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SUPERVISOR'S USE ONLY

Level 1 Mathematics and Statistics, 2018

91028 Investigate relationships between tables, equations and graphs

9.30 a.m. Tuesday 20 November 2018
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 2–12 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.

Merit

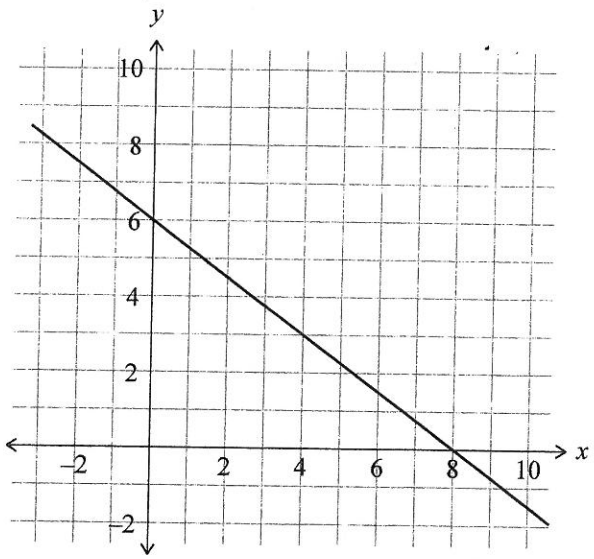
TOTAL 18

ASSESSOR'S USE ONLY

QUESTION ONE

ASSESSOR'S USE ONLY

(a) Give the equation of the graph shown below.



Equation: $y = \frac{-3}{4}x + 6$ //

U

(b) James takes 40 minutes to jog the 5 km from his home to school.

