OCR
Oxford Cambridge and RSA

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Thursday 4 June 2015 – Morning

GCSE APPLICATIONS OF MATHEMATICS

A382/01 Applications of Mathematics 2 (Foundation Tier)

4855615170

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

A382/01

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

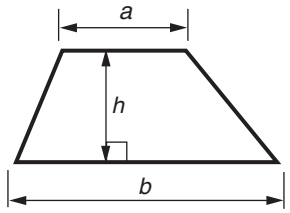
- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- Your quality of written communication is assessed in questions marked with an asterisk (*****).
- The total number of marks for this paper is **90**.
- This document consists of **28** pages. Any blank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

You are permitted to use a calculator for this paper

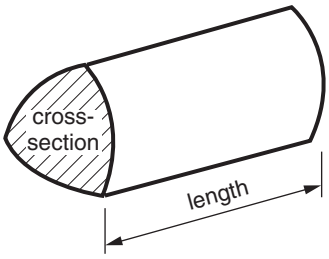
DC (KN/SW) 104012/3

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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Answer **all** the questions.

1 Jade sees this.

Save IT Times

Ideas and thoughts to save energy

Energy costs go through the roof!

25% of heat lost in an average home goes through the roof

A recent survey has shown that despite great progress made in energy conservation

(a) What **fraction** of heat lost in an average home is lost through the roof?

(a) ..... **[1]**

Insulating your loft can save you £100s a year

Jade decides to investigate.

Ask the Boffin

I don't have loft insulation.
How can I calculate how much I could save if I did?

Answer

Use this formula.
It assumes that you pay an average price for your heat.

Average savings a year in £s is:

$0.1 \times$ (loft area in m^2) $\times$ (average difference in temperature (°C) between inside and outside) $\times (2.3 - U)$

U depends on the type and thickness of the insulation. Con the Conserver

- The insulation Jade wants has a *U*-value of 0.15.
- Her loft has an area of 120 m^2.
- The average difference between inside and outside temperature is about 6 °C.

(b) Is the claim that insulating a loft can save £100s a year true?
You **must** support your answer with clear calculations.

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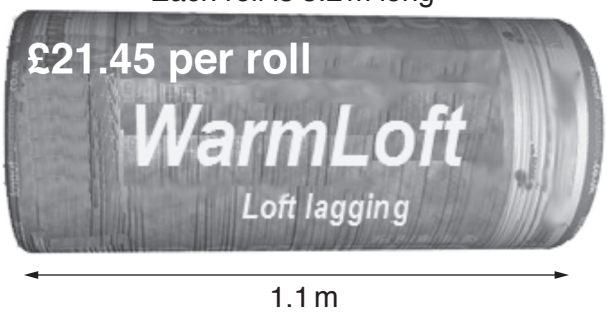
..... **[3]**

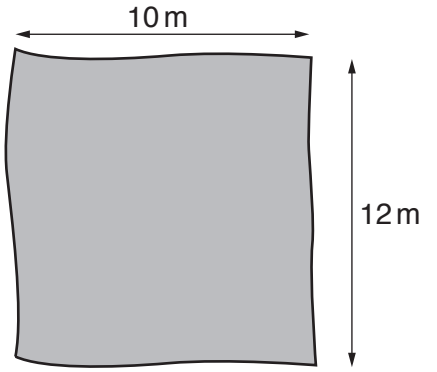
Jade decides to insulate her loft with lagging.
She lays down the lagging herself.
It can be cut into small pieces to fit if needed.

Each roll is 5.2 m long



Jade buys *WarmLoft* lagging.

This is a sketch of Jade's rectangular loft.



Not to scale

(c)* How much will it cost Jade to cover her loft with a layer of lagging? Show clearly how you decide.

(c) £ ..... **[4]**

Payback time …
is how long it takes to pay for something using the savings made by having it. For example, buying something for £100 which saves £2 a year has a payback time of 100 ÷ 2 which is 50 years. Not a good investment!

(d) (i) Complete this table for some energy-saving methods.

Method	Cost	Saving in a year	Payback time
Energy-efficient boiler	£1500	£150	10 years
Draught proofing	£90	£30	
Energy-saving light bulbs	£25	£50	
Jade's loft lagging	*	*	

[1] **[1]** **[1]**

*from your answers to part **(b)** and part **(c)**.

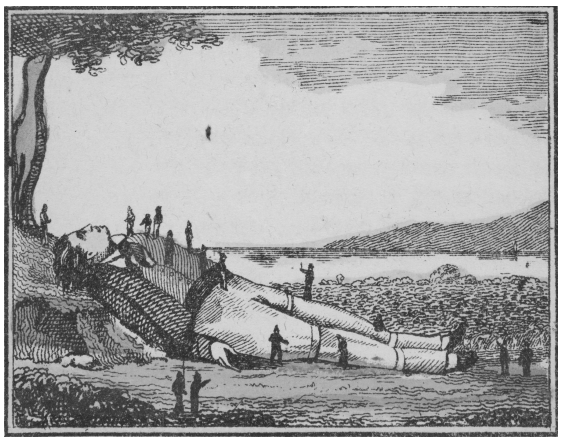
(ii) Which of the four methods above is the best investment?
Give a reason for your answer.

.....

because .....

..... **[2]**

2 *Gulliver's Travels* by Jonathan Swift is a book about Gulliver, a man who visits a land of very small people. These very small people are called Lilliputians.
This is a picture from the original book. It shows Gulliver and some Lilliputians.



(a) Write down the approximate ratio of a Lilliputian's height to Gulliver's height.
Only use whole numbers in your answer.

(a) ..... **[2]**

(b)* Gulliver also visited a land of giants.
This picture shows Gulliver being looked at by one of these giants.

Estimate the height of the giant.
Write down any assumptions you make.
Include the units in your answer.

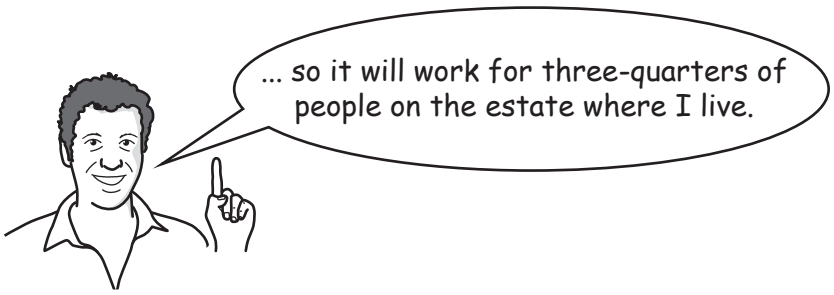
(b) ..... **[4]**

(c) The Lilliputians used ratio to measure Gulliver to make new clothes for him.
In the book Gulliver says:

'They measured my right thumb to use a mathematical computation that **twice round the thumb is once round the wrist.**'

Seth tests the rule by measuring the thumbs and wrists of some friends.
Here are his results. All measurements are to the nearest centimetre.

Distance round wrist (centimetres)	Distance round thumb (centimetres)
20	10
18	9
19	10
16	8
18	9
16	8
17	8
22	11



(i) Is Seth's **first** statement correct?
Support your answer with some numbers.

