

**OXFORD CAMBRIDGE AND RSA EXAMINATIONS**  
**GCSE**

**A382/02**

**APPLICATIONS OF MATHEMATICS**

**Applications of Mathematics 2**  
**(Higher Tier)**

**FRIDAY 14 JUNE 2013: Morning**

**DURATION: 2 hours**  
**plus your additional time allowance**

**MODIFIED ENLARGED**

<b>Candidate forename</b>		<b>Candidate surname</b>	
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<b>Centre number</b>						<b>Candidate number</b>				
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**Candidates answer on the Question Paper.**

**OCR SUPPLIED MATERIALS:**

**Insert for question 4(d)**

**Insert for question 7**

**OTHER MATERIALS REQUIRED:**

**Scientific or graphical calculator**

**Geometrical instruments**

**Tracing paper (optional)**

<p><b>You are permitted to use a calculator for this paper</b></p>
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**READ INSTRUCTIONS OVERLEAF**

## **INSTRUCTIONS TO CANDIDATES**

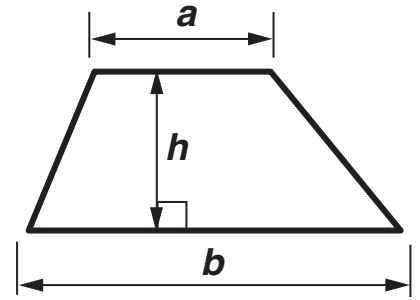
- **Write your name, centre number and candidate number in the boxes on the first page. Please write clearly and in capital letters.**
- **Use black ink. HB pencil may be used for graphs and diagrams only.**
- **Answer ALL the questions.**
- **Read each question carefully. Make sure you know what you have to do before starting your answer.**
- **Your answers should be supported with appropriate working. Marks may be given for a correct method even if the answer is incorrect.**
- **Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).**

## **INFORMATION FOR CANDIDATES**

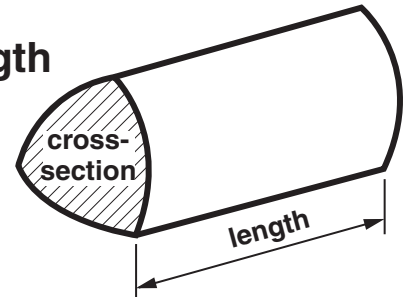
- **The number of marks is given in brackets [ ] at the end of each question or part question.**
- **Your Quality of Written Communication is assessed in questions marked with an asterisk (\*).**
- **The total number of marks for this paper is 90.**
- **Any blank pages are indicated.**

# FORMULAE SHEET: HIGHER TIER

Area of trapezium =  $\frac{1}{2}(a + b)h$



Volume of prism = (area of cross-section)  $\times$  length

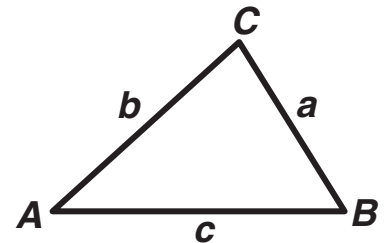


In any triangle  $ABC$

Sine rule  $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

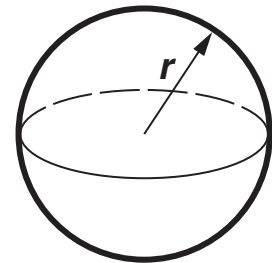
Cosine rule  $a^2 = b^2 + c^2 - 2bc \cos A$

Area of triangle =  $\frac{1}{2} ab \sin C$



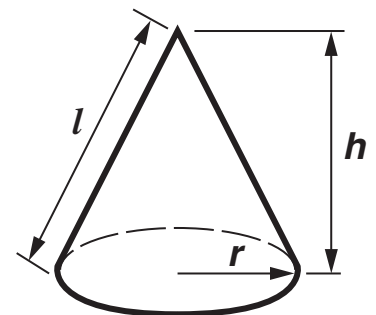
Volume of sphere =  $\frac{4}{3} \pi r^3$

Surface area of sphere =  $4\pi r^2$



Volume of cone =  $\frac{1}{3} \pi r^2 h$

Curved surface area of cone =  $\pi r l$



The Quadratic Equation

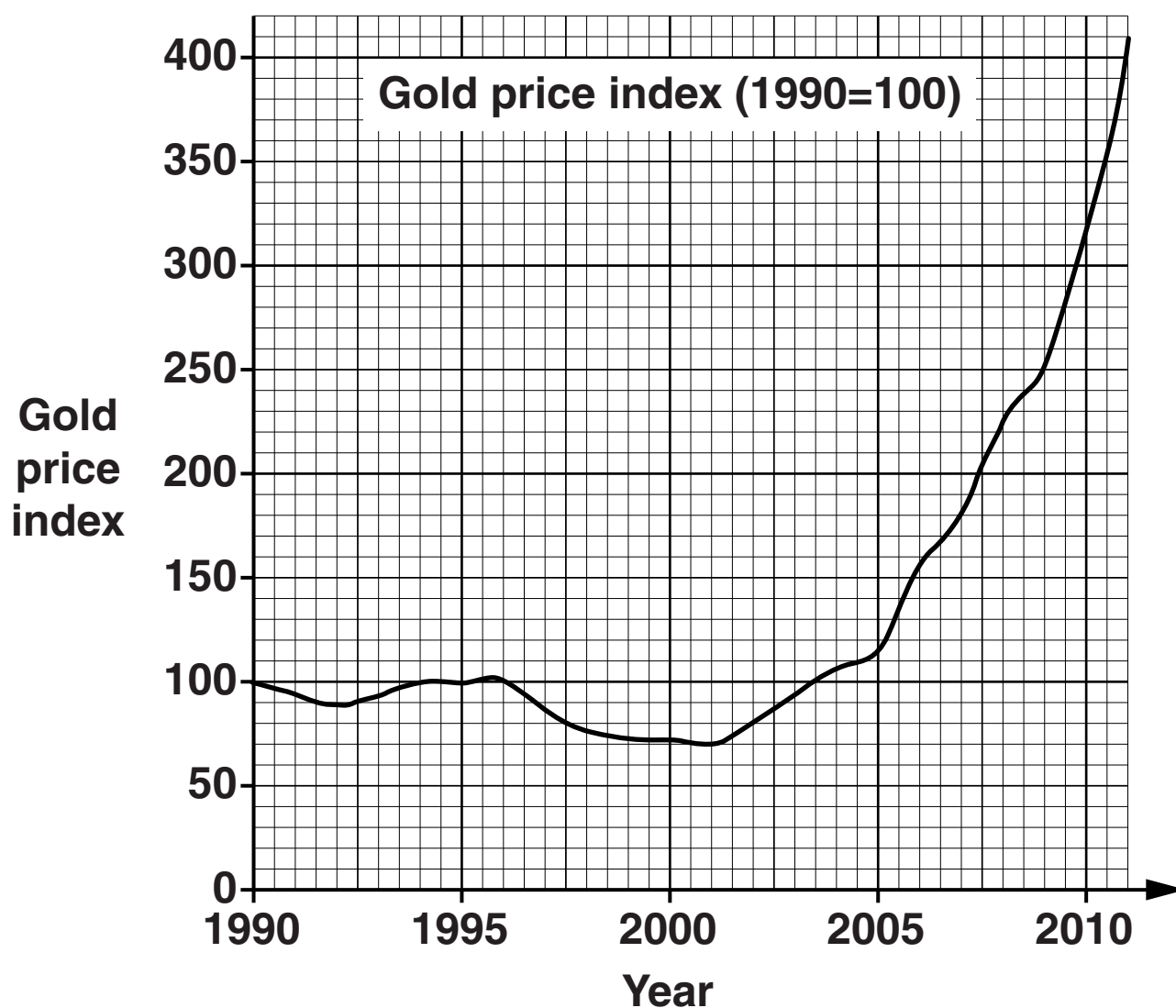
The solutions of  $ax^2 + bx + c = 0$ ,  
where  $a \neq 0$ , are given by

