X007/701

BIOLOGY
ADVANCED HIGHER

SECTION A—Questions 1–25 (25 marks)

Instructions for completion of Section A are given on *Page two*.

SECTIONS B AND C

The answer to each question should be written in ink in the answer book provided. Any additional paper (if used) should be placed inside the front cover of the answer book.

Rough work should be scored through.

Section B (55 marks)

All questions should be attempted. Candidates should note that Question 8 contains a choice.

Question 1 is on Pages 10, 11 and 12. Questions 2, 3 and 4 are on Page 13. Pages 12 and 13 are fold-out pages.

Section C (20 marks)

Candidates should attempt the questions in **one** unit, **either** Biotechnology **or** Animal Behaviour **or** Physiology, Health and Exercise.

SQA ©

Read carefully

1 Check that the answer sheet provided is for **Biology Advanced Higher (Section A)**.

2 For this section of the examination you must use an **HB pencil** and, where necessary, an eraser.

3 Check that the answer sheet you have been given has **your name**, **date of birth**, **SCN** (Scottish Candidate Number) and **Centre Name** printed on it.

Do not change any of these details.

4 If any of this information is wrong, tell the Invigilator immediately.

5 If this information is correct, **print** your name and seat number in the boxes provided.

6 The answer to each question is **either** A, B, C or D. Decide what your answer is, then, using your pencil, put a horizontal line in the space provided (see sample question below).

7 There is **only one correct** answer to each question.

8 Any rough working should be done on the question paper or the rough working sheet, **not** on your answer sheet.

9 At the end of the exam, put the **answer sheet for Section A inside the front cover of the answer book**.

Sample Question

Which of the following molecules contains six carbon atoms?

A Glucose

B Pyruvic acid

C Ribulose bisphosphate

D Acetyl coenzyme A

The correct answer is **A**—Glucose. The answer **A** has been clearly marked in **pencil** with a horizontal line (see below).
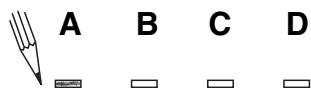
Changing an answer

If you decide to change your answer, carefully erase your first answer and using your pencil, fill in the answer you want. The answer below has been changed to **D**.
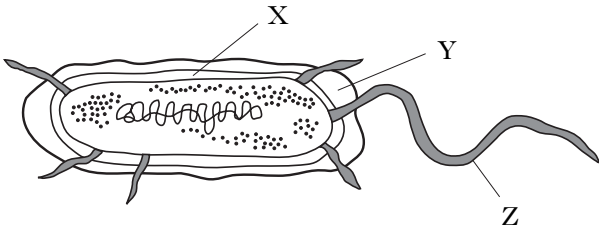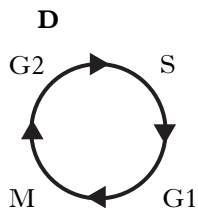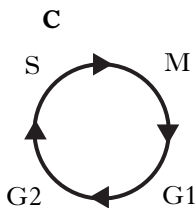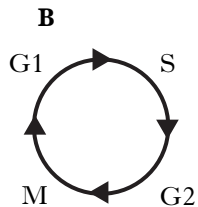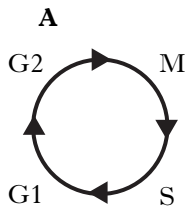
1. The diagram shows a bacterial cell.

Which line in the table below correctly identifies the labelled structures?

	X	Y	Z
A	cell wall	capsule	flagellum
B	capsule	cell wall	flagellum
C	cell wall	capsule	pilus
D	capsule	cell wall	pilus

2. Which of the following diagrams best represents the sequence of phases involved in the cell cycle?

3. The covalent chemical bonds between nucleotides in DNA are

A peptide

B phosphodiester

C glycosidic

D hydrogen.

4. Which line in the table below classifies correctly the four bases in DNA as either purines or pyrimidines?

	Purines	*Pyrimidines*
A	adenine and thymine	cytosine and guanine
B	cytosine and guanine	adenine and thymine
C	cytosine and thymine	adenine and guanine
D	adenine and guanine	cytosine and thymine

5. The table below shows the number of cells from a cell culture at different points in the cell cycle.

Stage	*Number of cells*
Interphase	462
Prophase	23
Metaphase	24
Anaphase	4
Telophase	16

The mitotic index of the sample is

A 14·5%

B 12·7%

C 85·5%

D 74·7%.

[Turn over

6. The percentage of adenine bases in a double stranded DNA molecule is 30% and in a single stranded RNA molecule it is 25%.

Which line in the table below shows the number of other bases in each molecule for which the percentage could be calculated?

	RNA	DNA
A	none	three
B	none	none
C	one	two
D	one	three

7. During a biochemical reaction the transfer of a phosphate group from one molecule to another is catalysed by

A ligase

B ATPase

C kinase

D nuclease.

8. The diagram below shows an enzyme-catalysed reaction.
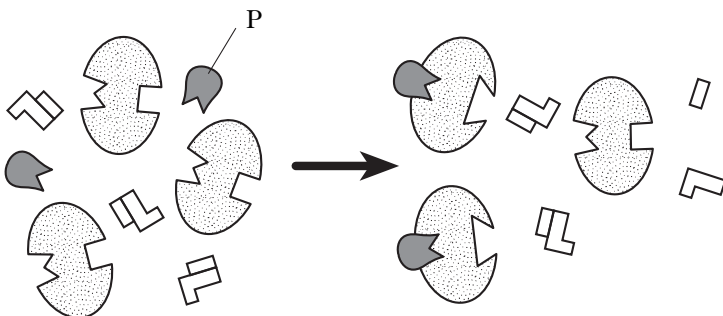
Which of the following correctly identifies molecule P?

A Substrate

B Activator

C Competitive inhibitor

D Non-competitive inhibitor

9. The diagram below shows the changes in the activity of enzymes that synthesise tryptophan and utilise lactose in a cell after the addition of tryptophan and lactose.
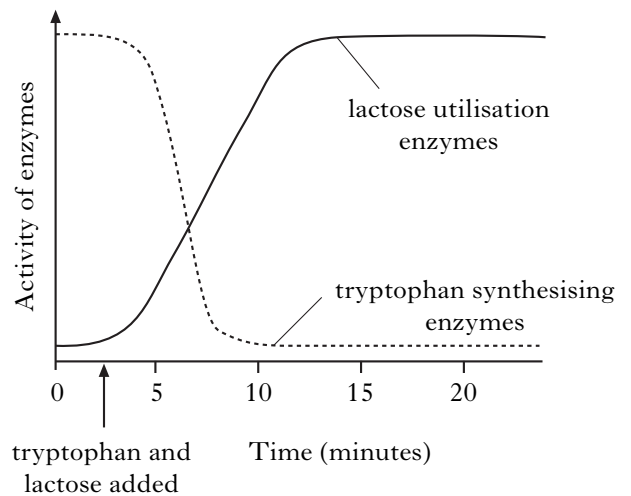
What valid conclusion may be made from the graph?

A Addition of lactose acts as a negative enzyme modulator.

B Addition of tryptophan acts as a positive enzyme modulator.

C Enzyme induction is occurring in lactose utilisation enzymes.

D Enzyme induction is occurring in tryptophan synthesising enzymes.

