

Surname						Other Names					
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Free-Standing Mathematics Qualification
June 2006
Intermediate Level



USING ALGEBRA, FUNCTIONS AND GRAPHS Unit 8

6988/2

Wednesday 17 May 2006 9.00 am to 10.15 am

For this paper you must have:

- a clean copy of the Data Sheet (enclosed)
- a calculator
- a ruler

Time allowed: 1 hour 15 minutes

Instructions

- Use blue or black ink or ball-point pen. Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- Answer the questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want marked.
- You may **not** refer to the copy of the Data Sheet that was available prior to this examination. A clean copy is enclosed for your use.

Information

- The maximum mark for this paper is 50.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.

Advice

- In all calculations, show clearly how you work out your answer.

For Examiner's Use			
Number	Mark	Number	Mark
1		5	
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Total (Column 1) →			
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Examiner's Initials			

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SECTION A

Answer **all** questions in the spaces provided.

Use **Halley's Comet** on page 2 of the Data Sheet.

1 One Astronomical Unit is equal to 1.496×10^{11} metres.

- (a) When Halley's Comet is at its maximum distance from the Earth, it is 35 Astronomical Units away.

Calculate the maximum distance of Halley's Comet from the Earth.
Give your answer in standard form, in metres, to one decimal place.

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Answer
(3 marks)

- (b) Light travels at 2.998×10^8 metres per second.

How long does it take for light to travel one Astronomical Unit?
Give your answer in minutes, to the nearest minute.

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Answer
(3 marks)

SECTION B

Answer **all** questions in the spaces provided.

Use **Greenhouse heaters** on page 2 of the Data Sheet.

- 2** The cost, £ P , of making n greenhouse heaters is given by the formula $P = c + dn$, where c and d are constants.

The cost of making 1000 greenhouse heaters is £ 24 000.

The cost of making 2500 greenhouse heaters is £ 51 000.

- (a) (i) Write down two equations in terms of c and d .

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Answers

and
 (2 marks)

- (ii) Solve the equations in (i) to find the values of c and d .

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Answers $c =$, $d =$
 (3 marks)

(b) The company sells the greenhouse heaters to garden centres for £ 22 each.

(i) Write down the selling price of n greenhouse heaters.

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Answer
(1 mark)

(ii) When the selling price is the same as the cost, the company makes no profit.

Find the value of n when the company makes no profit.

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Answer
(3 marks)

9

Turn over for the next question

Turn over ►

SECTION C

Answer **all** questions in the spaces provided.

Use **Wind chill** on page 2 of the Data Sheet.

- 3** An approximate formula for calculating the effective temperature, e ° Celsius, from the actual temperature, a ° Celsius, when the wind speed is w km per hour is

$$e = (1.1 + 0.02w)a - (3 + 0.6w)$$

- (a) Work out the simplified formula when the wind speed is 20 km per hour.