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

- 1 In 1990, when Mia was born, her rich uncle bought her a diamond which she could sell on her 21st birthday.

Below are shown the price of diamonds and the gold price index for the last 21 years.

YEAR	PRICE OF 1 CARAT DIAMOND (\$)
1990	14050
2000	15100
2002	16095
2004	18300
2006	23050
2008	24500
2011	29100



**Would Mia have got more money on her 21st birthday if her uncle had spent the same amount on gold rather than a diamond?  
Justify your answer by making use of the information above.**

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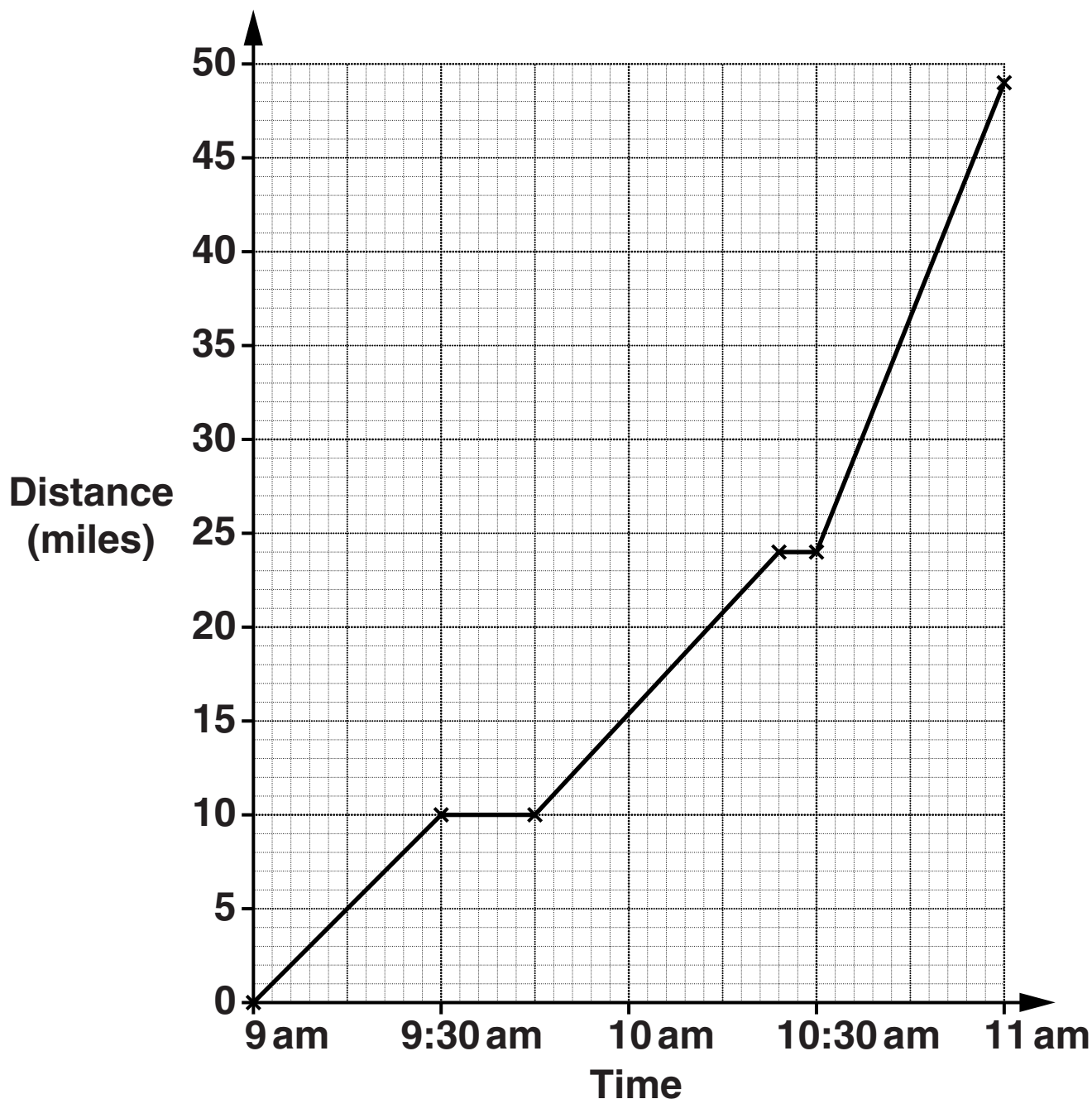
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**[2]**

- 2 In an electric car race, teams compete to see how far they can travel in 2 hours.  
The cars run on batteries.

The graph shows the whole race for Team Red.



(a) How far did Team Red travel in total?

(a) \_\_\_\_\_ miles [1]

**(b) Between which two times did Team Red travel at the fastest speed?**

**(b) \_\_\_\_\_ and \_\_\_\_\_ [1]**

**(c) Team Red made two stops during the race.  
In the first stop they changed a tyre. In the second stop they changed the battery.**

**How long did each stop take?**

**(c) Tyre \_\_\_\_\_ minutes**

**Battery \_\_\_\_\_ minutes [2]**

**Team Blue also started at 9am and travelled 40 miles in 2 hours.**

- Team Blue travelled the first 25 miles in 30 minutes, then**
- stopped for 45 minutes to make repairs.**

**(d) On the grid, draw the graph for Team Blue. [3]**

**(e) Complete this sentence.**

**Team \_\_\_\_\_ overtook Team**

**\_\_\_\_\_ at \_\_\_\_\_ am. [2]**

- 3 Zoe investigated the number of days it took letters to be delivered using two courier services, CAO and ISW.**

