[C007/SQP154]

Advanced Higher Biology

Specimen Question Paper

Time: 2 hours 30 minutes

NATIONAL QUALIFICATIONS

SECTION A—Questions 1–25 (25 marks)

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

SECTIONS B, C AND D

The answer to each question should be written in a **separate** answer book. Square-ruled paper (if used) should be placed inside the front cover of the appropriate answer book.

Rough work should be scored through.

Section B (30 marks)

Both questions should be attempted.

Section C (30 marks)

Questions 1 and 2 in this section each contain a choice.

Section D (15 marks)

This section contains a choice. Only **one** of the six questions should be answered.

SCOTTISH QUALIFICATIONS AUTHORITY

SECTION A

Read carefully

1. Check that the answer sheet provided is for Biology Advanced Higher (Section A).
2. Fill in the details required on the answer sheet.
3. In this section a question is answered by indicating the choice A, B, C or D by a stroke made in **ink** in the appropriate place on the answer sheet—see the sample question below.
4. For each question there is only **one** correct answer.
5. Rough working, if required, should be done only on this question paper or on the rough working sheet provided—**not** on the answer sheet.
6. At the end of the examination the answer sheet for Section A **must** be placed inside the front cover of this answer book.

SAMPLE QUESTION

Which of the following molecules contains six carbon atoms?

A Pyruvic acid

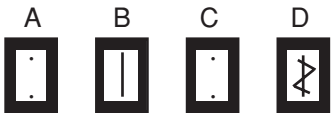
B Glucose

C Ribulose bisphosphate

D Acetyl co-enzyme A

The correct answer is **B**—glucose. A **heavy** vertical line should be drawn joining the two dots in the appropriate box in the column headed **B** as shown **in the example on the answer sheet**.

If, after you have recorded your answer, you decide that you have made an error and wish to make a change, you should cancel the original answer and put a vertical stroke in the box you now consider to be correct. Thus, if you want to change an answer **D** to an answer **B**, your answer sheet would look like this:



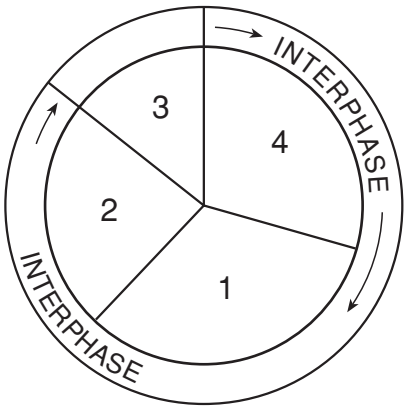
If you want to change back to an answer which has already been scored out, you should **enter a tick (✓)** to the RIGHT of the box of your choice, thus:

SECTION A

All questions in this section should be attempted.

Answers should be given on the separate answer sheet provided.

1. The diagram below represents the four phases of the cell cycle.



Which line of the table correctly identifies the four phases?

	1	2	3	4
A	Synthesis	G2 Growth	Mitosis	G1 Growth
B	G2 Growth	Synthesis	G1 Growth	Mitosis
C	Synthesis	G1 Growth	Mitosis	G2 Growth
D	G1 Growth	Mitosis	Synthesis	G2 Growth

2. Totipotency is the ability of somatic cell nuclei to

A regenerate all cell types

B grow exponentially

C form tumours

D form hybrids.

3. The sodium-potassium pump transports

A sodium and potassium ions out of a cell

B sodium and potassium ions into a cell

C sodium ions into a cell and potassium ions out of a cell

D sodium ions out of a cell and potassium ions into a cell.

4. The table shows typical concentrations of three ions inside and outside the nerve cell of a squid.

Concentration (mol l^{-1})		
Ion	*Inside*	*Outside*
Potassium	0·40	0·02
Sodium	0·05	0·45
Chloride	0·12	0·56

Which of the following conclusions based on the data is correct?

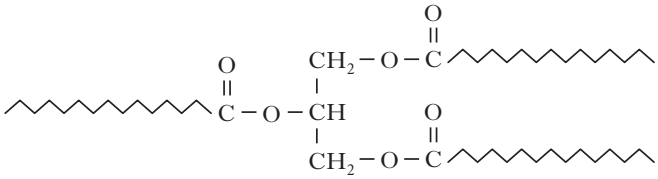
A The ratio of potassium ions inside the cell to potassium ions outside is 1:20.

B The concentration of sodium ions outside the cell is nine times greater than inside.

C There are three times more chloride ions than potassium ions in the cell.

D Sodium ions show the biggest concentration difference across the membrane.

5. The diagram below represents an organic molecule.



The molecule represented is a

A phospholipid

B triglyceride

C fatty acid

D steroid.