(i) What is James's average speed when he is jogging from his home to school?

8 minutes per Km

0.125 Km/m //

U

ASSESSOR'S USE ONLY

(ii) Emma lives further away from the school than James.

They leave their homes at the same time.

Emma rides her bike to school, and James jogs to school.

They meet 20 minutes after they leave their homes.

After they meet, both James and Emma change their travelling speeds so they are the same.

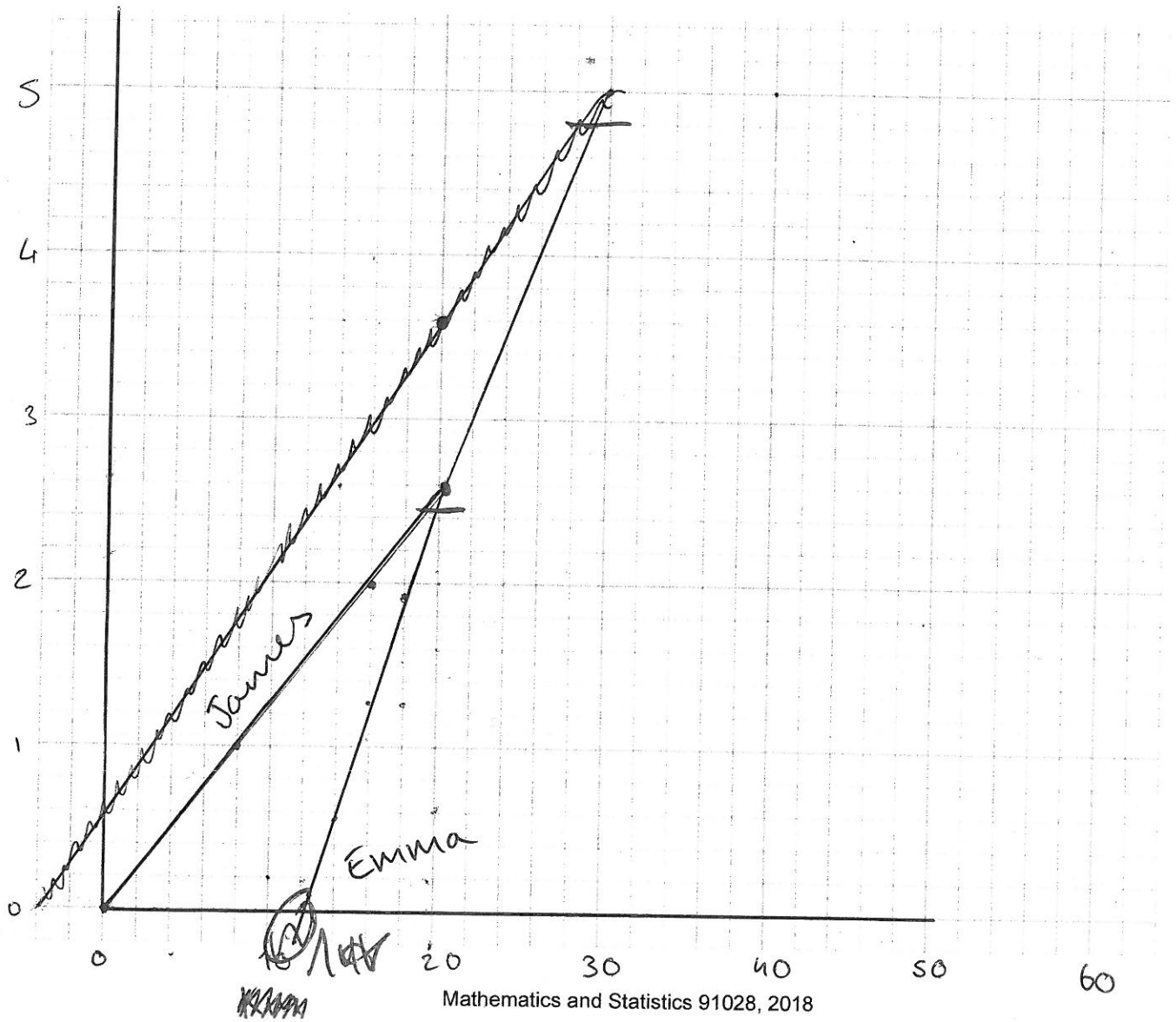
James begins running and Emma rides her bike at ¾ of the speed she had been travelling before they met.