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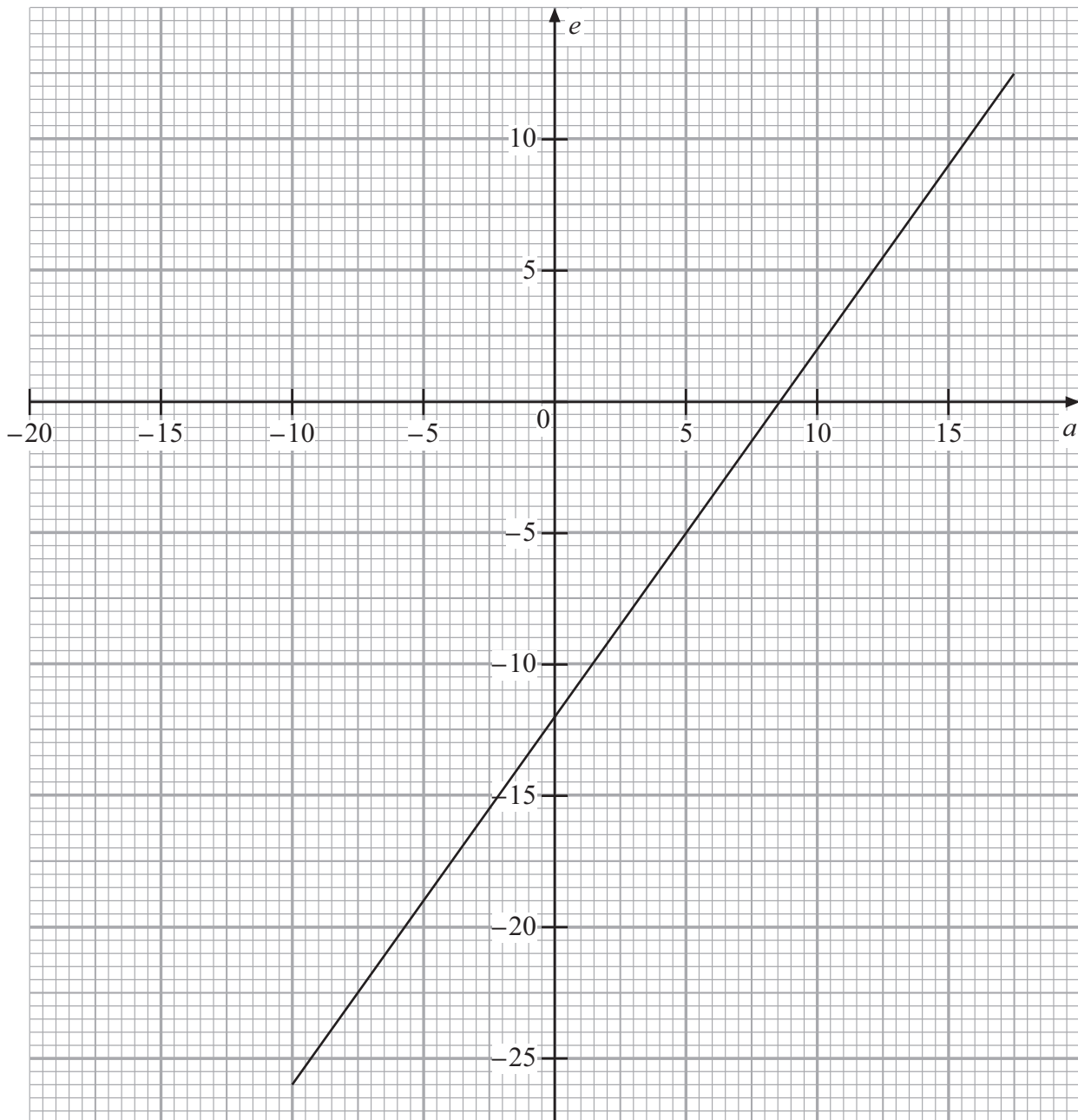
Answers.....
(2 marks)

- (b) The graph drawn on the opposite page represents the result of a wind speed of 15 km per hour. The equation of the line is $e = 1.4a - 12$.

Write down the gradient of this line.

Answer
(1 mark)

- (c) On the same axes, draw the line $e = 1.3a - 9$. (3 marks)



(d) When the effective temperature is -20° Celsius or colder, the weather is described as hazardous.

(i) On the axes above, draw the line $e = -20$. (1 mark)

(ii) For a wind speed of 15 km per hour, find the actual temperature which would bring about hazardous conditions.

Answer (2 marks)

SECTION D

Answer **all** questions in the spaces provided.

Use **Rockets** on page 3 of the Data Sheet.

- 4 At a firework display, a rocket is fired vertically upwards.

Its vertical height, h metres, is given by the equation $h = 20t - 5t^2$, where t is the time in seconds after firing.

- (a) Complete the table for values of h , using the given values of t .

t (seconds)	0	1	2	3	4
h (metres)	0			15	

(2 marks)

