University of Cambridge Local Examinations Syndicate

Biomedical Admissions Test

Wednesday   5 November 2003   Morning   One hour

SECTION 1   Aptitude and Skills

Instructions to Candidates

Please read this page carefully, but do not open the question paper until you are told that you may do so.

A separate answer sheet is provided for this section. Please check you have one. You also require a soft pencil and an eraser.

Please first write your name, date of birth, Biomedical Admissions Test candidate number and UCAS number (if known) in the spaces provided on the answer sheet. Please write very clearly.

Please also write your BMAT candidate number in the space below.

BMAT Candidate Number

Speed as well as accuracy is important in this section. ***Work quickly, or you may not finish the paper.*** There are no penalties for incorrect responses, only points for correct answers, so you should attempt all 40 questions.
Unless otherwise stated, all questions are worth one mark.

Answer on the sheet provided. Many questions ask you to show your choice between options by shading a circle (or circles, if specified in the question). If questions ask you to write in words or numbers, be sure to write clearly in the spaces provided. If you make a mistake, erase thoroughly and try again.

Any rough work should be done on this question paper.

Calculators are NOT permitted.

**Please wait to be told you may begin before turning this page.**

This paper consists of 18 printed pages and 2 blank pages.

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1   A farmer has an underground water tank which he decided to calibrate by adding known volumes of water and measuring the depth using a dip-stick. His calibration graph is shown below. The horizontal cross section of the tank is circular at all points.
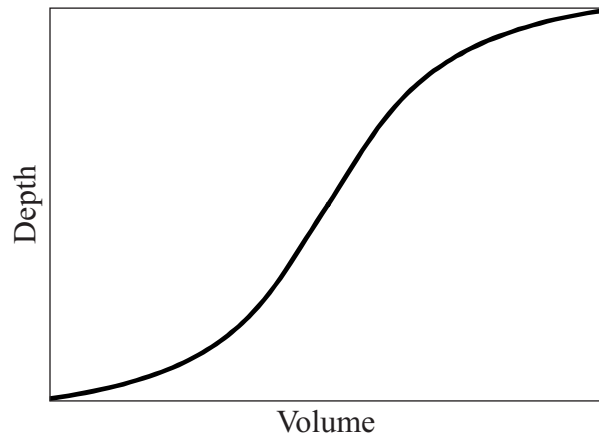
Which **one** of the following shows a possible vertical cross sectional shape of the tank?
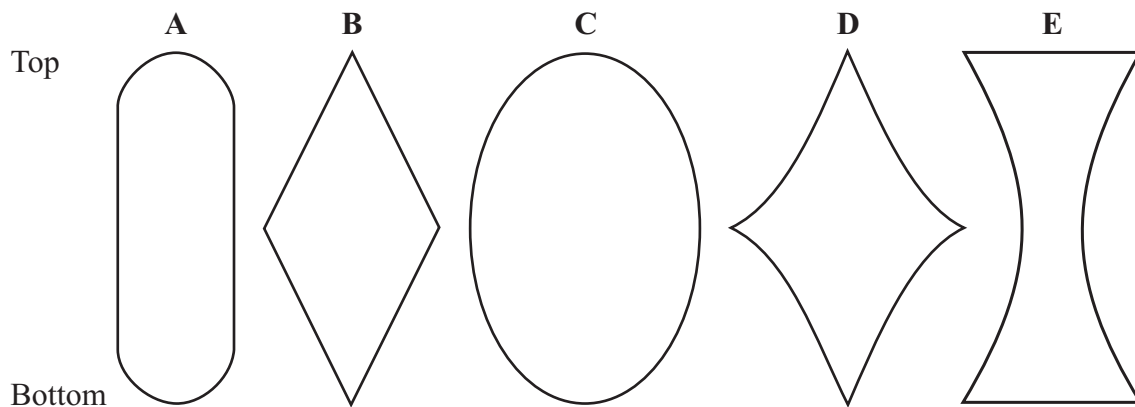
2   "Ready meals" should be labelled with health warnings in the same way as cigarettes are. There has been a big rise in the number of ready meals being sold by the supermarkets. These meals are quick and easy to use, but they tend to have high levels of salt, fat and preservatives in them, which are not good for our long term health.

Which **one** of the following, if true, would strengthen the above argument?

A   People buy ready meals because they do not know how to cook.

B   People who buy ready meals do not have time to cook for themselves.

C   People who buy ready meals are unaware of their unhealthy properties.

D   People who buy ready meals tend also to take little exercise.

E   People who buy ready meals would not respond to a health warning.

3   A survey has been carried out of the methods of transport to school used by pupils. The results, broken down by year group, are shown below.

