OCR
Oxford Cambridge and RSA

# Thursday 18 May 2023 – Afternoon

## Level 3 Certificate Core Maths B (MEI)

**H869/01** Introduction to Quantitative Reasoning

**Time allowed: 2 hours**

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

**You can use:**
- a scientific or graphical calculator

* H 8 6 9 0 1 *

* 9 9 2 1 9 9 3 3 5 2 *

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. You can use extra paper if you need to, but you must clearly show your candidate number, the centre number and the question numbers.
- 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.

**1** **(a)** Anika has been given her grandfather's music collection of 31 classic 1980s vinyl records to sell. She finds the online selling price of each record. Her results are summarised in **Fig. 1.1**.

Estimate the value of the whole record collection. Show your calculations; you may find it useful to use the empty cells in **Fig. 1.1**. **[3]**

**1(a)**

**Fig. 1.1**

| Value, £$V$ | Number of records | | |
|---|---|---|---|
| $10 \leqslant V < 50$ | 15 | | |
| $50 \leqslant V < 90$ | 4 | | |
| $90 \leqslant V < 130$ | 7 | | |
| $130 \leqslant V < 170$ | 5 | | |
| Total | 31 | | |

**(b)** One of Anika's friends sold a 1980s vinyl record to a dealer.
The dealer later sold the record for £45.60.
This was a profit of 50% on what the dealer paid Anika's friend.
Anika did a calculation and said that the dealer must have paid her friend £22.80.

Check if Anika was correct. **[4]**

| | |
|---|---|
| **1(b)** | |

**(c)** Anika receives two offers from online dealers.

- UK dealer: £1850
  They will collect, so Anika will not have to pay any postage.
- Canadian dealer: 3600 Canadian dollars (CAD)
  Anika's bank will change the CAD into £s at an exchange rate of £0.5579 for 1 CAD. The bank will charge Anika a handling fee of £7.

**(i)** How much, in £s, will the 3600 CAD be worth to Anika once it is transferred into her bank account? **[2]**

| | |
|---|---|
| **1(c)(i)** | |
| | |
| | |
| | |
| | |
| | |

Anika collects some information about the cost of sending the 31 records to Canada.

- A typical vinyl record weighs 135 g.
- Each record is in a sleeve typically weighing 100 g.
- Air freight insurance costs a total of £80.
- The air freight cost of sending a box big enough for all the records is shown in this table.

| Weight (kg) up to … | 6.0 | 7.0 | 8.0 | 9.0 | 10.0 | 11.0 | 12.0 |
|---|---|---|---|---|---|---|---|
| Cost (£) | 108.35 | 112.75 | 121.55 | 130.35 | 139.35 | 145.95 | 152.75 |

**(ii)** How much will it cost, including insurance, to air freight the 31 records to Canada? **[4]**

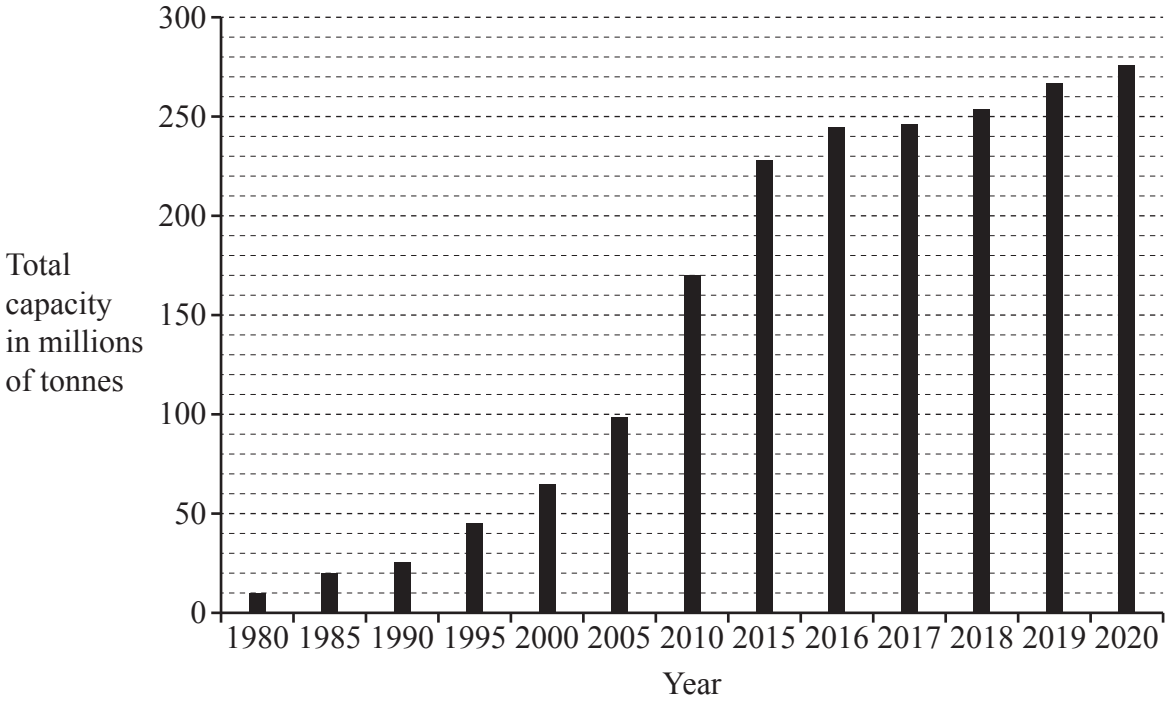
**(iii)** Which is the better deal for Anika, the UK or the Canadian dealer?
Justify your decision. **[2]**

| | |
|---|---|
| **1(c)(ii)** | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| **1(c)(iii)** | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |

**2 This question refers to article A in the pre-release material, 'Containers'. You can find the article on the insert accompanying this paper.**

**(a)** A TV programme shows a vertical line chart in **Fig. 2.1** for total global container capacity for 1980 to 2020. It is misleading.