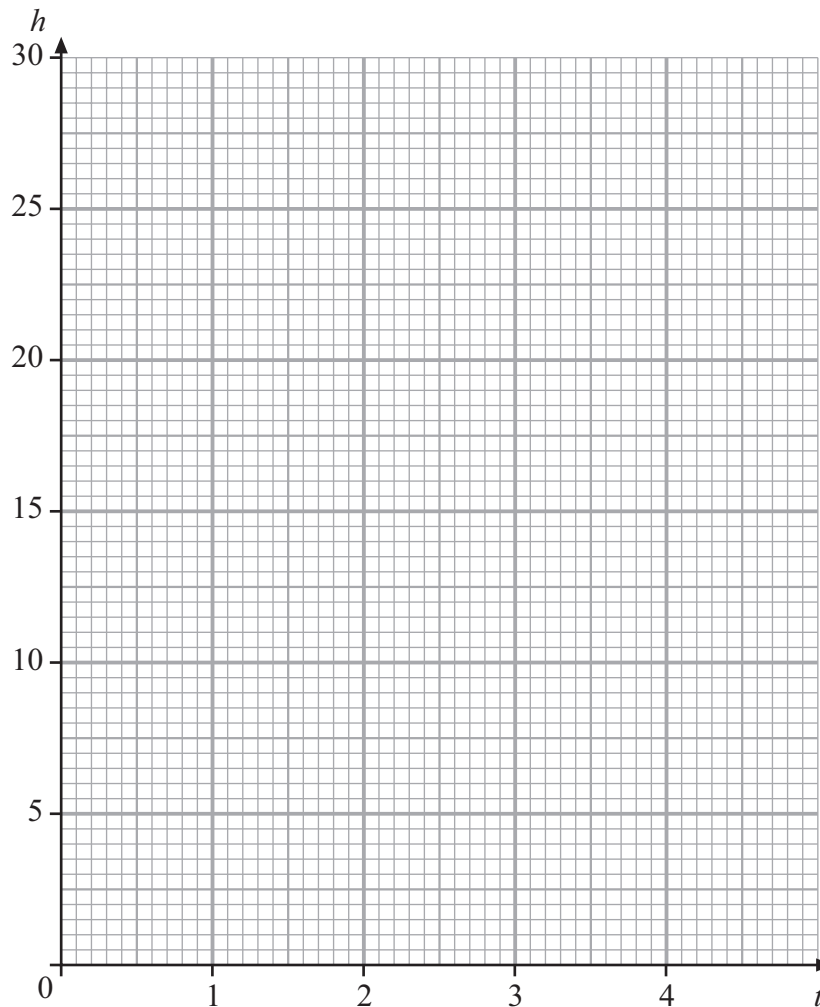
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- (b) On the axes below, draw the graph of $h = 20t - 5t^2$, for $0 \leq t \leq 4$.



(2 marks)

- (c) Use the graph to estimate:

- (i) the time when the rocket first reaches a height of 18 metres;

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Answer

(1 mark)

- (ii) the speed of the rocket when it first reaches a height of 18 metres.

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Answer

(2 marks)

Question 4 continues on the next page

Turn over ►

- (d) When the rocket is at a height of 12 metres, the values of t can be found using the equation $5t^2 - 20t + 12 = 0$.

Solve this equation to calculate the times when the rocket reaches a height of 12 metres. Give your answers to two decimal places.

The solutions of $at^2 + bt + c = 0$, where $a \neq 0$, are given by $t = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$.

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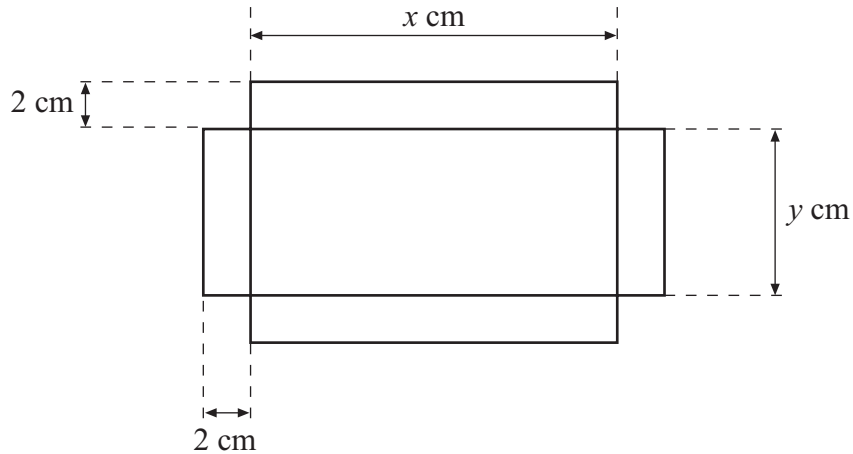
Answers: $t = \dots\dots\dots$ and $t = \dots\dots\dots$
(4 marks)

SECTION E

Answer **all** questions in the spaces provided.

Use **Trays** on page 3 of the Data Sheet.

- 5 The base of a tray is a rectangle x cm long and y cm wide.
The tray is 2 cm deep.



- (a) Write down the formula for the volume, $V \text{ cm}^3$, of this tray.

Answer $V = \dots\dots\dots$
(1 mark)

- (b) Find an expression for the surface area, $S \text{ cm}^2$, of the metal used for the tray.
Simplify the expression.

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Answer $S = \dots\dots\dots$
(2 marks)

Question 5 continues on the next page

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- (c) A tray is to be made with a volume of 300 cm^3 .

