PEARSON EDEXCEL IGCSE BIOLOGY · 4BI1

BIOLOGY



EXAM QUESTION PACK

SECTION 3: REPRODUCTION AND INHERITANCE (PACK 3)

SCORE	PERCENTAGE
/216	%

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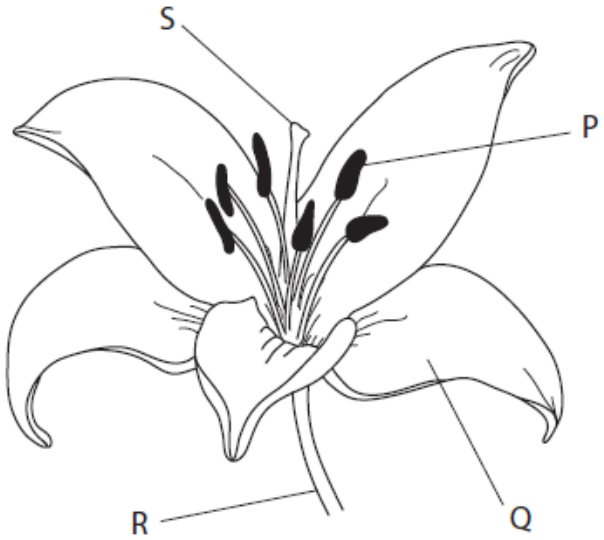
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Q1.

The diagram shows an insect-pollinated flower called a lily.



(a) (i) Which of these is the name of structure P?

(1)

☒ **A** anther

☒ **B** filament

☒ **C** stigma

☒ **D** style

(ii) Which of these is the name of structure Q?

(1)

☒ **A** leaf

☒ **B** petal

☒ **C** stem

☒ **D** style

(iii) On which structure do pollen grains germinate?

(1)

☒ **A** P

☒ **B** Q

☒ **C** R

☒ **D** S

(b) Describe how the structures of P, Q and S would differ in a wind-pollinated flower.

(3)

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(c) Plants can also reproduce by asexual reproduction.

(i) Give one natural method that plants use to reproduce asexually.

(1)

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(ii) Give one artificial method that a plant grower may use to reproduce a plant asexually.

(1)

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(iii) Suggest why a plant grower may choose to reproduce a plant asexually rather than allowing the plant to reproduce sexually.

(2)

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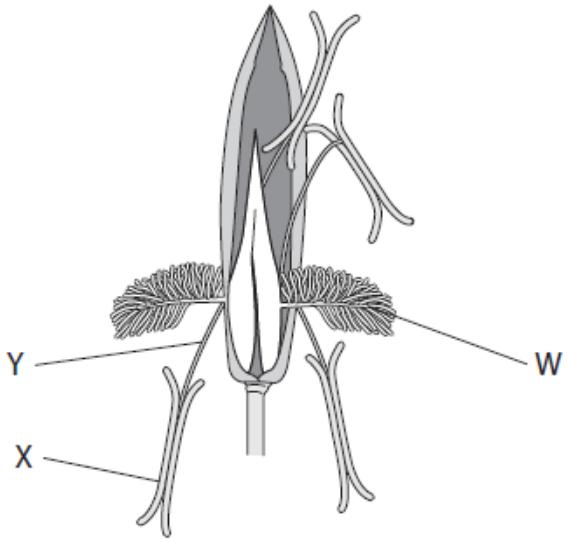
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Q2.

The diagram shows a wind-pollinated flower with some structures labelled W, X and Y.



(a) (i) Describe how structures W, X and Y are adapted for wind pollination.

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(ii) Structures W, X and Y are adapted for wind pollination.

Give two other differences between wind-pollinated flowers and insect-pollinated flowers.

(2)

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2 .....