10. During the production of transgenic plants, which of the following bacteria would be used to transfer recombinant plasmids into plant protoplasts?

A *Agrobacterium*

B *E. coli*

C *Pseudomonas*

D *Rhizobium*

11. The diagram below shows the restriction enzyme sites in a plasmid that carries the genes for resistance to the antibiotics ampicillin and tetracycline.

*Bam*HI

gene encoding
resistance to
ampicillin

*Pst*I

restriction
sites

gene encoding
tetracycline
resistance
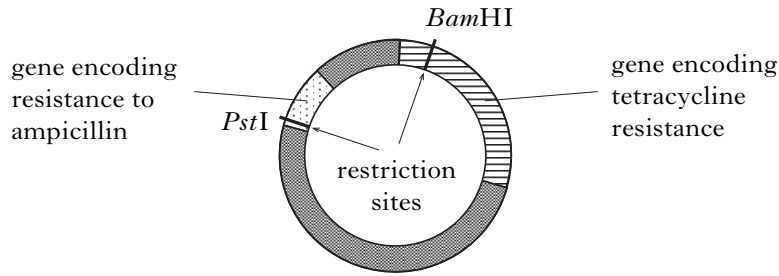
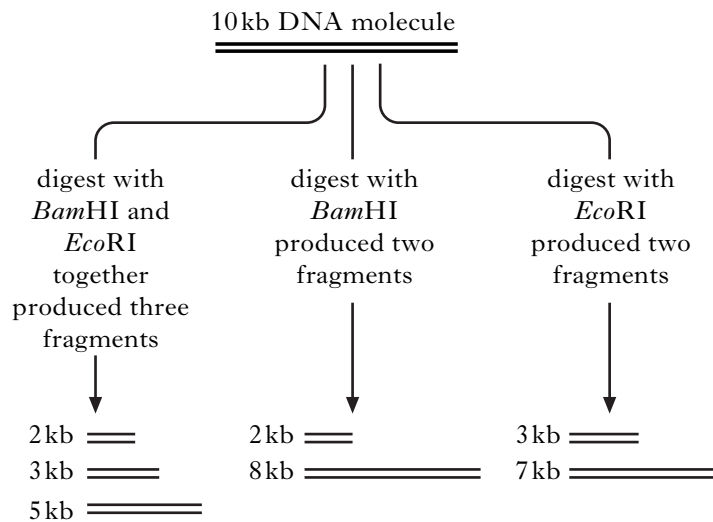Which line in the table below identifies correctly the antibiotic resistance that would remain when a gene is inserted at these restriction enzyme sites?

	Gene inserted into restriction enzyme site	*Antibiotic resistance remaining*
A	*Bam*HI	tetracycline and ampicillin
B	*Pst*I	ampicillin
C	*Pst*I	tetracycline and ampicillin
D	*Bam*HI	ampicillin

12. A piece of DNA was digested using the restriction enzymes *Bam*HI and *Eco*RI. The results are shown below.

10 kb DNA molecule

digest with
*Bam*HI and
*Eco*RI
together
produced three
fragments

digest with
*Bam*HI
produced two
fragments

digest with
*Eco*RI
produced two
fragments

2 kb
3 kb
5 kb

2 kb
8 kb

3 kb
7 kb

Which of the following restriction maps can be drawn from these results?

*Bam*HI   *Eco*RI
A   5 kb   3 kb   2 kb

*Bam*HI   *Eco*RI
B   5 kb   2 kb   3 kb

*Bam*HI   *Eco*RI
C   2 kb   5 kb   3 kb

*Bam*HI   *Eco*RI
D   2 kb   3 kb   5 kb
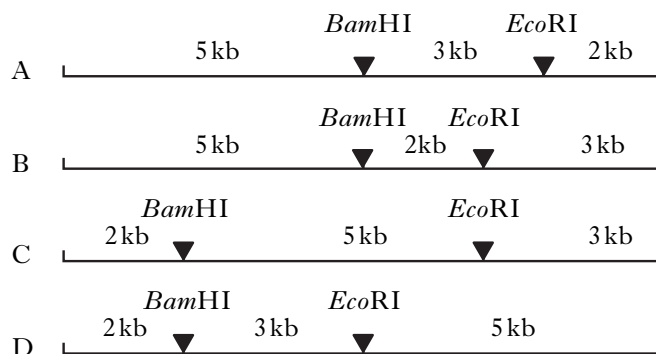
13. The graph below shows variation in biomass throughout one year in an aquatic ecosystem.
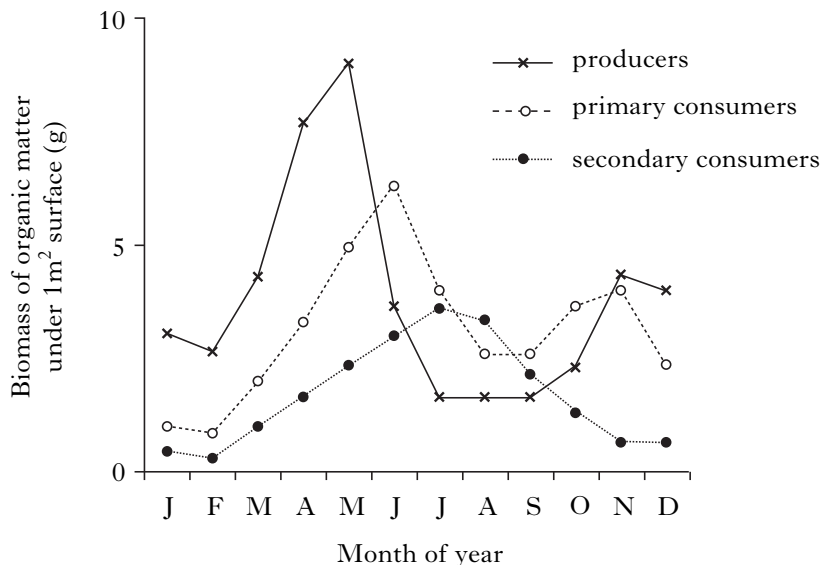
During which month of the year would the following pyramid of biomass be applicable?

Secondary consumers

Primary consumers

Producers
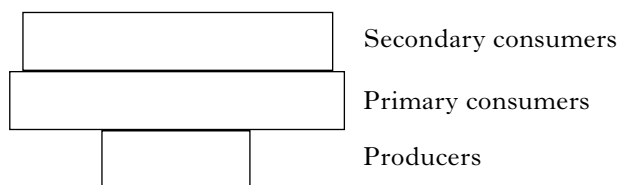
- A   June
- B   July
- C   August
- D   September

14. The table below shows measurements of energy in a grassland ecosystem.

	Units of energy m^{-2} $year^{-1}$
Solar energy entering ecosystem	471·00
Fixed in photosynthesis	5·83
Released in respiration by autotrophs	0·88

What is the net productivity (*units of energy m^{-2} $year^{-1}$*) for this ecosystem?

- A   4·95
- B   6·71
- C   465·17
- D   470·12

15. Which of the following statements best describes a detritivore?

- A   Micro-organism with external enzymatic digestion
- B   Micro-organism with internal enzymatic digestion
- C   Invertebrate with external enzymatic digestion
- D   Invertebrate with internal enzymatic digestion

16. The release of nutrients from the remains of dead organisms in the soil is called

- A   assimilation
- B   humus formation
- C   mineralisation
- D   nitrification.

