H

National Qualifications
SPECIMEN ONLY

Mark

SQ04/H/01

Biology
Section 1 — Answer Grid and Section 2

Date — Not applicable

Duration — 2 hours and 30 minutes

SQ04H01

Fill in these boxes and read what is printed below.

Full name of centre

Town

Forename(s)

Surname

Number of seat

Date of birth

Day	Month	Year
D D	M M	Y Y

Scottish candidate number

Total marks — 100

SECTION 1 — 20 marks

Attempt ALL questions.

Instructions for completion of Section 1 are given on *Page two*.

SECTION 2 — 80 marks

Attempt ALL questions.

Write your answers clearly in the spaces provided in this booklet. Additional space for answers and rough work is provided at the end of this booklet. If you use this space you must clearly identify the question number you are attempting. Any rough work must be written in this booklet. You should score through your rough work when you have written your final copy.

Use **blue** or **black** ink.

Before leaving the examination room you must give this booklet to the Invigilator; if you do not you may lose all the marks for this paper.

SQA

SQ04H0101

SECTION 1— 20 marks

The questions for Section 1 are contained in the question paper SQ04/H/02.
Read these and record your answers on the answer grid on Page three opposite.
Do NOT use gel pens.

1. The answer to each question is **either** A, B, C or D. Decide what your answer is, then fill in the appropriate bubble (see sample question below).

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

3. Any rough working should be done on the additional space for answers and rough work at the end of this booklet.

Sample Question

The thigh bone is called the

     A   humerus

     B   femur

     C   tibia

     D   fibula.

The correct answer is **B**—femur. The answer **B** bubble has been clearly filled in (see below).

A	B	C	D
◯	⬤	◯	◯

Changing an answer

If you decide to change your answer, cancel your first answer by putting a cross through it (see below) and fill in the answer you want. The answer below has been changed to **D**.

A	B	C	D
◯	✖	◯	⬤

If you then decide to change back to an answer you have already scored out, put a tick (✓) to the **right** of the answer you want, as shown below:

A	B	C	D		A	B	C	D
◯	✖✓	◯	✖	or	◯	✖✓	◯	◯

You must record your answers
to Section 1 questions on the
answer grid on **Page 3** of
your **answer booklet**
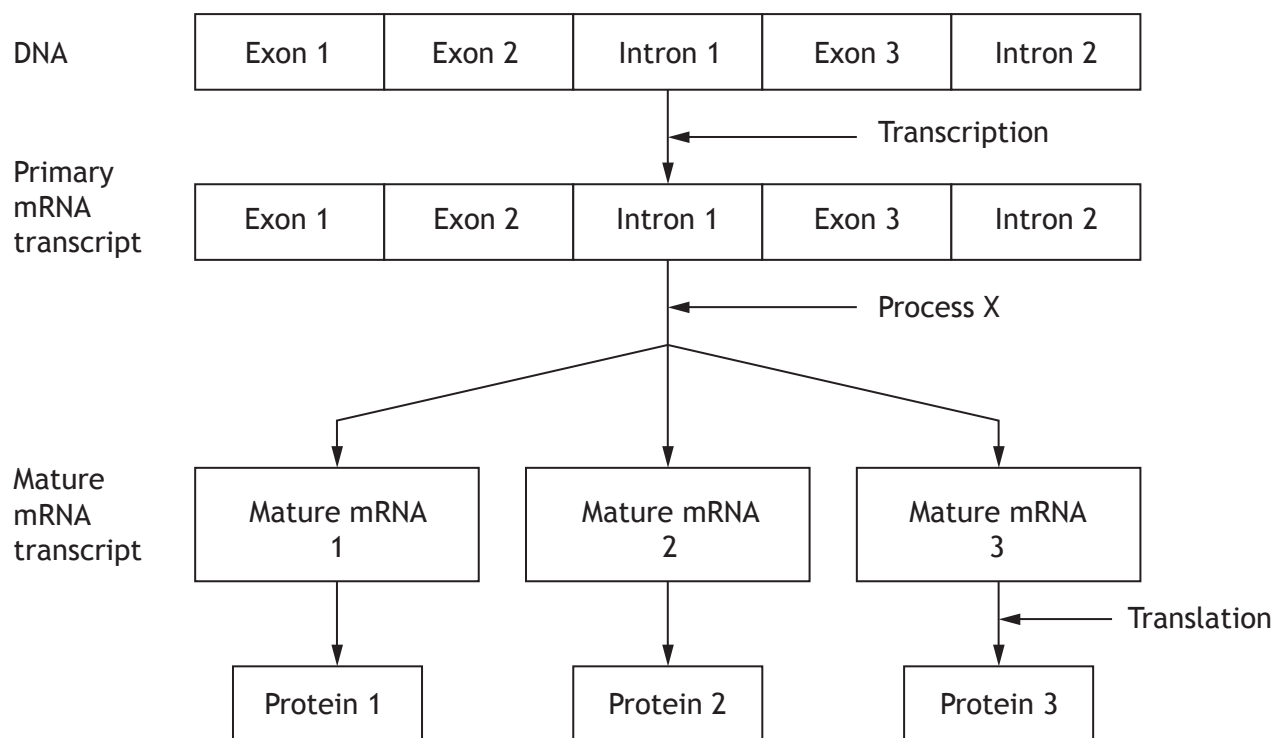
SECTION 2 — 80 marks

Attempt ALL questions

It should be noted that questions 8 and 14 contain a choice.

