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91028



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# Level 1 Mathematics and Statistics, 2017

## 91028 Investigate relationships between tables, equations and graphs

9.30 a.m. Monday 20 November 2017

Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Investigate relationships between tables, equations and graphs.	Investigate relationships between tables, equations and graphs, using relational thinking.	Investigate relationships between tables, equations and graphs, using extended abstract thinking.

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

**You should attempt ALL the questions in this booklet.**

Show ALL working.

Grids are provided on some pages. This is working space for the drawing of a graph or a diagram, constructing a table, writing an equation, or writing your answer.

If you need more space for any answer, use the page(s) provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–15 in the correct order and that none of these pages is blank.

**YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.**

**Achievement**

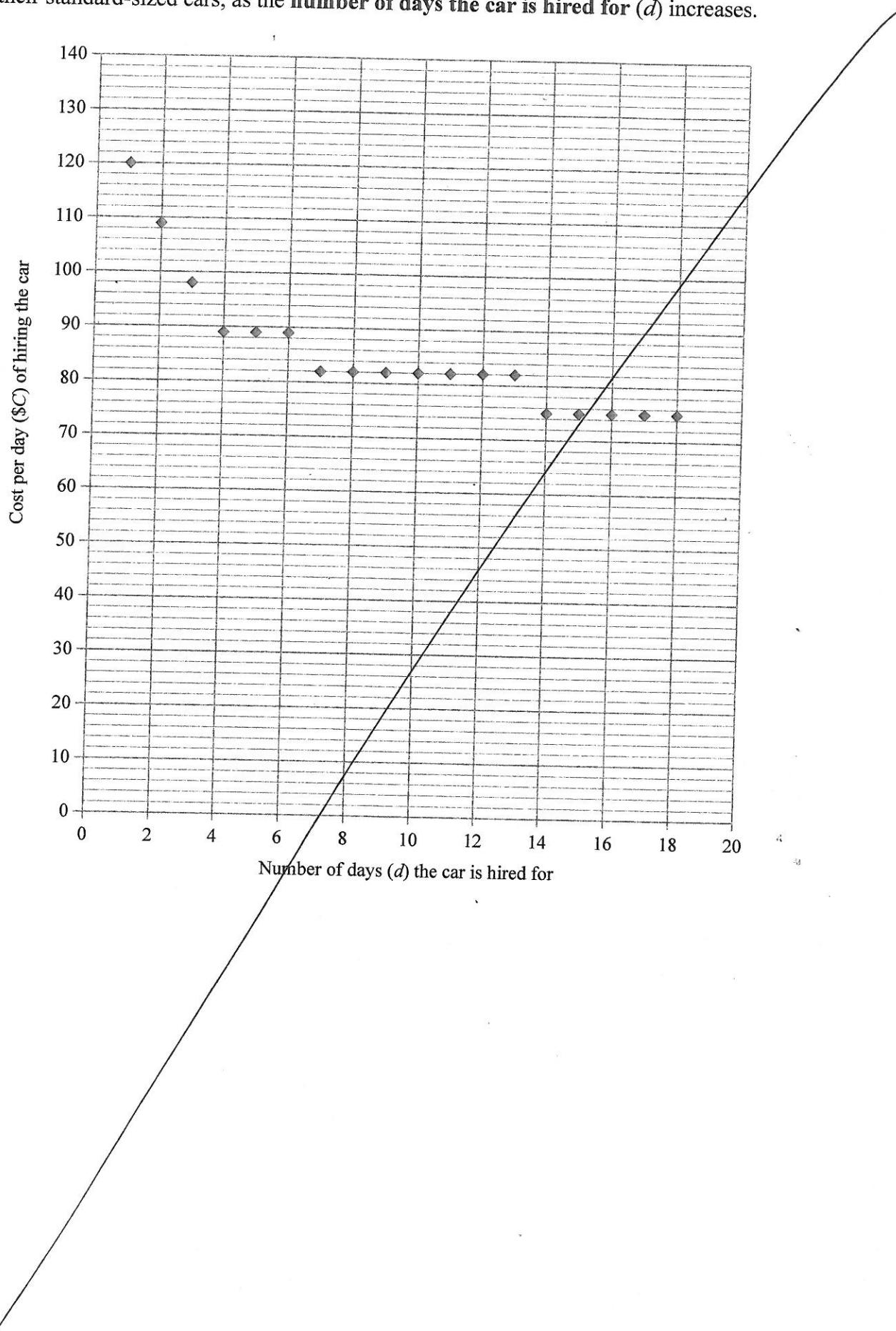
**TOTAL**

**12**

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**QUESTION ONE**

- (a) *Rent A Car* is a car rental company. The graph below shows the cost per day ( $\$C$ ), of hiring one of their standard-sized cars, as the number of days the car is hired for ( $d$ ) increases.



