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NZQA

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

For Supervisor's use only

Level 2 CAS Mathematics, 2009

90806 Demonstrate an understanding of mathematical relationships

Credits: Six
9.30 am Monday 16 November 2009

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

Make sure you have the Formulae Sheet L2-MATHF.

Answer ALL the questions in this booklet.

The questions in this paper are NOT in order of difficulty. Attempt all questions or you may not provide enough evidence to achieve the required standard.

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 2–7 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.

For Assessor's use only	**Achievement Criteria**	
Achievement	**Achievement with Merit**	**Achievement with Excellence**
Demonstrate an understanding of mathematical relationships. ☐	Demonstrate an understanding of mathematical relationships in multistep situations. ☐	Demonstrate an understanding of mathematical relationships in more complex situations. ☐
Overall Level of Performance ☐		

You are advised to spend 70 minutes answering the questions in this booklet.

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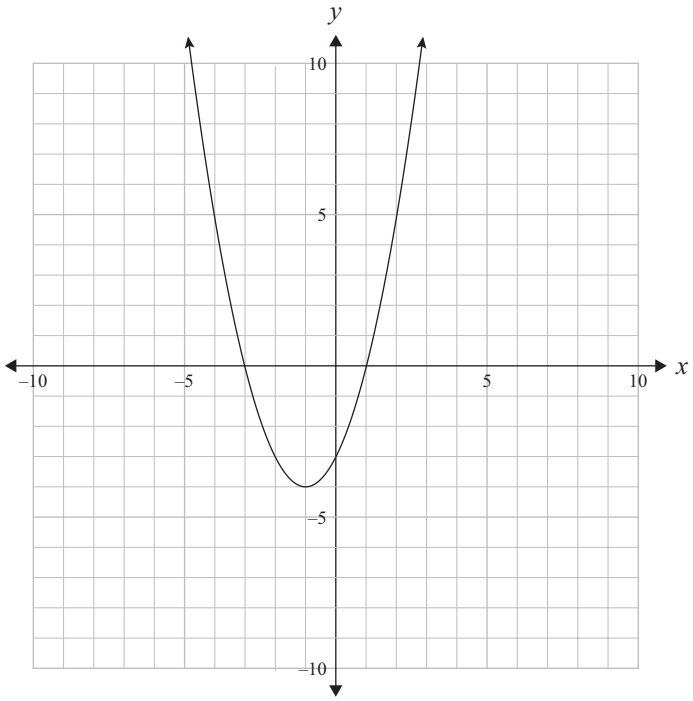
QUESTION ONE

(a) The graph below is translated so that its vertex is at (1,2).

Give the equation of the new graph.



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(b) The monthly profit of a school Young Enterprise Scheme (YES) group is modelled by the function:

$$y = -x(x - 8)$$

where x is the number of months that the YES group has been trading and y is the profit **(in hundreds of dollars)** for the month.

(i) Find when the maximum monthly profit occurs, and calculate the maximum monthly profit (r) in hundreds of dollars.

(ii) Jake does not think that the model $y = -x(x - 8)$ fits well after the first 4 months of the group's trading.

After 4 months of trading, he uses the model $(x - 4)^2 + y^2 = r^2$ for the remaining 6 months of the project.

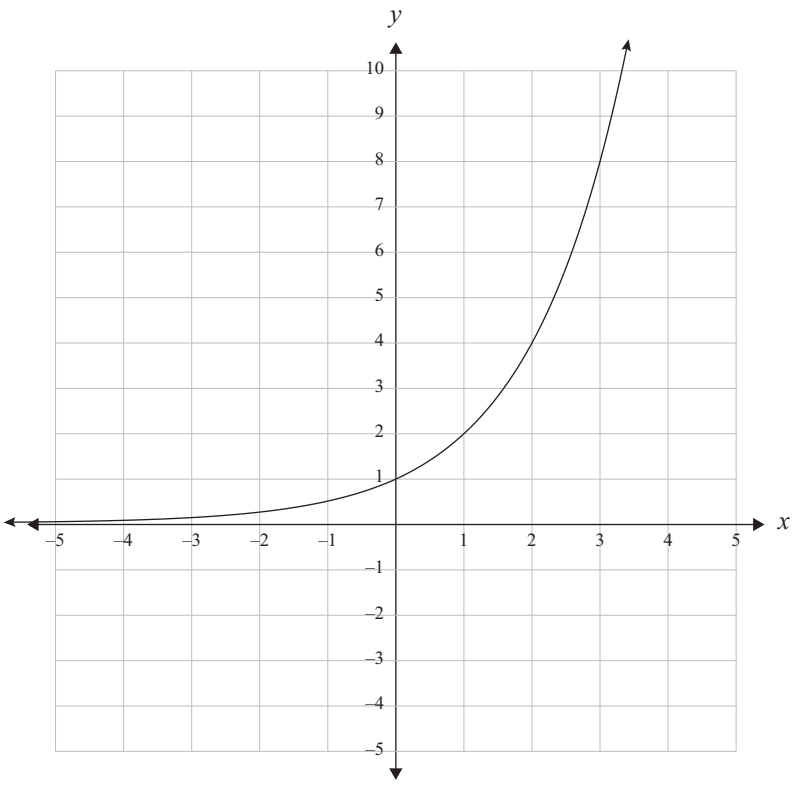
The YES project ends after 10 months.

For the 10 months that the group is trading, define the functions, giving any restrictions on the x and y values of the monthly profit models.

QUESTION TWO

Assessor's use only

(a) (i) The graph below can be used as a model to predict the number of bacteria at the end of each week in a contaminated pond, if their growth is not controlled.



y is the predicted number of bacteria, in thousands, in the contaminated pond and x is the number of weeks since the number of bacteria was first recorded.

Find the increase in the number of bacteria from the end of the first week ($x = 1$) to the end of the fourth week if their growth rate is not controlled.

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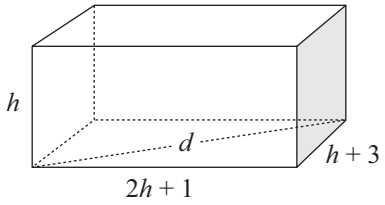
(ii) At the end of the first week, a scientist adds some chemical to the pond.
The chemical reduces the **growth rate** of the bacteria by 80% each week for 5 weeks.

How many bacteria would be expected to be in the pond at the end of 5 weeks of treatment (6 weeks after the first count)?

(b) The diagram shows a cuboidal container with a width of $(h + 3)$ metres, and length $(2h + 1)$ metres.
The length of the diagonal of the base of the container is d metres.



Show that the height is given by $h = -1 \pm \sqrt{\frac{d^2 - 5}{5}}$.

QUESTION THREE

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(a) Solve $3\sin(x) = 1.2 \quad (0 \le x \le 2\pi)$.

(b) The equation $\tan^2 a(x - \pi) = 4.7$, where a is a whole number, has exactly 12 solutions for $-\pi \le x \le \pi$.

Find the value of a.

(c) A wheel in a factory is mounted vertically.
The wheel rotates at a constant speed of three complete revolutions in one minute.
Q is a point on the circumference of the wheel.

The maximum height of Q above the factory floor is 2.5 m and the minimum is 1.1 m.
The height h metres of Q at any time t seconds after it is at its highest point is given by a trigonometric function of the form:

$$h = A \operatorname{Cos} Bt + C$$

where A, B and C are constants.

Find:

- the actual equation for h
- the height of Q 10 seconds after it is at its highest point.

Extra paper for continuation of answers if required.
Clearly number the question.

Assessor's use only

Question number