OCR
RECOGNISING ACHIEVEMENT

F

Friday 14 June 2013 – Morning

GCSE APPLICATIONS OF MATHEMATICS

A382/01 Applications of Mathematics 2 (Foundation Tier)

A317050613

Candidates answer on the Question Paper.

OCR supplied materials:
None

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

Duration: 1 hour 30 minutes

A382201

Candidate forename		Candidate surname	

Centre number						Candidate number				

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

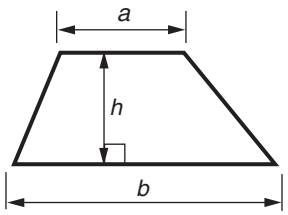
- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- Your Quality of Written Communication is assessed in questions marked with an asterisk (*).
- The total number of marks for this paper is **90**.
- This document consists of **28** pages. Any blank pages are indicated.

You are permitted to use a calculator for this paper

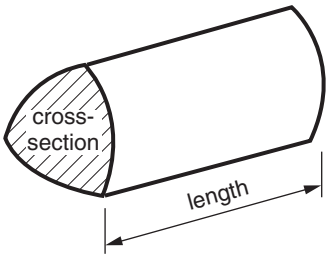
DC (NH/SW) 67119/3

Formulae Sheet: Foundation Tier

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



Volume of prism = (area of cross-section) × length



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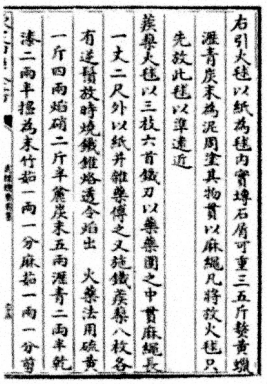
1 Gunpowder was first made in China.
It is a mixture of saltpetre, charcoal and sulphur.



(a) This is a Chinese recipe for gunpowder.
It was printed in 1044.

"To make 20 jin of gunpowder mix together
15 jin of saltpetre, 2 jin of sulphur and 3 jin of charcoal."

The jin is an ancient Chinese unit of weight.

(i) How much sulphur is needed to make 10 jins of gunpowder?

(a)(i) _____ jin **[1]**

(ii) What weight of charcoal is needed to make 40 grams of gunpowder?
Include the units in your answer.

(ii) _____ **[2]**

(iii) What fraction of gunpowder is made up of saltpetre?
Write your fraction in its simplest form.

(iii) _____ **[2]**

(b) Amy and Alex find this picture of an ancient Chinese rocket in a book.

They want to compare it with a modern firework rocket.
First they need to estimate the weight of gunpowder in the ancient Chinese rocket.
They use the picture to help.

Amy jots down some rough calculations.

Complete her working out.

(b) (i) Estimated total length of the real Chinese rocket _____ cm. **[1]**

Estimated volume of rocket = 160 x the total length

(ii) which gives _____ cubic centimetres. **[1]**

About half this volume is filled with gunpowder.
One cubic centimetre of gunpowder weighs 1.6 g,

(iii) so the weight of gunpowder in the rocket is _____ g. **[2]**

(iv) Alex reads this in a book.

> Ancient Chinese rockets could reach heights of one kilometre!

He collects some information about modern firework rockets from the internet.

Weight of gunpowder (g)	Height reached (m)
15	30
50	100
100	200

Is it likely that ancient Chinese rockets could reach heights of one kilometre?
Explain your answer using the internet information and your answer to part **(iii)**.

_____

_____

_____ **[2]**

(v) Amy finds a formula giving the height a small firework rocket can reach.
She ends up with the calculation below.

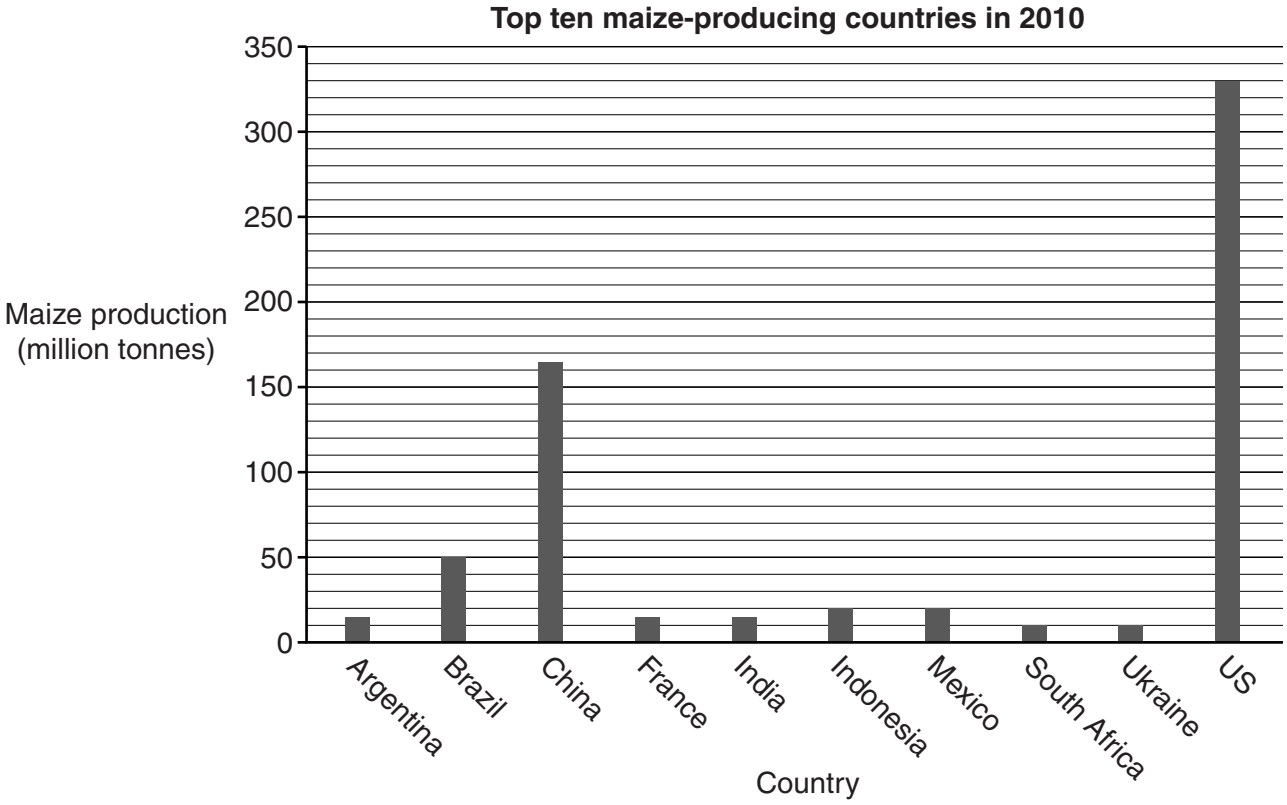
Complete her calculation.