	Year 7	Year 8	Year 9	Year 10	Year 11	Total
Car	30	33	16	18	10	102
Bus	14	16	13	15	18	76
Bicycle	5	12	23	25	30	95
Walk	101	89	100	92	108	490
Total	150	145	152	150	166	763

One of the individual entries in the above table has been typed incorrectly, although the marginal totals are correct. Which value is wrong?

A   14

B   33

C   23

D   92

E   18

4   The UK government wishes to increase the number of young people from poorer families entering university education. However, it has recently changed the way in which it provides financial support for students. Whereas it used to provide grants that the student did not need to repay, it now provides loans that the student must repay when he or she enters employment. Research shows that students from poorer families are more likely to be deterred from going to university by the prospect of debt.

Which **one** of the following is an inference that can be drawn from the passage above?

A   Students from poorer families are less interested in entering university.

B   Universities will not be willing to help meet the government's target.

C   The government's action is likely to deter poorer students from going to university more than richer.

D   The prospect of debt is a deterrent to all students, not just the poorer ones.

E   Maintenance grants were too expensive for the government to fund.

5   A gardener decides to lay out his cabbage patch as a square grid. He has a lot of cabbages so cannot be bothered to count them, but lays them out on the ground. On completing his square, he finds he has 9 left over. He then lays them out again with one extra cabbage on each side of the grid. He then finds that he is 12 cabbages short.

How many cabbages has he?

6   A proposal to counteract low turnout by voters in elections is to introduce the option of voting via the Internet. There are a number of practical issues (such as loss of secrecy, fear of abuse of the system) which mean the proposal would have to be carefully controlled. It may be undemocratic by favouring some political parties more than others. Those parties whose voters tend to be young and better educated would be likely to gain more votes than others.

Which of **one** the following best expresses the main conclusion of the argument?

A   Low turnout by voters is endangering our democracy.

B   Voting via the Internet risks loss of secrecy in voting.

C   Some political parties object to the Internet voting proposal.

D   Internet voting would unfairly discriminate against some sections of society.

E   Internet voting would have to be carefully controlled.

PLEASE TURN OVER

Questions 7 to 12 refer to the following information:

The table below shows statistics for consultations by family doctors in the country of Santesia for the years 1995 and 2000. Santesia has a population of approximately 10 million and there are 5000 family doctors (these figures have not changed significantly over the five years between the two surveys).

	1995	2000
Average number of surgery sessions a week	8.5	8.4
Average length of a surgery session (min)	140	165
Average length of a consultation (min:sec)	9:59	10:00
Average time spent on home visits a week (min)	408	412
Average length of a home visit (min)	25.5	25.0
Average number of patients seen per week	135	155

7   A doctor's consultation appointments are made 10 minutes apart and all patients attend. How many patients would been seen in an average surgery session in 1995?

A   14

B   16

C   17

D   30

8   To the nearest hour, how many hours a week did the average family doctor spend on surgery and home visits in 1995?

9   If the doctors work for 50 weeks per year, approximately how many times did the average patient see their family doctor in 2000?

A   2

B   3

C   4

D   8

E   13

10 If the number of family doctors was cut to 4500 but the total number of consultations and surgery sessions remained the same, approximately how long would an average surgery session have to be to ensure that all patients were seen?

    A   126 mins

    B   148 mins

    C   154 mins

    D   183 mins

    E   198 mins

11 Which **one** of the following contributed most to the rise in numbers of patients seen per week between 1995 and 2000?