1. The diagram below shows stages in the production of three different proteins that are coded for by one gene.

(a) (i) Identify a non-coding region of DNA. **1**

_____

(ii) Name process X. **1**

_____

(iii) Explain how process X can produce different mature mRNA transcripts. **2**

_____

_____

(b) Some proteins undergo post translational modification to make them functional.

Give **one** example of post translational modification. **1**

_____

2. A chromosome mutation in humans can result in the formation of the Philadelphia chromosome, which is associated with a form of leukaemia.

The stages leading to the formation of a Philadelphia chromosome are shown in the diagram below.

normal chromosome 9

normal chromosome 22

mutated chromosome 9

mutated chromosome 22

exchange

Philadelphia chromosome
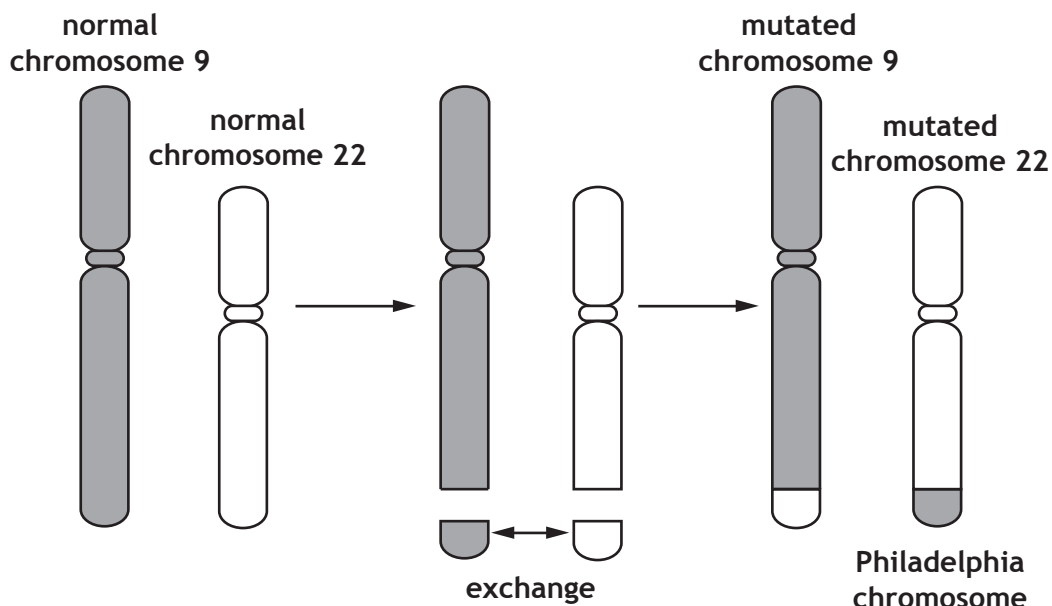
(a) Name the type of chromosome mutation, shown in the diagram, which results in the formation of a Philadelphia chromosome. **1**

_____

(b) (i) The presence of a Philadelphia chromosome causes a form of leukaemia through the over-production of an enzyme.

A drug has been used to successfully treat this form of leukaemia by blocking the active site of the enzyme.

Name the type of enzyme inhibition shown by this drug. **1**

_____

2. **(b)** **(continued)**

    (ii) White blood cell counts in humans normally range from 5000 to 10 000 cells per μl of blood.

        The table below shows the white blood cell counts from a patient with leukaemia before and after treatment with this drug.

	Number of white blood cells (per μl blood)
Before treatment	150 000
After treatment	7500

        Calculate the percentage decrease in the number of white blood cells after treatment with this drug. **1**

        Space for calculation

_____ %

    (iii) Explain how the results suggest that the type of leukaemia in this patient was a result of the presence of a Philadelphia chromosome. **2**
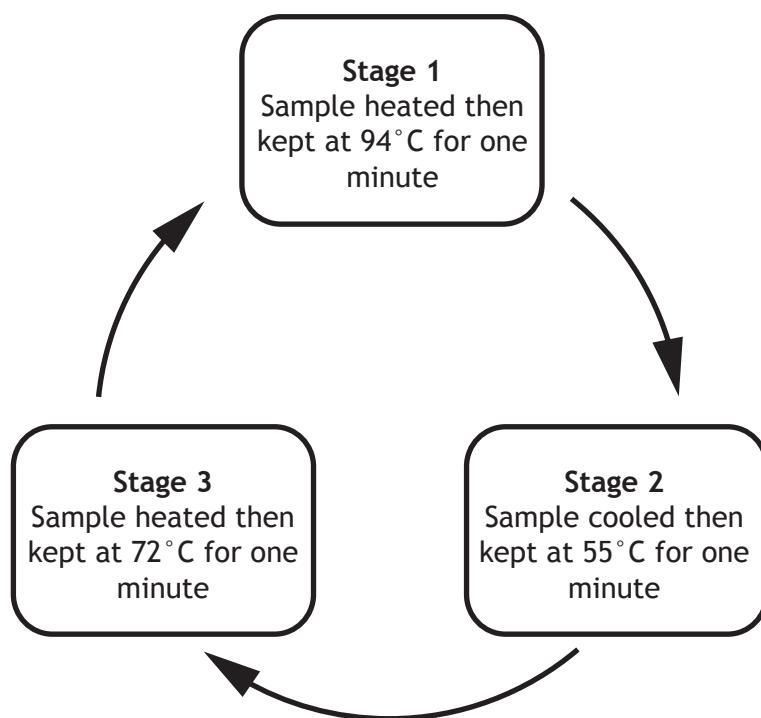
_____

_____

_____

3. The polymerase chain reaction (PCR) amplifies specific sequences of DNA.

The flow chart below shows how a sample of DNA was treated during a cycle of the PCR procedure.