They arrive at school 30 minutes after they left their homes.

Represent Emma and James's journeys from their homes on a graph.

6 m per K

2.4 K / 10m



(iii) Give the equations that represent Emma's and James's journeys.

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Before 20m:

James: $y = \frac{1}{8}x$

Emma: $y = 0.6x$ A

After 20m:

$y = \frac{1}{4}x - 1.3$ // U

(iv) Describe Emma's and James's journeys to school, including their speeds and how far Emma's home is from the school.

James traveled at 0.125 Km/m for the first 20m then at 0.25 km/m for the remainder of the trip

Emma travels at 0.25 km/m for the last 10m// U

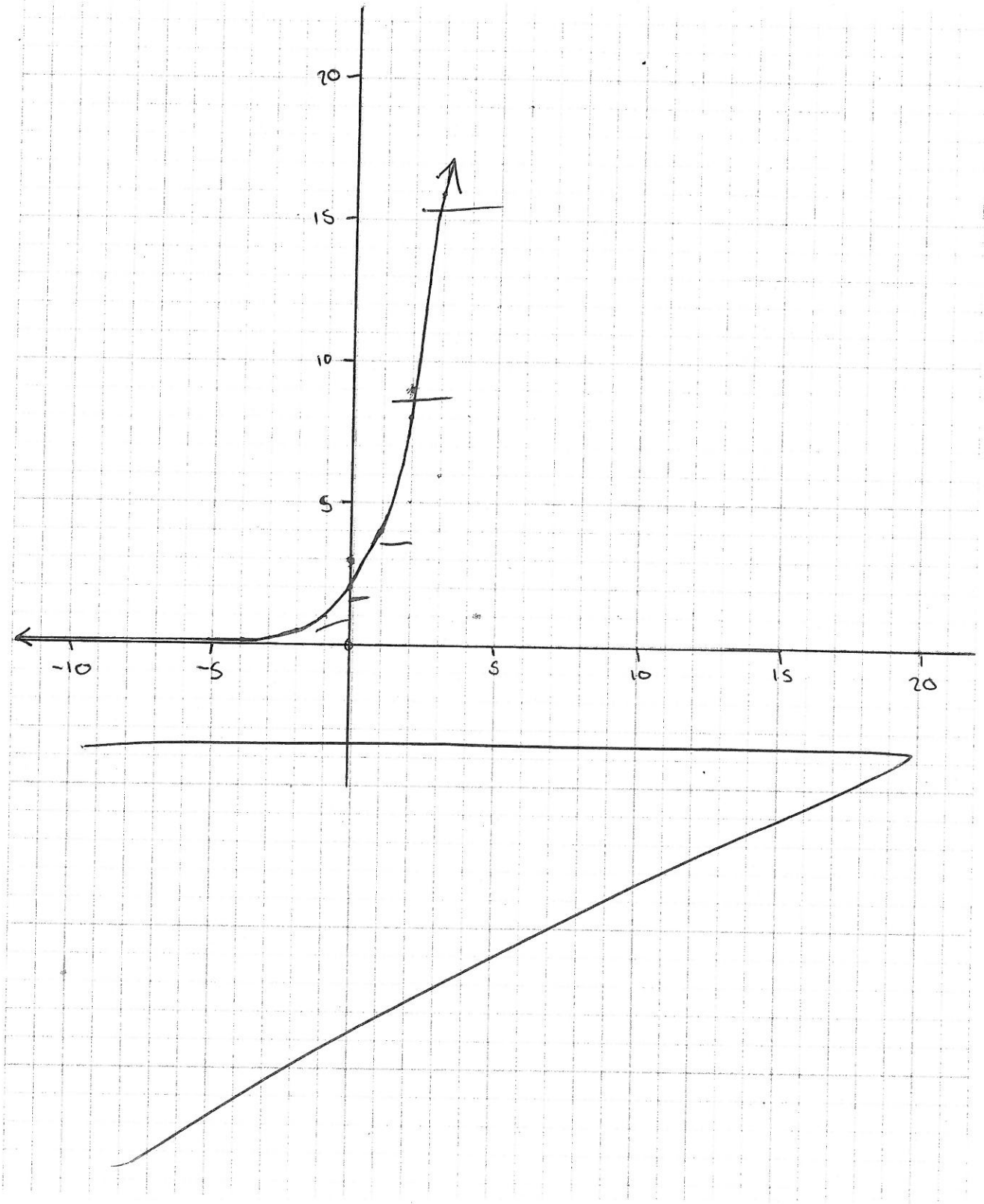
James's home is 5km from school// A

E7

QUESTION TWO

ASSESSOR'S USE ONLY

(a) (i) Draw the graph of $y = 2^{(x+1)}$ on the grid below.



(ii) If this graph was moved 3 units to the right and 4 units up, give the equation of the translated graph.

$2^{(x-2)} + 4$

r

r

(b) A stomach bug spreads through a large school.

The **total** number of different students who go to the nurse at least once because of the stomach bug is recorded. Each student's name is recorded only once.

The **total** number of students whose name has been recorded can be modelled by:

$y = 2^n + 3$

where n is the number of days since the first students visit the school nurse with the stomach bug.

(i) How many **more** students visited the nurse for the first time on the fourth day than on the third day?

Show your working.