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..... **[3]**

(ii) Explain why Seth's conclusion may not be right.

.....

.....

..... **[1]**

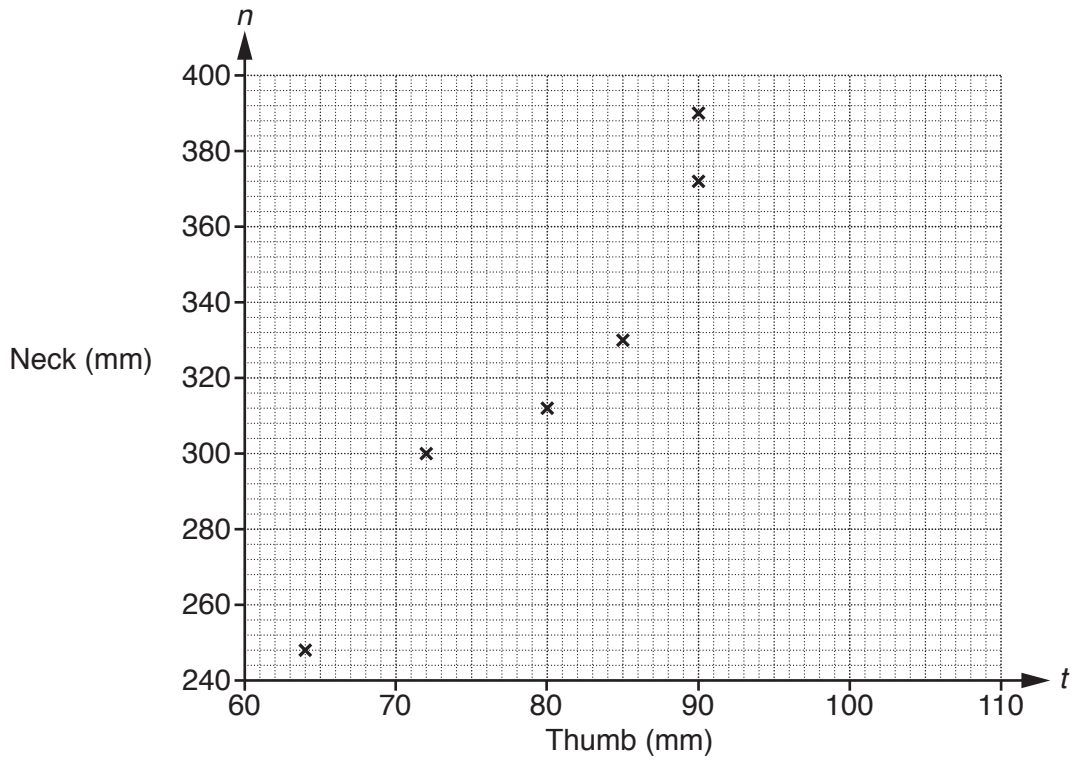
(d) Gulliver also said:

'The measurement round the neck is four times the measurement round the thumb.'

Seth decides to investigate whether this is true.
Here are the measurements Seth collected.

Thumb, *t* mm	90	72	64	90	85	80	98	95	90	92
Neck, *n* mm	372	300	248	390	330	312	390	380	360	352

The first six measurements have been plotted on the scatter diagram.



(i) Complete the scatter diagram. **[2]**

(ii) Draw a line of best fit for the data on your diagram. **[1]**

(iii) Explain why your line of best fit should not be used for a thumb measurement of 105 mm.

.....

..... **[1]**

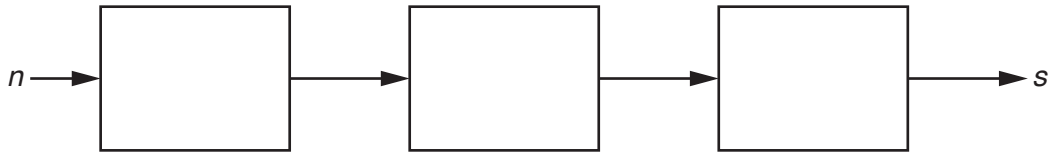
(iv) Assuming Gulliver's statement is **true**, write down an equation connecting *n* and *t*.

(d)(iv) ..... **[2]**

(e) (i) Shirt sizes for men are given in inches to the nearest half inch.

To find a man's shirt size:
- use the distance around his neck in **inches**
- add half an inch
- **round up** to the next inch or half inch.

Complete the flow diagram to find shirt size, s, for a neck size measurement of n mm.
Use 1 inch = 25.4 mm.



[3]

(ii) The distance round Joe's **thumb** is 106 mm.

Work out Joe's shirt size.
Assume the statement in part **(d)** is true.

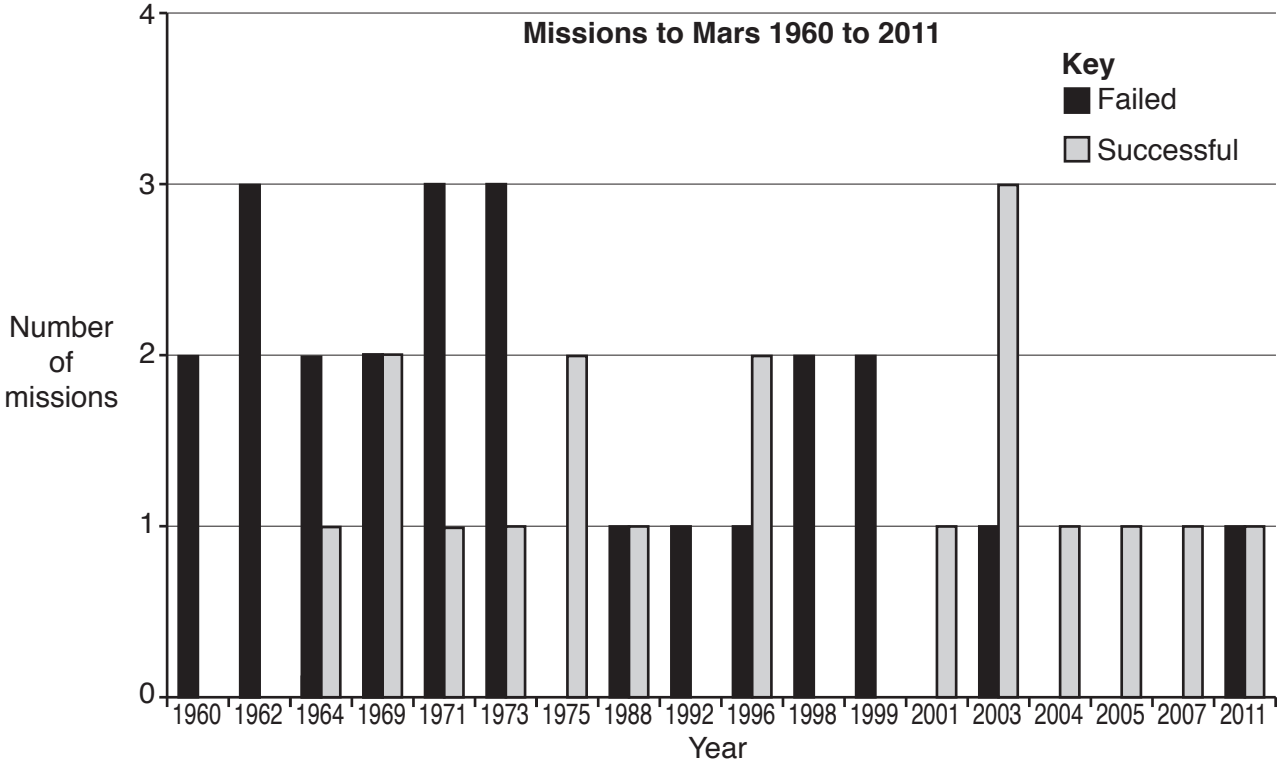
(e)(ii) ..... **[3]**

3 **(a)** This calculation estimates the time taken, t days, for a space craft to reach Mars from Earth. Complete the calculation, giving your answer correct to the nearest day.