- (i) How much cheaper per day is it to hire the car for 3 days than 1 day?

$$1 \text{ day} = 120$$

$$120 - 89 = 31$$

$$3 \text{ day} = 89$$

$\textcircled{\$31}$  'cheaper'

- (ii) Give the equation for the cost per day of hiring the car:

- (1) for 4 to 6 days

$$\text{yester } C = 89 \text{ } \underline{+ 0d} + 89$$

- (2) for the first 3 days.

he hired the car for ear \$89 for  
the first first three car//

d	C
1	98
2	89
3	89
4	89
5	89
6	89

- (b) *Rent A Car* decides to introduce a special deal, and produces a sign as shown on the right.

Mere is trying to find the cheapest option for renting a car. She asks what this 'SPECIAL DEAL' actually means.

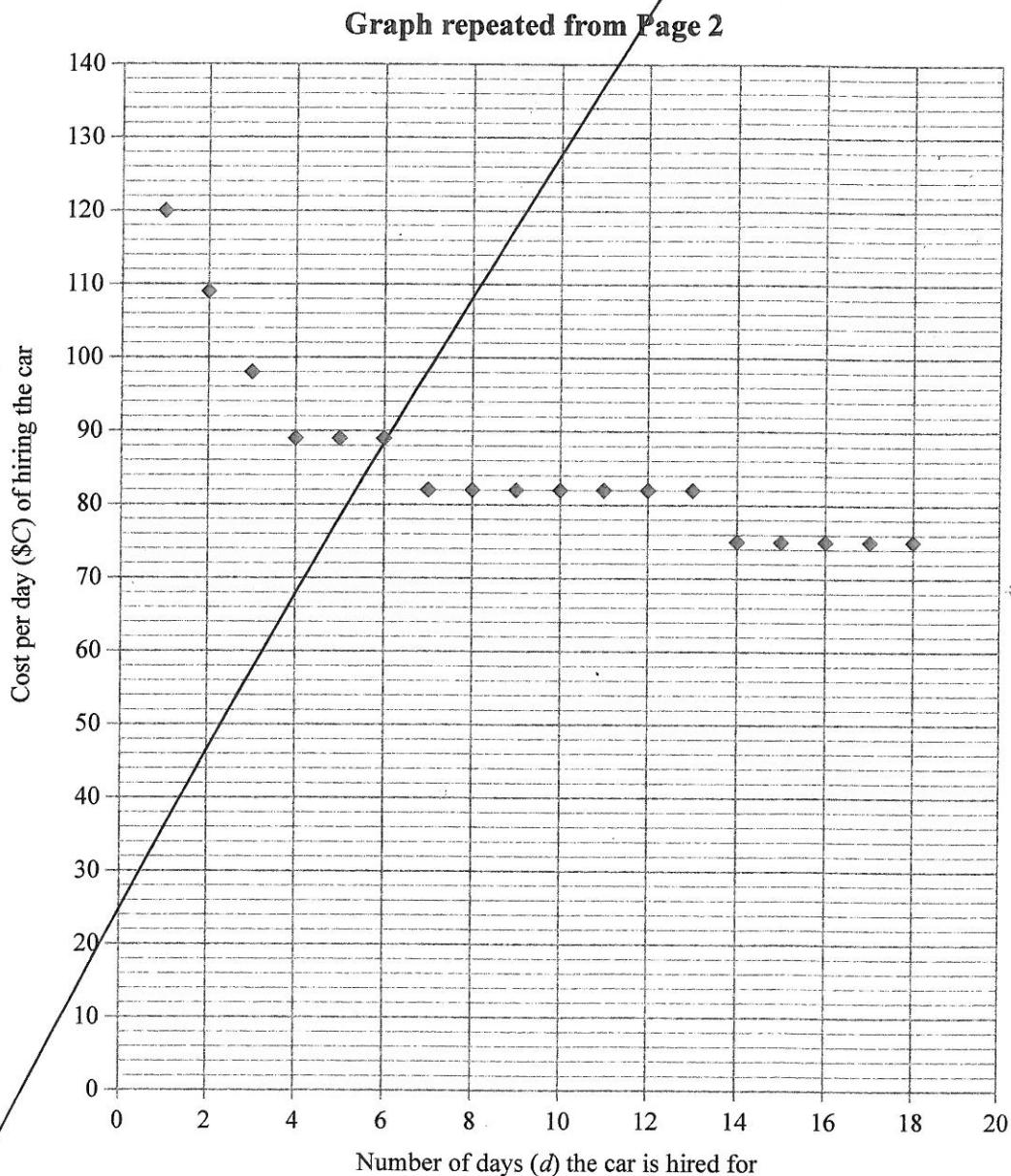
The company gives Mere the formula they use to work out the daily rate.

