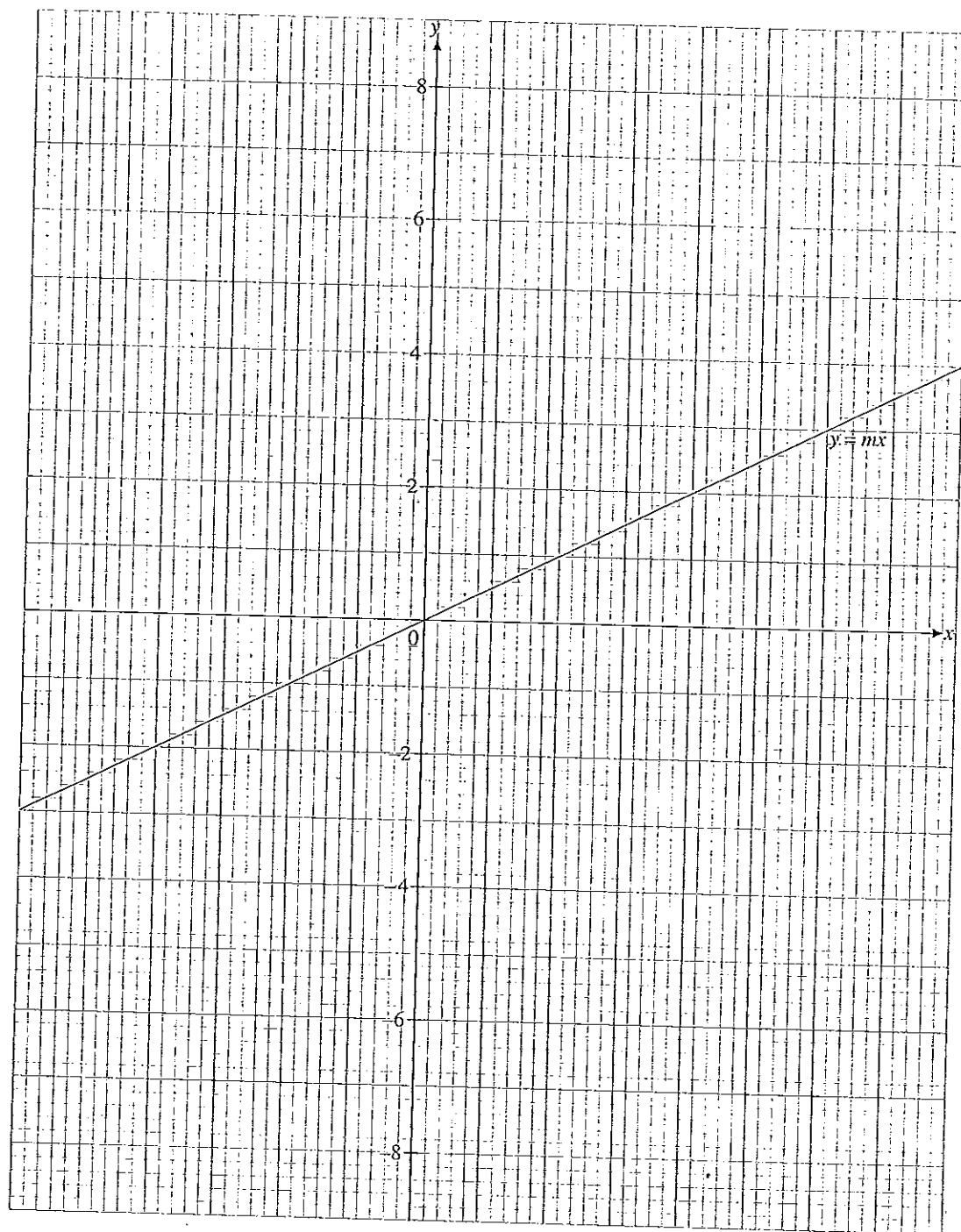
(b)  $\dots\dots\dots$  [1]



- 8 The diagram shows the graph of  $y = mx$ . On the same diagram, sketch and label clearly the lines
- (a)  $y = -mx$ ,
  - (b)  $y = mx - 6$ .

Answer (a), (b)

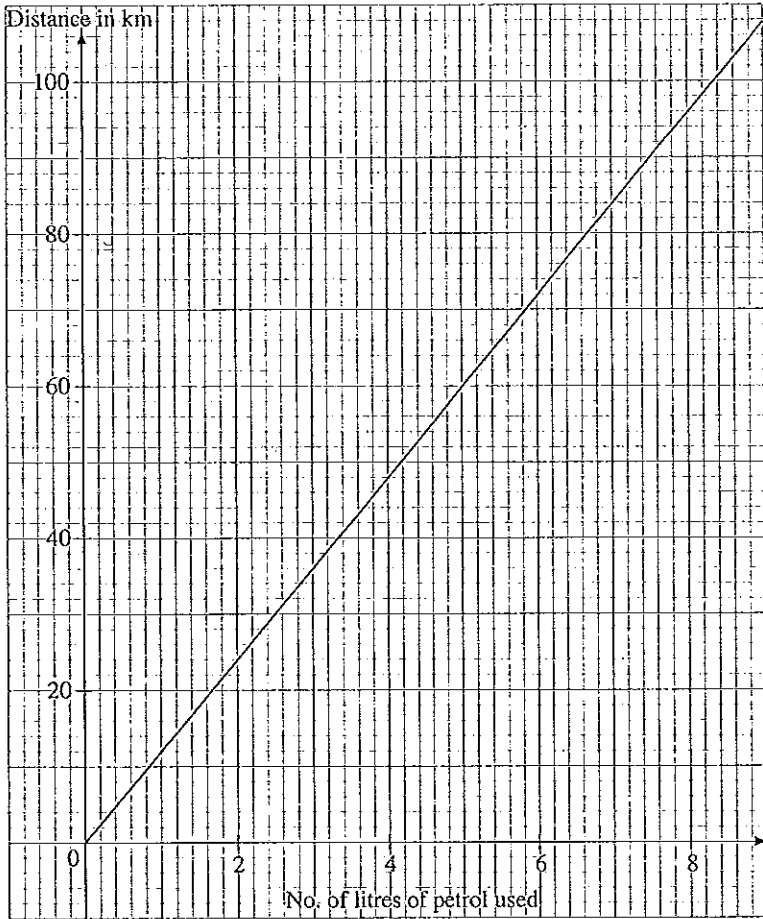
[2]



9 The diagram below shows the relation between the number of litres of petrol used by a car and the distance travelled by the car.