Show that the formula for the surface area can be expressed as

$$S = 4x + 150 + \frac{600}{x}$$

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(4 marks)

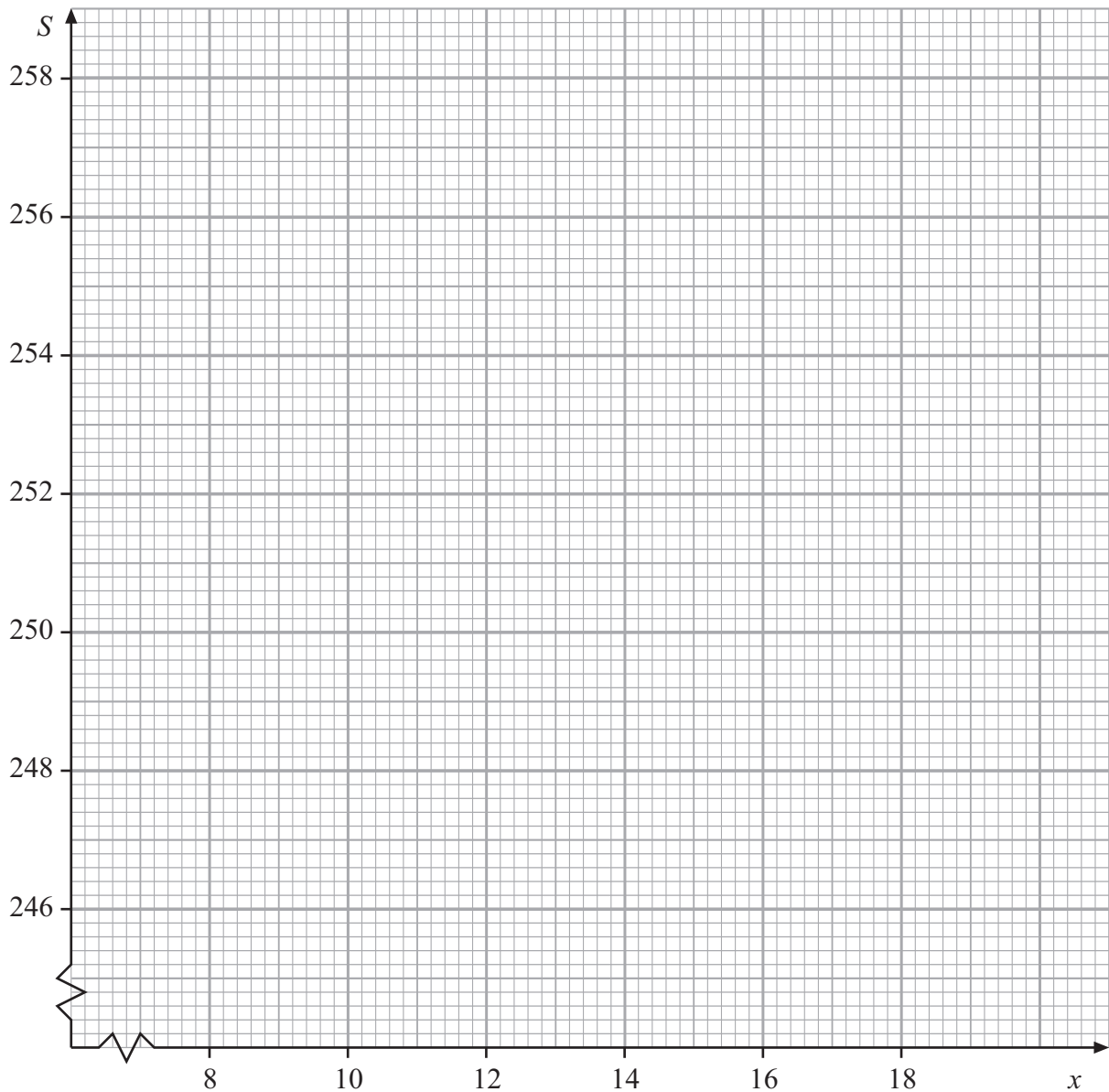
- (d) Complete the row of values for $S = 4x + 150 + \frac{600}{x}$.

You may find completing the other rows helpful.

x	8	10	12	14	16	18
$4x$		40				72
150	150	150	150	150	150	150
$\frac{600}{x}$		60				33
S		250				255

(3 marks)

- (e) On the graph below, plot the curve with the equation $S = 4x + 150 + \frac{600}{x}$.



(3 marks)

- (f) Use the graph to find the minimum area of metal needed to make the tray.

Answer
(1 mark)

- (g) Find the value of x when the minimum area of metal is used to make the tray.

Answer
(1 mark)

END OF QUESTIONS

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