**Fig. 2.1**




The chart in **Fig. 2.1** is used on the TV programme to conclude that the growth of global capacity has slowed considerably since 2015.

State **one** feature of the chart which makes this a false conclusion. **[1]**

| | |
|---|---|
| **2(a)** | |

**(b)** Use the information in the box below to check this statement.

"A TEU container can hold over £12 million worth of smart phones."

Show your method and state any assumptions you might make. **[5]**

Typical relevant values are:

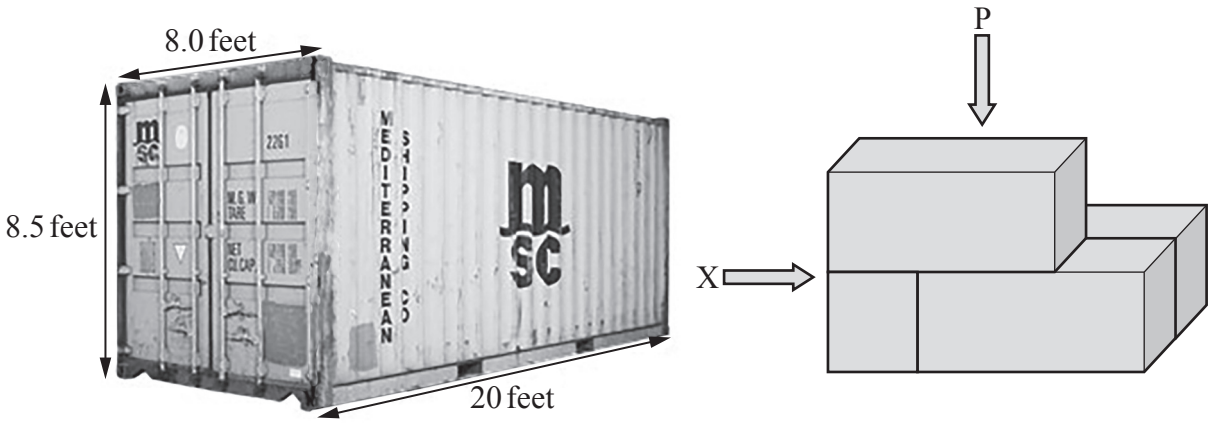
- Internal dimensions of a TEU container **in metres** are 5.9 by 2.4 by 2.3.
- The price of a new smart phone is £330.
- Each smart phone is contained in a box. The box measures, **in centimetres**, 15 by 9 by 8.

**2(b)**

**Assumptions:**

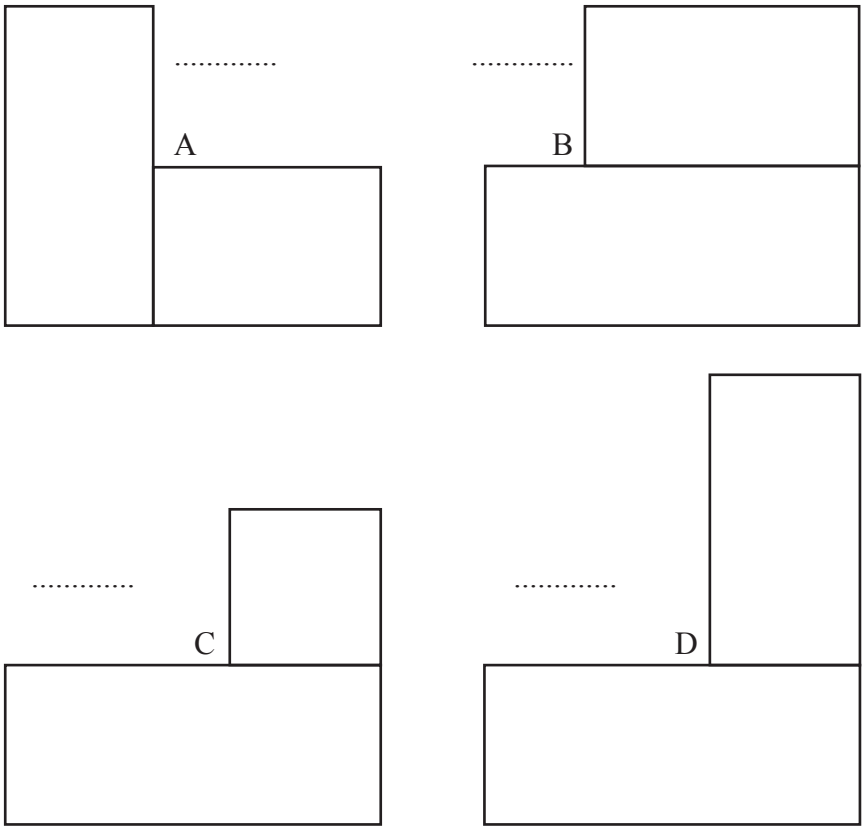
**(c)** **Fig. 2.2** shows a TEU container and a drawing of an emergency shelter made from 4 of these containers. The dimensions of each of the containers, in feet, is $20 \times 8 \times 8.5$.