Use the graph to find

- (a) how far the car can travel using 5 litres of petrol,
- (b) the number of litres of petrol needed by the car to travel 80 km,
- (c) the cost of petrol to travel a distance of 90 km, given that 1 litre of petrol costs \$1.40.



Answer (a) ..... km [1]

(b) ..... l [1]

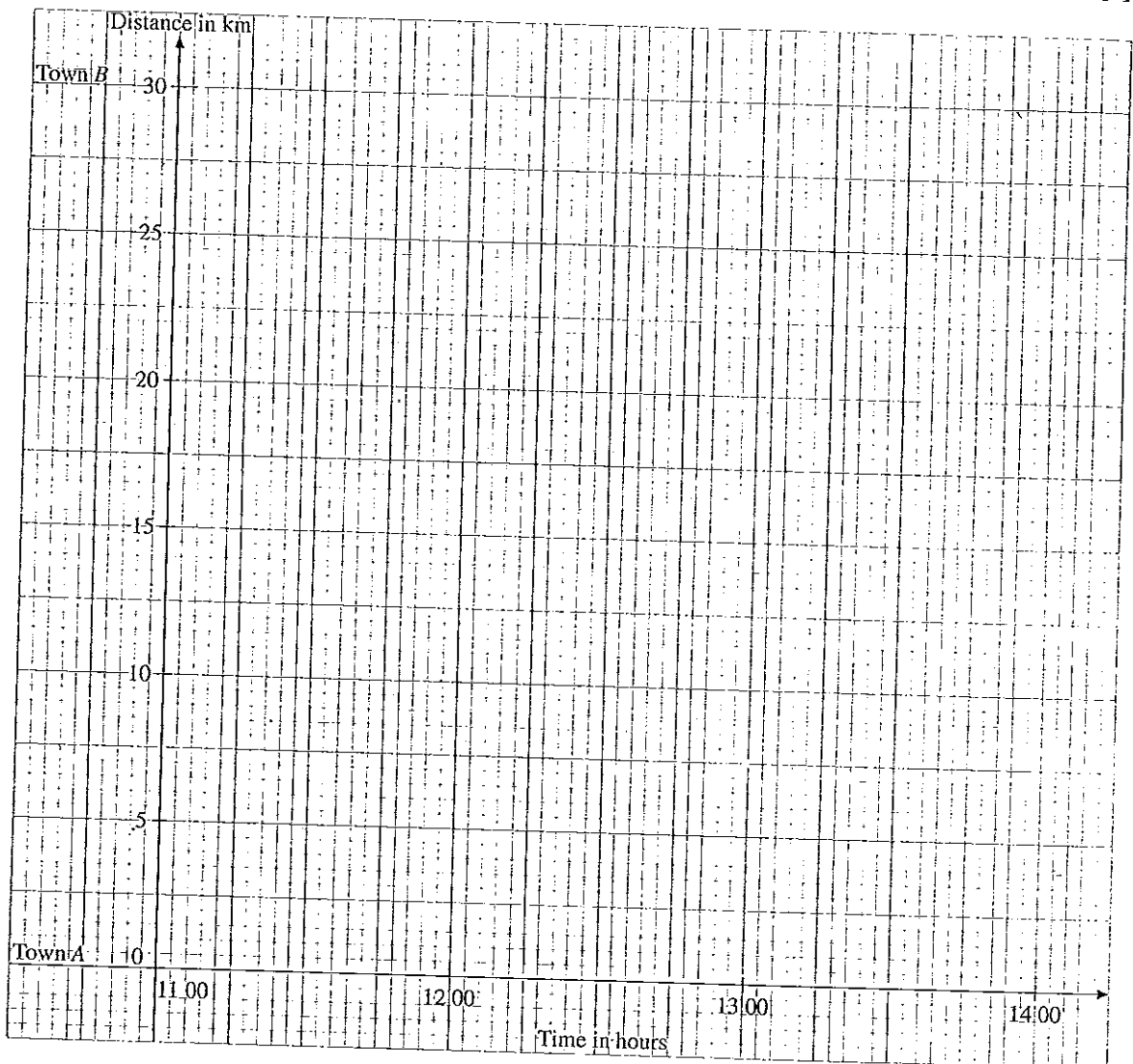
(c) \$ ..... [2]

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- 10 Marc left Town A at 11 00 and cycled to Town B which was 30 km away. He cycled at an average speed of 20 km/h for 45 minutes before stopping for lunch. He then continued his journey at an average speed of 15 km/h and arrived at Town B at 13 30.
- On the axes provided, draw the distance-time graph of Marc.
  - How long did he stop for lunch? Give your answer in minutes.
  - Eythan left Town B at 11 15 and drove to Town A at an average speed of 50 km/h.
    - On the same axes, draw the distance-time graph of Eythan.
    - At what time did Marc and Eythan meet each other?

Answer (a), (c) (i)

[4]



Answer (b) ..... min [2]

(c) (ii) ..... [1]