$$t = 180 \times 1.25 \times \sqrt{1.25}$$

(a) ..... days **[2]**

(b) Sending missions to Mars is very difficult.
This bar chart shows the number of missions which failed and the number which were successful over the 50 years up to 2011.
There are only bars for the years in which Mars missions were launched.



(i) How many missions failed in 1960?

(b)(i) ..... **[1]**

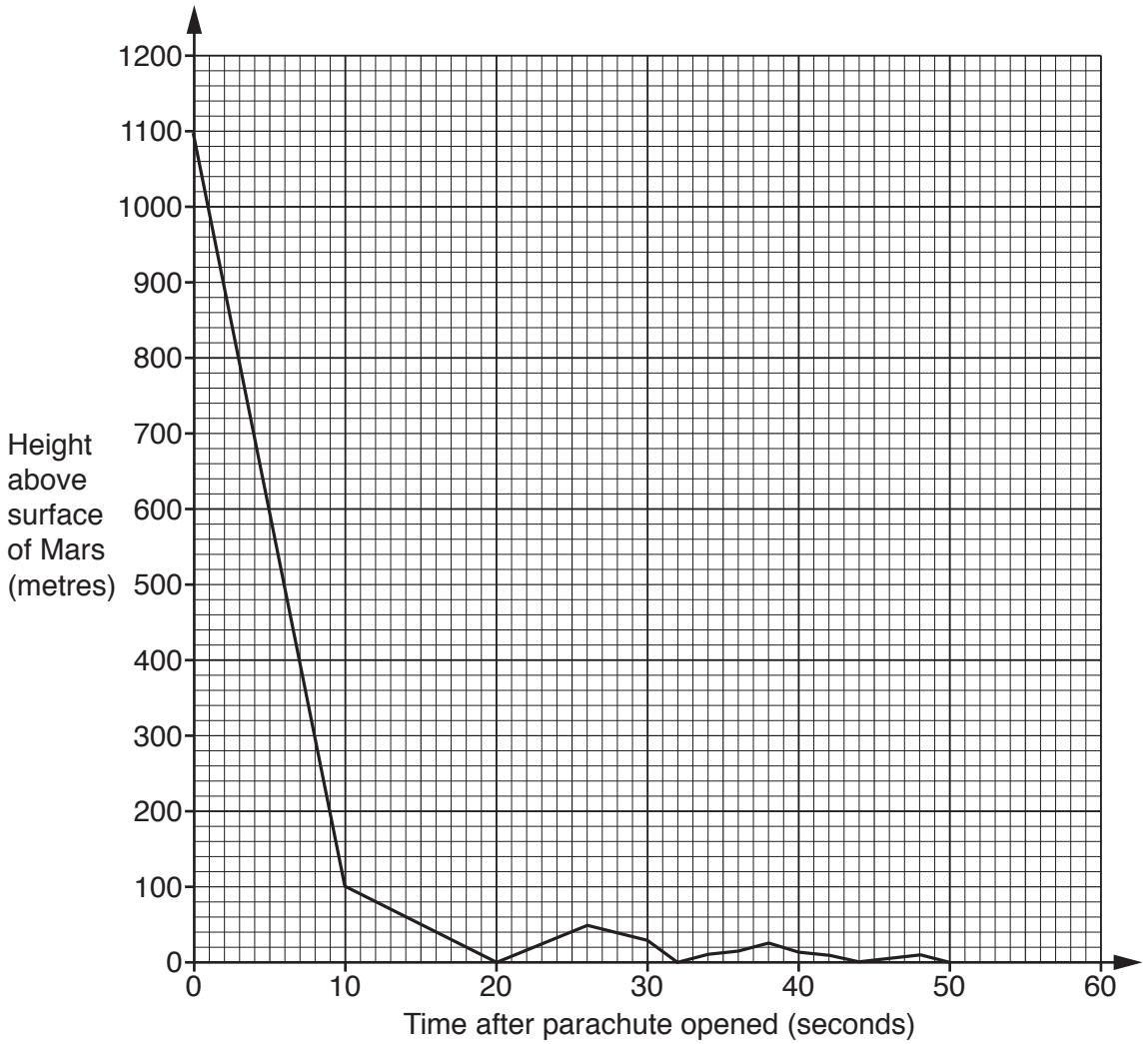
(ii) How many missions **in total** were there in 2003?

(ii) ..... **[1]**

(iii) In which years were there **more** successes **than** failures?

(iii) ..... **[2]**

(c) This chart shows how the height of a landing craft above the surface of Mars changed after the parachute had opened. A rocket was fired to slow the landing craft further.



(i) How far above the surface of Mars was the landing craft 2 seconds after the parachute opened?

(c)(i) ..... m **[1]**

(ii) How many seconds after the parachute opened was the rocket fired?

(ii) ..... s **[1]**

(iii) Describe in full what happened to the landing craft from 20 seconds to 50 seconds after the parachute opened.

.....

.....

..... **[2]**

(d) Since 1971 several space craft have actually landed on Mars.
This table shows some information about the craft that landed before 2013.

Landing craft	Landed	Mass (kg)	Outcome
Mars 2	1971	1210	Failed
Mars 3	1971	1210	Failed
Mars 6	1973	635	Failed
Viking 1	1976	657	Successful
Viking 2	1976	657	Successful
Mars Pathfinder	1997	360	Successful
Mars Polar	1999	500	Failed
Spirit Rover	2004	185	Successful
Opportunity Rover	2004	185	Successful
Phoenix Mars	2008	350	Successful
Mars Science Laboratory	2012	900	Successful

Use the table to answer the questions on the next page.

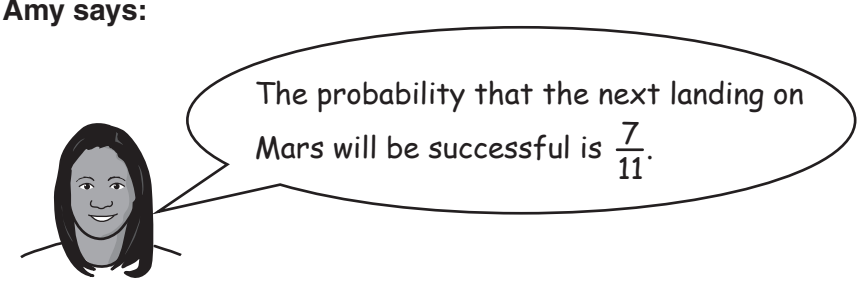
(i) Which successful landing craft had the greatest mass?