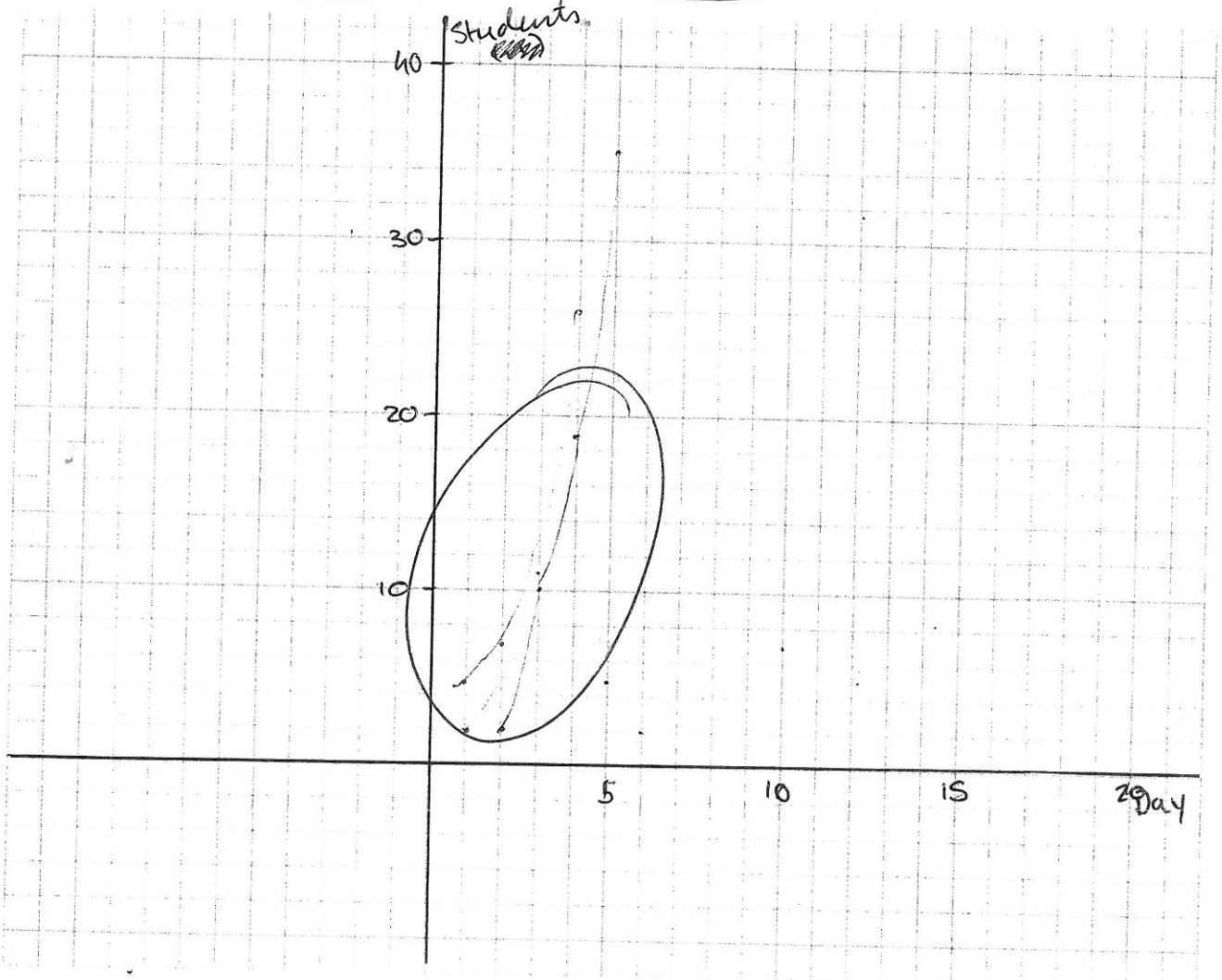
$y = 2^3 + 3 = 11$ $\quad y = 2^4 + 3 = 19$

8 more students visited on the 4th than the 3rd

(ii) Give the equation that best represents the **number** of students who were recorded as going to the nurse **on any day** n, when $n > 1$.

Give your equation in the simplest form.

Equation: $y = 2^{(n)} + 3 - (2^{(n+1)} + 3)$



ASSESSOR'S USE ONLY

(iii) After the **total** number of different students who have visited the nurse reaches 67, the daily number of students who visit begins to decrease.