Stage 1
Sample heated then kept at 94°C for one minute

Stage 3
Sample heated then kept at 72°C for one minute

Stage 2
Sample cooled then kept at 55°C for one minute

(a) Explain the purpose of the different heat treatments in Stage 1 and Stage 2.

2

3. (continued)

(b) The number of DNA molecules doubles during each cycle of the PCR procedure.

Caculate the number of cycles needed to produce 128 copies of a single DNA molecule.
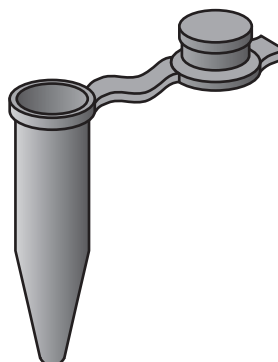
1

Space for calculation

_____ cycles

(c) The diagram below shows the contents of a tube used in PCR.

Contents of tube

— DNA
— DNA nucleotides
— primers
— enzyme and buffer

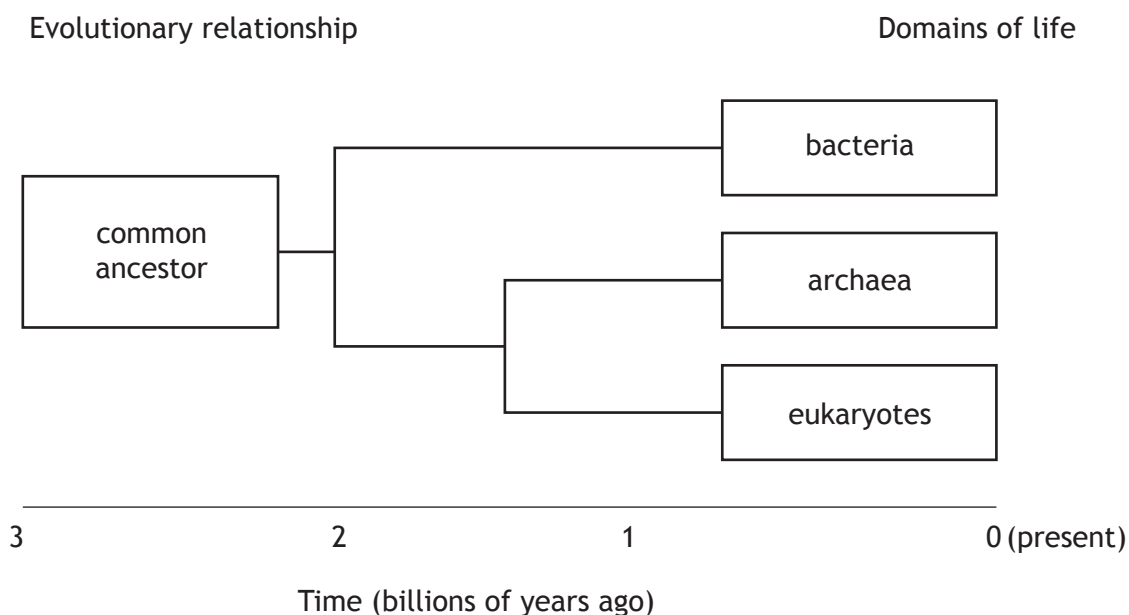Describe the contents of a suitable control tube designed to show that primers are needed in the reaction.

1

_____

_____

(d) State **one** practical application of PCR.

1

_____

4. The phylogenetic tree below shows the evolutionary relationship between the three domains of life into which all present day living things can be divided.

Evolutionary relationship   Domains of life

| bacteria |

| common ancestor |

| archaea |

| eukaryotes |

3   2   1   0 (present)

Time (billions of years ago)

(a) Name the type of data that can be used to confirm the evolutionary relationships between the domains of life shown on the diagram. **1**
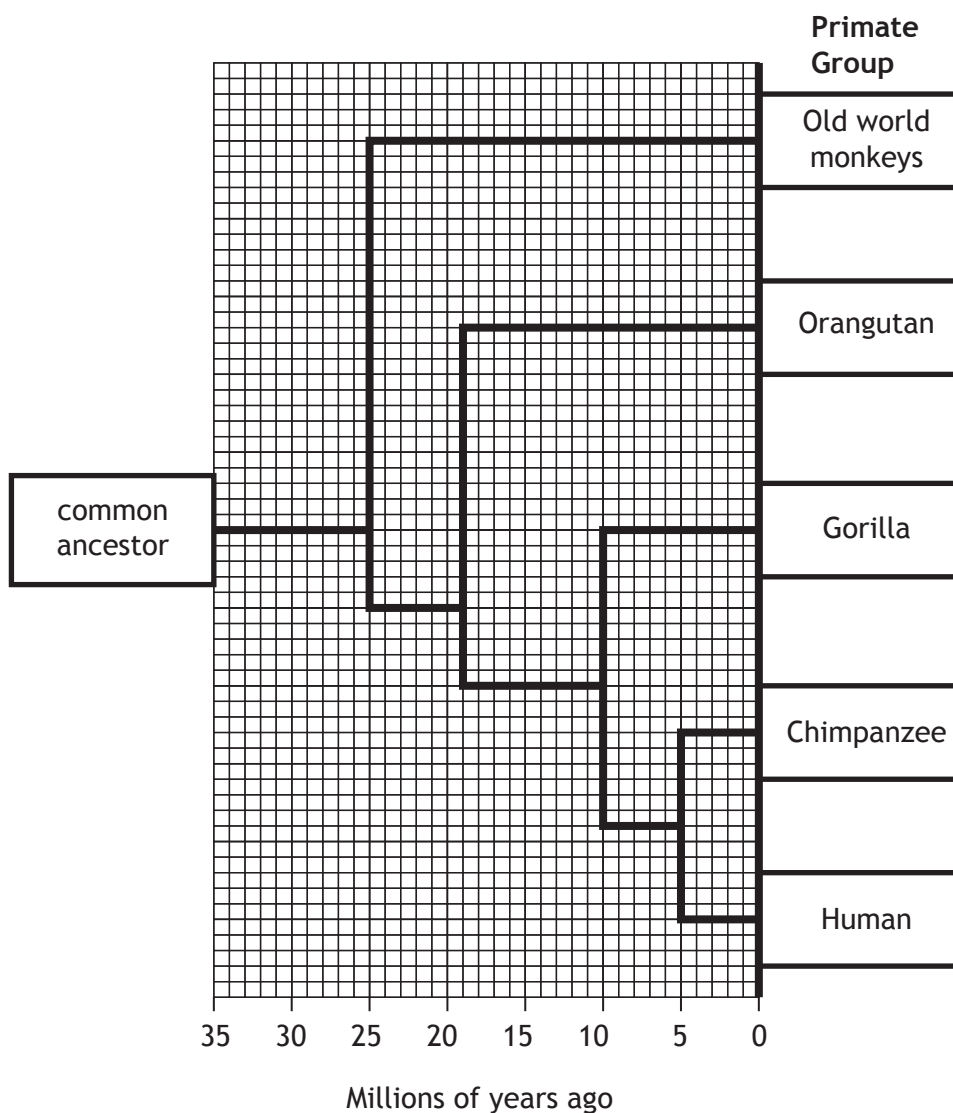
_____