(d)(i) ..... **[1]**

(ii) How many of the landing craft had a mass of between 600 kg and 1000 kg?

(ii) ..... **[1]**

Amy says:



(iii) Explain how Amy arrived at this figure.

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..... **[2]**

(iv) Why is she probably wrong?

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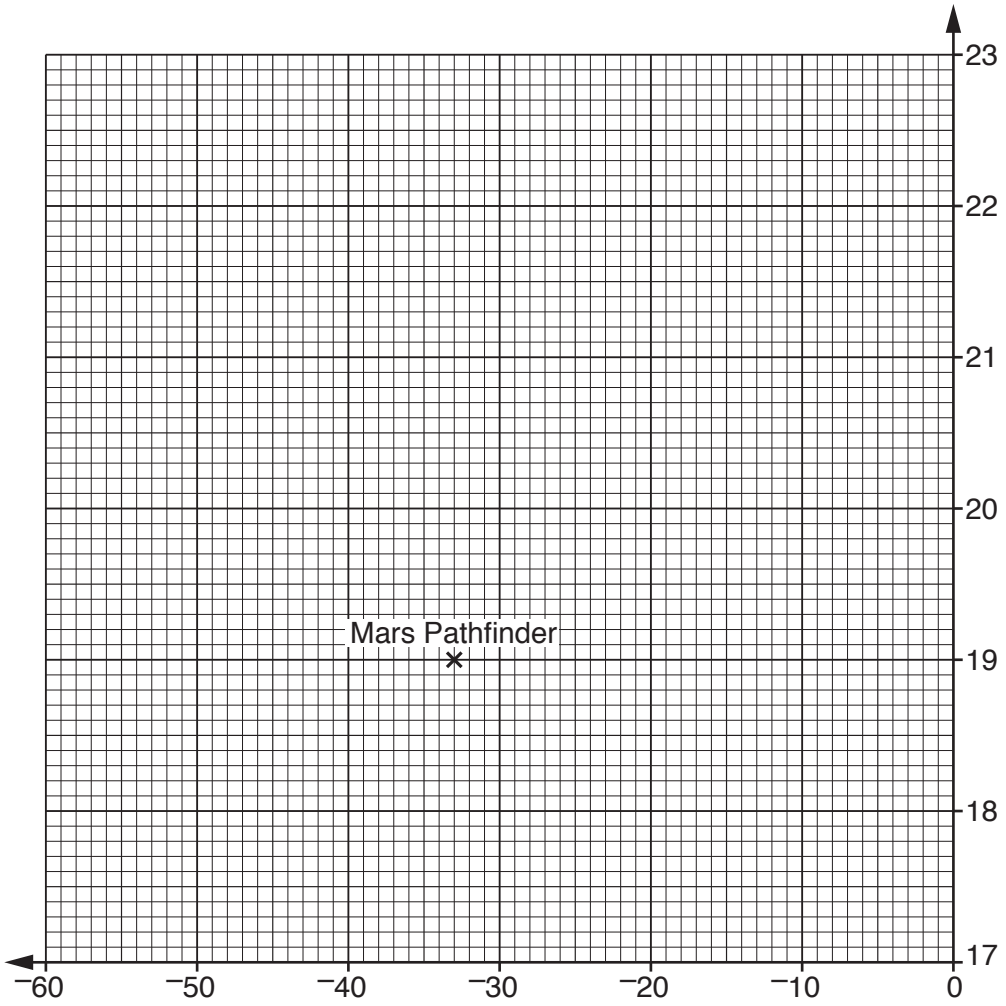
..... **[2]**

(e) This GPS grid for Mars shows the position of the landing craft *Mars Pathfinder*.



(i) Complete these GPS coordinates for where *Mars Pathfinder* landed.

(e)(i) (−33 , ...) **[1]**

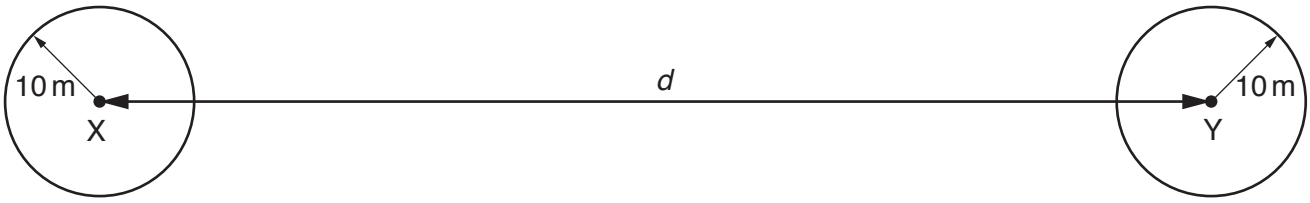
(ii) Mark clearly on the grid the position of *Viking 1* which landed at (−48, 22). **[1]**

(iii) What are the GPS coordinates of a point which is midway between Arago Crater (30, 10) and Schöner Crater (50, 20)?

(iii) (..... , ...) **[2]**

It is planned to have a GPS system on Mars which will locate points to within 10 metres.

This diagram shows two points X and Y which GPS states are distance d metres apart.



Because of the 10 m possible error in GPS each point could be anywhere inside the circles. (Each of these circles has a radius of 10 metres.)

T represents the distance between the actual positions of X and Y.
The smallest value of T is $d - 20$.

(iv) Write down an expression for the largest value of T.