$$C = 140 \times 0.9^{d-1}$$

where  $C$  is the daily cost and  $d$  is the number of days for which the car is hired.

Investigate, using an equation, table, or graph, whether Mere is any better off with this 'special deal' offer compared to the original price, as shown on the graph from page 2 (reproduced below).

*Justify your answer.*



$$C = 140 \times 0.9^{d-1}$$

d	C
1	140
2	126
3	113.1
4	102.06
5	91.85

$$C = 140 \times 0.9^{d-1}$$

$$= 140 \times 0.9^1$$

= 113.1

$$C = 140 \times 0.9^{d-1}$$

$$= 140 \times 0.81$$

$$= 140 \times 0.729$$

$$= 102.06$$

$$C = 140 \times 0.9^{d-1}$$

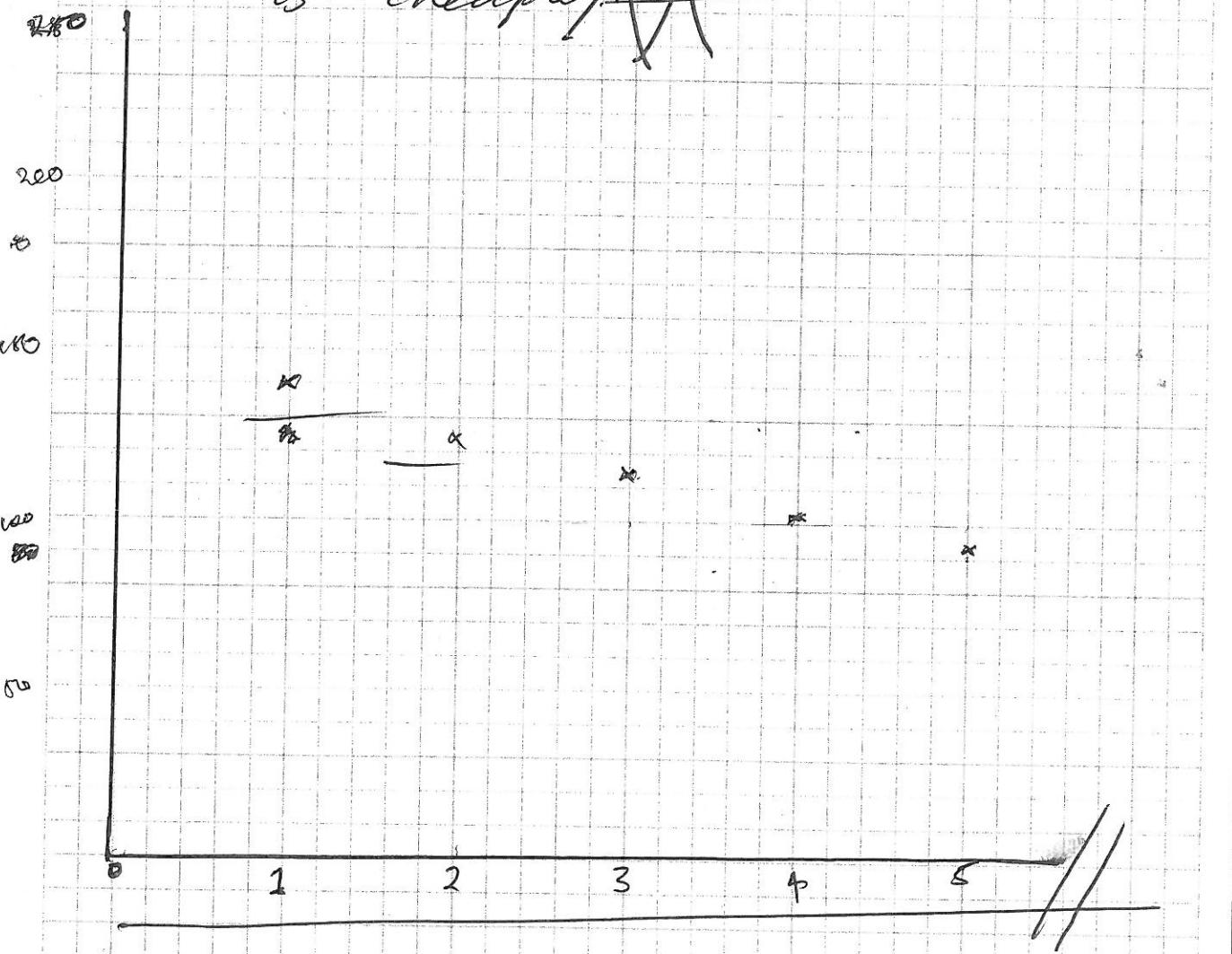
$$= 140 \times 0.9$$

$$= 126$$

The second one

The Special Deal is not cheaper than the first one. On the graph you can see that for the first day it cost \$140 (second graph) and the other one it cost \$126 for the first day. This means the first one is recommended that.

Mere should choose the first one because she can save a lot of money and also because it is cheaper.

