

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
GCSE
A382/01

APPLICATIONS OF MATHEMATICS
Applications of Mathematics 2
(Foundation Tier)

THURSDAY 4 JUNE 2015: Morning
DURATION: 1 hour 30 minutes
plus your additional time allowance
MODIFIED ENLARGED 24pt

Candidate forename						Candidate surname				
Centre number						Candidate number				

Candidates answer on the Question Paper.

OCR SUPPLIED MATERIALS:

3D model for Question 3(k)

OTHER MATERIALS REQUIRED:

Scientific or graphical calculator

Geometrical instruments

Tracing paper (optional)

YOU ARE PERMITTED TO USE A CALCULATOR FOR THIS PAPER

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.

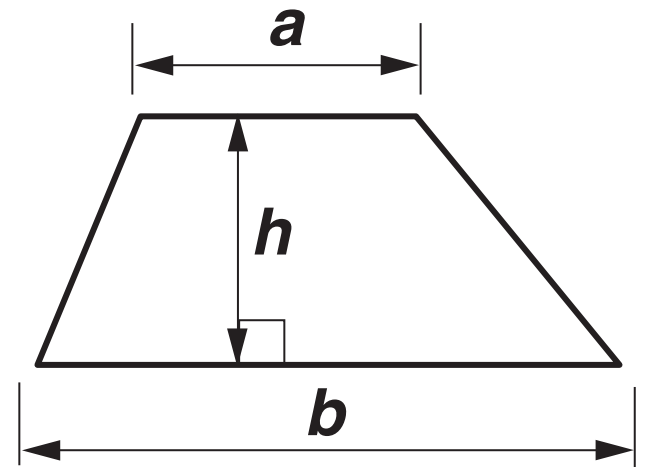
Your quality of written communication is assessed in questions marked with an asterisk (*).

The total number of marks for this paper is 90.

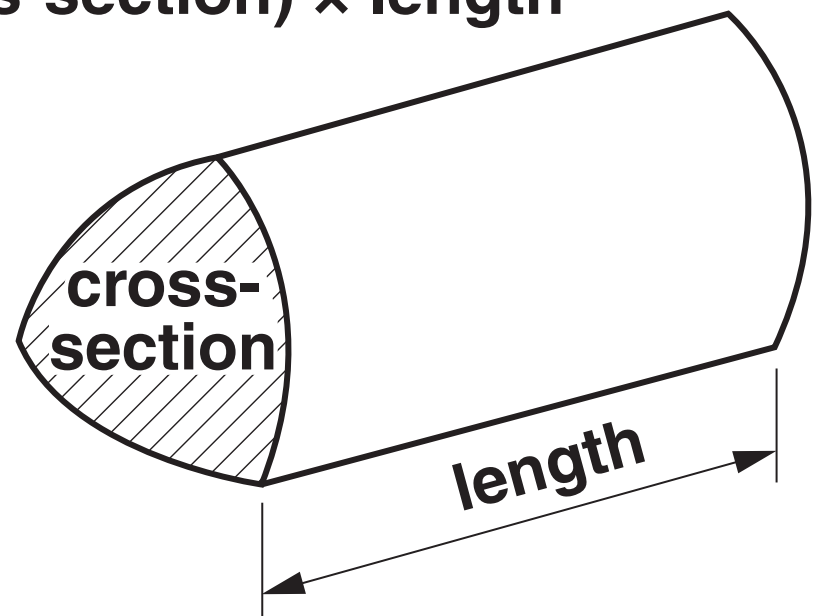
Any blank pages are indicated.

FORMULAE SHEET: FOUNDATION TIER

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



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



Answer ALL the questions.

1 Jade sees this.

Save IT Times

Energy costs go through the roof!

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

(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:

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

U depends on the type and thickness of the insulation.

The insulation Jade wants has a *U*-value of 0.15.

Her loft has an area of 120 m².

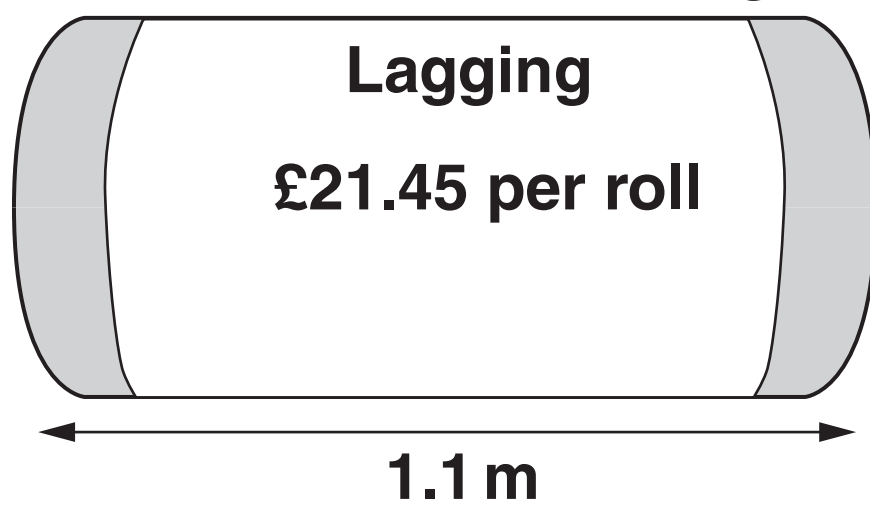
The average difference between inside and outside temperature is about 6 °C.

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

[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.**

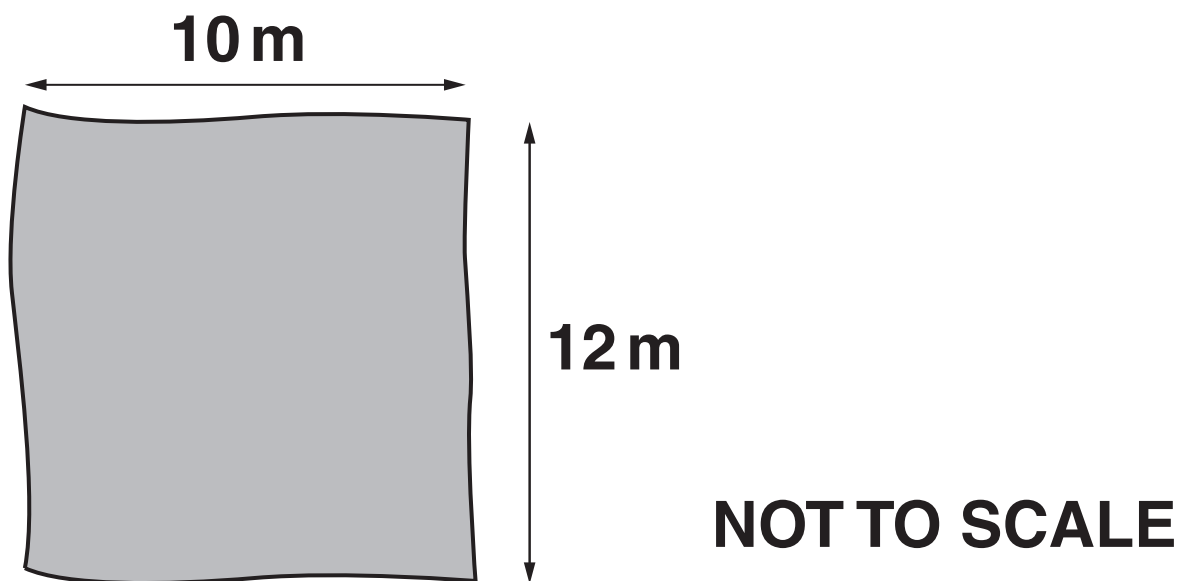
Each roll is 5.2 m long



Jade buys lagging.