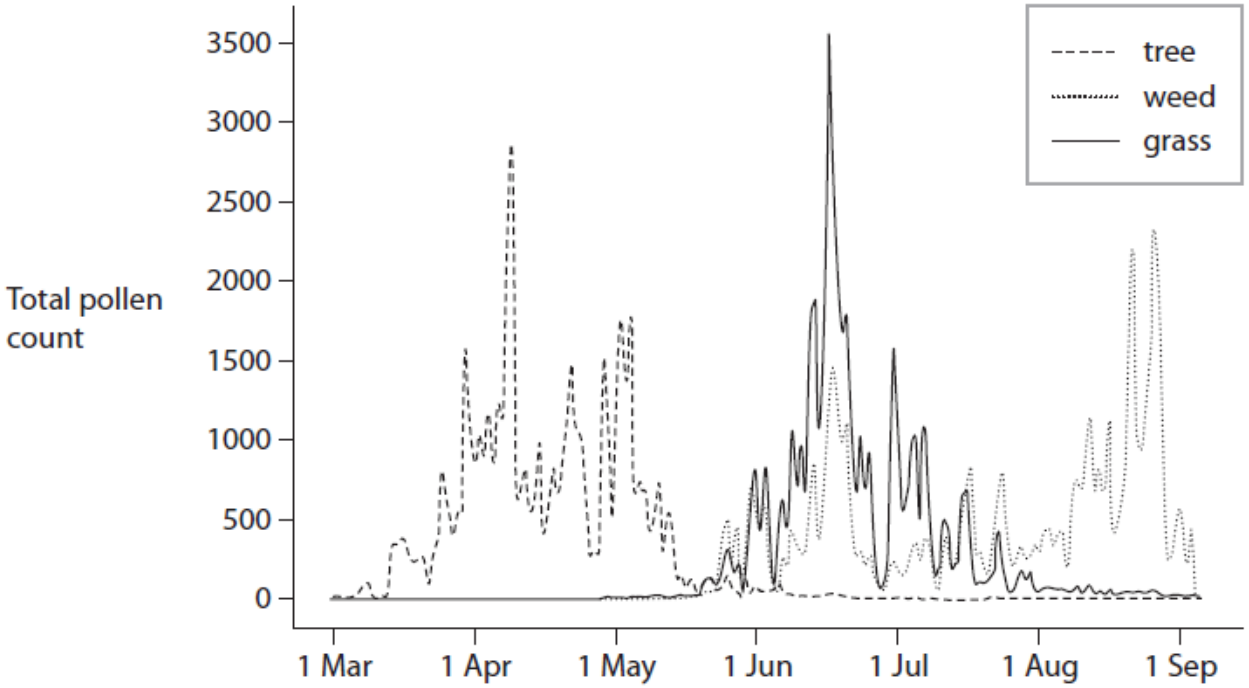
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(b) Wind-pollinated flowers often cause an allergic response in people. This is known as hay fever.

Most people in the United Kingdom who get hay fever have the symptoms from April to September.

The graph shows the changes in total pollen count for three different plant types from March to September during one year in the United Kingdom.



As part of an investigation into pollen allergy, five people keep a diary of their hay fever symptoms. They do this for the same year as the pollen count.

The table gives their results.

Person	Months with severe symptoms	Months with mild symptoms	Months with no symptoms
A	April and May	March and June	July to September
B	June and July	March to May August	none
C	April to September	March	none
D	none	none	all
E	June to September	March to May	none

Using the data in the table and the information from the graph, discuss the likely causes of the allergic responses in each person.

(5)

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(c) The allergic response to pollen is part of the body's immune response.

Explain what is meant by the term **immune response**.

(2)

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(Total for question = 12 marks)

Q3.

The chromosomes found in human cells can be photographed and arranged in order to produce a karyotype.

The karyotype shown in Diagram 1 is from a normal human body cell.