**Zoe sent 40 letters using CAO and 60 letters using ISW.**

**She recorded how many days it took for each letter to be delivered.**

**These are her results.**

<b>Number of days to be delivered</b>	<b>Number of letters using CAO</b>	<b>Number of letters using ISW</b>
<b>1</b>	<b>11</b>	<b>0</b>
<b>2</b>	<b>14</b>	<b>6</b>
<b>3</b>	<b>12</b>	<b>42</b>
<b>4</b>	<b>0</b>	<b>9</b>
<b>5</b>	<b>1</b>	<b>3</b>
<b>6</b>	<b>2</b>	<b>0</b>



**Zoe also found this information about the number of days letters should take to be delivered.**

<b>Courier service</b>	<b>CAO</b>	<b>ISW</b>
<b>Expected delivery time</b>	<b>1 to 3 days</b>	<b>3 to 5 days</b>

**(a) Use both tables to estimate the probability that the letters are delivered**

**(i) within 1 to 3 days for CAO,**

**(a)(i) \_\_\_\_\_ [1]**

**(ii) within 3 to 5 days for ISW.**

**(ii) \_\_\_\_\_ [1]**

**The mean number of days it took for Zoe's letters to be delivered using ISW is 3.15 days.**

**(b) Calculate the mean number of days Zoe's letters took to be delivered using CAO.**

**(b) \_\_\_\_\_ [3]**

**(c) Use your results, and the information, to give a reason why someone might use the courier service**

**(i) ISW,**

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**[1]**

**(ii) CAO.**

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**[1]**

**(d) Zoe repeated her investigation the following week.**

**Would you expect Zoe to get the same results?  
Give a reason for your answer.**

\_\_\_\_\_ **because** \_\_\_\_\_

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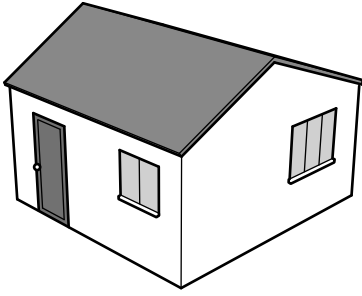
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**[1]**

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**4 This is a picture of Evan's house.**



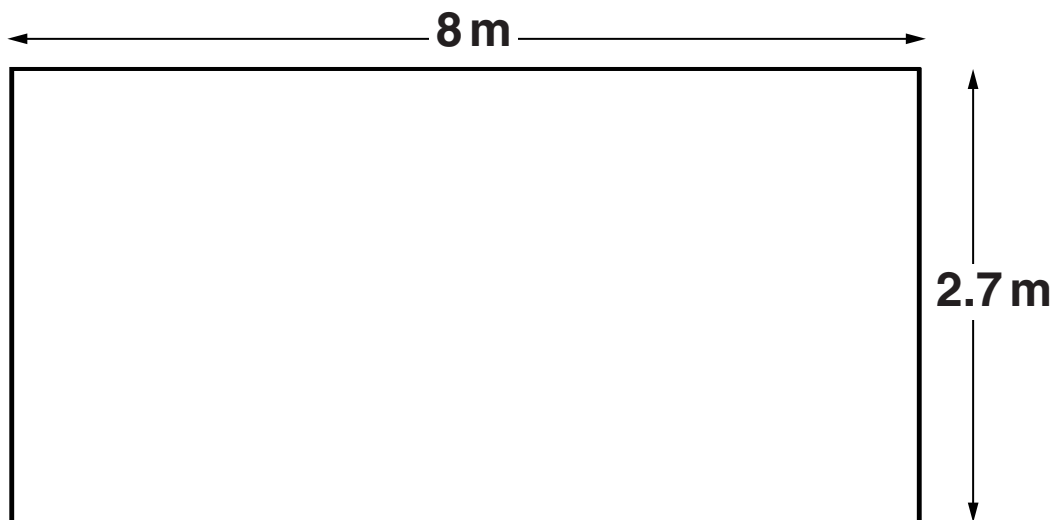
**The sloping sides of the roof are rectangles with length 8 m and width 2.7 m.**

**Evan installs solar panels on one side of the roof. Each panel is a rectangle that measures 0.9 m by 1.2 m.**

**The edge of any panel must be 0.3 m or more from any edge of the roof.**

- (a) On the diagram below, sketch an arrangement of 12 panels that will fit on the roof. Include all relevant measurements on your diagram.**  
**You do not need to draw your diagram to scale.**

**NOT TO SCALE**

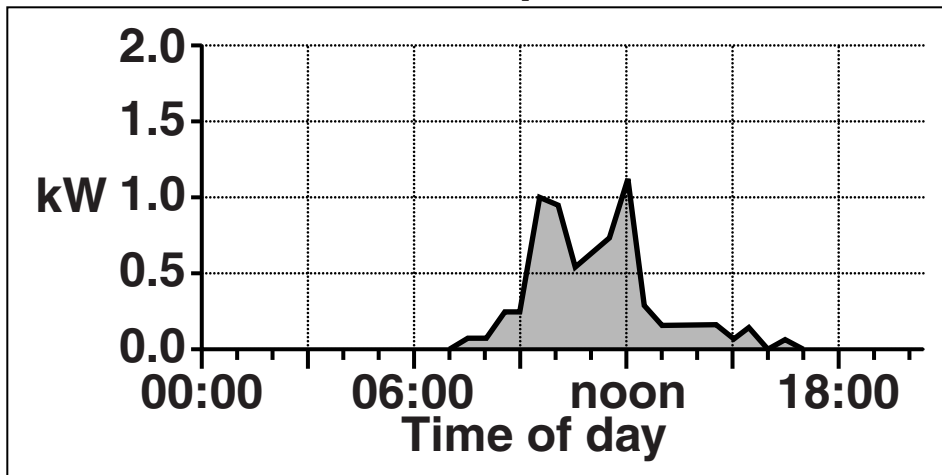


**[3]**

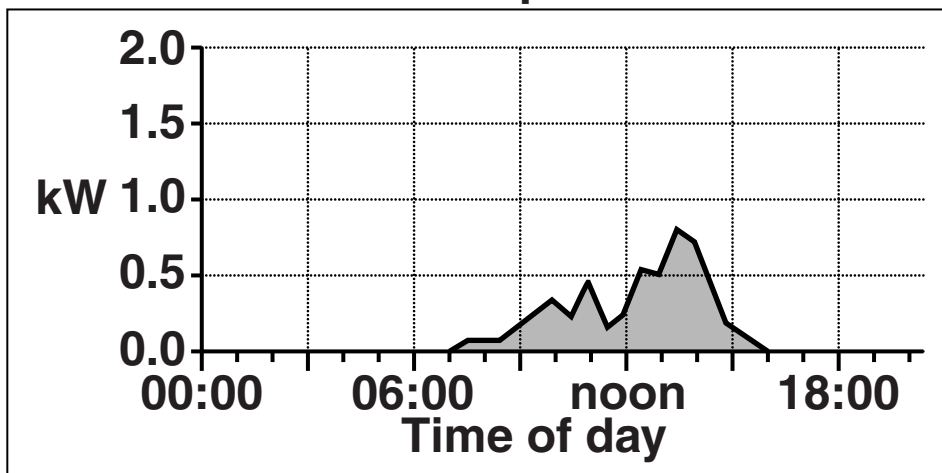
The solar panels produce electricity. The amount of electricity produced, measured in kilowatts (kW), depends on the intensity of light each panel receives.