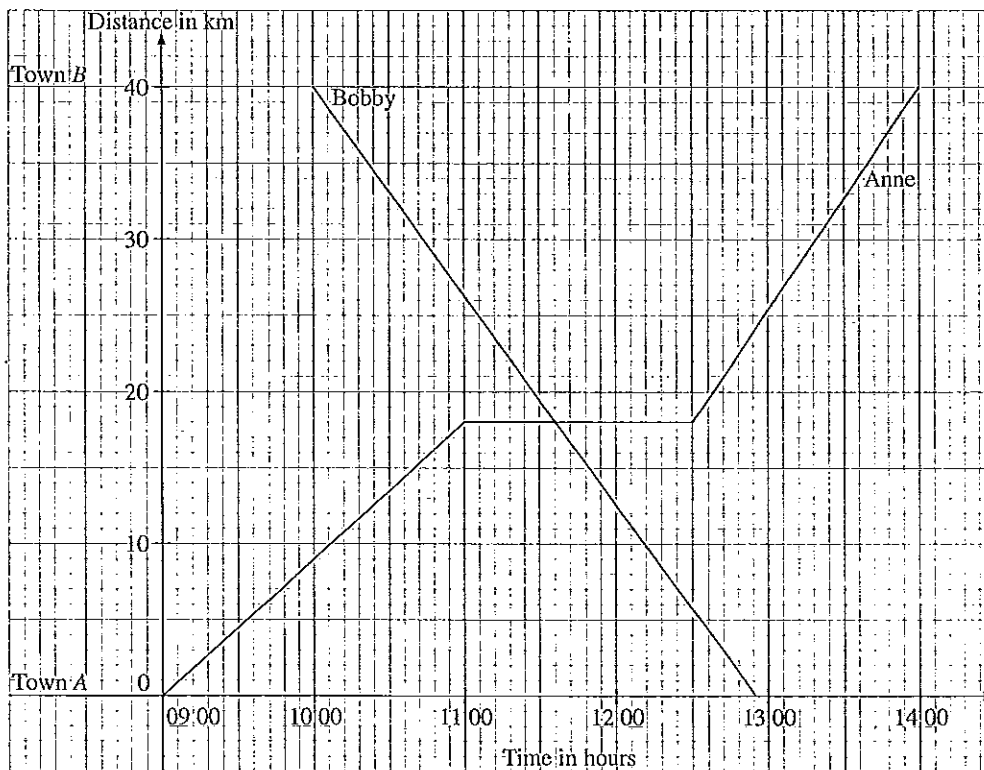
## INSTRUCTIONS TO CANDIDATES

Section B (40 marks)

Time: 45 minutes

1. Answer all the questions in this section.
2. Calculators may be used in this section.
3. All working must be clearly shown. Omission of essential working will result in loss of marks.
4. The marks for each question is shown in brackets [ ] at the end of each question.

- 11 The diagram below shows the travel graph of the journeys of two cyclists Anne and Bobby. Anne left Town A at 09 00 and cycled to Town B which was 40 km away. Bobby left Town B at 10 00 and travelled towards Town A.
- (a) Find the average speed of
    - (i) Anne,
    - (ii) Bobbyfor the whole journey.
  - (b) How far was Bobby from Town A when he met Anne?
  - (c) Find how long Anne rested. Give your answer in hours.
  - (d) How far was Anne from Town B when Bobby arrived at Town A?
  - (e) Did Anne travel faster before or after the rest? Explain your answer.



- Answer (a) (i) ..... km/h [2]  
 (ii) ..... km/h [2]  
 (b) ..... km [1]  
 (c) ..... h [1]  
 (d) ..... km [1]

(e) .....  
 ..... [2]

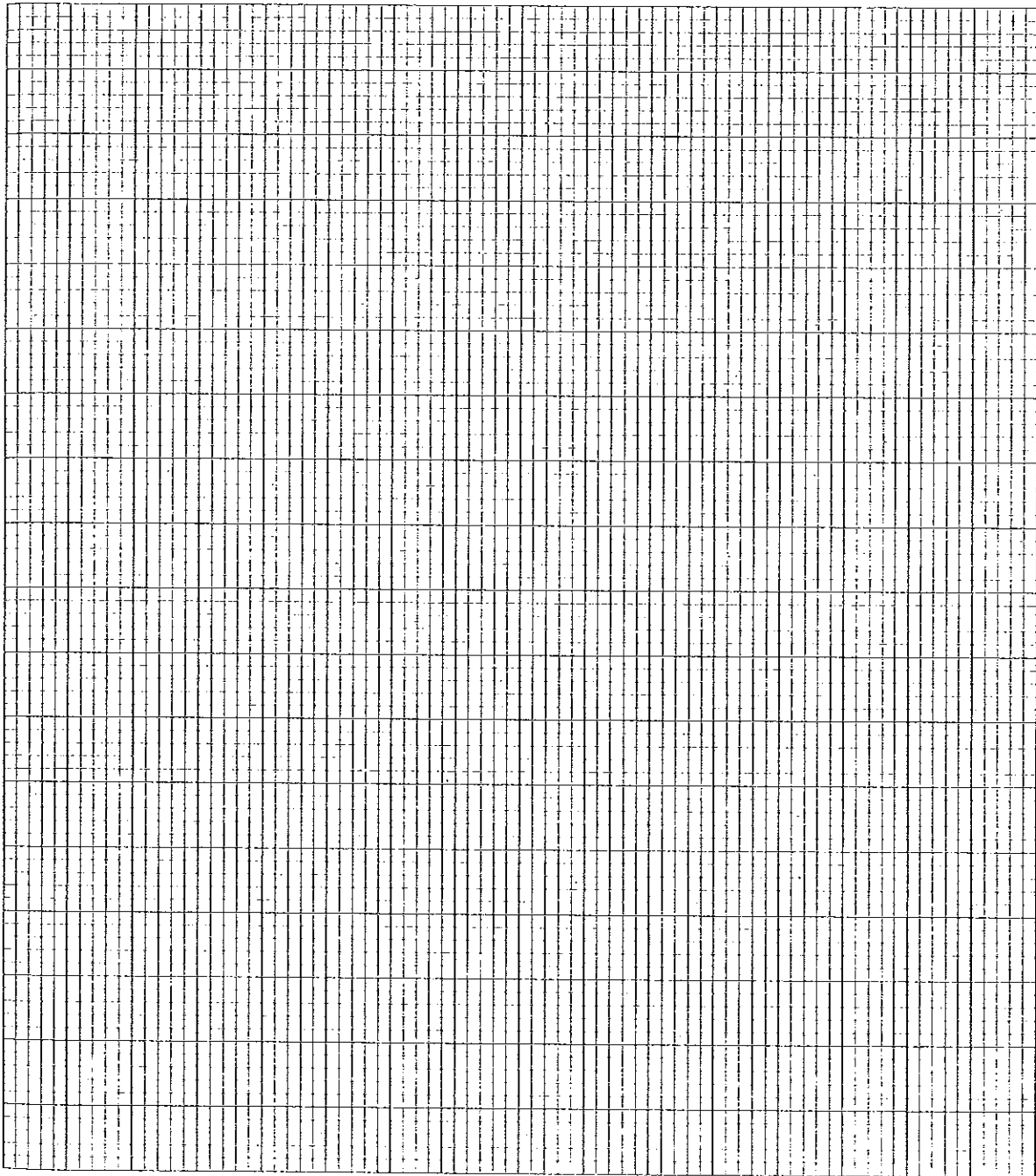
12 A spring stretches when a weight is attached to it. The table below shows the different lengths of the spring when different weights are attached to it.