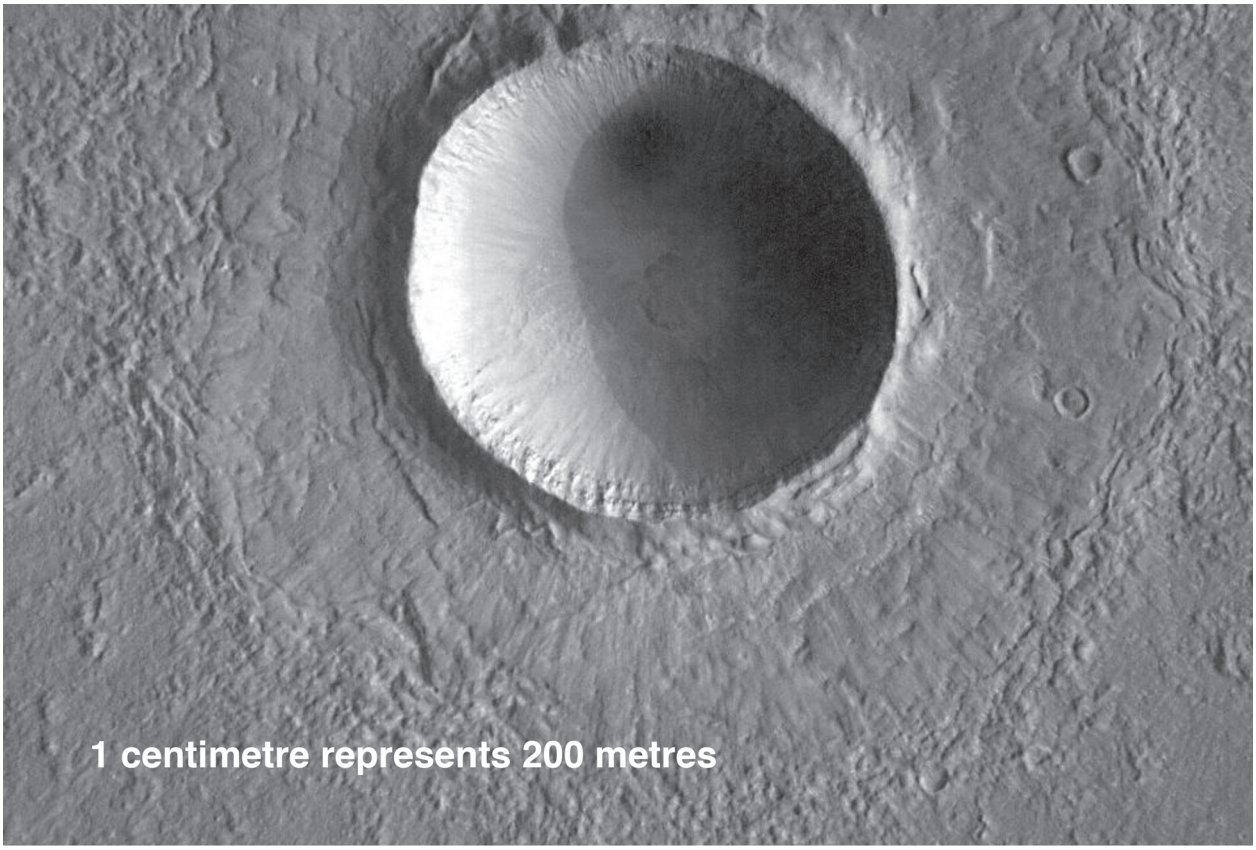
(iv) ..... **[1]**

(v) Tick the two inequalities that are true for T.

$d - 20 > T > d + 20$	☐	$d - 20 \leqslant T \leqslant d + 20$	☐
$d - 20 \geqslant T \geqslant d + 20$	☐	$d + 20 < T > d - 20$	☐
$d + 20 \geqslant T \geqslant d - 20$	☐	$d + 20 > T < d - 20$	☐

[2]

(f) This is a photo of a crater on Mars.



(i) What is the diameter of the real crater?

(f)(i) ..... metres **[2]**

(ii) How far would a rover vehicle have to travel if it went once around the edge of the crater?

(ii) ..... metres **[2]**

(g) This table shows some temperatures recorded by the landing craft *Mars Pathfinder*.

Time	Temperature (°C)
11:30:07	−28.2
11:59:08	−25.4
12:28:08	−23.4
12:57:08	−22.4
13:26:09	−21.0

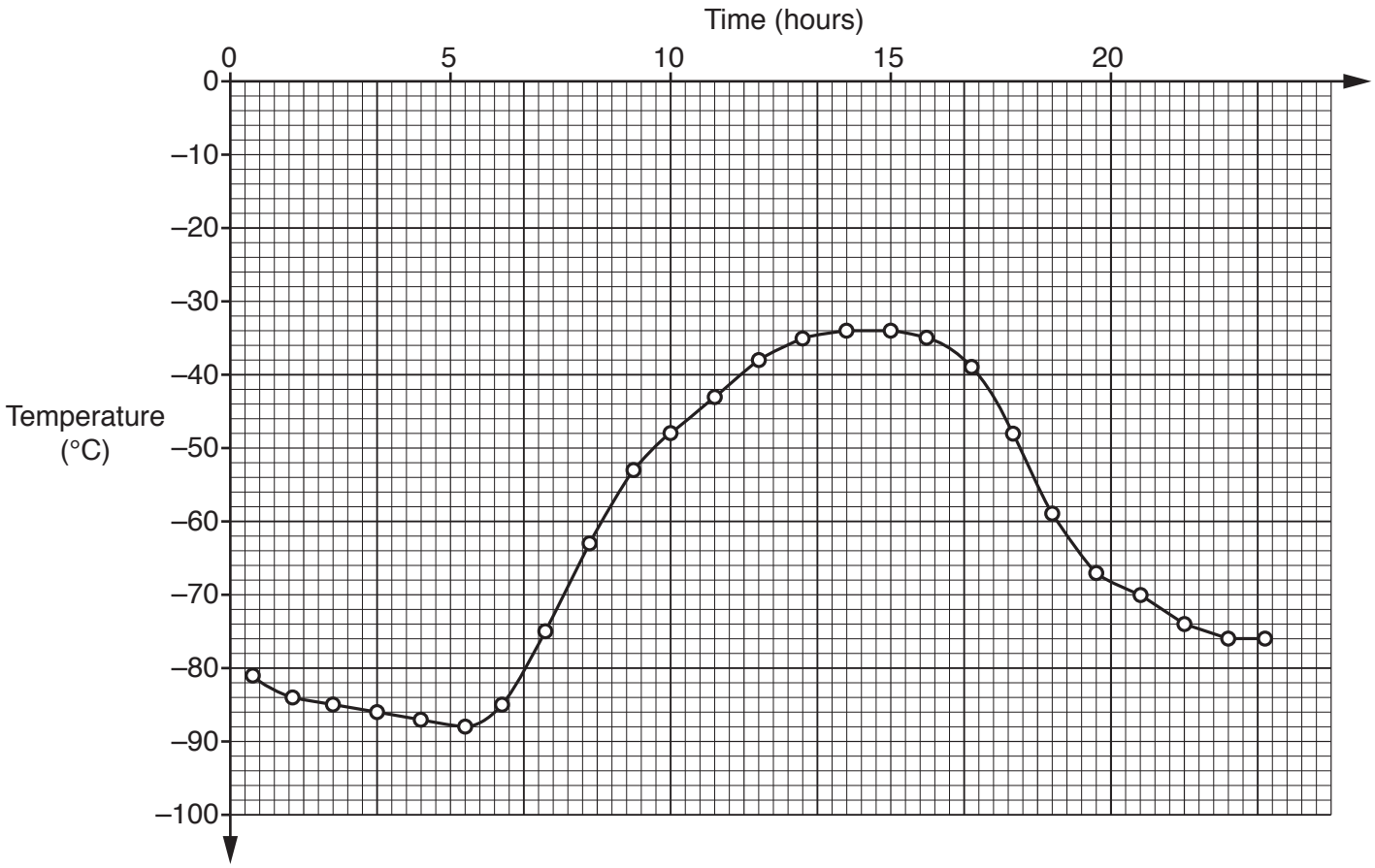
(i) Work out the mean of these temperatures.

(g)(i) ..... °C **[3]**

(ii) What is the median temperature?

(ii) ..... °C **[1]**

This graph shows the temperature on Mars recorded by the landing craft *Viking 1*.
It is for a typical day in March 1978.