This is a sketch of Jade's rectangular loft.

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



(c) £ _____ [4]

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 $100 \div 2$ 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	*	*	

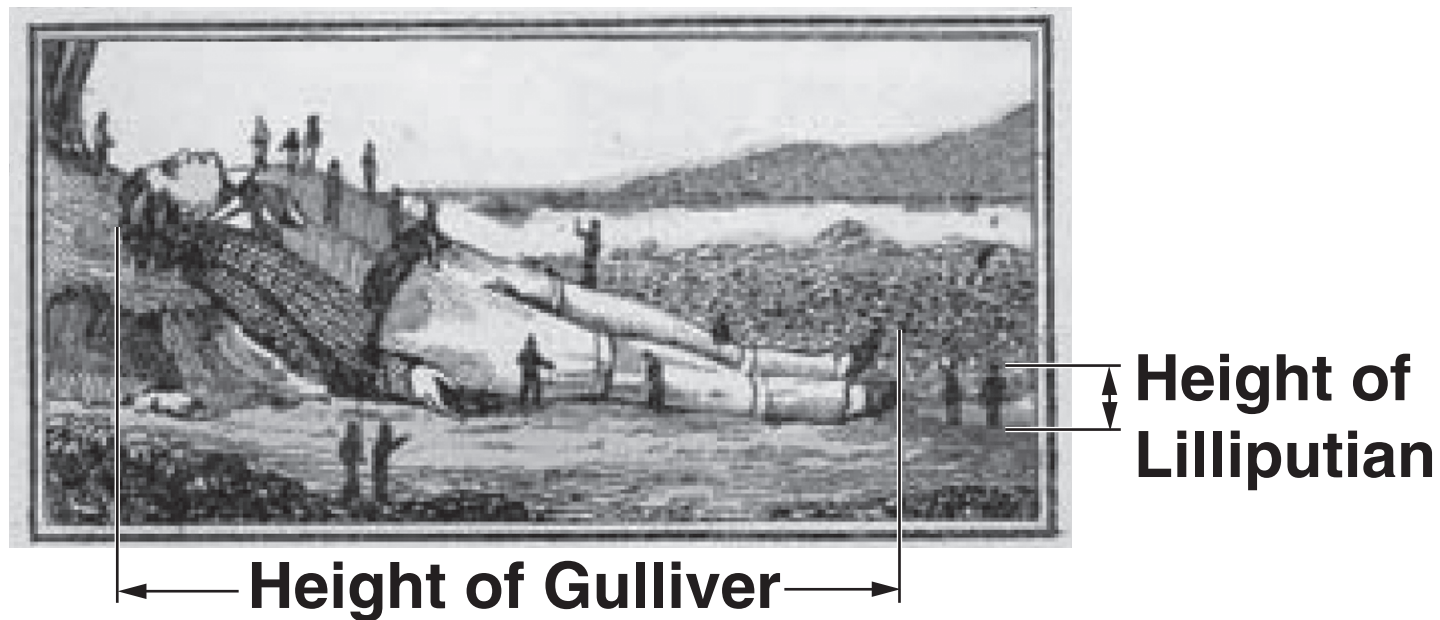
***from your answers to part (b) and part (c).**

**(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

Seth says

‘It works for 75% of my friends

so it will work for three-quarters of people on the estate where I live’.

(i) Is Seth’s FIRST statement correct?
Support your answer with some numbers.

[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 opposite.

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

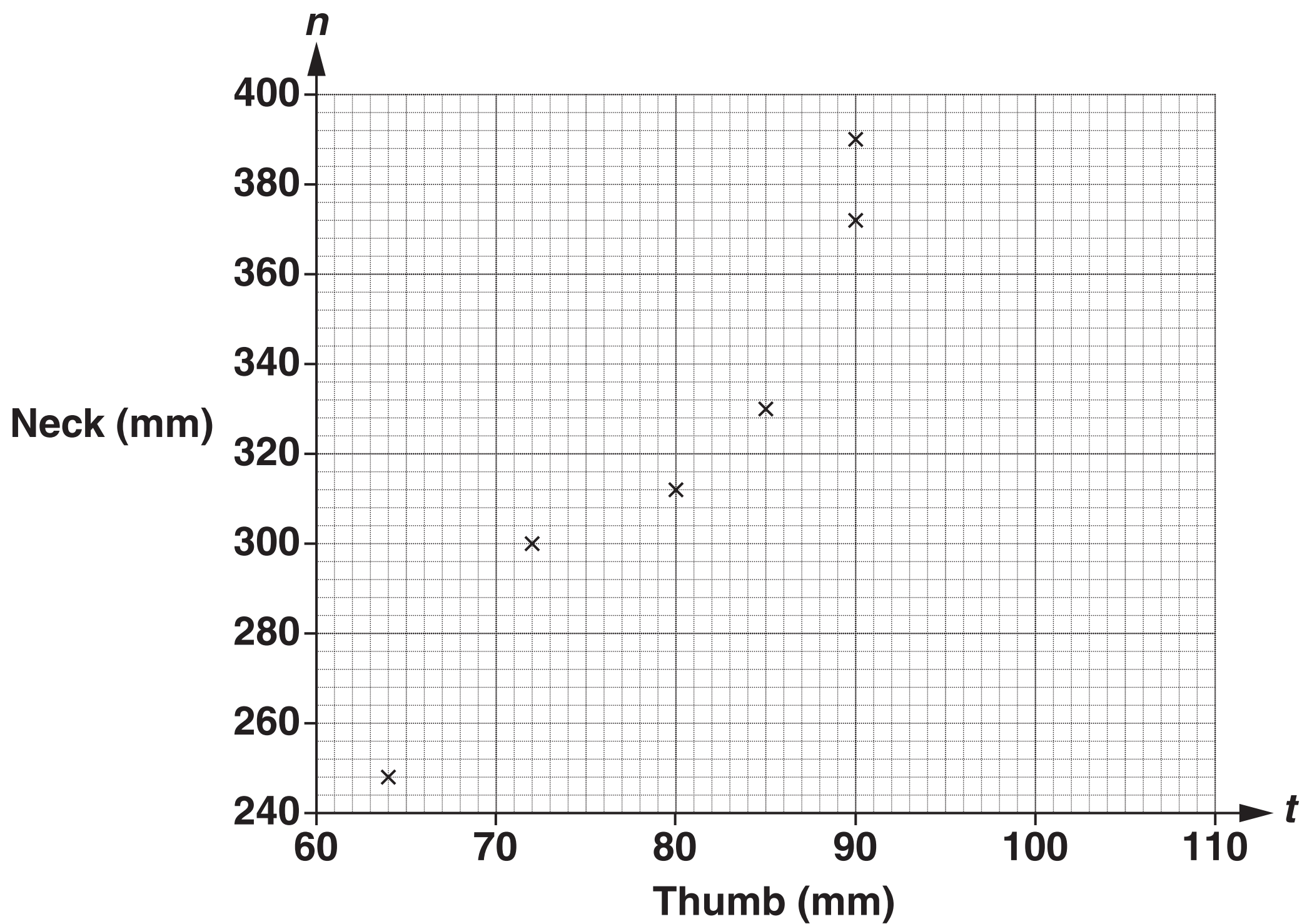
(ii) Draw a line of best fit for the data on your diagram. [1]

(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:

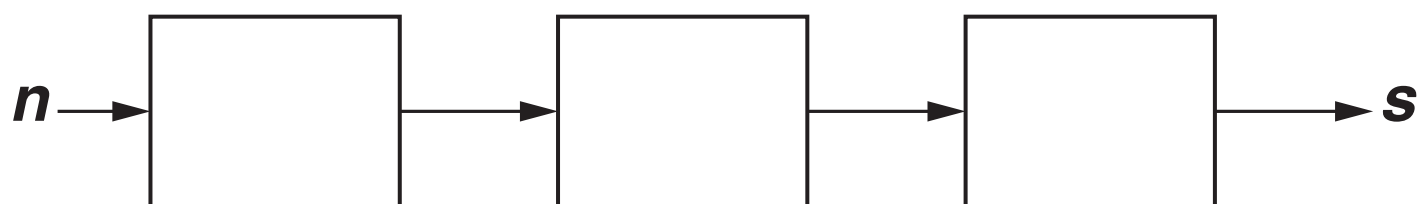
use the distance around his neck in INCHES

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 opposite 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?