17. Which of the following promotes the loss of nitrogen from soil due to the activity of denitrifying bacteria?

A   Leaching of nitrate from soil in drainage water

B   Anaerobic conditions caused by water saturation

C   High levels of phosphate from addition of fertilisers

D   The presence of a leguminous crop such as clover

18. A flask containing a solution of ammonium salts was set up to demonstrate the activity of some of the micro-organisms involved in the nitrogen cycle. A sample of fresh soil was added to the solution and the concentration of nitrite measured over several weeks. The results are shown in the graph below.
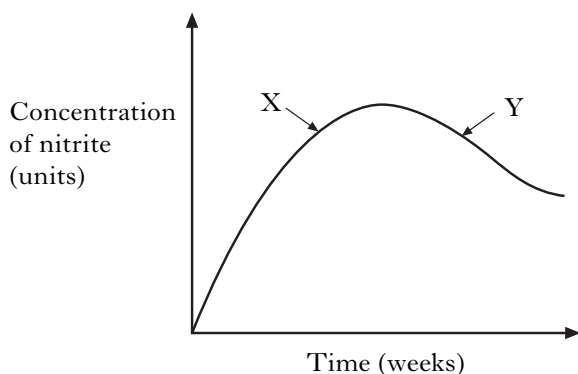
Which line in the table below correctly represents bacterial activity which can account for the changes shown at X and Y?

	Bacteria active at X	*Bacteria active at Y*
A	*Nitrosomonas*	*Rhizobium*
B	*Nitrobacter*	*Nitrosomonas*
C	*Nitrobacter*	*Rhizobium*
D	*Nitrosomonas*	*Nitrobacter*

19. Coral snakes are highly venomous and have a pattern of dark red, yellow and black bands.

This is an example of

A   aposematic colouration

B   Batesian mimicry

C   camouflage

D   Mullerian mimicry.

20. A species of Latin American ant inhabits the thorns of a species of *Acacia*. The ant receives nectar and shelter from the plant. The plant receives protection from the ants.

This is an example of

A   parasitism

B   commensalism

C   mutualism

D   predation.

21. *Hydra* is a small freshwater animal that uses its tentacles to catch food. One variety (green hydra) has photosynthetic algae living in its tissues. Another variety (colourless hydra) has no algae.
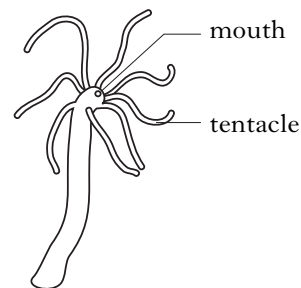
The relationship between *Hydra* and the algae is believed to be an example of mutualism.

Under what conditions would a comparison of the growth rates of green and colourless *Hydra* test this hypothesis?

A   Light; food supplied

B   Light; no food supplied

C   Dark; food supplied

D   Dark; no food supplied.

[Turn over

22. Animals may interact with their environment by conformation or regulation. Each statement below applies to one of these interactions.

1 A wide range of habitats can be occupied.
2 A restricted range of habitats can be occupied.
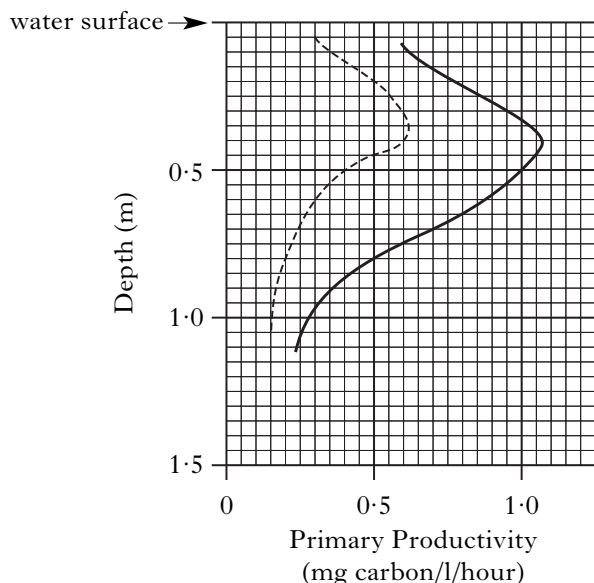3 There is a high energy cost.
4 There is no energy cost.

Which statements apply to regulation?

A 1 and 3 only

B 1 and 4 only

C 2 and 3 only

D 2 and 4 only

23. The graph below shows primary productivity in a loch at different depths. Data were collected before and after an experiment in which phosphate was added to the loch.

Key
before phosphate added ------
after phosphate added ———

Calculate the percentage increase in productivity at a depth of 0·5 m that results from the addition of phosphate.

A 60%

B 75%

C 150%

D 300%

24. Which line in the table correctly identifies the effect of each pollutant?

	Biomagnification	Eutrophication	Global warming
A	phosphate	DDT	CFCs
B	DDT	phosphate	CFCs
C	CFCs	phosphate	DDT
D	DDT	CFCs	phosphate

25. The concentrations of some toxic organic chemicals in sea water were compared to concentrations known to produce lethal effects in laboratory experiments.
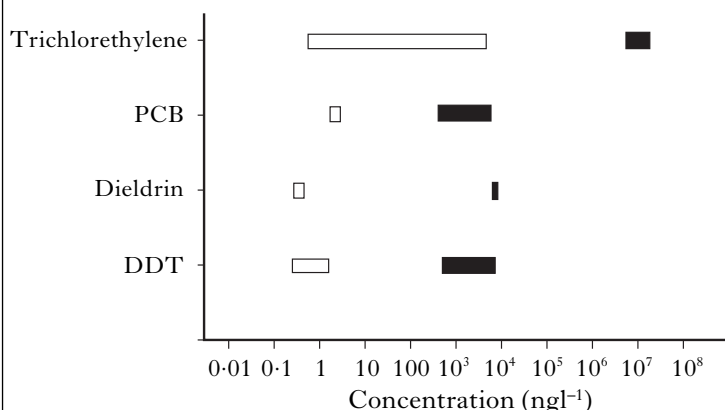
Which of the following is a valid conclusion from the data shown?

A All the toxic organic chemicals are found at lethal concentrations in sea water.

B Trichlorethylene is the only chemical found at lethal concentrations in sea water.

C DDT produces toxic effects in sea water due to biomagnification through the ecosystem.

D There is no evidence that the concentrations of toxic organic chemicals in sea water could produce lethal effects.

[*END OF SECTION A*]

Candidates are reminded that the answer sheet MUST be returned INSIDE the front cover of the answer book.

[Turn over for Section B on *Page ten*]

SECTION B

All questions in this section should be attempted.
All answers must be written clearly and legibly in ink.

1. The effects of large carnivores on ecosystems are not well understood. Predators can have a "top-down" effect that ripples down through the trophic levels below them. The effect is called a *trophic cascade*. In a trophic cascade a predatory species significantly affects consumer populations, which in turn results in significant changes at the producer level. Two recent studies in the USA have investigated trophic cascades.