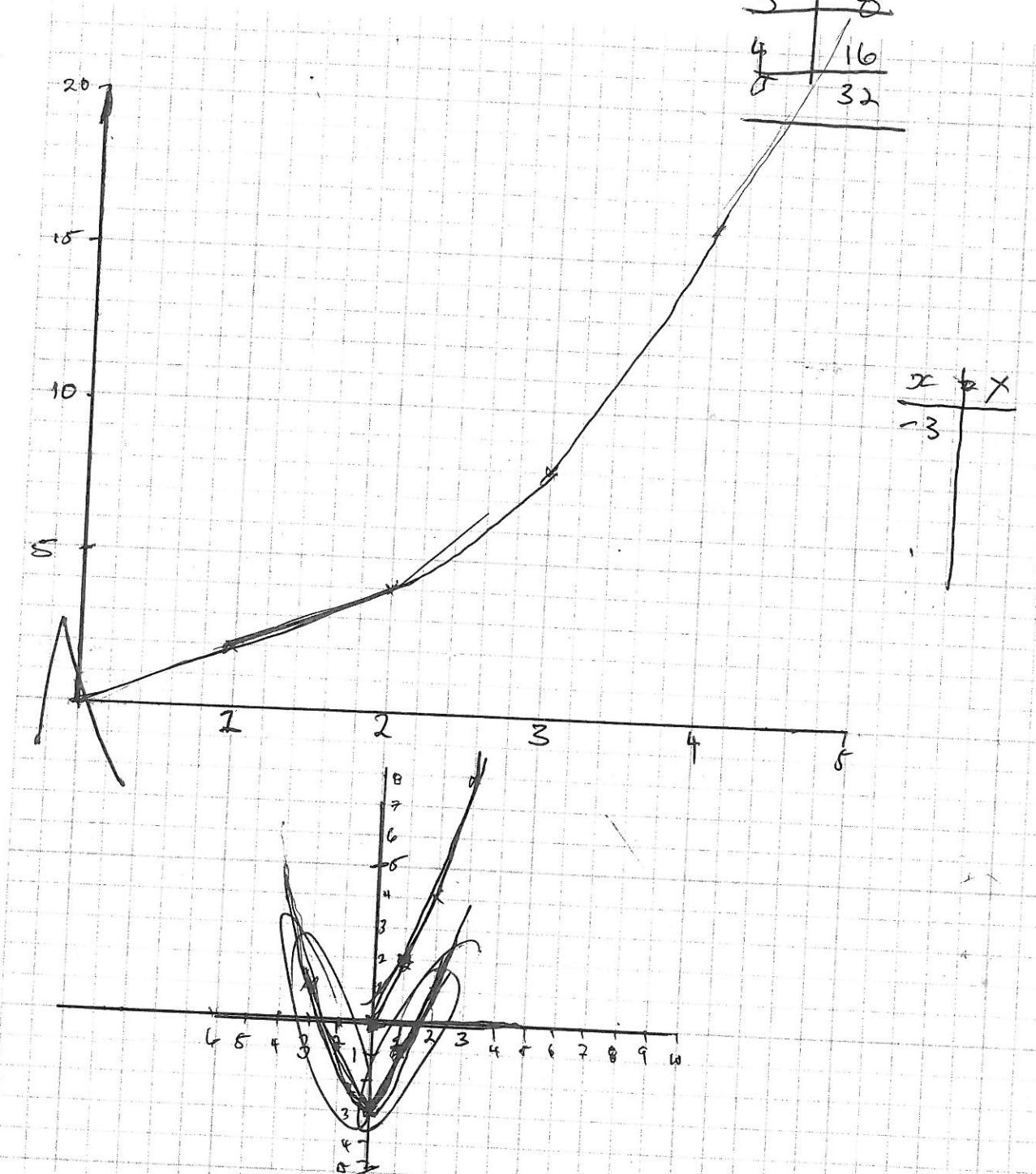


$x$	$y$
0	1
1	2
2	4
3	8
4	16
5	32

 ~~$2^x$~~ 

## QUESTION TWO

- (a) (i) Sketch the graph of
- $y = 2^x$
- .



- (ii) Give the equation of this graph if it is translated down by 3 units, and then reflected in the
- $y$
- axis.

$$y = a(x + 2.5)(x - 1.5)$$

$$y = a(x - 1)^2 + 3$$

$$y = a(x)$$

$$3 = a(0 + 2.5)(0 - 1.5)$$

$$3 = a(2.5)(-1.5)$$

$$\frac{3}{-3.75} = \frac{-3.75}{3.75}$$

$$y = 0.8(x + 2.8)(x - 1.5)$$

$$0.8 = 9$$

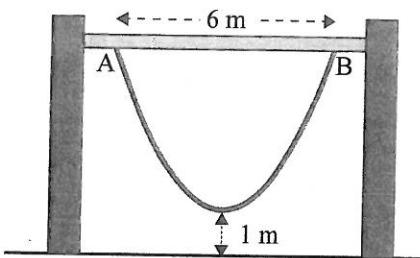
- (b) In a children's playground there is a rope hanging from two points, A and B, on a horizontal beam.

A and B are 6 metres apart.

The lowest point of the rope is 1 m above the ground.

The shape of the rope can be modelled by

$$y = \frac{x}{3}(x-p) + 4$$



where  $y$  is the height above the ground, and  $x$  is the distance from A.

- (i) How high above the ground is A?

