

FOR OFFICIAL USE

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Totals for  
Sections  
B and C

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**X274/12/02**

NATIONAL WEDNESDAY, 15 MAY  
QUALIFICATIONS 1.00 PM – 3.30 PM  
2013

**BIOLOGY**  
**HIGHER (REVISED)**

Fill in these boxes and read what is printed below.

Full name of centre

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Town

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Forename(s)

--

Surname

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Date of birth

Day    Month    Year

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Scottish candidate number

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Number of seat

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**SECTION A—Questions 1—30 (30 Marks)**

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

For this section of the examination you must use an **HB pencil**.

**SECTIONS B AND C (100 Marks)**

- (a) All questions should be attempted.  
(b) It should be noted that in **Section C** questions 1 and 2 each contain a choice.
- The questions may be answered in any order but all answers are to be written in the spaces provided in this answer book, **and must be written clearly and legibly in ink**.
- Additional space for answers will be found at the end of the book. If further space is required, supplementary sheets may be obtained from the Invigilator and should be inserted inside the **front** cover of this book.
- The numbers of questions must be clearly inserted with any answers written in the additional space.
- Rough work, if any should be necessary, should be written in this book and then scored through when the fair copy has been written. If further space is required, a supplementary sheet for rough work may be obtained from the Invigilator.
- Before leaving the examination room you must give this book to the Invigilator. If you do not, you may lose all the marks for this paper.



### Read carefully

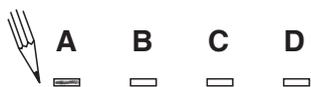
- 1 Check that the answer sheet provided is for **Biology Higher (Revised) (Section A)**.
- 2 For this section of the examination you must use an **HB pencil**, and where necessary, an eraser.
- 3 Check that the answer sheet you have been given has **your name, date of birth, SCN** (Scottish Candidate 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 examination, put the **answer sheet for Section A inside the front cover of this answer book**.

### Sample Question

The apparatus used to determine the energy stored in a foodstuff is a

- A calorimeter
- B respirometer
- C klinostat
- D gas burette.

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



### Changing an answer

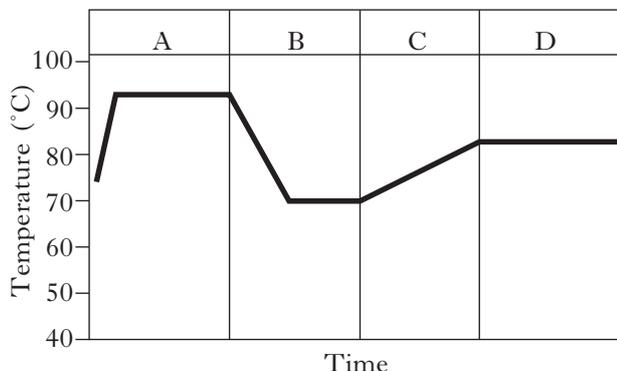
If you decide to change your answer, carefully erase your first answer and using your pencil fill in the answer you want. The answer below has been changed to **D**.



## SECTION A

**All questions in this section should be attempted.  
Answers should be given on the separate answer sheet provided.**

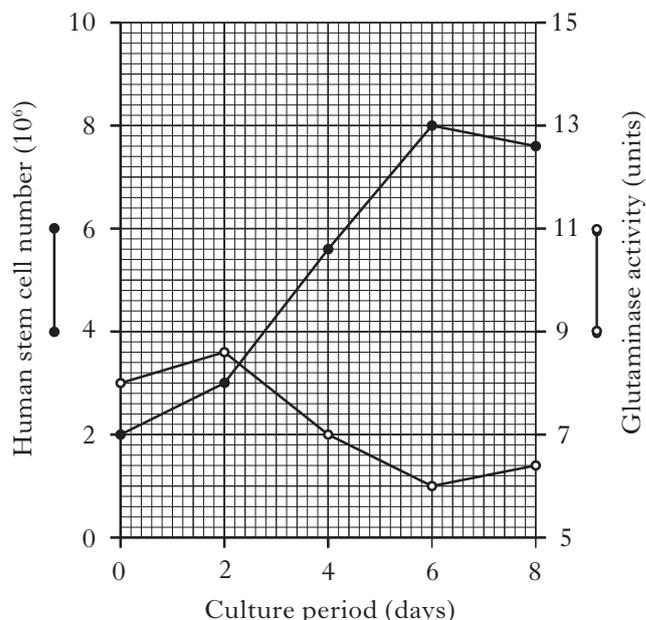
1. The graph below shows the temperature changes involved in one cycle of the polymerase chain reaction (PCR).



Which letter indicates when primers would bind to target sequences of DNA?

2. Which of the following statements related to cell differentiation is correct?
- A Meristems are regions of differentiated cell types in plants.
  - B Embryonic stem cells can differentiate into a limited range of cell types.
  - C A differentiated cell only expresses genes that produce proteins characteristic of that cell type.
  - D Adult tissue stem cells can differentiate into all cell types.

3. The graph below shows the changes in number of human stem cells in a culture. The activity of the enzyme glutaminase present in the cells over an eight day period is also shown.



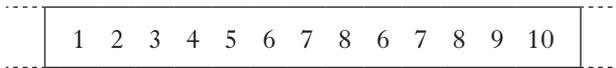
How many units of glutaminase activity were recorded when the cell number was 50% of its maximum over the eight day period?

- A 3
  - B 4
  - C 8
  - D 9
4. Genetic drift is a change in gene frequency, particularly in small populations.
- Which of the following is true of genetic drift?
- A It is random and influenced by the founder effect.
  - B It is non-random and influenced by the founder effect.
  - C It is random and influenced by natural selection.
  - D It is non-random and influenced by natural selection.

5. The diagram below shows a section of a chromosome and the locations of ten genes.

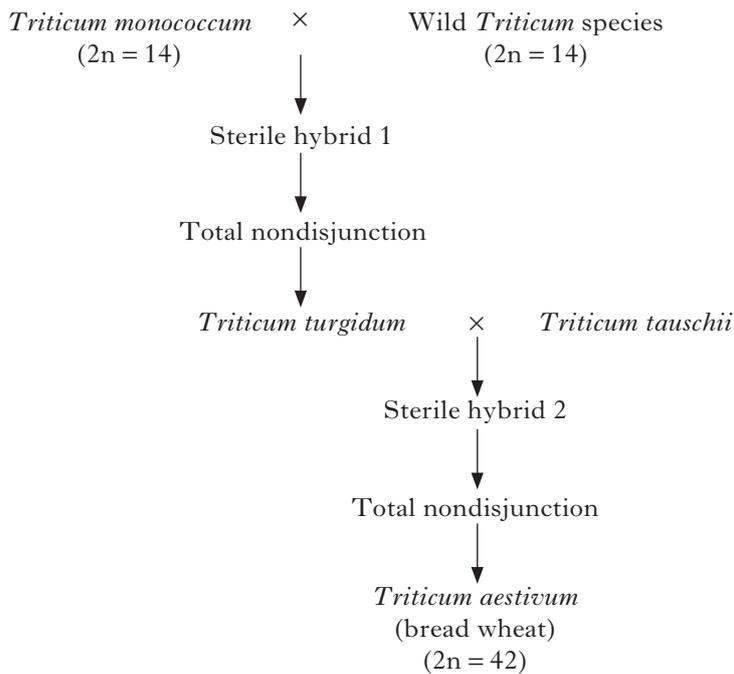


A mutation during cell division resulted in the following sequence of genes on the same chromosome.



The type of mutation involved in this example is

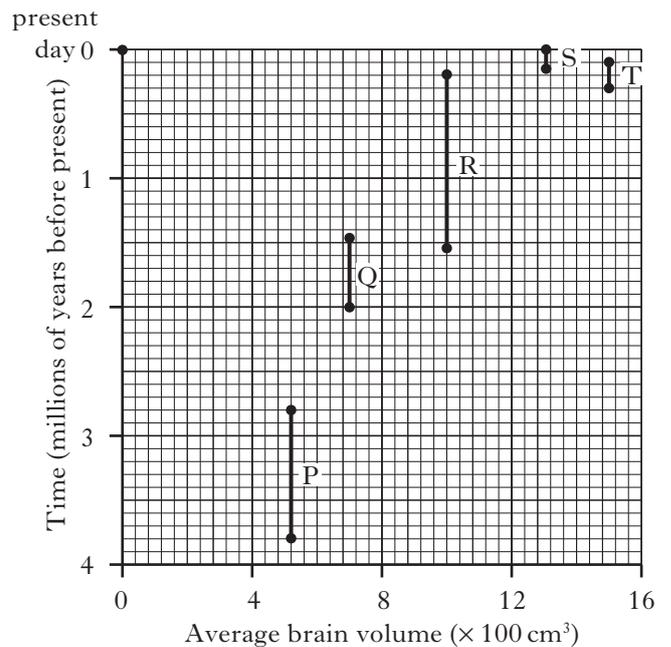
- A deletion
  - B translocation
  - C duplication
  - D inversion.
6. The diagram below represents stages in the evolution of *Triticum aestivum* (bread wheat). The diploid chromosome numbers of some species involved are given.