(b) Around one billion years ago genes were transferred between archaea and bacteria.

Give the term that describes this form of gene transfer. **1**

_____

4. **(continued)**

(c) The phylogenetic tree below illustrates the evolutionary relationships between primate groups.

Primate Group

Millions of years ago

(i) State how long ago the last common ancestor of gorillas and old world monkeys existed.

1

_____ million years ago

4.   (c)   (continued)

      (ii)   Humans are more closely related to chimpanzees than to orangutans.

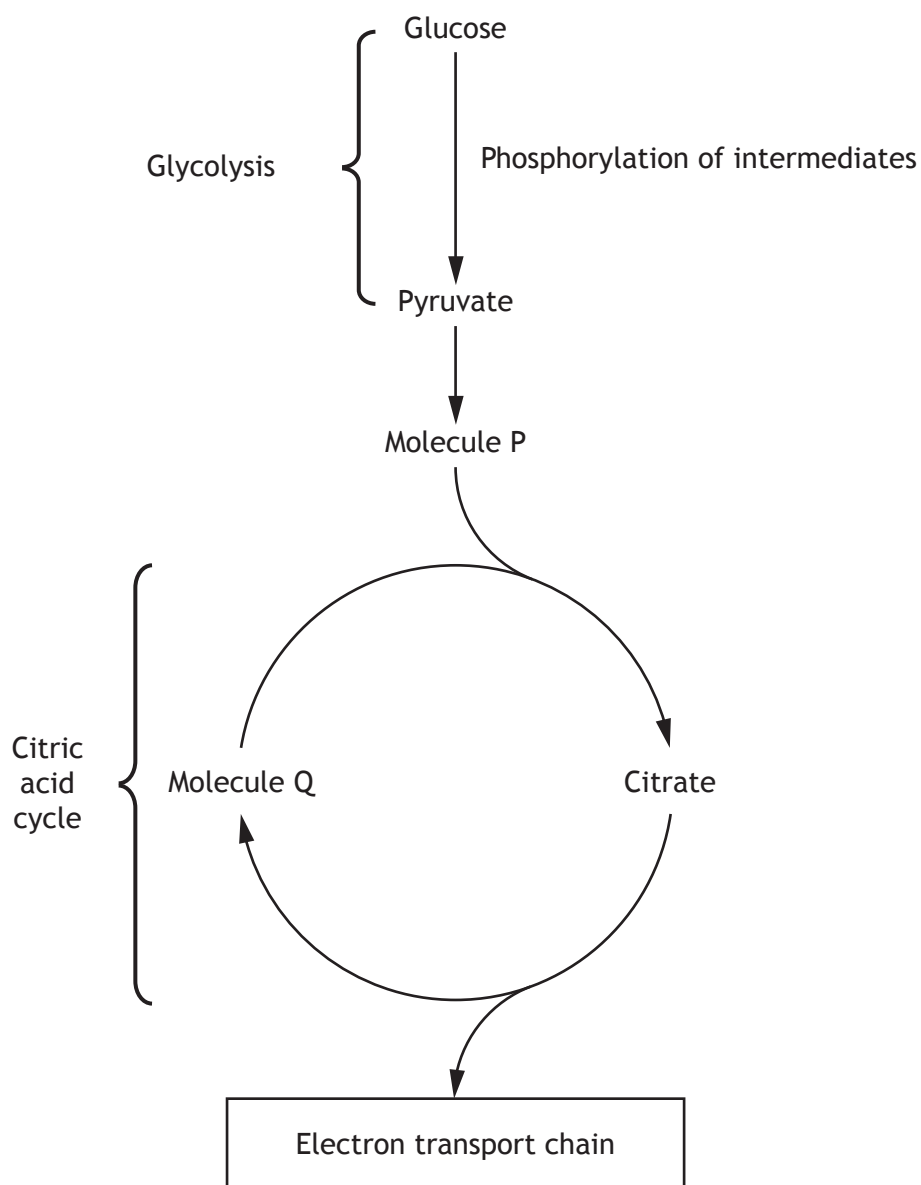   Explain how this is known, using information from the phylogenetic tree above.