$$y = \frac{x}{3}(x-p) + 4$$

$$\cancel{y}(y-4) = \frac{x}{3}(x-p)$$

$$3y - 12 = x(x-p)$$

$$3y - 12 = x^2 - px$$

$$(x-p)(x+3) = 0$$

- (ii) Give the value of  $p$ .

$$y = \frac{x}{3}(x-p) + 4$$

$$y = \frac{x}{3}(x-p) + 4$$

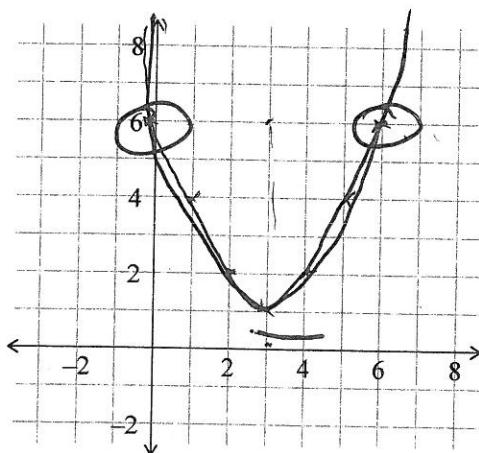
$$3y = x(x-p) + 12$$

$$3y - 12 = x^2 - px$$

$$\cancel{3}x = x^2 - 3y + 4$$

$$p = x - 3y + 4$$

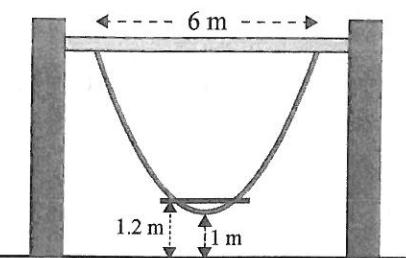
- (iii) On the grid below sketch the graph that models the shape of the rope.



- (iv) Holes are drilled through a 2 m long horizontal board.

The rope passes through the holes to make the seat of a swing.

The height of the seat is 1.2 metres above the ground.



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How far apart would the holes in the board need to be if the shape of the rope above the seat stays the same?

Give your answer to 2 dp.