(b) These graphs show the electricity produced by the panels on four consecutive days.

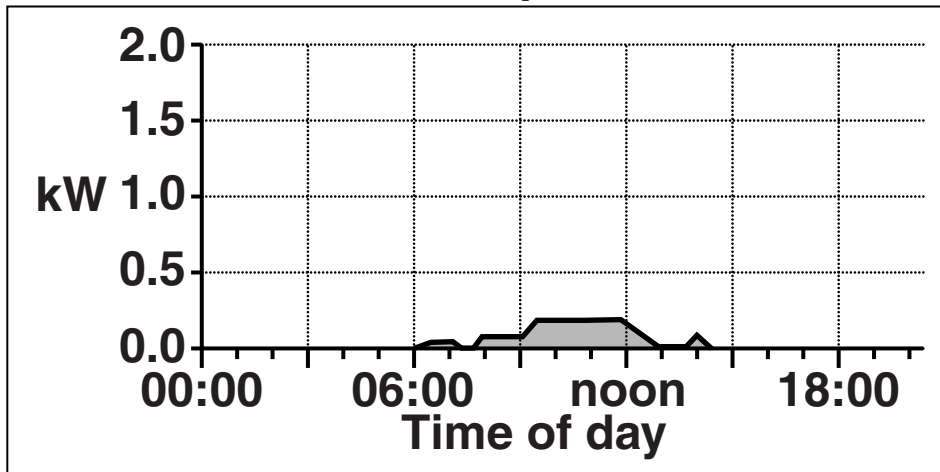
11th April



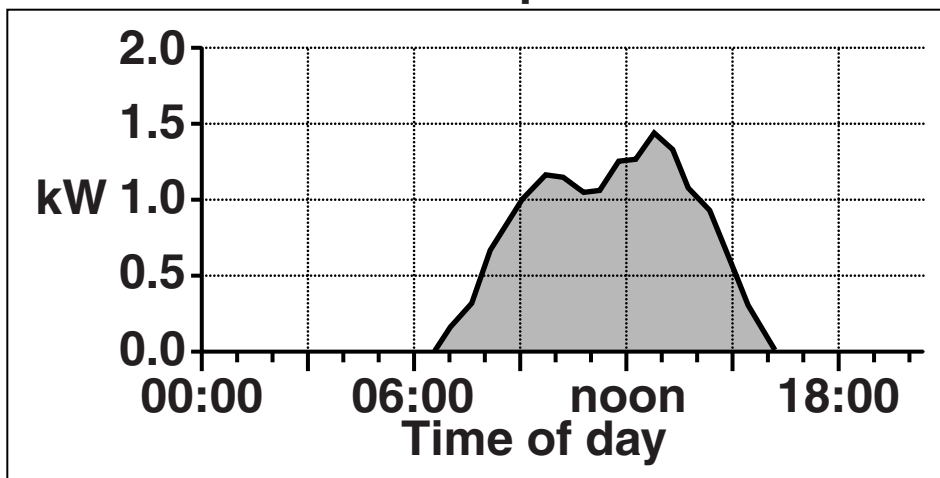
12th April



### 13th April



### 14th April



- (i) Write the four dates in the order, most to least, of the amount of electricity produced.

\_\_\_\_\_, \_\_\_\_\_,  
*most*  
 \_\_\_\_\_, \_\_\_\_\_  
*least*

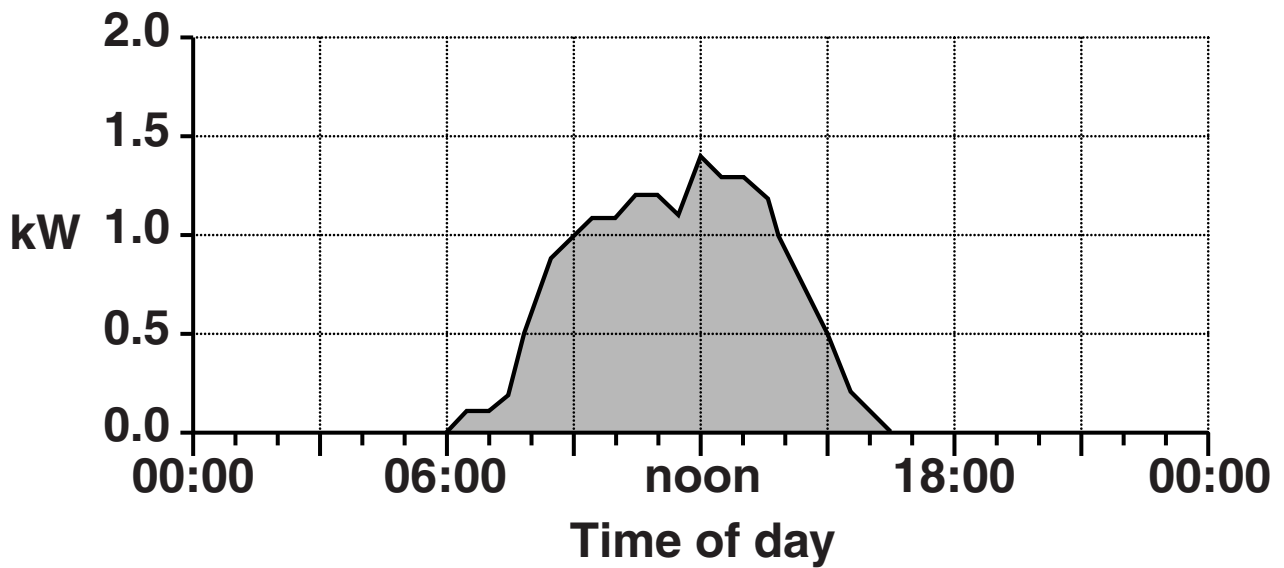
[1]

- (ii) Describe the possible weather conditions during the daytime on 13th April.

\_\_\_\_\_  
 \_\_\_\_\_

[1]

**(c) The graph below shows the electricity produced by Evan's solar panels on another day.**

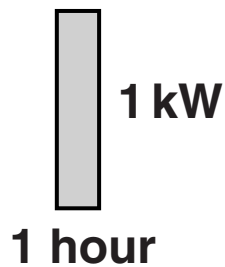


**(i) For how long did the solar panels produce electricity on that day?**

**(c)(i)** \_\_\_\_\_ **[2]**



- (ii) One unit of electrical energy is 1 kilowatt hour (kWh). This is equivalent to one kilowatt of electricity produced for one hour and would be shown on the graph by the following rectangle.



