General Certificate of Education
June 2006
Advanced Subsidiary Examination

AQA

ASSESSMENT and
QUALIFICATIONS
ALLIANCE

GENERAL STUDIES (SPECIFICATION A)   **GSA2**
Unit 2   Science, Mathematics and Technology

Monday 22 May 2006   1.30 pm to 2.45 pm

For this paper you must have:
- an objective test answer sheet
- a Data Booklet for Questions 1 to 25 (enclosed)
- a black ball-point pen

You may use a calculator.

Time allowed: 1 hour 15 minutes

Instructions
- Use a black ball-point pen.
- Answer **all** questions.
- Answer **both** Section 1 (Questions 1 to 25) **and** Section 2 (Questions 26 to 50) using the answer sheet provided.
- For each question there are several alternative responses. When you have selected the response which you think is the best answer to a question, mark this response on your answer sheet.
- Mark all responses as instructed on your answer sheet. If you wish to change your answer to a question, follow the instructions on your answer sheet.
- Do all rough work in this book, **not** on your answer sheet.

Information
- The maximum mark for this paper is 50.
- This paper consists of **two** sections.
  Section 1 contains 25 objective test questions based on material provided in a separate Data Booklet.
  Section 2 contains 25 objective test questions testing mathematical reasoning and its application.
- There is 1 mark for each question. No deductions will be made for wrong answers.
- 2 mm graph paper is available from the Invigilator.

GSA2

SECTION 1

Answer **Questions 1** to **25.**

There is 1 mark for each question.

Read the passage entitled **Demographic Difficulties** which is printed in the separate data booklet.

Questions 1 to 20

Each of **Questions 1** to **20** consists of a question or an incomplete statement followed by four suggested answers or completions. You are to select the most appropriate answer (**A** to **D**) in each case.

1   Which of the following pairs shows an r-strategist followed by a k-strategist (paragraphs 2 and 3)?

   A   panda, lion
   B   forget-me-not, bacterium
   C   dandelion, cow
   D   duck, herring

2   Which of the following correctly describes properties of the two different strategies (paragraph 2)?

	r-strategy	k-strategy
A	rear their young	have few offspring
B	large number of eggs	do not rear their young
C	do not rear their young	offspring quite mature
D	most mammals	most birds

3   What is the meaning of cold-blooded (paragraph 2)?

   A   colder than the environment
   B   temperature varies with the environment
   C   warmer than the environment
   D   always at the same temperature

4 Ground-nesting chicks need to be more advanced than tree-nesting chicks (paragraph 3) because

    1   they are more vulnerable to predators.
    2   tree-top nests keep fledglings warm.
    3   there are too many for the parents to bring food.

    Answer

    A   if **1** and **2** only are correct.
    B   if **1** and **3** only are correct.
    C   if **2** and **3** only are correct.
    D   if all are correct.

5 Which of the following must be true when the carrying capacity of a human population is reached?

    1   the birth rate is equal to the death rate
    2   environmental pressures prevent further growth
    3   existing medical knowledge cannot reduce mortality rates
    4   people are generally living longer

    Answer

    A   if **1** and **2** only must be true.
    B   if **1** and **3** only must be true.
    C   if **2** and **4** only must be true.
    D   if **1**, **2** and **3** only must be true.

6 The carrying capacity of an environment will remain stable **only** if

    A   the organisms have no predators.
    B   food production is unchanged.
    C   the organisms are not overcrowded.
    D   the environment does not change.

7 The population growth illustrated in **Figure 1** can best be described as

    A   slow, fast, slow.
    B   fast, slow, fast.
    C   a steady increase.
    D   a steady population.

Turn over ▶

8 Which of the following provides the strongest confirmation that the world's population has not yet reached its carrying capacity (paragraph 6 and **Figure 2**)?

    A   The population is getting older.
    B   The birth rate is still high in some places.
    C   The birth rate is falling in some countries.
    D   The graph's curve has not begun to flatten.

9 Referring to **Figure 2** and paragraph 6, approximately how many times greater is today's population than in the year zero?

    A   5
    B   20
    C   50
    D   100

10 De Wit's 1967 estimate based on photosynthesis of the world's carrying capacity (**Figure 3**) is likely to be wrong because

    A   photosynthesis is dependent on rainfall.
    B   insects and animals eat plants.
    C   many plants cannot be eaten by humans.
    D   humans cannot survive on a plant diet.

11 Looking at the estimates of the carrying capacity for the human population (**Figure 3**), which of the following is likely to be the most accurate?

    A   Ravenstein in 1891
    B   Penck in 1925
    C   Hulett in 1970
    D   Kates in 1991

12 The estimates of the world's carrying capacity by Revelle, Clark and Higgins were all larger than those of Ravenstein and Penck over half a century earlier (**Figure 3**). This is likely to be because

    1   food production increased more than was anticipated during the intervening time.
    2   the mathematical model used for the earlier predictions was wrong.
    3   people are living longer than had been expected.
    4   health care is better than would have been predicted.