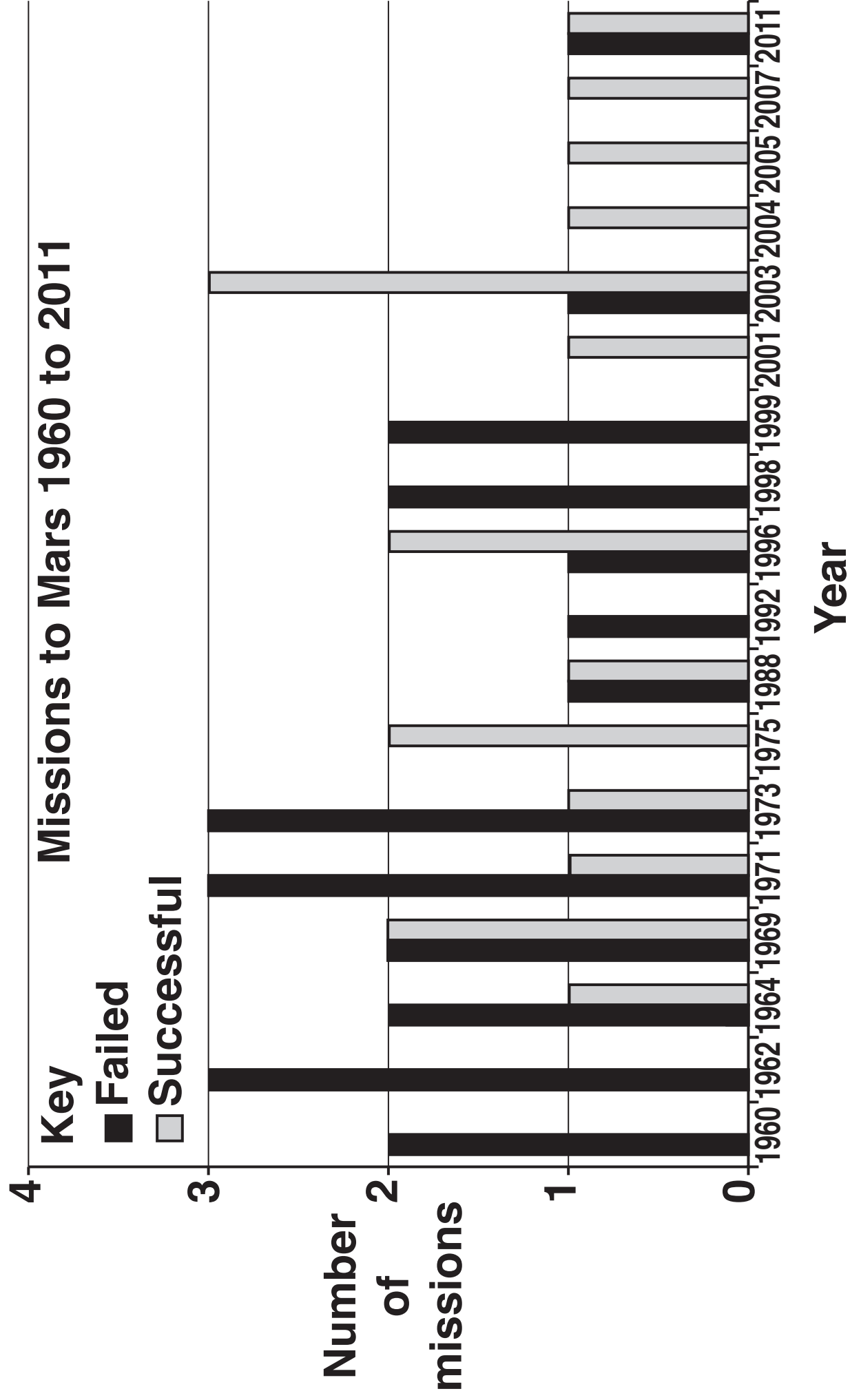
(b)(i) _____ [1]

(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) The chart opposite 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?

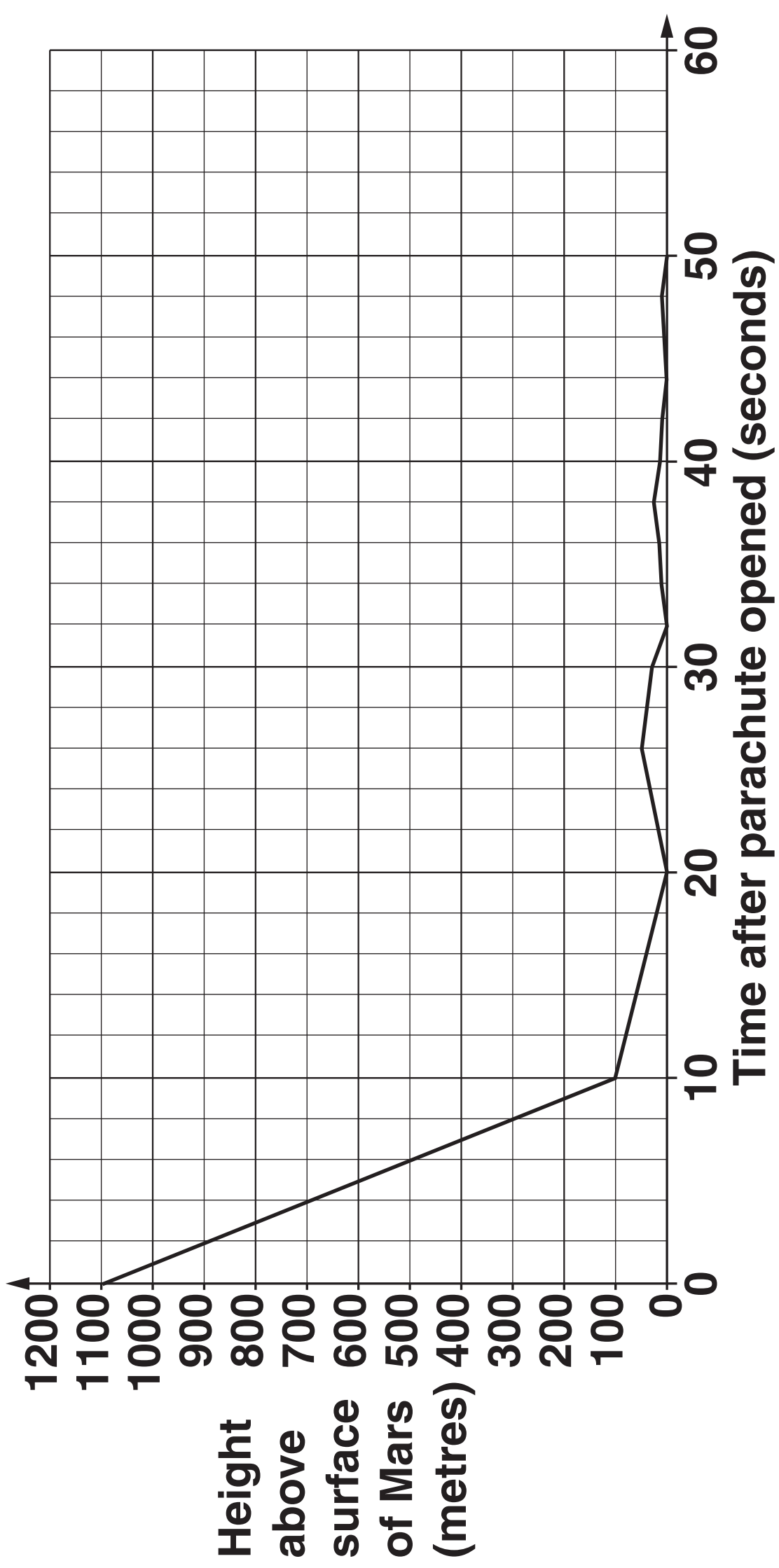
(c)(i) _____ m [1]