**Estimate the number of kilowatt hours of electricity produced on that day.  
You must show how you worked out your estimate.**

(ii) \_\_\_\_\_ kWh [3]

- (d) Information on electricity produced by Evan's panels each day is available via the internet.**

**The graph on the insert shows the electricity produced on each day in May.**

- (i) The internet connection was not working on 6th May.**

**Evan wanted to estimate the electricity produced.**

**He decided to estimate it by working out the average of electricity produced on 5th May and 7th May.**

**Use information from the graph on the insert to explain whether Evan's method is sensible.**

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**[2]**

- (ii) Evan later finds out that the panels actually produced 2 kWh on 6th May.

Work out on which day in May the median amount of electricity was produced and write down an estimate of this median amount.

(d) (ii) Day \_\_\_\_\_ Median \_\_\_\_\_ kWh [3]

**(e) Evan is paid for each kWh of electricity that the solar panels produce.**

**Evan is also paid for each kWh of electricity the panels produce that he does not use.**

**This is electricity that he EXPORTS.**

**Evan has to pay for each kWh of electricity he uses that is not produced by the panels.**

**This is electricity he IMPORTS.**

**The table below shows, in pence, the price of each kWh of electricity.**

<b>Type of use</b>	<b>Amount</b>
<b>Amount paid to Evan for each kWh produced</b>	<b>43.3p</b>
<b>Amount paid to Evan for each kWh EXPORTED</b>	<b>3.1p</b>
<b>Amount Evan pays for each kWh IMPORTED</b>	<b>13.0p</b>

**In one year the solar panels produced 2600 kWh of electricity.**

**Evan used 3500 kWh of electricity in that year, 50% was from the panels and 50% was imported.**

**Work out how much Evan received that year after he paid for the electricity he imported.**

**(e) \_\_\_\_\_ [6]**

- 5 The plan of a circular building is drawn on a square grid.  
The edge of each square represents a distance of 1 metre.  
Two security cameras are positioned on the wall of the building.  
The points (40, 20) and (72, 52) mark the positions of the cameras.  
A straight cable passes through the centre of the building and joins the two cameras.**

**(a) Calculate the coordinates of the centre of the building on the plan.**

**(a) ( \_\_\_\_\_ , \_\_\_\_\_ ) [2]**

**(b) Calculate the length of the cable.**

**(b) \_\_\_\_\_ m [3]**

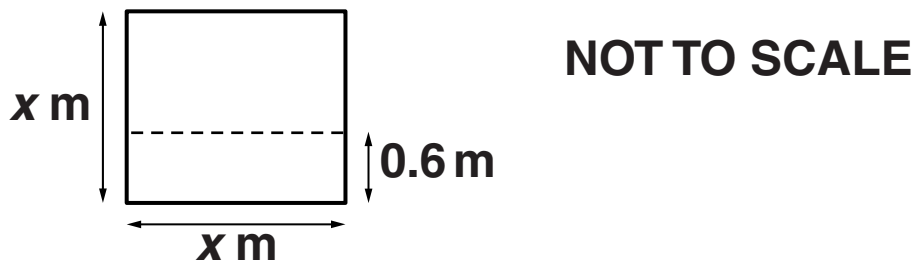
- 6 Reuben collects chip oil, oil that has previously been used to fry chips.**

**He stores the oil in a tank that is a cube.**

**Each edge of the cube is  $x$  metres long.**

**The oil in the tank has a depth of 0.6 m.**

**The following diagram shows a side view of the tank.**



**Reuben fills the tank by adding  $1.25 \text{ m}^3$  of oil.**

**This EXTRA oil just fits in the tank.**

**This extra oil can be represented using the following equation.**

$$x^3 - 0.6x^2 = 1.25$$



- (a) Use trial and improvement to find  $x$ .  
Give your answer correct to two decimal places.

(a) \_\_\_\_\_ m [4]

- (b) Reuben uses a mix of diesel and chip oil in his car.  
This is the ratio Reuben uses.**

**diesel : chip oil = 7 : 3**

**The fuel tank in Reuben's car holds 64 litres.  
The tank is one quarter full when Reuben decides  
to fill the tank with a mixture of diesel and chip oil.**

**How much diesel and how much chip oil should  
Reuben use?**

**(b) Diesel\_\_\_\_\_ litres**

**Chip oil\_\_\_\_\_ litres [4]**

- 7 The table below shows some information about personal allowance and income tax rates for incomes up to £100 000.  
A tax year starts on 6th April and ends on 5th April the following year.**

<b>Taxable income</b>	<b>2010–2011</b>	<b>2011–2012</b>
<b>Personal allowance – 0%</b>	<b>up to £6475</b>	<b>up to £7475</b>
<b>Basic rate – 20%</b>	<b>next £37 400</b>	<b>next £35 400</b>
<b>Higher rate – 40%</b>	<b>remaining amount</b>	<b>remaining amount</b>

**Personal allowance is the income a person is allowed to earn without paying any tax.**

**For example in the 2010–2011 tax year the tax paid by a person with an income of £50 000 will be worked out as follows.**

<b>Personal allowance</b>	<b><math>0\% \times 6475 = £ 0</math></b>	
<b>Basic rate</b>	<b><math>20\% \times 37\,400 = £7480</math></b>	
<b>Higher rate</b>	<b><math>40\% \times 6125 = £2450</math></b>	<b><math>(£50\,000 - (£6475 + £37\,400)) = £6125</math></b>
	<b>Total = £9930</b>	