    Answer

    A   if **2** and **4** only are correct.
    B   if **1**, **2** and **3** only are correct.
    C   if **1**, **3** and **4** only are correct.
    D   if all are correct.

13 The human population of the world at present is approximately

  A   5.9 billion.
  B   6.3 billion.
  C   9 billion.
  D   40 billion.

14 Referring to **Figure 4**, which of the following statements is/are correct?

  1   A high birth rate and a high death rate can produce a low population.
  2   If the death rate falls then the population may rise.
  3   If the birth rate and the death rate both fall then the population must fall.
  4   A low birth rate and a low death rate can produce a high population.

  Answer

  A   if **2** and **3** only are correct.
  B   if **1**, **2** and **3** only are correct.
  C   if **1**, **2**, and **4** only are correct.
  D   if all are correct.

15 Which of the following combinations will result in an increase in a population (**Figure 4**)?

  1   birth rate constantly high and death rate declines
  2   birth rate declines and death rate rises
  3   birth rate and death rate decline at the same rate
  4   birth rate high and death rate lower, both constant

  Answer

  A   if **1** and **3** only are correct.
  B   if **1** and **4** only are correct.
  C   if **2** and **4** only are correct.
  D   if **1**, **2** and **3** only are correct.

16 According to **Figure 5**, the highest recorded birth rate per thousand of the population in England and Wales since 1700 is

  A   30
  B   33
  C   35
  D   38

17 If fertility rates are below replacement level in 75% of the world by 2050 (paragraph 10) it implies that

    A   the other 25% will be reproducing rapidly.
    B   population growth will slow.
    C   famine will increase.
    D   demand for clean water will reduce.

18 Each of the following is a cause of death rates increasing **except**

    A   the number of AIDS cases in Africa continues to rise.
    B   some diseases are becoming resistant to existing antibiotics.
    C   new diseases are always evolving.
    D   people are living longer.

19 The head of the United Nations Population Division has reduced his estimate of the world's population from 9.3 billion to

    A   9.1 billion.
    B   9.0 billion.
    C   8.9 billion.
    D   6.3 billion.

20 How is the overall conclusion of the passage best summarised?

    A   Urgent measures to increase birth control should be adopted.
    B   The world's population may not grow as quickly as earlier predictions suggested.
    C   People will live longer and longer.
    D   The carrying capacity will soon be reached.

Questions 21 to 25

For each of **Questions 21** to **25** you are given an assertion followed by a reason. Consider the assertion and decide whether, on its own, it is a true statement. If it is, consider the reason and decide if it is a true statement. If, and only if, you decide that *both* the assertion and the reason are true, consider whether the reason is a valid or true explanation of the assertion. Choose your answer (**A** to **D**) as follows and indicate your choice on the answer sheet.

	Assertion	Reason	Argument
			Directions summarised
A	True	True	Reason is **a correct** explanation of assertion
B	True	True	Reason is **not a correct** explanation of assertion
C	True	False	Not applicable
D	False	–	Not applicable

ASSERTION   **REASON**

21   Human reproductive style is   because   a lot of energy is used in the rearing
described as following the   of offspring.
k-strategy

22   The fertilised eggs of aquatic   because   most r-strategy animals are cold-
animals (paragraph 2) will be   blooded and cannot regulate their
suited to the even temperature   temperature.
of water

23   According to paragraph 8,   because   they will be dependent on their
more young people going to   parents for longer.
university will increase the
birth rate

24   Serious epidemics could reduce   because   the death rate could become greater
the world population   than the birth rate.

25   The writer implies (paragraph 10) because   a high proportion of people will
that the world's population   survive AIDS.
will rise

Turn over for Section 2

SECTION 2

Answer **Questions 26** to **50**.

There is 1 mark for each question.

For each of **Questions 26** to **50** choose the answer you consider the best of the alternatives offered in **A, B, C** and **D**. You are reminded that graph paper is available on request from the Invigilator.

Questions 26 to 28

A catering company uses the formula

$$C = 400 + 10(N - 20) \qquad (N > 0)$$

to calculate the cost, £C, for a party of N people.

26 The cost of catering for a party of 380 people is

- **A** £2200
- **B** £4000
- **C** £4180
- **D** £4400

27 When the catering charge is £2000 the number of people is

- **A** 24
- **B** 160
- **C** 180
- **D** 220

28 Each of the following is a correct rearrangement of the formula **except**

- **A** $N = 0.1(C - 200)$

- **B** $N = \dfrac{C}{10} - 20$

- **C** $N = \dfrac{(C - 400) + 200}{10}$

- **D** $N = \dfrac{(C - 400)}{10} - 20$

29 A gas bill is made up of a fixed standing charge plus a charge that is proportional to the number of units of gas used.

A graph showing how the total bill is related to the number of units of gas used is of the form
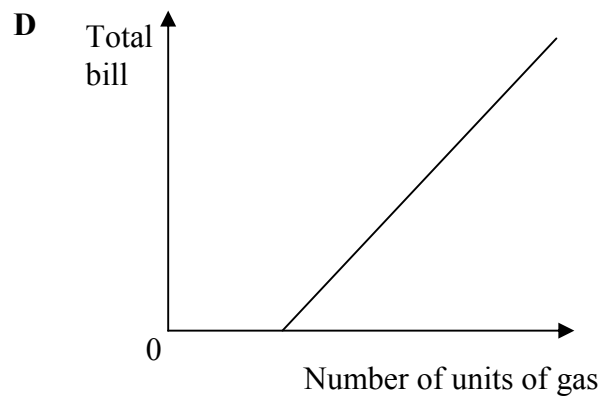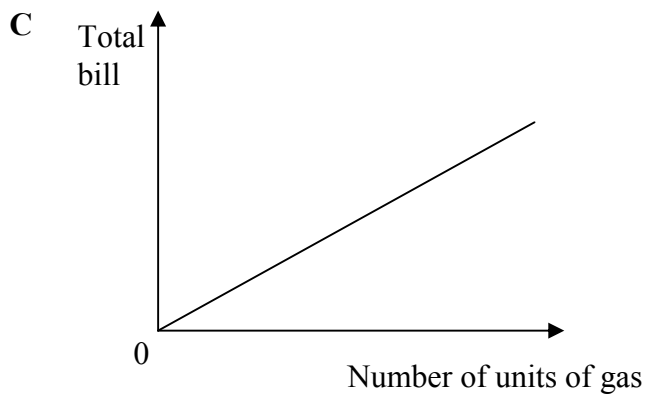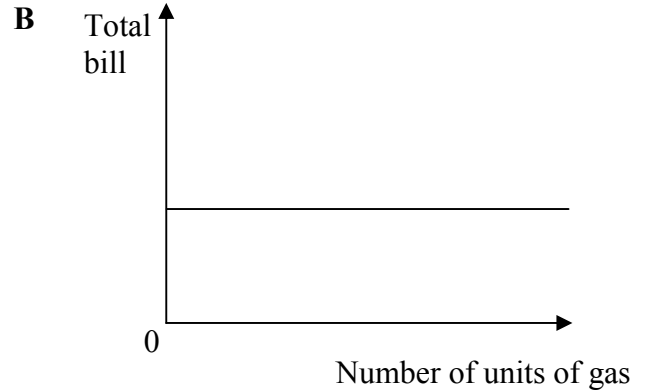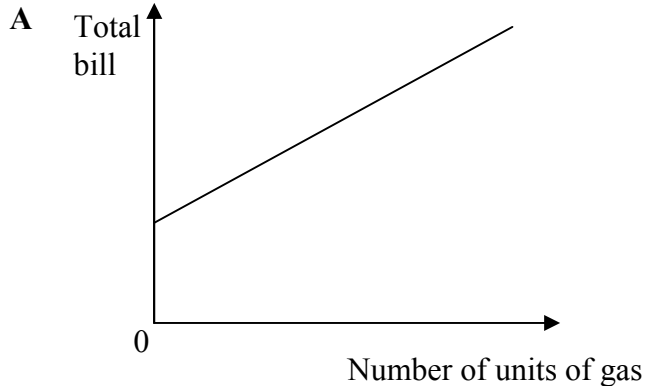
30 The concentrations of blood sugar (mmol/l) for a sample of 12 sixth form students were measured as

4.2   3.9   3.7   4.5   5.0   3.8   4.1   4.2   5.1   4.6   3.9   3.7

The median blood sugar concentration for this sample is

A   3.8
B   3.95
C   4.1
D   4.15

Turn over ▶

Questions 31 and 32

The table below shows the number of road deaths per 100 000 population in the year 2000 for some countries in Europe.

ROAD DEATHS Per 100 000 population in the year 2000	
Spain	14.6
Italy	11.0
Germany	9.1
Sweden	6.7
United Kingdom	6.0

31 The populations in the year 2000 of four of the countries in the table are given below.

Spain	40 million
Italy	58 million
Germany	83 million
United Kingdom	60 million

Which of the following lists these countries in descending order of the actual number of road deaths in 2000?

A   Germany, Italy, Spain, United Kingdom
B   Germany, United Kingdom, Italy, Spain
C   Spain, Italy, Germany, United Kingdom
D   United Kingdom, Germany, Italy, Spain

32 From other data it is known that there were 590 road deaths in Sweden in the year 2000. What was the approximate population of Sweden in the year 2000?

A   1 million
B   4 million
C   9 million
D   40 million

Questions 33 and 34

p, q, r and s are four positive numbers and $p > q > r > s$.

33 Which of these will have the greatest value?

A $\dfrac{p + q}{r + s}$

B $\dfrac{p - q}{r + s}$

C $\dfrac{p + q}{r - s}$

D $\dfrac{p - q}{r - s}$

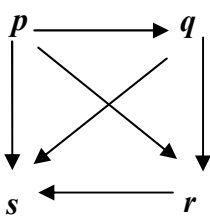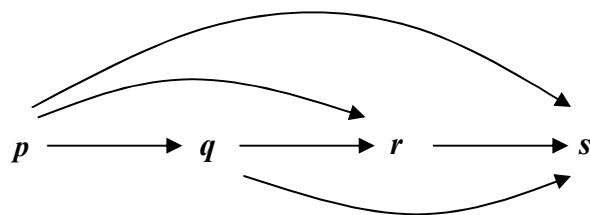**34** Which diagram does **not** show the relationship 'is greater than' for p, q, r and s?

A
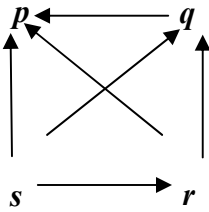
B
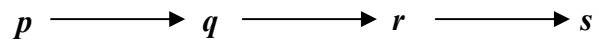
C

D

Turn over ▶

Questions 35 and 36

The masses in grams of 50 freshwater shrimps were recorded to 1 decimal place.

The data are summarised in the table.

Mass of shrimp (g)	Number of shrimps
2.2 - 2.4	5
2.5 - 2.7	9
2.8 - 2.9	14
3.0 - 3.1	15
3.2 - 3.4	7
Total	50

35 An estimate of the mean mass of the shrimps in this sample is

    A   2.80 g
    B   2.82 g
    C   2.87 g
    D   2.94 g

36 A histogram to illustrate the masses of shrimps in the sample is
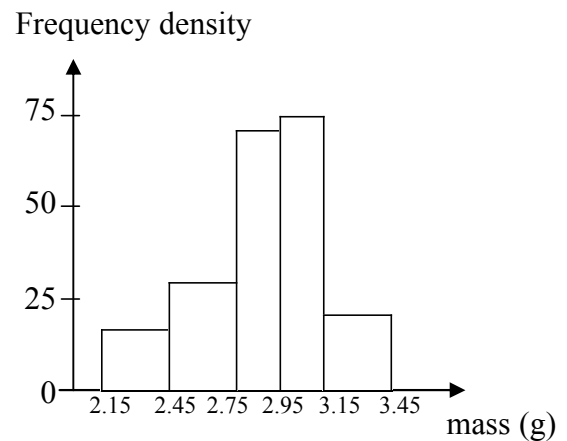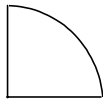
A
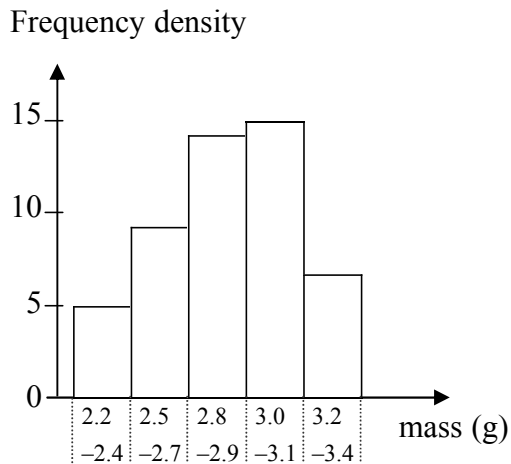
B
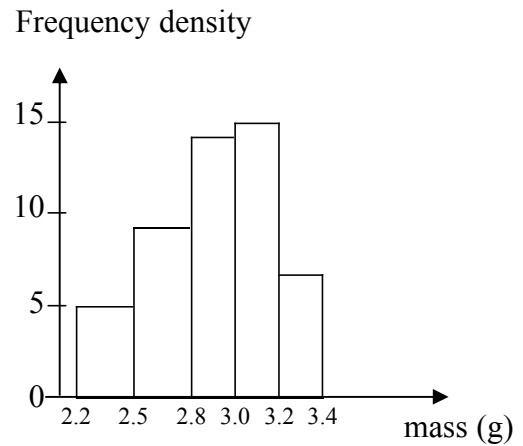
C
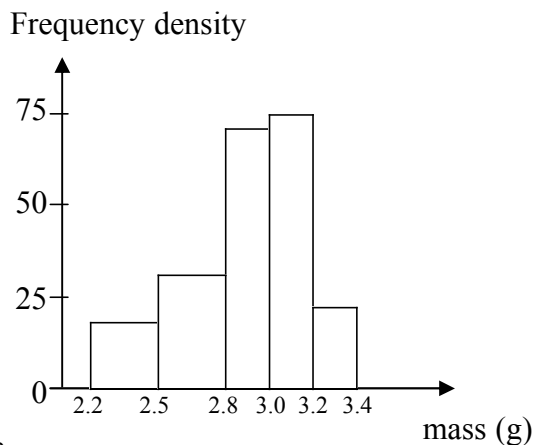
D

37 In July 2003 a Eurostar passenger train set a British rail speed record when it covered a section of track in Kent at 208 miles per hour. Given that 1 mile = 1.61 km, the best estimate of the speed of the train in metres per second is

A $36\,\text{ms}^{-1}$
B $93\,\text{ms}^{-1}$
C $130\,\text{ms}^{-1}$
D $335\,\text{ms}^{-1}$

Questions 38 to 40

A quadrant of a circle has a radius of 3 cm.

