OCR
Oxford Cambridge and RSA

Level 3 Certificate
Quantitative Problem Solving (MEI)
H867/01 Introduction to Quantitative Reasoning

Wednesday 17 May 2017 – Morning
Time allowed: 2 hours

You must have:
• the Insert (inserted)

You may use:
• a scientific or graphical calculator

First name	
Last name	

Centre number						Candidate number				

INSTRUCTIONS
• Use black ink. You may use an HB pencil for graphs and diagrams.
• Complete the boxes above with your name, centre number and candidate number.
• Answer **all** the questions.
• Write your answer to each question in the space provided.
• Additional paper may be used if required but you must clearly show your candidate number, centre number and question number(s).
• Do **not** write in the barcodes.
• You are advised that an answer may receive **no marks** unless you show sufficient detail of the working to indicate that a correct method is being used.

INFORMATION
• The total mark for this paper is **72**.
• The marks for each question are shown in brackets **[ ]**.
• This document consists of **20** pages.
• Final answers should be given to a degree of accuracy appropriate to the context.

Turn over

1   This question refers to the article "Lotteries and raffles". This was given out as pre-release material and is available as an insert.

A couple have won the EuroMillions draw – for the second time.

The extraordinarily lucky pair, from Scunthorpe, Lincs, have scooped their second £1 million prize in less than two years.

That means they have beaten the incredible odds of over 1 in 253 billion in winning it twice.

The article above describes a couple who won twice on the Euromillions raffle.

   (i) The median UK salary is £22 000 per year. How many years would it take **one person** at this salary to earn the total amount of £2 million won by the couple in the article?   **[2]**

1 (i)	

   (ii) Suppose the couple invest the entire £2 million won in a savings bond paying 3.2% per year tax free. The interest is paid in equal weekly instalments.

   How many complete weeks would it take for the couple to earn the median UK salary from interest alone?   **[4]**

1 (ii)	

(iii) Assume that the newspaper is correct and the probability of winning this raffle twice with just two entries is 1 in 253 billion. Show that the probability of winning it once with one ticket is about 1 in 500 000, assuming that the outcomes are independent and the probability of winning each time is constant. **[3]**

1 (iii)	

2 The boxplots below show the results of a survey of many doctors' estimates of smoking prevalence (i.e. the proportion of people they treat who smoke) along with the level of deprivation of the people they treat. People with low deprivation scores generally have higher incomes and better access to services.