Weight (g)	0	200	400	600	800	1000	1200
Length (cm)	3	4.6	6.2	7.8	9.4	11.0	12.6

- (a) Using a horizontal scale of 1 cm to represent 100 g and a vertical scale of 1 cm to represent 1 cm, draw a graph to represent the data above on the graph paper provided.  
 (b) Use your graph to find  
 (i) the attached weight if the spring is 9 cm long,  
 (ii) the extension of the spring when the attached weight is 1100 g.  
 (c) Find the original length of the spring when no weight is attached to it.

Answer (a)

[3]



Answer (b) (i) ..... g [1]

(ii) ..... cm [2]

(c) ..... cm [1]

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- 13 (a) Using a scale of 2 cm to represent 1 unit on each axis, draw the graphs of  $x + y = 2$  and  $x - 3y = 6$  on the graph paper provided.
- (b) Hence, solve the simultaneous equations  
 $x + y = 2$   
 $x - 3y = 6$   
graphically.
- (c) On the same axes, draw the graph of  $y = 3x + 6$ . Hence solve the simultaneous equations  
 $y = 3x + 6$   
 $x + y = 2$   
graphically.
- (d) Name the special triangle formed by these three lines.

Answer (b)  $x = \dots\dots\dots$ ,  $y = \dots\dots\dots$  [2]

(c)  $x = \dots\dots\dots$ ,  $y = \dots\dots\dots$  [2]

(d)  $\dots\dots\dots$  [1]

A large grid of graph paper, consisting of 20 columns and 20 rows of small squares. The grid is intended for plotting a linear graph. The grid is mostly empty, with only a few faint lines visible.

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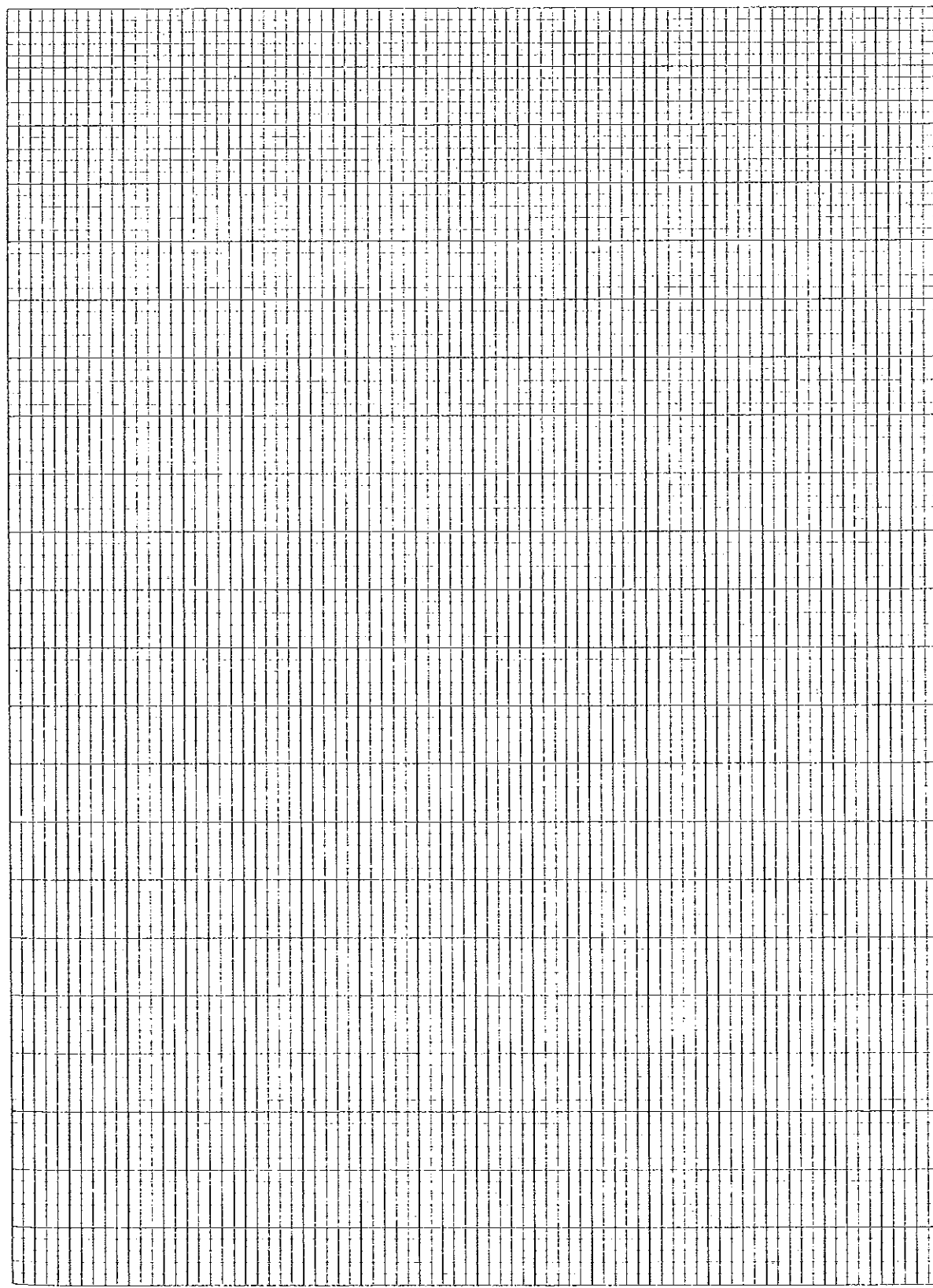


- 14 Town  $P$  is 85 km from Town  $Q$ . Jim drove from Town  $P$  at 08 00 and travelled towards Town  $Q$  at 50 km/h. Ryan cycled from Town  $Q$  at 08 00 and travelled to Town  $P$  at average speed of 21 km/h.
- Draw the distance-time graph of Jim's and Ryan's journey on the graph paper provided. Use a scale of 6 cm to represent 1 hour for times from 08 00 to 10 00 on the horizontal axis and 2 cm to represent 10 km for distances from Town  $P$  to Town  $Q$  on the vertical axis.
  - At what time did they pass each other?
  - How far was Ryan from Town  $P$  when he met Jim?
  - At what time did Jim reach Town  $Q$ ?
  - At what time were Jim and Ryan 38 km apart?