**Fig. 2.2**



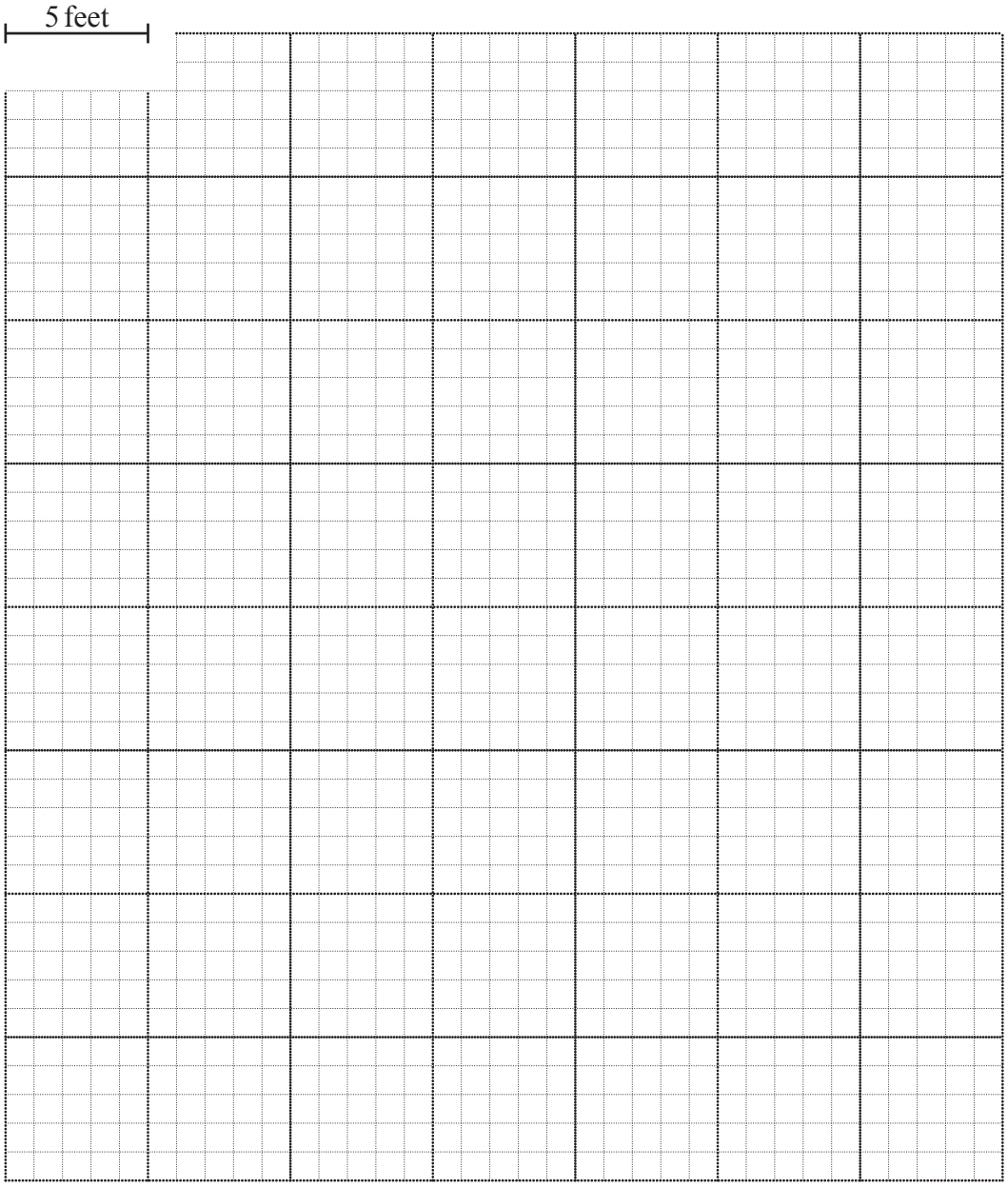

**(i)** Tick the correct view, A, B, C or D, looking sideways in the direction along X. **[1]**

**2(c)(i)**



**(ii)** Make a scale drawing of the plan (looking down, along direction P) on this grid. Remember lengths are given in feet. **[3]**

**2(c)(ii)**




**A spare grid is available on page 24 at the end of this paper.**
**If you use it, cross out your answer on this page.**

**3** Bread prices are used by historians investigating living conditions in the past.

The table shows the indexed mean bread prices in London every ten years since 1600.