Dots show outliers. "Least" refers to a group with a deprivation score below that which would get into the group with a deprivation score of 10. "Most" refers to a group with a deprivation score above that which would get into the group with a deprivation score of 50.
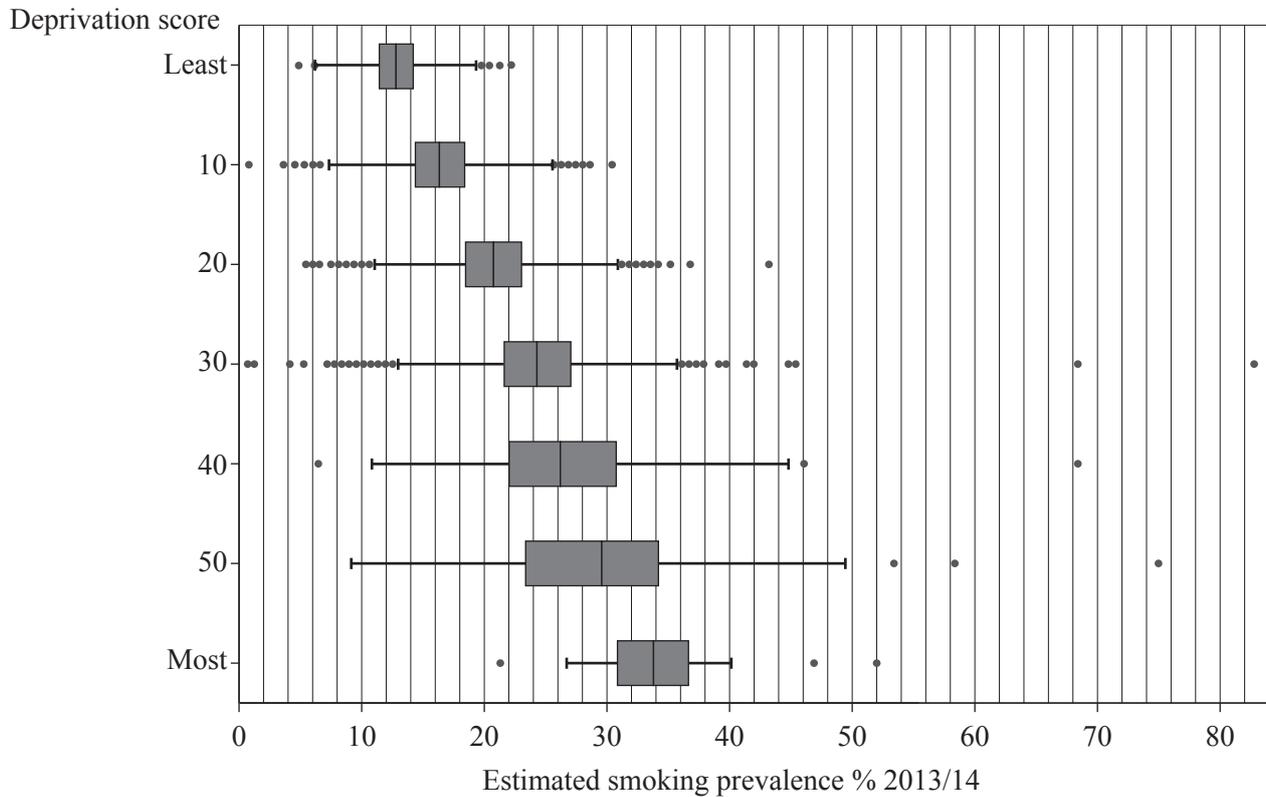
Source: publichealthmatters.blog.gov.uk/2014/12/11/datablog-good-news-on-smoking/

(i) Summarise the main point this chart is showing. **[1]**

2 (i)	

(ii) What is the median estimated smoking prevalence of those with a deprivation score of 50? **[1]**

2 (ii)	

(iii) What is the interquartile range (IQR) in the estimated smoking prevalence of those with a deprivation score of 50? **[2]**

2 (iii)	

(iv) The formula *Upper Quartile* + 1.5 × *IQR* is used to find a cut off point for high value outliers. Use this formula to find the cut off for outliers of those with a deprivation score of 50. **[3]**

2 (iv)	

(v) Jemima says that groups with higher deprivation scores tend to have greater variation in the estimated smoking prevalence than groups with lower deprivation scores. Identify the feature of the chart which supports Jemima's idea. **[1]**

2 (v)	

3 **This question refers to the article "Car rental". This was given out as pre-release material and is available as an insert.**

Danielle wants to hire a car to take her from London to Edinburgh. The table below gives the distances in miles between some places in Britain.

	Birmingham	Cardiff	Carlisle	Dover	Hull	London	Manchester	Newcastle	Norwich	Plymouth
Aberdeen	425	532	232	587	375	545	355	234	487	628
Dundee	348	449	153	542	287	461	273	169	411	543
Edinburgh	298	399	98	463	246	411	222	106	359	495
Fort William	409	510	209	591	379	522	333	239	491	606
Glasgow	296	397	97	478	266	409	220	154	379	493
Inverness	458	558	258	639	486	571	381	266	540	654
Oban	387	488	193	581	350	450	312	231	473	582
Perth	346	446	146	504	292	459	267	151	405	542
Stirling	307	408	113	502	270	420	232	148	393	502
Stranraer	306	406	106	487	276	419	227	164	388	503
Ullapool	501	602	307	695	464	614	426	321	587	696
Wick	560	661	360	742	530	673	481	369	642	757

(i) Use the table above to find the distance from London to Edinburgh. **[1]**

3 (i)	

Danielle needs a car for at least 5 people. She also wants to find the car with the best motorway fuel efficiency. She looks at the advert shown in the insert of the pre-release material.

(ii) Which car should she choose, assuming they are all available? **[1]**

| 3 (ii)	

(iii) A car has a fuel efficiency of 30 miles per gallon for motorway driving. On the graph below plot a line showing the fuel required for distances between zero and 450 miles. Assume that the fuel consumption is proportional to distance travelled. **[2]**

3 (iii)

Fuel used (gallons) — vertical axis

Distance travelled (miles) — horizontal axis
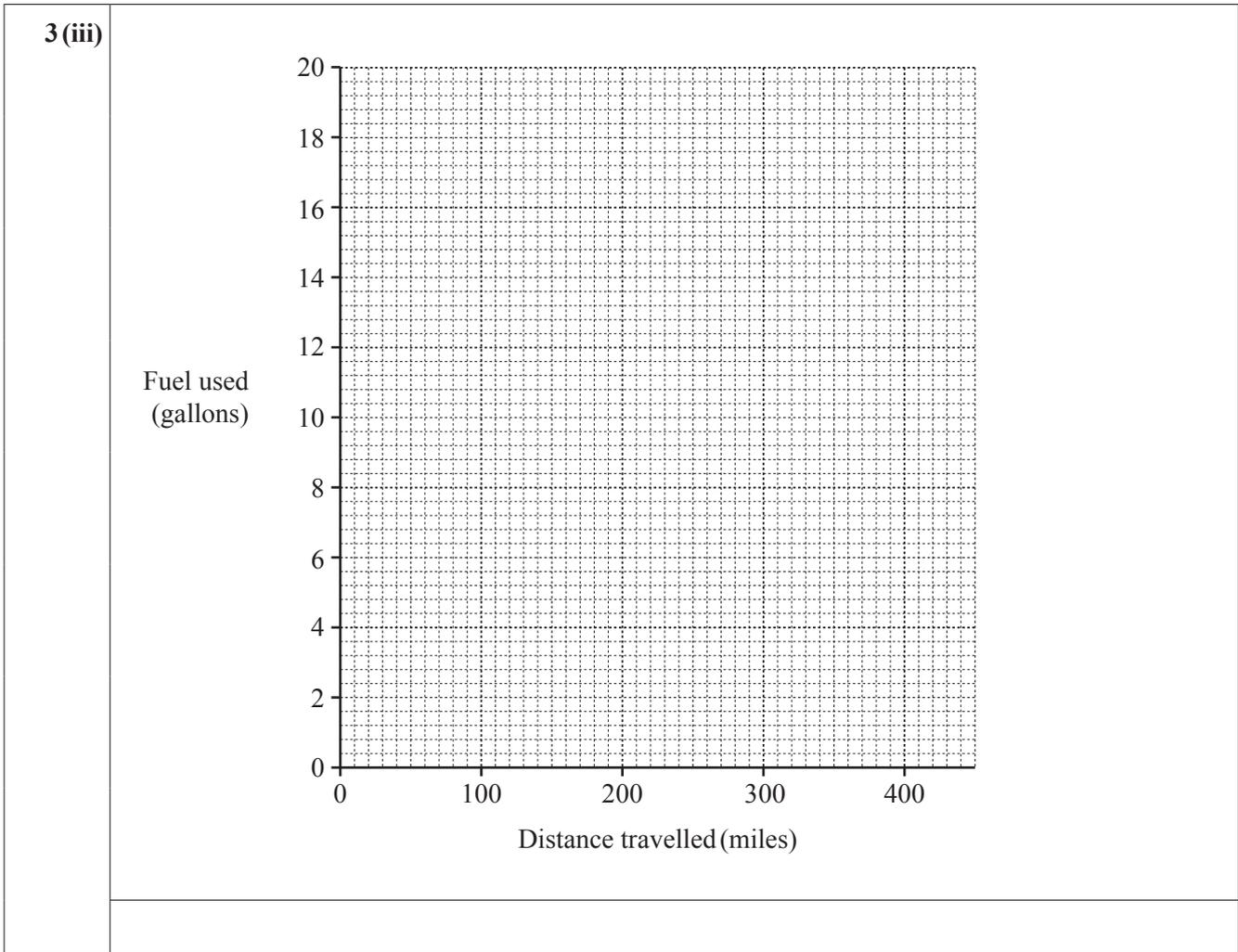
(iv) 1 gallon of petrol costs £4.96. Show how you can estimate, **without a calculator**, the amount of money which should be allowed to pay for petrol costs for a one-way trip from London to Edinburgh using a car with a motorway fuel efficiency of 30 mpg, assuming that nearly all of the journey is on the motorway. Write your answer to an appropriate level of accuracy. **[5]**