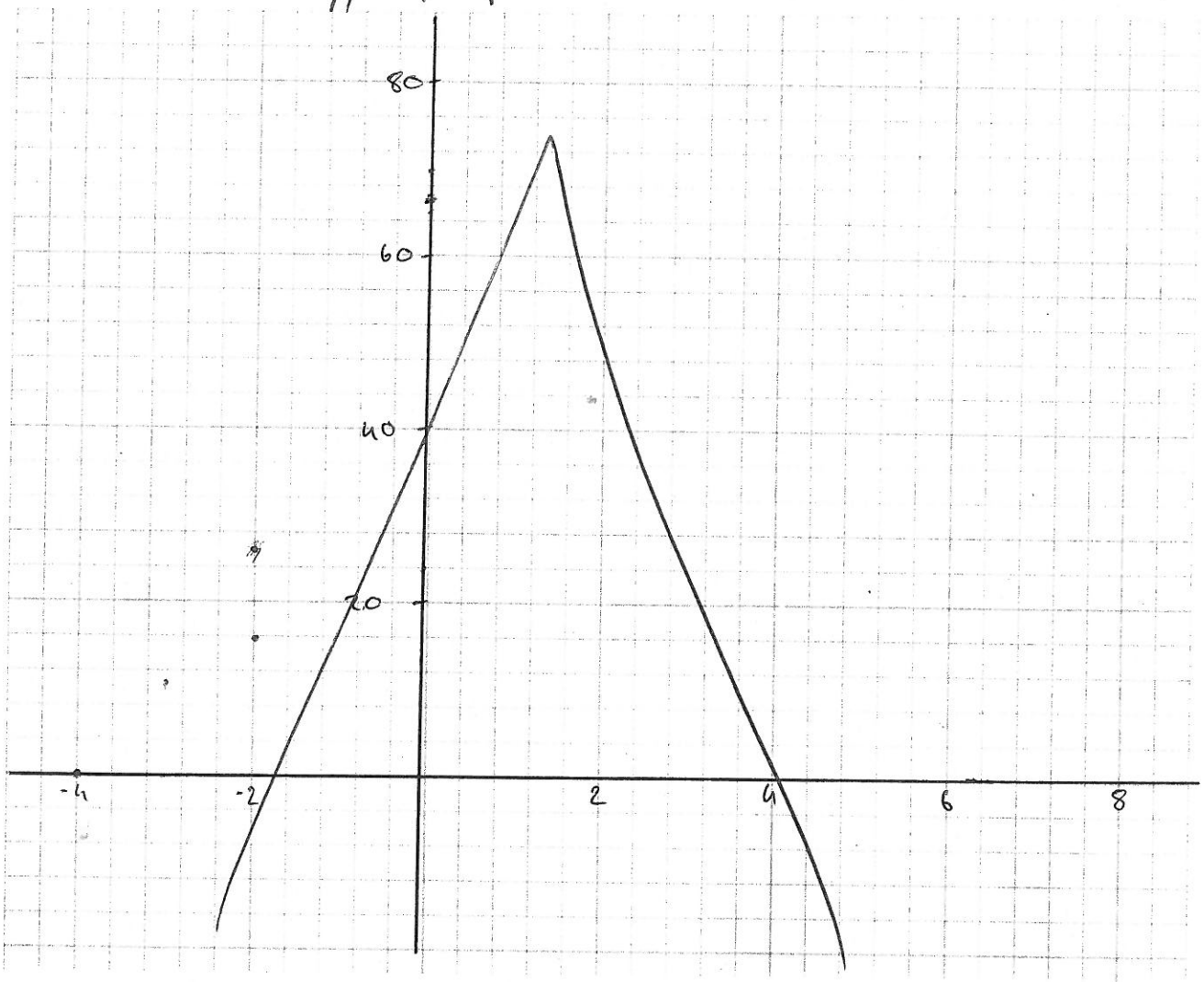
The number of different students going to the nurse can now be modelled by:

$$M = -(x - 5)(x + 3) + 9$$

where x is the number of days after the daily number of students visiting the nurse starts to decrease.

How many days after the first students went to the school nurse with the stomach bug would there be no students going to the school nurse with the same stomach bug?

Number of days: 11



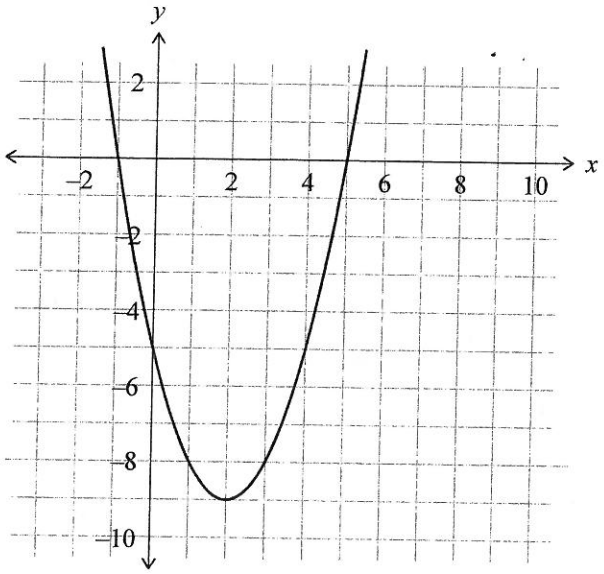
ASSESSOR'S USE ONLY

M6

QUESTION THREE

ASSESSOR'S USE ONLY

(a) Give the equation of the graph shown below.