**The flowchart on the insert shows how income tax, T, can be calculated for the 2010 – 2011 tax year.**

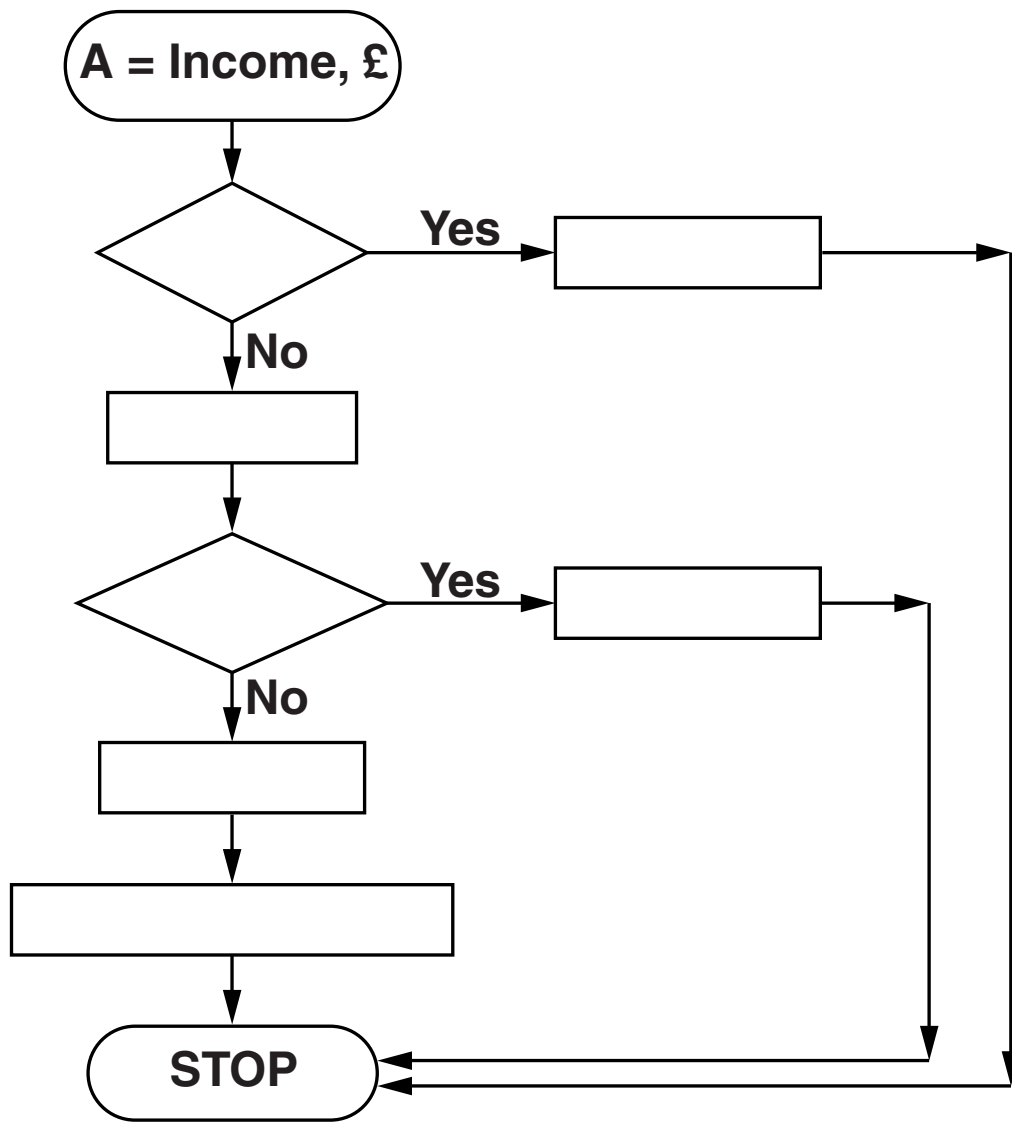
- (a) Income tax is deducted from the amount you earn. Esther earned £46 000 in the tax year 2010–2011.**

**Use the flowchart to calculate how much Esther was paid after income tax had been deducted.**

**(a) £ \_\_\_\_\_ [4]**

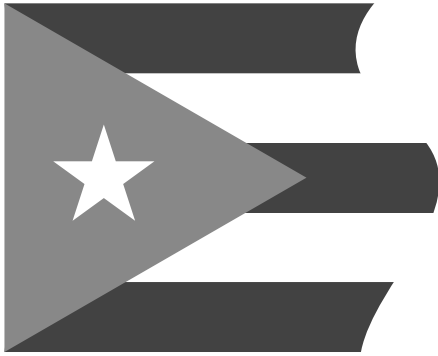
- (b) The flowchart for the tax year 2010 - 2011 can be changed to show the calculation to work out income tax for the tax year 2011 - 2012 by changing FIVE of the boxes.**

**On the flowchart opposite, fill in the FIVE boxes that must be changed for the calculation for 2011 - 2012 to be correct.**



[3]

**8 This is part of the flag of Cuba.**



**Inside the equilateral triangle is a star.**

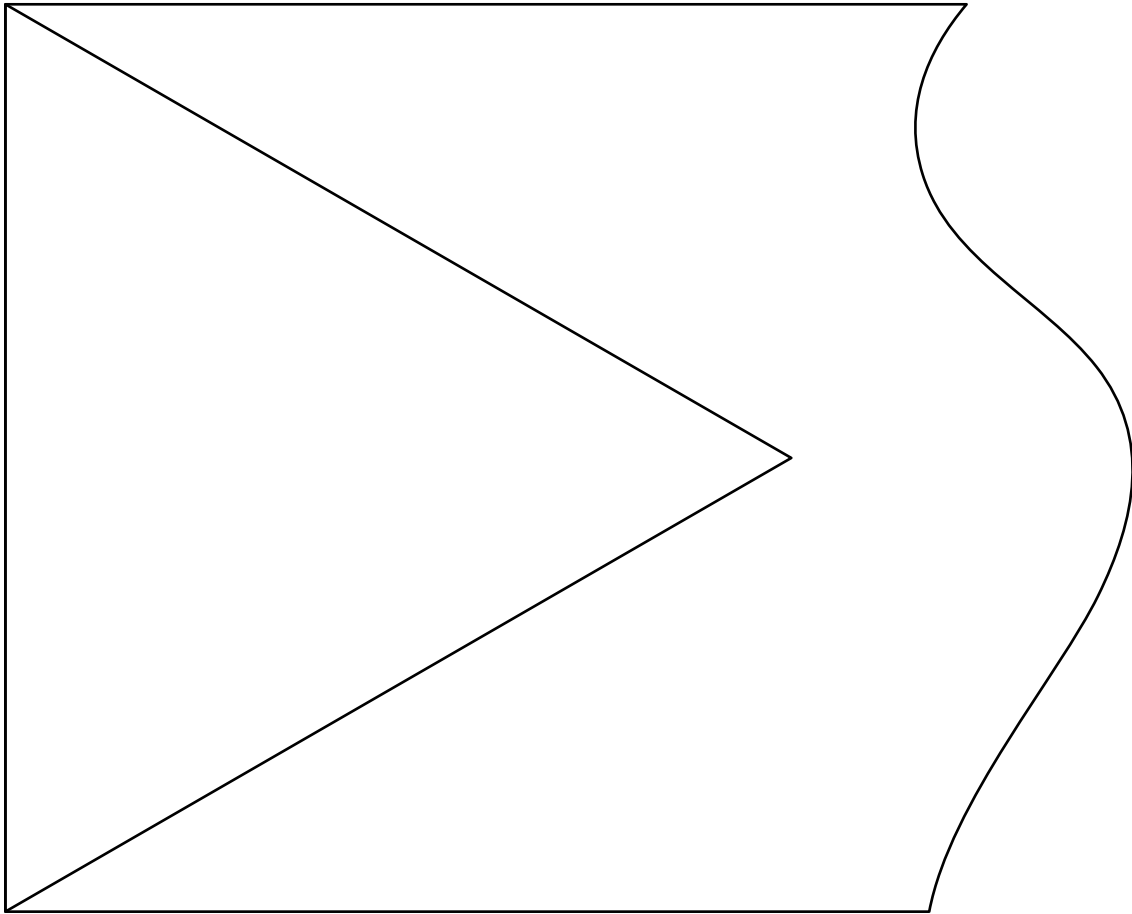
**A circle can be drawn through the five points of the star.**