3 (iv) **Do not use a calculator for this part of the question.**

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Turn over

4   The vertical line chart below shows the percentage change in average house prices in the UK over each of the 20 months from January 2008 to August 2009.
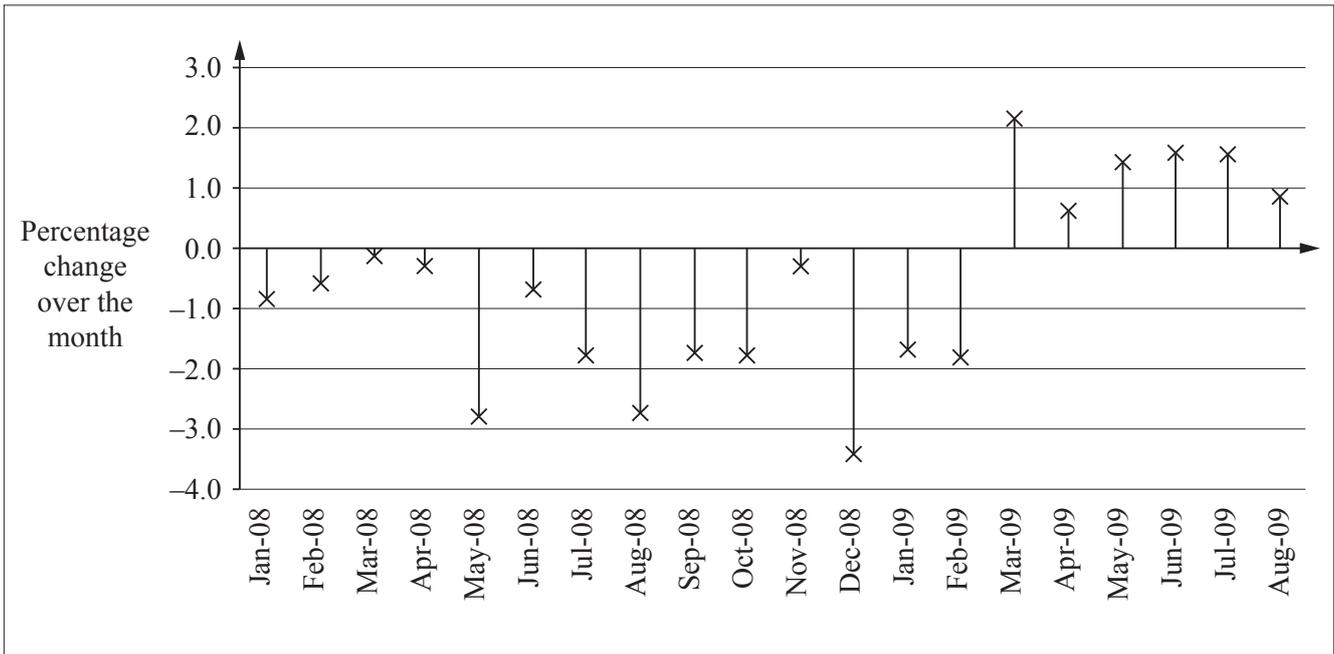
(i) Describe what is happening to average house prices during this period. **[2]**

