

Friday 14 June 2013 – Morning
GCSE APPLICATIONS OF MATHEMATICS

A382/02 Applications of Mathematics 2 (Higher Tier)

Candidates answer on the Question Paper.

OCR supplied materials:
None

- Other materials required:**
- Scientific or graphical calculator
 - Geometrical instruments
 - Tracing paper (optional)

Duration: 2 hours



| | | | |
|--------------------|--|-------------------|--|
| Candidate forename | | Candidate surname | |
|--------------------|--|-------------------|--|

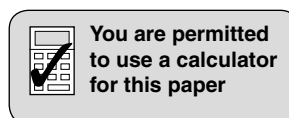
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|---------------|--|--|--|--|--|------------------|--|--|--|--|
| Centre number | | | | | | Candidate number | | | | |
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INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. 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).
- Do **not** write in the bar codes.

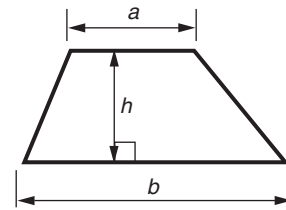
INFORMATION FOR CANDIDATES

- 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**.
- This document consists of **24** pages. Any blank pages are indicated.

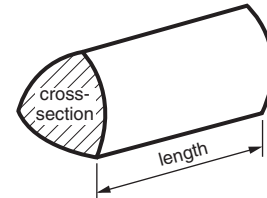


Formulae Sheet: Higher Tier

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



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



In any triangle ABC

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

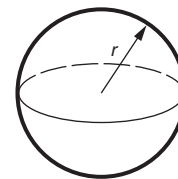
Cosine rule $a^2 = b^2 + c^2 - 2bc \cos A$

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



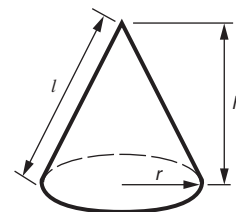
Volume of sphere = $\frac{4}{3}\pi r^3$

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

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

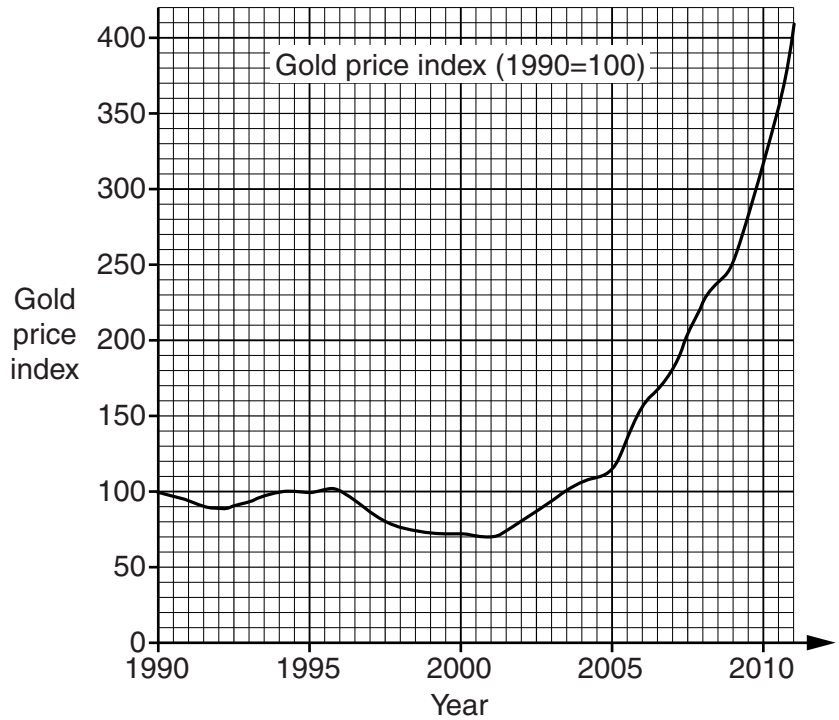
PLEASE DO NOT WRITE ON THIS PAGE

- 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?