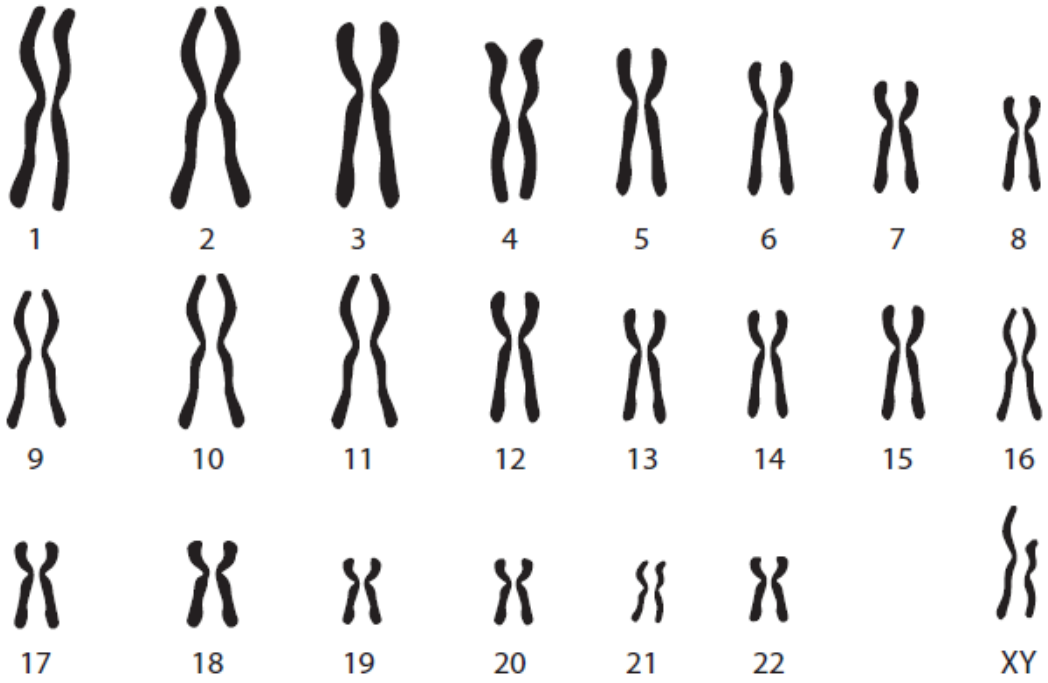


Diagram 1

(a) (i) Explain how you can identify the sex of the person from the karyotype shown in Diagram 1.

(2)

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(ii) Cells can be described using the terms diploid or haploid.

Explain the difference between these two terms using the information in Diagram 1.

(2)

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(b) The karyotype shown in Diagram 2 is from a body cell of a person with a condition called Klinefelter syndrome.

This condition only affects males.

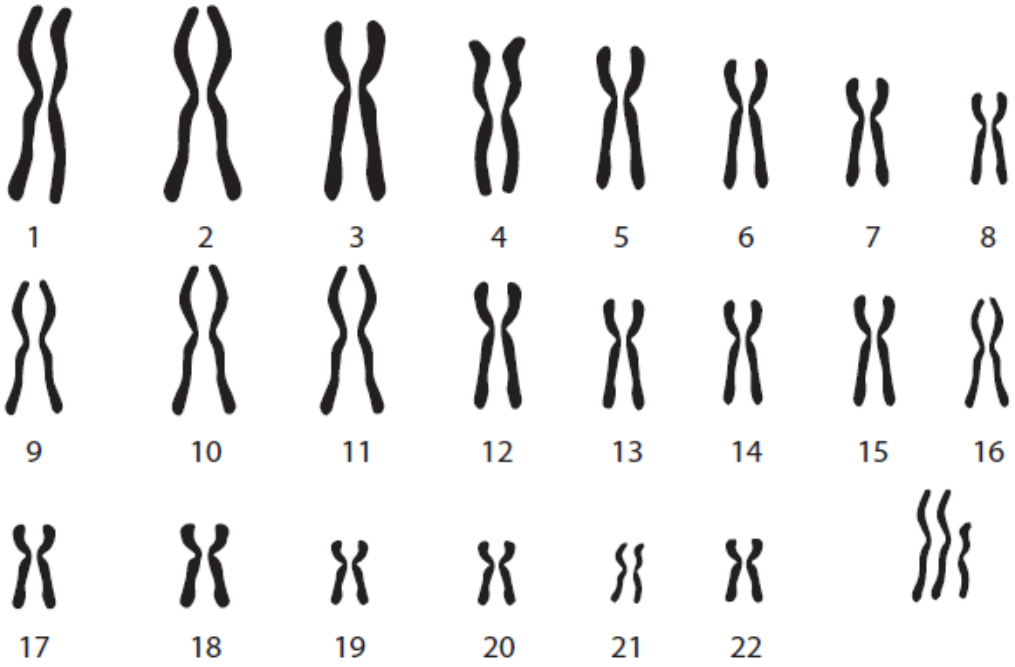


Diagram 2

(i) Describe the differences between the karyotype in Diagram 1 and the karyotype in Diagram 2.

(2)

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(ii) Suggest how the karyotype in Diagram 2 may have been caused.

(2)

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(iii) The frequency of Klinefelter syndrome in the United Kingdom is 1 in every 660 males.

The population of the United Kingdom is 66 million, of which 49% are male.

Calculate the total number of males in the United Kingdom with Klinefelter syndrome.

(2)

number of males = ...

(iv) Suggest why females who are aged over 35 are more likely to give birth to a baby with the Klinefelter karyotype.