**The bisectors of the angles of the triangle meet at the centre of this circle.**

**The radius of the circle is one sixth of the side of the triangle.**

**In this part of the question use only a ruler, a pair of compasses and a pencil.**

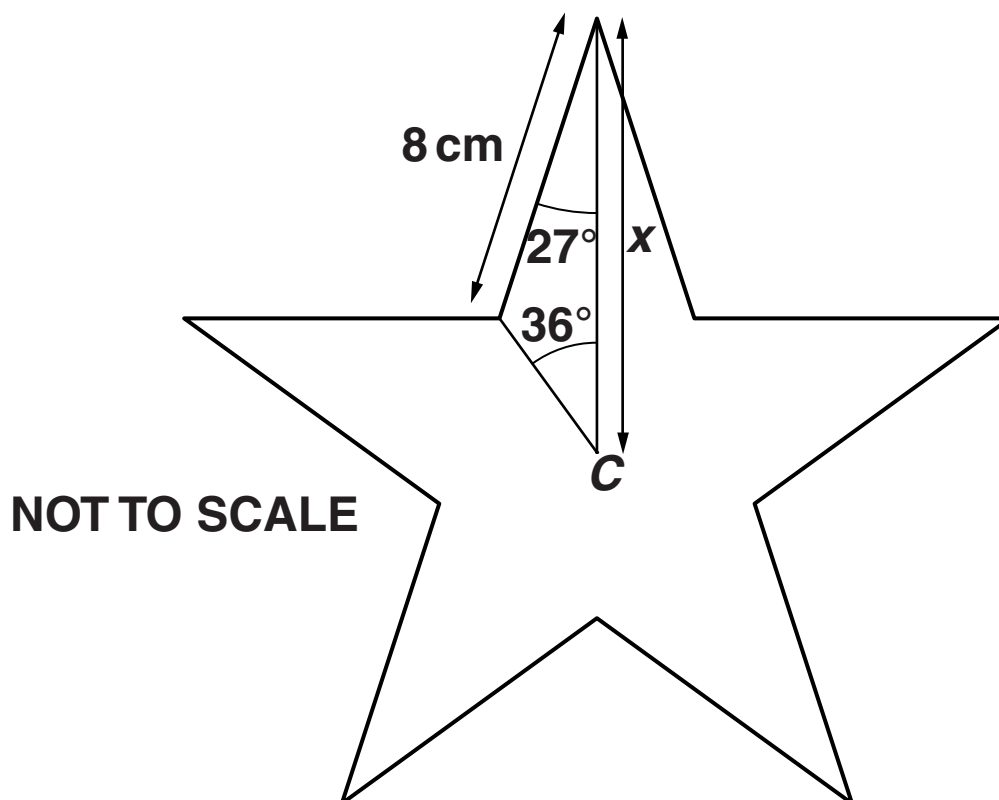
- (a) (i) Use constructions to find the centre of the circle, C.  
Show all your construction lines and mark C on your diagram below.**



**[3]**

- (ii) Draw the circle that would pass through all five points of the star. [1]**

**(b)\* This diagram shows a five pointed star, centre C.**





**Each edge of the star is 8 cm.**

**Calculate  $x$ .**

**Show clearly all steps in your working.**

**(b) \_\_\_\_\_ cm [5]**

- 9 Nina carried out a survey at an 11 - 16 secondary school.  
She gave a questionnaire to 120 students at the school.  
This was one of the questions.

Spin a coin.  
If the coin shows tails tick the Yes box.  
If the coin shows heads answer this question truthfully.

Did you truant from school yesterday?

☐

Yes

☐

No

- (a) If none of the students had truanted from school, how many would you expect to tick the Yes box?

(a) \_\_\_\_\_ [1]

**(b) When all the forms are returned 69 have the Yes box ticked.**

**Estimate the probability that a student had truanted.**

**(b) \_\_\_\_\_ [2]**

**(c) Nina also collected information from student identity cards.**

**All students at the school register their attendance by swiping their identity card.**

**There were 840 students at the school.**

**This table summarises this information.**

<b>Day</b>	<b>Number present</b>	<b>Number with authorised absence</b>	<b>Number with unauthorised absence</b>
<b>Monday</b>	<b>802</b>	<b>26</b>	<b>12</b>
<b>Tuesday</b>	<b>815</b>	<b>18</b>	<b>7</b>
<b>Wednesday</b>	<b>820</b>	<b>15</b>	<b>5</b>
<b>Thursday</b>	<b>818</b>	<b>14</b>	<b>8</b>
<b>Friday</b>	<b>794</b>	<b>36</b>	<b>10</b>

**Does the result of Nina's question to the 120 students agree with this information?  
Justify your answer using information from the table and your answer to part (b).**

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**[3]**

**(d) Nina also asked the students which year group they were in.**

**Design a two-way table for Nina to use to record the responses to BOTH questions.**

**[2]**

**10 Andi is making clay mugs and plates to sell.**

**The following table shows the time taken and amount of clay used to make mugs and plates.**

	<b>Time</b>	<b>Amount of clay</b>
<b>Mug</b>	<b>16 minutes</b>	<b>250 g</b>
<b>Plate</b>	<b>10 minutes</b>	<b>400 g</b>