    One study investigated the effects of reintroducing wolves (*Canis lupus*) to Yellowstone National Park in 1994. The strength of the trophic cascade was assessed by measuring feeding damage caused by elk (*Cervus elaphus*) to saplings produced by regenerating aspen trees (*Populus tremuloides*) (Table 1).

    In the second study, a trophic cascade was quantified in a comparison of two neighbouring canyons in Zion National Park. These two canyons, Zion Canyon and North Creek, have similar geology, climate and plant species but are visited by substantially different numbers of tourists. The Figure shows the age structure of populations of cottonwood trees (*Populus fremontii*) in the two canyons. The age of cottonwood trees was estimated by measuring their diameter at chest height. Other than the trees, the most significant species within the community are the predatory cougar (*Puma concolor*) and the herbivorous mule deer (*Odocoileus hemionus*).

    To compare the abundance of these species in the two canyons, data were collected from two-metre-wide transects following the course of river and stream banks. Evidence of cougars, which are highly sensitive to human disturbance, was determined by searching for scats (droppings) along 4000m of walking trails in the two localities (Table 2).

Table 1 : Survey data for Yellowstone National Park

Year	Wolf population	Elk population	Feeding damage (%)	Average aspen sapling height (cm)
1993	0	17 500	No data	No data
1997	24	13 000	95	30
2001	74	12 000	80	50
2005	82	9000	20	170

Figure: Age structure of cottonwood trees in two canyons in Zion National Park

North Creek	Year of germination	Zion Canyon

1880–1889
1890–1899
1900–1909
1910–1919
1920–1929
1930–1939
1940–1949
1950–1959
1960–1969
1970–1979
1980–1989
1990–1999

300 250 200 150 100 50 0   0 50 100 150 200 250 300

Number of trees of each age group per kilometre
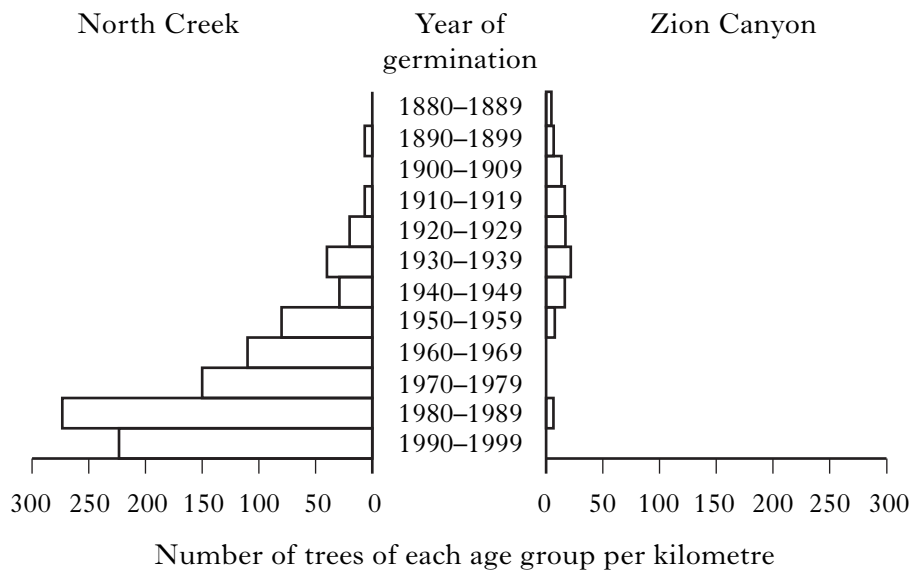
Table 2: Comparative data for three species in Zion National Park

	Canyon	
Species	*North Creek*	*Zion Canyon*
Cougar (scats per km)	1·75	0
Deer (hoof prints per km)	3·3	700
Young cottonwood (saplings per km)	900	23

Question 1 (continued)

   (*a*) Top-down effects are caused by heterotrophs. What is meant by the term heterotroph?   **1**

   (*b*) Using data from Table 1:

      (i)   describe the trophic cascade caused by the reintroduction of wolves;   **2**

     (ii)   calculate the percentage increase in wolf population over the period 1997 to 2001;   **1**

    (iii)   suggest **one** reason why the herbivore population declined by less than 8% over the same period.   **1**

   (*c*) Compare the abundance of old and young cottonwood trees in North Creek and Zion Canyon.   **2**

   (*d*) Suggest why the investigators used cougar scats rather than sightings to estimate cougar abundance.   **1**

   (*e*) Zion Canyon has been accessible to a large number of tourists since the 1930s, whereas North Creek is rarely visited. Justify the conclusion that, by influencing the trophic cascade, tourism is responsible for the poor survival of young cottonwoods.   **2**

   (*f*) (i)   What term describes biotic effects that increase in intensity as the population in an area increases?   **1**

     (ii)   Explain how the intensity of grazing can influence the *diversity* of plant species.   **2**

                                              (13)

2. (*a*) Himalayan balsam (*Impatiens glandulifera*) is an exotic species that spread into Scotland after being introduced into the UK in 1839. Left unchecked it can form an ecologically harmful monoculture. Himalayan balsam is an annual plant (its whole life cycle takes place within one year). Seeds of this species can remain dormant in the soil for up to two years.


   (i) What is the benefit of a period of dormancy in seeds? **1**

  (ii) Describe a damaging effect arising from the spread of an exotic species. **1**

 (iii) Suggest a method for controlling Himalayan balsam. **1**

 (iv) How would the seed dormancy of the Himalayan balsam affect the design of an eradication programme? **1**

(*b*) Give **one** effect on soil when monoculture is used in intensive food production. **1**

(5)

3. Explain how the use of fossil fuels disrupts the symbiotic relationship in coral. **(4)**

4. (*a*) Why is competition regarded as a negative interaction? **1**

(*b*) Explain what is meant by a fundamental niche. **1**

(*c*) A survey of birds in the Bismarck Islands, Papua New Guinea, found that two similar species of cuckoo-doves, *Macropygia mackinlayi* and *M. nigrirostris*, are never found breeding on the same island.

M. mackinlayi   *M. nigrirostris*

The two species are believed to have very similar fundamental niches. Suggest an explanation for the two species occupying different islands. **2**

(*d*) Parasites may be transmitted between closely related species.

   (i) Why is the transmission of parasites less common between **unrelated** species? **1**

  (ii) State **one** way in which parasites can be transmitted. **1**

(6)

5. The diagram below shows a section of plasma membrane with proteins labelled A to E.
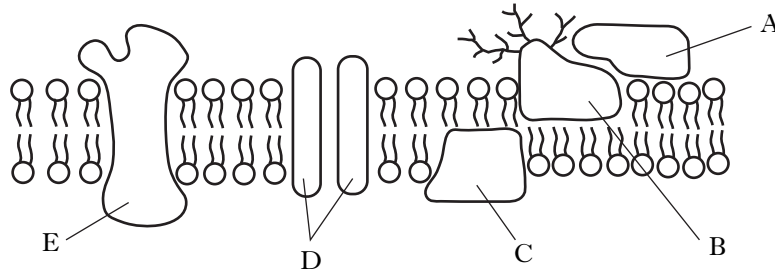
(*a*) (i) Identify which of the proteins A to E are integral membrane proteins. **1**

(ii) Which type of signalling molecule requires a receptor protein at the cell surface? **1**

(*b*) The membranes of most eukaryotic cells contain a proportion of the steroid cholesterol.