Equation: $y = 1x^2 - 4x - 5$

4

(b) Pippa is designing a new label for a drink bottle.

The design is made up of two circles placed one on top of the other as shown in the diagram.

The maximum height of the two circles is to be 10 cm.

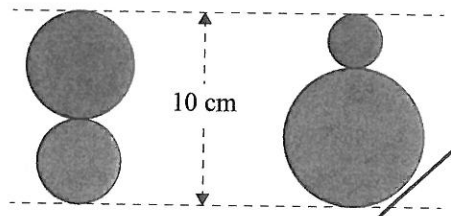
The minimum diameter of either circle is 2 cm (radius is at least 1 cm).

The bottom circle is coloured red and the top one blue.

She wants to know the approximate area of each circle.

Remember $A = \pi r^2$.

Pippa uses π as 3.



One possible logo design

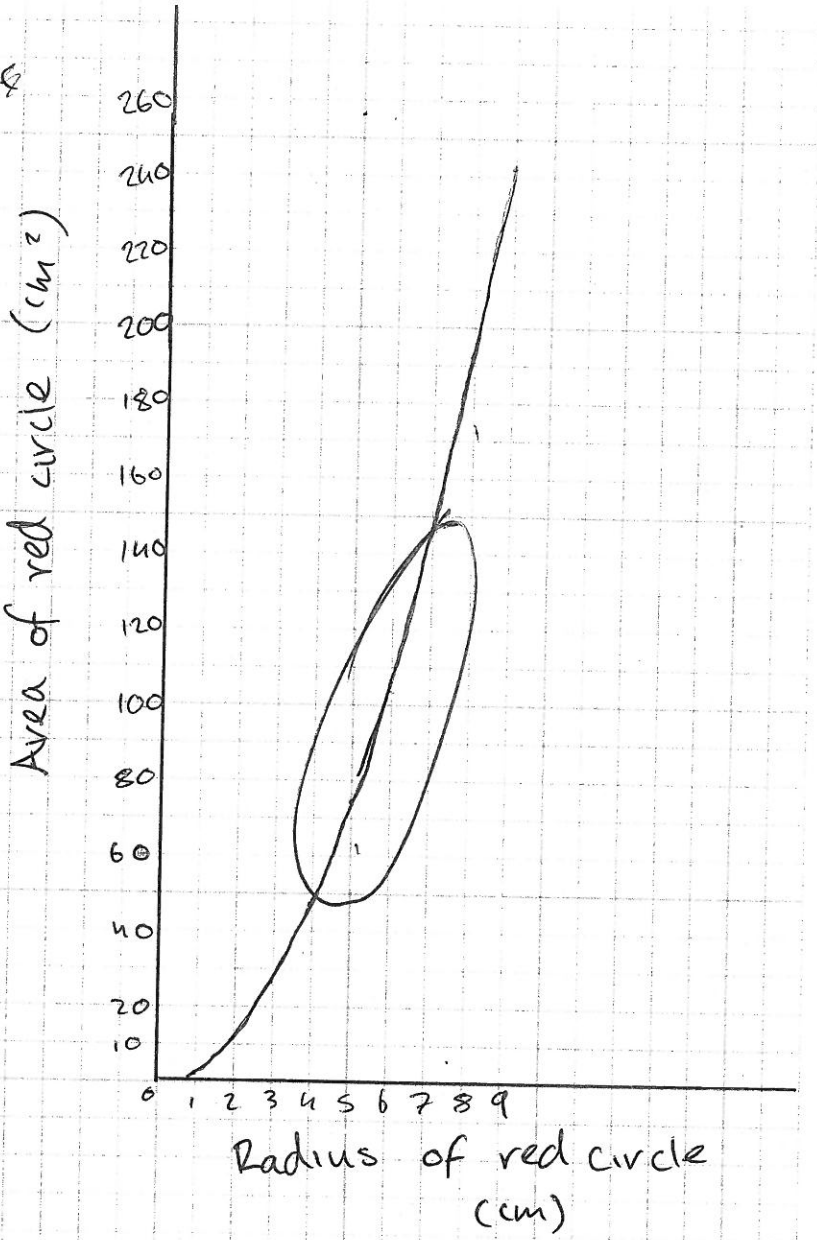
Another possible logo design

ASSESSOR'S USE ONLY

(i) Use a table or graph to investigate the relationship between the area of the red circle and its radius as the radius increases.

A	B
3	1
12	2
27	3
48	4
75	5
108	6
147	7
192	8
243	9

$y = 3x^2$



(ii) Describe the major features of the graph that represents the relationship between the area of the red circle and its radius as the radius increases.

I notice that the graph has a parabolic relationship but only half of the parabola can be seen, and it is the positive half. As the ~~area~~ radius of the red circle increases, the area also increases.

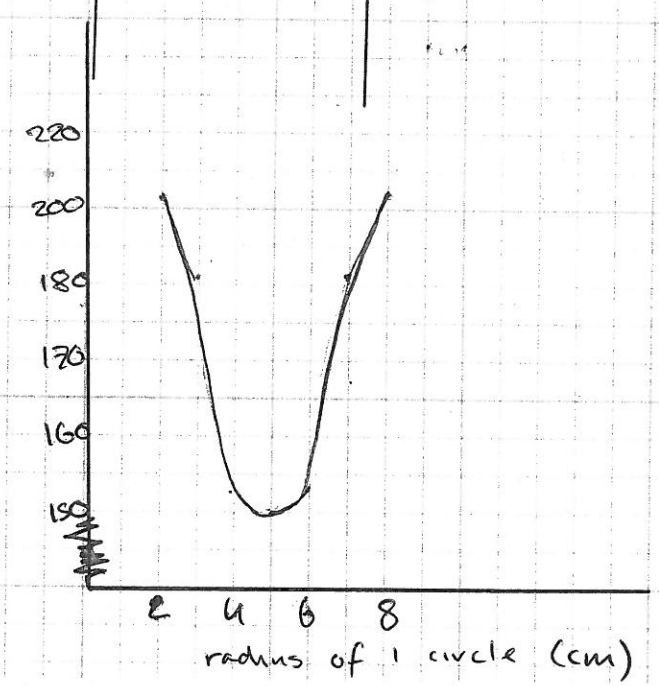
ASSESSOR'S USE ONLY

(iii) State the equation of the graph that represents the **total** of the areas of the red and the blue circles as the radii change.

$3\text{red}^2 + 3\text{blue}^2 = \text{total area}$

$\text{total area} = 3r^2 + 3b^2$ // A

red	blue	total area
2	8	204
3	7	184
4	6	156
5	5	150
6	4	156
7	3	184
8	2	204



$y = 5.28x^2 - 55.28x + 296$

(iv) Give the general equation of the graph which represents the **total** of the areas of the red and blue circles, where the sum of their radii is n cm.

n

n

M5

Merit Exemplar 2018

Subject	Level 1 Mathematics and Statistics	Standard	91028	Total score	18

Q	Grade score	Annotation
1	E7	The candidate successfully found the equation of the line and the speed of James. Candidate was able to graph the journey. For an E8 the candidate would need to have a detailed description of the journey with correct speed and distances and/or correct equations.
2	M6	The candidate successfully drew and translated an exponential. They also began to algebraically find a formula for the number of students who were recorded as going to the nurse on any day. For an E7 the candidate would need to have simplified their equation fully or solved the problem in 3b) iii.
3	M5	The candidate successfully found the equation of the parabola from the graph. The candidate found and commented on the relationship between the radius and the area. For an M6 the candidate would have needed to restrict the radius to between 1 and 4 to fit in to the restrictions given.