- The mean price in 1600, 0.74 p in today's currency, has index value 100.
- All the indexed prices have been calculated for the equivalent of an 800 gram, uncut loaf.

| Year | Index |
|---|---|
| 1600 | 100 |
| 1610 | 104 |
| 1620 | 83 |
| 1630 | 124 |
| 1640 | 97 |
| 1650 | 236 |
| 1660 | 179 |
| 1670 | 137 |
| 1680 | 132 |
| 1690 | 117 |

| Year | Index |
|---|---|
| 1700 | 129 |
| 1710 | 228 |
| 1720 | 127 |
| 1730 | 122 |
| 1740 | 174 |
| 1750 | 117 |
| 1760 | 126 |
| 1770 | 149 |
| 1780 | 174 |
| 1790 | 166 |

| Year | Index |
|---|---|
| 1800 | 351 |
| 1810 | 328 |
| 1820 | 234 |
| 1830 | 261 |
| 1840 | 249 |
| 1850 | 169 |
| 1860 | 219 |
| 1870 | 199 |
| 1880 | 174 |
| 1890 | 149 |

| Year | Index |
|---|---|
| 1900 | 129 |
| 1910 | 147 |
| 1920 | 299 |
| 1930 | 211 |
| 1940 | 199 |
| 1950 | 311 |
| 1960 | 674 |
| 1970 | 1213 |
| 1980 | 4987 |
| 1990 | 8760 |

| Year | Index |
|---|---|
| 2000 | 9434 |
| 2010 | 16308 |
| 2020 | 14556 |

**(a)** What would have been the price of an 800 gram loaf of bread in 1700?
Give your answer in today's currency, correct to **2** sf. **[2]**

| | |
|---|---|
| **3(a)** | |
| | |
| | |
| | |

**(b)** Describe **two** important features about how the price of bread varied from 1600 to 2020. **[2]**

| | |
|---|---|
| **3(b)** | **1** |
| | |
| | |
| | **2** |
| | |
| | |

**(c)** In 1920 the typical wage in London was £4.56 per week.
In 1970 this had risen to £20.77. This was an increase of just over $4\frac{1}{2}$ times.

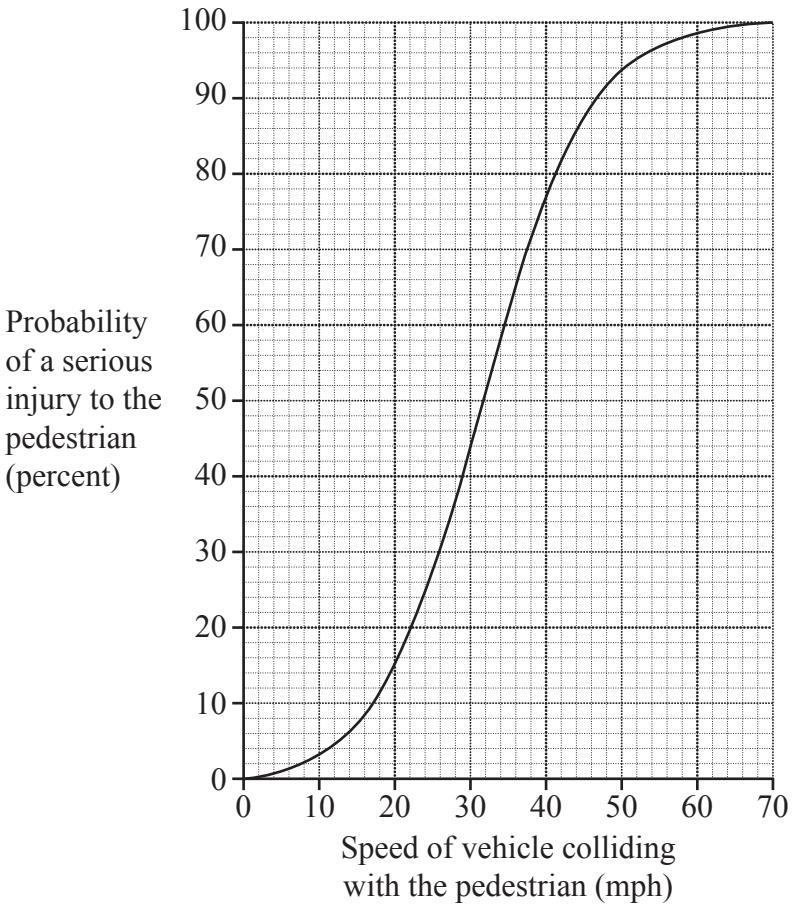
Compare this increase in wages to that of the price of bread over the same time. **[3]**

| | |
|---|---|
| **3(c)** | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |

**4 This question refers to article B in the pre-release material, "Pedestrian accidents". You can find the article on the insert accompanying this paper.**

**(a)** **Fig. 4.1** illustrates the probability of serious injury to pedestrians involved in road accidents with vehicles travelling at different speeds.

**Fig. 4.1**




**(i)** At what collision speed is the probability of a serious pedestrian injury 60%? **[1]**

| | |
|---|---|
| **4(a)(i)** | |
| | |
| | |
| | |
| | |

**(ii)** It has been suggested that in an accident in which the vehicle is travelling at 30 mph, the pedestrian is 3 times as likely to have a serious injury as in one with a vehicle speed of 20 mph.

Is this suggestion consistent with the data used for the graph in **Fig. 4.1**? **[4]**

| | |
|---|---|
| **4(a)(ii)** | |

**(b)** In Bristol, pedestrian road accident records before and after installation of 20 mph zones in seven regions were analysed. **Fig. 4.2** shows the results for one of these regions.

**(i)** Complete the cells in **Fig. 4.2** for the mean annual number of injuries after the 20 mph speed limit was imposed. **[2]**

**4(b)(i)**

**Fig. 4.2**

| Type of injury | 72 months before the 20 mph speed limit imposed | | 36 months after the 20 mph speed limit imposed | |
|---|---|---|---|---|
| | Number of injuries | Mean annual number of injuries | Number of injuries | Mean annual number of injuries |
| Serious | 243 | 40.5 | 109 | ..... |
| Slight | 1849 | 308.2 | 753 | ..... |
| Total | 2092 | 348.7 | 862 | 287.3 |

**(ii)** Data in **Fig. 4.2** show that if there was an accident **before** the 20 mph speed limit was imposed the probability that it was serious was 0.116 correct to 3 dp.

Show that the corresponding probability was 0.126 **after** the 20 mph speed limit was imposed. **[2]**

**4(b)(ii)**

**(iii)** Make **one** comparison, supported by numbers, for pedestrian accidents before and after the installation of the 20 mph speed zones. **[1]**

**4(b)(iii)**

**5 This question refers to article C in the pre-release material, "Passwords". You can find the article on the insert accompanying this paper.**

**(a)** Using only the 26 upper case letters, 308 915 776 different 6-letter passwords are possible.

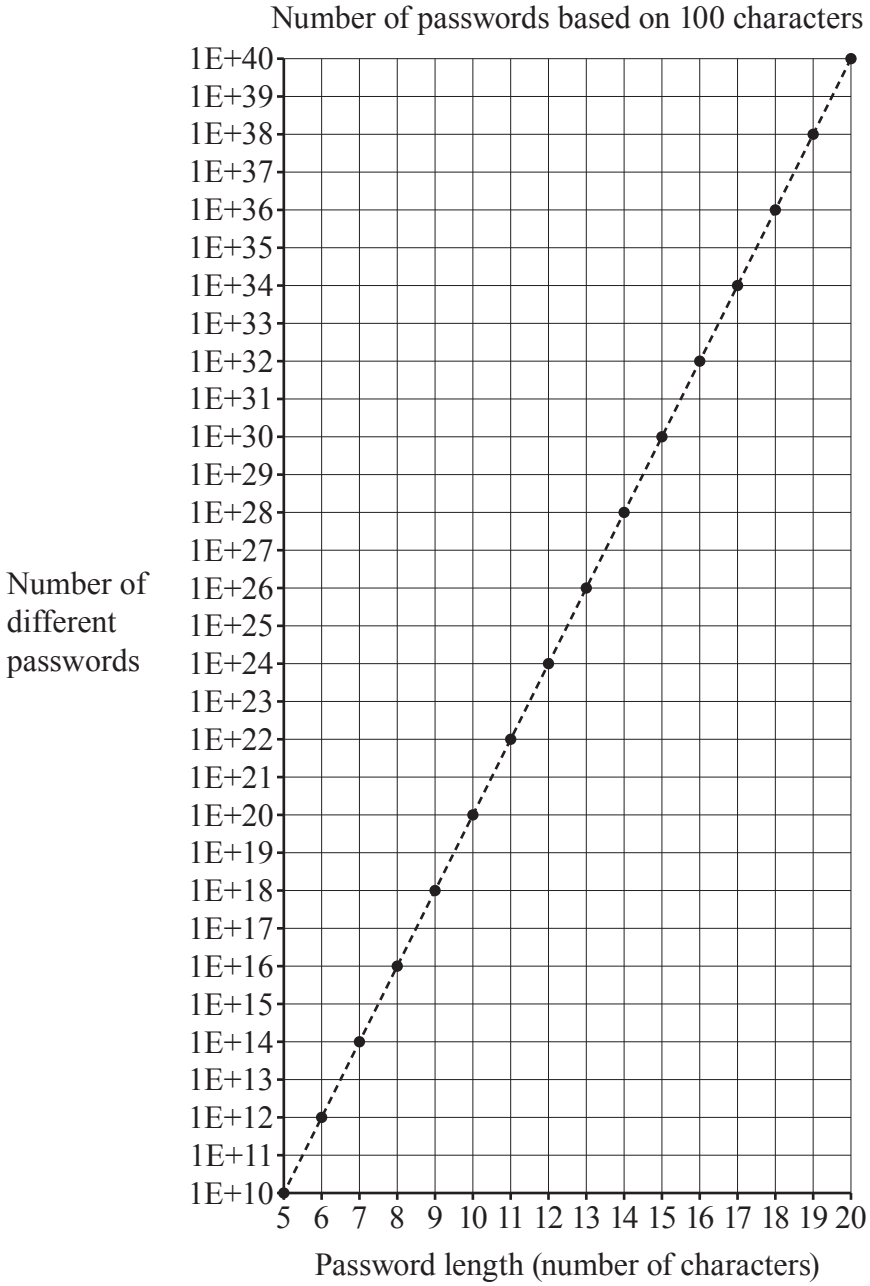
**(i)** What is the probability of guessing correctly, on first try, a 6-letter password made from the 26 upper case letters? Give your answer as a fraction. **[1]**

**(ii)** When the number 308 915 776 is written in standard form, correct to 1 significant figure, the answer is $3 \times 10^n$.