    A   average length of a surgery session

    B   average length of a consultation

    C   average time spent on home visits per week

    D   average length of a home visit

12 Which **one** of the following bar charts best represents the average numbers of patients seen per week in home and surgery consultations during the two years?
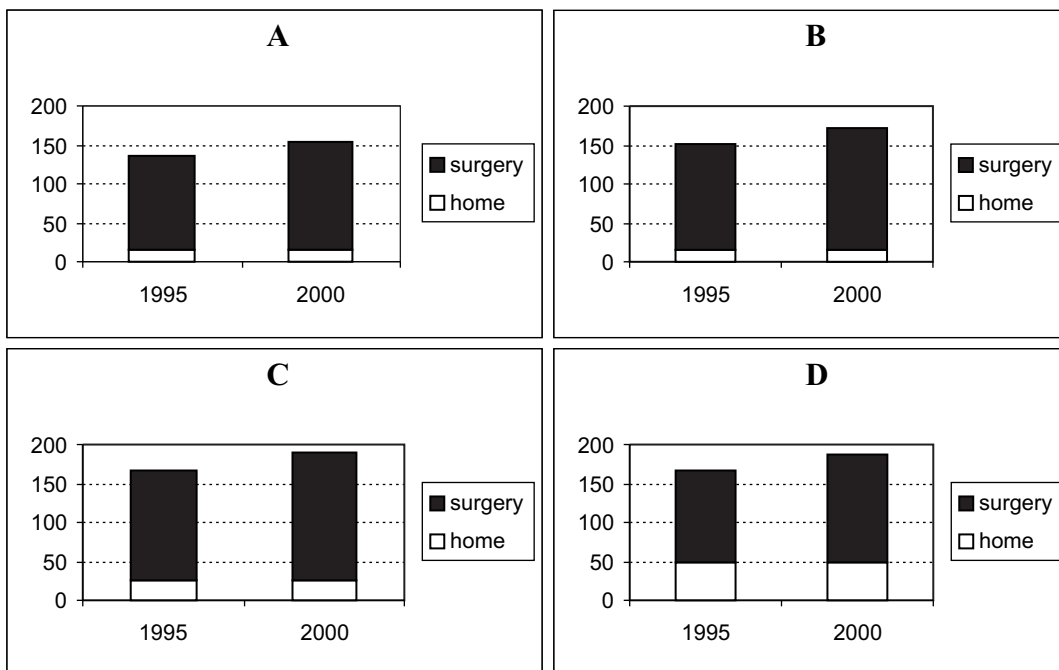
13   A commuter bus taking people home from work loads up in town and then stops at various places on its way to the edge of town. Nobody gets on the bus after the place where it loads up, but 1/3 of the people on the bus get off at the first stop and at each subsequent stop up to the fourth, where the last 8 people get off.

How many people boarded the bus originally?

A   18

B   27

C   36

D   54

14   While the Internet brings undoubted advantages to young people, the effects of excessive use are serious. Some teenagers are spending as much as 8 hours per day using the Internet. Isolation and obesity are increasing amongst children. Parents must enforce stricter controls over their children, to make sure that the Internet is not causing their children to have long term physical and emotional ill health.

Which **one** of the following best expresses the flaw in the above argument?

A   It understates the benefits of Internet usage.

B   It focuses only on teenagers who spend 8 hours per day using the Internet.

C   It assumes that parents can enforce stricter controls.

D   It says nothing about the effects of watching TV and using computer games.

E   It assumes that excessive Internet use causes isolation and obesity.

15   Twelve teams will take part in the Pitchball World Cup next month. They will compete in two pools of six. Every team will play two matches against each of the other teams in the same pool and one match against each team in the other pool. The winners of each pool will then contest the final.
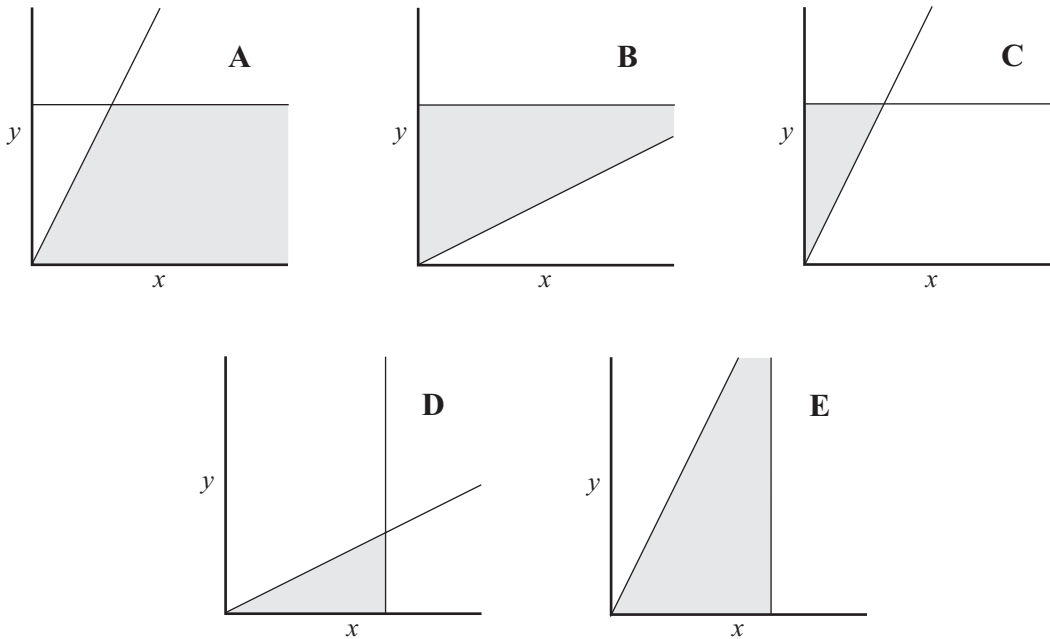
How many matches will be played altogether during the tournament?

A   67

B   91

C   97

D   109

E   193

16 In the graphs below, the *x* and *y* scales are identical, and the same for each graph. On which **one** does the shaded area correctly represent the conditions:

$$y>2x \quad \text{and} \quad 0<y<5 \quad ?$$

17 On a particular experimental farm, it is found that the number of nematode worms per cubic metre in the soil tends to be greater when there is a lower concentration of fertiliser residues in the soil.