(1)

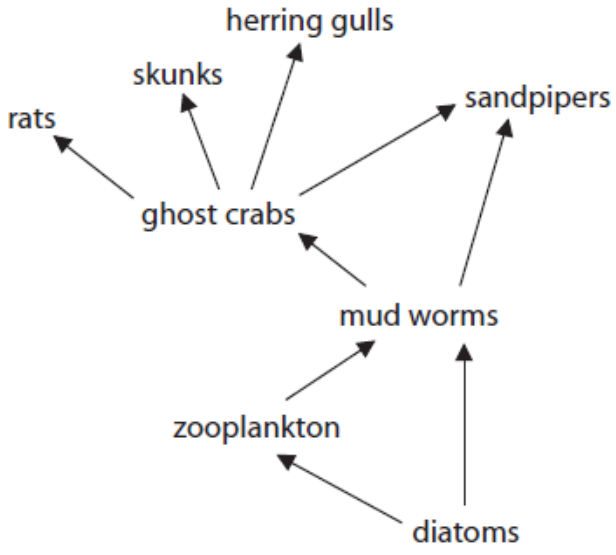
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(Total for question = 11 marks)

Q4.

The diagram shows a food web.



(a) Use information from the food web to complete the table.

The first one has been done for you.

(3)

number of organisms	8
number of producers	
number of primary consumers	
number of food chains	

(b) Explain why the energy in the mud worms is not all transferred to the organisms that eat them.

(4)

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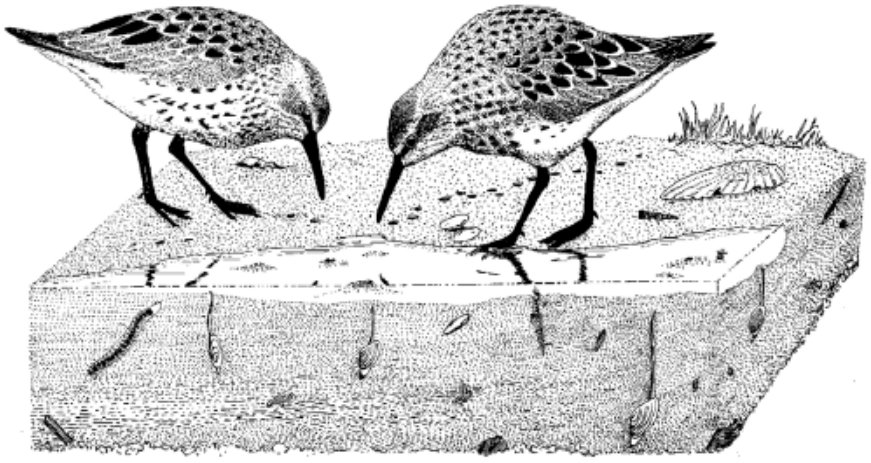
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(c) The diagram shows sandpipers feeding.

Sandpipers have long beaks so that they can dig for worms in the mud.



(Source: © Birchside www.fotosearch.com)

Explain how sandpipers evolved to have long beaks.

(4)

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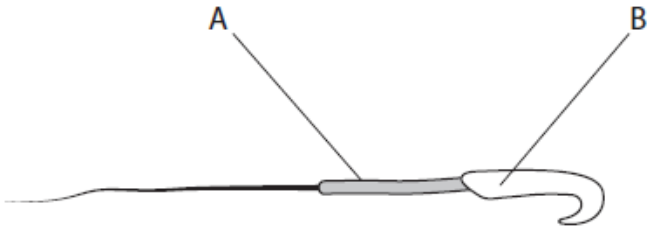
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(Total for question = 11 marks)

Q5.

The diagram shows a sperm cell from a rat.



(a) (i) Describe the role of a sperm cell.

(1)

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(ii) Describe the structures found in part B.

(2)

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(iii) Explain why part A contains many mitochondria.

(2)

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(b) Nicotine is a chemical found in cigarettes.

A scientist investigates how nicotine affects sperm cells.

The scientist gives male rats different concentrations of nicotine.

He then calculates the percentage of damaged sperm cells in the semen produced by each rat.

The table shows his results.

Concentration of nicotine in mg per kg of rat	Percentage of damaged sperm cells (%)
0.0	6.4
0.5	16.8
1.0	24.8

(i) The sample of semen from a rat given a nicotine concentration of 1.0 mg per kg contains 5.8×10^7 sperm cells.