38 What is the area of the quadrant, to the nearest square centimetre?

A $5\,\text{cm}^2$
B $7\,\text{cm}^2$
C $22\,\text{cm}^2$
D $28\,\text{cm}^2$

39 What is the perimeter of the quadrant, to the nearest centimetre?

A 8 cm
B 10 cm
C 11 cm
D 13 cm

40 Which of the following statements is/are true?

1 The quadrant has 1 line of symmetry.
2 The quadrant has rotational symmetry of order 4.

Answer

A if both **1** and **2** are true.
B if **1** alone is true.
C if **2** alone is true.
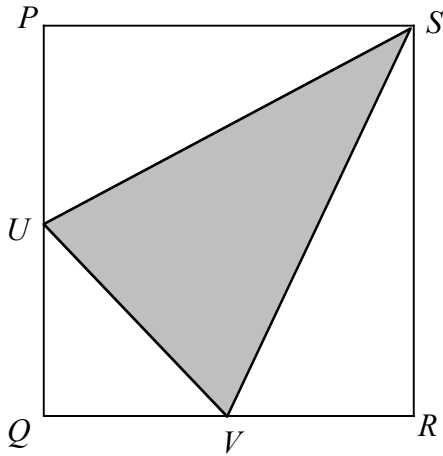**D** if neither **1** nor **2** is true.

Turn over ▶

41 In a national lottery game, six different winning numbers are drawn at random from the numbers 1 to 49 inclusive.

If the first number drawn is an even number, what is the probability that the second number is odd?

A $\dfrac{24}{48}$

B $\dfrac{24}{49}$

C $\dfrac{25}{48}$

D $\dfrac{25}{49}$

42

In the diagram, *PQRS* is a square with sides of length 1 unit. *U* is the mid-point of *PQ* and *V* is the mid-point of *QR*. What is the area of the triangle *UVS*?
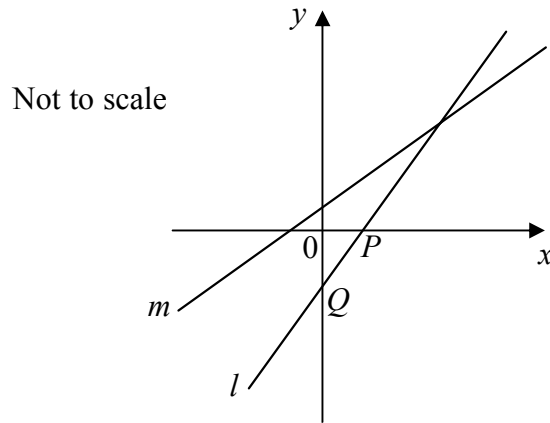
A $\dfrac{3}{8}$

B $\dfrac{1}{2}$

C $\dfrac{5}{8}$

D $\dfrac{3}{4}$

Questions 43 and 44

The sketch shows the approximate position of two lines *l* and *m*.

The line labelled *l* has the equation $y = 5x - 3$.
It crosses the *x*-axis at the point *P* and the *y*-axis at the point *Q*.

Not to scale

43 The coordinates of points *P* and *Q* are respectively

    A $P(\frac{3}{5}, 0)$ and $Q(0, -3)$.

    B $P(-3, 0)$ and $Q(\frac{3}{5}, 0)$.

    C $P(\frac{5}{3}, 0)$ and $Q(0, -3)$.

    D $P(0, -3)$ and $Q(\frac{5}{3}, 0)$.

44 Which of these could be the equation of the line labelled *m*?

    1 $y = 4x - 2$
    2 $y = 4x + 2$
    3 $y = 5x + 2$

Answer

    A   if **1** alone is correct.
    B   if **2** alone is correct.
    C   if **1** and **2** only are correct.
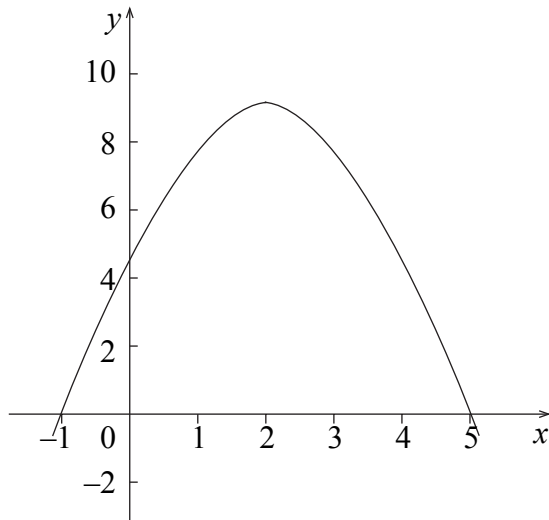   **D**   if **2** and **3** only are correct.