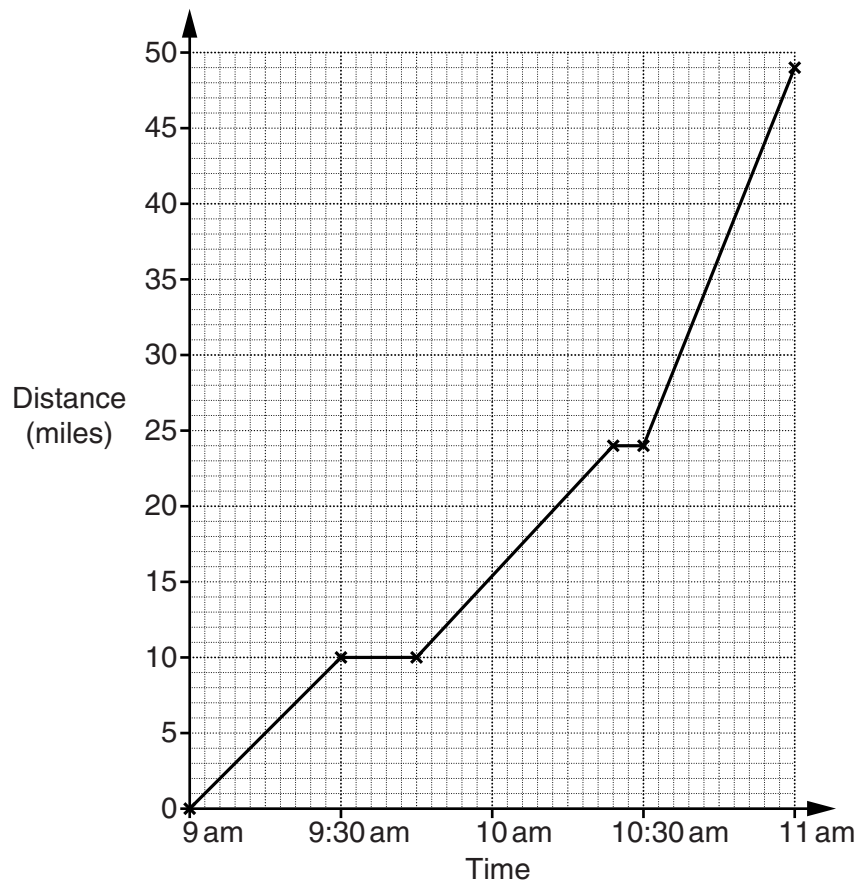
Justify your answer by making use of the information above.

[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.

| Number of days to be delivered | Number of letters using CAO | Number of letters using ISW |
|--------------------------------|-----------------------------|-----------------------------|
| 1 | 11 | 0 |
| 2 | 14 | 6 |
| 3 | 12 | 42 |
| 4 | 0 | 9 |
| 5 | 1 | 3 |
| 6 | 2 | 0 |

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

| Courier service | CAO | ISW |
|------------------------|-------------|-------------|
| Expected delivery time | 1 to 3 days | 3 to 5 days |

(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,

_____ [1]

(ii) CAO.

_____ [1]

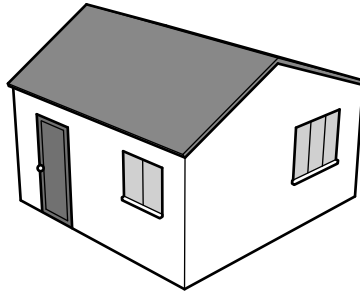
(d) Zoe repeated her investigation the following week.

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

_____ because _____

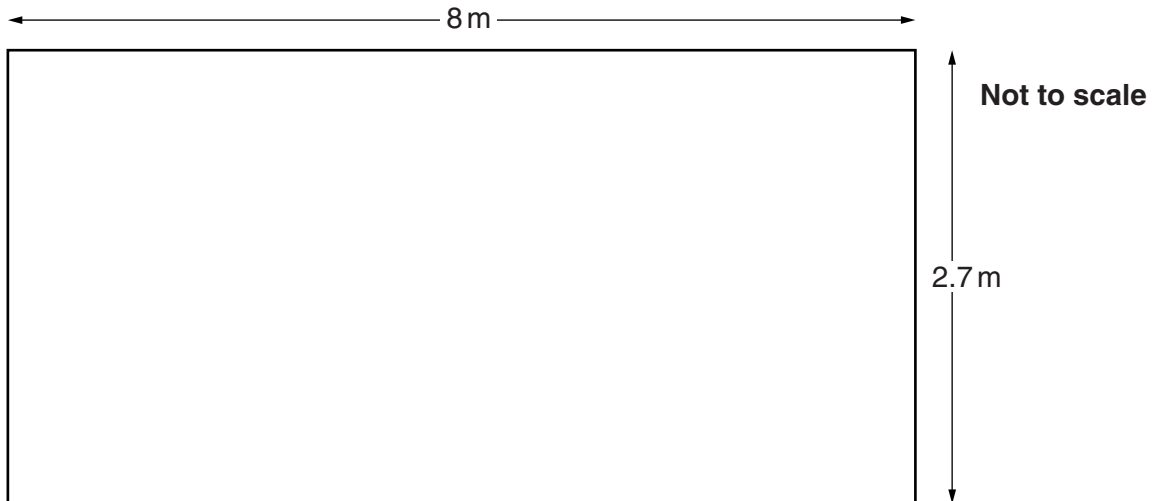
_____ [1]

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



The sloping sides of the roof are rectangles 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.