Which line in the table below indicates correctly the diploid chromosome numbers of *Triticum turgidum* and *Triticum tauschii*?

	<i>Triticum turgidum</i>	<i>Triticum tauschii</i>
A	14	14
B	28	28
C	14	28
D	28	14

7. The graph below shows the average brain volume of several related species of hominid and the time periods during which they lived.



**Key**

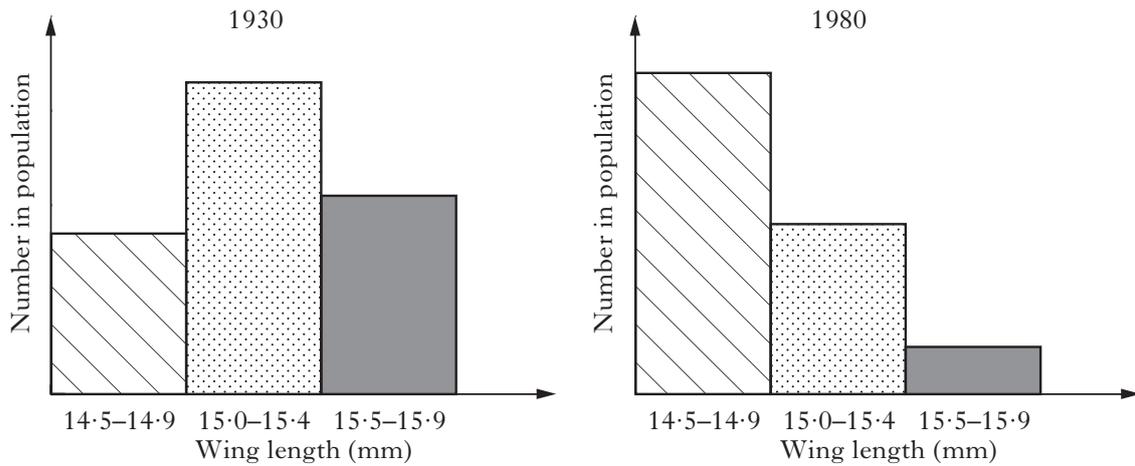
- P – *Australopithecus afarensis*
- Q – *Homo habilis*
- R – *Homo erectus*
- S – *Homo sapiens* (modern humans)
- T – *Homo neanderthalensis*

Which conclusion can be drawn from the graph?

- A *Homo sapiens* is the most intelligent species.
- B *Homo neanderthalensis* had the largest brain.
- C *Homo sapiens* evolved from *Homo erectus*.
- D The more recently the species lived the larger its brain volume.

**Questions 8 and 9 refer to the following information.**

The graphs below show the effects of natural selection pressure on wing span in a population of house sparrows between 1930 and 1980.



8. Which line in the table below correctly compares the statistical data in the two graphs?

	<i>Mean</i>	<i>Range</i>
A	same	same
B	same	different
C	different	same
D	different	different

9. Which line in the table below correctly describes the change in gene frequency and the type of selection involved in this case?

	<i>Change in gene frequency</i>	<i>Type of selection</i>
A	non-random	stabilising
B	random	directional
C	non-random	directional
D	random	stabilising

10. The following list gives descriptions of three areas of study which use genomic sequencing.

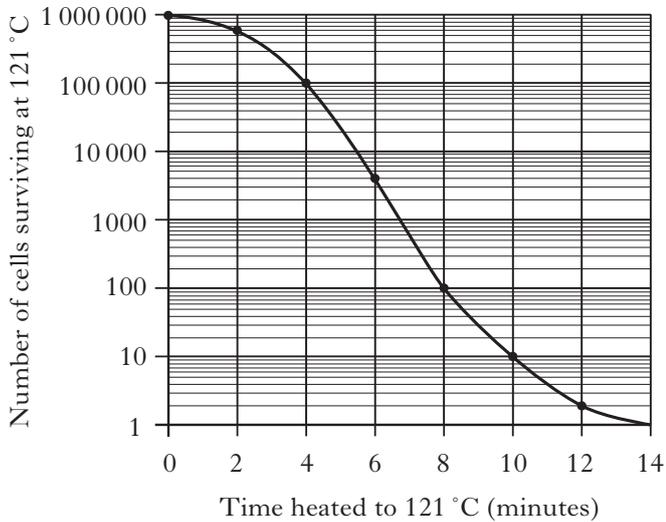
- X study of evolutionary relatedness
- Y study of comparative gene sequences using computers and statistics
- Z study of genomes related to personalised medicine

Which line in the table below correctly matches the name of the areas of study with their descriptions?

	<i>Area of study</i>		
	<i>Bioinformatics</i>	<i>Pharmacogenetics</i>	<i>Phylogenetics</i>
A	Y	Z	X
B	Y	X	Z
C	Z	Y	X
D	X	Z	Y

11. Bacterial cells were heated to 121°C for increasing lengths of time to determine the number of live cells left after treatment.

The graph below shows the number of bacterial cells which survived.

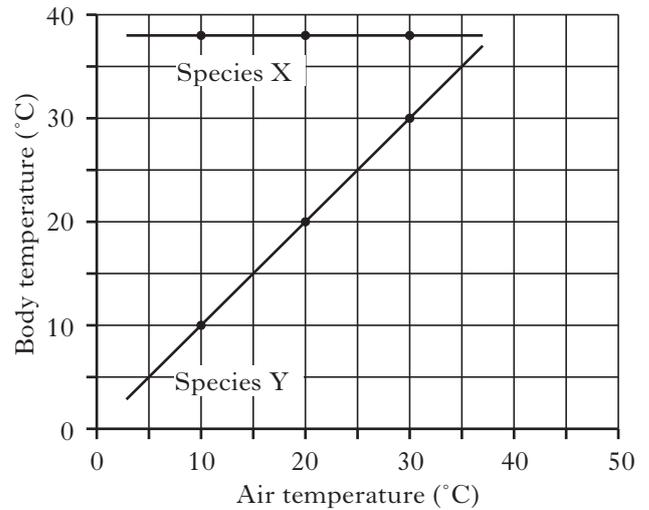


How many cells survive after 6 minutes?

- A 1300  
 B 4000  
 C 5000  
 D 5500
12. The final electron acceptor in the electron transport chain of respiration is

- A NADH  
 B water  
 C ATP  
 D oxygen.

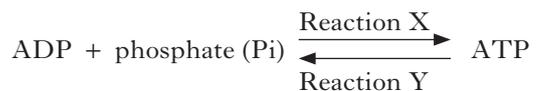
13. The graph below shows the relationship between air temperature and the body temperature of two animal species X and Y.



Which line in the table below correctly describes species X and Y?

	<i>Species X</i>	<i>Species Y</i>
A	regulator	regulator
B	regulator	conformer
C	conformer	regulator
D	conformer	conformer

14. The diagram below shows the regeneration of ATP in a cell.



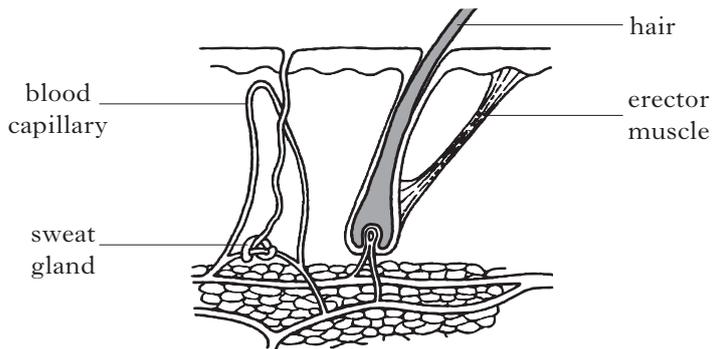
The following statements relate to this diagram.

- Reaction X releases energy for anabolic pathways.
- Reaction Y releases energy for anabolic pathways.
- Reaction X is catalysed by ATP synthase.
- Reaction Y is catalysed by ATP synthase.

Which statements are correct?

- A 1 and 3  
 B 1 and 4  
 C 2 and 3  
 D 2 and 4

15. The diagram below shows a section through the skin of a mammal.



Which line in the table below correctly identifies the state of the erector muscle and the change in blood flow in the capillary which would be expected if the skin was exposed to low temperature?

	<i>State of erector muscle</i>	<i>Change in blood flow in capillary</i>
A	contracted	increase
B	contracted	decrease
C	relaxed	increase
D	relaxed	decrease

16. The giant bullfrog of South Africa lives in a habitat in which hot and dry conditions can occur at any time of year. To survive these conditions, the frogs respond by becoming dormant.

Which of the following descriptions applies to this type of dormancy?

- A Predictive aestivation
- B Predictive hibernation
- C Consequential aestivation
- D Consequential hibernation

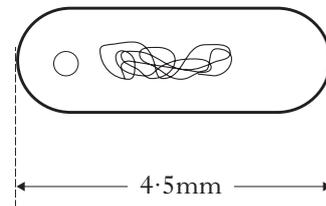
17. Using recombinant DNA technology, the bacterium *E. coli* can be modified so that it can produce human insulin. The following steps are involved.

- 1 Culture large quantities of *E. coli* in nutrient medium.
- 2 Insert human insulin gene into *E. coli* plasmid DNA.
- 3 Cut insulin gene from human chromosome using enzymes.
- 4 Extract insulin from culture medium.

The correct order of these steps is

- A 3, 2, 1, 4
- B 3, 1, 2, 4
- C 1, 4, 3, 2
- D 1, 2, 3, 4.

18. The diagram below shows an image of a bacterial cell that has been magnified 1500 times.

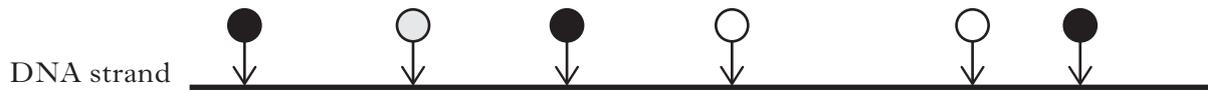


What is the actual length of the cell in micrometres ( $\mu\text{m}$ )?

- A 0.003
- B 3.000
- C 6750
- D 6.750

[Turn over

19. The diagram below shows part of a DNA strand and the sites at which three different endonucleases can cut the strand.



- EcoRI endonuclease
- HindIII endonuclease
- SmaI endonuclease

Which line in the table below identifies correctly the number of DNA fragments which would be obtained if this DNA strand was cut with the endonuclease(s) shown in the table?

	<i>Endonucleases</i>			
	<i>EcoRI</i>	<i>SmaI</i>	<i>HindIII</i>	<i>EcoRI and HindIII</i>
A	2	2	1	3
B	2	3	2	3
C	4	2	1	5
D	4	3	2	5

20. Domestic chickens kept in social groups form a social hierarchy in which the most dominant birds give most pecks to others and receive least.

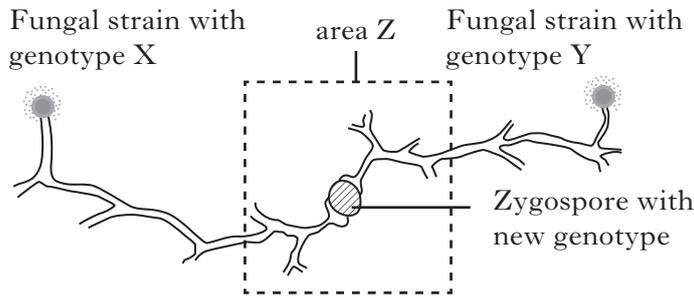
In an investigation, four individual domestic chickens from a group were marked with lettered leg rings. The number of pecks given and received by each bird in one hour was recorded and the results shown in the table below.

		<i>Number of pecks given by each bird to the others</i>			
		Leg ring letter	W	X	Y
<i>Number of pecks received by each bird from the others</i>	W	–	0	12	9
	X	15	–	8	7
	Y	0	0	–	0
	Z	0	0	10	–

The social hierarchy among the chickens with the most dominant bird first is

- A Y, Z, W, X
- B X, W, Z, Y
- C Y, W, Z, X
- D X, Z, W, Y.

21. The diagram below shows interaction between two strains of fungi X and Y with different genotypes in an area Z.



Which statement describes the process occurring in area Z?

- A mutagenesis  
 B selective breeding  
 C transfer of plasmids  
 D sexual reproduction
22. The following statements refer to photosynthesis.

- 1 Carbon dioxide is fixed by RuBisCO.
- 2 Sugar molecules are combined to form starch.
- 3 G3P is used to regenerate RuBP.

Which of the statements correctly refer to the Calvin cycle?

- A 1 and 2 only  
 B 1 and 3 only  
 C 2 and 3 only  
 D 1, 2 and 3
23. Natural selection reduces in-breeding depression in self-pollinating plant species by eliminating
- A deleterious alleles  
 B recessive alleles  
 C mutated alleles  
 D dominant alleles.

24. Crop pests may be controlled by various methods.

Which control methods are used in integrated pest management?

- A biological only  
 B systemic and selective chemicals  
 C selective chemicals only  
 D chemical and biological

25. The numbers of plants of five different species present in two plant communities were counted.

Community X was grazed by deer.  
 Community Y had deer excluded by fences.

The results are shown in the table below.

Plant species	Number of plants present	
	Plant community X	Plant community Y
1	300	40
2	325	48
3	341	1431
4	319	32
5	315	49

Based on the information given, which comparison of plant community X with community Y is correct?

In comparison with plant community X, community Y has

- A the same species richness but a lower species diversity  
 B the same species richness and a higher species diversity  
 C different species richness but lower species diversity  
 D different species richness and higher species diversity.

[Turn over

26. Mink is a naturalised mammal in many parts of the UK.

A program designed to control mink numbers in a region of Scotland was started at the end of May 2009. The population of adult animals was surveyed every three months for a year and the results are shown in the table below.

<i>Survey date</i>	<i>Population of adult mink</i>
End May 2009	1250
End August 2009	750
End November 2009	520
End February 2010	340
End May 2010	50

What was the average decrease in number of adult mink per month during the programme?

- A 100
- B 240
- C 243
- D 582

27. Northern elephant seals have very low genetic variation caused by a catastrophic decline in numbers of this species due to over-hunting by humans.

Present day animals have all descended from the small number that survived.

What term is used to refer to the loss of genetic variation associated with a serious decline in population?

- A Founder effect
- B Stabilising selection
- C Bottleneck effect
- D Directional selection

28. The list of statements below refers to advantages gained by hunting behaviour.

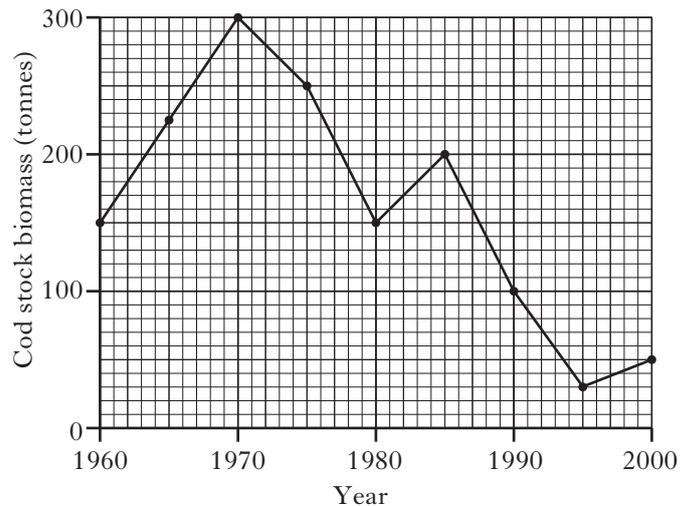
- 1 Much larger prey may be killed than by hunting alone.
- 2 Both dominant and subordinate animals benefit.
- 3 Individuals gain more energy than by hunting alone.

Which of the statements could be true of cooperative hunting?

- A 1 and 2 only
- B 1 and 3 only
- C 2 and 3 only
- D 1, 2 and 3

29. Cod is an important fish species which is caught for human food.

The graph below shows changes in the estimated biomass of cod stocks in a region of the North Sea between 1960 and 2000.



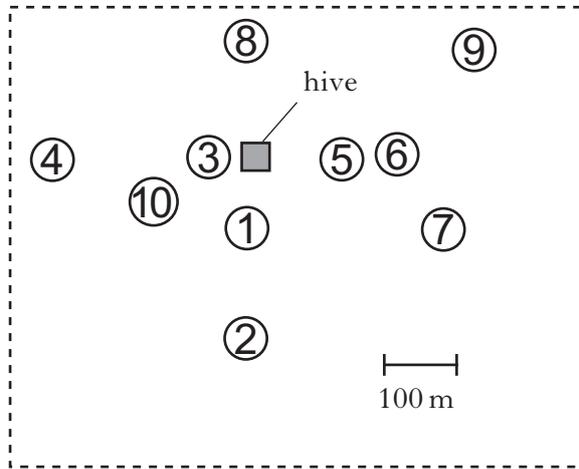
Which line in the table correctly shows the overall decrease in estimated cod biomass in this region in the ten year periods shown?

	<i>Ten year period</i>	<i>Decrease in estimated cod biomass in the region (tonnes)</i>
A	1960 and 1970	150
B	1970 and 1980	100
C	1980 and 1990	100
D	1990 and 2000	50

30. Bees are social insects. The workers forage for food and indicate the distance and direction of food sources which they have located, to the rest of their hive, by dance-like movements of two different types.