4 (i)	

(ii) In what percentage of months were average house prices rising according to the vertical line chart? **[2]**

4 (ii)	

(iii) The vertical line chart shows that the average house price decreased by 1.7% during January 2009 and by 1.8% during February 2009. Hanna bought her house for £245 000 at the beginning of January 2009. A bank used the information from the graph to estimate the value of her house at the end of February 2009. What value did they find? Give your answer to the nearest pound. **[4]**

4 (iii)	

(iv) Give two reasons why the value found in part **(iii)** might not give the true value of Hanna's house. **[2]**

4 (iv)	

5 Manjit wants to open a sandwich shop on the high street to serve people of all ages in a town. He conducts a survey to find out how much people would pay for a sandwich.

(i) State one statistical issue which might occur if Manjit conducted the survey in a local sixth form college. **[1]**

5(i)	

Manjit conducts a survey on a representative sample of potential customers. He asks the question "What is the maximum you would be prepared to pay for a sandwich?"

The results of Manjit's survey are summarised in the chart below.

(ii) Which group should be discarded as outliers? Explain why people may have given these responses. **[2]**

5(ii)	

(iii) Use this sample to estimate the mean maximum price potential customers are prepared to pay for a sandwich, excluding the outliers. **[4]**

5 (iii)	

(iv) State two reasons why your answer to part **(iii)** is only an estimate of the true mean maximum price potential customers are prepared to pay. **[2]**

5 (iv)	

Turn over

12

After further market research Manjit constructs this demand curve for sandwiches.
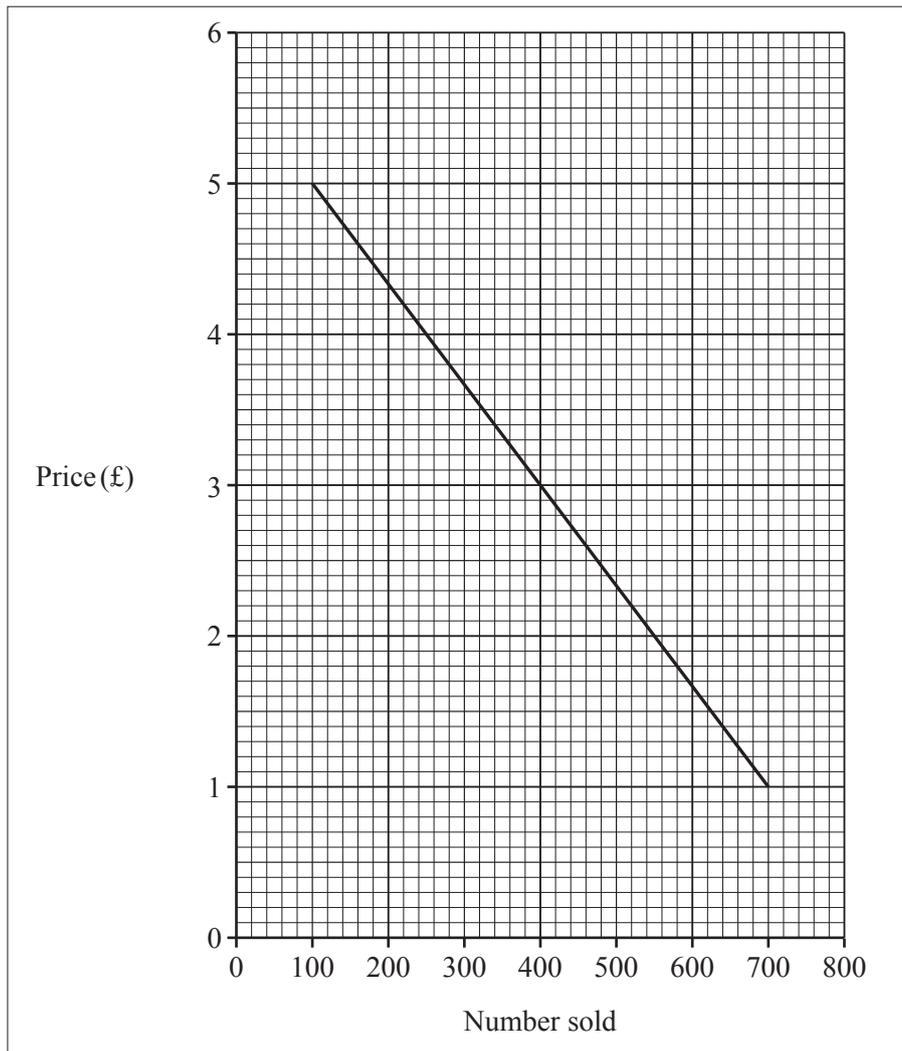
Manjit uses this model and a spreadsheet to work out how to make the maximum profit. Manjit wants to sell each sandwich for a multiple of 50p. Each sandwich costs 80p to make. Manjit can make up to 700 sandwiches each day.

(v) Fill in the rest of the numbers in columns B, C and D. **[5]**

5(v)

	A	B	C	D
1	Customer price (£)	Number sold per day	Production cost for Manjit (£)	Total profit (£)
2	1.00	700	560	140
3	1.50	625		
4	2.00	550		
5	2.50	475		
6	3.00			
7	3.50			
8	4.00			
9	4.50			
10	5.00	100	80	420

(vi) What formula should Manjit type in cell C2 so that he can copy it down the column to give the number sold per day? **[2]**

5(vi)

(vii) What formula should Manjit type in the cell D2 so that he can copy it down the column to give the profit? **[2]**

5(vii)

(viii) State the price he should sell the sandwiches for to make the maximum profit. **[1]**

5(viii)

(ix) Manjit intends to sell sandwiches on 20 days each month. He estimates that his total costs (excluding making the sandwiches) will be £8 000 pounds each month.

Would you recommend that Manjit goes ahead with his plan to start this business? Give a reason for your answer and show relevant calculations. **[2]**

5(ix)	

6 **This question refers to the article "Glaciers". This was given out as pre-release material and is available as an insert.**

(i) The water from a glacier feeds into a lake. A climate scientist estimates that 2 billion litres melts from the glacier each year. (Note: 1 billion $=10^9$)

Use the fact that 1 litre is $1000 \, \text{cm}^3$ to write 2 billion litres in cubic metres (m^3). Give your answer in standard form. **[3]**

6(i)	

16

(ii) The lake is modelled as a cylinder with radius 2 km as shown below. The axis of symmetry is vertical.

2 km
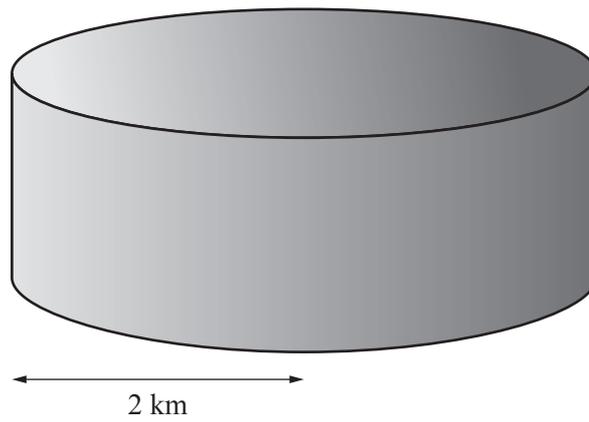
Show that the annual change in height of the lake due to the water melting from the glacier is 16 cm to the nearest centimetre. **[4]**

6 (ii)	

17

The table below shows the percentage volume decrease in a glacier in three consecutive years.