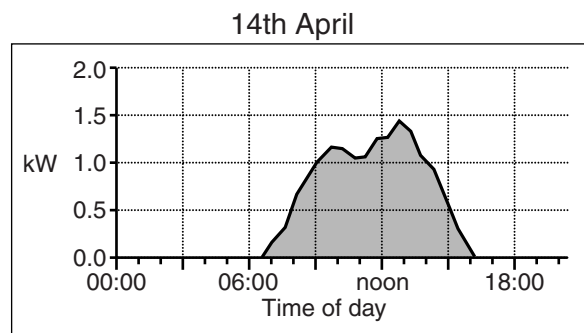
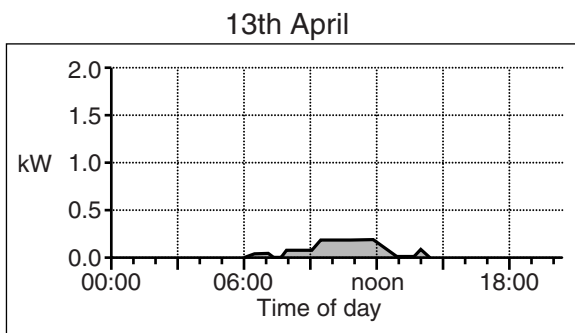
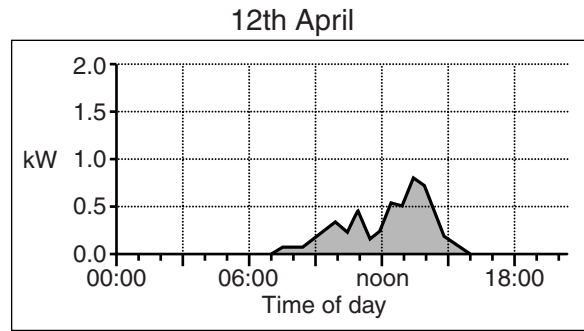
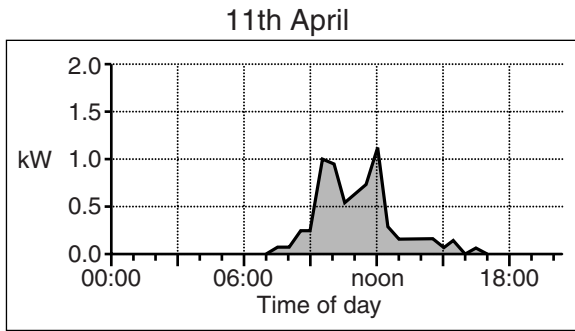
- (a) Sketch an arrangement of 12 panels that will fit on the roof.
Include all relevant measurements on your diagram.
You do not need to draw your diagram to scale.



[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.



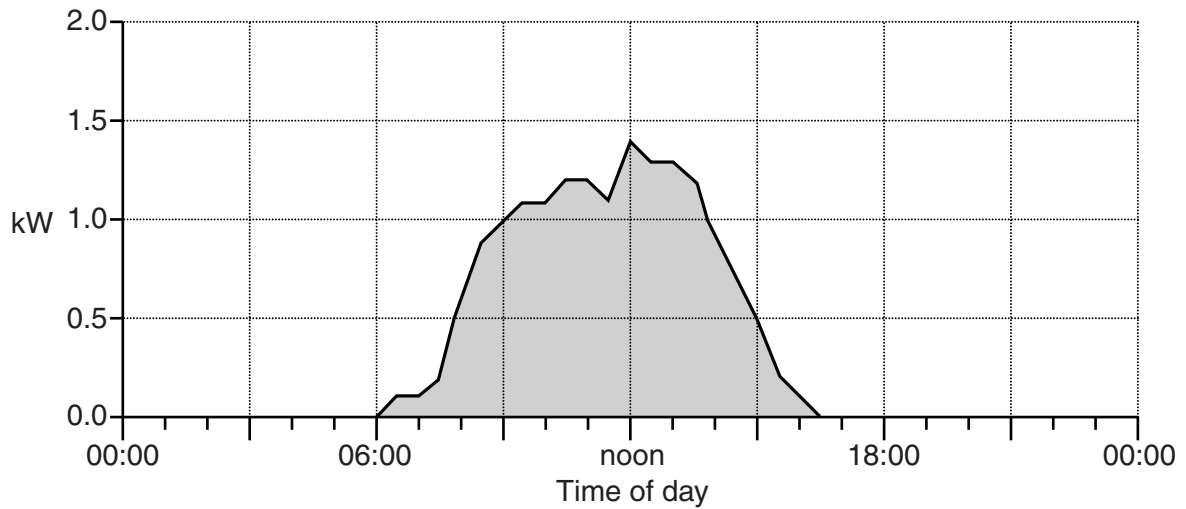
(i) Write these dates in the order, most to least, of the amount of electricity produced.