Calculate the number of damaged sperm cells in this sample.

(2)

number = ...

(ii) The scientist concludes that cigarette smoking could make male humans infertile.

Discuss this conclusion.

(5)

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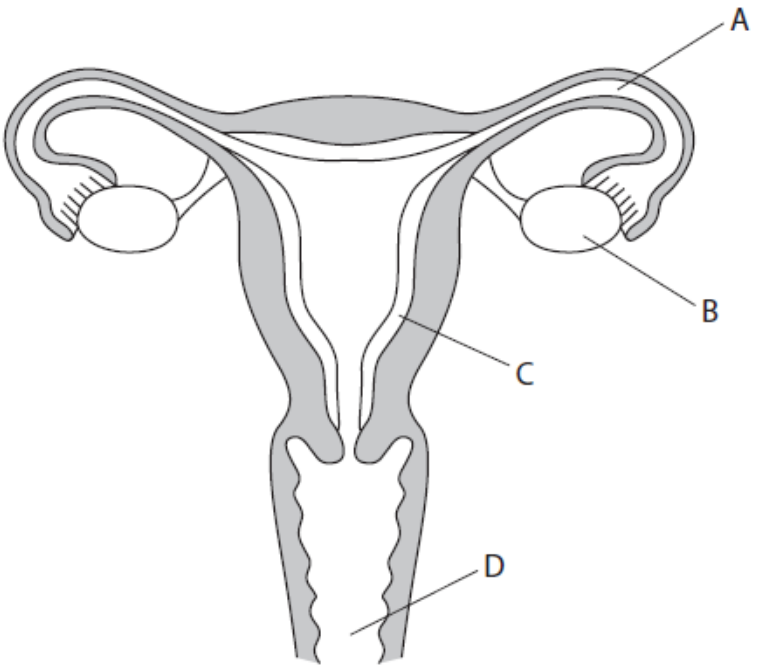
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(Total for question = 12 marks)

Q6.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

The diagram shows the female reproductive organs with structures A, B, C, and D labelled.



(a) Name the structures labelled C and D.

(2)

C .....

D .....

(b) Describe the role of structure A in human reproduction.

(2)

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(c) Explain the role of structure B in the development of secondary sexual characteristics.

(2)

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(Total for question = 6 marks)

Q7.

Wheat seeds contain stores of a large insoluble molecule.

This molecule is digested by amylase as the seeds germinate.

(a) What is the name of this large insoluble molecule?

(1)