Answer (b) ..... [1]  
 (c) ..... km [1]  
 (d) ..... [1]  
 (e) ..... [1]

Answer (a)

[3]



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[1]  
[1]  
[1]  
[1]  
—

ons

- 15 A shopkeeper bought some paper and plastic files. The cost of each paper file is \$3 and each plastic file is \$5.
- (a) The shopkeeper paid \$170 for 40 files. Using  $x$  to represent the number of paper files and  $y$  to represent the number of plastic files, write down two equations to represent the information given.
  - (b) Draw the graphs to represent the above equations using a scale of 2 cm to represent 10 files on each axis on the graph paper provided.
  - (c) Find the number of each type of file bought by the shopkeeper.



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Answer (b)

[3]

A large grid of graph paper, consisting of 20 columns and 20 rows of small squares, intended for plotting a linear graph.

Answer (a) .....  
..... [3]

(c) Paper file: .....

Plastic file: ..... [2]

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7. (a)  $\$500 - \$25 - \$25 = \$450$   
 (b) Cost of the  $n$ th painting  
 $= \$500 - (n - 1)\$25$   
 $= \$500 - \$25n + \$25$   
 $= \$(525 - 25n)$   
 (c) Cost of 5 paintings  
 $= \$500 + \$475 + \$450 + \$425 + \$400$   
 $= \$2250$   
 Percentage discount received  
 $= \frac{\$2250 - \$1912.50}{\$2250} \times 100\%$   
 $= 15\%$

8. (a) Tim's average speed =  $x$  km/h  
 Philip's average speed =  $(x - 5)$  km/h  
 Bobby's average speed =  $(x + 5)$  km/h

Time taken by Tim	Average speed
$= \frac{360 \text{ km}}{x \text{ km/h}}$	$= \frac{\text{Total distance travelled}}{\text{Total time taken}}$
$= \left(\frac{360}{x}\right) \text{ h}$	$\therefore \text{Total time taken} = \frac{\text{Total distance travelled}}{\text{Average speed}}$

Time taken by Philip  
 $= \frac{360 \text{ km}}{(x - 5) \text{ km/h}}$

$= \left(\frac{360}{x - 5}\right) \text{ h}$

Time taken by Bobby

$= \frac{(360 + 25) \text{ km}}{(x + 5) \text{ km/h}}$

$= \left(\frac{385}{x + 5}\right) \text{ h}$

- (b)  $\frac{360}{x - 5} - \frac{385}{x + 5} = 1$  Given that Philip took 1 hour longer than Bobby.  
 $360(x + 5) - 385(x - 5) = (x - 5)(x + 5)$  Multiply throughout by the LCM,  $(x - 5)(x + 5)$ .  
 $360x + 1800 - 385x + 1925 = x^2 - 25$   
 $x^2 + 25x - 3750 = 0$  Shown

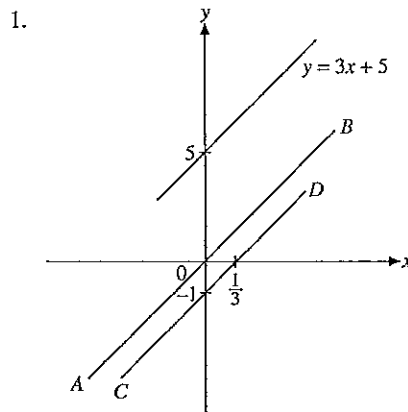
- (c)  $x^2 + 25x - 3750 = 0$   
 $(x - 50)(x + 75) = 0$   
 $\therefore x - 50 = 0$  or  $x + 75 = 0$   
 $x = 50$  or  $x = -75$

- (d) Time taken by Tim  
 $= \left(\frac{360}{x}\right) \text{ h}$   
 $= \frac{360}{50} \text{ h}$  Subs.  $x = 50$ ; Reject  $x = -75$ .  
 $= 7.2 \text{ h}$   
 $= 7 \text{ h } 12 \text{ min}$

9. (a) No. of dots in Diagram 5  
 $= 1 + 2 + 3 + 4 + 5 = 15$  dots  
 (b) (i) No. of dots in Diagram 6  
 $= \frac{6 \times 7}{2} = 21$   
 (ii) No. of dots in Diagram 188  
 $= \frac{188 \times 189}{2} = 17\,766$   
 (c) No. of dots in Diagram  $n = m$   
 $\frac{n \times (n + 1)}{2} = m$   
 $\therefore m = \frac{n(n + 1)}{2}$   
 (d)  $\frac{p(p + 1)}{2} = 171$   
 $p(p + 1) = 342$   
 $p^2 + p - 342 = 0$   
 $(p - 18)(p + 19) = 0$   
 $\therefore p - 18 = 0$  or  $p + 19 = 0$   
 $p = 18$  or  $p = -19$  (rejected)  
 $\therefore p = 18$

## Test 11: Linear Graphs and Their Applications

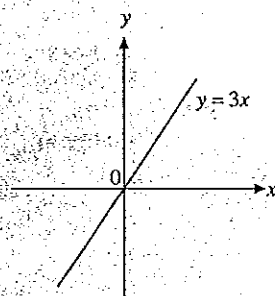
### Section A



- (a) Equation of AB is  $y = 3x$ .



### Teacher's Tip



$y = 3x$  is the equation of the straight line passing through the origin. The gradient of the line is 3 since it is parallel to the line  $y = 3x + 5$ . Its  $y$ -intercept is 0.

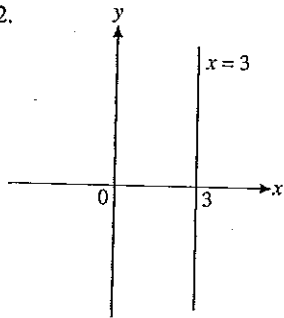
(b) Equation of CD is  $y = 3x - 1$ .



**Teacher's Tip**

The gradient of the line CD is 3 and its y-intercept is -1.  
 $\therefore$  Equation of CD is  $y = 3x - 1$ .

2.

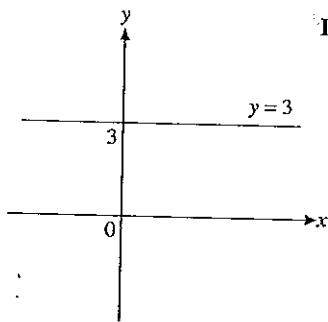


A : R



**Teacher's Tip**

The graph of  $x = 3$  is a vertical line passing through (3, 0) and is parallel to the y-axis.