2

5. The diagram below shows some stages in the aerobic respiration of glucose.

Glucose

Glycolysis { Phosphorylation of intermediates

Pyruvate

Molecule P

Citric acid cycle { Molecule Q   Citrate

Electron transport chain

(a) Name molecules P and Q.   **2**

Molecule P _____

Molecule Q _____

(b) Explain why the phosphorylation of intermediates in glycolysis is referred to as an energy investment stage.   **2**

_____

_____

5. **(continued)**

(c) Describe the role of the coenzymes NAD and FAD.

2

_____

_____

(d) People who suffer from chronic fatigue syndrome have mitochondria in which some of the proteins embedded in the inner mitochondrial membrane are damaged.

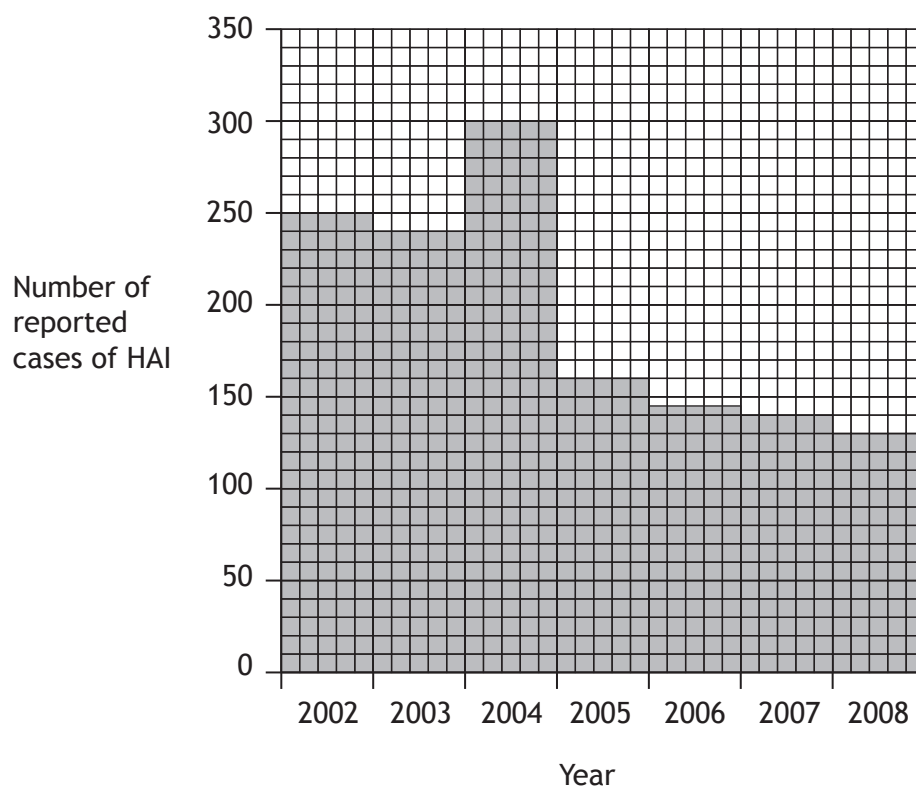Explain how this might result in the tiredness that is a feature of this condition.

2

_____

_____

_____

6. The graph below shows the number of reported cases of hospital acquired infections (HAI) in one hospital between 2002 and 2008. The overall number of patients remained constant during this time.

(a) Using information from the graph, calculate the average decrease per year in reported cases of HAI between 2002 and 2008.

1

Space for calculation

_____ cases per year

6. **(continued)**

(b) The decrease in the number of cases in 2005 was due to introduction of a new hand washing procedure at the hospital.

Predict what would happen to the number of reported cases of HAI in 2009.

Circle **one** answer and give a reason for your choice.

increase   decrease   stay the same

Reason _____

_____

(c) The table below shows the percentage of cases of HAI in the hospital attributed to two types of bacteria, *Clostridium* and *Staphylococcus*, between 2002 and 2008.

Bacterial types	Percentage of cases of HAI in each year attributed to bacterial types						
	2002	2003	2004	2005	2006	2007	2008
Clostridium	32	30	30	51	54	57	59
Staphylococcus	34	32	33	30	31	33	33

Using information in the table, compare the overall trend in the percentage of *Clostridium* cases with that of *Staphylococcus* cases.

_____

_____

(d) Using information from the graph and the table, draw a conclusion about the effectiveness of the hand washing procedure against *Staphlycoccus*. Justify your answer.

Conclusion _____

_____

Justification _____

_____

6. (continued)

(e) Some bacteria form endospores to survive adverse conditions. Identify which of the two types of bacteria in the table forms endospores and give a reason for your answer.

1

Bacterial type _____

Reason _____

_____

7. Mammals are regulators and can control their internal environment.

(a) Give **one** reason why it is important for mammals to regulate their body temperature.

1

_____

_____

(b) (i) Name the temperature monitoring centre in the body of a mammal.

1

_____

(ii) State how messages are sent from the temperature monitoring centre to the skin.

1

_____

(c) The blood vessels in the skin of a mammal respond to a decrease in environmental temperature.

(i) Describe this response.

1

_____

(ii) Explain the effect of this response.

1

_____

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

    A   Describe how animals survive adverse conditions.

    OR

    B   Describe recombinant DNA technology.

    Labelled diagrams may be used where appropriate.

9. The average yield, fat and protein content of the milk from each of three breeds of dairy cattle were determined.

The results are shown in the table below.