The diagram below shows a hive and the location of food sources ① – ⑩. The table shows the type of dance workers performed after finding sources ① – ⑧.

**Diagram**



**Table**

<i>Food Source</i>	<i>Dance</i>
①	round
②	waggle
③	round
④	waggle
⑤	round
⑥	round
⑦	waggle
⑧	waggle

Which line in the table indicates the dances likely to be performed by workers on finding food sources ⑨ and ⑩?

	<i>Type of dance performed</i>	
	Food Source ⑨	Food source ⑩
A	waggle	waggle
B	waggle	round
C	round	waggle
D	round	round

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

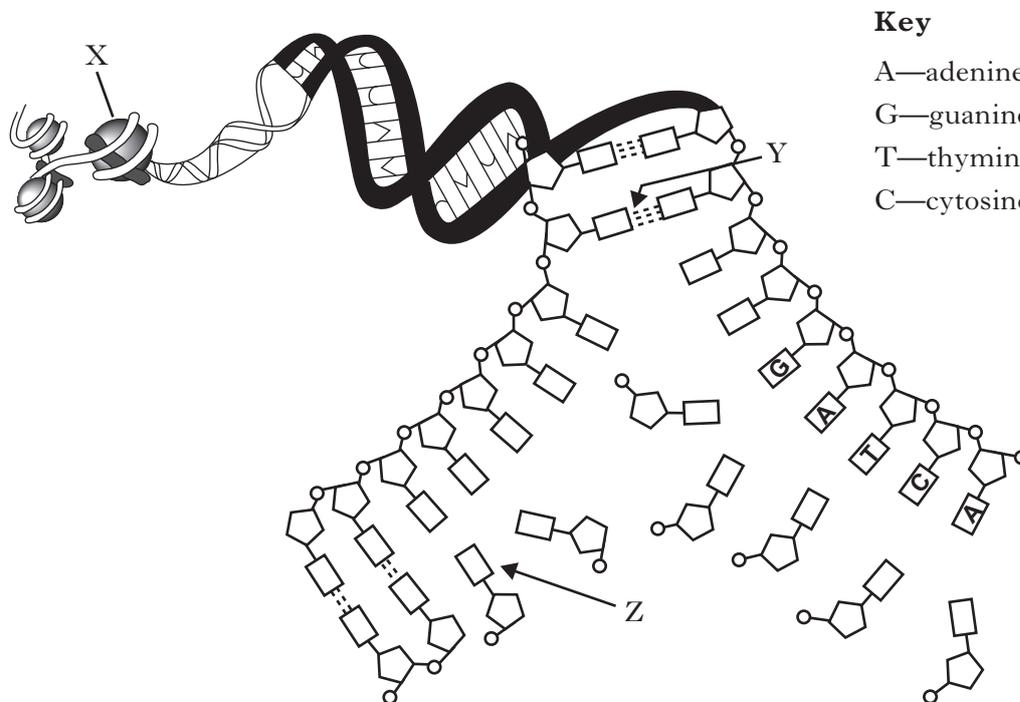
**[Turn over**

Marks

**SECTION B**

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

1. The diagram below shows part of a DNA molecule during replication and other molecules associated with it.



- (a) Name molecule X which is associated with the tightly coiled DNA.

\_\_\_\_\_

1

- (b) Name the type of bond shown at Y.

\_\_\_\_\_

1

- (c) Name base Z.

\_\_\_\_\_

1

- (d) Underline one word in each pair to make the sentence correct.

DNA is a double stranded  $\left\{ \begin{array}{l} \text{parallel} \\ \text{antiparallel} \end{array} \right\}$  molecule with  
deoxyribose and  $\left\{ \begin{array}{l} \text{bases} \\ \text{phosphate} \end{array} \right\}$  at the 3' and 5' ends of each strand respectively.

1

- (e) State the role of DNA polymerase in the process of DNA replication.

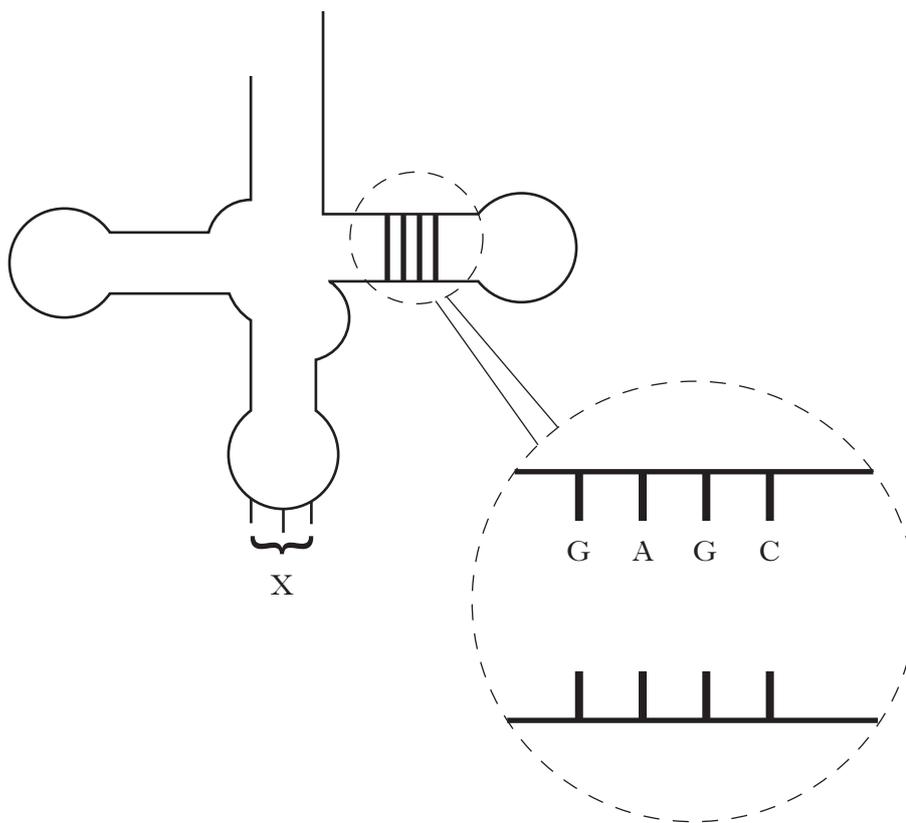
\_\_\_\_\_

\_\_\_\_\_

1

Marks

2. The diagram below shows a molecule of tRNA. A section of the diagram has been enlarged.



- (a) **Complete the enlarged section of the diagram** by inserting the letters of the complementary bases. 1
- (b) Using the letter P, **label the diagram** to show the position of the amino acid attachment site. 1
- (c) Name part X and explain its importance in the process of translation. 1

Name \_\_\_\_\_ 1

Importance \_\_\_\_\_

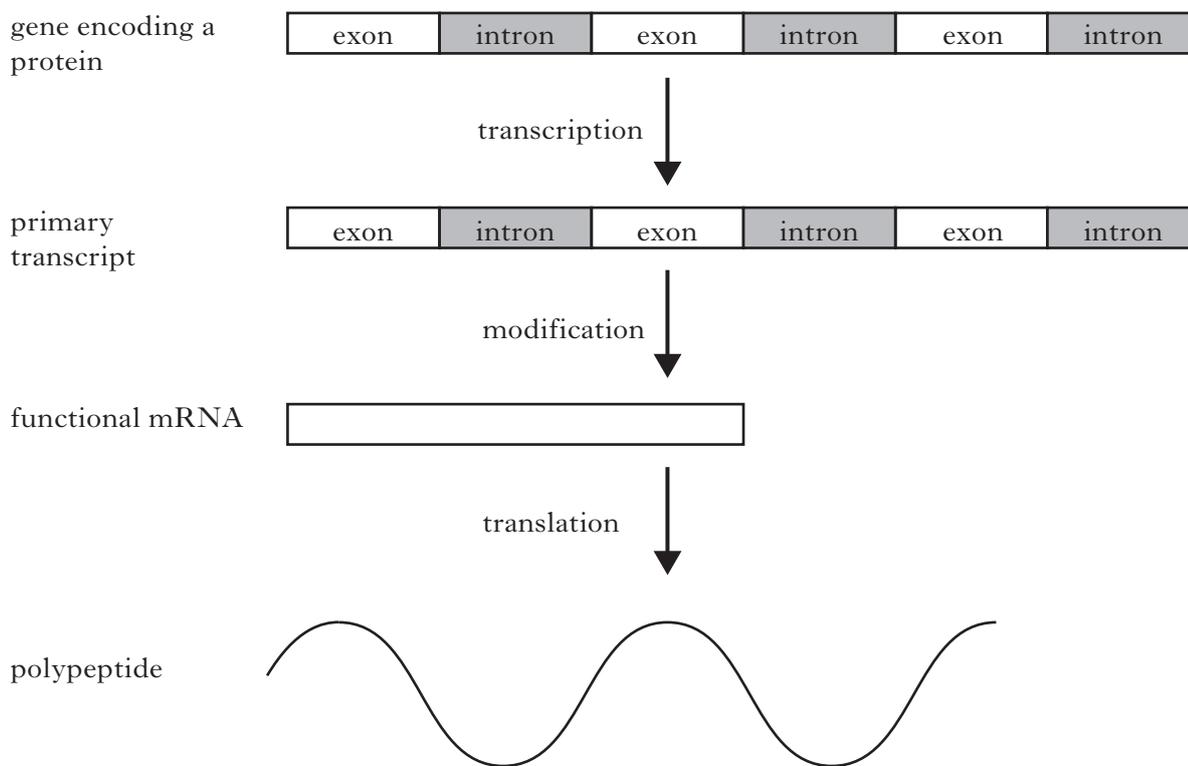
\_\_\_\_\_

\_\_\_\_\_ 1

[Turn over

Marks

3. The diagram below shows stages involved in the transcription and translation of a eukaryotic gene. Both introns and exons are transcribed and then the primary transcript is modified to produce the functional mRNA which is then translated.