_____ , _____ , _____ , _____ [1]
most *least*

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

 _____ [1]

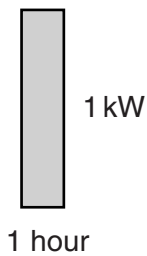
(c) The graph shows the electricity produced by Evan’s solar panels on another day.



(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 this rectangle.

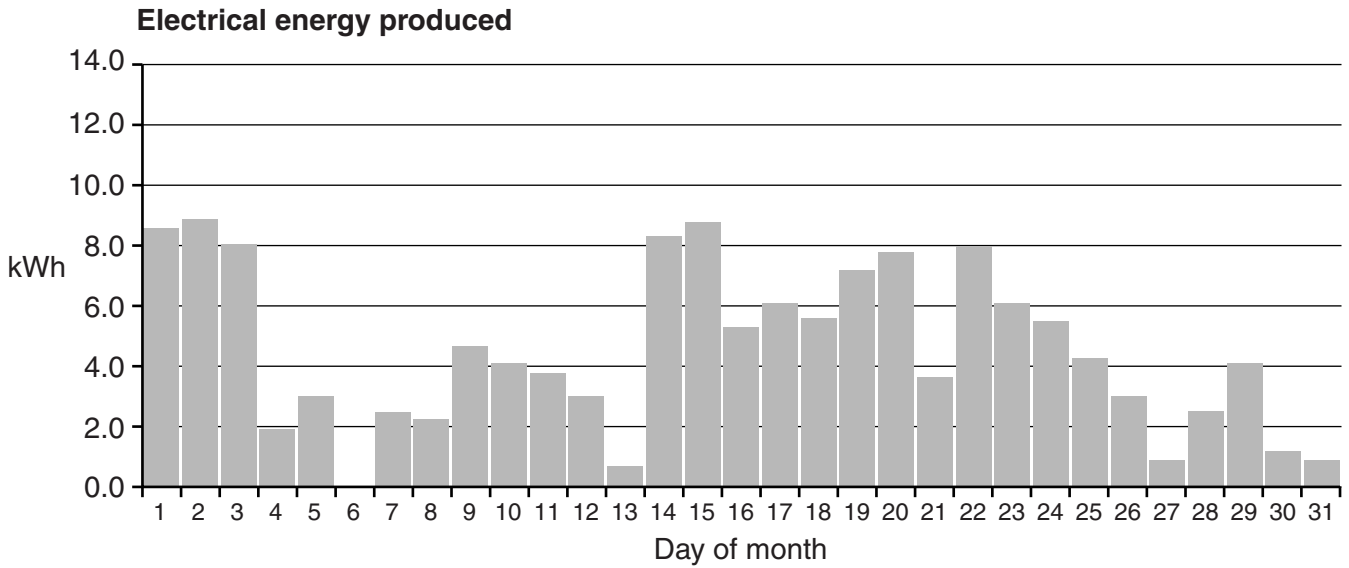


Estimate the number of kilowatt hours of electricity produced on that day.
You must show how you worked out your estimate.

(ii) _____ kWh [3]

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

This graph 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 to explain whether Evan’s method is sensible.

[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 shows, in pence, the price of each kWh of electricity.

| Type of use | Amount |
|--|--------|
| Amount paid to Evan for each kWh produced | 43.3p |
| Amount paid to Evan for each kWh exported | 3.1p |
| Amount Evan pays for each kWh imported | 13.0p |

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.