Breed	Average milk yield per cow (kg per day)	Average fat content of milk (%)	Average protein content of milk (%)
Pure bred Holstein	44·80	4·15	3·25
F$_1$ hybrid Holstein × Normande	48·64	4·25	3·10
F$_1$ hybrid Holstein × Scandinavian Red	51·52	4·25	3·15

(a) Calculate the percentage increase in average milk yield per cow from the F1 hybrid Holstein × Scandinavian Red compared to pure bred Holstein cattle.

Space for calculation

1

_____ %

(b) The fat content of milk is important for butter production.

Calculate the total fat content in the milk produced in a day from a herd of 200 F1 hybrid Holstein × Normande cattle.

Space for calculation

1

_____ kg per day

9. (continued)

(c) Select **one** from: average milk yield per cow; average fat content of milk; or average protein content of milk.

For your choice, draw a conclusion about the effects of crossbreeding. **1**

Choice _____

Conclusion _____

_____

(d) The development of pure breeds such as Holsteins has led to an accumulation of deleterious recessive alleles.

State the term that describes this. **1**

_____

(e) Some F2 offspring from crosses of F1 hybrid Holstein × Scandinavian Red cattle will have less desirable milk-producing characteristics than their parents.

(i) Give **one** reason for this. **1**

_____

_____

(ii) Name a process breeders would have to carry out to maintain the milk-producing characteristics of the F1 hybrids in further generations. **1**

_____

10. An investigation was carried out to compare the rate of photosynthesis, at different light intensities, of green algal cells immobilised into gel beads.

Test tube

20 gel beads containing green algal cells and $10\,cm^3$ of bicarbonate indicator
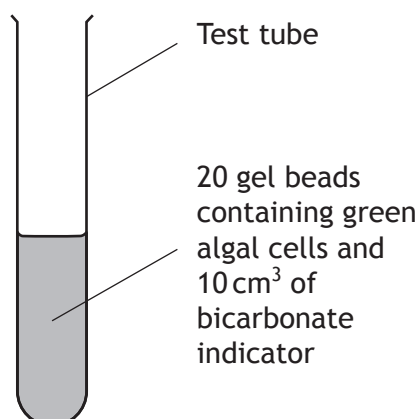
Seven tubes were set up as shown in the diagram and each positioned at a different distance from a light source to alter the light intensity.

Photosynthesis causes the bicarbonate indicator solution to change colour.

After 60 minutes, the bicarbonate indicator solution was transferred from each tube to a colorimeter.

The higher the colorimeter reading, the higher the rate of photosynthesis that has occurred in the tube.

Results are shown in the table.

Tube	Distance of tube from light source (cm)	Colorimeter reading (units)
1	25	92
2	35	92
3	50	83
4	75	32
5	100	14
6	125	6
7	200	0

10. **(continued)**

(a) Identify the dependent variable in this investigation.

1

(b) Describe how the apparatus could be improved to ensure that temperature was kept constant.

1

(c) State an advantage of using algae immobilised into gel beads.

1

(d) Describe how the experimental procedure could be improved to increase the reliability of the results.

1

10. (continued)

(e) On the grid below, complete the line graph to show the colorimeter reading against distance of tube from light source.

2

(Additional graph paper if required will be found on *Page twenty-nine*)
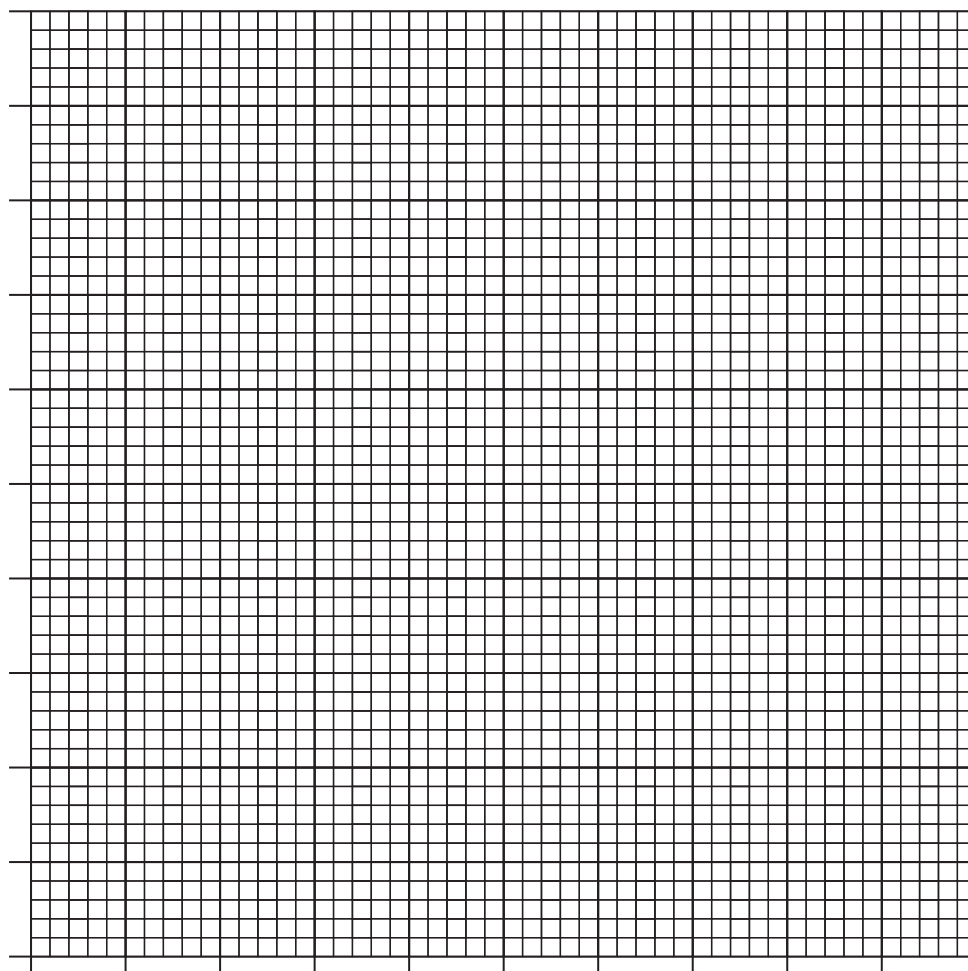
(f) From the results of this investigation, draw a conclusion about the effect of light intensity on the rate of photosynthesis.