(i) Describe the general structure of a steroid. **1**

(ii) State **one** role of cholesterol in membranes. **1**

(iii) The table below shows the proportion of cholesterol in membranes from different locations.

Membrane location	*Proportion of cholesterol* (g cholesterol per g membrane)
Liver plasma membrane	0·18
Mitochondrial membrane	0·03
Endoplasmic reticulum	0·06

Show, as a simple whole number ratio, the relative amounts of cholesterol in liver plasma membrane, mitochondrial membrane and endoplasmic reticulum. **1**

(5)

6. Binding of specific proteins to DNA is important in the control of gene expression.

(*a*) Describe the effect of repressor protein binding to DNA in the *lac* operon. **1**

(*b*) Binding to DNA of the *engrailed* protein of the fruit fly *Drosophila melanogaster* is required during development of the fruit fly embryo.

The DNA-binding region of the engrailed protein consists of a stretch of sixty amino acids that contain two α-helices connected by a short extended chain of amino acids as shown in Figure 1.

Figure 1
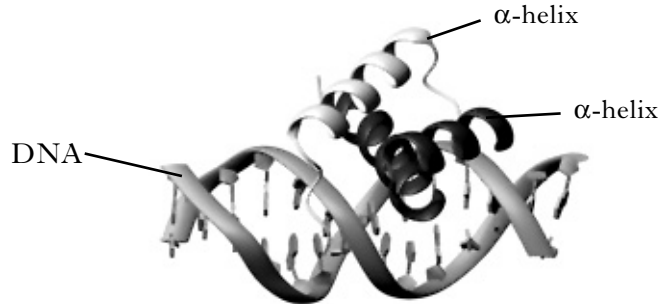
(i) What level of protein structure is an α-helix? **1**

(ii) The side chains of the amino acids within the α-helix regions interact directly with DNA. Figure 2 shows the amino acids in a short stretch of one of the α-helix regions of the engrailed protein.

Figure 2
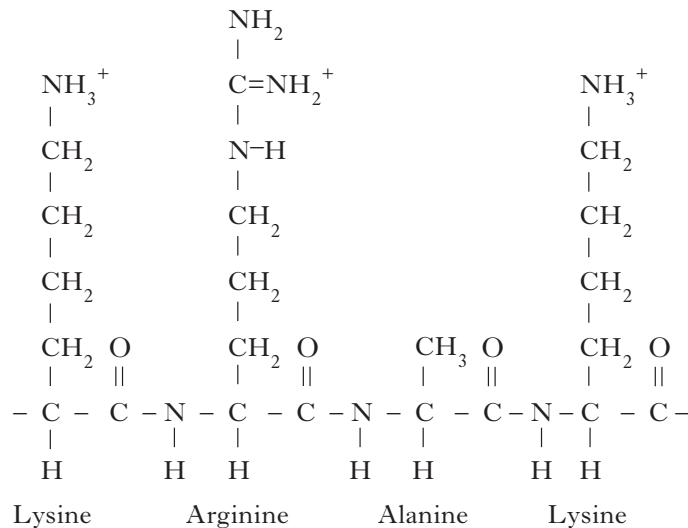
Name the class of amino acid to which lysine belongs. **1**

(iii) The binding region of the engrailed protein contains a high proportion of lysine residues. Suggest how the presence of these amino acids would assist in the binding of the engrailed protein to DNA. **1**

(4)

[Turn over

7. Enzyme kinetics is the study of the rate of enzyme-catalysed reactions.
The graph below shows the rates of the reaction for the enzyme penicillinase over a range of substrate concentrations. The substrate is penicillin.

The Michaelis constant (K_m) of an enzyme is the substrate concentration at which the reaction rate is half its maximum rate.
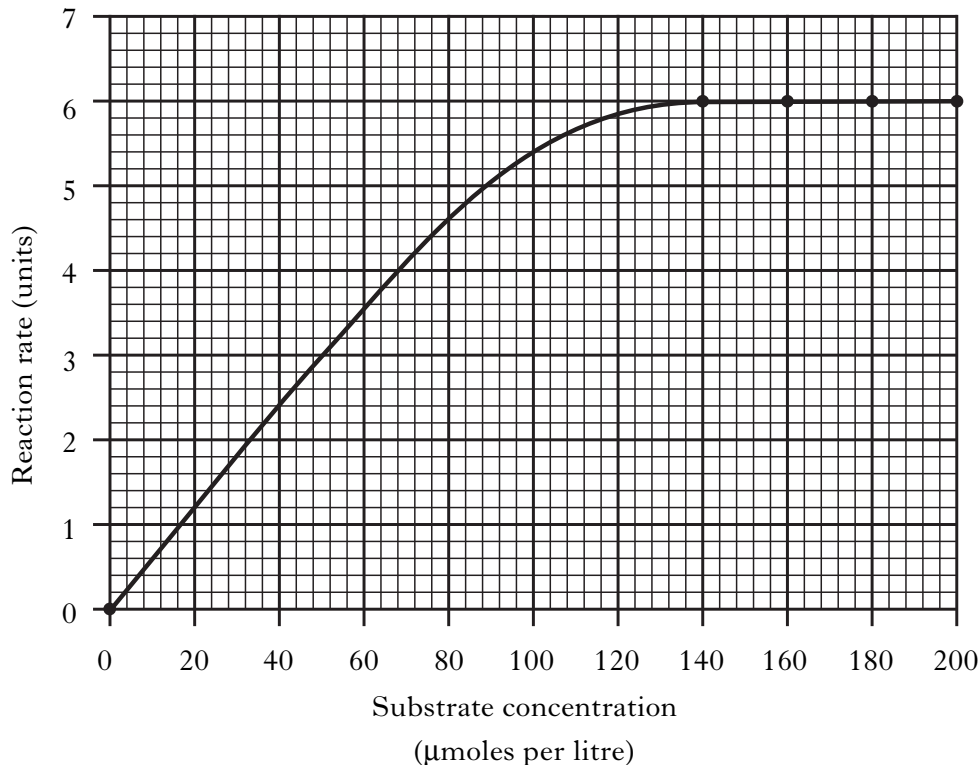
(*a*) Calculate the K_m of penicillinase assuming the graph shows that the maximum rate has been reached. **1**

(*b*) Explain why the K_m of an enzyme increases when a competitive inhibitor is present. **1**

(*c*) The turnover number of an enzyme is the number of substrate molecules converted into product by an enzyme in one second when an enzyme is working at its maximum rate. The turnover number for penicillinase is 2000 per second.

Calculate the time taken to catalyse the breakdown of one penicillin molecule. **1**

(3)

8. Answer **either** A **or** B.

A. Describe the structure of the monosaccharide glucose. Discuss the structures and functions of the main polysaccharides made using glucose as a monomer. **(15)**

OR

B. Give an account of the processes involved in the polymerase chain reaction (PCR) and DNA profiling. **(15)**

[*END OF SECTION B*]

Candidates should attempt questions on <u>one</u> unit, <u>either</u> Biotechnology <u>or</u> Animal Behaviour <u>or</u> Physiology, Health and Exercise.

The questions on Animal Behaviour can be found on pages 20–23.