Year	Percentage reduction
1	4
2	10
3	8

(iii) Find the overall percentage reduction in volume in these three years. **[3]**

6 (iii)	

The long term average annual percentage volume decrease is 7%.

(iv) Assume that this average percentage reduction will continue. Which one of these graphs best represents the percentage of the 2016 glacier remaining in future years? Tick the appropriate box.   **[1]**

% Remaining

100

A

0

Time since 2016 reading

% Remaining

100

B

0

Time since 2016 reading

% Remaining

100

C

0

Time since 2016 reading

% Remaining

100

D

0

Time since 2016 reading
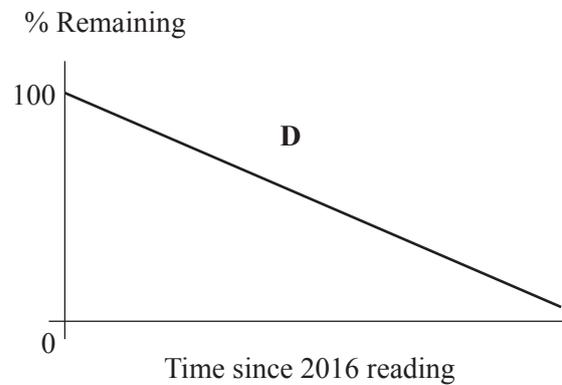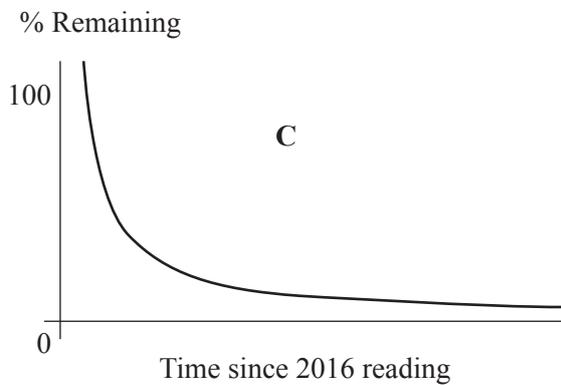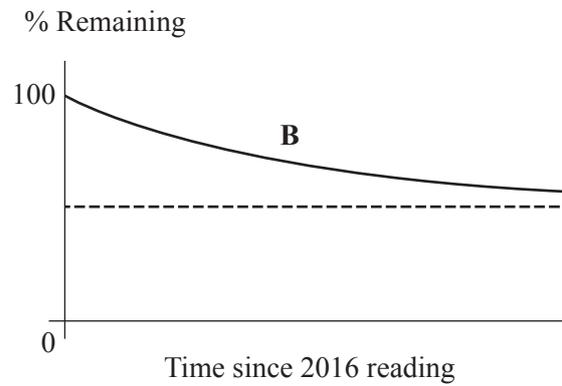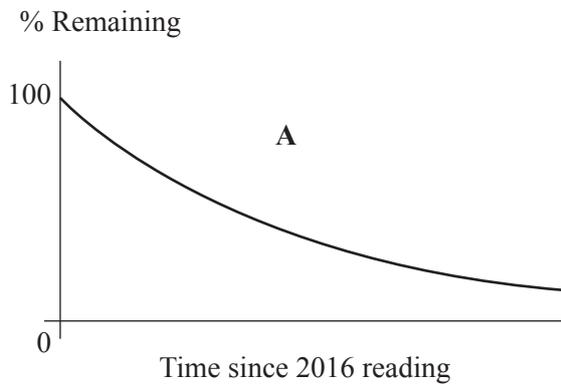
6 (iv)	A	B	C	D
Tick one box				

(v) How many complete years would it take for the glacier to reduce by 50% from its current volume? **[3]**

6 (v)	

(vi) To make the comparisons between different years valid the measurements of the volume of the glacier are all conducted by the same team of scientists. State one other factor which must stay the same in all measurements to allow a valid comparison. **[1]**

6 (vi)	

END OF QUESTION PAPER

PLEASE DO NOT WRITE ON THIS PAGE