Write down the value of $n$. **[1]**

| | |
|---|---|
| **5(a)(i)** | |
| **5(a)(ii)** | |

**(b)** A typical PC keyboard can produce 100 different characters.
The graph shows the number of passwords of different lengths which can be made from 100 characters.




**(i)** How many different 9-character passwords can be made from 100 characters?
Give your answer in standard form. **[1]**

| | |
|---|---|
| **5(b)(i)** | |

**(ii)** What password length will give a million times more different passwords than your answer to **part (b)(i)**? **[2]**

| | |
|---|---|
| **5(b)(ii)** | |

**(c)** An approximate rule for calculating the time it takes the latest super-computer to generate and test $x$ passwords is

$8 \times 10^{-19} \times x$ years.

**(i)** Use this rule and the graph opposite to calculate how many years it would take to generate and test all the 20-character passwords based on 100 different characters. Give your answer in standard form. **[2]**

| | |
|---|---|
| **5(c)(i)** | |

**(ii)** How many times more is your answer to **part (c)(i)** than the age of the Universe? The age of the Universe is 13.8 billion years. (A billion is $10^9$.) **[1]**

| | |
|---|---|
| **5(c)(ii)** | |

**6 This question refers to article D in the pre-release material, "Using indicators". You can find the article on the insert accompanying this paper.**

**(a)** The educational opportunity indicator is the mean of these two indicators:

- Expected years of school attendance indicator.
- Expected years of schooling available indicator.

**Fig. 6.1** shows the set global values and the actual values of these features for Australia.

**Fig. 6.1**

| Feature | Set global feature values | | Feature value for Australia |
|---|---|---|---|
| | minimum | maximum | |
| Expected years of school attendance | 0 | 15 | 12.7 |
| Expected years of schooling available | 0 | 18 | 22.0 |

**(i)** Calculate the expected years of school attendance indicator for Australia. **[2]**

**(ii)** Calculate the expected years of schooling available indicator for Australia. **[1]**

**(iii)** The indicator for educational opportunity is the mean of the expected years of school attendance indicator and the expected years schooling available indicator.

Calculate the indicator for educational opportunity for Australia. **[1]**

| | |
|---|---|
| **6(a)(i)** | |
| **6(a)(ii)** | |
| **6(a)(iii)** | |

**(b)** The United Nations (UN) publish a spreadsheet giving the indicators for educational opportunity for 189 countries. A student wants to find the mean and median educational opportunity indicators for the countries in the spreadsheet.
The student inserts rows 192 and 193 into the UN spreadsheet, as shown in **Fig. 6.2**.

**Fig. 6.2**

| | A | B |
|---|---|---|
| 1 | **Country** | **2019** |
| 2 | Afghanistan | 0.414 |
| 3 | Albania | 0.746 |
| | | |
| 188 | Yemen | 0.350 |
| 189 | Zambia | 0.557 |
| 190 | Zimbabwe | 0.587 |
| 191 | | |
| 192 | mean | 11.282 |
| 193 | median | 0.682 |

**(i)** Which of their results, in cells B192 and B193, obviously wrong and why? **[2]**

| | |
|---|---|
| **6(b)(i)** | because |
| | |
| | |
| | |

**(ii)** **Fig. 6.3** shows the coding the student uses to find the mean and median of the indicators for educational opportunity for the 189 countries.

**Fig. 6.3**

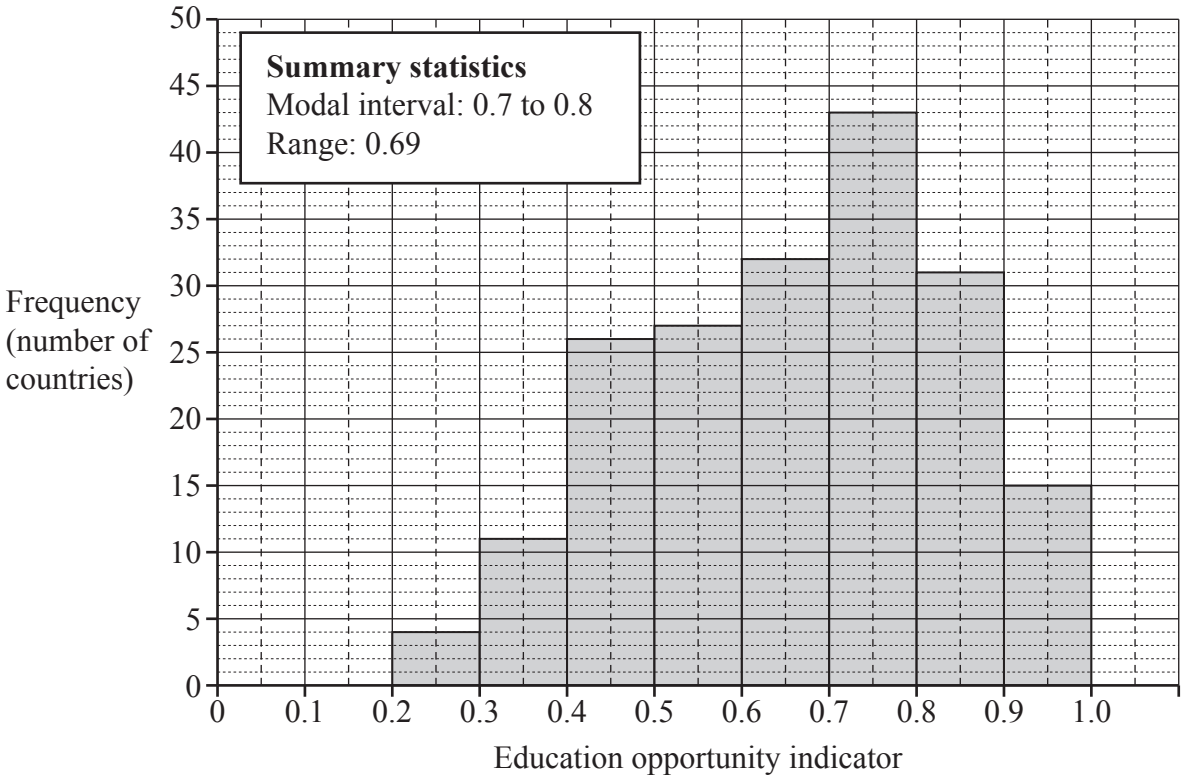
| | | |
|---|---|---|
| 191 | | |
| 192 | mean | =AVERAGE(B1:B190) |
| 193 | median | =MEDIAN(B2:B190) |