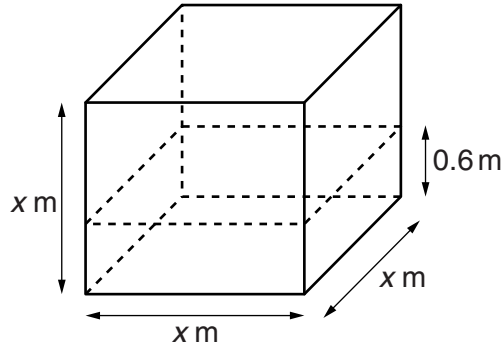
(a) (_____ , _____) [2]

(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.



Reuben fills the tank by adding 1.25 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.

$$\text{diesel} : \text{chip oil} = 7 : 3$$

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 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.

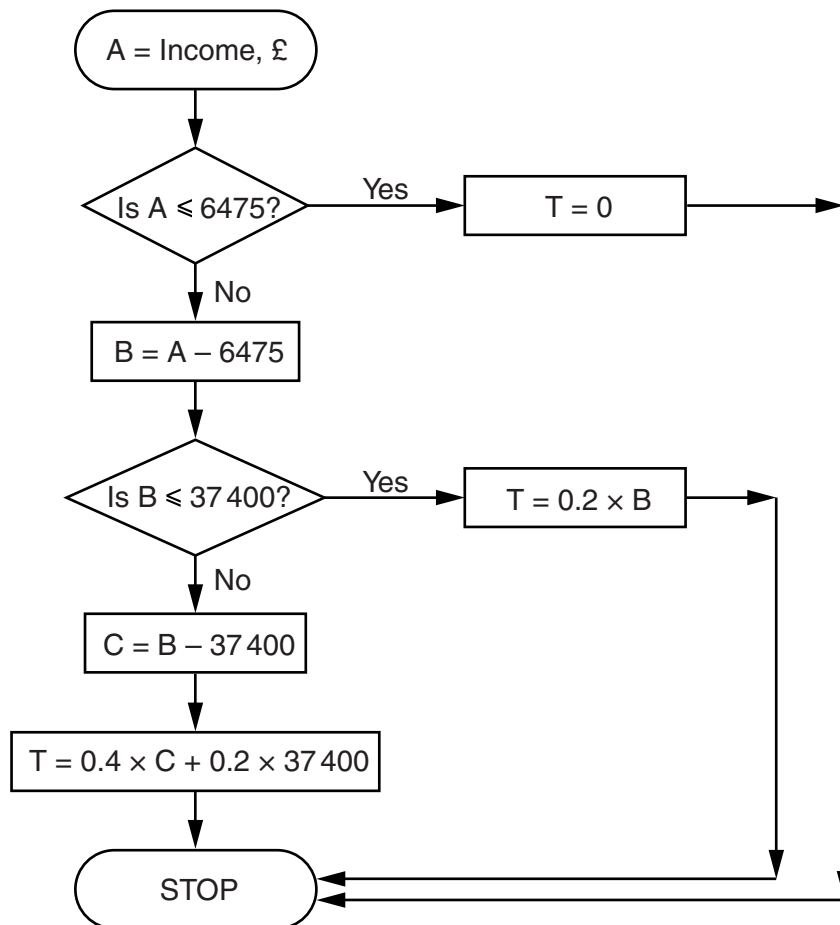
| Taxable income | 2010–2011 | 2011–2012 |
|-------------------------|------------------|------------------|
| Personal allowance – 0% | up to £6475 | up to £7475 |
| Basic rate – 20% | next £37 400 | next £35 400 |
| Higher rate – 40% | remaining amount | remaining amount |

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.

| | | |
|--------------------|------------------------------------|---|
| Personal allowance | $0\% \times 6475 = \text{£ } 0$ | |
| Basic rate | $20\% \times 37400 = \text{£}7480$ | |
| Higher rate | $40\% \times 6125 = \text{£}2450$ | $(\text{£}50000 - (\text{£}6475 + \text{£}37400)) = \text{£}6125$ |
| | Total = £9930 | |