The rope is 1.2 m apart from the ground

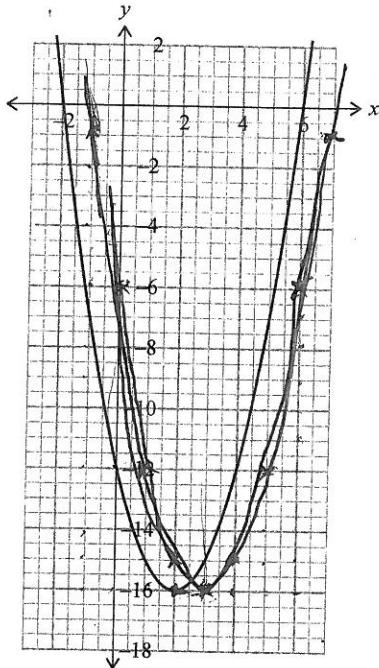
They would be 6.

n

A3

## QUESTION THREE

- (a) (i) Give the equation of the parabola shown below.



$$y = a(x + 2)(x - 6)$$

$$-12 = a(0 + 2)(0 - 6)$$

$$(2)(-6)$$

$$-12 = -12a \quad a = 1$$

$$\boxed{y = 1(x + 2)(x - 6)}$$

- (ii) Give the equation of the above graph if it is translated by 2 units to the right.

$$y = a(x - 3)^2 + 16 \quad (x - 3)(x - 3)$$

$$y = a(x + 1)(x - 7)$$

~~- 12a~~

$$-6 = a(0 + 1)(0 - 7)$$

$$(1)(-7)$$

$$\frac{-6}{7} = \frac{-7a}{7}$$

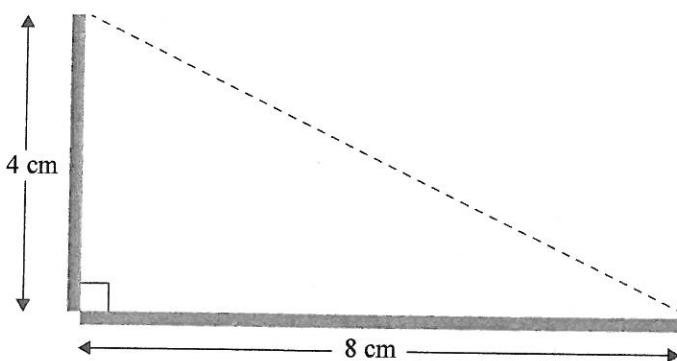
$$\boxed{y = 5(x + 1)(x - 7)}$$

$$5 \cdot 8a = 9$$

- (b) Jono has some strips of plastic that are each 12 cm long.

He cuts one of these strips into two pieces and uses them as the two shorter sides of a right-angled triangle.

He starts by cutting a piece 4 cm long from a 12 cm strip, and uses this as one side of a right-angled triangle. He places the remaining 8 cm piece at right angles as the second side, as shown below.



He then calculates the area of the triangle that would be formed by joining the two end points.

- (i) Use a table, equation, or graph to investigate the relationship between the area of the triangle, and the different lengths of the piece of plastic that can be cut from the 12 cm strip.

$$A = \text{triangle}$$

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

$$A = \frac{8}{2} \times 4$$

$$A = 4 \times 4$$

$$\underline{A = 16}$$

$\frac{B \times h}{2}$	A
$\frac{8 \times 4}{2}$	16
$\frac{9 \times 3}{2}$	13.5
$\frac{8 \times 7}{2}$	17.5
$\frac{6 \times 6}{2}$	18
$\frac{11 \times 1}{2}$	5.5