(h) Write down two general facts the graph shows about the daily temperature on Mars in March.

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.....

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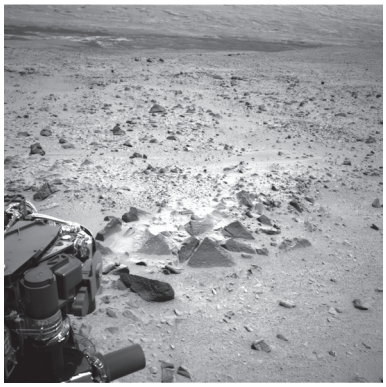
..... **[2]**

(i) A day on Mars is longer than a day on Earth.
A Mars day is called a sol.
A sol is 1.027 Earth days.



(i) This picture was taken 344 Earth days after the rover *Curiosity* landed on Mars.

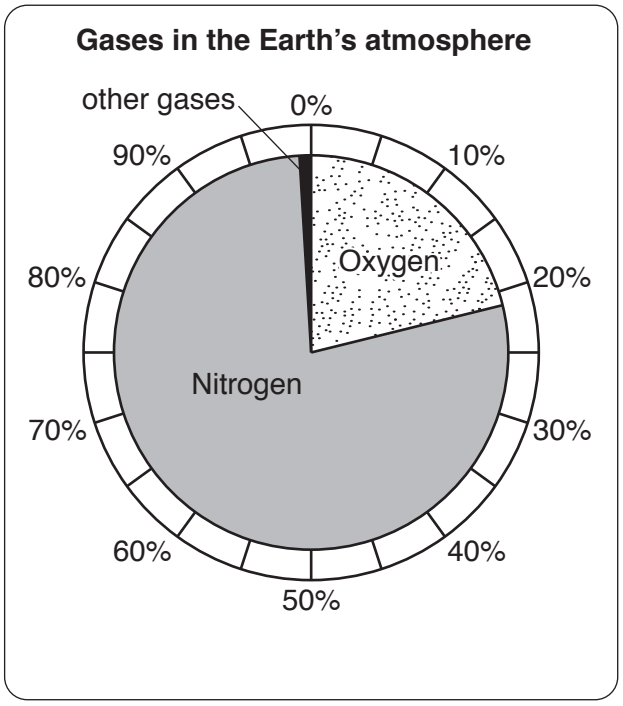
How many sols was this after the rover *Curiosity* landed on Mars?

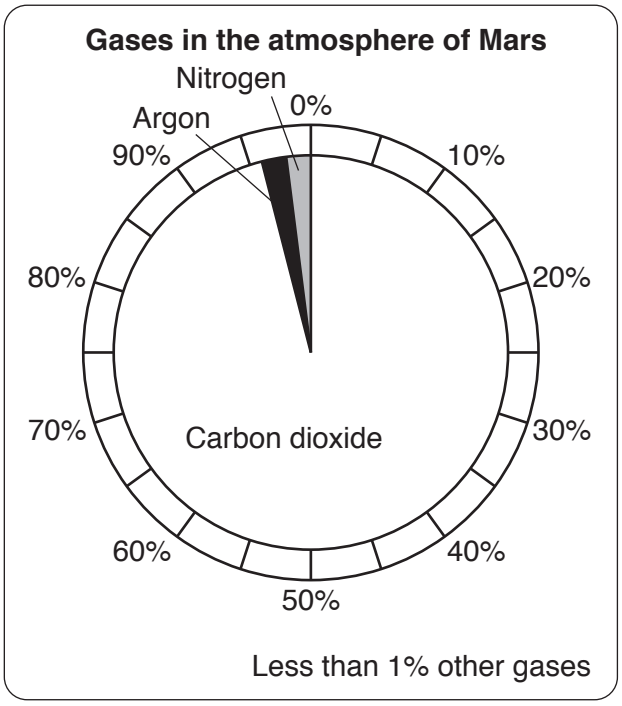
(i)(i) ..... sols **[1]**

(ii) An Earth day has 1440 minutes.
How many Earth minutes is 1 sol?

(ii) ..... minutes **[1]**

Mars has a different proportion of gases in its atmosphere compared with Earth.
These two pie charts show the proportion of the main gases in each atmosphere.





(j) Complete the sentences.

(i) The most common gas in the atmosphere of Mars is ..... .

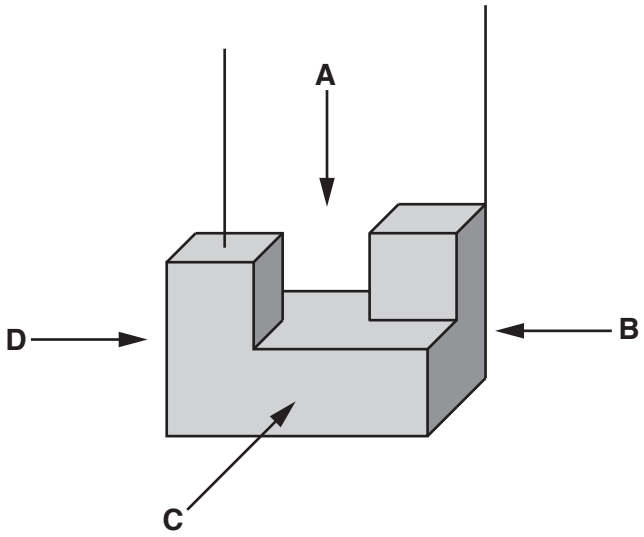
It makes up roughly ..... % of the atmosphere. **[2]**

(ii) Nitrogen is present on Earth and on Mars.

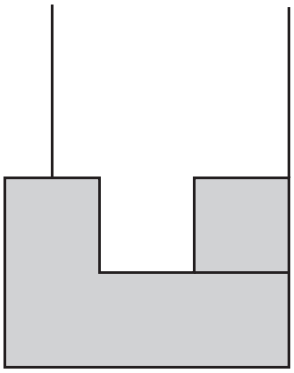
On Earth it makes up roughly ..... % of the atmosphere.

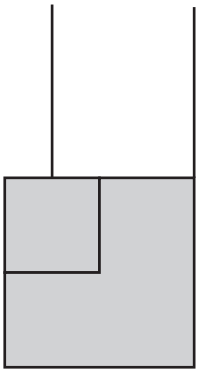
On Mars it makes up roughly ..... % of the atmosphere. **[2]**

(k) This is a model of a rover vehicle's radio module.



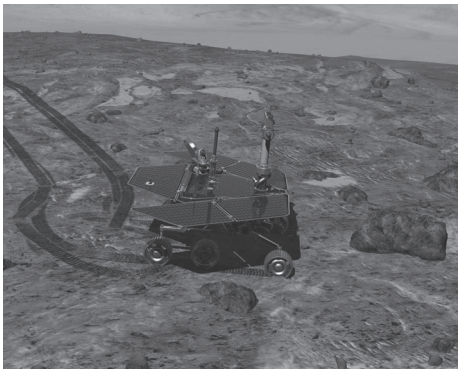
Choose the direction letter for each of these views.