(a) State the difference between introns and exons.

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1

(b) Name the enzyme responsible for the synthesis of the primary transcript.

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1

(c) Name the process that involves the modification of the primary transcript to form the functional mRNA.

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1

(d) Describe how different functional mRNA molecules can be produced from the same primary transcript sequence.

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1

(e) Describe **one** way in which the polypeptide structure can be modified **following** translation.

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1

**[Turn over for Question 4 on *Page sixteen***

Marks

4. Different varieties of banana can have different numbers of chromosome sets in their cells. Banana flesh contains carotenoids and different varieties have different carotenoid contents. Extracts of five different varieties of banana were placed in a colorimeter to measure the transmission of light through them. The darker the flesh the lower the percentage of light transmitted.

The results are shown in the table below.

<i>Banana variety</i>	<i>Number of sets of chromosomes</i>	<i>Carotenoid content (mg per kg banana flesh)</i>	<i>Light transmitted through extract (%)</i>
Tuugia	2 (diploid)	1.6	82
Khai	2 (diploid)	9.4	64
Figo Cinza	3 (triploid)	2.8	72
Saney	3 (triploid)	19.2	52
Porp	4 (tetraploid)	2.2	76

- (a) Describe the relationship between carotenoid content and darkness of flesh.

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1

- (b) (i) Express as the simplest whole number ratio the average carotenoid content of the diploid to that of the triploid varieties.

*Space for calculation.*

\_\_\_\_\_ : \_\_\_\_\_  
diploid      triploid

1

- (ii) It has been suggested that additional carotenoid content in the diet gives humans increased protection against certain cancers.

Calculate the mass of carotenoid which would be found in a 125 g sample of Figo Cinza flesh.

*Space for calculation.*

\_\_\_\_\_ mg

1

*Marks***4. (b) (continued)**

- (iii) Using the information given, decide if the statement in the table below is true or false.

Add your choice to the table and give a reason for your answer.

<i>Statement</i>	Banana varieties with increased numbers of chromosome sets have increased carotenoid content in their cells.
<i>True (T) or False (F)</i>	
<i>Reason</i>	

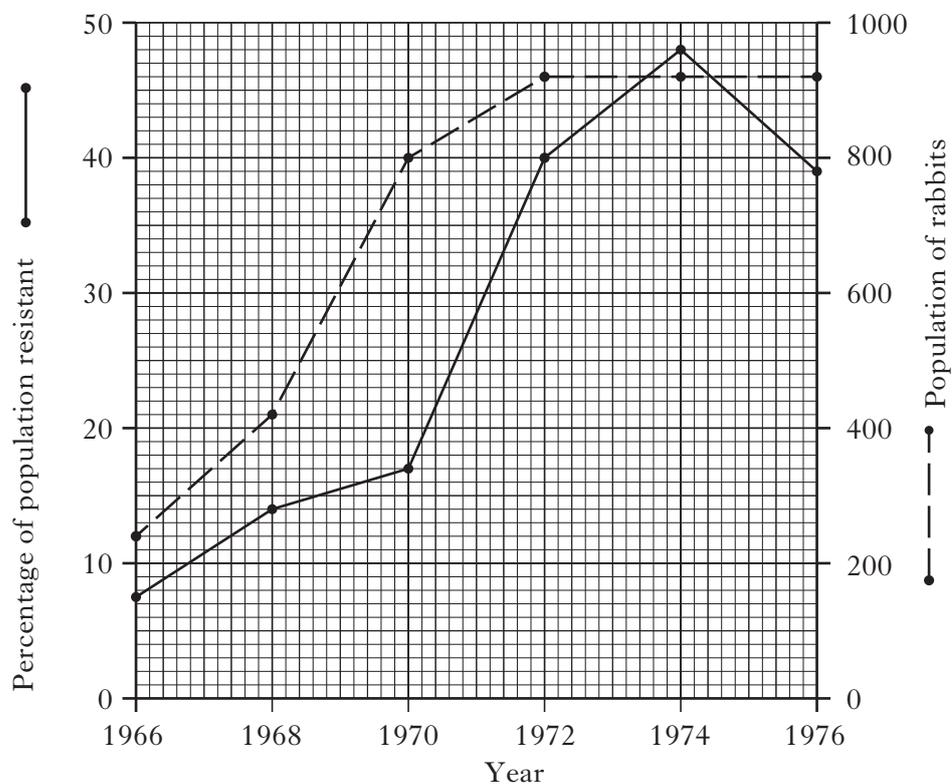
**1****[Turn over**

Marks

5. Myxomatosis is a viral disease to which some rabbits are resistant and survive while others die.

A rabbit population was monitored for 10 years. The percentage of the population which was resistant was recorded.

The results are shown in the graph below.



- (a) (i) Calculate the number of rabbits which were resistant in 1972.

*Space for calculation.*

\_\_\_\_\_ rabbits **1**

- (ii) Calculate the average increase in the rabbit population per year between 1966 and 1970.

*Space for calculation.*

\_\_\_\_\_ rabbits per year **1**

- (iii) Identify the two year period during which there was the greatest change in the percentage of the population resistant to myxomatosis.

Tick (✓) the correct box below.

1966–1968

1968–1970

1972–1974

1974–1976

**1**

Marks

**5. (continued)**

- (b) Explain the increase in resistance to myxomatosis in the rabbit population in terms of the frequency of genetic sequences.

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**1**

- (c) Describe evidence from the graph that indicates that the myxomatosis virus underwent mutation during the 10 year period.

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**1**

**[Turn over**

Marks

6. *Mytilus edulis* and *Mytilus trossulus* are two closely related species of mussel which have evolved after populations of their common ancestor became separated by a geographical barrier.

(a) Name the type of speciation involved in this case.

\_\_\_\_\_

1

(b) Describe the evidence needed to confirm that *M. edulis* and *M. trossulus* are different species.

\_\_\_\_\_

\_\_\_\_\_

1

(c) Regions have been discovered in which the two closely related species occur together and sometimes interbreed.

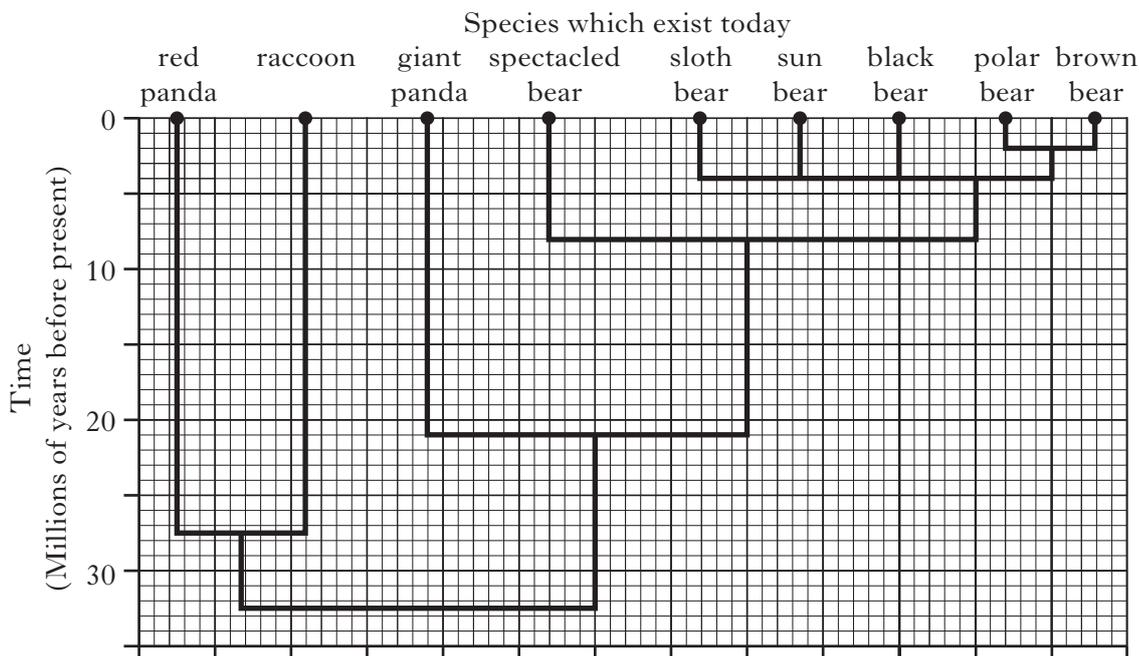
What name is given to these regions?