The questions on Physiology, Health and Exercise can be found on pages 24–26.

All answers must be written clearly and legibly in ink.

Labelled diagrams may be used where appropriate.

BIOTECHNOLOGY   *Marks*

1. The Figure below shows the final stage in a test that confirms a blood sample contains antibodies against *Herpes simplex* virus (HSV). HSV antigen is attached to the plastic well and any unbound areas are coated with non-reactive material.
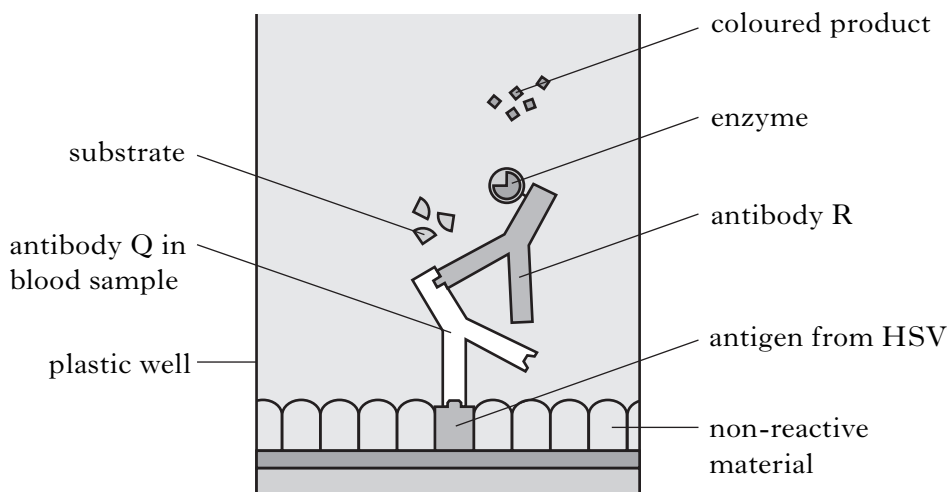
(*a*) (i) Identify the technique represented in the diagram.   **1**

    (ii) Explain why the test represented would not reveal if the person had been infected with chickenpox virus.   **1**

    (iii) Use information in the Figure to explain why inadequate rinsing just before the stage shown might result in a *false* positive result.   **2**

(*b*) Antibody R was produced commercially in a fermenter from hybridoma cells.

    What **two** cell types are combined to make hybridoma cells?   **1**

                                                                                            (5)