The student has made a mistake, write the corrected coding below. **[1]**

| | | |
|---|---|---|
| **6(b)(ii)** | | |
| | mean | |
| | median | |
| | | |

**(c)** The grouped frequency chart in **Fig. 6.4** shows the education opportunity indicators for the 189 countries, together with some summary statistics.

**Fig. 6.4**




**(i)** 31 countries have an education opportunity indicator 0.8 or more but less than 0.9.

How many countries have an education opportunity indicator of 0.8 or more? **[1]**

**(ii)** How many countries have an education opportunity indicator less than 0.4? **[1]**

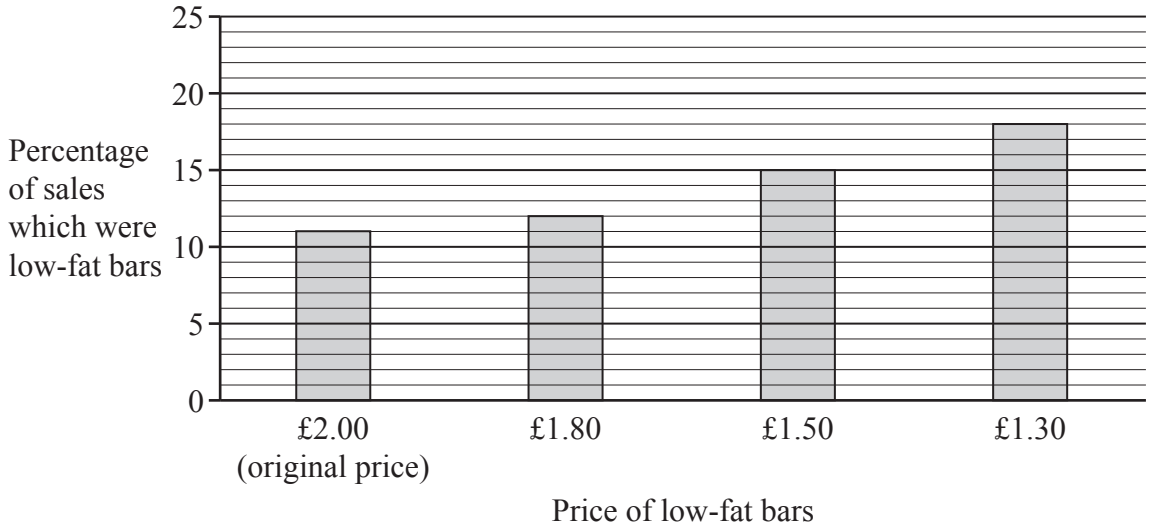
**(iii)** Give one reason for stating that education opportunity indicators are not Normally distributed. **[1]**

| | |
|---|---|
| **6(c)(i)** | |
| | |
| | |
| **6(c)(ii)** | |
| | |
| | |
| **6(c)(iii)** | |
| | |
| | |

**7** A company has a large number of vending machines selling 5 different snacks.
One of them is a low-fat bar but it does not sell as well as the other snacks.

The company want to know whether the poor sales of the low-fat bar are because of its price or because customers just don't like it.

As a test they reduce the price of the low-fat bar by various amounts in some of their vending machines. The results are shown below.




**(a) (i)** What is the percentage of low-fat bar sales at the original price? **[1]**

| | |
|---|---|
| **7(a)(i)** | |

**(ii)** Find the increase in the percentage of low-fat bar sales at a price of £1.30 compared to at a price of £2. **[1]**

| | |
|---|---|
| **7(a)(ii)** | |

**(b)** The results are plotted on a scatter diagram and a line of best fit is drawn by eye.
It has the equation $s = 31 - 10p$, where
$s$ is the percentage of low-fat bars sold and
$p$ is the price, in £, of low-fat bars.