2

_____

_____

_____

11. (a) The honey bee (*Apis mellifera*) is a social insect that lives in colonies.

The queen is the only female in a colony that reproduces. Other females are workers that collect food, maintain the colony and care for the developing offspring.

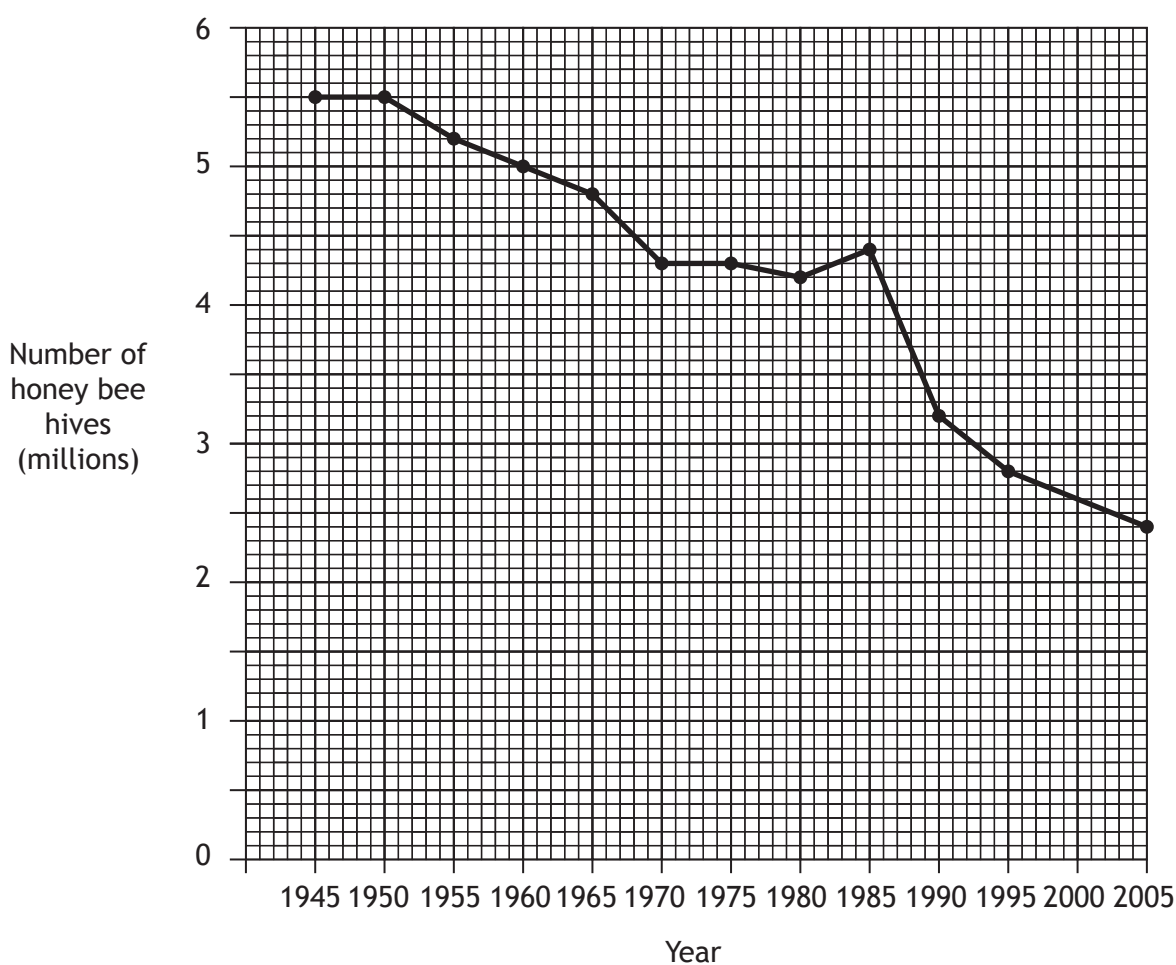Explain the advantage to the worker bees of caring for the offspring of the queen.

2

(b) The graph below shows the changes in the number of honey bee hives kept by bee-keepers in the USA from 1945 to 2005.

11. **(b)** **(continued)**

(i) **Using values from the graph**, describe changes in the number of bee hives from 1980 to 1995.