Turn over ▶

45 The value of a computing system, initially costing £25 000, is assumed to depreciate at a rate of 20% each year.

To the nearest £50, what is the value of the computing system after 3 years?

A   £20 000
B   £12 800
C   £10 000
D   £5 000

46

The graph of $y = 5 + 4x - x^2$ is shown in the diagram. How many times does the line $2x + y = 10$ cut this curve?

A   0
B   1
C   2
D   3

47 Rosie is taller than Steph and Tanya.
Tanya is shorter than Ursula, but is taller than Steph.
Vicki is taller than Rosie, but shorter than Ursula.
The girls stand in a line in order of height.
The order is

A   Steph, Tanya, Rosie, Ursula, Vicki.
B   Tanya, Steph, Ursula, Rosie, Vicki.
C   Steph, Tanya, Rosie, Vicki, Ursula.
D   impossible to determine.

48   *p* and *q* are two numbers that add up to 100.
        If also *pq* = 2304 which of these equations could be solved to give the value of *p*?

1 $\dfrac{100}{p} = 2304 - p$

2 $100 - p = \dfrac{2304}{p}$

3 $100 = 2304p - p^2$

4 $p^2 + 2304 = 100p$

Answer

A	if **1** and **3** only.
B	if **2** and **4** only.
C	if **1**, **2** and **3** only.
D	if **2**, **3** and **4** only.

49   A rectangle is drawn with its corners on the circumference of a circle of diameter 10 cm as shown. The angle between the diagonal of the rectangle and one of its sides is 30°.

Not to scale
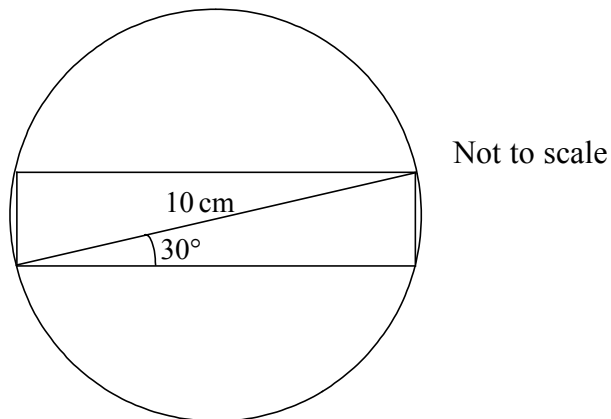
The area of the rectangle is approximately

A	43 cm²
B	57 cm²
C	87 cm²
D	100 cm²

Turn over ▶

50 Two pieces of information, *P* and *Q,* and a statement *S*, are given below.

P: $x^2 = 1$

Q: $x < 0$

S: $x = -1$

Answer

A if *S* can be deduced by using neither *P* nor *Q*.
B if *S* can be deduced by using *P* alone but not *Q* alone.
C if *S* can be deduced by using *Q* alone but not *P* alone.
D if *S* can be deduced only by using both *P* and *Q*.

END OF QUESTIONS

There are no questions printed on this page

There are no questions printed on this page

General Certificate of Education
June 2006
Advanced Subsidiary Examination

GENERAL STUDIES (SPECIFICATION A)   GSA2
Unit 2   Science, Mathematics and Technology

Data Booklet

Data Booklet for use with **Section 1 Questions 1** to **25**

PASSAGE AND FIGURES FOR QUESTIONS 1 TO 25

Consider the following passage and **Figures 1** to **5**.

Demographic Difficulties

(1)   The world's human population has been growing significantly during the last century, and at present is continuing to do so at a significant rate. This growth cannot continue indefinitely, however, and this passage considers some of the issues associated with the size of the world's population in the future.

(2)   If organisms do not reproduce they will become extinct within one generation. For reproduction, all organisms use a proportion of the energy they have available to them. They may use this energy to produce large numbers of fertilised eggs, which are then left to develop on their own, or they may produce fewer offspring at a more mature stage, and use more energy to rear them. We describe these alternative reproductive styles as 'r-strategy'– where many offspring are produced, and 'k-strategy' – where the energy is used in rearing. R-strategists tend to be plants, or animals which are both aquatic and cold-blooded, since an aquatic environment will provide nutrients, support and a constant temperature.

(3)   K-strategists vary in the number of offspring. For instance, ground-nesting birds often have larger numbers of offspring that are at a more developed stage (i.e. able to run about and feed themselves on hatching) than do tree-nesting birds. Parent tree-nesters spend many hours providing food for their relatively undeveloped young.