[Turn over

2. The flow chart shows steps involved in the manufacture of yoghurt.

```
┌──────────────┐   ┌──────────────┐   ┌──────────────┐
│ Skimmed milk │   │ Heated to 95°C│   │ Milk mixture │
│ powder added │──▶│ for 20 minutes│──▶│ homogenised  │
│ to milk      │   │              │   │              │
└──────────────┘   └──────────────┘   └──────────────┘
                                              │
                                              ▼
                                       ┌──────────────┐
                                       │Mixture cooled│
                                       │  to 40°C     │
                                       └──────────────┘
                                              │
┌──────────────┐   ┌──────────────┐   ┌──────────────┐
│ Yoghurt cooled│  │ Incubated in a│   │  Bacterial   │
│ and stored   │◀──│ fermenter at │◀──│  culture     │
│              │   │ 40°C for 5 hours│ │  added       │
└──────────────┘   └──────────────┘   └──────────────┘
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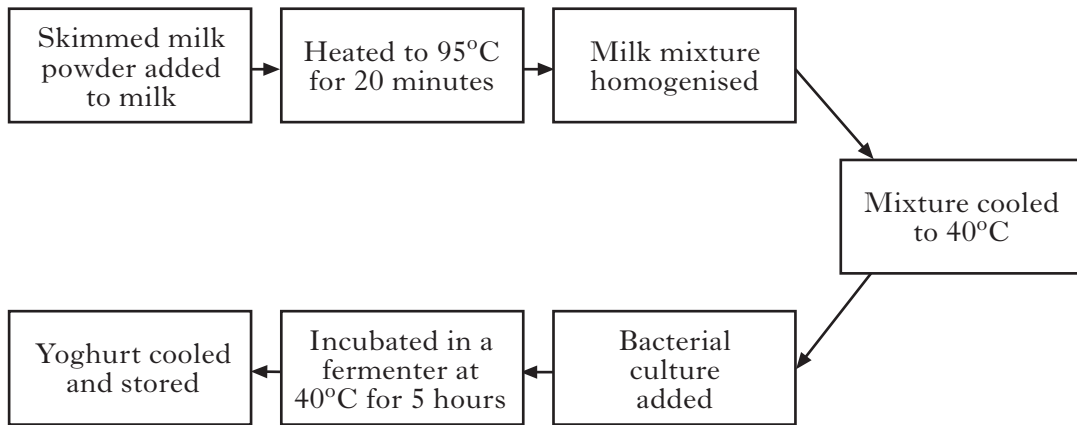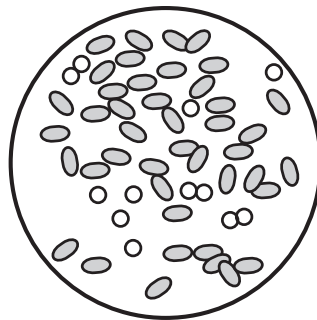
(*a*) The milk mixture is heated to 95 °C for 20 minutes to remove dissolved oxygen.

    (i)   What chemical conversion is promoted by the anaerobic conditions? **1**

    (ii)   Give a further reason for the heat treatment at this stage. **1**

(*b*) During incubation in the fermenter, yoghurt samples were removed and examined under a microscope. The figure below shows the field of view.

   (i)   What can be observed? **1**

    (ii)   Account for the observation. **1**

                                                                              (4)

3. Describe the scaling up process required to produce a suitable volume of pure bacterial culture for an industrial fermenter. **(5)**

4. Silage is used for winter feeding of farm animals and is commonly made by wrapping baled grass in polythene. Ensilage of plants in this way preserves the nutritional quality by limiting protein breakdown.

(*a*) Apart from wrapping bales, give **one** other method of making silage. **1**

(*b*) Explain how changes that take place within the wrapped bale help to preserve the silage. **2**

(*c*) Name a bacterial species that would be added before the baled grass is wrapped. **1**

(*d*) In a study involving ensilage of harvested lupin plants, researchers evaluated the effect of adding bacteria to the bales. The graphs below show the data obtained. Error bars show variation between replicates.
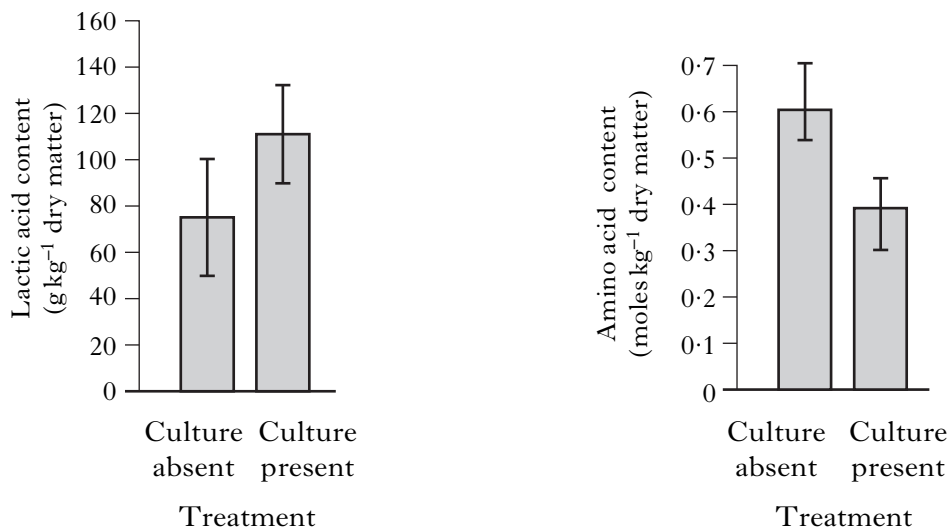

(i) What evidence supports the conclusion that the treatment with bacteria preserves the nutritional quality of the plant material? **1**

(ii) Draw **one** other conclusion about the effect of adding bacteria to fermenting silage. **1**

(6)

(20)

[End of *Biotechnology* questions. *Animal Behaviour* questions start on Page 20]

ANIMAL BEHAVIOUR

1. The eastern spinebill (*Acanthorhyncus tenuirostris*) is a small bird from eastern Australia. One of its major foods is nectar from the mountain correa (*Correa lawrenciana*).

**Figure 1: Eastern spinebill feeding on mountain correa**
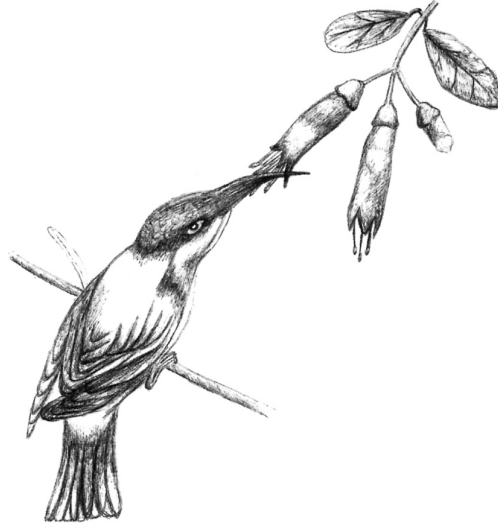
(*a*) In a study of eastern spinebill foraging, flowers of mountain correa were assigned to different developmental stages (Floral stages 1–5). Some characteristics of each stage are shown in the Table. Figure 2 shows the abundance of floral stages available and the foraging choices made by eastern spinebills feeding on the flowers.

Table: Characteristics of mountain correa flowers at different stages

Floral stage	Age (days)	Pollen production	Volume of nectar produced per flower over 24 hours (μl)
1	1–2	Pollen present, not released	1·0
2	3–7	Pollen released	3·1
3	8–9	Little, if any, pollen present	0·5
4	10–13	No pollen	0
5	14+	No pollen	0

1. **(*a*) (continued)**

Figure 2: Proportions of floral stages available and foraging choices made by eastern spinebills
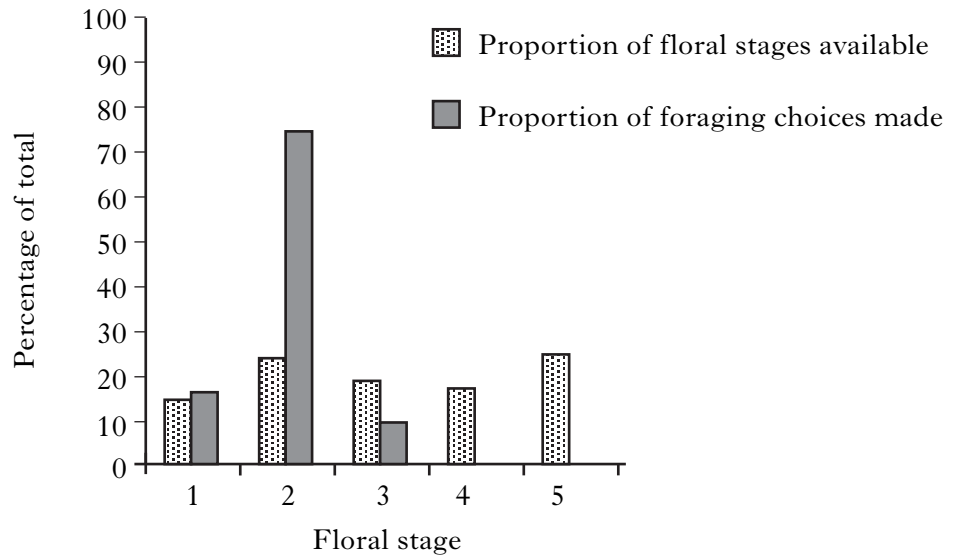
(i) Use the data in Figure 2 to compare floral stages 2 and 5. **2**

(ii) What is meant by the term optimal foraging? **1**

(iii) How does the information provided in both the Table and Figure 2 demonstrate optimal foraging in spinebills? **1**

(*b*) The eastern spinebill's nest is a small cup made mainly from twigs, grass, bark, feathers and spider webs. Only the female builds the nest and incubates the eggs but both parents feed the young after they have hatched.

(i) This information suggests greater investment by the female parent. Describe another way in which female investment is likely to be greater than that of the male parent. **1**

(ii) Explain how nest building in the eastern spinebill provides an example of an extended phenotype. **1**

(*c*) The eastern spinebill does not show any marked sexual dimorphism.

Figure 1 shows a male bird. What would the female bird look like in comparison? **1**

(7)

[Turn over

2. The silk produced by female spiders often contains chemical deposits that provide males with important information about species identity, age, sex and the reproductive status of a female.