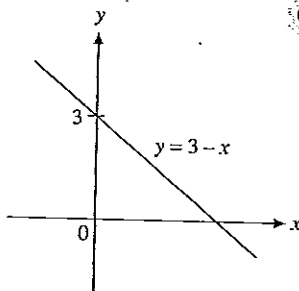


B : P



**Teacher's Tip**

The graph of  $y = 3$  is a horizontal line passing through the point (0, 3) and is parallel to the x-axis.

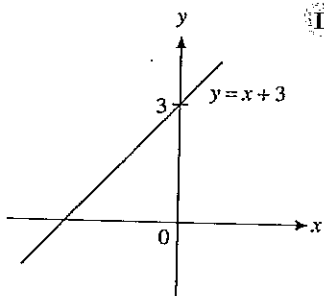


C : S



**Teacher's Tip**

The equation of the line can be rewritten as  $y = -x + 3$ . The gradient of the graph is -1 and the y-intercept is 3. Here, the gradient is negative, so the line slopes upwards to the left.



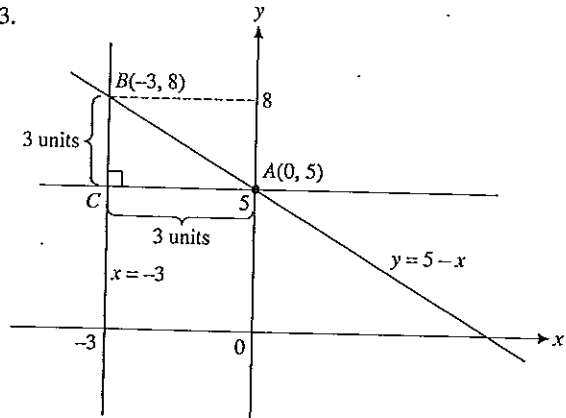
D : Q



**Teacher's Tip**

The equation  $y = x + 3$  has gradient 1 and y-intercept 3. Since the gradient is positive, the line slopes upwards to the right.

3.



(a)  $y = 5 - x$

At the point A,  $x = 0$ ,

$\therefore y = 5 - 0$

$= 5$

$\therefore A = (0, 5)$ .

At the point B,  $x = -3$ ,

$\therefore y = 5 - (-3)$

$= 5 + 3$

$= 8$

$\therefore B = (-3, 8)$ .

(b)  $C = (-3, 5)$

(c) Area of  $\triangle ABC$

$= \frac{1}{2} \times 3 \times 3$

$= 4\frac{1}{2}$  units<sup>2</sup>



**Teacher's Tip**

Alternatively, rewrite the equation of the line as  $y = -x + 5$

$\therefore$  the gradient is -1

and the y-intercept is 5.

Recall:

The general equation of the straight line is  $y = mx + c$  where  $m =$  gradient and  $c =$  y-intercept.

Area of  $\triangle$

$= \frac{1}{2} \times b \times h$

$b =$  base,  $h =$  height



4. (a)  $y = \frac{1}{3}x - 5$

x	-3	0	3
y	-6	-5	-4

↑

E.g. When  $x = -3$ ,

$y = \frac{1}{3}(-3) - 5 = -6$



**Teacher's Tip**

To draw the graph of

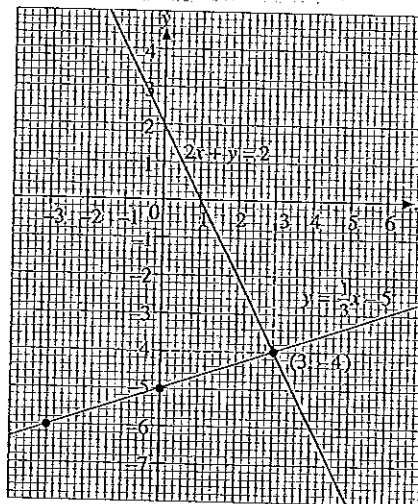
$y = \frac{1}{3}x - 5$ :

(1) Locate 3 points.

(2) Plot the points and

draw a straight line

through all the points.

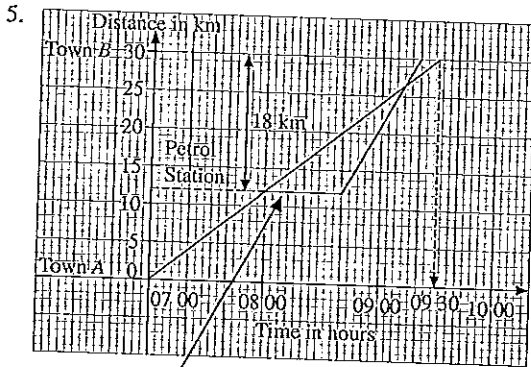


(b)  $\therefore$  the solution set is  $x = 3$  and  $y = -4$ .



**Teacher's Tip**

- To solve a pair of simultaneous equations graphically, find the coordinates of the point of intersection of the two graphs.
- The point of intersection  $(3, -4)$  represents the solution  $x = 3$  and  $y = -4$ .



**Teacher's Tip**

The horizontal section of the graph indicates that the cyclist stopped for a break, as the distance remained the same.  $\therefore$  he rested from 08 00 to 08 40.

(a) The petrol station is 18 km from Town B.

(b) Average speed =  $\frac{\text{Total distance travelled}}{\text{Total time taken}}$

$$= \frac{30 \text{ km}}{2\frac{1}{3} \text{ h}} = \frac{30}{\frac{7}{3}} = 30 \times \frac{3}{7} = \frac{90}{7} = 12\frac{6}{7} \text{ km/h}$$

(c) He would have arrived in Town B at 09 30.



**Teacher's Tip**

To find the time taken if there were no stops, extend the straight line representing the first part of the journey.

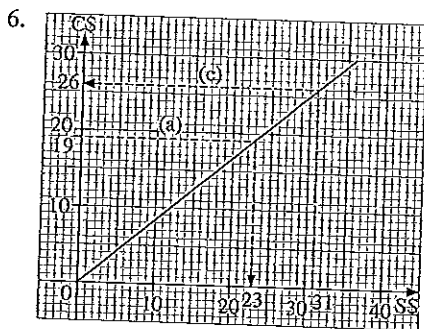


Diagram I

(a) From the graph,  $\text{C}\$19 \approx \text{S}\$23$ .