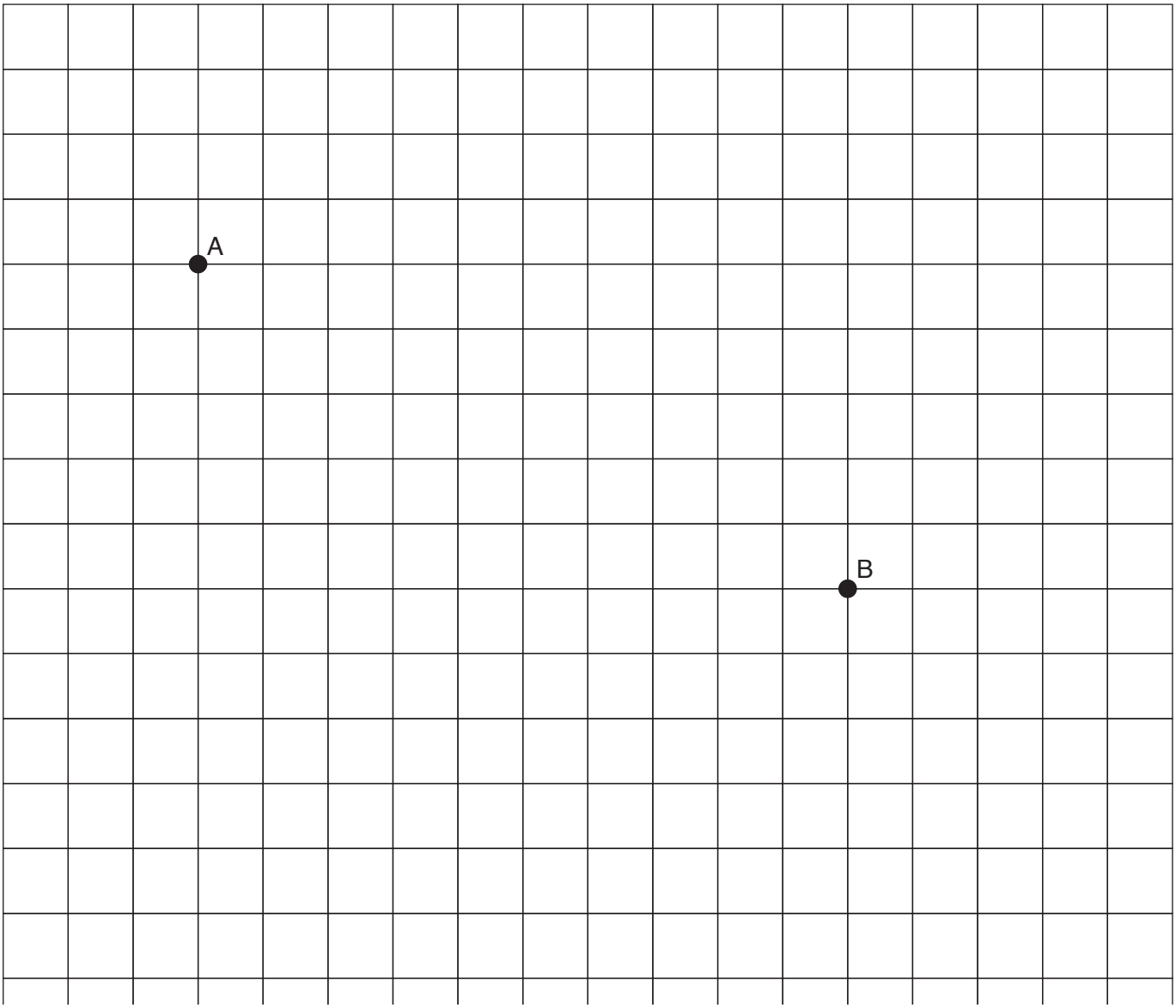
.... **[2]**

(l) Rover vehicles have to be carefully controlled.



(i) In a planned mission a rover vehicle must stay within 600 m from point A **and** stay within 800 m from point B.

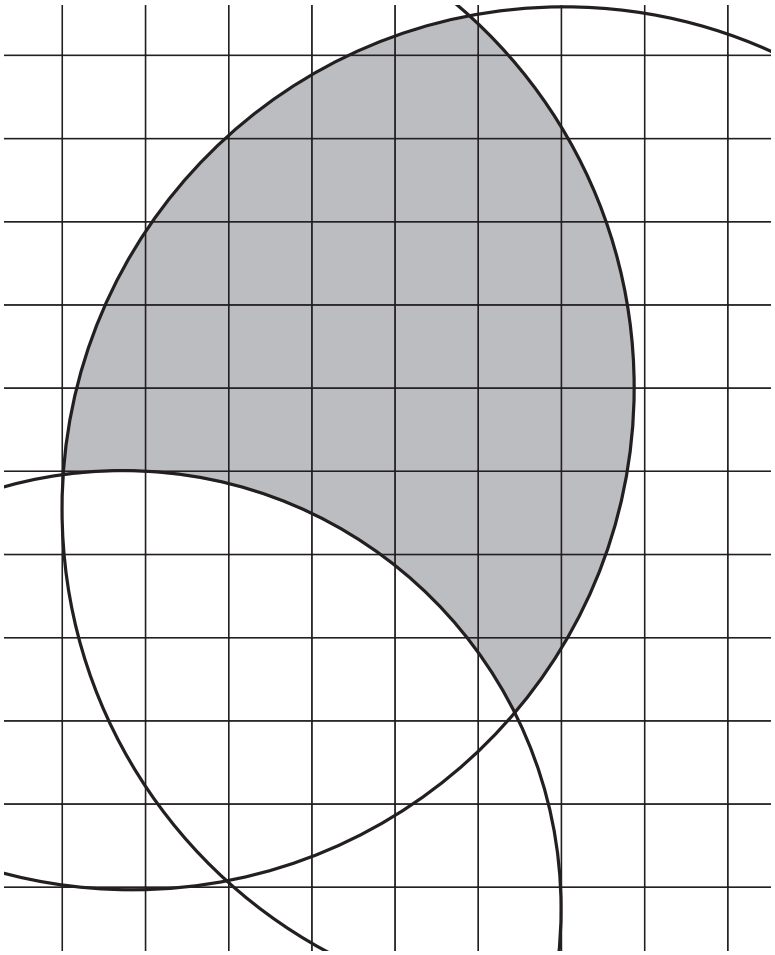
Shade the region which the rover vehicle can explore.
Use a scale of 1 cm to represent 100 m.
Leave in any construction lines or arcs you need to draw.



[3]

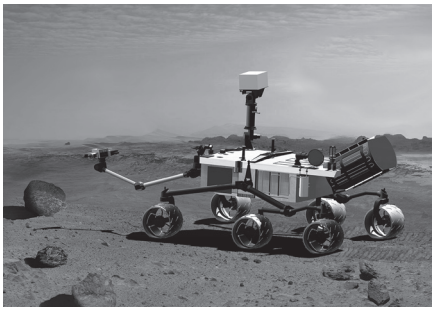
(ii) The shaded region below shows another region it is planned to explore.