**$M$  is the number of mugs and  $P$  is the number of plates.**

**(a) Andi has a maximum of 2 hours to make the mugs and plates.**

**Show that  $8M + 5P \leq 60$ .**

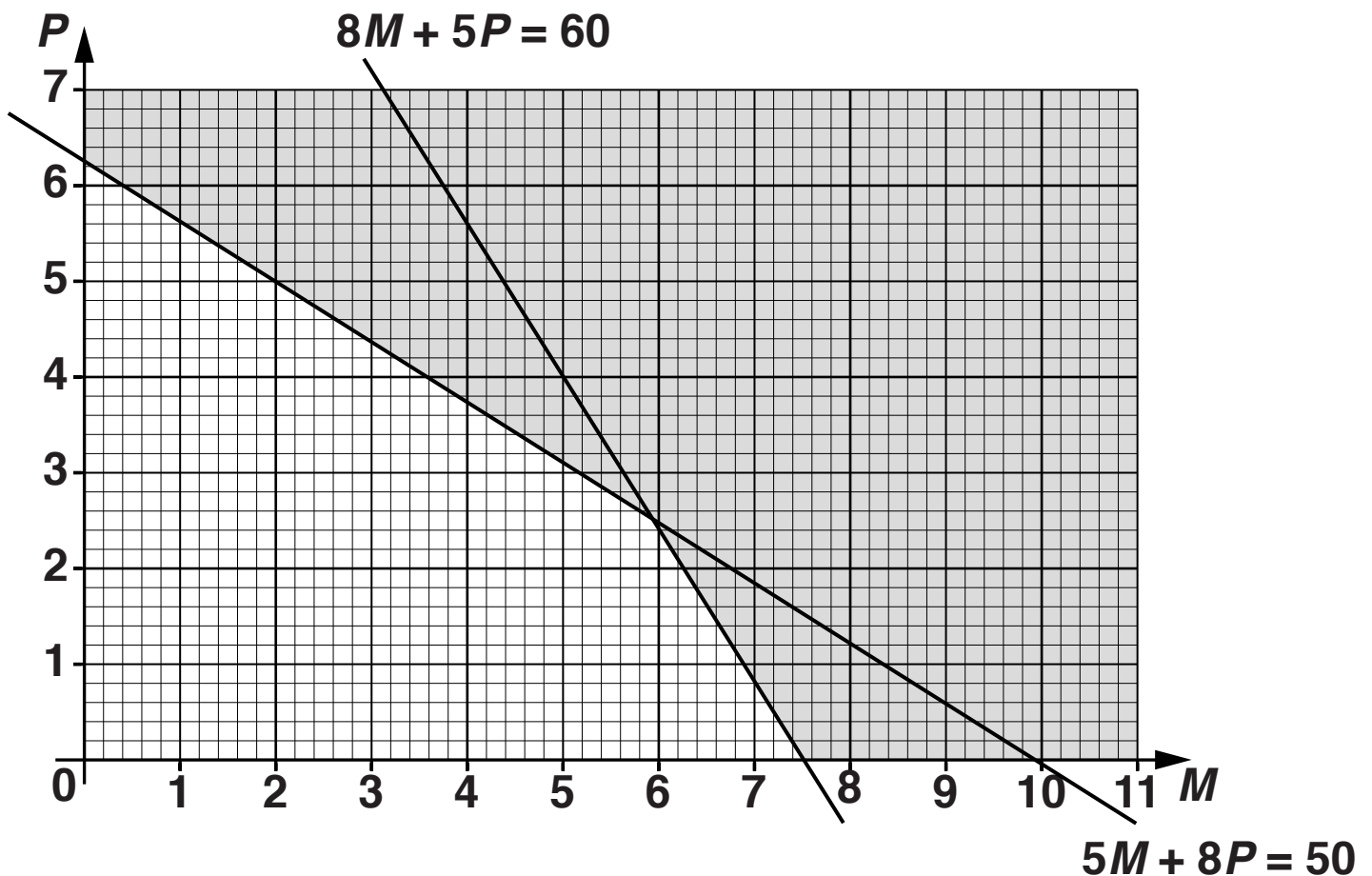
\_\_\_\_\_  
\_\_\_\_\_ [1]

**(b) Andi has 2500 g of clay to use.**

**Show that  $5M + 8P \leq 50$ .**

\_\_\_\_\_  
\_\_\_\_\_ [1]

(c) The following grid represents the inequalities for both time and amount of clay.

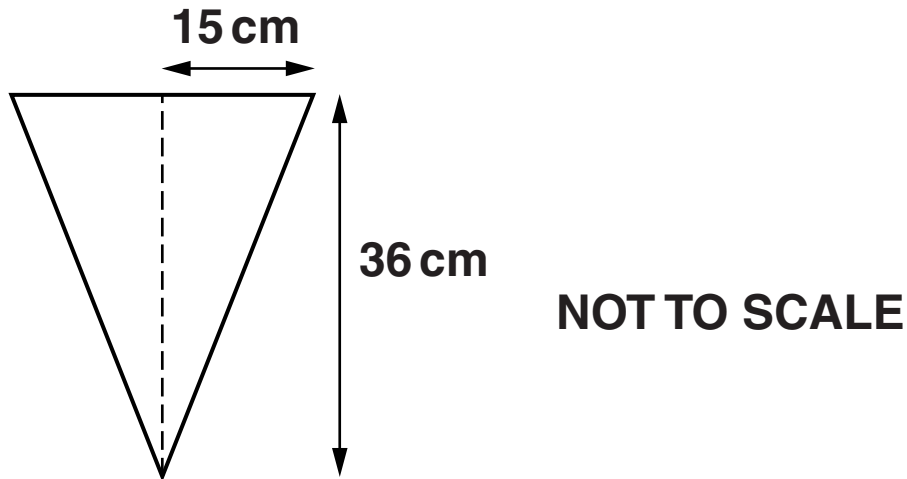


Andi can sell all the mugs and plates she makes. Her profit is £2.50 for each mug and £3 for each plate.

How many mugs and how many plates should Andi make to maximise her profit?  
How much is her total profit?

(c)  $M =$  \_\_\_\_\_,  $P =$  \_\_\_\_\_, Profit £ \_\_\_\_\_ [3]

- 11 Jia has a hanging basket for plants. It is the shape of a cone.  
The cone has a radius of 15 cm and a vertical height of 36 cm.  
The following diagram shows a side view of the cone.

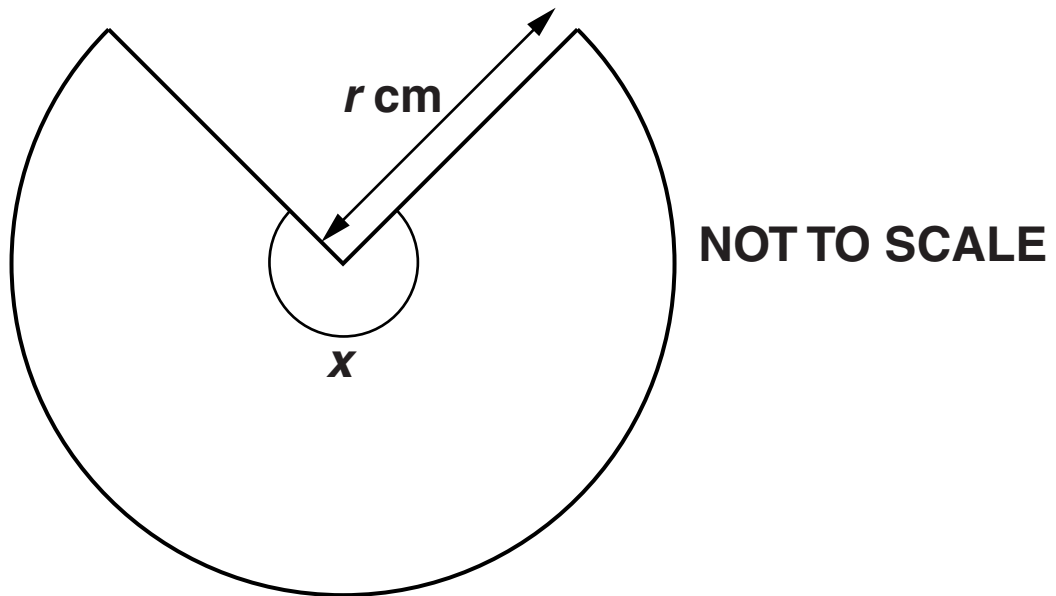


- (a) Calculate how much soil will fill the basket.

(a) \_\_\_\_\_  $\text{cm}^3$  [2]



- (b) Jia lines the basket with polythene.  
The following diagram shows the shape of the liner that fits exactly inside the basket.



- (i) Show that  $r = 39$ .

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[2]

**(ii) Work out angle  $x$ .**

**(b)(ii) \_\_\_\_\_° [4]**

**END OF QUESTION PAPER**

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