Which **one** of the following claims does this finding justify?

A Nematode worms help break down fertiliser residues in the soil.

B The number of nematode worms per cubic metre of soil is negatively correlated with the concentration of fertiliser residues.

C Removing fertiliser residues from the soil would encourage the growth of nematode worm populations.

D Fertiliser residues interfere with the reproduction of nematode worms.

18 There are 15 entries for the BMAT from a sixth-form college. Three of the candidates are taking biology, chemistry, mathematics and physics; the remainder are taking three out of these four subjects. All 15 candidates are taking chemistry and 13 of them are taking biology. There are 9 girls. What is the largest number of boys that could be taking both mathematics and physics?

19 At the end of daylight saving time, when clocks should be put back one hour, Julie puts hers forward one hour by mistake. Her friend Clare completely forgets about it and leaves hers unchanged. They had arranged to meet at 11 am the following day.

If neither realises her mistake before going to keep the appointment, what will happen?

A Julie arrives 2 hours after Clare

B Julie arrives 1 hour after Clare

C They arrive at the same time

D Julie arrives 1 hour before Clare

E Julie arrives 2 hours before Clare

20 It has been shown that men are much less likely to use preventive medical care than women: men tend to wait for a crisis before seeking help, whereas women are quick to consult a doctor when they have only minor symptoms. The effect of this is that doctors are seeing men with advanced conditions which are more difficult – and expensive – to treat. Time and money spent on persuading men to seek advice at an earlier stage would easily be offset by savings on treating advanced conditions.

Which **one** of the following, if true, weakens the above argument?

A Men are more reluctant to discuss health problems with their doctor.

B Early consultation for minor symptoms incurs high costs in doctors' time.

C Women are advised by magazines to consult their doctor whenever they are worried.

D It would be difficult to persuade men to change their behaviour.

E Treating advanced conditions usually involves other health professionals.

21 A cheetah's top speed is 110 km/h and that of a zebra is 60 km/h. If both are running at top speed in a straight line and the cheetah is 100 m behind, how many seconds will it take the cheetah to catch the zebra?

22 On a Roman archaeological site, three coins were found with dates corresponding to 88, 123 and 157 AD. The coins were mixed with other Roman debris so must have entered the site during Roman occupation.

Which **one** of the following can definitely be said about the dates of occupation of the site?

A It was abandoned not later than 157 AD.

B It was first occupied before 88 AD.

C It was not in use before 88 AD.

D It was occupied only from 88 to 157 AD.

E It was abandoned in or later than 157 AD.

23 Gardeners are being encouraged to use alternatives to peat, as peat harvesting endangers the wetland habitats of wading birds. But gardening has become the most popular hobby in the UK, with thousands of people visiting garden centres to buy – among other things – peat-based compost. The habitats of wading birds will therefore inevitably decline if gardening continues to be so popular.

Which **one** of the following is an underlying assumption of the above argument?

A Gardening will remain the UK's most popular hobby.

B Gardeners will ignore encouragement to use alternatives to peat.

C The declining habitats of wading birds are being ignored by environmentalists.

D Garden centres cannot provide cheap alternatives to peat.

E The habitats of wading birds are under greater threat than those of other wildlife.

PLEASE TURN OVER

Questions 24 to 27 refer to the following information:

The Ruritanian Institute for Economic Studies has totalled up the effects of the Ruritanian Finance Minister's six budgets prior to April 2003. Its calculations suggest that tax and benefit measures introduced by the Finance Minister have resulted in the redistribution of income from the better off to less well off. A lone parent, for example, is on average $24 better off in today's money as a result of the Finance Minister's measures – an 11% gain.
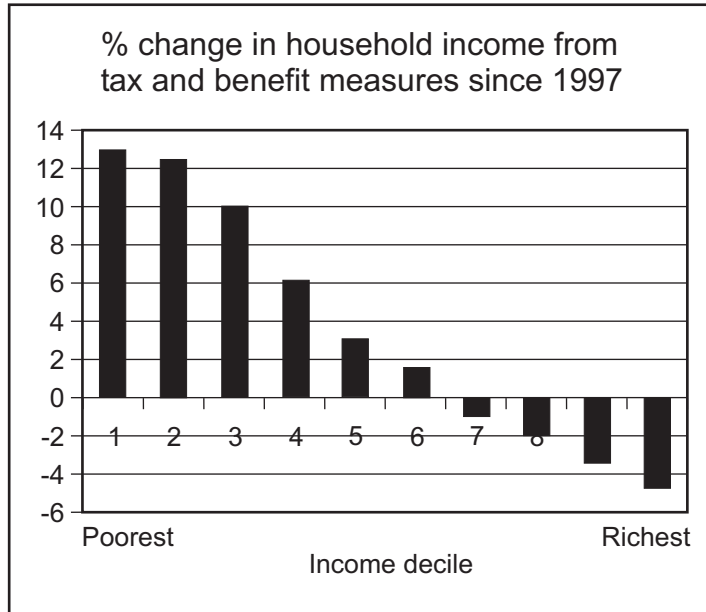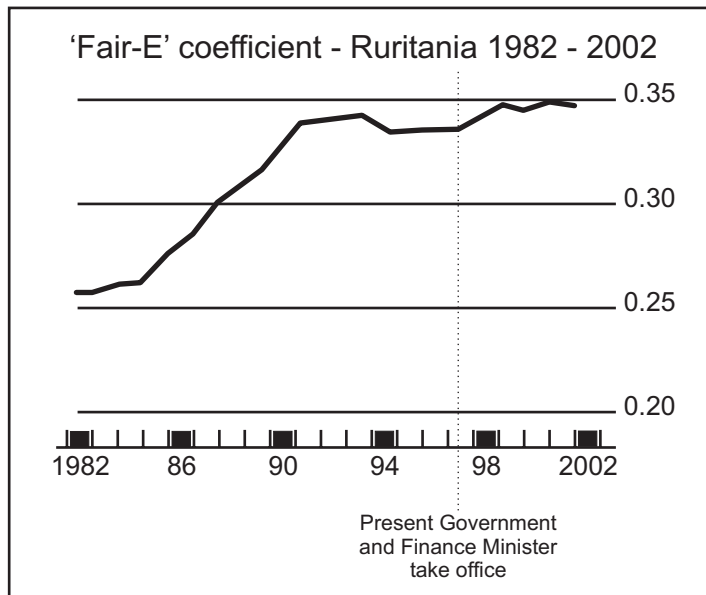
Chart 1

% change in household income from tax and benefit measures since 1997

Chart 2 shows trends in the 'Fair-E coefficient' since 1982.

Chart 2

'Fair-E' coefficient - Ruritania 1982 - 2002

Present Government and Finance Minister take office

The Fair-E coefficient is a number between zero and one that measures the degree of inequality in the distribution of income in a given society. The coefficient would register zero inequality for a society in which each member received exactly the same income and it would register a coefficient of 1.0 if one member got all the income and the rest got nothing. In practice, coefficient values range from around 0.2 for, e.g., the Slovak and Czech republics and Poland, to

around 0.6 for places like Mexico, Guatemala, Honduras and Panama where powerful elites dominate the economy. The coefficient is particularly useful to show trends. It reveals the change towards greater equality in Cuba from 1953 to 1986 (0.55 to 0.22) and the growth of inequality in the USA in the last three decades when the Fair-E went from 0.35 in the 1970s to 0.40 in the 1990s (and still rising).

Assuming that the information and coefficient above are valid:

24   Which **one** of the following can be reliably concluded from the information given above?

  A   The top 40% of earners in Ruritania are less well off than they were in 1997.

  B   Low earners in Ruritania are no better off than they were in 1997.

  C   Despite the Finance Minister's tax and benefit measures, income inequality in Ruritania has not been reduced.

  D   The Finance Minister's tax and benefit measures have resulted in a rise in the overall standard of living in Ruritania.

  E   People in the top income decile have seen their real wealth fall by over 4%.

25   Which **one** of the following can be reliably concluded from the information given above?

  A   The government's fiscal policy since 1997 has caused inequality to rise in Ruritania to its highest level in 20 years.

  B   Raising taxes on wealth, and increasing benefits for the low-paid, are not effective ways to reduce income differentials.

  C   Lower income groups were better off, in real terms, under the previous government.

  D   Even after tax, above average incomes in Ruritania have continued to rise more rapidly than those that are below the average.

  E   If reducing poverty was the present government's objective, figures show that they have failed so far.

26   Which of the following claims are compatible with the figures and trends given above?

  1   Many of the new benefits are means-tested and complicated, with the result that $4.5 billion-worth are going unclaimed.
  2   According to the Ruritanian Ministry of Finance, the number of people paying top-rate income tax rose from 2.1 million to 3.2 million.
  3   Since 1996-97 there has been a surge in the number of high earners.

  A   1 only

  B   2 only

  C   1 and 2 only

  D   2 and 3 only

  E   1, 2 and 3

27 If countries were listed in order of the degree of inequality between their rich and poor, with the lowest first, which **one** of the following listings would be consistent with the information given above?

    A   Poland, Ruritania, Panama, USA

    B   Panama, USA, Ruritania, Poland

    C   Poland, Ruritania, USA, Panama

    D   Poland, Panama, Ruritania, USA

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28 At 11 years old, the children of parents who smoke are shorter on average than the children of parents who do not smoke. Therefore, parental smoking tends to reduce the growth rate of children up to 11 years old.

Which **one** of the following explains what is wrong with this argument?

    A   By 18 years old the children of parents who smoke might be the same size, on average, as the children of parents who do not smoke.

    B   Lower average heights in 11 year olds may be associated with parental smoking, but not caused by it.

    C   Children of smokers may be shorter on average at 11 years old, but this does not mean that all children of smokers are shorter than all children of non-smokers at this age.

    D   Even though they are shorter, the children of parents who smoke might be better developed in other ways than the children of non-smokers.

29 Julie has a bag of sweets which are red, blue and yellow. She invites Amanda to choose one. The probability of Amanda choosing a red sweet is 30%, and the probability of her choosing a blue one is twice the probability of her choosing a yellow one. What is the minimum number of sweets in the bag.

    A   7

    B   10

    C   14

    D   21

    E   30

30 Doctors in Great Britain can work for the public health service, a commercial service, or both. 30% of doctors in Great Britain work, at least some of the time, for the commercial sector. On the basis of this information alone, deduce which of the following statements are true of doctors in Great Britain.

 1   Some doctors work only in the public health service.
 2   More doctors work in the public health service than the commercial sector.
 3   Some doctors spend more time on commercial work than in the public health service.

A   1 only

B   2 only

C   1 and 2 only

D   2 and 3 only

E   1, 2 and 3

31 Which **two** of these statements are equivalent?

A   Anne is not older than Susan.

B   Susan is younger than Anne.

C   Susan is at least as old as Anne.

D   Anne is not younger than Susan.

32 Recent threats of terrorism in the UK have resulted in fear of air travel, and consequently more people are taking holidays in domestic resorts than abroad. The consequences for road planning, car parking and the rail network are immense, and travel agents risk going out of business. The government must act quickly to plan for these changes in holiday patterns.

Which **one** of the following is an underlying assumption of the above argument?

A   People may be tempted by bargain offers of holidays abroad.

B   The government is not willing to respond to these changes in holiday patterns.

C   People will prefer to use private cars rather than public transport to reach their destination.

D   There has been an over-reaction to threats of terrorism.

E   The change in holiday patterns will be more than a short term phenomenon.

33   Just four horses start in the 3:15 race, a short sprint. They are: Arctic Ape, Bistro, Crackdown and Drumbeat. At the first turn Bistro is ahead of Drumbeat and Crackdown is ahead of Arctic Ape, but nothing more specific is known. By the half way mark the only change is that Drumbeat has dropped back one place. Then, in the last furlong, Bistro moves up one place and that is how they finish.

On the basis of this information, which **one** of the following gives the correct result of the race?

A   1st Crackdown, 2nd Drumbeat, 3rd Arctic Ape

B   1st Bistro, 2nd Crackdown, 3rd Drumbeat

C   1st Bistro, 2nd Drumbeat, 3rd Arctic Ape

D   1st Bistro, 2nd Crackdown, 3rd Arctic Ape

E   1st Drumbeat, 2nd Arctic Ape, 3rd Crackdown

34   A food supplement is diluted from concentrate by adding 8 parts water to 1 part concentrate. By mistake, Jean added $400\,\text{cm}^3$ water to $40\,\text{cm}^3$ concentrate.

What must she add to the resulting mix to obtain the correct concentration?

A $80\,\text{cm}^3$ water

B $320\,\text{cm}^3$ water

C $10\,\text{cm}^3$ concentrate

D $15\,\text{cm}^3$ concentrate

E $50\,\text{cm}^3$ concentrate

35 Figure 1 shows the number of births and deaths recorded during each year, over a ten-year period on an island. The total population at the start of the ten-year period was 100 000 people.

Figure 1
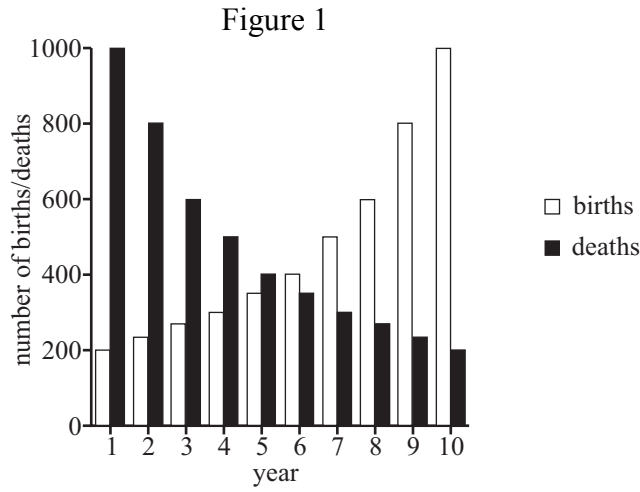
Assuming there is not any immigration or emigration on the island, which of the following shows the total population over the ten-year period?
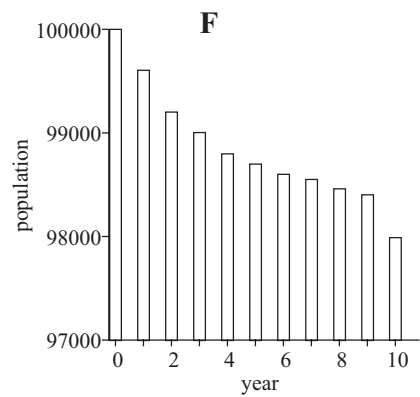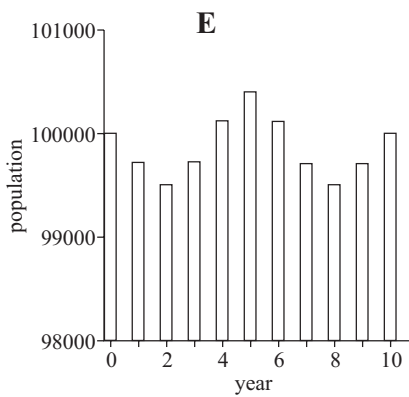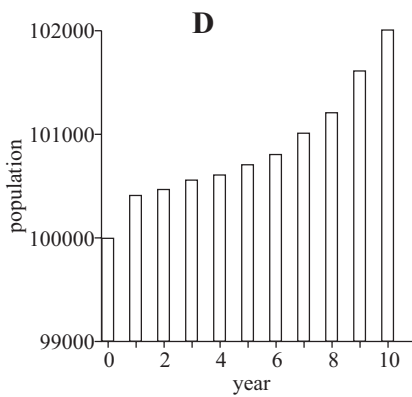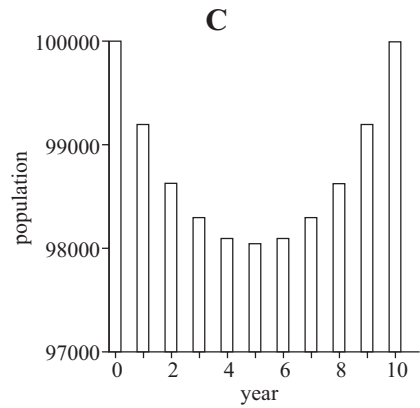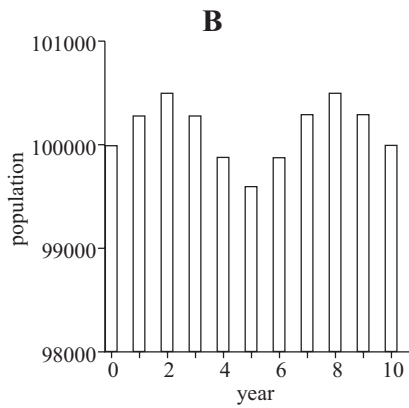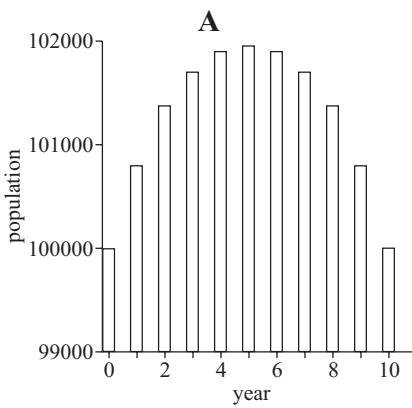
Questions 36 to 40 refer to the following information:

The dates of two of the battles supposedly fought by the semi-legendary King Arthur have caused confusion because there are inconsistencies in the early manuscripts.
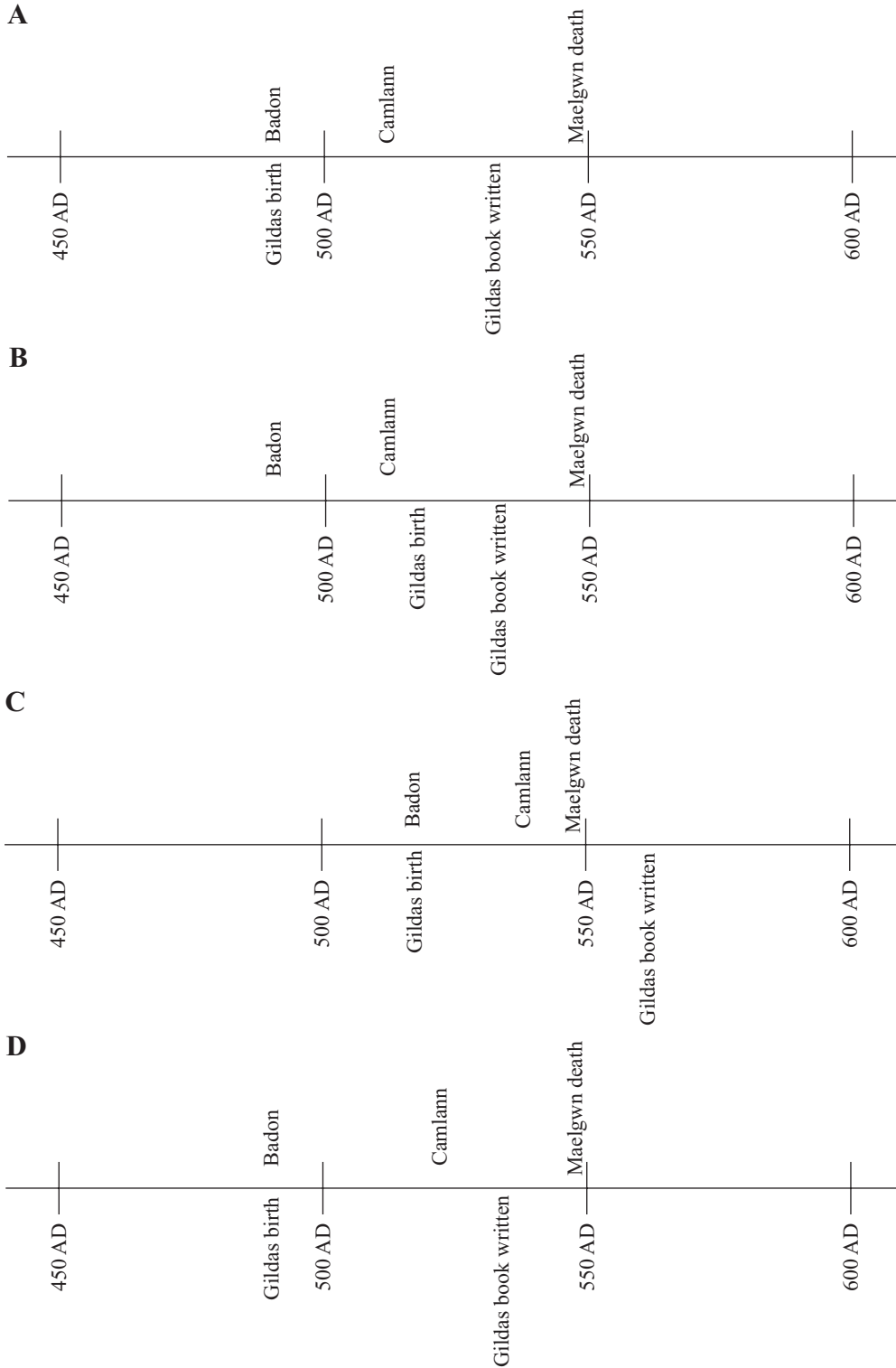
The Welsh Annals give the Battle of Badon as "year 72" and the Battle of Camlann as "year 93". They also record the death of King Maelgwn of Gwynedd as "year 103". There is definite evidence from the calculation of the dates of Easter that "year 9" in the Welsh Annals coincides with 455 AD in our modern dating system.

The dark age historian, Gildas, records these battles without any mention of Arthur. Records indicate that Gildas was born in the year of the battle of Badon and wrote his book "On the Ruin and Conquest of Britain" when he was 43.

However, Maelgwn was still alive when Gildas wrote his book, which is inconsistent with the other dates given by Gildas and the Welsh Annals.

36   If the dates given in the Welsh Annals are correct, when was the Battle of Badon?

   A   455 AD
   B   518 AD
   C   527 AD
   D   539 AD
   E   549 AD

37   Which **one** of the following further pieces of information would confirm the date of the battle of Badon?

   A   The birth date of King Arthur
   B   The death date of King Maelgwn
   C   The birth date of Gildas
   D   The age of King Arthur at the Battle of Badon

38   The most likely explanation for the inconsistency in dates is that the dates in the Welsh Annals, which exist only in a copied form from the 9th century, were too late by 28 years (the length of one of the cycles used in the calculation of the date of Easter). If this is so, when was the battle of Camlann?

   A   490 AD
   B   511 AD
   C   521 AD
   D   539 AD
   E   567 AD

39 The Welsh Annals' date for the death of King Maelgwn is confirmed from other sources. If this, and Gildas, are correct but the Welsh Annals are wrong on the dates of Badon and Camlann, what is the latest possible date for the Battle of Badon?

40 Which **one** of the following time lines best represents the data given by Gildas and the Welsh Annals?

END OF SECTION 1

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