\_\_\_\_\_

1

Marks

7. The diagram below shows the divergence of lineages in the evolution of the giant panda and related species which exist today.



- (a) Give **two** sources of evidence which can provide information used to produce diagrams of this type.

1 \_\_\_\_\_

2 \_\_\_\_\_

2

- (b) (i) State how long ago the last common ancestor of the giant panda and polar bear existed.

\_\_\_\_\_ million years before present

1

- (ii) State the number of other species with which the sun bear shared a common ancestor eight million years before present.

\_\_\_\_\_ species

1

- (c) Evidence has suggested the existence of three main domains of life.

Name the **three** main domains of life.

1 \_\_\_\_\_

2 \_\_\_\_\_

3 \_\_\_\_\_

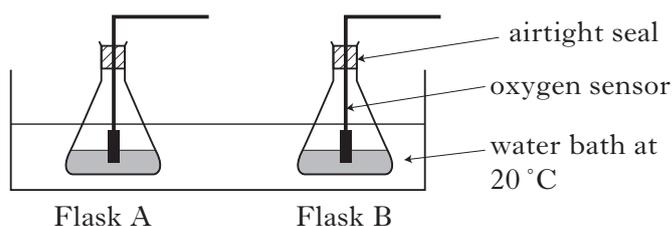
2

Marks

8. In an investigation into the effect of lead ion concentration on respiration in yeast, two flasks were set up as described below.

Flask	Contents
A	200cm <sup>3</sup> glucose solution + 5cm <sup>3</sup> 0.2% lead nitrate solution
B	200cm <sup>3</sup> glucose solution + 5cm <sup>3</sup> 1.0% lead nitrate solution

The flasks were placed in a water bath at 20 °C for 10 minutes. After this time 2.5cm<sup>3</sup> of yeast suspension was added to each and oxygen sensors fitted as shown in the diagram below.



The flasks were left for a **further** 10 minutes and then oxygen concentration was measured in each flask every 20 seconds for 2 minutes.

The results are shown in the table below.

Time (s)	Oxygen concentration (mg per litre)	
	Flask A 0.2% lead nitrate	Flask B 1.0% lead nitrate
0	10.2	10.8
20	8.4	9.3
40	6.1	7.6
60	3.8	6.2
80	1.7	5.1
100	0.2	4.0
120	0.0	3.2

- (a) (i) Identify the independent variable in this investigation.

\_\_\_\_\_ 1

- (ii) Identify **one** variable, not already mentioned, which would have to be kept constant so that valid conclusions could be drawn.

\_\_\_\_\_ 1

- (iii) Explain why the flasks were left for 10 minutes **before** the yeast suspension was added.

\_\_\_\_\_

\_\_\_\_\_ 1

8. (a) (continued)

Marks

- (iv) Explain why the flasks were left for a **further** 10 minutes **after** the yeast suspensions were added before measurements of oxygen concentrations were taken.

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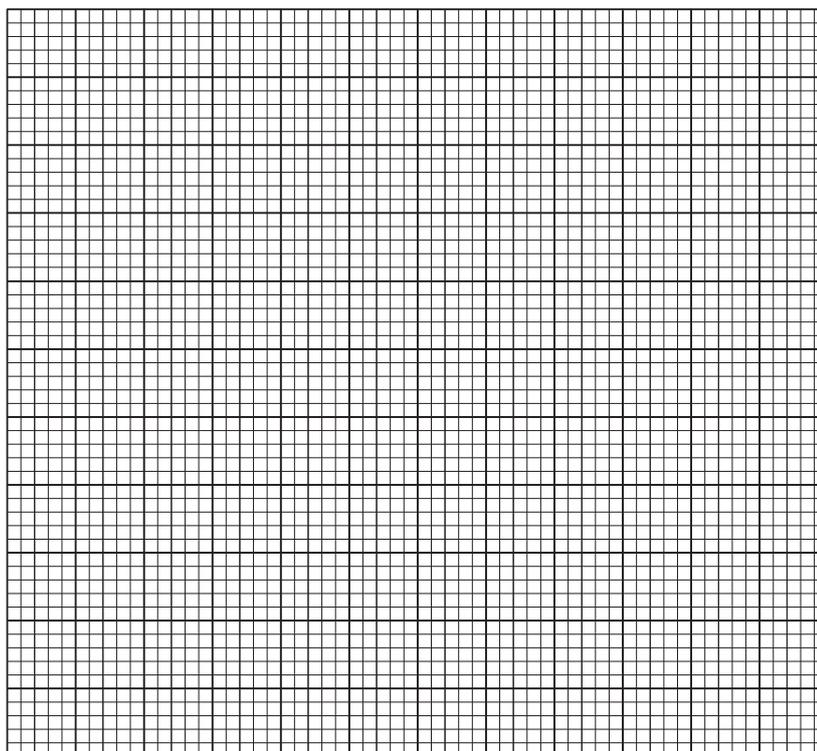


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1

- (b) On the grid provided, draw a line graph to show the oxygen concentration in **Flask A** against time. Use appropriate scale to fill most of the grid.

(Additional graph paper, if required, will be found on *Page forty*.)



2

- (c) Using information from the table, state the effect of increasing lead ion concentration on the aerobic respiration of yeast.

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1

- (d) Bubbles of carbon dioxide appeared in both flasks throughout the investigation. Explain why this gas continued to be produced in **Flask A** after 120s.

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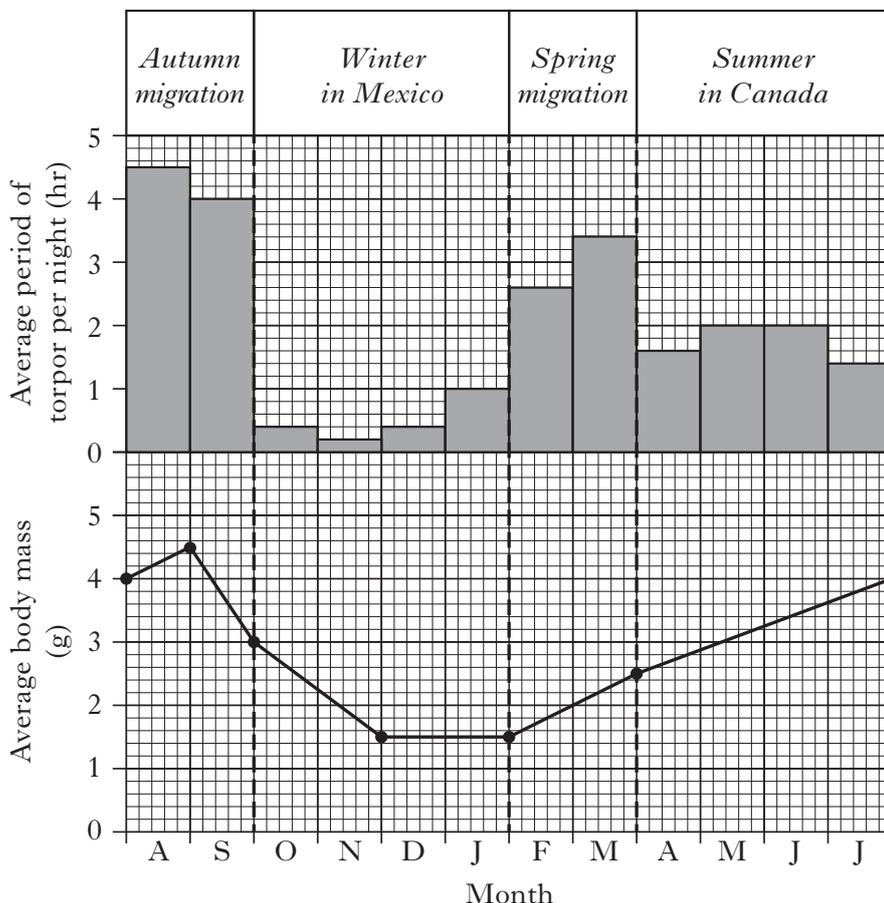
1

9. Rufous hummingbirds migrate thousands of kilometres each year between their summer breeding areas in Canada and their wintering areas in Mexico.

Marks

They feed on nectar throughout the year and save energy at night by entering a temporary state known as torpor in which body temperature and respiration rate are greatly reduced.

The **chart** below shows the average body mass of the hummingbirds and the average number of hours per night spent in torpor throughout the year.