Height (in metres) is $(25 \times 3) + (0.2 \times 3^2)$

(v) _____ m **[2]**

2 Maize is the most common grain in the world, more common than rice or wheat.

(a) This chart shows the amount grown by the biggest maize-producing countries.



Use the chart to answer these questions.

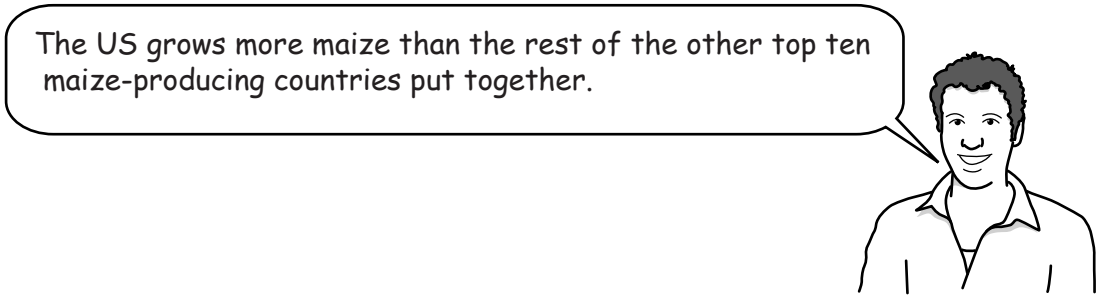
(i) Which country produced the greatest amount of maize?

(a)(i) _____ **[1]**

(ii) How many million tonnes of maize did Brazil produce?

(ii) _____ million tonnes **[1]**

(iii)



Is this true? You must support your answer with some calculations.

_____

_____

_____ **[3]**

(iv) Maize can be grown in the UK.
This table shows the production of maize, in millions of tonnes, in the UK for several years.

UK Maize Production

Year	1980	1990	2000	2005	2010
Maize grown (million tonnes)	0.1	0.2	0.7	1.1	1.5

Use the table and the chart in part **(a)** to complete these sentences.

UK maize production in 2010 was about
_____ times the UK maize production in 1980.

Maize production in France in 2010 was
_____ million tonnes.
This was _____ times the UK maize production in 2010.

[3]

(b) Maize is grown in many parts of Africa.

Sunshine is not a problem, but finding enough water can be difficult.

Banji has a small farm in the south of Africa.
The farm has an area of 4 hectares.

When there is enough rain he grows 2 tonnes of maize per hectare.

The maize sells at $135 a tonne.

When there is no rain the maize does not grow and he gets nothing.

(i) How much money can Banji get for all his maize when there is enough rain?

(b)(i) $ _____ **[1]**

(ii) Banji's family keep a record of the seasons that had enough rain (✓) and those that did not. (✗).
Here are the results for the last 20 seasons.

✗	✓	✗	✗	✓	✓	✓	✓	✓	✓
✓	✓	✓	✗	✓	✓	✗	✓	✓	✗

Use these results to estimate the probability that there will be enough rain next season.

(ii) _____ **[2]**

(iii)* A new water company can make sure that Banji's maize has enough water next season.
This will cost Banji $300.

By looking at the risks show clearly what is best for Banji next season –

to pay the $300 and ensure a crop
or
to take a chance on there being enough rain next season?

_____

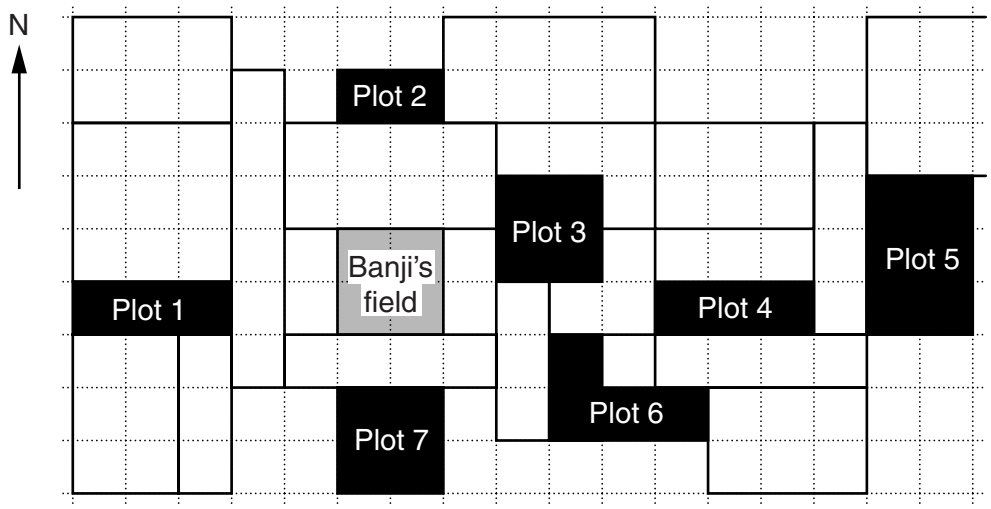
_____

_____

_____

_____ **[4]**

This is a plan of the plots of land near to Banji's field.
It is to scale, with 1 small square of the grid representing 1 hectare.
Seven plots are for sale. They are labelled on the plan.