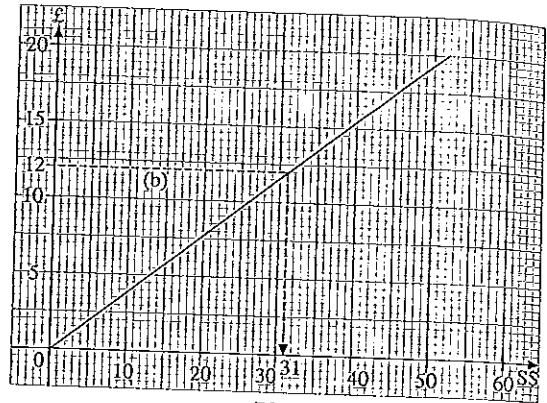


Diagram II

(b) From the graph,  $\text{£}12 \approx \text{S}\$31$ .

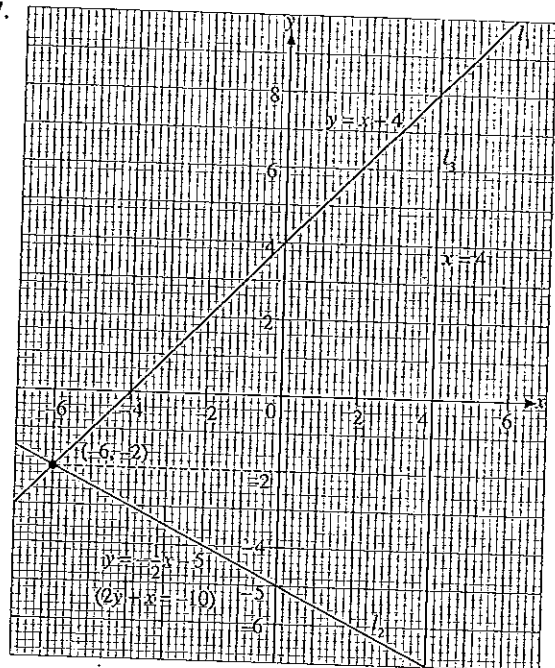
(c) From the graphs,  $\text{£}12 \approx \text{C}\$26$ .



**Teacher's Tip**

$\text{£}12 \approx \text{S}\$31$ , graph from Diagram II.  
 $\text{S}\$31 \approx \text{C}\$26$ , graph from Diagram I.

7.



(a) The solution set is  $x = -6$  and  $y = -2$ .

To solve the pair of simultaneous equations:  $y = x + 4$  and  $2y + x = -10$ , find the coordinates of the point of intersection of the two graphs.

(b) Equation of line  $l_3$  is  $x = 4$ .

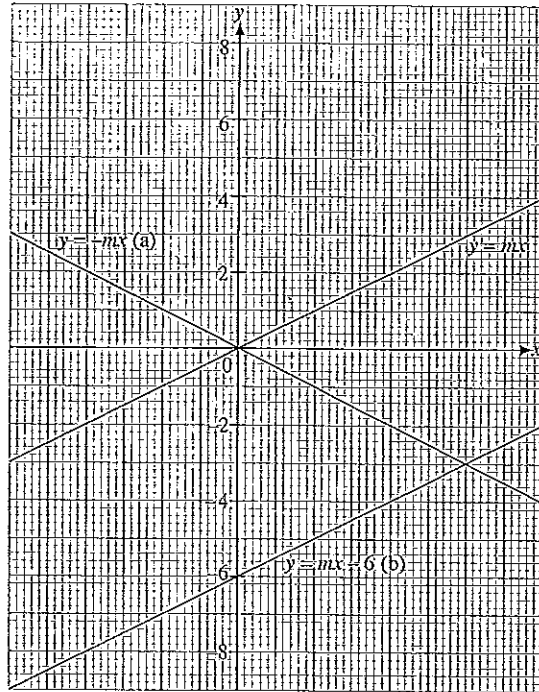


**Teacher's Tip**

Identify the lines  $l_1$  and  $l_2$  using its gradient and y-intercept.

- $l_1: y = x + 4$   
 $\therefore$  gradient = 1  
 $\therefore$  y-intercept = 4
- $l_2: 2y + x = -10$   
 $\Rightarrow y = -\frac{1}{2}x - 5$   
 $\therefore$  gradient =  $-\frac{1}{2}$   
 $\therefore$  y-intercept = -5

8.



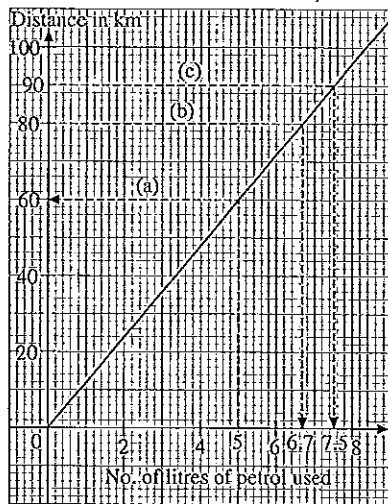
**Teacher's Tip**

To draw the graphs, consider the gradients and y-intercepts.

(a)  $y = -mx$ , gradient =  $-m$ , y-intercept = 0.

(b)  $y = mx - 6$ , gradient =  $m \Rightarrow$  parallel to the graph of  $y = mx$ , y-intercept =  $-6$ .

9.



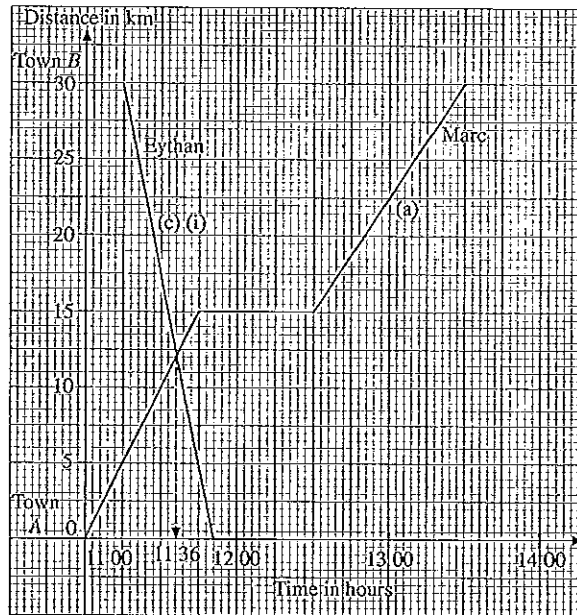
(a) From the graph, the car can travel 60 km using 5 l of petrol.