(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: ‘The probability that the next landing on Mars will be successful is $\frac{7}{11}$ ’.

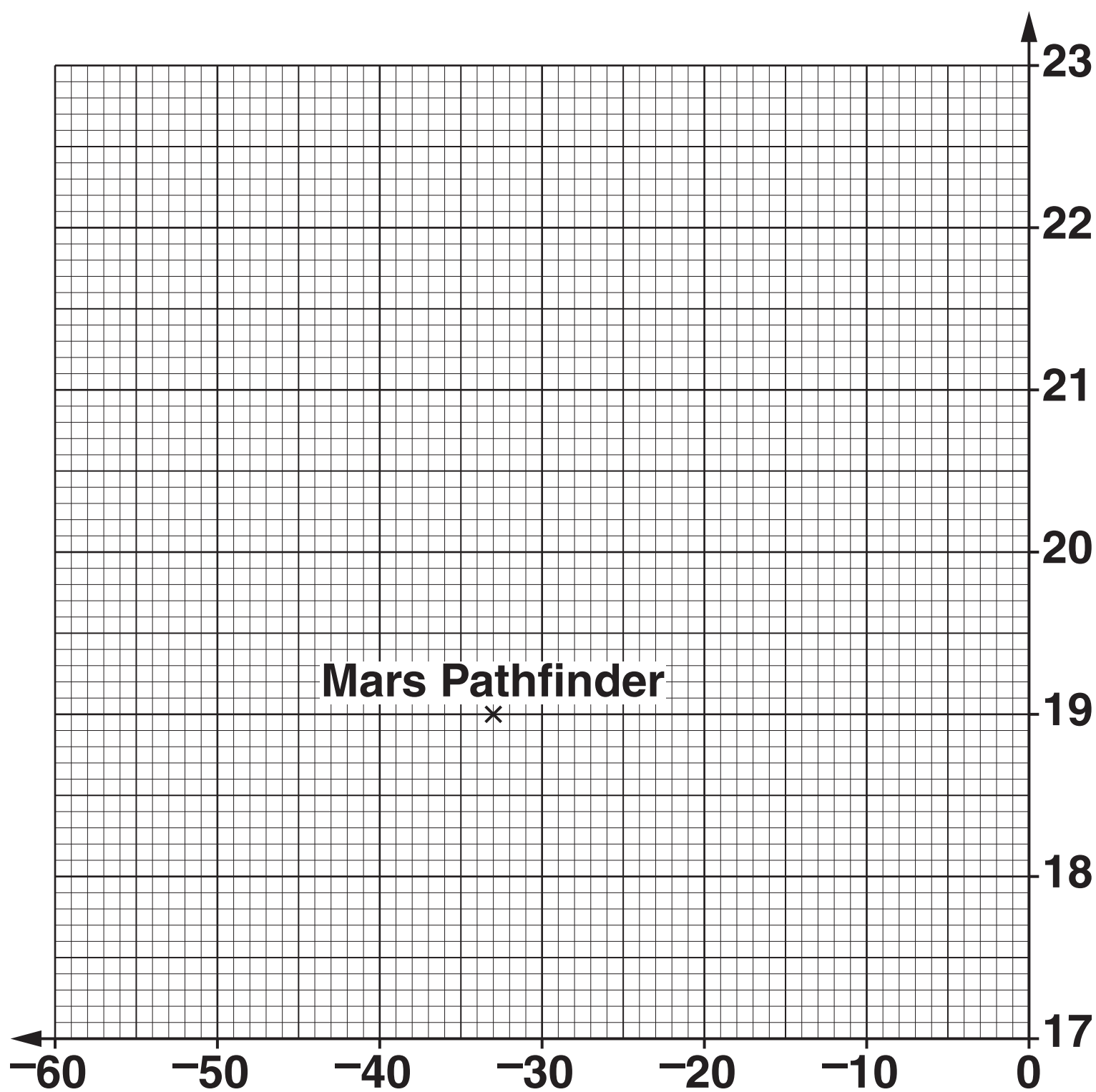
(iii) Explain how Amy arrived at this figure.

[2]

(iv) Why is she probably wrong?

[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]

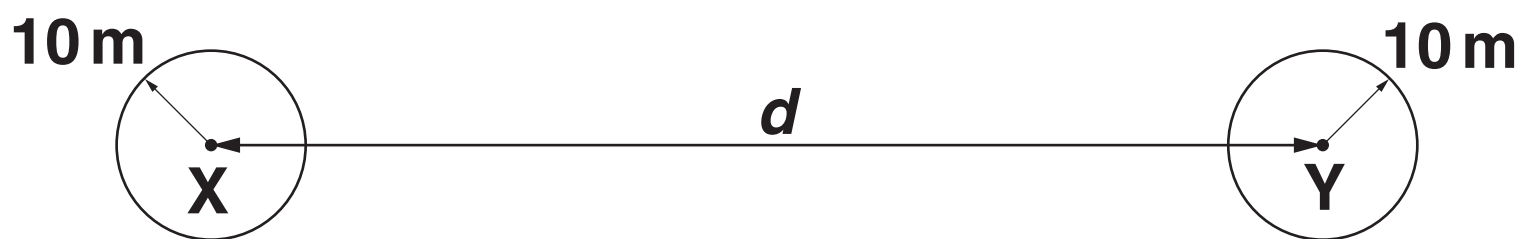
(ii) Mark clearly on the grid the position of ‘Viking 1’ which landed at $(-48, 22)$. [1]

(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 .