6. Which of the following forms of non-covalent bonding stabilises the secondary structure of a protein?

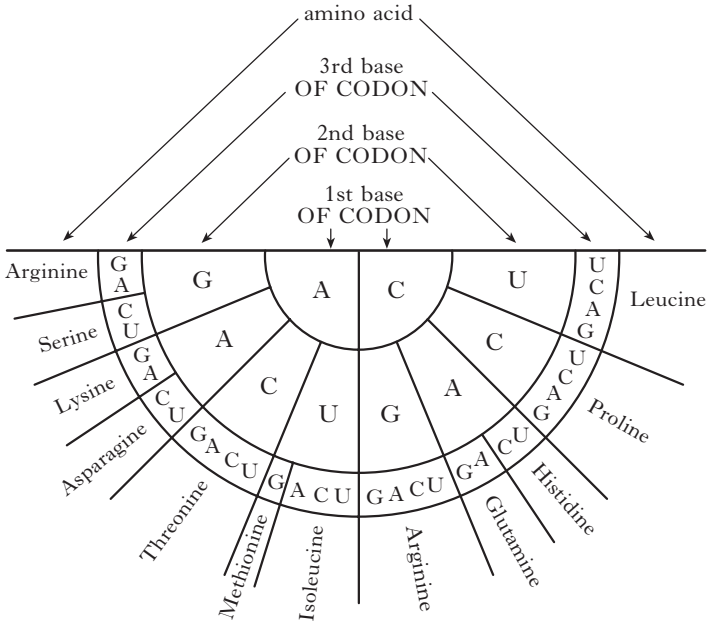
A Ionic bonding

B Hydrogen bonding

C Van der Waals forces

D Hydrophobic interaction

7. The diagram below can be used to identify the mRNA codons for some amino acids.



Which of the mRNA codon sequences would **not** produce the following sequence of amino acids?

ARGININE-LEUCINE

A CGC CUG

B AGA CUC

C CGU CUG

D GGA AUC

8. The diagram below represents part of a metabolic pathway in a bacterium.

Amino acid 1 $\xrightarrow{\textit{enzyme X}}$ Amino acid 2 $\xrightarrow{\textit{enzyme Y}}$ Amino acid 3

An excess of amino acid 3 reduces the rate of the reaction catalysed by enzyme X. This is due to

A competitive inhibition

B non-competitive inhibition

C end product inhibition

D excess substrate inhibition.

9. Neurotransmitters, peptides and steroids are all involved in cell signalling. Signalling molecules may be either hydrophobic or hydrophilic.

Which of the following correctly represents the characteristics of the signalling molecules?

	Neurotransmitters	*Peptides*	*Steroids*
A	hydrophobic	hydrophilic	hydrophobic
B	hydrophobic	hydrophobic	hydrophilic
C	hydrophilic	hydrophilic	hydrophobic
D	hydrophilic	hydrophobic	hydrophilic

10. Lambda DNA (λDNA) is cut into fragments by the restriction endonucleases *Eco*RI and *Hin*dIII at the sites indicated.

*Eco*RI cut site ▼
*Hin*dIII cut site △

If λDNA was cut with both of the restriction endonucleases, the number of fragments would be

A 6

B 8

C 13

D 14.

11. Forensic science uses a technique known as DNA profiling as a means of identification.

Which of the following genetic features is identified by DNA profiling?

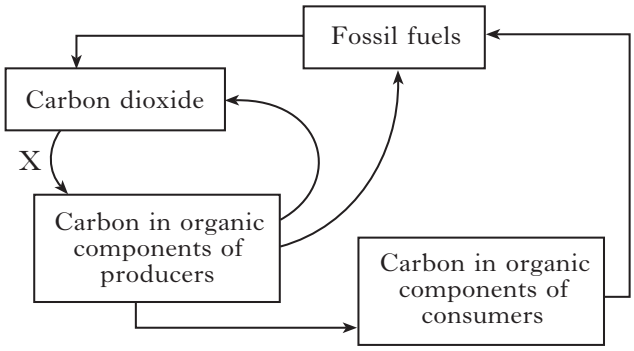
A Chromosome abnormalities

B Specific genes

C Mutated genes

D Hypervariable regions

12. The diagram below represents the carbon cycle.



The process indicated at X is

A photosynthesis

B decomposition

C combustion

D respiration.

13. Ammonium sulphate is often added to soils as a fertiliser.

Before being absorbed by plant roots, it is normally converted to another form. The micro-organisms that carry out this conversion are the

A nitrogen-fixing bacteria

B dentrifying bacteria

C root nodule bacteria

D nitrifying bacteria.

14. Which of the following statements about leghemoglobin is correct?

A It is made by root cells to supply bacteria with oxygen.

B It is made by bacteria to maintain anaerobic conditions.

C It is made by root cells to stop oxygen reaching bacteria.

D It is made by bacterial cells to ensure aerobic conditions.

15. In a survey of a moth population, 70 individuals were captured, marked and then released. Twenty-four hours later, another sample of moths, numbering 60, was captured. Ten of these moths were found to be marked.

The population can be estimated from the following formula:

$$\frac{\text{number in population}}{\text{number in first sample}} = \frac{\text{number in second sample}}{\text{number recaptured from first sample}}$$