**(i)** Calculate the price of low-fat bars which would be expected to give sales of 20%. **[3]**

| **7(b)(i)** | |
|---|---|
| | |
| | |
| | |
| | |

**(ii)** Calculate what the equation predicts for sales of low-fat bars priced at £3.10. **[2]**

| **7(b)(ii)** | |
|---|---|
| | |
| | |
| | |
| | |

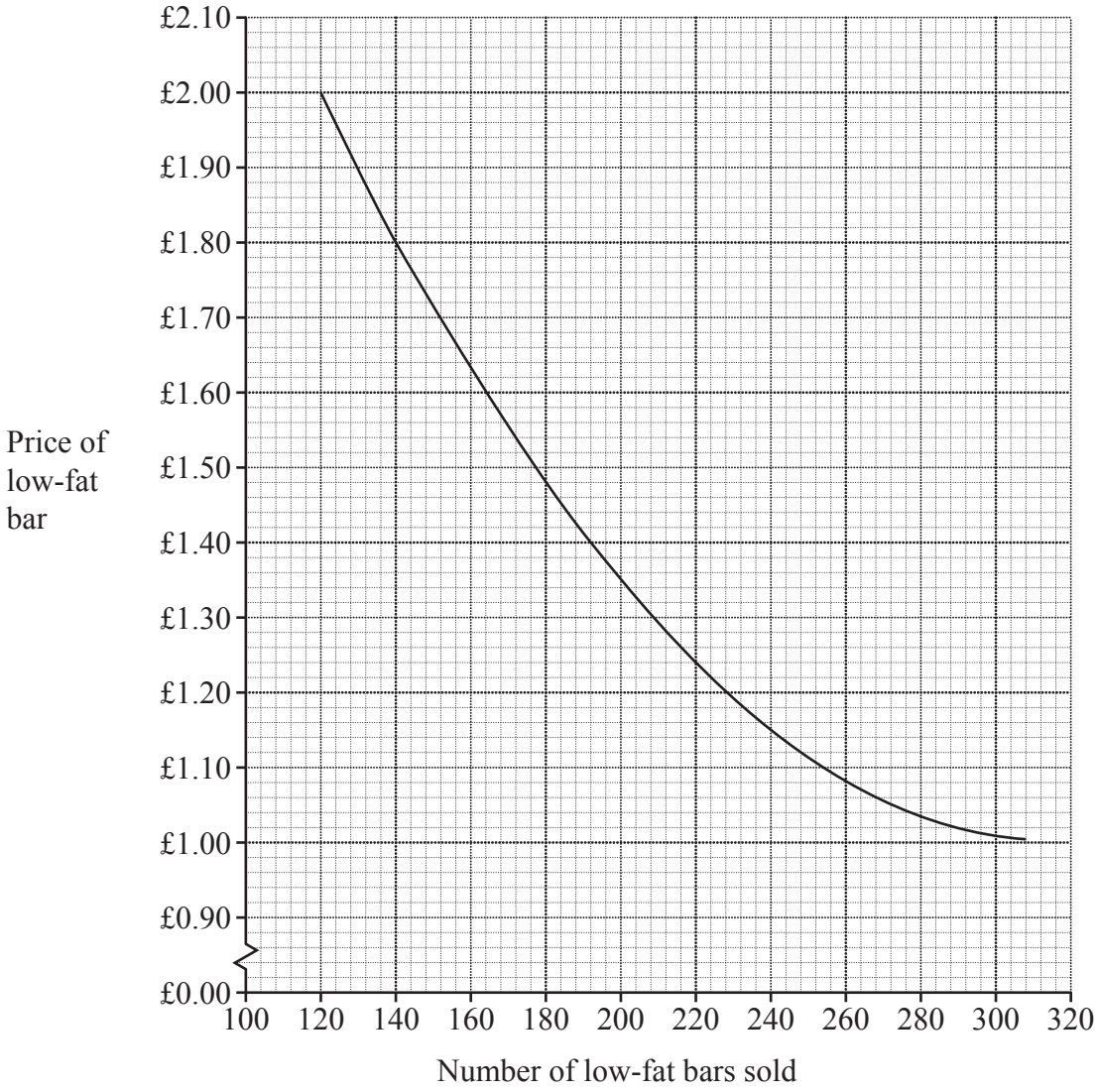
**(c)** Reducing the price of low-fat bars by 50% reduces the average monthly profits of a vending machine from £498 to £480.

The percentage drop in profit is $\frac{498-480}{498} \times 100$.

Without using a calculator, calculate an estimate for the answer to the calculation.
Show all the steps in your estimation. **[2]**

| **7(c)** | |
|---|---|
| | |
| | |
| | |
| | |
| | |

**(d)** Given the possible drop in profit, the company carry out a more thorough investigation of the sales of low-fat bars for different prices.
They produce the demand curve shown below.




**(i)** How many low-fat bars does the demand curve predict will be sold at £1.60? **[1]**

| | |
|---|---|
| **7(d)(i)** | |

**(ii)** The original price of the low-fat bars is £2.
What price would double the number of sales made at the original price? **[2]**

| | |
|---|---|
| **7(d)(ii)** | |

**END OF QUESTION PAPER**

**2(c)(ii)** Spare grid for **Q2(c)(ii)**
If you use this grid, cross out your answer on page 9.