$d - 20 > T > d + 20$ ☐

$d - 20 \leq T \leq d + 20$ ☐

$d - 20 \geq T \geq d + 20$ ☐

$d + 20 < T > d - 20$ ☐

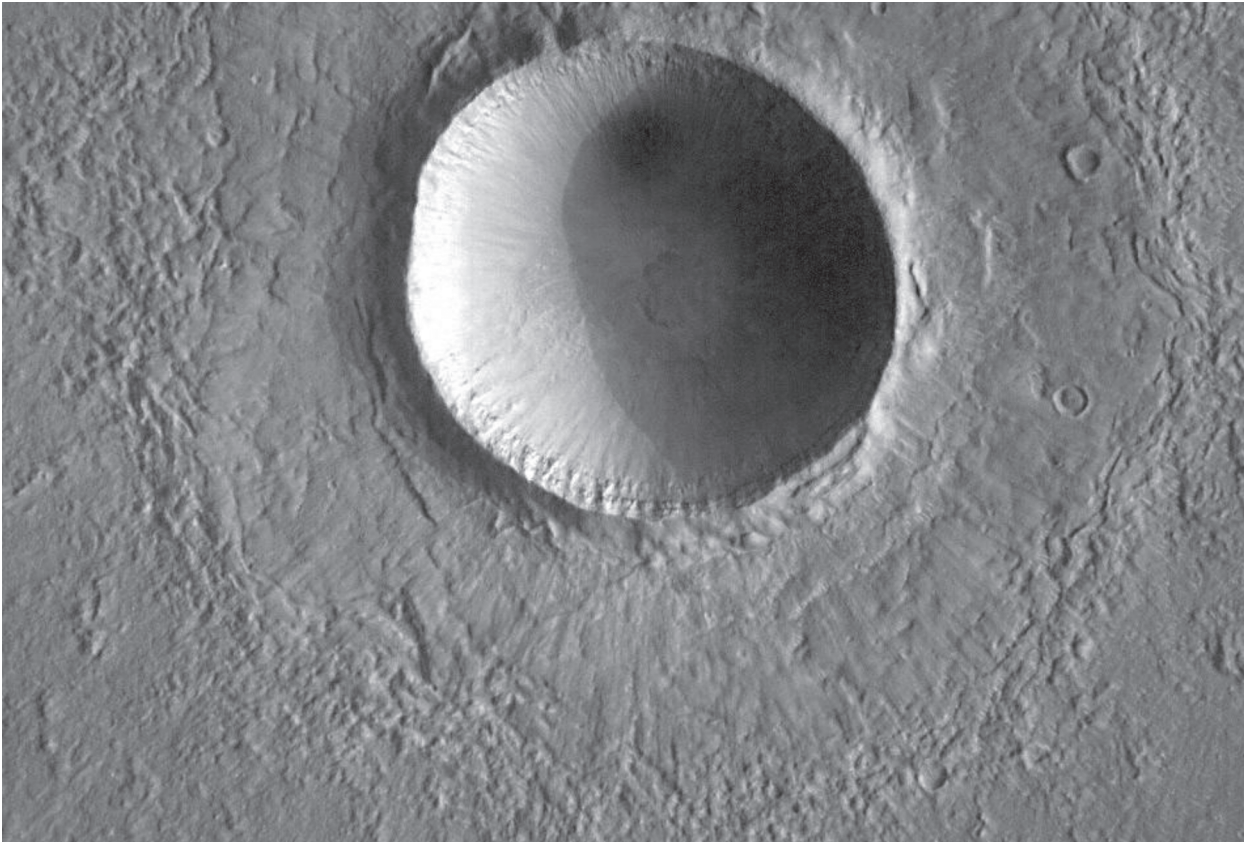
$d + 20 \geq T \geq d - 20$ ☐

$d + 20 > T < d - 20$ ☐

[2]

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

1 centimetre represents 200 metres



(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?

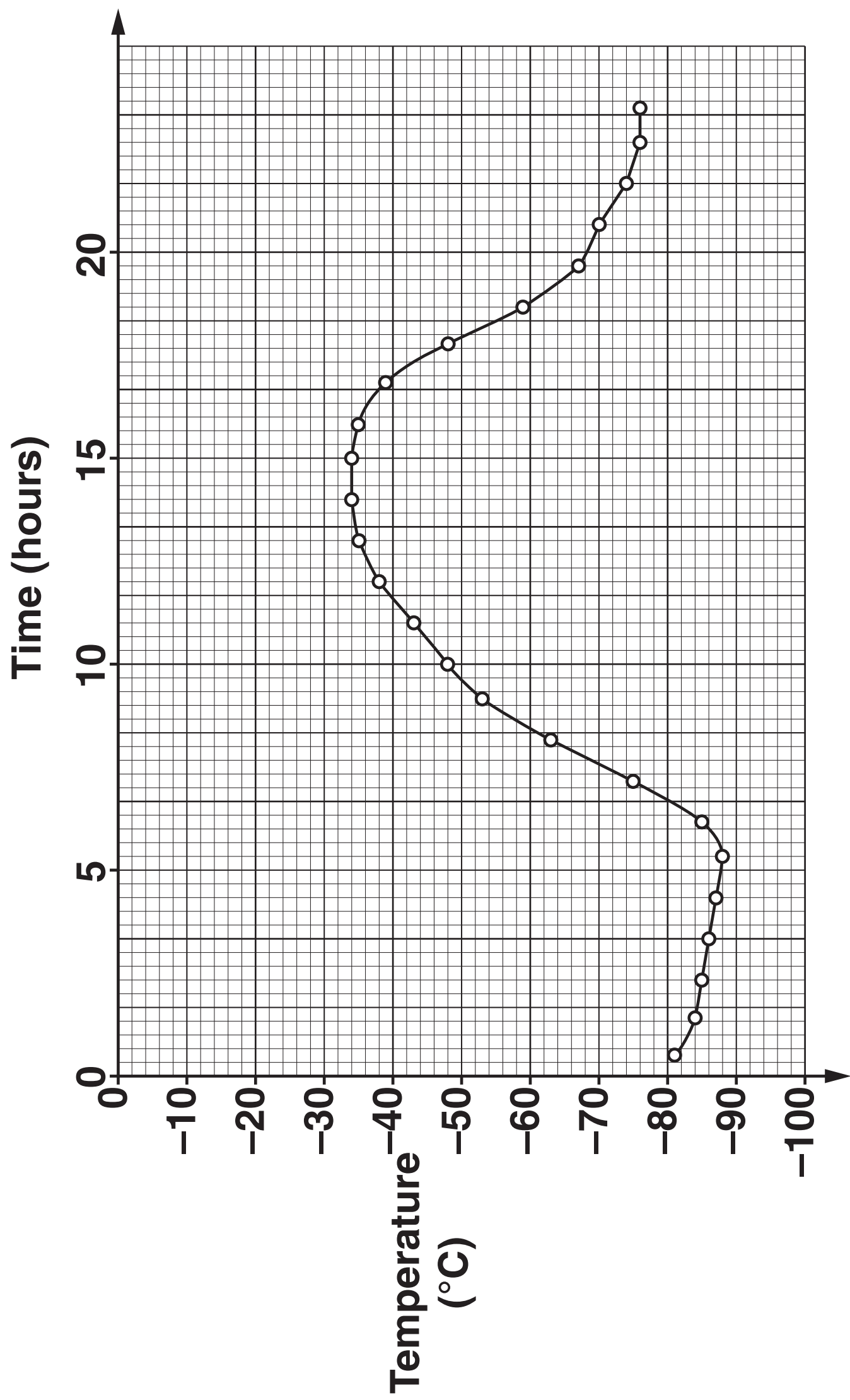
(ii) _____ °C [1]

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The graph opposite 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.

[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) A 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]

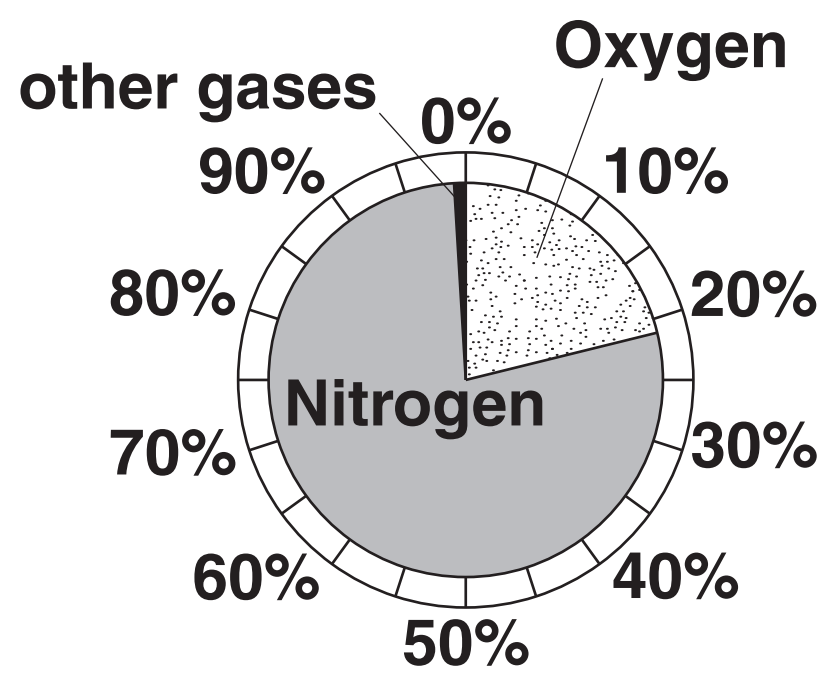
- (ii) An Earth day has 1440 minutes.
How many Earth minutes is 1 sol?**

(ii) _____ minutes [1]

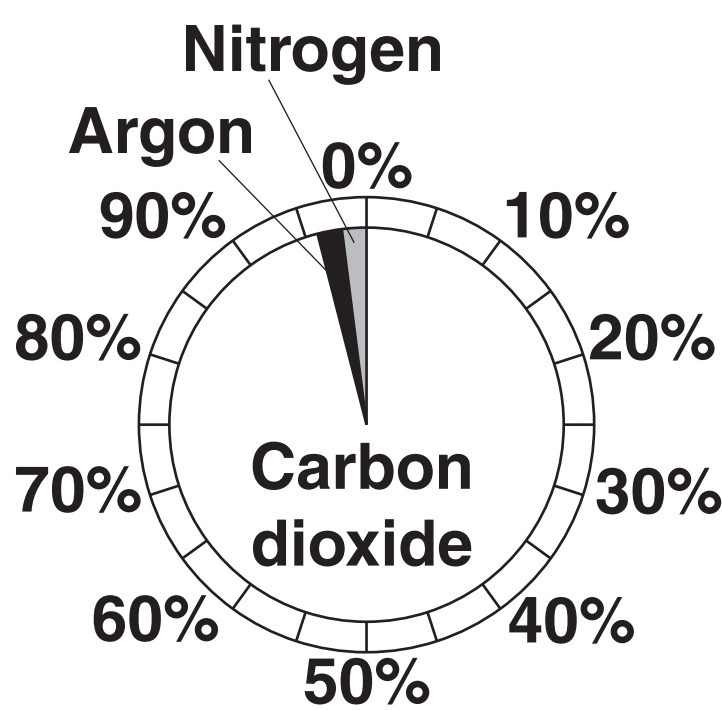
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Mars has a different proportion of gases in its atmosphere compared with Earth. These two pie charts show the proportion of the main gases in each atmosphere.

Gases in the Earth’s atmosphere



Gases in the atmosphere of Mars



Less than 1% other gases

(j) Complete the sentences.

(i) The most common gas in the atmosphere of

Mars is _____ .

It makes up roughly _____ % of the atmosphere.

[2]

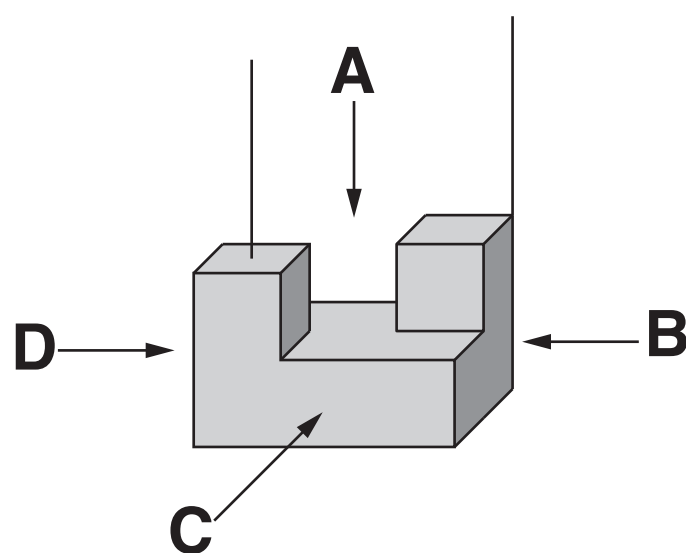
(ii) Nitrogen is present on Earth and on Mars.

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

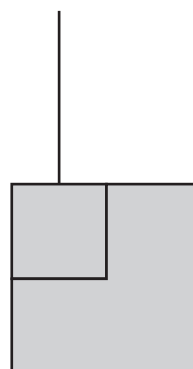
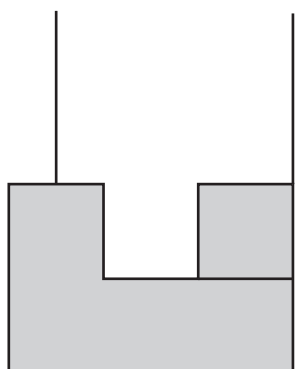
On Mars it makes up roughly _____ % of the atmosphere.

[2]

**(k) This is a model of a rover vehicle's radio module.
You may use the model provided to help you.**



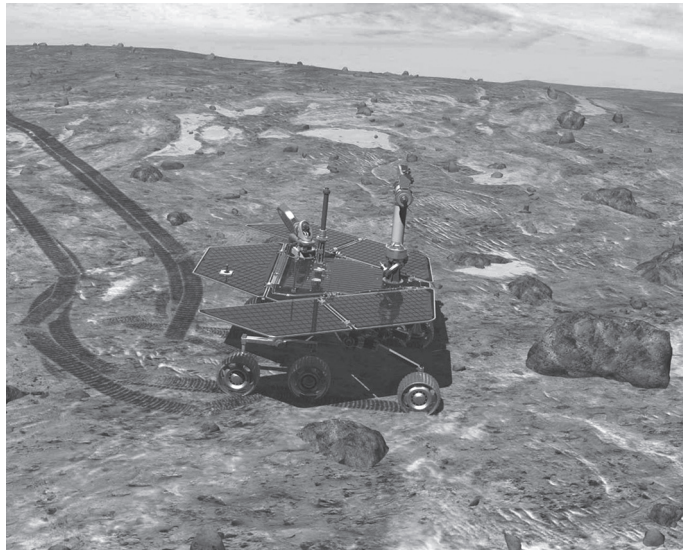
Choose the direction letter for each of these views.



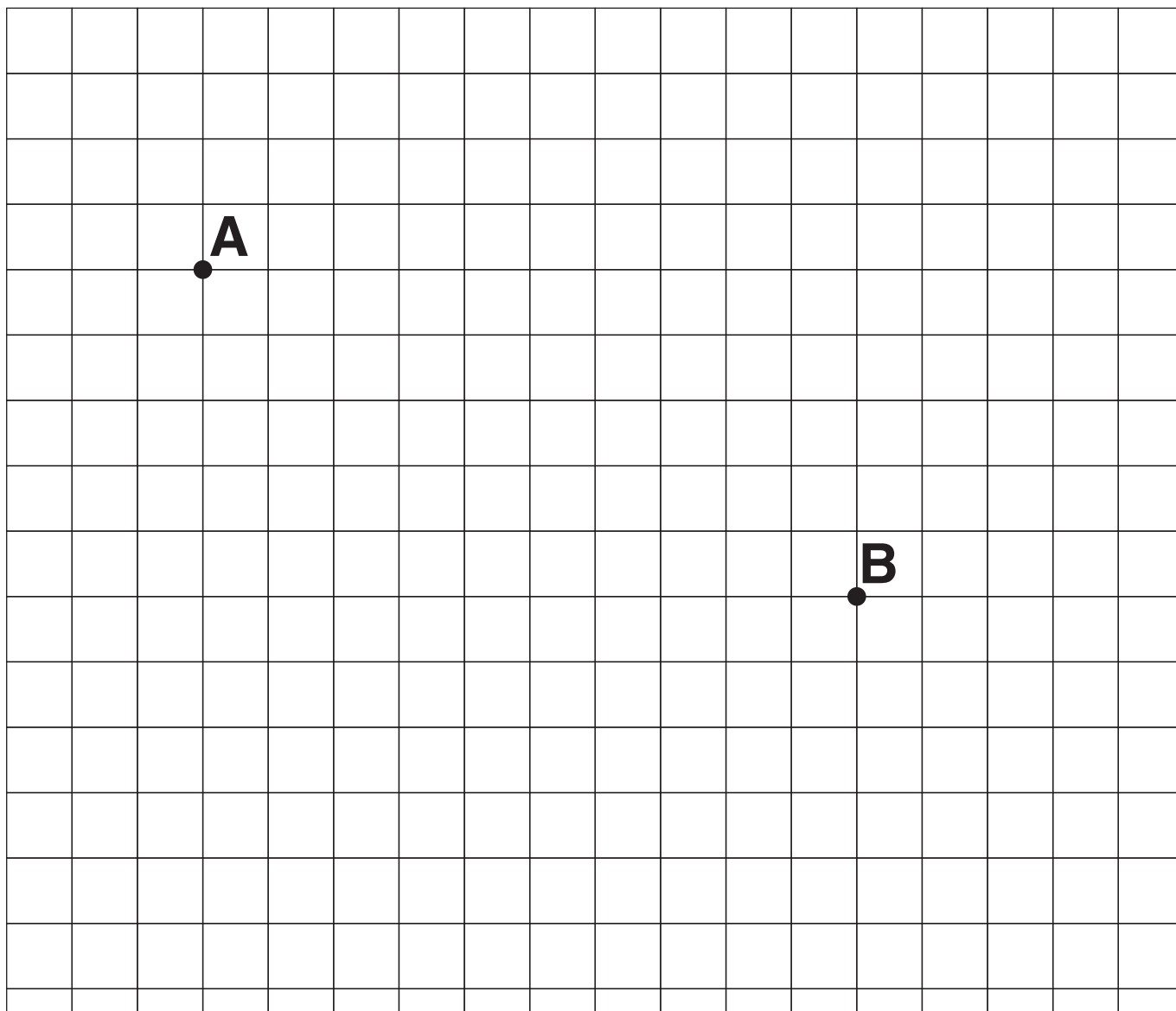
[2]

(I) 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.**



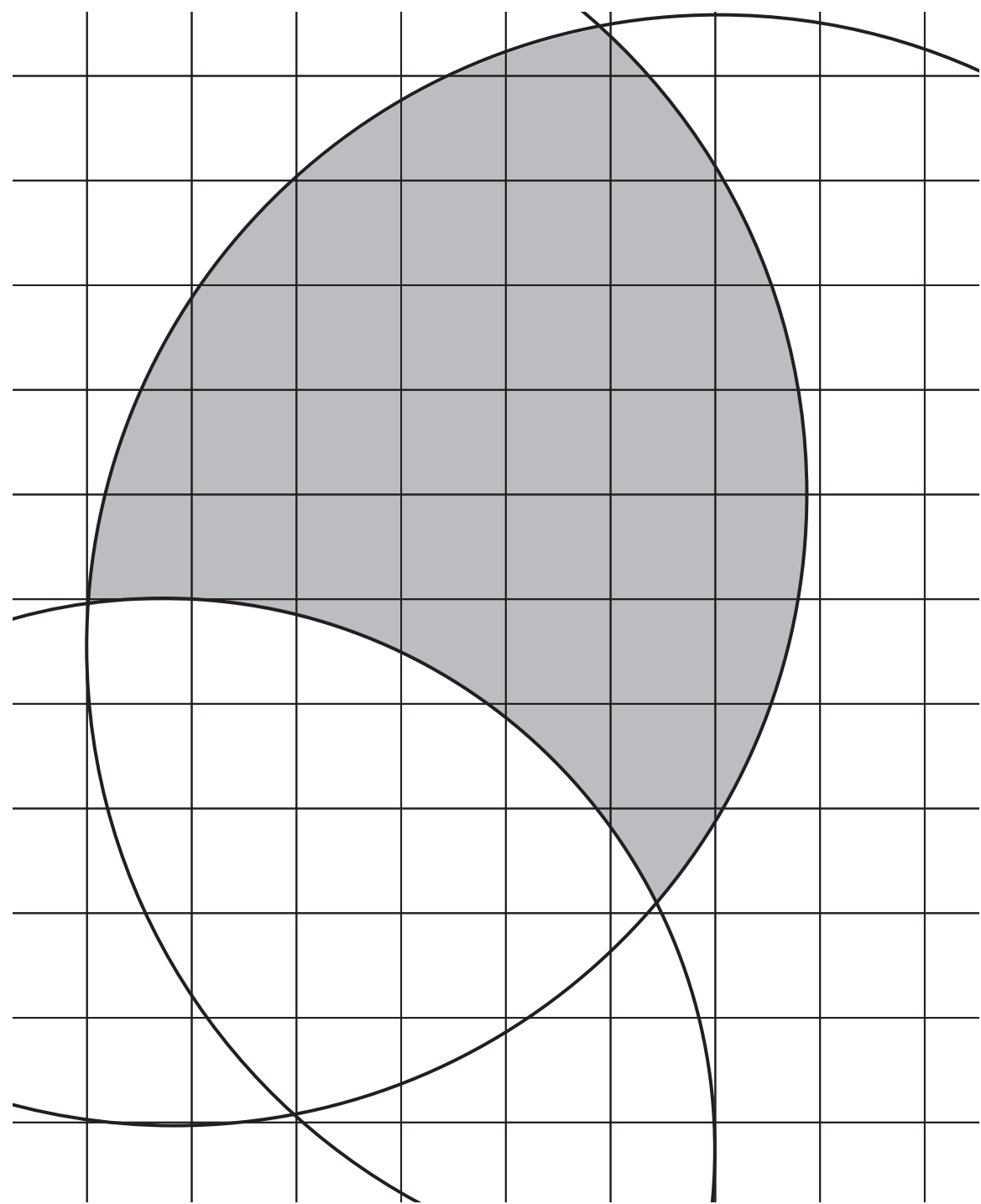
**Shade the region which the rover vehicle can explore.
Use a scale of 1 cm to represent 100 m.
Leave in any construction lines or arcs you need to draw.**



[3]

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

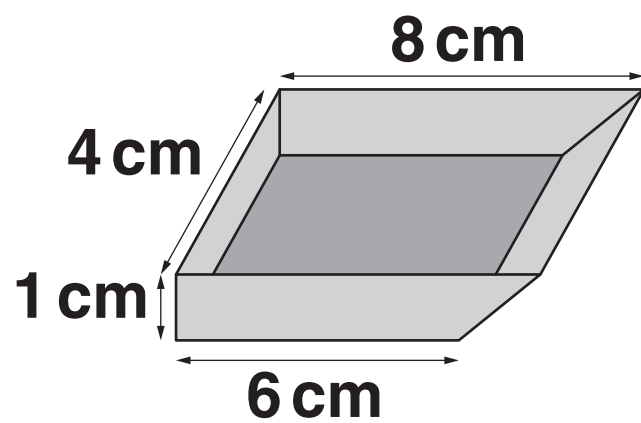
Estimate the area to be explored.
Each square has an area of 100m^2 .
Show clearly how you arrived at your answer.



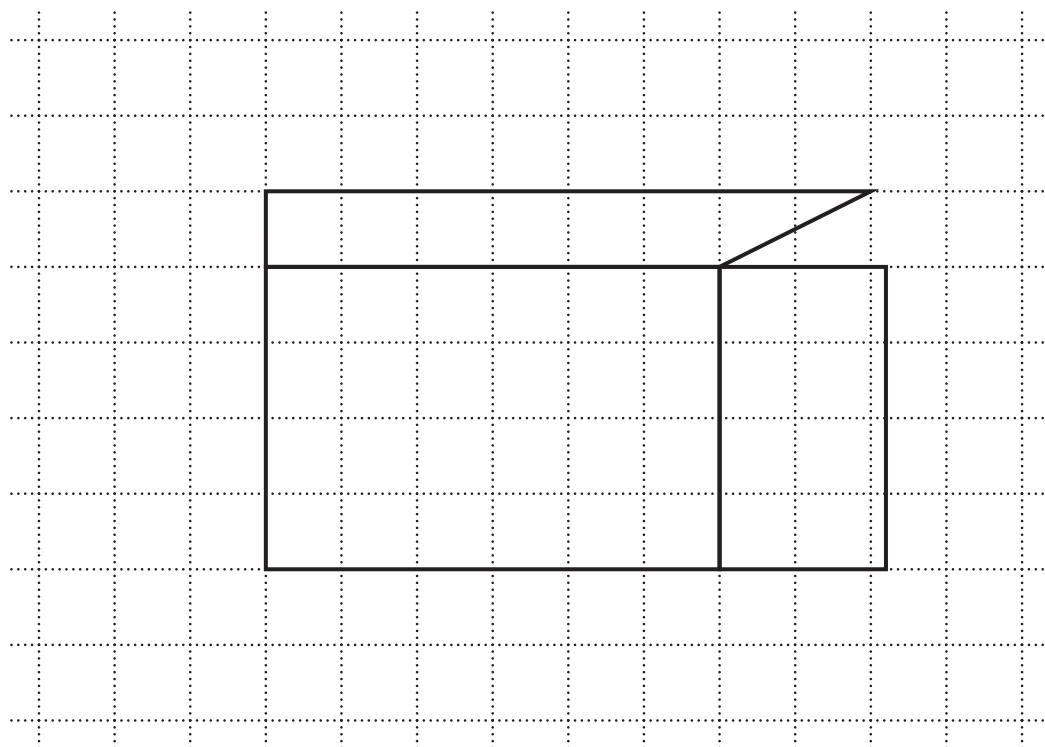
(ii) _____ m^2 [3]

(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.**

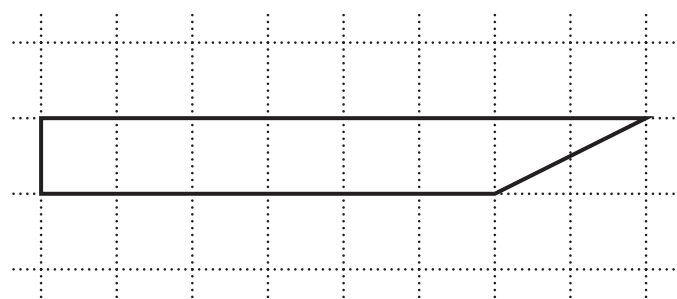


**(i) Complete this net of the scoop.
(Remember it has an open top.)**



[3]

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



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

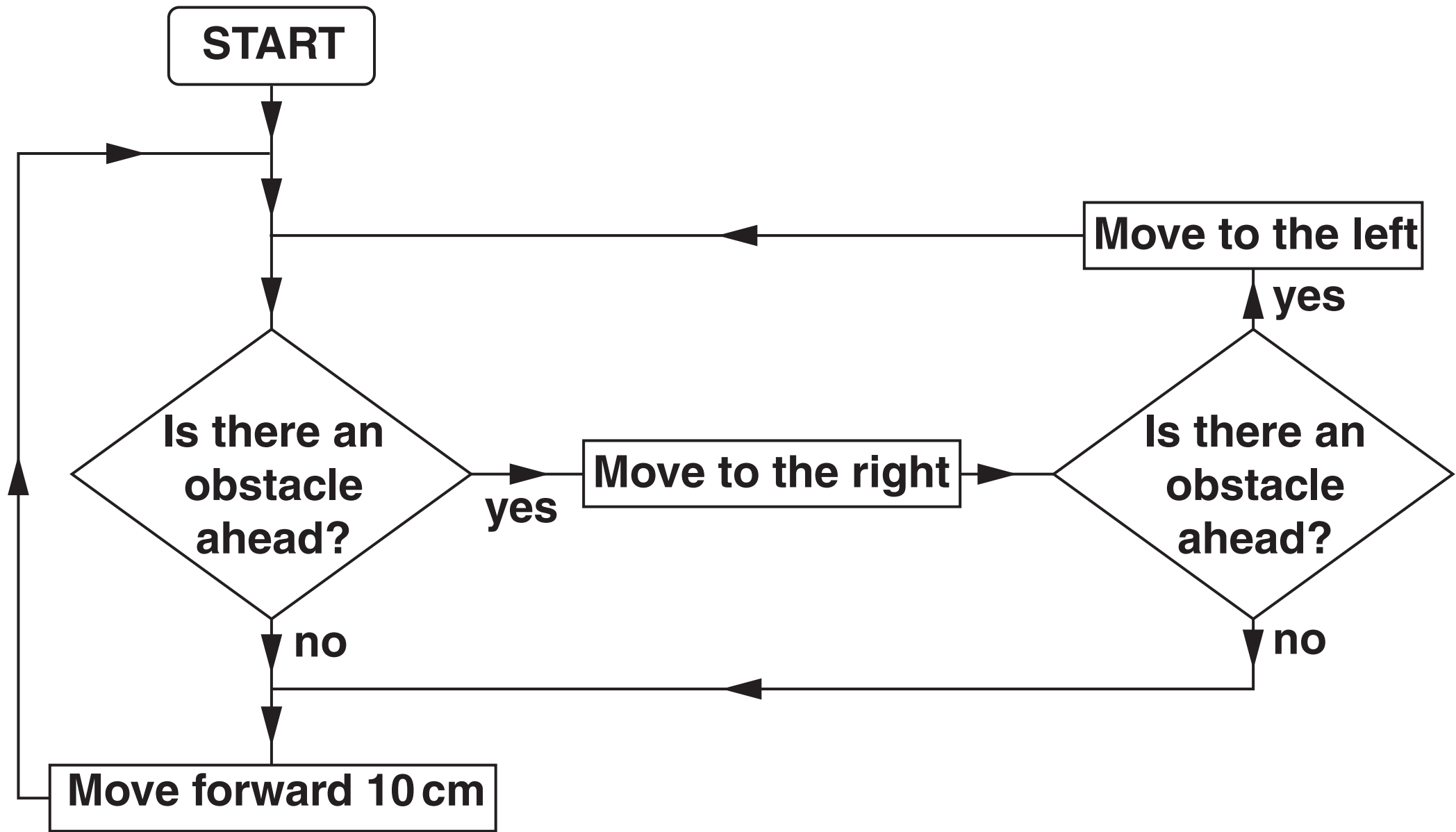
(ii) _____ cm^2 [1]

(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]

END OF QUESTION PAPER

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