Using this method, the estimated population size for the moths was

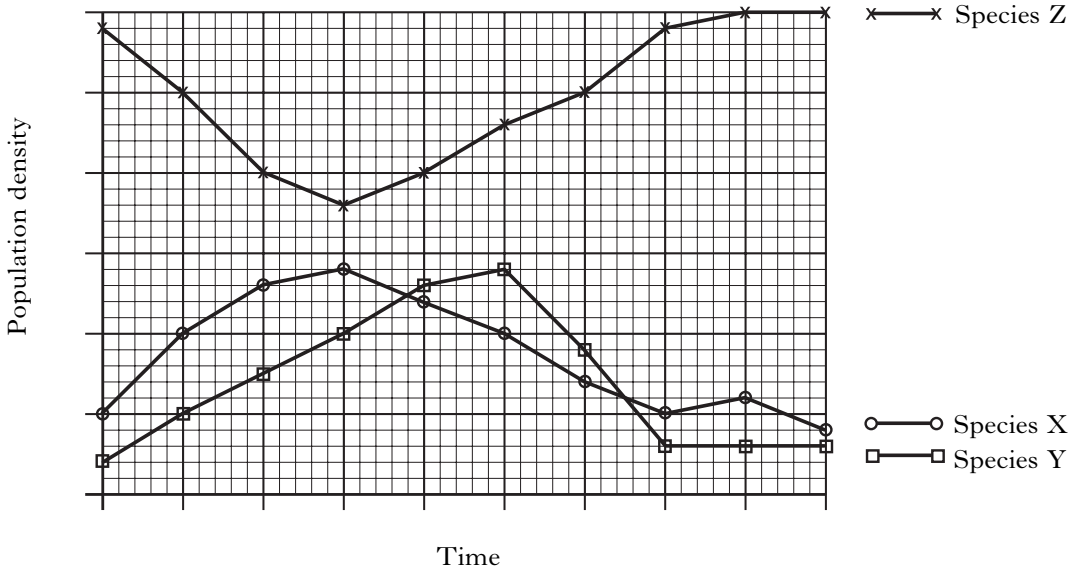
A 130

B 140

C 420

D 4200.

16. The graph below shows the changes in population density which occurred after three interacting species were introduced into a pond.



Which of the following food chains best accounts for the trends shown by the graph?

A X → Y → Z

B Z → Y → X

C X → Z → Y

D Z → X → Y

17. A biotic interaction beneficial to one species which leaves the other unaffected is called

A parasitism

B mutualism

C competition

D commensalism.

18. Which of the following interactions between two species leads to a reduction in the population density of both?

A Competition

B Commensalism

C Predation

D Parasitism

19. Which of the following descriptions of conformers is correct?

A Internal environment changes passively.

B Internal environment stays constant passively.

C Internal environment changes actively.

D Internal environment stays constant actively.

20. Herbicides are used in agriculture to

A promote the health of primary consumers

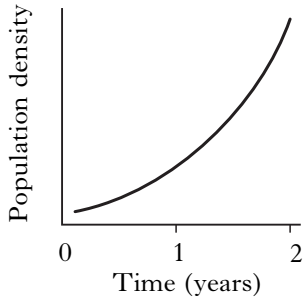
B reduce plant competition

C destroy insect populations

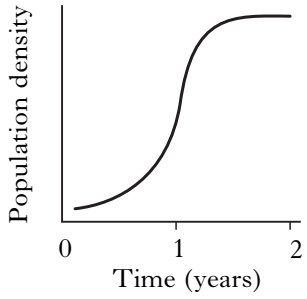
D increase soil nutrients.

21. Which of the following graphs best represents the effect of a density-dependent factor on the density of a population?

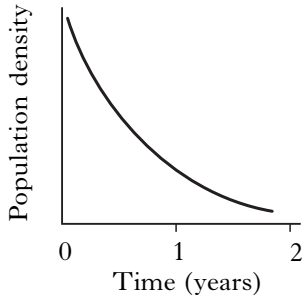
A



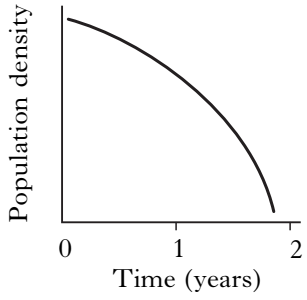
B



C



D



Questions 22 and 23 refer to the information given below.

The table below gives estimates of global grain production between 1950 and 2000.

Date	*Grain production (million tonnes)*	*Harvested area (million hectares)*
1950	631	587
1960	824	646
1970	1079	663
1980	1430	772
1990	1769	691
2000	1680	682

22. Global grain production increased fastest between

A 1980 and 1990

B 1970 and 1980

C 1960 and 1970

D 1950 and 1960.

23. The mass of grain produced per hectare doubled between

A 1960 and 1970

B 1960 and 1980

C 1960 and 1990

D 1960 and 2000.

24. In which of the following would you expect to find the highest concentration of DDT?

A Insectivorous birds

B Raptors that feed on herbivores

C Raptors that feed on insectivores

D Herbivorous insects

25. The table below shows the number of beet armyworm larvae found in plots of cotton plants that had, or had not, been treated with an insecticide. The insecticide was applied on both the 27th of June and the 1st of August.

Sampling dates	*Number of beet armyworm larvae*	
	Treated plots	*Untreated plots*
July 8	3	3
15	33	2
22	22	17
29	42	10
August 5	120	8
12	160	10

Which of the following is the most likely explanation for the differences between the treated and untreated plots?

A The insecticide kills a predator of the larvae.

B The larvae are resistant to the insecticide.

C The beet armyworm breeds in July.

D The larvae have a short lifecycle.

[*END OF SECTION A*]

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

SECTION B begins on *Page ten*

SECTION B

Both questions in this section should be attempted.

Cell and Molecular Biology

1. Ethene is a gas produced in plants from the amino acid methionine. The metabolic pathway is shown in Figure 1.

The molecular structure of amino acids is shown in Figure 2.

Ethene influences the ripening process in fruits by enhancing the action of respiratory enzymes. Ethene also stimulates the production of the enzyme cellulase which breaks down cellulose present in plant cell walls, causing the fruits to soften.