(iv) Which of these plots is West of Banji's field?

(iv) _____ **[1]**

(v) Which is the smallest of the plots to the East of Banji's field?

(v) _____ **[1]**

(c) Maize can survive in a range of temperatures.

(i) The temperatures, T °C, that maize can survive in are given by $0 < T < 44$.

Write down one temperature at which maize can survive.

(c)(i) _____ °C **[1]**

(ii) Maize grows best in daytime temperatures anywhere from 25 °C to 32 °C.

Write this range as an inequality with T representing the temperature in °C.

(ii) _____ **[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.

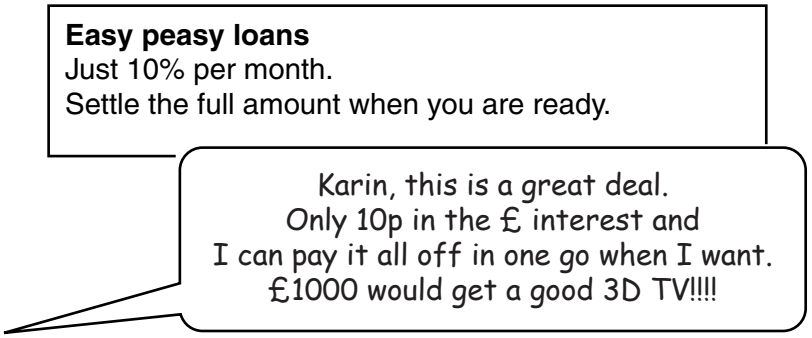
(ii) _____ **[1]**

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]**

4 Karin's uncle sees this advert.



Karin tries to explain that it is not such a good deal because interest is charged on the interest. She builds the spreadsheet below for a loan of £1000.

	A	B	C	D
1	**Month**	**Total owed at start of month**	**Interest for month**	**Total owed at end of month**
2	1	£1,000.00	£100.00	£1,100.00
3	2	£1,100.00	£110.00	£1,210.00
4	3	£1,210.00	£121.00	£1,331.00
5	4	£1,331.00	£133.10	£1,464.10
6	5	£1,464.10	£146.41	

(a) (i) What amount should go into cell D6?

(a)(i) D6 =£ _____ **[1]**

(ii) Here is the row for the end of the 12th month.

	A	B	C	D
	Month	**Total owed at start of month**	**Interest for month**	**Total owed at end of month**
13	12	£2,853.12	£285.31	£3,138.43

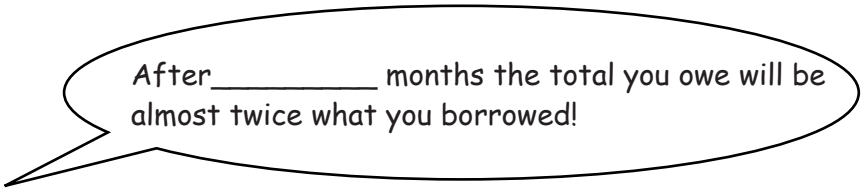
Karin's uncle plans to pay the loan off at the end of 12 months.
How much interest will he be charged at the end of 12 months?

(ii) £ _____ **[1]**

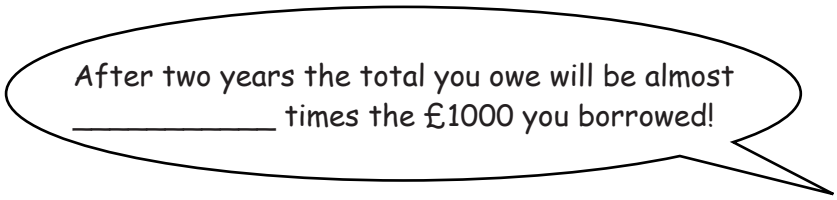
(iii) Karin shows her uncle the spreadsheet for 6 months to 2 years.

Month	Total owed at start of month	Interest for month	Total owed at end of month
6	£1,610.51	£161.05	£1,771.56
7	£1,771.56	£177.16	£1,948.72
8	£1,948.72	£194.87	£2,143.59
9	£2,143.59	£214.36	£2,357.95
10	£2,357.95	£235.79	£2,593.74
11	£2,593.74	£259.37	£2,853.12
12	£2,853.12	£285.31	£3,138.43
13	£3,138.43	£313.84	£3,452.27
14	£3,452.27	£345.23	£3,797.50
15	£3,797.50	£379.75	£4,177.25
16	£4,177.25	£417.72	£4,594.97
17	£4,594.97	£459.50	£5,054.47
18	£5,054.47	£505.45	£5,559.92
19	£5,559.92	£555.99	£6,115.91
20	£6,115.91	£611.59	£6,727.50
21	£6,727.50	£672.75	£7,400.25
22	£7,400.25	£740.02	£8,140.27
23	£8,140.27	£814.03	£8,954.30
24	£8,954.30	£895.43	£9,849.73

Complete the sentences in Karin's argument.



[1]



[1]

(b) Karin thinks there must be other people who do not realise how expensive loans can be. She finds this rough rule for working out the time it takes for a debt to double.

> **The rule of 70**
>
> The time it takes your **total** debt (loan + total interest) to **double** in days or weeks or months or years is
>
> 70 ÷ rate of interest (per day, per week, per month or per year).
>
> So if you borrow at 2% per **week** the total debt doubles in
>
> 70 ÷ 2 = 35 **weeks**.

(i) Does the rule fit Karin's spreadsheet figures?
Support your answer with some numbers.

_____

_____

_____ **[2]**

(ii) Some payday loan firms charge an interest of 1% per day.

How many days would it take for the total debt to double?

(b)(ii) _____ days **[1]**

5 **(a)**

Weights of diamonds can be given in grams, carats or points.

1 carat = 0.2 grams and 1 point = 0.01 carats.

(i) A diamond in a ring weighs 0.7 carats.

How many grams is this?

(a)(i) _____ grams **[1]**

(ii) How many points is 0.7 carats?

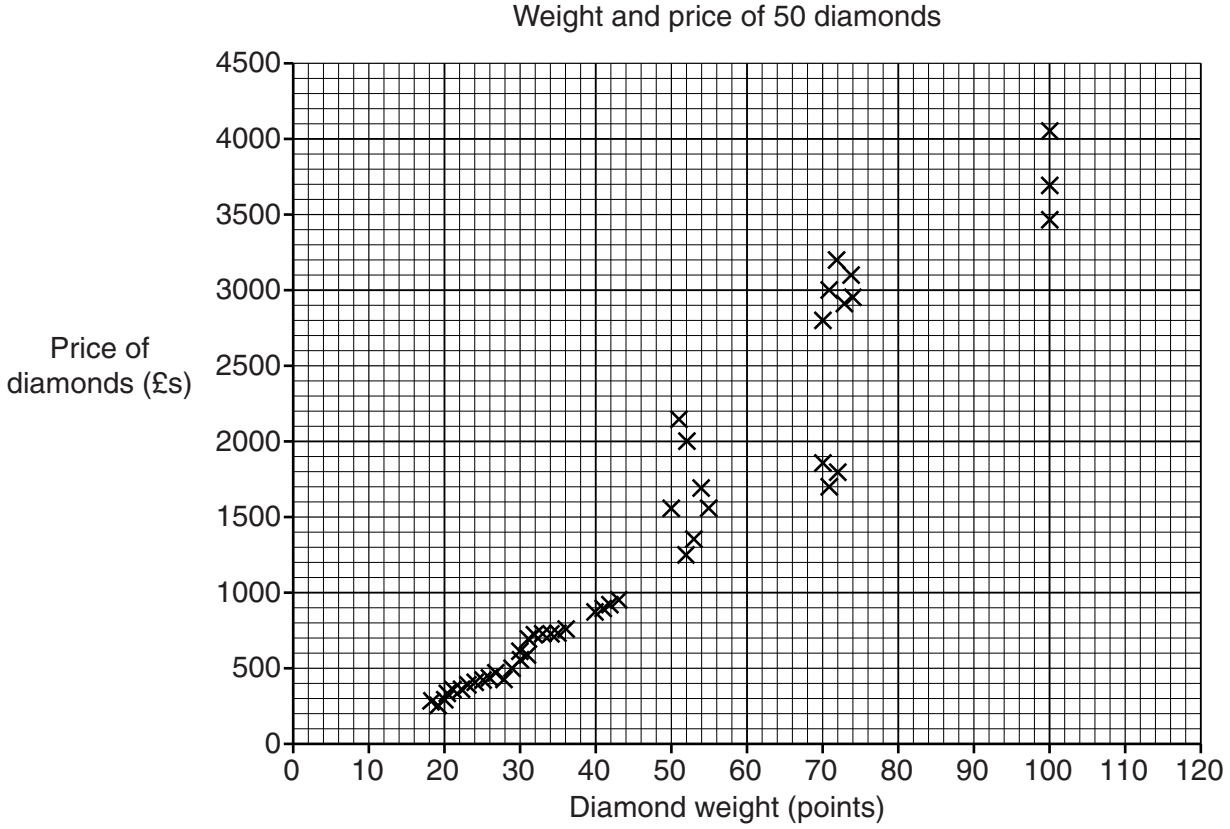
(ii) _____ points **[1]**

(iii) Rough diamonds are found in rocks called Kimberlite.
About 100 000 kg of Kimberlite rock have to be mined to produce 1 carat of rough diamonds.

Find the ratio of the weight of 1 carat of rough diamonds to the weight of Kimberlite rock mined.
Give your answer in the form 1: *n*.

(iii) 1 : _____ **[3]**

(b) This scatter graph shows the weights in points of 50 diamonds sold online and their prices.



Use the scatter graph to answer these questions.

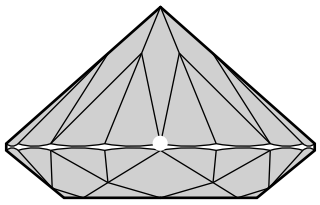
(i) What is the approximate price of a 30 point diamond?

(b) (i) £ _____ **[1]**

(ii) What weight of diamond will £2500 buy?
Show how you worked out your answer.

(ii) _____ points **[2]**

(iii) Which is worth more



- 1 large diamond,

or

- several small diamonds which have a total weight the same as the weight of the large diamond?

Show clearly how you arrived at your answer.

_____

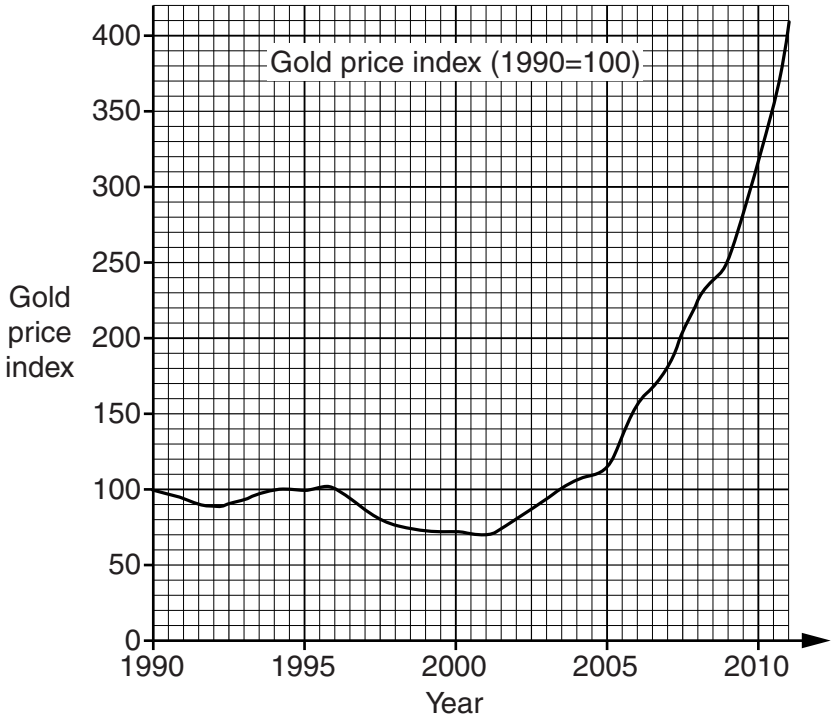
_____

_____

_____ **[3]**

(c) 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.

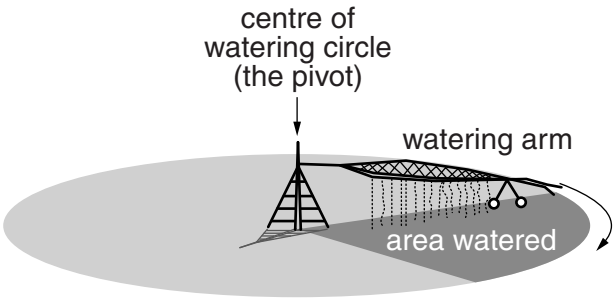
_____

_____

_____

_____ **[2]**

6 A popular system for watering crops is called centre pivot irrigation.



A long pipe on wheels pumps out water whilst rotating about the pivot.
A circular area is watered with the pivot at its centre.

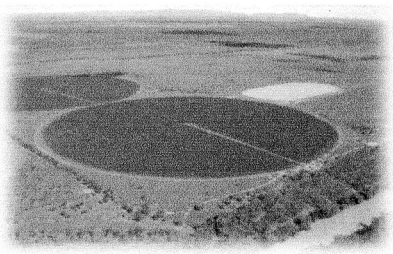
(a) In 2012 there were 300 000 systems in use around the world.
This number is expected to increase by 20% each year.

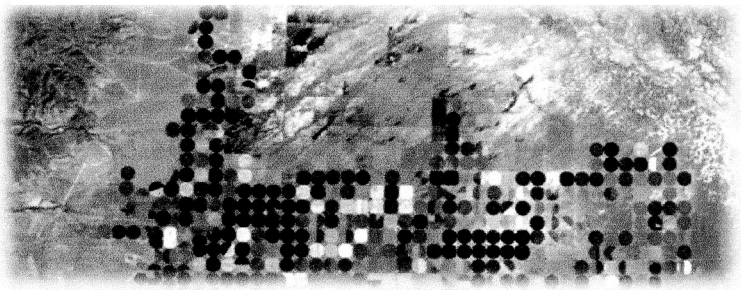
Work out the total number of systems that are expected to be in use in 2013.

(a) _____ **[2]**

The watered area where the crops have grown shows as a circle from the air.

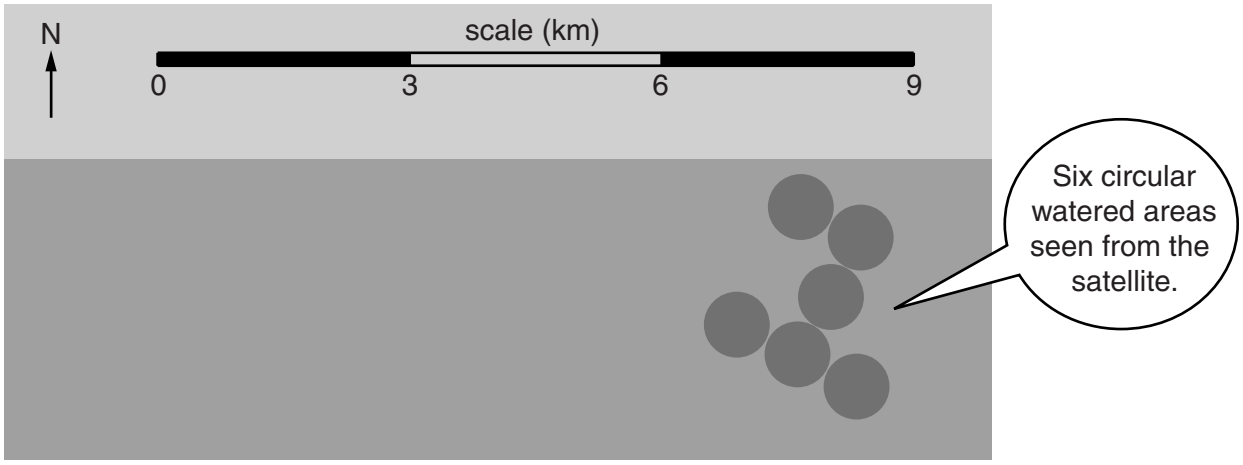
These circles can be seen from satellites.





(b) This photo was taken from the Landsat satellite.

Use the scale to estimate the diameter of one of these circular watered areas.



(b) _____ km **[1]**

(c) The dark grey areas of the satellite photos below show the area of land watered.
The photos were taken at different times on the same day.
The times are shown on the photos.

(i) Estimate the fraction of land in the circular field that has been watered between 0800 and 1300.

(c)(i) _____ **[1]**

(ii) Estimate how many hours the watering pipe takes to make a complete turn.
Show clearly how you worked this out.

(ii) _____ hours **[2]**

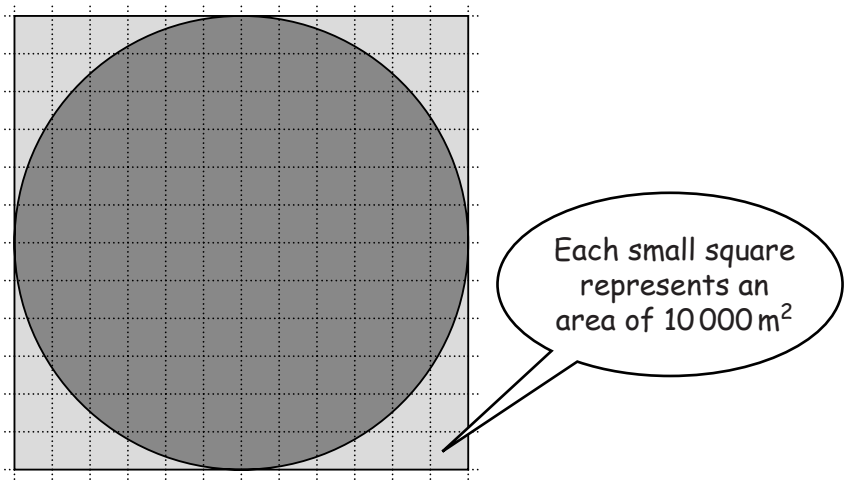
(d) This is a photo taken from the air of a centre pivot watering system in Australia.
The radius of the watered circle is 400 m.

Calculate the watered area.

(d) _____ m^2 **[2]**

(e) The central pivot system of watering leaves areas un-watered.

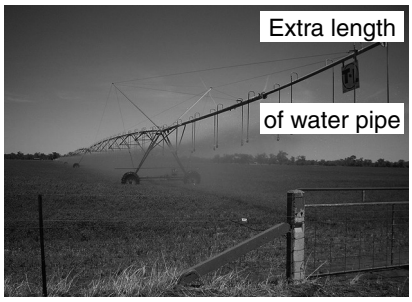
(i) The area not watered in this large 1200 m by 1200 m square field is shaded light grey.

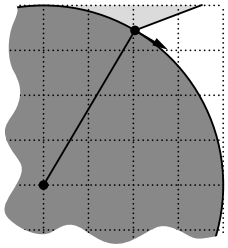


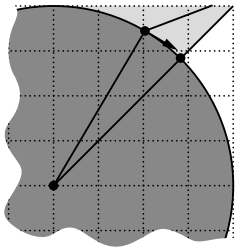
Estimate the area of the square field that is **not** watered.

(e)(i) _____ m^2 **[2]**

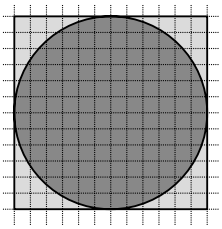
(ii) Modern central pivot systems can water into corners.
They have an extra watering pipe.
This extra watering pipe pivots at the end of the main pipe.
It moves so that the light grey areas get watered.



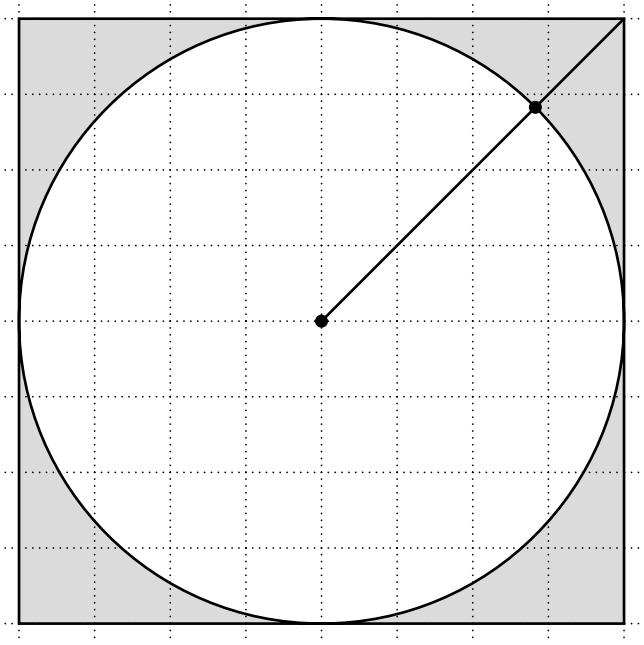




The watered area is now in the shape of a square.



Below is a scale drawing of a central pivot system with the extra watering pipe.

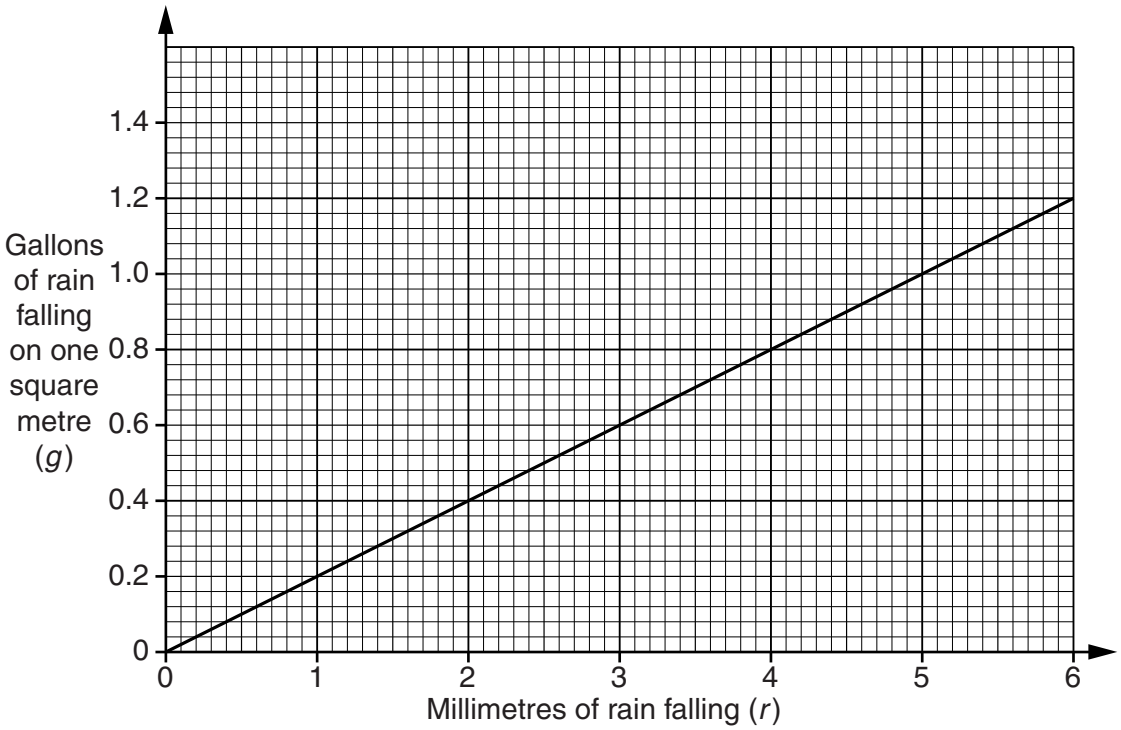


Scale: 1 cm represents 10 m

Work out the length of the extra watering pipe.
Show how you got your answer.

(ii) _____ m **[2]**

(f) This graph shows the connection between the amount of rainfall, in mm, and the number of gallons of water that falls on one square metre of land.



(i) One day 4 mm of rain fell.

How many gallons of water fell on one square metre?

(f)(i) _____ gallons **[1]**

(ii) Maize needs an average of 3 mm of rain each day to grow.
A field of maize has an area of 50 000 m^2.

Show that the field needs an average of 30 000 gallons of water each day.

_____

_____

_____ **[2]**

(iii) Write down an equation connecting millimetres of rain (r) and gallons of rain (g) falling on one square metre.

(iii) _____ **[2]**

(g) Wind power can be used to pump water from a well for irrigation.
The power in watts generated by a medium sized windmill is given by this formula.

$$p = v^3 - 0.1v^2$$

Where p watts is the power produced from the wind blowing at v miles per hour.

Phil's pump needs about 1600 watts.
He is thinking of getting a windmill to power it.

He uses a spreadsheet to see what power is produced by different wind speeds.

	A	B
1	*v* (miles per hour)	*p* (watts)
2	10	990
3	20	7960
4	30	26910
5		

(g) (i) Complete the formula that should be in this cell.

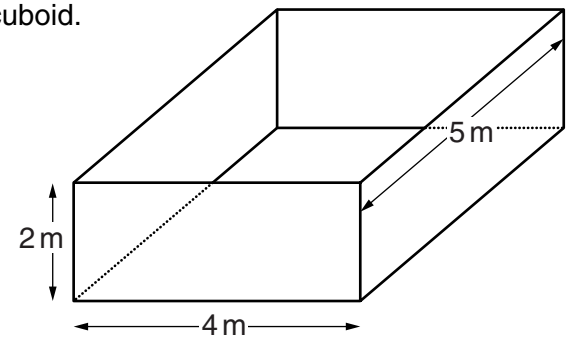
= A4^3

[1]

(ii) Use trial and improvement to find the wind speed that will produce 1600 watts.
Give your answer correct to the nearest whole number.
You must show all your trials clearly.

(ii) _____ miles per hour **[3]**

Phil plans to build a large **open-topped** water tank to collect and store rainwater.
Here is a sketch of the tank.
It is in the shape of a cuboid.

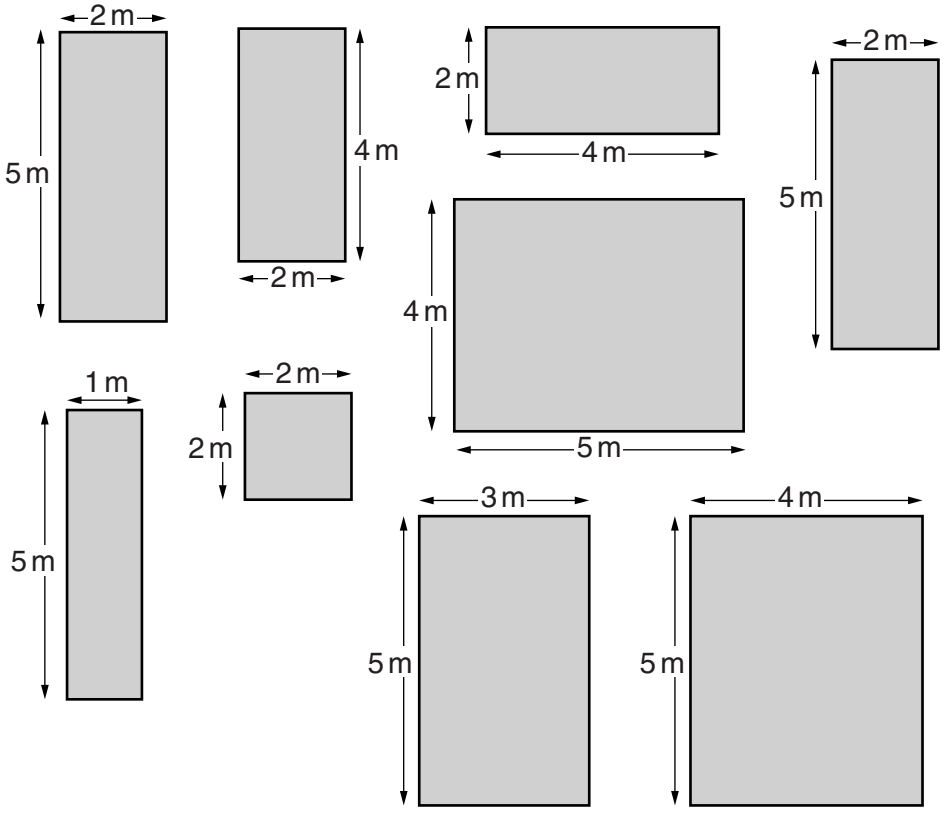


(iii) Calculate the volume of water the tank will hold when full.

(iii) _____ m^3 **[1]**

(iv) Phil has some scrap metal sheets.
These are shown below together with their sizes.

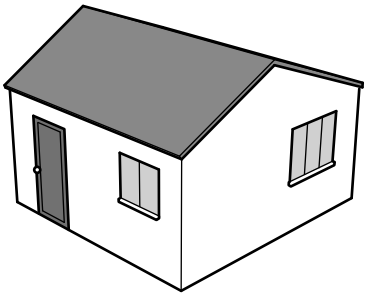
Tick inside the sheets that he needs to weld together to make the water tank.
Each side must be made from a single metal sheet and no sheets may be cut.



Not to scale

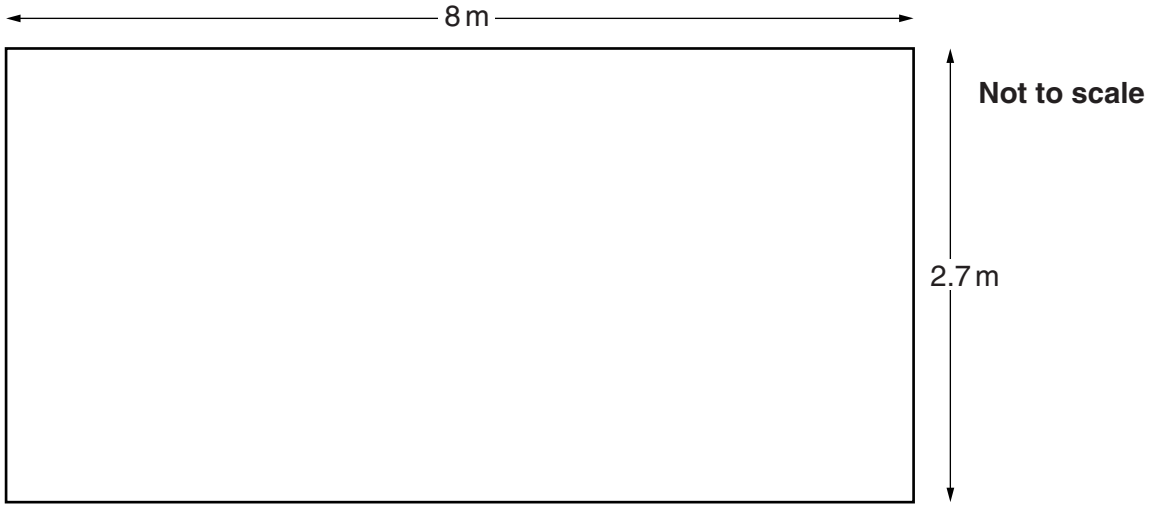
[2]

7 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 is planning to install 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.

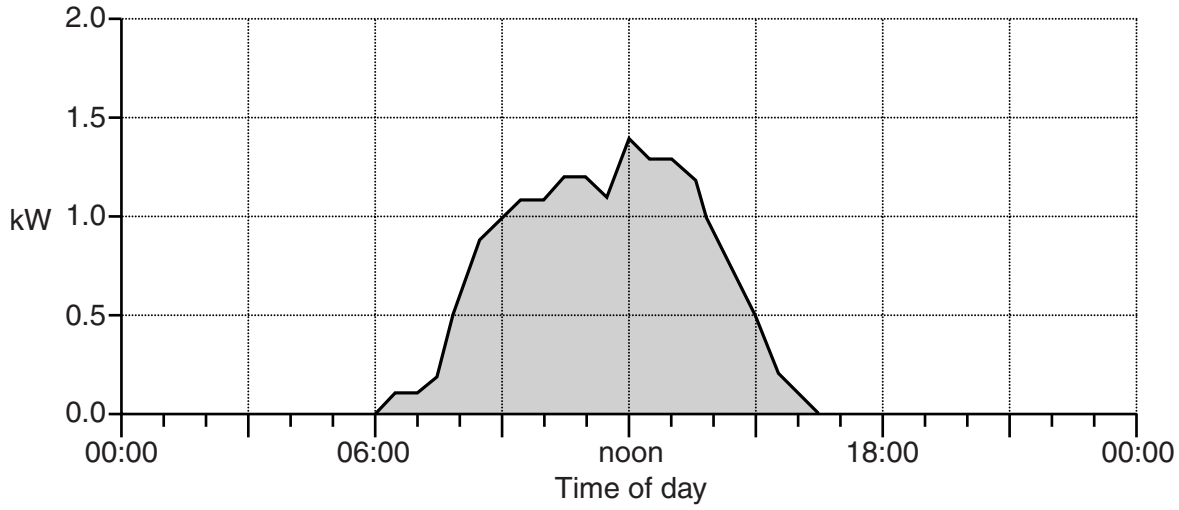
(a) Sketch an arrangement of 12 panels that will fit on the roof.
Include all relevant measurements on your diagram.
You do not need to draw your diagram to scale.



[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) The graph shows the electricity produced by a neighbour's solar panels in a day.

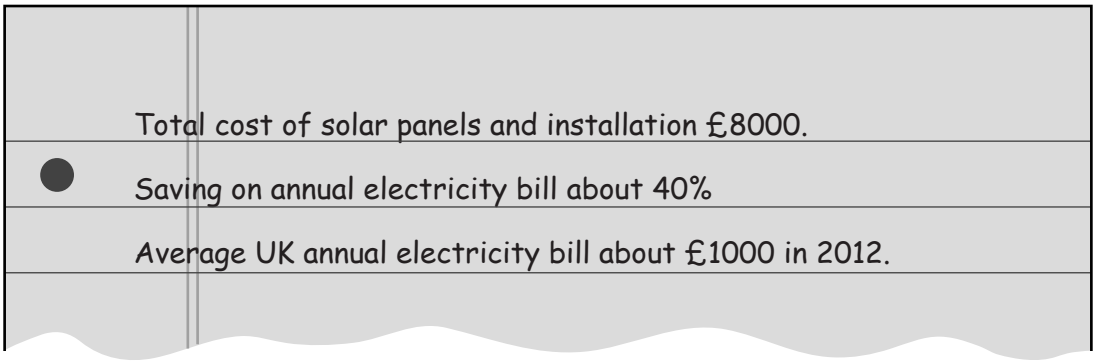


For how long did the solar panels produce electricity on that day?

(b) _____ hours **[1]**

TURN OVER FOR part (c)

(c)* Before finally deciding on whether to go ahead with the solar panels Evan looks on some consumer websites. This is what he finds.



The payback time is the number of years it will take for the saving on the electricity bills to pay back the cost of buying and installing solar panels.

Work out the payback time for Evan.
Is it a good idea for Evan to have solar panels installed?
Jot down any assumptions you make to help you decide.

_____

_____

_____

_____

_____ **[4]**

END OF QUESTION PAPER