(4)   For all organisms, however, whether r-strategists or k-strategists, in a perfect and limitless environment population size increases exponentially, but in practice when populations reach a certain size environmental pressures prevent further growth. Births and deaths then balance and the population stabilises. The size of this stable population is known as the carrying capacity.

Figure 1: Pattern of population growth
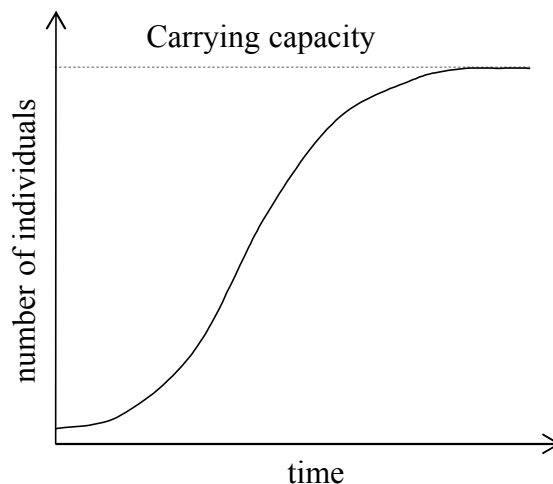
(5)   Human beings operate a k-strategy, and human infants have a long period of dependency on their parents. The natural gap between offspring is in the region of two years, which implies that each woman is capable of producing in the region of fifteen living offspring. Very few women, however, ever used to reach that maximum and even fewer do so now. In primitive societies the population grows only slowly because of high infant mortality and high maternal mortality, both of which result in the mean number of living offspring per woman falling well short of the maximum. However, even small improvements in public health can cause a rapid population rise as fewer infants and mothers die.

(6)   Globally, the human population does not yet seem to have reached its carrying capacity. Estimations of the world's carrying capacity have varied from 1 billion to 1000 billion. Currently the world population is approximately 6300 million and it is estimated that this will rise to about 9 billion by 2050.

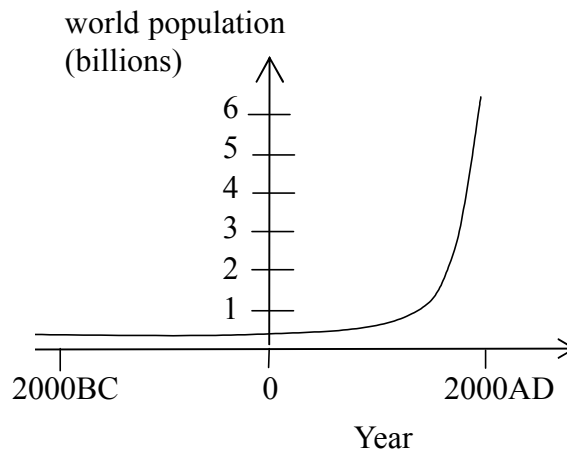**Figure 2: World population over the last 4000 years**

Figure 3: Estimated world carrying capacity

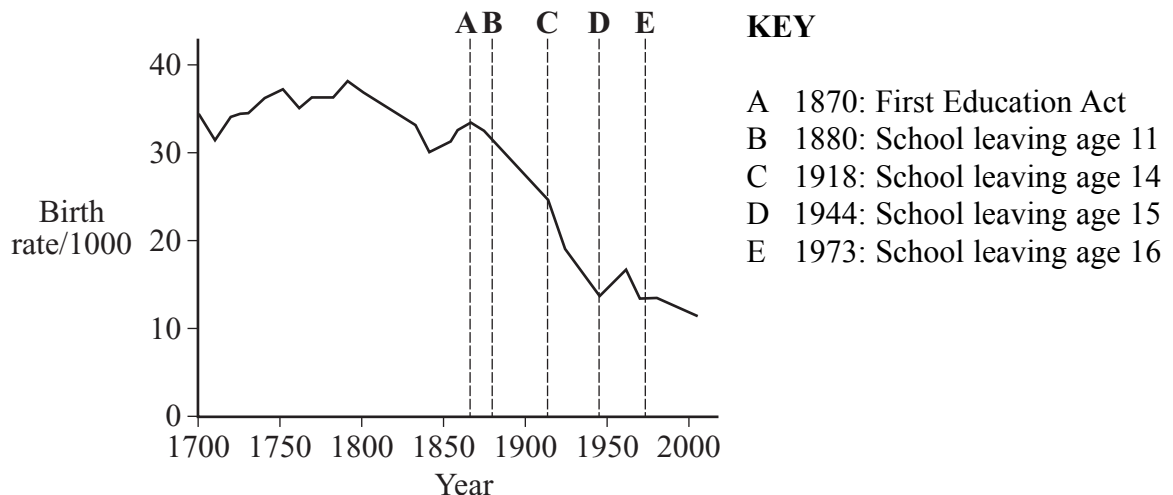| Predictions for the world's future carrying capacity			
Author	**Year**	**Predicted carrying capacity (billion)**	**Basis of prediction**
Ravenstein	1891	6	Food production
Penck	1925	8–16	Food production
De Wit	1967	1000	Photosynthesis
Hulett	1970	1	Food production
Revelle	1976	40	Food production
Clark	1977	28–157	Food production
Higgins et al	1983	33	Food production
Kates et al	1991	2.9–5.9	Food production

Turn over ▶

(7)   This 'global picture' masks huge variations in population patterns across the world. In many developed countries (including the UK) birth rates are now below replacement levels. Populations are still growing only because people are living longer – they have undergone a demographic transition. This ageing of the population in developed countries has been referred to as a 'demographic time bomb'.

Figure 4: An example of demographic transition
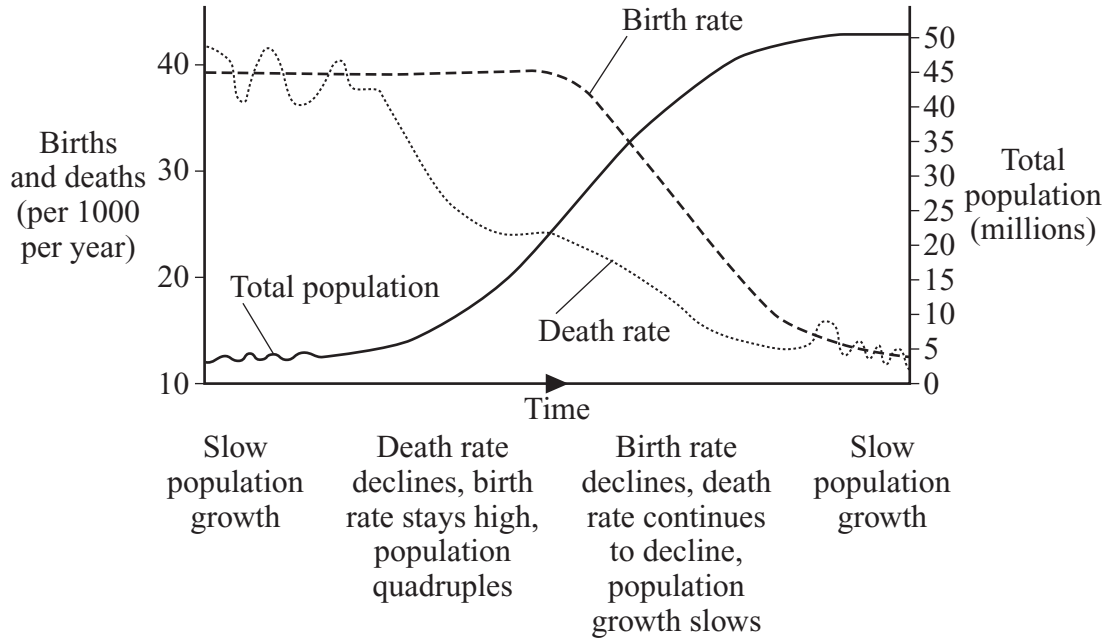
(8)   Elsewhere, in societies dependent on subsistence agriculture, children are able to contribute to the family welfare from a very young age, and to provide a net gain to the family from the age of puberty. In developed countries, however, the period of dependency of children has been artificially extended.   Prolonging the period of dependency increases the demand on k-strategy reproducers and the biological response is to have fewer offspring. This implies that any action that increases the period of dependency, for instance raising the school-leaving age, will result in a lowered birth rate, and that this effect will occur before the later-leaving students themselves reach reproductive age.

Figure 5: Birth rate in England and Wales since 1700

KEY

A   1870: First Education Act
B   1880: School leaving age 11
C   1918: School leaving age 14
D   1944: School leaving age 15
E   1973: School leaving age 16

(9)   Consequently, in recent years most of the world's population growth has come from the less economically developed regions, particularly from China, Africa and the Indian sub-continent. While China has responded with the 'one child' policy and India has used many strategies to encourage the use of birth control, in much of Africa little or nothing has been done.

(10)   Is it likely that the world population will increase by almost 50% in the next 50 years? The greying of the population in developed countries will reach its natural halt long before 2050 – all the evidence seems to indicate that while many more people will reach very old age (90+), the maximum length of life is unlikely to be greatly extended. Demographic predictions assume that there is no increase in death rates and that the determinant of population size is the birth rate. However, across sub-Saharan Africa the AIDS epidemic is raging unchecked; in Zimbabwe it is estimated that 30% of the population is HIV positive. Many lethal diseases are developing resistance to the drugs used to treat them, and there is always the possibility of the evolution of a new and untreatable disease. The head of the United Nations Population Division reduced his 2002 estimate of 9.3 billion by 400 million in March 2003, and it may yet need to be further reduced. He also stated that "fertility rates will be below replacement level in three-quarters of the world by 2050."

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