The data shown in the Table relate to an experiment in which apple trees were sprayed with methionine one month prior to harvesting the fruit. Apple fruits, because of their acidity and hardness, are often inedible even when fully grown.

Figure 1
Metabolic pathway showing the production of ethene

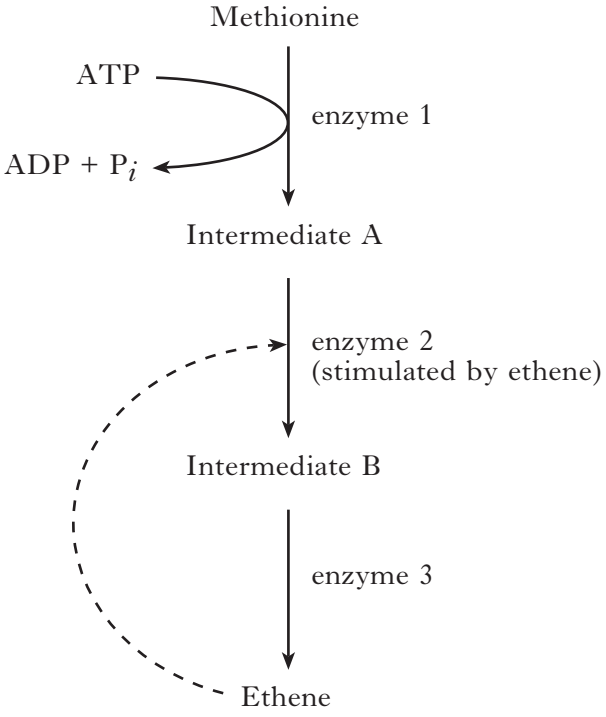
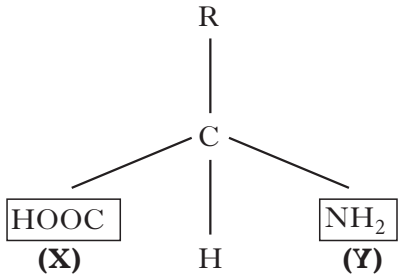


Figure 2
Molecular structure of amino acids



1. (continued)

Table: Effects of methionine on apple fruits.

The experimental trees were sprayed with a solution of methionine, while the control trees were sprayed with water—in both cases one month prior to harvesting.

	Treatment with methionine solution	*Treatment with water (control)*
Fruit drop (%)	38·5	17·2
Hardness	9·8	11·2
Acidity	9·5	13·3
Sweetness	14·5	13·8
Increase in fruit diameter (cm)	2·5	1·8
Rate of ethene production ($\mu l\,kg^{-1}\,h^{-1}$)	8·0	5·7

Note: In the scales for hardness, acidity and sweetness, the higher the number, the harder, more acid and sweeter the apple was at harvesting.

(*a*) (i) Metabolic pathways can be regulated by *end product inhibition*.
Explain the term *end product inhibition* and state the advantage of this as a control mechanism. **2**

(ii) With reference to Figure 1, give one piece of evidence supporting the statement that the production of ethene is not controlled by end product inhibition. **1**

(iii) From Figure 1, predict the effect of an increase in respiration rate on the production of ethene in an apple. Give reasons for your answer. **3**

(*b*) (i) From Figure 2, identify the components **X and Y** in the molecular structure of amino acids. **1**

(ii) Explain how different types of amino acid arise from this basic structure. **1**

(iii) List the four main classes of amino acids based on their functional group. **2**

(*c*) (i) Use the Table to list **three** effects of added methionine on apples. **1**

(ii) Calculate the volume of ethene produced by 100 kilograms (kg) of apples treated with methionine over a period of 24 hours.
Express your answer in millilitres (ml). **2**

(*d*) One ripe apple can speed up the ripening process of all other apples in a barrel.
Using the information provided, explain this effect. **2**

(15)

2. An investigation into changes in the population size of the Douglas squirrel (*Tamiasciurus douglasii*) was carried out in the coniferous forests of British Columbia from March 1978 to September 1979. The main food source of the Douglas squirrel is seeds from the cones of coniferous trees especially those of the Douglas Fir.

Two 9 hectare areas (a control area and an experimental area) were chosen for the investigation. Information on the forest composition of the two areas is shown in Table 1. The population sizes of the squirrels in the two areas were estimated by live trapping. The traps were checked twice daily and the squirrels were then released. The control area received no additional food but, in the experimental area, sunflower seeds were distributed around each trap every week. The results of the survey are shown in the Figure.

Adult survival was also investigated. Calculations of survival rates are shown in Table 2.

Figure: Estimated population size of the Douglas squirrel in the study areas during 1978–1979.