- (a) (i) Use values from the chart to describe the changes in average body mass of the hummingbirds from the beginning of August until the end of January.

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2

- (ii) Calculate the percentage increase in average body mass during the summer in Canada.

Space for calculation

\_\_\_\_\_ % 1

9. (a) (continued)

Marks

- (iii) Suggest **one** reason for the increase in body mass of the birds during the summer in Canada.

\_\_\_\_\_

\_\_\_\_\_

1

- (b) (i) Suggest why the increased time spent in torpor during migration is an advantage to the birds.

\_\_\_\_\_

\_\_\_\_\_

1

- (ii) Calculate the average period of torpor per month throughout the winter in Mexico.

*Space for calculation*

\_\_\_\_\_ hours per night

1

- (c) The **table** below shows how the average oxygen consumption of the birds at rest is affected by their body temperature.

<i>Body temperature</i>	<i>Average oxygen consumption at rest (cm<sup>3</sup> per gram of body mass per hour)</i>
Normal	15.0
Lowered during torpor	2.0

Using information from the **chart** and the **table**, calculate the average volume of oxygen consumed per hour by a hummingbird at the end of September at normal body temperature.

*Space for calculation*

\_\_\_\_\_ cm<sup>3</sup>

1

- (d) Describe a technique which could be used to track species such as the rufous hummingbird which undertake long distance migration.

\_\_\_\_\_

\_\_\_\_\_

1

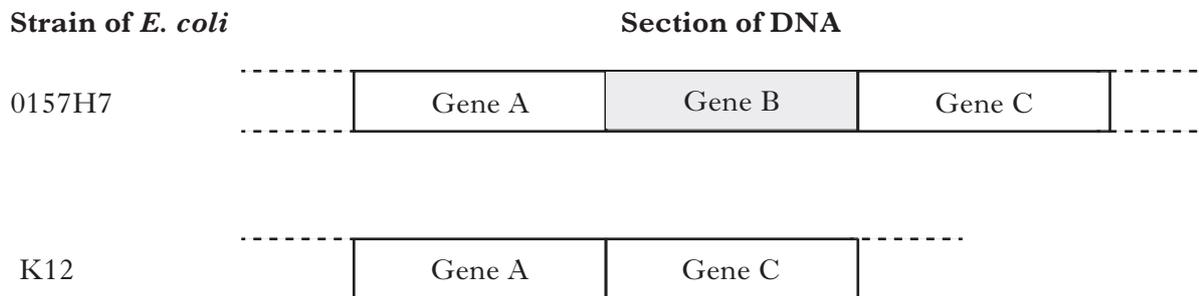
[Turn over

Marks

10. *Escherichia coli* is a species of bacteria found in the lower intestines of humans.

Sections of the DNA of two strains of *E. coli* are shown below.

Gene B codes for a protein known as Shiga toxin which can cause serious food poisoning in humans.



(a) The gene for Shiga toxin has been acquired by *E. coli* 0157H7.

Give **two** methods by which the bacterial strain could have acquired this gene.

1 \_\_\_\_\_

2 \_\_\_\_\_

2

(b) (i) *E. coli* K12 is routinely used in recombinant DNA technology. Explain why *E. coli* K12 is used whereas *E. coli* 0157H7 is not.

\_\_\_\_\_

\_\_\_\_\_

1

(ii) Bacteria are used in recombinant DNA technology.

Explain why animal DNA which has been transferred to bacteria may produce proteins which are not functional.

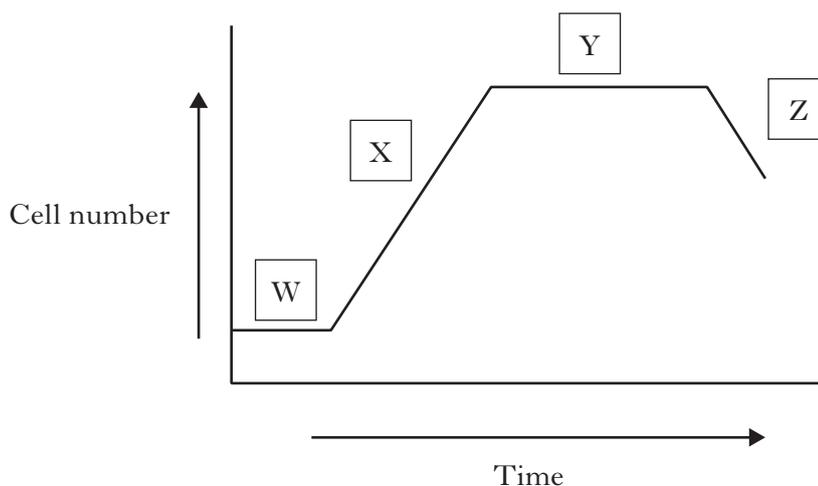
\_\_\_\_\_

\_\_\_\_\_

1

Marks

11. A growth curve in a culture of bacteria is shown in the diagram below.



(a) In culturing bacteria it is important to control the pH of the culture medium. Describe how the pH of a culture medium can be controlled.

\_\_\_\_\_ 1

(b) (i) Name each of the phases of growth indicated by letters on the graph.

W \_\_\_\_\_

X \_\_\_\_\_

Y \_\_\_\_\_

Z \_\_\_\_\_

2

(ii) Give the letter which indicates a region of the graph in which most enzymes are being induced to metabolise the available substrate.

Letter \_\_\_\_\_

1

(iii) Give **one** reason for the decrease in number of cells at phase Z.

\_\_\_\_\_

\_\_\_\_\_

1

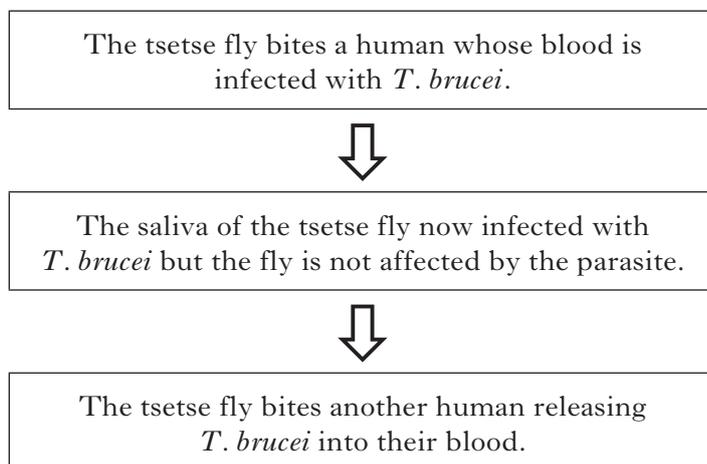
[Turn over

Marks

12. (a) The unicellular organism *Trypanosoma brucei* is a parasite which attacks the human nervous system causing sleeping sickness.

Sleeping sickness occurs in regions of the world such as Africa where tsetse flies are found.

The diagram below shows how the tsetse flies are involved in the transmission of sleeping sickness.



- (i) Give the meaning of the term parasite.

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1

- (ii) Parasitism is one form of symbiosis.  
Name **one** other type of symbiosis.

---

1

- (iii) The tsetse fly transmits *T. brucei* from one human to another.  
Give the term which describes organisms which transfer parasites to hosts.

---

1

- (b) (i) In an effort to control sleeping sickness in a region of Africa, infertile male tsetse flies were released into wild fly populations.  
Suggest how this measure could reduce the number of cases of sleeping sickness in this region.

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2

*Marks*

**12. (b) (continued)**

- (ii) The release of infertile male tsetse flies is a form of biological control.  
Describe **one** other form of biological control of a pest.

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---

**1**

- (iii) Identify a possible risk to a food web which could be associated with the use of a biological control method.

---

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**1**

**[Turn over**

Marks

13. Red Fife and Coteau are cultivars of wheat. Their grain is grown for bread-making. A field trial was carried out to compare their economic and biological yields. Equal numbers of plants of each cultivar were grown in 16 field plots for six months as shown in the **diagram** below.

The **graph** below shows the average economic yield of grain and the average yield of the remaining plant biomass from samples of each cultivar.

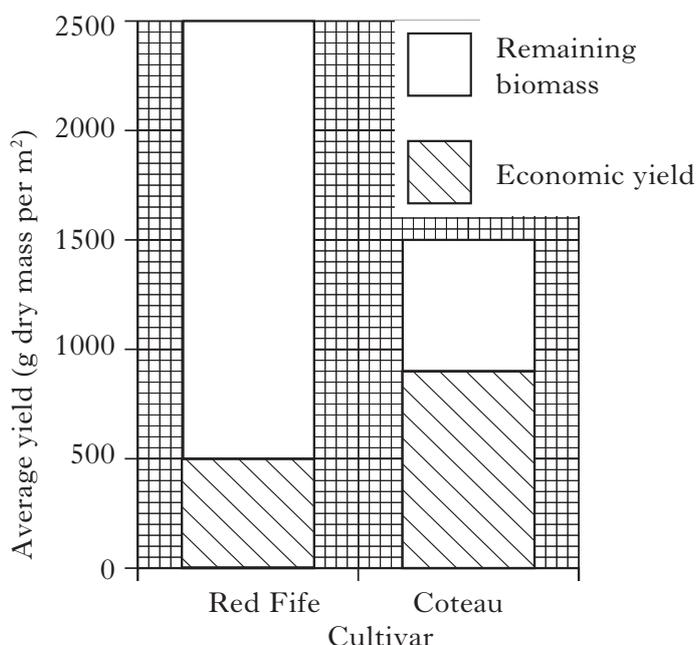
**Diagram**

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16

**Key**

	Red Fife plot
	Coteau plot

**Graph**



(a) In designing a field trial, account should be taken of the factors in the list below.

- A selection of treatments
- B number of replicates
- C randomisation of treatments

Complete the table below using letters from the list to match the reasons for taking the factors into account.

<i>Factor to be taken into account</i>	<i>Reason</i>
	To take account of the variability within samples.
	To ensure fair comparisons.
	To eliminate bias when measuring the treatment effects.

2

Marks

13. (continued)

- (b) Give **one** precaution, not already mentioned, which would have to be taken so that the comparison of the yields from each cultivar was valid and explain the reason for it.

Precaution \_\_\_\_\_

Reason \_\_\_\_\_

\_\_\_\_\_

2

- (c) (i) Red Fife has a harvest index of 0.2.  
Calculate the harvest index of Coteau.

*Space for calculation*

\_\_\_\_\_

1

- (ii) Name the cultivar which would be of the greatest value in food production and justify your choice.

Name \_\_\_\_\_

Justification \_\_\_\_\_

\_\_\_\_\_

1

- (d) Plants can be grown for human food or used as food for livestock.

In terms of food security, explain **one** benefit of using plants rather than livestock for human food.

\_\_\_\_\_

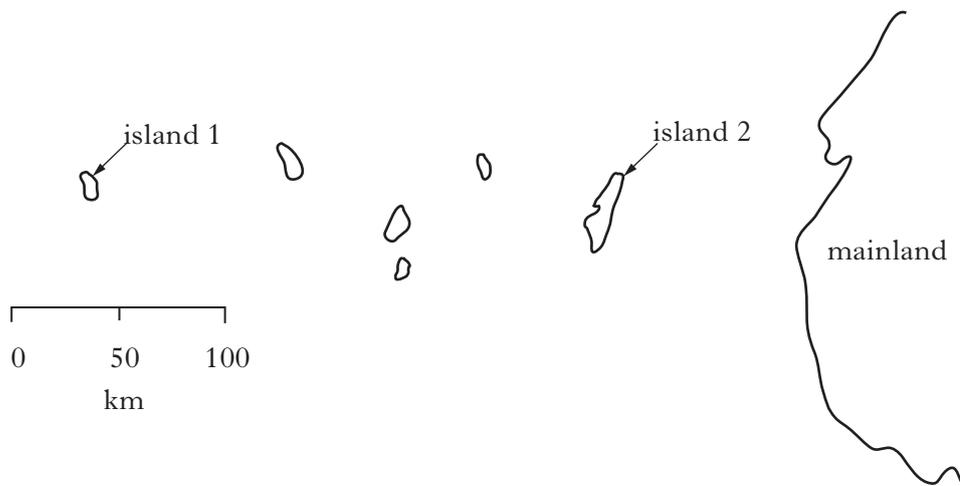
\_\_\_\_\_

1

[Turn over

Marks

14. (a) The map below shows the position of several islands and their distances from the mainland.



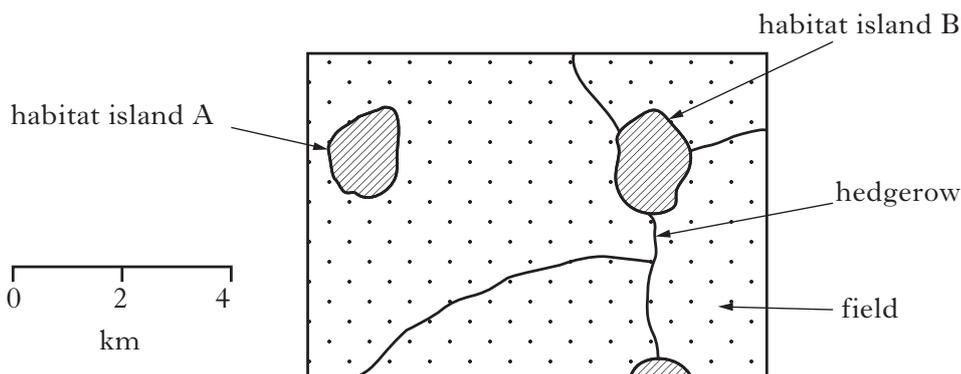
Predict the difference in species diversity which would be expected between islands 1 and 2 and give **two** reasons to justify your answer.

Difference \_\_\_\_\_ 1

Reason 1 \_\_\_\_\_ 1

Reason 2 \_\_\_\_\_ 1

- (b) Habitat islands of native forest are present in large areas of farmland in the UK. They are often connected together by the hedgerows which separate the individual fields as shown in the diagram.



Compared with habitat island A, habitat island B has a greater species diversity. Using information from the map, explain how this has arisen.

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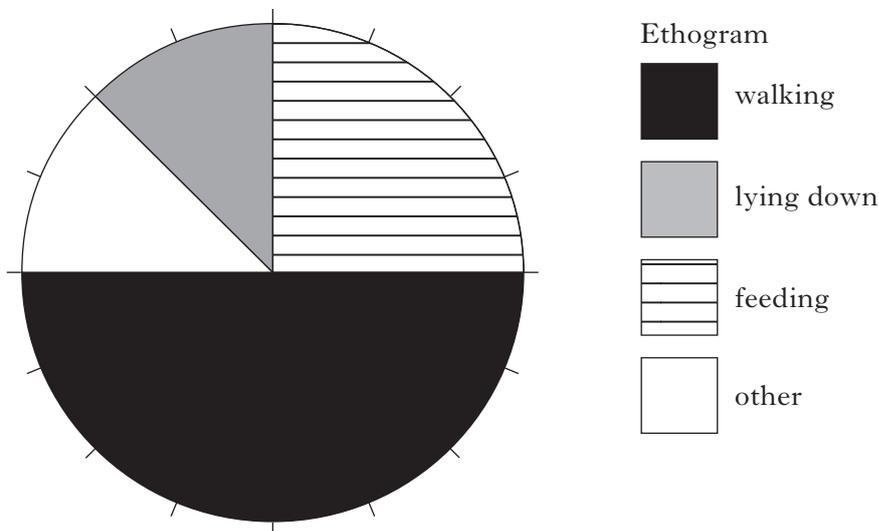


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2

Marks

15. In an investigation, the behaviour of a group of pigs in an enclosure was observed. Each pig's behaviour was observed initially and then every ten seconds for twenty minutes. The behaviours observed were allocated to different categories and the results shown in the pie chart below.



- (a) Calculate how long the pigs spent feeding.

*Space for calculation*

\_\_\_\_\_ minutes **1**

- (b) Express as the simplest whole number ratio the proportion of time spent walking, lying down and feeding.

*Space for calculation*

\_\_\_\_\_ walking: \_\_\_\_\_ lying down: \_\_\_\_\_ feeding **1**

- (c) Suggest **one** improvement which could be made to this investigation to improve the reliability of the results.

\_\_\_\_\_  
\_\_\_\_\_ **1**

- (d) Give **one** example of a type of behaviour which could indicate poor welfare of the pigs.

\_\_\_\_\_  
\_\_\_\_\_ **1**

[Turn over for Section C on Page thirty-four

Marks

**SECTION C****Both questions in this section should be attempted.**

Note that each section contains a choice.

**Questions 1 and 2 should be attempted on the blank pages, which follow.****Supplementary sheets, if required, may be obtained from the Invigilator.****Labelled diagrams may be used where appropriate.****1. Answer either A or B.****A.** Write notes on photosynthesis under the following headings:

- (i) energy capture and photosynthetic pigments;
- (ii) use of captured energy and the light dependent stage.

4

6

**OR****(10)****B.** Write notes on social behaviour under the following headings:

- (i) altruism and kin selection;
- (ii) primate behaviour.

5

5

**(10)****In question 2, ONE mark is available for coherence and ONE mark is available for relevance.****2. Answer either A or B.****A.** Give an account of glycolysis and the citric acid cycle in cells.**(10)****OR****B.** Give an account of enzyme action and enzyme inhibition.**(10)***[END OF QUESTION PAPER]*

**SPACE FOR ANSWERS**

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**SPACE FOR ANSWERS**

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**SPACE FOR ANSWERS**

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**SPACE FOR ANSWERS**

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**SPACE FOR ANSWERS**

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**SPACE FOR ANSWERS**

ADDITIONAL GRAPH PAPER FOR QUESTION 8 (b)