(b) From the graph, the car needs approximately 6.7 l of petrol to travel 80 km.

(c) From the graph, the car needs 7.5 l of petrol to travel 90 km.

$\therefore$  cost of petrol =  $\$1.40 \times 7.5$  Given that 1 l of petrol costs  $\$1.40$ .  
=  $\$10.50$

10. (a), (c) (i)



(b) He stopped for 45 minutes for lunch.

(c) (ii) Marc and Eythan met each other at 11 36.

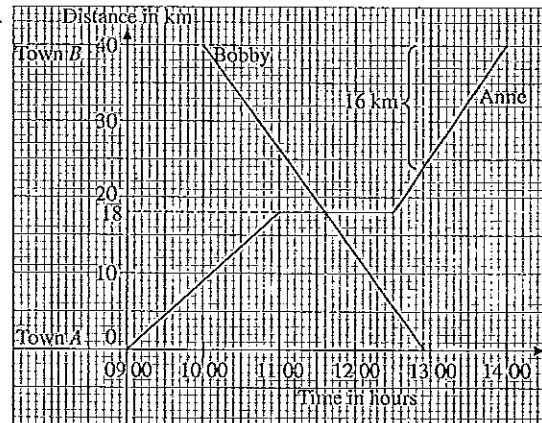


**Teacher's Tip**

To find the time they met each other, find the point of intersection of the two graphs.

**Section B**

11.



(a) (i) Average speed of Anne

$$= \frac{40 \text{ km}}{5 \text{ h}} = 8 \text{ km/h}$$

$$\text{Average speed} = \frac{\text{Total distance travelled}}{\text{Total time taken}}$$



(ii) Average speed of Bobby

$$= \frac{40 \text{ km}}{2\frac{9}{10} \text{ h}}$$

$$= 13\frac{23}{29} \text{ km/h or } 13.8 \text{ km/h (correct to 3 sig. fig.)}$$

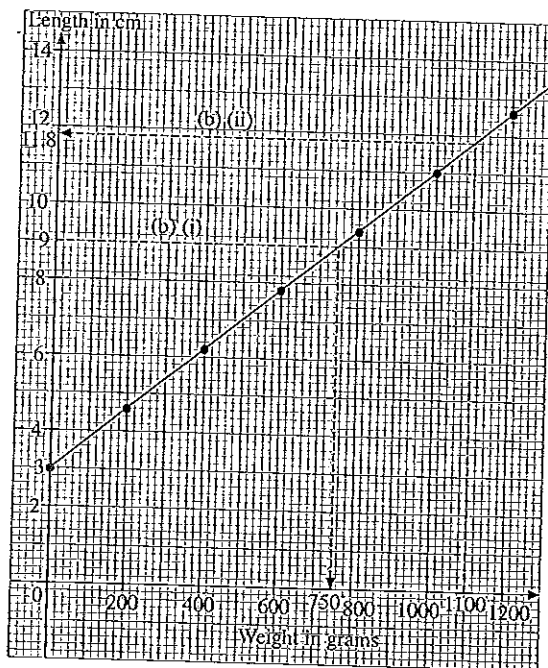
- (b) From the graph, Bobby was 18 km away from Town A when he met Anne.
- (c) Anne rested for  $1\frac{1}{2}$  hours.
- (d) Anne was 16 km from Town B when Bobby arrived at Town A.
- (e) Anne travelled faster after the rest. The graph after the rest was steeper.



**Teacher's Tip**

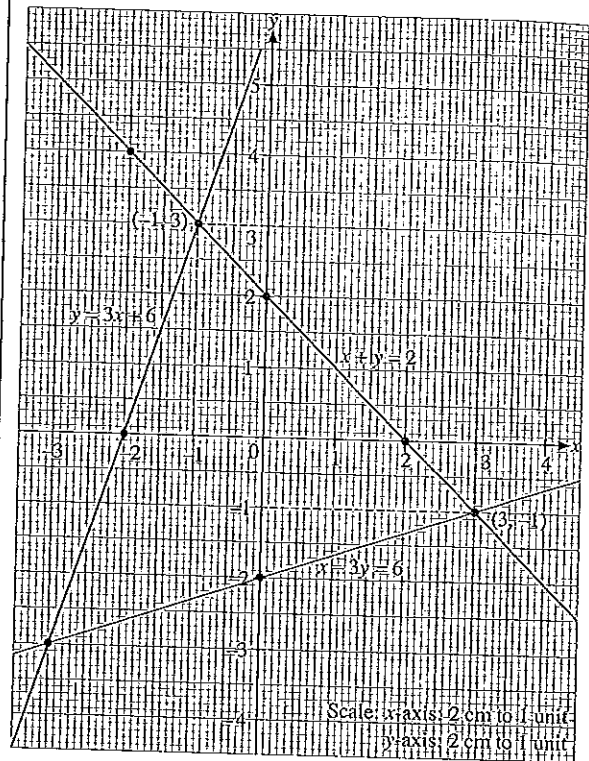
The steeper the graph, the faster the speed.

12. (a)



- (b) (i) From the graph, when the spring is 9 cm long, the attached weight is approximately 750 g.
- (ii) From the graph, when the attached weight is 1100 g, the length of the spring is approximately 11.8 cm.  
 $\therefore$  extension of spring =  $11.8 - 3 = 8.8$  cm.
- (c) Original length of spring = 3 cm.

13. (a), (c)



$$x + y = 2$$

$$y = -x + 2$$

x	-2	0	2
y	4	2	0

$$x - 3y = 6$$

$$3y = x - 6$$

$$y = \frac{1}{3}x - 2$$

x	-3	0	3
y	-3	-2	-1



**Teacher's Tip**

To draw each of the graphs,

- locate 3 points,
- plot the points and draw a straight line through all the points.

(b) The solution set is  $x = 3$  and  $y = -1$ .



**Teacher's Tip**

- To solve the pair of simultaneous equations  $x + y = 2$  and  $x - 3y = 6$  graphically, find the coordinates of the point of intersection of the two graphs.
- The point of intersection  $(3, -1)$  represents  $x = 3$  and  $y = -1$ .

(c)  $y = 3x + 6$

x	-3	-2	-1
y	-3	0	3

The solution set is  $x = -1$  and  $y = 3$ .

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