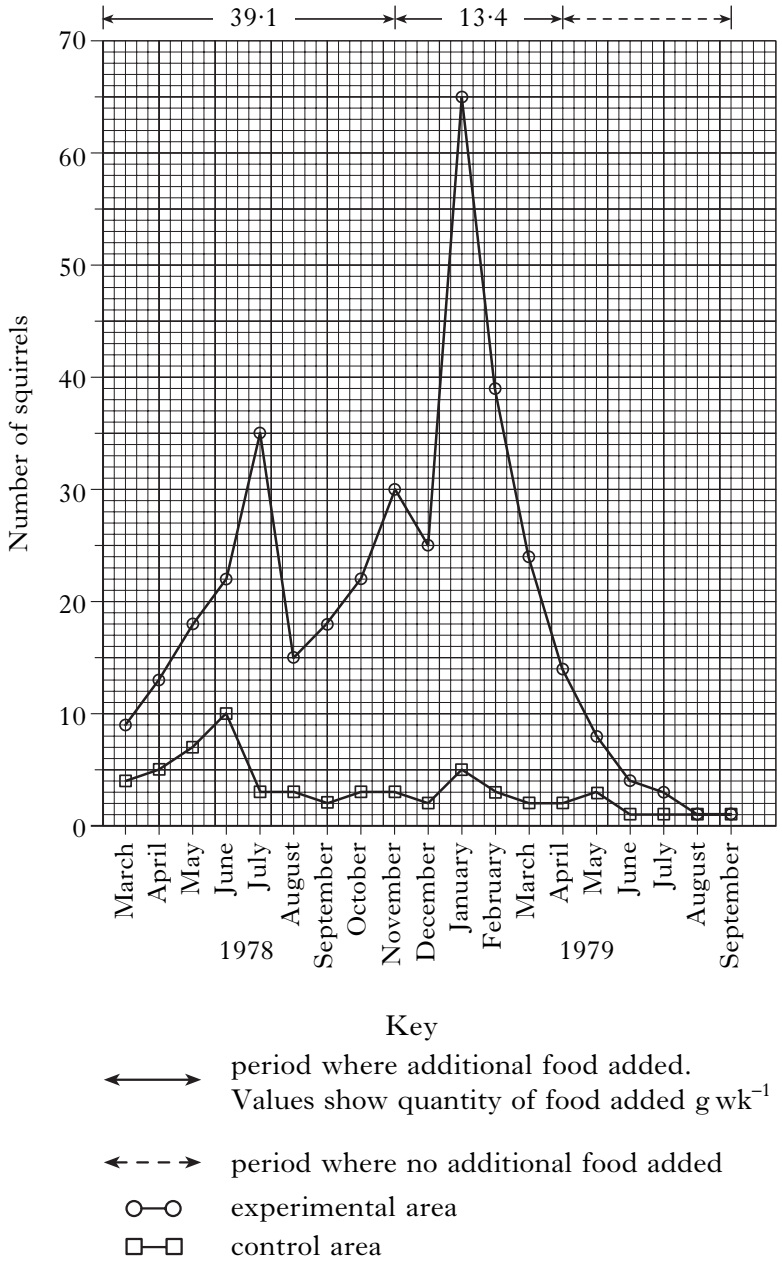


Table 1: Forest composition of the two study areas.

	Control Area	*Experimental area*
Species		
Western Hemlock	30·9 %	7·0 %
Douglas Fir	52·3 %	66·2 %
Red Cedar	15·6 %	13·0 %
Red Alder	1·2 %	13·8 %
Number of Trees	685	700

Table 2: Survival rates for adult male Douglas squirrels in the study areas.

	Control Area	*Experimental area*
1978	0·27	0·64
1979	0·33	0·32

[0 = none survive; 1 = all survive]

2. (continued)

(*a*) Using the information in the Figure, describe the changes in population size of the squirrels in the experimental area during 1978 and 1979. **3**

(*b*) To the nearest whole number, how many more Douglas Fir trees were there in the experimental area compared to the control area? **1**

(*c*) From Table 2, compare the survival rates of squirrels in control and experimental areas in 1978 and 1979.
Suggest an explanation. **2**

(*d*) The biologists who carried out the study concluded that availability of food limited population size in the Douglas squirrel.

(i) State one piece of evidence which supports this conclusion. **1**

(ii) Give one reason why such a conclusion might not be valid. **1**

(*e*) (i) Why is intra-specific competition most intense in the experimental area from January to July 1979? **1**

(ii) What effects of this competition are likely to account for the change which occurred in the population during this time? **2**

(iii) Explain why competition between individual Douglas squirrels is likely to be more intense than competition with other species of squirrels. **1**

(*f*) Whilst the fundamental niche of the Douglas squirrel remains constant, the realised niche may vary from year to year and from place to place.

(i) Explain what is meant by the term *fundamental niche*. **2**

(ii) Describe one way in which the realised niche of the squirrels was different in the two areas studied. **1**

(15)

[*END OF SECTION B*]

SECTION C

Both questions in this section should be attempted.

Note that each question contains a choice.

Labelled diagrams may be used where appropriate.

Cell and Molecular Biology *Marks*

1. Answer **either** A **or** B.

A. Name the main polysaccharides in plants and animals and outline their functions. Describe how the structure of each arises from glucose as a monomer. **15**

OR

B. Summarise the main structural features that distinguish eukaryotic plant cells from prokaryotic bacterial cells. (You may use a table if you wish.) **15**

Environmental Biology

2. **Answer** either A **or** B.

A. Give an account of symbiotic relationships, including a detailed example of each. **15**

OR

B. Give an account of the development of ecosystems using the following themes:

(i) succession and types of succession;

(ii) changes in complexity of ecosystems during succession;

(iii) the effects of intensive farming on the complexity of natural ecosystems. **15**

SECTION D

Note this section contains a choice.

Answer ONE of the following questions.

Labelled diagrams may be used where appropriate.

Animal Behaviour *Marks*

1. Outline the principles and problems involved in observing and interpreting animal behaviour. **15**

OR

2. Briefly compare the strategies used by solitary and group predators to capture prey, then outline the range of defence strategies prey animals have for avoiding capture. **15**

OR

Biotechnology

3. Give an account of the commercial production of monoclonal antibodies. **15**

OR

4. Give an account of the factors to be considered at each stage in the industrial production of an extra-cellular enzyme suited to working at high temperature. **15**

OR

Physiology, Health and Exercise

5. Give an account of how cardiovascular diseases arise and outline some of the risk factors in their development. **15**

OR

6. Discuss the factors that influence the energy needs and energy expenditure of the body. **15**

[*END OF QUESTION PAPER*]

[C007/SQP154]

Advanced Higher Biology

NATIONAL QUALIFICATIONS

Specimen Marking Instructions

SCOTTISH QUALIFICATIONS AUTHORITY

SECTION A

Q No.	Key
1	A
2	A
3	D
4	B
5	B
6	B
7	D
8	C
9	C
10	C
11	D
12	A
13	D
14	C
15	C
16	D
17	D
18	A
19	A
20	B
21	B
22	B
23	C
24	C
25	A

SECTION B

Marks

Cell and Molecular Biology

Question 1:

(*a*) (i) Product inhibits the first enzyme earlier in the pathway/
The output of the pathway is regulated according to the quantity of product **1**
Avoids waste/conserves resources and conserves energy **1**

(ii) Ethene stimulates rather than inhibits/acts on second enzyme not first **1**

(iii) Increased rate of ethene production **1**
Increase in respiration rate produces more ATP needed for enzyme one **1**
This may increase the rate of ethene production thus stimulating the activity of enzyme two **1**

(*b*) (i) X = carboxylic acid/carboxyl group
Y = amino/amine group (*both*) **1**

(ii) differ according to the variable R group **1**

(iii) polar, non-polar, acidic, basic (*all 4 = 2 marks, 2 or 3 = 1mark*) **2**

(*c*) (i) Increased fruit drop/size/sweetness/ethene production/
decreased hardness/acidity (*any three*) **1**

(ii) $8{\cdot}0\ \mu l\ kg^{-1}\ h^{-1}$ **1**
$8{\cdot}0 \times 100\ kg \times 24\ hours = 19\,200\ \mu l$ **1**
$= 19{\cdot}2\ ml$ **1**

(*d*) Ripe apple is source of ethene (*must have*) **1**
Ethene is a gas so it can diffuse easily **or**
Results in an increase in cellulase activity in unripe apples leading to softening of fruit/other ripening effect **1**

(15)

Question 2:

(*a*)

Starts at 9	Mar 78	Good description specifying months (Deduct 1 mark if months not given)	**2**
Increase to 35	July 78		
Decrease to 15	Aug 78		
Increase to 30	Nov 78		
Decrease to 26	Dec 78	Minimum 3 quantifications	**1**
Increase to 65	Jan 79		
Decrease to 1	Sep 79		

(*b*) 105 (accept 104 to 106) **1**

(*c*) 1978 – survival rate greater in experimental area
1979 – survival rates similar in both areas
1978 – survival rate increases in control between 78 and 79
1979 – survival rate decreases in experimental area between 78 and 79

any 2/4 = **1**

Explanation:
control area increase 78 to 79 = better climatic conditions/trees more productive
or
experimental area drop 78 to 79 = reduction in supplementary food **1**

(*d*) (i) Population sizes similar when no added food
or
Population sizes in experimental area greater than control area when additional food present **1**

(ii) Forest composition different between the two areas
or
Sample size/squirrel numbers very low **1**

(*e*) (i) Population density is highest at the start of this period/competition is density dependent **1**

(ii) Reduced reproduction/birth rate
Increased mortality/death rate
Exclusion from habitat

any 2/3 **2**

(iii) Members of the same species have the same niche requirements and must therefore compete for all resources **1**

(*f*) (i) Conditions preferred/resources utilised **1**
in the absence of competing species **1**

(ii) Food/sunflower seeds added to experimental area
or
Greater proportion/number of Douglas Fir in experimental area
or
Population density **1**

(15)

Section C

Cell and Molecular Biology

Marks

Question 1A

cellulose – *plant cell walls* – *rigidity/support*	all elements in row to be correct	**3**
glycogen – *animal cells* – *glucose/energy storage*		
starch – *plant cells* – *glucose/energy storage*		

glucose linear structure illustrated
ring form illustrated
positions of OH on ring form C1 – drawn or described
illustration of glycosidic link/condensation reaction
condensation reaction described
glycosidic links between C1 and C4 can be OH α or β
glycosidic link can be between C1 and C6

first 3 points plus any 1 other **max 4**

starch
named molecule – amylose or amylopectin
sequence of glucose monomers bonded α – 1,4 *stated*
long chain unbranched structure
twists to form helical amylose
amylopectin is amylose chains joined by α –1,6 glycosidic bonds
to give branching structure
illustration

first 3 points plus any 1 other **max 4**

glycogen
sequence of glucose molecules bonded α – 1,4 *stated*
glucose chains joined by α – 1,6 glycosidic bonds to give branches
similar to amylopectin but more branched

first point plus any 1 other **max 2**

cellulose
sequence of glucose molecules bonded β – 1,4 *stated*
straight chains form fibrils
glucose inverted every second molecule

first point plus any 1 other **max 2**

Marks

Question 1B

Eukaryotic plant cell

organised nucleus with membrane boundary		**1**
DNA present as true chromosomes		**1**
cell wall made of cellulose		**1**
central vacuole (bounded by tonoplast)		**1**
may have chloroplasts for photosynthesis		**1**
golgi apparatus (dictyosome) present		**1**
ER present		**1**
cytosol organised by membranes		**1**
cell wall has middle lamella		**1**
plasmodesmata present in walls		**1**
labelled diagram		**1**
	first point plus any 8	**max 9**

Prokaryotic bacterial cell

nuclear material free in cytoplasm		**1**
DNA is circular molecule		**1**
cell wall of peptidoglycan		**1**
cytoplasm lacks membrane organisation/ER/Golgi/chloroplasts/central vacuole		**1**
pili present as surface projections		**1**
flagella may be present		**1**
capsule of mucilage		**1**
labelled diagram		**1**
	first point plus any 5	**max 6**

Only differences between the cell types can score as above.
Similarities do not negate.

Question 2A

Define symbiosis: set of relationships between individuals of different species	**1**
Define parasitism: interaction between 2 species where one benefits and one is harmed	**1**
Describe example – host/parasite named	**1**
Host resources are used for food and reproduction	**1**
Relationship highly specific	**1**
Problem faced by host/symptoms	**1**
Transmission briefly described	**2**
first 3 plus any 2	**max 5**

Define commensalism: interaction between 2 species where one benefits and one is unaffected	**1**
Describe example – host/commensal named	**1**
Relationship usually based on feeding/protection	**1**
Benefit to commensal described	**1**
	max 4

Define mutualism: interaction between 2 species where both benefit	**1**
Describe example – both species named	**1**
Relationship involves – exchange of metabolic products	**1**
– close structural compatibility	**1**
Benefit to each species described	**2**
	max 5

Marks

Question 2B

(i) Define succession – sequential change in community structure **1**

Define autogenic – *any 4 from* **4**
– where biological processes modify conditions and resources
– primary succession: barren ground to climax vegetation
– example: bare rock to woodland; beach sand to woodland; etc
– secondary succession: existing soil to climax vegetation
– example: ploughed land to climax vegetation; regeneration after forest fire; etc

Define allogenic – caused by changing natural forces, eg climate change **1**
Define degradative – sequence of organisms associated with decomposition **1**
max 7

(ii) Succession increases complexity **1**
Factors increasing in complexity – *any 3 from* **3**
– number of species
– population sizes
– productivity
– variety of habitats
– variety of niches
– feeding relationships (food chains to food webs)
max 4

(iii) Intensive farming reduces complexity **1**
monoculture explained – large area occupied by single food/crop species **1**
implications of monoculture – *any 2 from* **2**
– reduction in plant diversity to a single species
– reduction in herbivore diversity
– reduction in carnivore density
– habitat loss
– soil status changes
– pest control reduces competitors, eg weeds
– pest control reduces disease species, eg fungus infections
max 4

Section D

Animal Behaviour

Marks

Question 1

Observation	– measurement/quantitative approach essential	**1**
	– latency explained/defined	**1**
	– problems	**1**
	– frequency explained/defined	**1**
	– eg application	**1**
	– duration explained/defined	**1**
	– problems	**1**
	– total duration explained (= frequency × duration)	**1**
	– advantage explained	**1**
other example where relevant		**1**
other discussion point where relevant		**1**
		max 9

Interpretation	– anthropomorphism defined/explained – eg anthropomorphic interpretation – scientific approach to testing interpretation	**max 2**
	– proximate cause of behaviour – eg nest building/alternative	**max 2**
	– ultimate cause of behaviour – eg nest building/alternative	**max 2**

Marks

Question 2

Predator strategies

Solitary	– "wait and see" approach explained	**1**
	– limitations	**1**
	– example	**1**
	– "active searchers" explained	**1**
	– limitations	**1**
	– example	**1**
		max 3
Group	– description to embody the idea of cooperation	**1**
	– advantages over solitary	**1**
	– example	**1**
		max 2

Prey defence strategies

warning colours	– purpose to advertise as distasteful and so deter predators	**1**
	– association with bright and bold colours, eg	**1**
	– experimental evidence	**1**
	– mimicry – resemblance to genuine distasteful prey (Batesian)	**1**
	– eg	
	– several distasteful species have the same markings (Mullerian)	**1**
		max 3
camouflage	– define – transformation to something not recognised as prey	**1**
	crypsis – blending with background, eg	**1**
	disruptive coloration – breaks up outline	**1**
	masquerade – disguise as another object	**1**
	– effectiveness associated with appropriate behaviour	**1**
		max 3
vigilance	– define purpose – to deter predator well in advance of attack	**1**
	– safety advantage of group size in spotting prey	**1**
	– economical in relation to other activities	**1**
		max 2
escape responses	– advertising fitness, eg (stotting, lark song, etc)	**1**
	– *any 3 examples from* – withdrawal into shell	
	– rolling into a ball	
	– playing dead	
	– toxic hairs/bristles	
	– spines	
	– stings	
	– unpleasant odours/sprays	
	– toxicity	**1**
		max 2

Marks

Question 3

Antibodies defined/explained	– proteins made by B lymphocytes in response to specific antigens	**1**
Monoclonal explained	– single B cell line secreting one specific antibody	**1**

Spleen is site of monoclonal B cell production	**1**
Mouse is source of desired B cells	**1**
Circulating B cells are called plasma cells	**1**
Antibodies can be extracted in low concentrations from blood plasma	**1**
Not viable commercially – a mixture of antibodies and at low concentration	**1**
B cells not easy to grow in large amounts in tissue culture	**1**
	max 3

Myeloma/plasmacarcinoma cells	– grow well in tissue culture	**1**
	– are plasma cells	**1**
	– but are not secreting	**1**
		max 2

Myeloma cells will hybridise with other cell types to form hybridomas	**1**
when polyethylene glycol (PEG) is present	**1**
When hybridised with active B cell, a secreting B cell line is cultured	**1**
	max 2

B cells are obtained by injecting mouse with antigen	**1**
Spleen cells are hybridised with myeloma	**1**
Secreting hybridomas cultured in batch culture	**1**
and pure antibodies extracted	**1**

Examples of commercial use	– any 2 examples	
	– disease treatment/passive immunisation	
	– highly specific/sensitive extraction process	
	– pregnancy testing	
	– immunoassay techniques/ELISA	
		max 2

Marks

Question 4

Stages listed – choice of microbe
– fermentation conditions
– product recovery (*all 3 = 2, 2 = 1, 1 = 0*) **2**

Choice – bacterium or fungus
– over-producer of the enzyme
– genetically engineered microbe or natural selection from high T environment
– strain must be robust enough to withstand culture conditions
max 3

Fermentation conditions and control

Conditions – *any 5 from 7* (*must have both condition and reason*)

sterility	– most likely will be batch culture
	– need for sterilised container/medium
	– stainless steel tanks which are designed for sterilising
nutrients	– carbon, N, minerals, vitamins
	– energy source; metabolites for growth
oxygen	– sterile – eg by filtration
	– sparger to create bubbles
	– most important limiting factor/needed for aerobic respiration
pH	– alters as substrate used/product formed
	– pH kept at optimum for microbe enzymes
temperature	– heat production by respiration
	– cooling system to keep T constant
	– T optimum for microbe enzymes
anti-foaming agents	– to prevent microbes blocking vents
	– ensure access to medium
time	– two to five days
	– growth finished by two to five days **max 5**

Control – oxygen, pH, temperature monitored by electrode
– stirring by impellers to mix contents of fermenter
– impellers distribute microbes evenly/break up hyphae into pellets **max 2**

Product recovery

Stages – separation, concentration and recovery **1**
Plus any two from
– extra-cellular enzyme separated from cells **1**
by flocculation and filtration/centrifugation **1**
– product concentrated **1**
by ultrafiltration/vacuum evaporation/reverse osmosis **1**
– purification by affinity/precipitation/chromatography **1**
max 3

Marks

Question 5

Cardiovascular disease (CVD) defined as diseases of the heart and blood vessels	**1**
– includes – two eg from – coronary heart disease (CHD)	
– angina	
– myocardial infarction	
– stroke	**1**
Atherosclerosis and hypertension are main disease processes leading to CVD	**1**
Atherosclerosis explained as atheromal/plaque deposition in artery walls	**1**
– mainly cholesterol at first	**1**
– then fibrous material and calcium	**1**
– leading to narrowing of arteries	**1**
– and restriction of blood flow	**1**
– loss of elasticity in artery walls/hardening of the arteries	**1**
– leads to increase in blood pressure	**1**
severe loss of blood flow through coronary arteries leads to angina pectoris	**1**
plaque roughens the interior lining of artery, making clot/thrombosis more likely	**1**
thrombosis is when artery is blocked by clot/coronary/cerebral thrombosis explained	**1**
thrombosis breaks off/embolus can block artery/embolism	**1**
– causes stroke when in brain artery	**1**
– causes myocardial infarction when in coronary artery	**1**
3 key points in italics plus any 9 others	**max 12**

Risk factors in CVD	– *any 6 for 3 marks, 4 = 2, 2 = 1*	
	– high blood pressure	
	– carbon monoxide in cigarettes	
	– diabetes mellitus	
	– high blood cholesterol	
	– obesity	
	– high salt intake	
	– high fat diet	
	– genetic predisposition	
	– stress	**max 3**

Marks

Question 6

Energy needs	– basal requirements	**1**
	– keeping heart beating/breathing	**1**
	– maintaining temperature	**1**
	– active transport/membrane functions/nerve transmission	**1**
	– active movement	**1**
	– synthesis of materials for growth and repair	**1**
	– pregnancy and lactation	**1**
		max 3
Expenditure		
Basal metabolic rate (BMR)	– defined – energy for normal body functions	**1**
	– eg typical value/range (approx)	**1**
	– conditions in which it is measured (resting + fasting)	**1**
	– 60-70% of output in sedentary adult	**1**
factors affecting BMR	– body weight + explanation	**1**
	– body composition/muscle : fat – explain	**1**
	– age – BMR decreases 2% per decade	**1**
	– sex – males have about half the % fatty tissue	**1**
	– fasting – BMR decreases with low energy diet	**1**
		max 5
Thermic effect	– defined – energy expended to digest food	**1**
	– goes up by 30% after meal, 10% over 24 hrs	**1**
	– example of dietary implications	**1**
		max 2
Physical activity	– define – energy expenditure above resting value	**1**
	– variable portion of expenditure related to type of activity	**1**
	– example to compare energy for two different activities	**1**
	– expenditure depends on both intensity and duration	**1**
	– example to compare	**1**
	– exercise elevation idea to justify regular exercise	**1**
	– effect of exercise in elevating BMR to justify regular exercise	**1**
		max 5

[*END OF MARKING INSTRUCTIONS*]