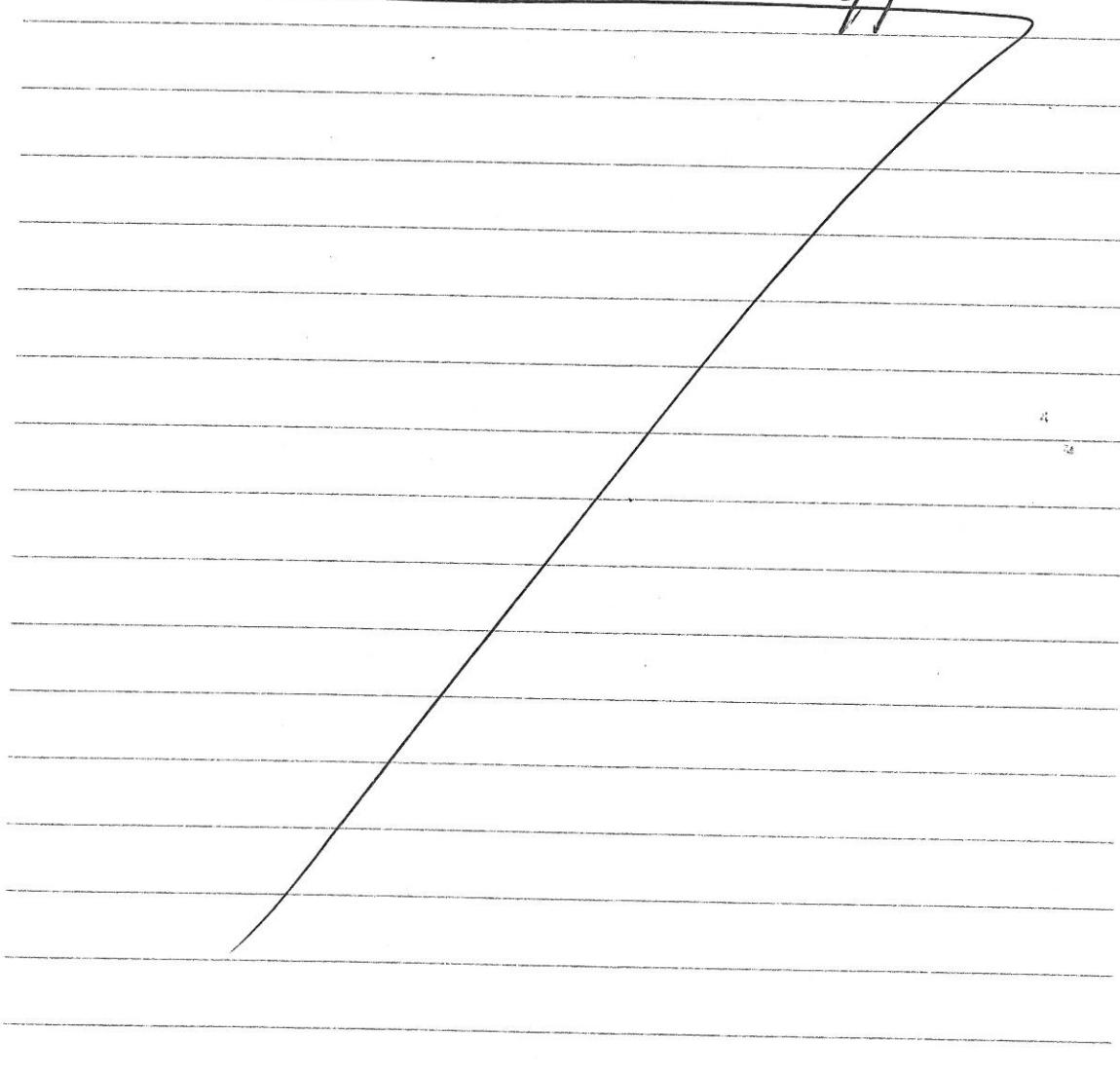
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I can see that if you times a odd with a odd you will get a Area in decimal but if you times a even number with an even you will get a even number.

State the equation that best represents the relationship between the area of the triangle and the length of plastic cut from the 12 cm strip.

- (ii) What features can be noticed about the area when Jono increases the length of the strip of plastic that he cuts from the 12 cm strip?

~~he can~~ he can noticed that the Area of the triangle ~~can~~ would not be the same if he change it. he can also noticed that the length will ~~also go big~~ and long. and it won't make the shape of a triangle and it will be uneven, also the height will go smaller making the area change.