1

_____

_____

(ii) Calculate the simplest whole number ratio of the number of bee hives in 1965 and 2005.
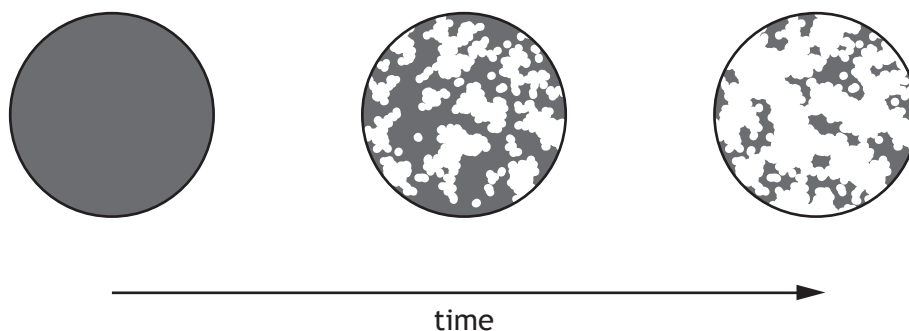
1

Space for calculation

_____ hives in 1965 : _____ hives in 2005

12. The biodiversity and the genetic diversity of individual species are affected when fragments of woodland become isolated.

The diagram below illustrates habitat fragmentation of an area of woodland over time.

The shaded areas represent woodland.

time

(a) (i) Name **one** component of genetic diversity.   **1**

_____

(ii) Suggest a reason why a decrease in genetic diversity of an individual species can lead to local extinctions within habitat fragments.   **1**

_____

_____

(b) Suggest how habitat edge species might affect interior species as the habitat fragments become smaller.   **1**

_____

_____

(c) Habitat corridors can be created to remedy habitat fragmentation.

(i) State what is meant by the term "habitat corridor".   **1**

_____

_____

(ii) Explain how a habitat corridor can increase biodiversity after local extinction.   **1**

_____

_____

13. Japanese knotweed (*Fallopia japonica*) was introduced to Britain as an ornamental plant. It grows to 3 metres in height and has large leaves. It has become naturalised and has colonised many parts of the country where it out-competes native plants.

(a) Give the term used for a naturalised species that eliminates native species.

1

_____

(b) Name **one** resource for which Japanese knotweed may outcompete the native plants.

1

_____

(c) An insect from Japan, which feeds on Japanese knotweed, has been proposed as a biological control agent.

   (i) Describe **one** possible risk of introducing this insect into Britain.

1

_____

_____

_____

   (ii) Describe a procedure that should be carried out to assess the risk of introducing this insect.

1

_____

_____

14. Answer **either A or B** in the space below.

   A   Describe DNA under the following headings.   **9**

      (i)   Structure of DNA

      (ii) Replication of DNA

   B   Describe the evolution of new species under the following headings.   **9**

      (i)   Isolation and mutation

      (ii) Selection
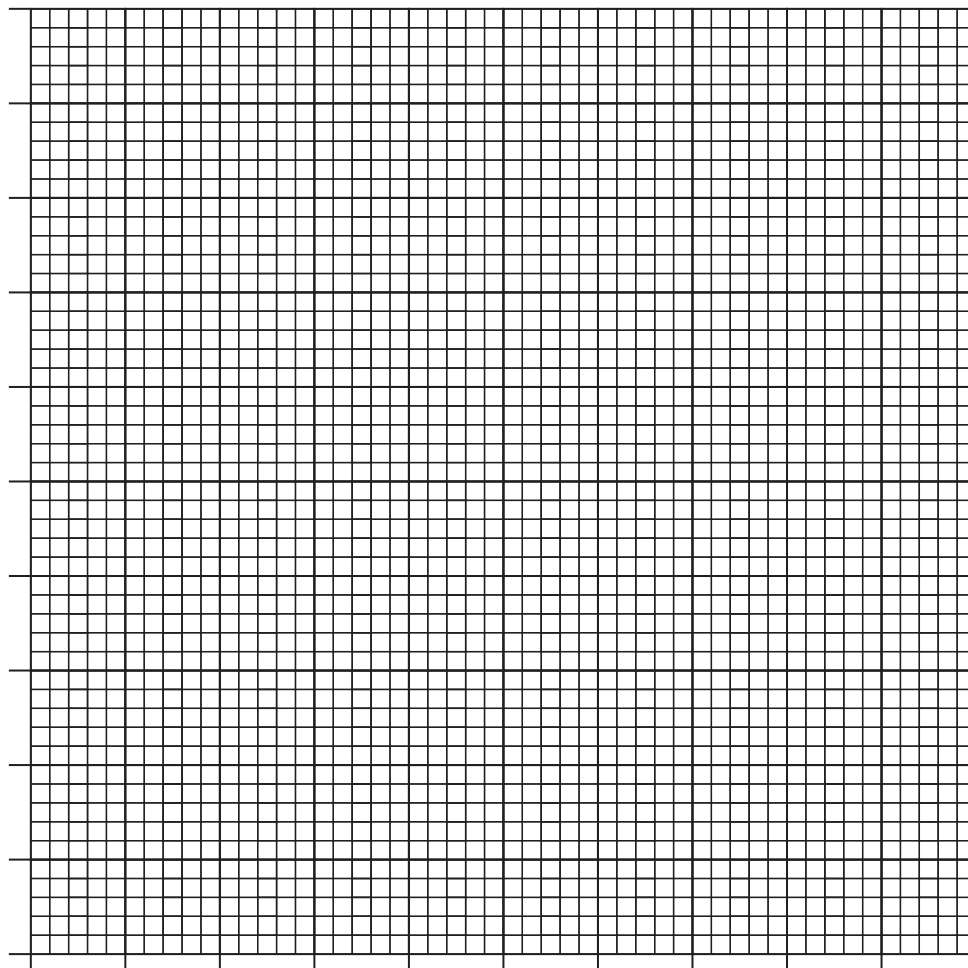
   Labelled diagrams may be used where appropriate.

[END OF SPECIMEN QUESTION PAPER]

ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK

ADDITIONAL GRAPH PAPER FOR QUESTION 10 (e)

ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK