OCR
Oxford Cambridge and RSA

Wednesday 07 October 2020 – Afternoon

Level 3 Certificate Core Maths A (MEI)

H868/01 Introduction to Quantitative Reasoning

Time allowed: 2 hours

You must have:
- the Insert (inside this document)

You can use:
- a scientific or graphical calculator

Please write clearly in black ink. **Do not write in the barcodes.**

Centre number | | | | | | Candidate number | | | | |

First name(s) _____

Last name _____

INSTRUCTIONS
- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided. If you need extra space use the lined pages at the end of this booklet. The question numbers must be clearly shown.
- Answer **all** the questions.
- Where appropriate, your answer should be supported with working.
- Give your final answers to a degree of accuracy that is appropriate to the context.

INFORMATION
- The total mark for this paper is **72**.
- The marks for each question are shown in brackets **[ ]**.
- This document has **24** pages.

ADVICE
- Read each question carefully before you start your answer.

Answer **all** the questions.

1 There is a simple method to estimate the age of a hedge. It is called Hooper's rule.

The age of the hedge is estimated using the formula

$$\text{Age} = 100n + 30$$

where n is the number of different species of trees and shrubs in a 30 m stretch of hedge.

A field is thought to be the site of the battle of Fulford in 1066.
It is surrounded by a hedge.

These are the numbers of different species of trees and shrubs found in 30 m stretches of the hedge.
The numbers have been put in order.

3	4	5	5	5	6	6	6
6	6	7	7	7	7	8	10

(i) Find the median and the inter-quartile range of these numbers. **[4]**

1 (i)	**Median**
	Inter-quartile range

(ii) It has been suggested that the hedge was there in 1066.
State, with reasons, whether the evidence supports this idea. **[4]**

1 (ii)	

(iii) Hooper's rule is sometimes simplified to:
'The age of a hedge in centuries is the number of species of shrubs and trees in a 30 metre stretch.'

Describe briefly, with the aid of a supporting example, the effect this simplified form of Hooper's rule has on an estimate of a hedge's age. **[2]**

1 (iii)	

2 The graph in Fig. 2.1 shows the height of a corn plant (cm) plotted against the number of weeks after planting.

(i) Join the points to make a smooth curve. **[1]**

2 (i) & (v)

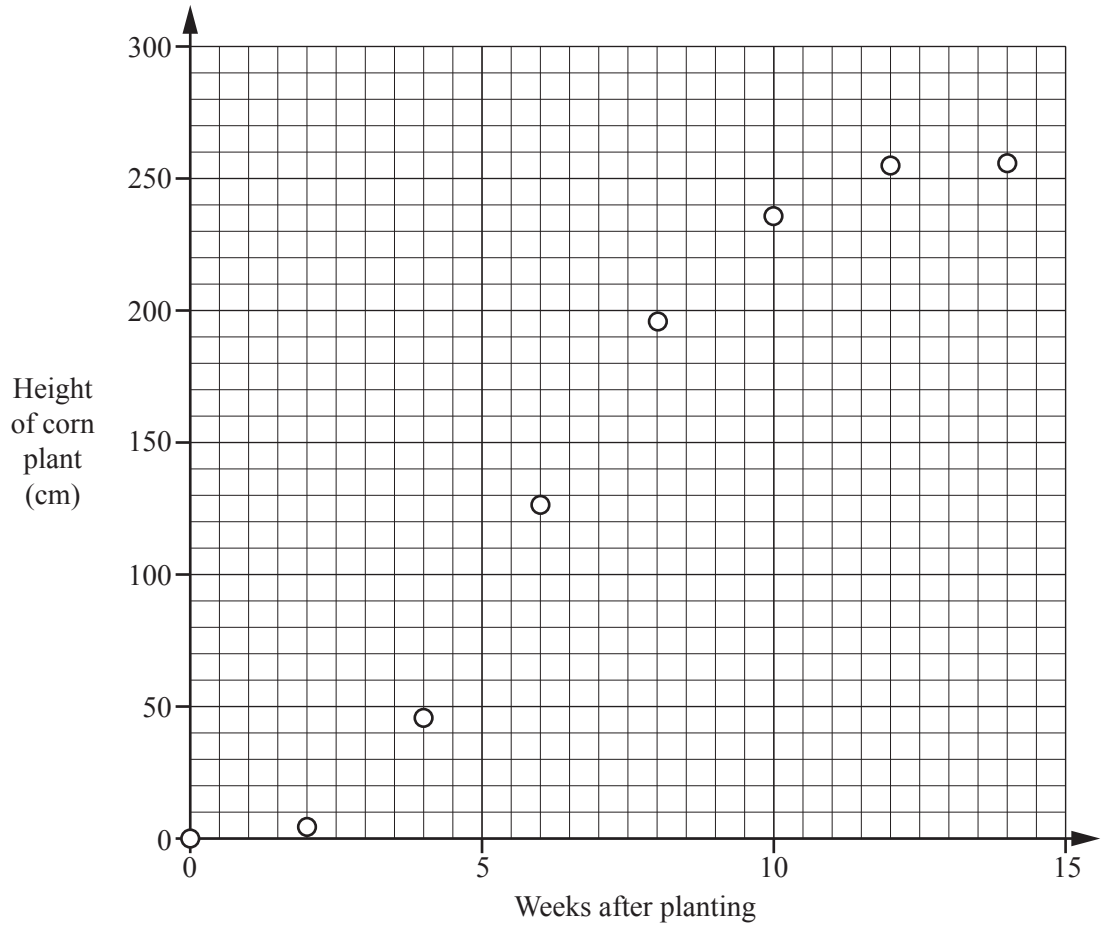


Fig. 2.1

(ii) Estimate the number of weeks after planting when the plant stops growing. **[1]**

2 (ii)	

(iii) After how many weeks has the plant reached half its maximum height? **[1]**

2 (iii)	

(iv) Use the graph in Fig. 2.1 to describe how the rate of growth of the plant changes from planting to 14 weeks after planting. **[3]**

2 (iv)

(v) Draw a suitable line on your graph in Fig. 2.1 and use it to estimate the rate of growth of the plant 10 weeks after planting, stating the units of your answer.
Show your working. **[3]**

2 (v)

3 Amber needs to borrow £2500 towards a new car. She finds these four deals.

Deal 1 One-year loan costing 14.5%; loan and interest repaid at the end of one year.

Deal 2 Loan with repayments of £60 per month for 5 years.

Deal 3 Loan with 24 monthly repayments of £119.59.

Deal 4 1% per month compounded interest loan; loan and interest repaid at the end of one year.

(i) Calculate the total amount of interest Amber would have to pay in each of the deals. **[8]**

3 (i)	**Deal 1**
	Total interest = £ …….
	Deal 2
	Total interest = £ …….

3 (i)	**Deal 3**
	Total interest = £ …….
	Deal 4
	Total interest = £ …….

(ii) Choose one of the deals to recommend to Amber.
State one reason why she might think this is the best option for herself and one reason against it. **[2]**

3 (ii)	**Deal to recommend**
	Amber's reason for
	Amber's reason against

4 This question refers to the article 'A Measuring happiness'. This was given out as pre-release material and is available as an insert.

(i) The **misery index** is the sum of the **percentage unemployment rate** and the **percentage inflation rate**.

(*A*) In 2017 Mexico had an unemployment rate of 3.4% and an inflation rate of 4.1%.

What was the misery index for Mexico in 2017? **[1]**

4 (i) (*A*)	

(*B*) In 2018 the UK misery index was 6.0.
The rate of inflation was 1.9%.

What was the unemployment rate in 2018? **[2]**

4 (i) (*B*)	

(ii) The scatter diagram in Fig. 4.1 shows the happiness index and misery index for a random selection of countries in 2018.

(*A*) Mark with a cross a new point for the Dominican Republic, which had a happiness index of 5.3 and a misery index of 23. **[1]**

4 (ii) (*A*)

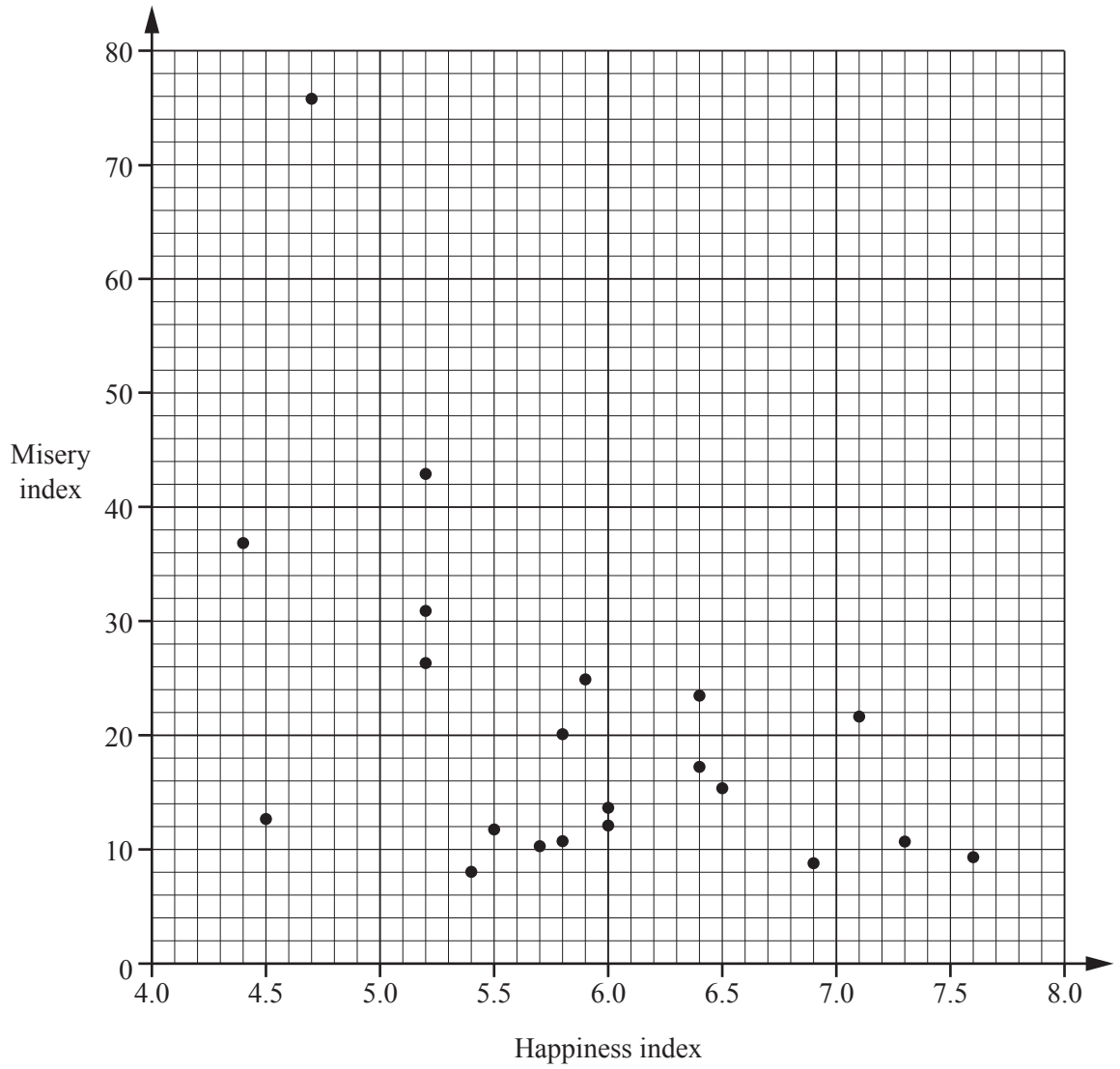


Fig. 4.1

(*B*) Use mathematical language to describe the correlation shown by the scatter diagram in Fig. 4.1. **[1]**

4 (ii) (*B*)	

(iii) Fig. 4.2 shows the happiness levels of people in the UK from 2012 to 2017.

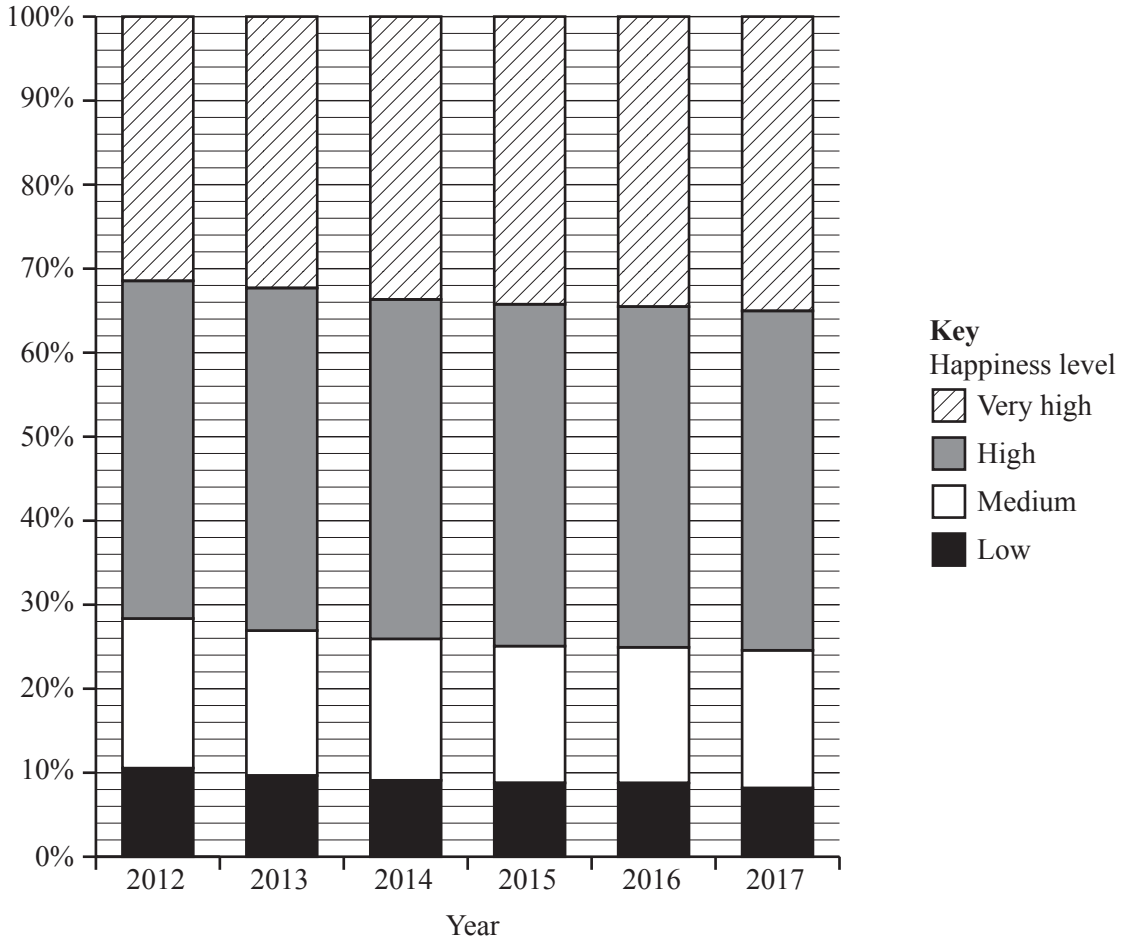


Fig. 4.2

(*A*) What percentage of people in the UK in 2015 had a very high happiness level? **[1]**

4 (iii) (*A*)	

(*B*) The sample size each year was 150 000. Find approximately how many people in the sample had medium happiness levels in 2017. **[3]**

4 (iii) (*B*)	

(iv) A government wants to survey the well-being of its citizens by telephone.

- 10 000 people have agreed to take part in the survey.
- The well-being telephone survey takes about 3 minutes to administer.
- Each interviewer can conduct telephone interviews for a total of 30 hours a week.
- The government wants to complete the telephone survey in a week.

Estimate how many people are needed to administer the survey in one week. **[4]**

4 (iv)	

(v) The spreadsheet in Fig. 4.3 shows the number of times particular words were used in a 1960s pop song (*Runaway* by Del Shannon) and the valence values of these words.
It also shows various calculations based on these figures.

	A	B	C	D
1	**Word**	**Valence of word (*V*)**	**Number of times word used (*n*)**	***V* × *n***
2	Wonder	6.03	7	42.21
3	Love	8.72	2	17.44
4	Strong	7.11	2	14.22
5	Heart	7.39	1	7.39
6	Young	6.89	1	6.89
7	Rain	5.08	2	10.16
8	Pain	2.13	2	4.26
9	Misery	1.93	2	3.86
10				
11	**Totals**	**45.28**	**19**	**106.43**

Fig. 4.3

(*A*) Use this sample to calculate the mean valence of the lyrics of *Runaway*. **[2]**

4 (v) (*A*)	

(*B*) Write down the **formula** that should be in cell D9. **[1]**

4 (v) (*B*)	

5 This question refers to the article 'B Glaciers and icebergs '. This was given out as pre-release material and is available as an insert.

(i) Fig. 5.1 shows the initial position of a trundle wheel resting on the Mont Blanc glacier.

Fig. 5.2 shows the situation 27 hours later. The wheel has rotated through 129°.

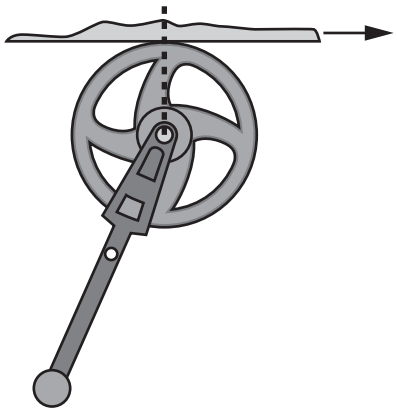


Fig. 5.1

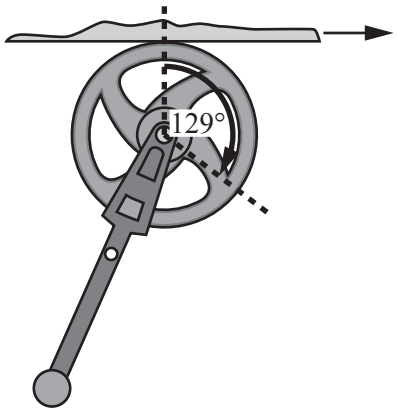


Fig. 5.2

The diameter of this trundle wheel is 60 cm.

Calculate the speed of the Mont Blanc glacier.
Give your answer in centimetres per second. **[5]**

5 (i)	

(ii) Fig. 5.3 is a plan of two icebergs.

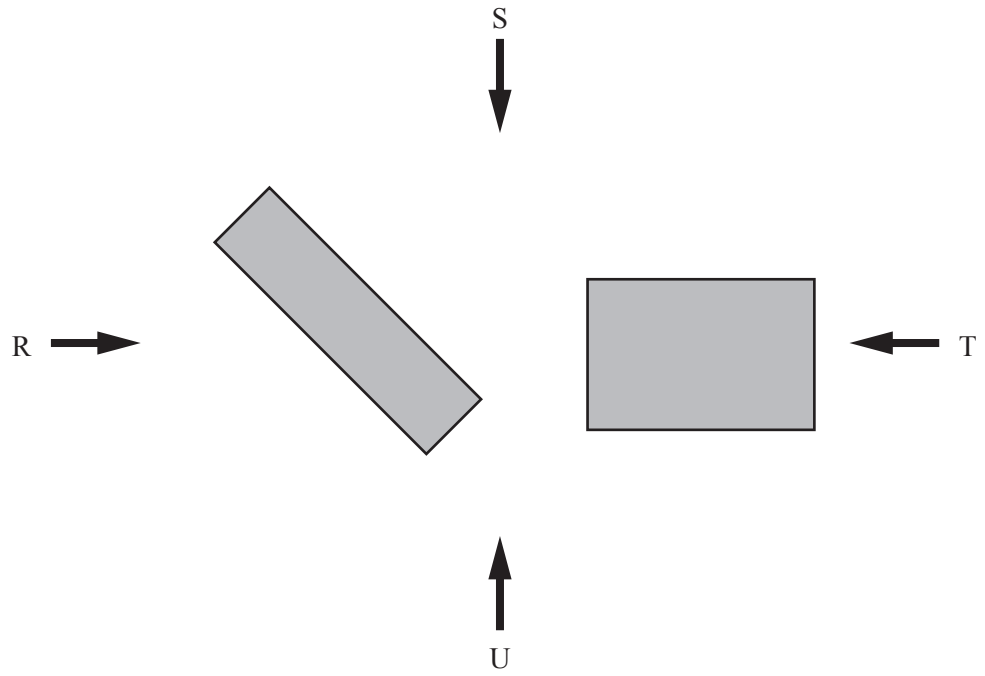
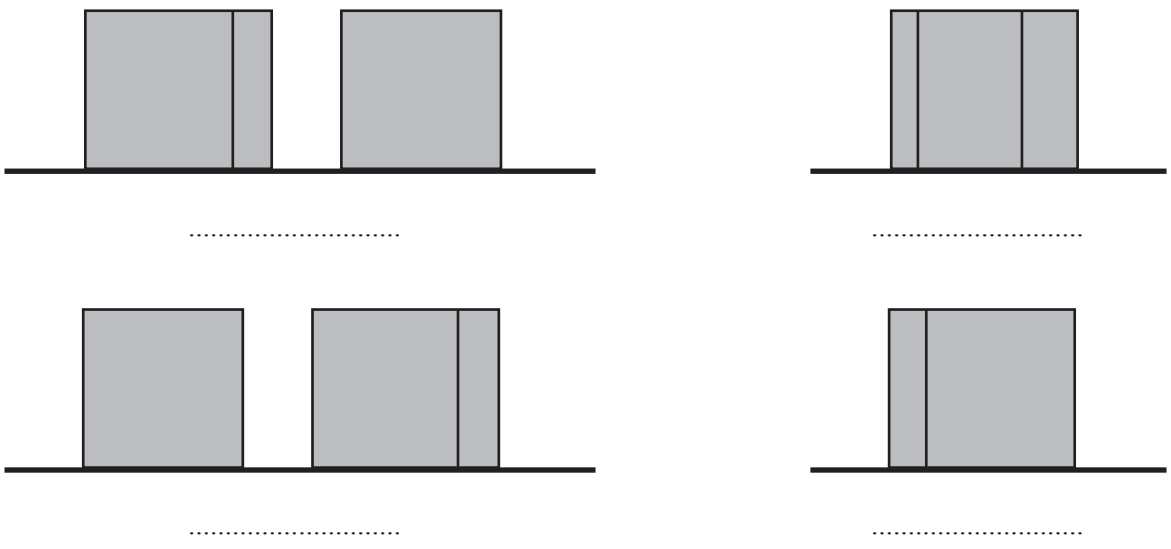


Fig. 5.3

In Fig. 5.4 there are four sketches showing side views looking along the directions R, S, T and U. Put the correct direction (R, S, T or U) under each view. **[2]**

5 (ii)



....

....

Fig. 5.4

(iii) The temperature on the surface of an iceberg is −2 °C.
The temperature of the ice falls by 1 °C for each metre down into the iceberg, until it becomes constant at −18 °C.

(*A*) Use the grid in Fig. 5.5 to show this information on a graph of temperature against depth into the iceberg. Complete the graph to a depth of 20 m. **[2]**

5 (iii) (*A*)

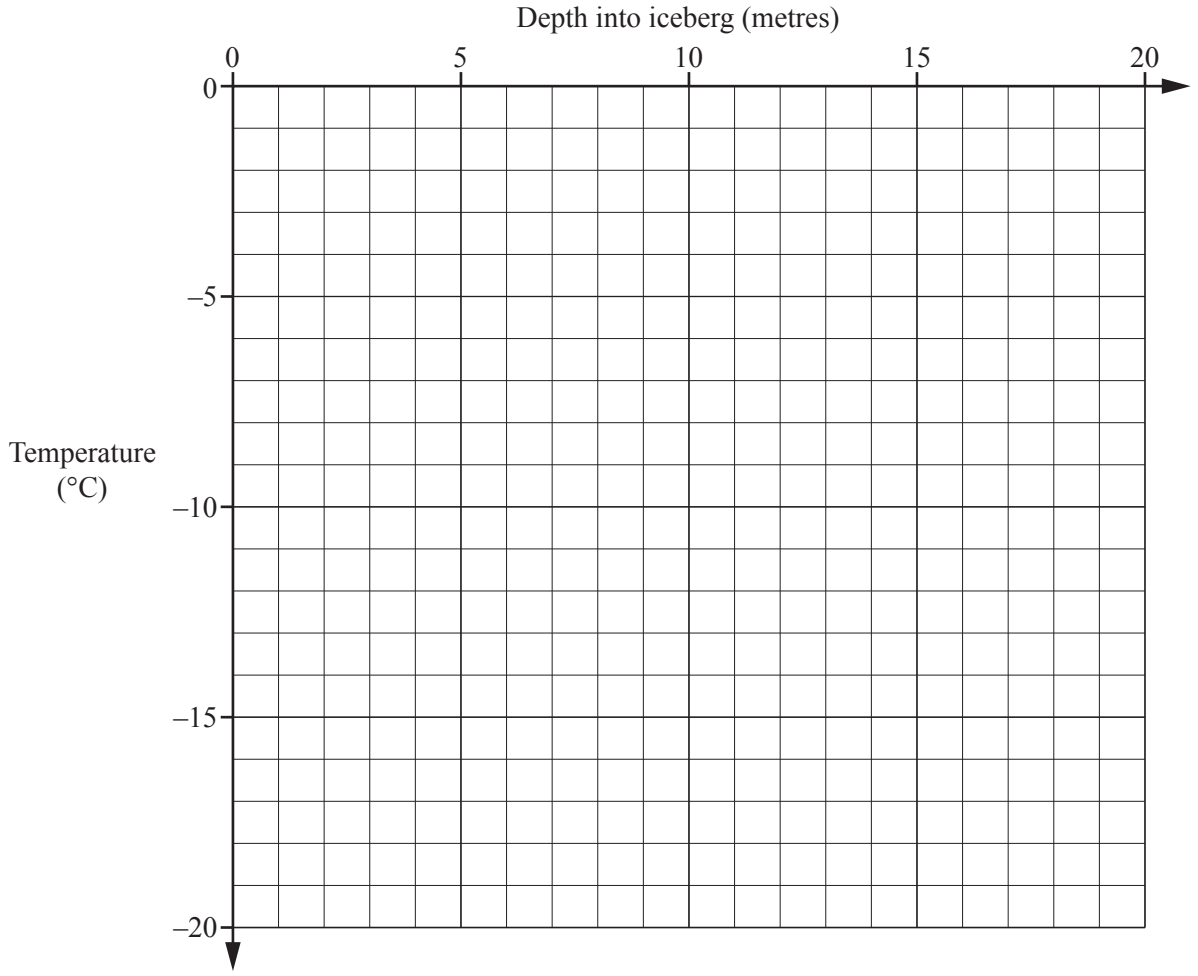


Fig. 5.5

(*B*) At what depth into the iceberg is the temperature −9 °C? **[1]**

5 (iii) (*B*)	

(iv) Engineers have calculated that the ideal shape for an iceberg to be towed is a cuboid measuring 1.5 km long by 0.35 km wide and 0.25 km high.

(*A*) Calculate, in cubic kilometres, the volume of such an iceberg. **[2]**

5 (iv) (*A*)	

(*B*) Calculations show that 0.006 km^3 of melted ice will give a day's supply of water for 1 million people.

Calculate the number of **complete** days' water supply the above iceberg would provide for 1 million people. **[2]**

5 (iv) (*B*)	

(*C*) Perth, in Western Australia, is short of fresh water.
Towing an iceberg from Antarctica to Perth is calculated to take 12 weeks.
During this time it is estimated that the proportion of iceberg remaining after n weeks will be 0.95^n.

Will more than half the original iceberg survive the journey from Antarctica to Perth? **[2]**

5 (iv) (*C*)	

6 (i) (*A*) A system is made from four components P, Q, R and S, as shown in Fig. 6.1.

Each component on its own has the same probability of failing after a year of use.

Fig. 6.1

Complete this list of the different ways two components could fail. **[1]**

6 (i) (*A*)	PQ PR PS
	QR

(*B*) Two of the four components fail.

What is the probability they are P and Q? **[1]**

6 (i) (*B*)	

(*C*) What assumption have you made in answering part **(*B*)**? **[1]**

6 (i) (*C*)	

(ii) The reliability of a component can be measured by the probability of it still working after a particular length of time.

Fig. 6.2 shows how the reliability of a certain component varies with time.
So after 5 years the reliability (probability of working) of the component is about 0.994.

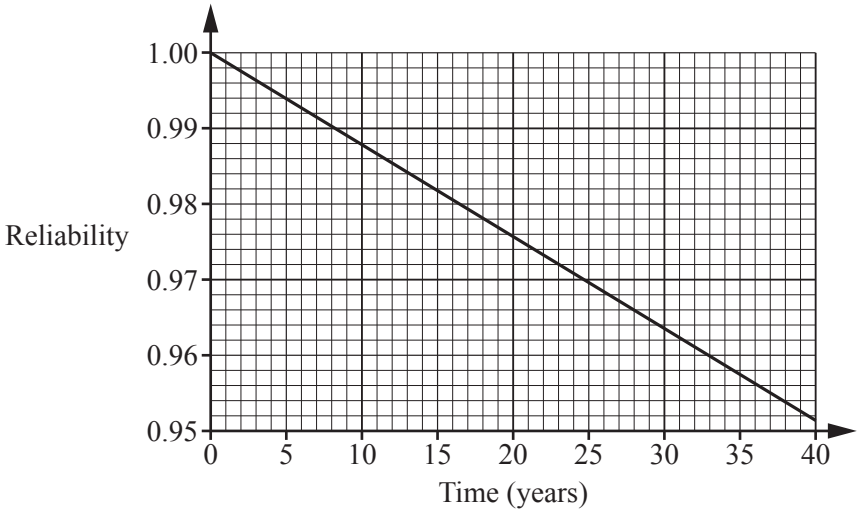


Fig. 6.2

(*A*) After how many years is the reliability 0.956? **[1]**

6 (ii) (*A*)	

(*B*) What is the probability that the component is still working after 10 years? **[1]**

6 (ii) (*B*)	

(iii) (*A*) A spacecraft's guidance system is made from two components.
Each component has a probability of 0.95 of working after 25 years.
Both components must work for the whole system to work.
Components fail independently of each other.

Fill in the missing numbers in the tree diagram in Fig. 6.3. **[2]**

6 (iii) (*A*)

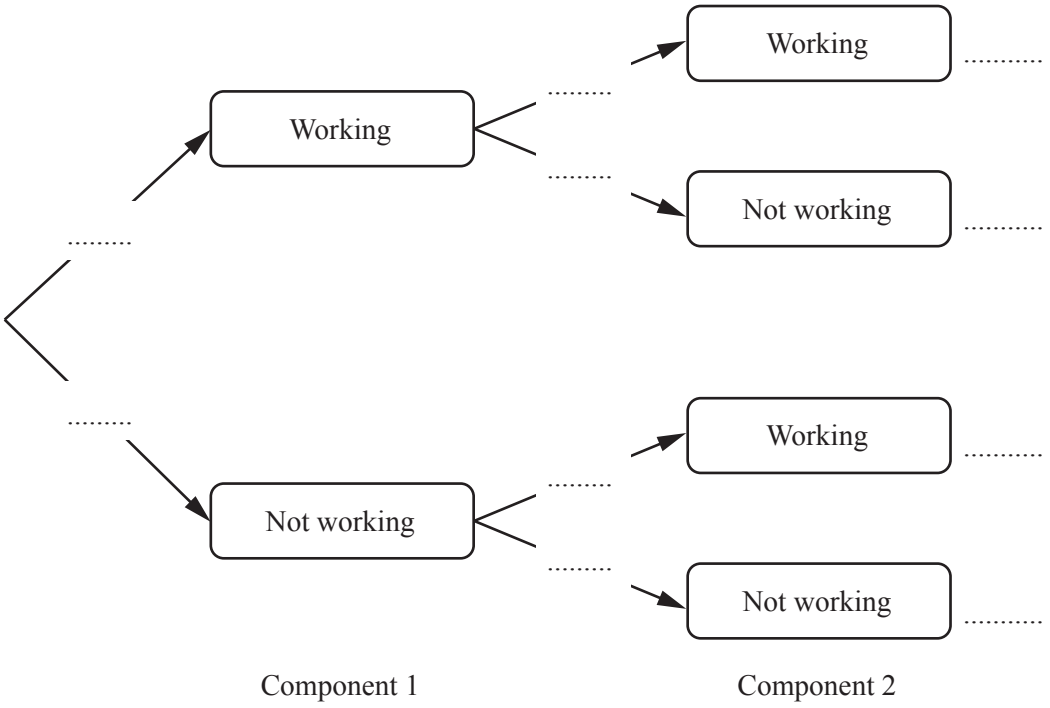


Fig. 6.3

(*B*) Using the tree diagram calculate the probability of the guidance system working after 25 years. **[1]**

6 (iii) (*B*)

(*C*) Show that if the system is adjusted so that it will work with only one component working then the probability of it working after 25 years is greater than 99%. **[3]**

6 (iii) (*C*)	

END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).