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



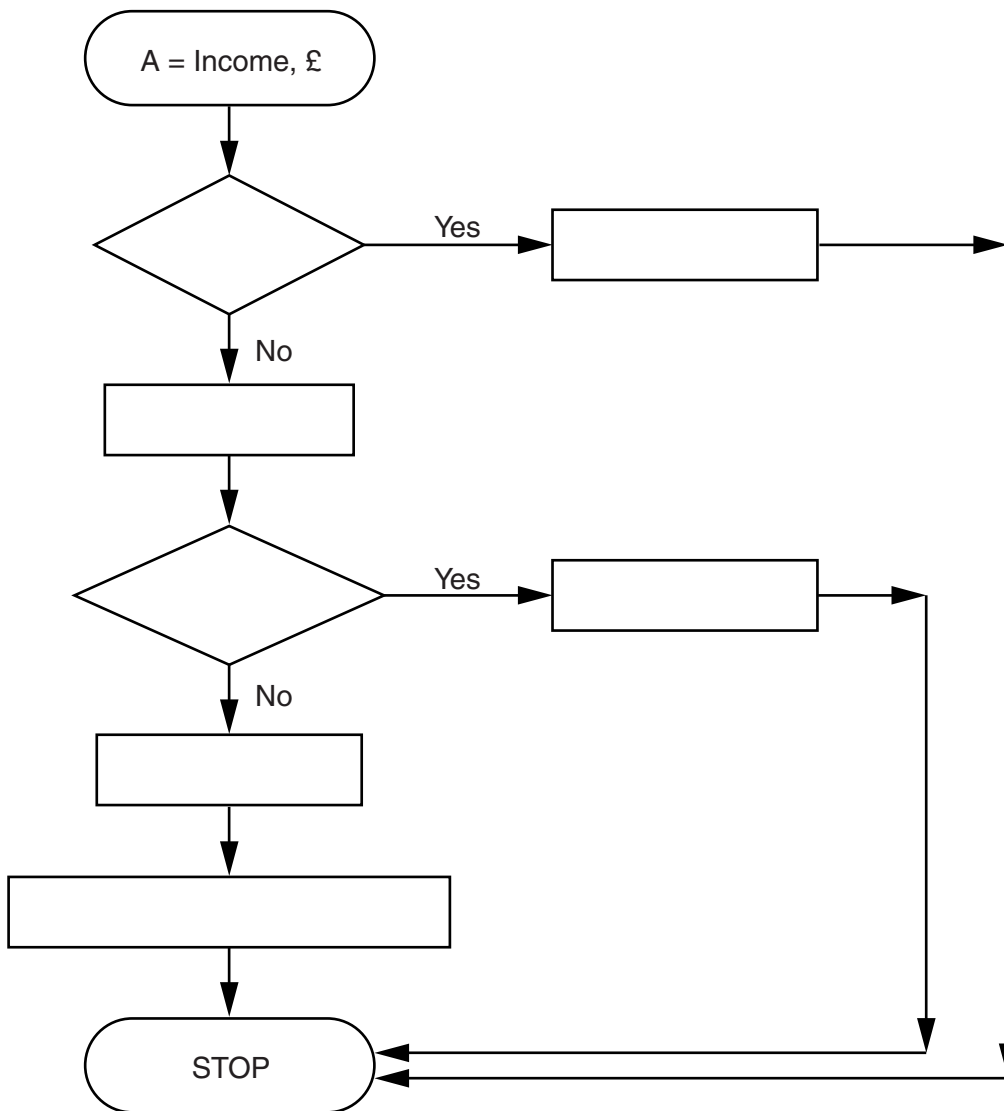
- (a) Income tax is deducted from the amount you earn.
Esther earned £46 000 in the tax year 2010–2011.

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

(a) £ _____ [4]

- (b) The flow chart 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.

Fill in the **five** boxes that must be changed for the calculation for 2011 - 2012 to be correct.



[3]

Turn over

8 This is part of the flag of Cuba.



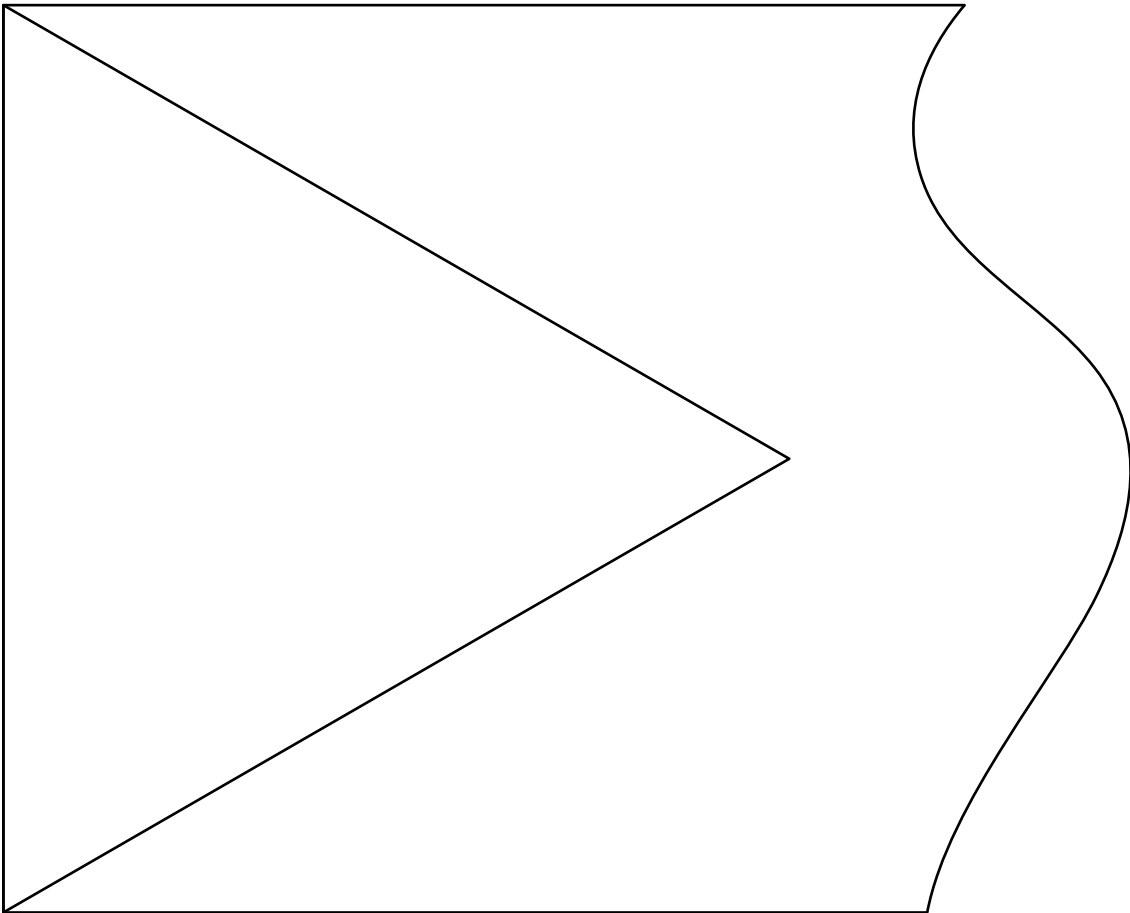
Inside the equilateral triangle is a star.

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.

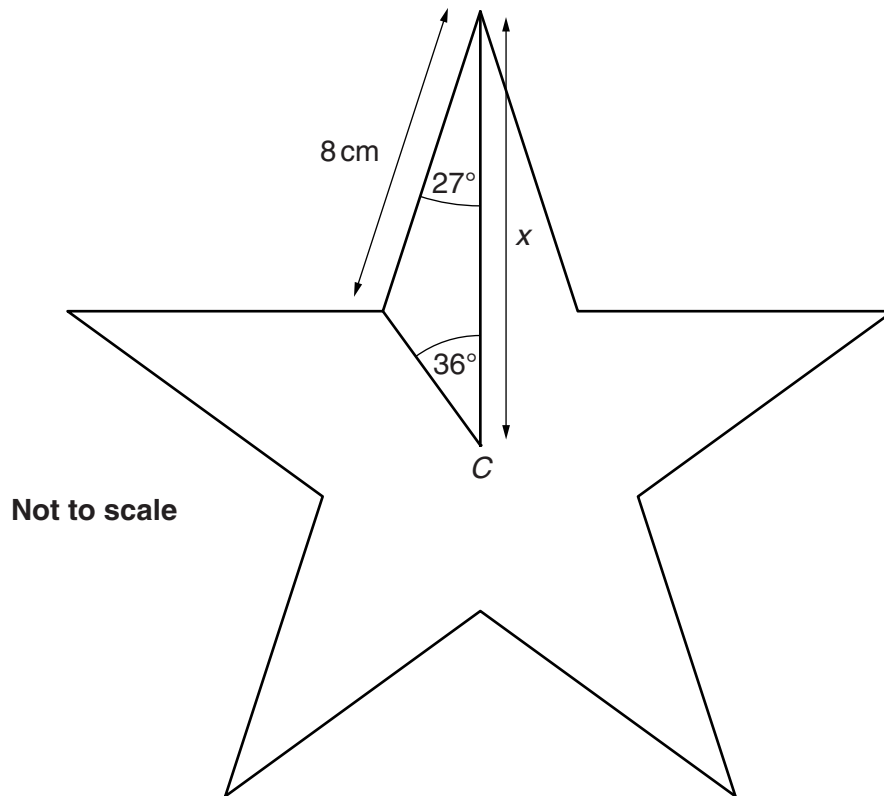


- (ii) Draw the circle that would pass through all five points of the star.

[3]

[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.

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

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).

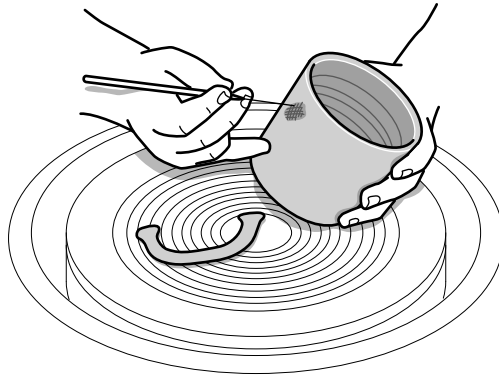
[3]

- (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 table shows the time taken and amount of clay used to make mugs and plates.

| | Time | Amount of clay |
|-------|------------|----------------|
| Mug | 16 minutes | 250 g |
| Plate | 10 minutes | 400 g |

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 $8M + 5P \leq 60$.

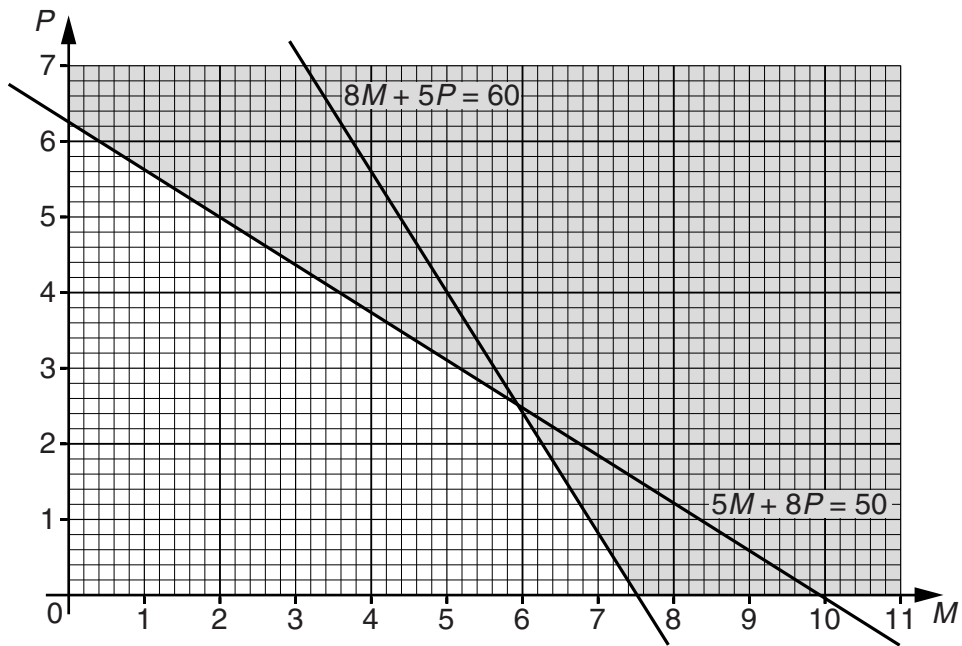
_____ [1]

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

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

_____ [1]

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



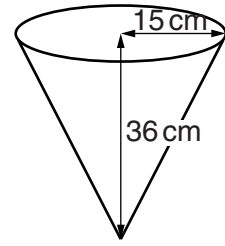
Andi can sell all the mugs and plates she makes.
Her profit is £2.50 for each mug and £3 for each plate.

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]

TURN OVER FOR QUESTION 11

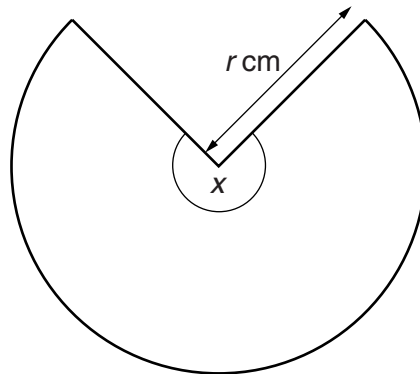
- 11 Jia has a hanging basket for plants. It is the shape of a cone. The cone has a radius of 15 cm and a vertical height of 36 cm.



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

(a) _____ cm³ [2]

- (b) Jia lines the basket with polythene. This is the shape of the liner that fits exactly inside the basket.



Not to scale

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

[2]

- (ii) Work out angle x .

(b)(ii) _____ ° [4]