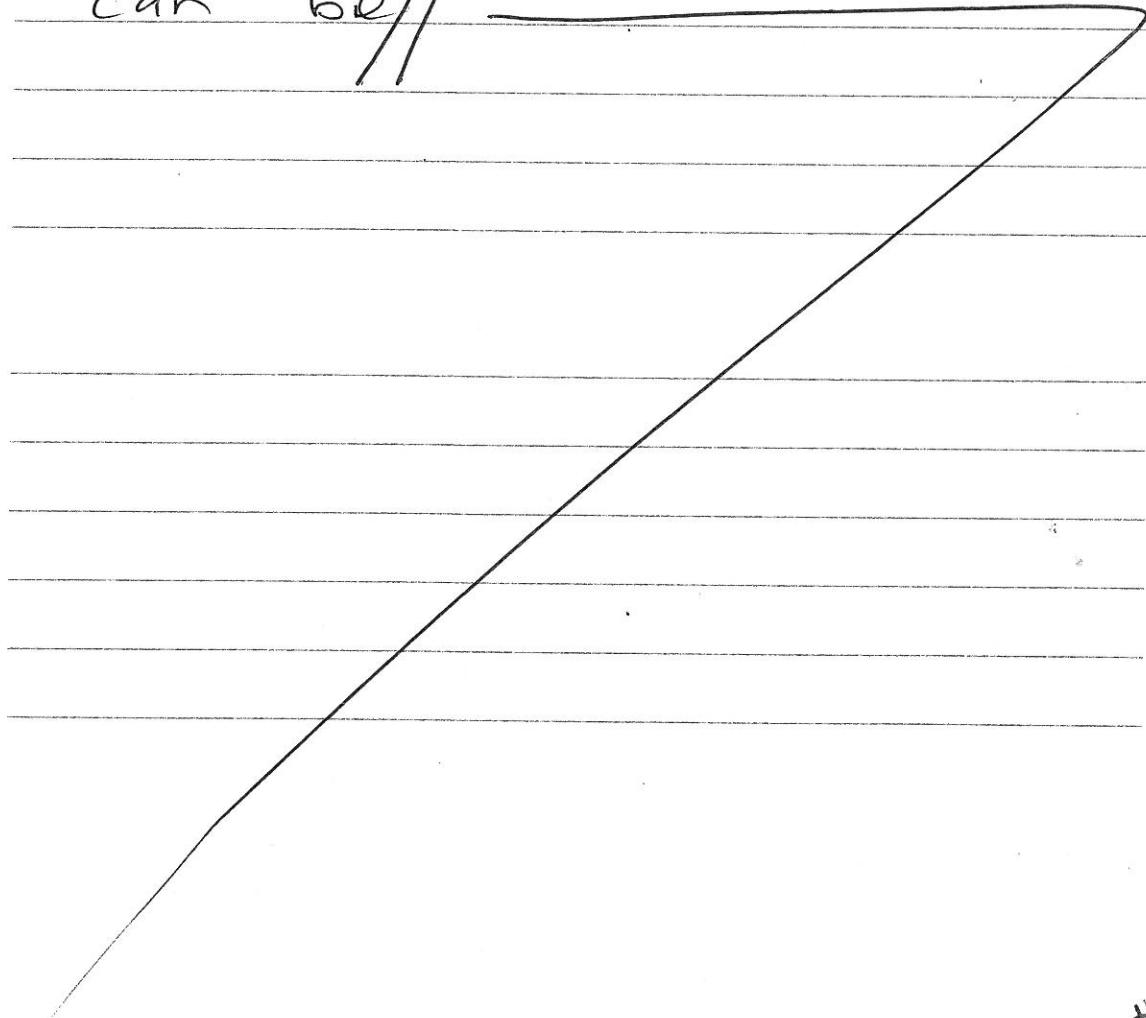


- (iii) Clearly describe how the features of the graph of the relationship would change if the total length of the strip of plastic was  $n$  cm longer.

Include the co-ordinates of the vertex of the parabola.

*NOTE: You do not need to draw the graph.*

If the total length was change to  $n^{\text{th}}$  longer, it can make the triangle a very long and big. the triangle can be in any size it can be big and small. the co-ordinate of the vertex can be anything because you can choose how big or long your triangle can be.



10  
10  
10  
10  
10

Subject:		Level 1 Mathematics	Standard:	91028	Total score:	12
Q	Grade score	Annotation				
1	A4	The candidate was able to find points and recognised the formula for a horizontal line in part a). In part b) the candidate was able to use the formula to find some points. In the communications of their findings the candidate looked only at a particular value. To gain an M5 or M6 the candidate would have needed to more fully connect the different concepts and representations and/or would have needed to develop a more complete answer to the investigation by looking at which deal would have been better over the whole renting period.				
2	A3	The candidate formed a table and got 5 points correctly found. The graph did not have the correct y intercept or the correct shape when $x < 0$ . Candidate had the correct vertex to the graph but was unable to draw the parabola correctly. To gain an A4 or higher the candidate would have needed to recognise and work with the equations in a more thorough way. Only parts of the connections between tables and equations were understood.				
3	M5	Candidate was able to link the equations to the graph and a horizontal shift in part a. (a 2 square shift to the right was also accepted). Candidate started the investigation and found some areas in part b). To gain an M6 the candidate would have needed to have an understanding of how the area shifted as the length of plastic became bigger in part b).				