   Female wolf spiders *Schizocosa ocreata* rarely mate with more than one male and, once they have mated, are more likely to cannibalise (eat) males. Males, on the other hand, will often try to mate with more than one female.

   The male has a courtship behaviour called a "jerky tap" that elicits a reaction from the female. The Table below shows measurements of the time taken for males to produce the jerky tap response after exposure to samples of silks from different origins.

Origin of silk	*Time until jerky tap response* (s)
Subadult female	155
Unmated adult female	22
Mated adult female	105

   (*a*) (i) State **one** conclusion that can be drawn from these results. 1

      (ii) What name is given to the delay between stimulus and response? 1

   (iii) Name another aspect of this jerky tap response that could be observed and used for comparison. 1

   (iv) Suggest **one** disadvantage of laboratory-based research into animal behaviour. 1

   (*b*) The "selfish gene" concept maintains that individual organisms should behave so as to maximise the survival of copies of their genes.

   Give **one** reason why the genes responsible for a male spider's response to silk in the selection of a mate can be described as "selfish". 1

   (5)

3. Cheetahs (*Acinonyx jubatus*) in the Serengeti National Park in Tanzania kill more male Thomson's gazelles (*Gazella thomsoni*) than would be expected from the sex ratio of the local gazelle population.

The Table below shows data obtained by observing groups of Thomson's gazelles.

	males	*females*
Proportion on periphery of group (%)	75	53
Nearest neighbour distance (m)	9·3	4·6
Proportion of time spent scanning with head up (%)	8·4	11·4
Proportion in population (%)	30	70
Proportion hunted (%)	63	37

(*a*) Suggest why male Thomson's gazelles are more likely than females to be selected as prey by hunting cheetahs.   **1**

(*b*) Calculate the number of males on the periphery of a group of 80 gazelles.   **1**

(*c*) What name is given to the scanning behaviour?   **1**

                                                                                          (3)

4. Describe how appeasement and ritualised displays in agonistic interactions can benefit all members of social groups. Illustrate your answer by reference to named species.   **(5)**
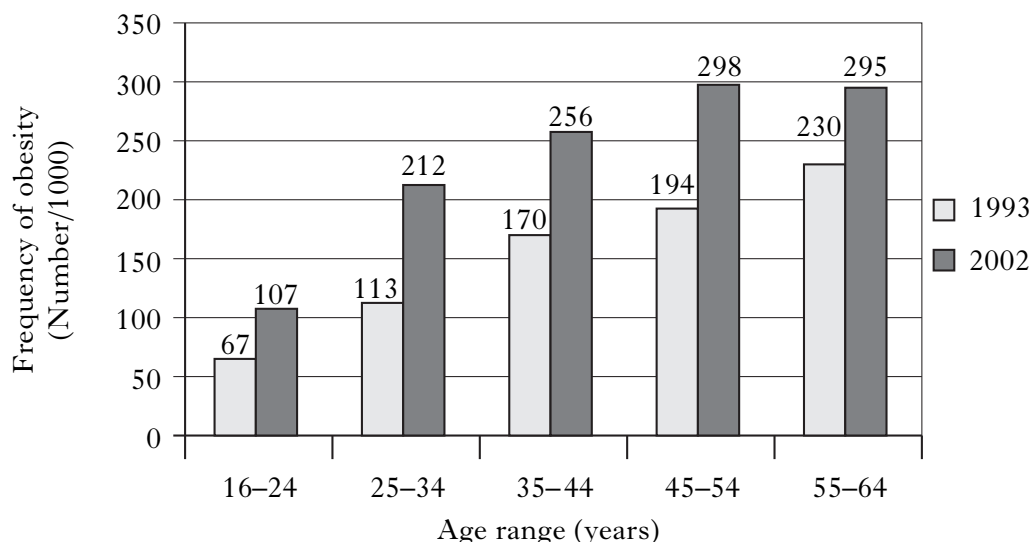
                                                                                          (20)

[End of *Animal Behaviour* questions. *Physiology, Health and Exercise* questions start on Page 24]

[Turn over

PHYSIOLOGY, HEALTH AND EXERCISE

1. (*a*) The graph shows obesity data for England in 1993 and 2002.

Individuals were described as obese if they had a body mass index (BMI) of 30 or greater.

		(i)	What two measurements are needed to calculate BMI?	**1**
		(ii)	Obesity has increased in all age ranges over the ten year period.	
			Which age range has shown the biggest percentage increase?	**1**
		(iii)	Give **one** other general trend shown by the data.	**1**
		(iv)	Name **one** medical condition for which obesity is a risk factor.	**1**
(*b*)		(i)	Bioelectrical impedance analysis (BIA) is a method used to determine percentage body fat. Outline the principle on which this method is based.	**2**
		(ii)	Give **one** limitation of BIA.	**1**
				(7)

2. Discuss the changes that take place in the cardiovascular system during a short period of strenuous exercise.　**(4)**

3. The Bruce protocol is a method used in maximal exercise testing to determine fitness. A subject wearing an oxygen-monitoring mask is supervised running on a treadmill while the gradient (slope) and speed of the treadmill are both increased in a standard way. When the subject is exhausted, the time is noted.

The Table below shows some results from a study using this method. The values have been selected for four young healthy males who each took the same time to reach exhaustion.

Time (min)	*Body mass* (kg)	*Maximum oxygen uptake* ($l\,min^{-1}$)	*Fitness* ($ml\,kg^{-1}\,min^{-1}$)
10·5	70	2·53	36·2
10·5	75	2·72	36·2
10·5	85	3·08	36·2
10·5	90	3·26	36·2

(*a*) Explain why measuring oxygen uptake is a valid way to assess fitness.   **2**

(*b*) Explain why the "Fitness" measurement is independent of body mass.   **1**

(*c*) Calculate the maximum oxygen uptake of an 80 kg male who took 10·5 minutes to reach exhaustion in the same test.   **1**

(*d*) Give an example of a situation where the individual given a treadmill test would **not** be stressed to exhaustion.   **1**

(5)

[Turn over for Question 4 on *Page twenty-six*

4. In an investigation into energy expenditure measured by direct calorimetry, subjects at rest were given a solution of either glucose or sucrose (a disaccharide). The results are shown in the graph below.
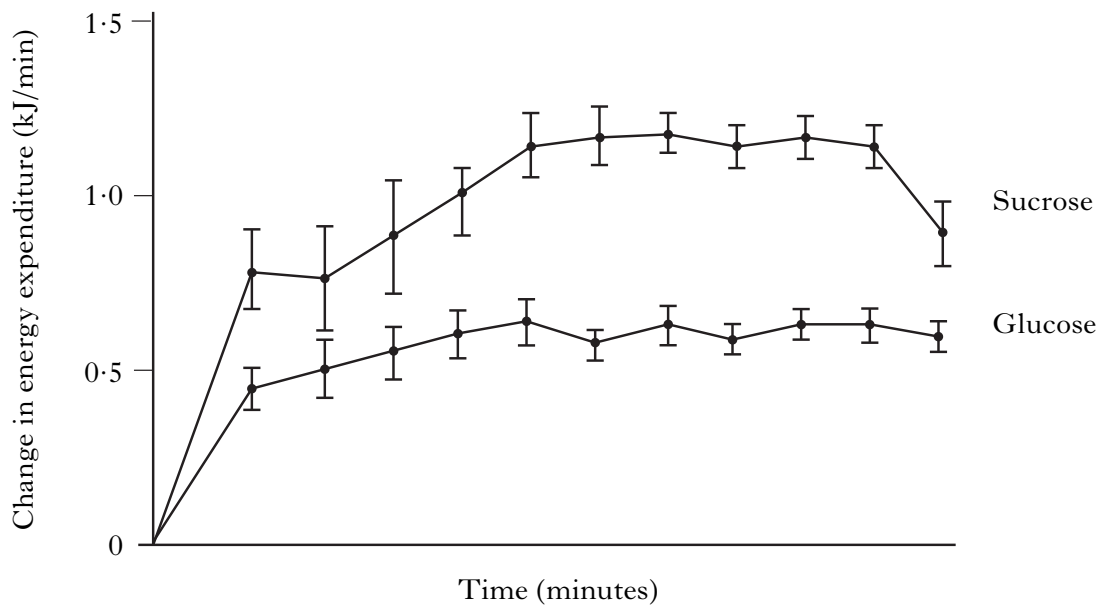
(*a*) Which component of total energy expenditure is being investigated in this study? **1**

(*b*) What evidence is there that diet affects energy expenditure? **1**

(*c*) What do the error bars in the graph indicate about the results presented? **1**

(*d*) The results in this investigation were obtained by direct calorimetry.

Give **one** way in which indirect calorimetry differs from direct calorimetry. **1**

(4)

(20)

[*END OF QUESTION PAPER*]