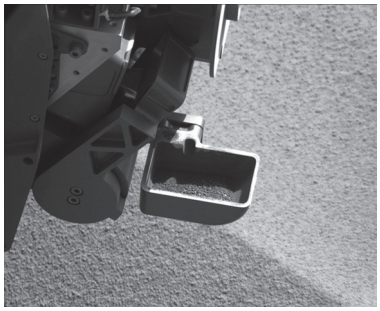
Estimate the area to be explored.
Each square has an area of 100 m^2.
Show clearly how you arrived at your answer.

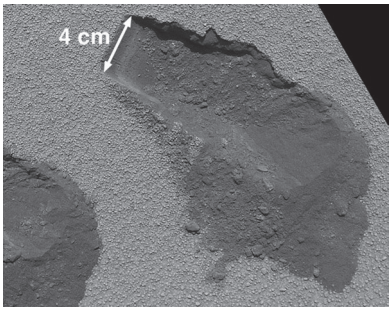


(ii) ..... m^2 **[3]**

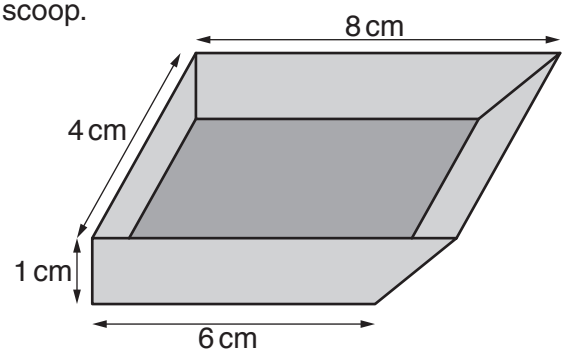
(m) Some rover vehicles used on Mars have a scoop to collect soil.



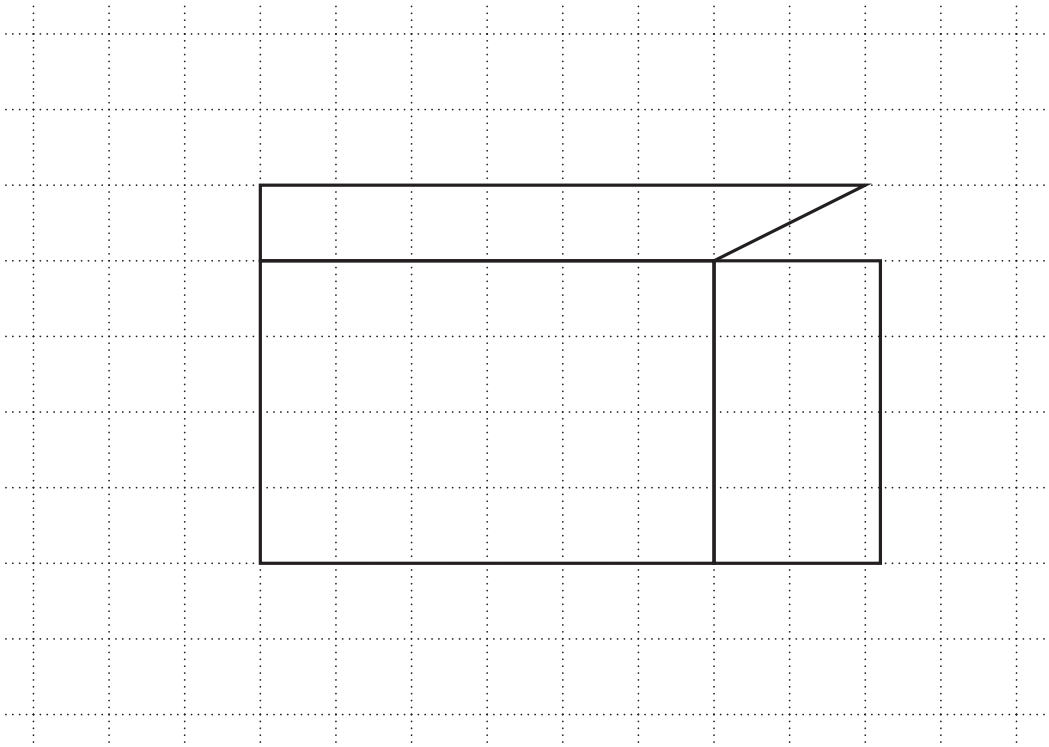




This is a sketch of a scoop.
It has an open top.



(i) Complete this net of the scoop.
(Remember it has an open top.)



[3]

Here is a side view of the scoop. It is full-size.

(ii) Find the area of the side of the scoop.

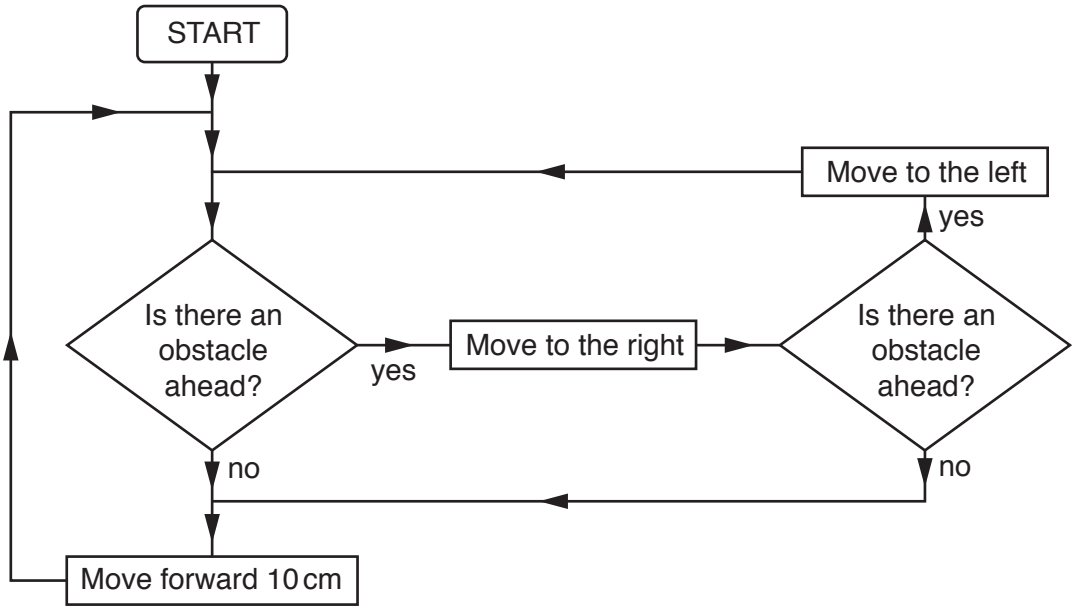
(ii) ..... cm^2 **[1]**

(iii) Use your answer to part **(m)(ii)** to calculate the capacity of the scoop.

(iii) ..... cm^3 **[2]**

(iv) Rover vehicles need to avoid large obstacles by 'thinking' for themselves.

Here is a suggested simple flowchart for avoiding large obstacles.



Work through the flowchart a few times yourself.
List two problems/errors that the flowchart has for the job of avoiding large obstacles.

.....

.....

.....

..... **[2]**

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