☒ **A** glucose

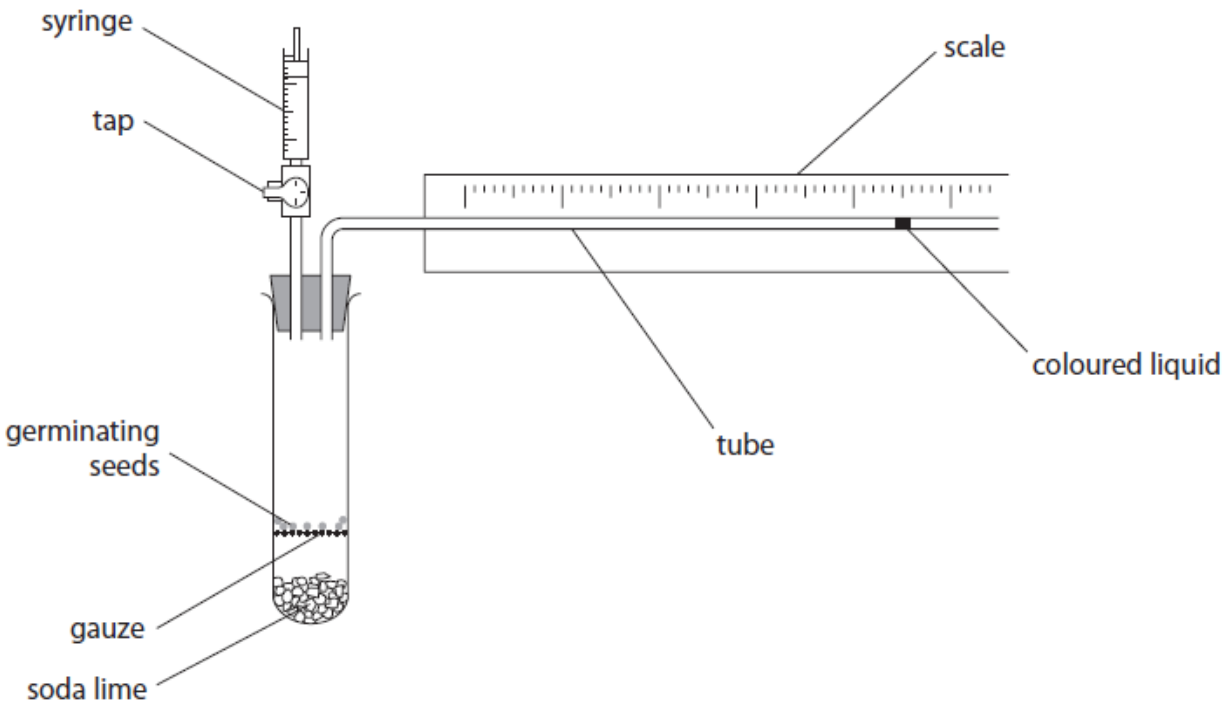
☒ **B** lipid

☒ **C** protein

☒ **D** starch

(b) A student investigates the oxygen absorbed by germinating seeds at different temperatures.

The diagram shows some of the student's apparatus.



(i) Suggest why the student opens the tap after obtaining one set of results.

(2)

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(ii) What is the function of the soda lime?

(1)

☒ **A** it absorbs carbon dioxide

☒ **B** it absorbs oxygen

☒ **C** it releases carbon dioxide

☒ **D** it releases oxygen

(iii) The student measures the distance moved by the coloured liquid and converts this to volume of oxygen absorbed.

The volume of oxygen absorbed can be calculated using the formula

volume = $\pi \times \text{radius}^2 \times \text{distance}$

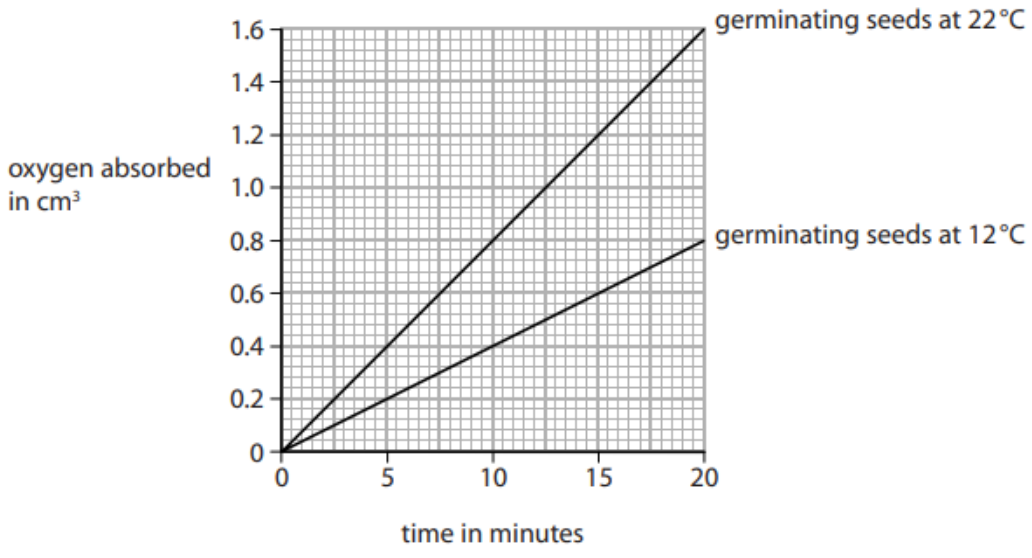
Calculate the volume of oxygen absorbed when the coloured liquid moves a distance of 6.0 mm.

[diameter of tube = 1.0 mm]

(3)

volume = ... cm^3

(c) The graph shows the results of the student's investigation.



(i) Calculate the percentage increase in the rate of oxygen absorption at 22 °C compared to the rate of oxygen absorption at 12 °C.

(2)

percentage = ...

(ii) Suggest why the rate of oxygen absorption is greater at 22 °C than at 12 °C.

(2)

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(Total for question = 11 marks)

Q8.

Humans can control their internal environment.

(a) State the term used to describe the control of an organism's internal environment.

(1)

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(b) Coordination uses hormones and nerves.

Some responses are simple reflex arcs.

Describe the structure and functioning of the withdrawal reflex of a finger from a hot object.

(4)

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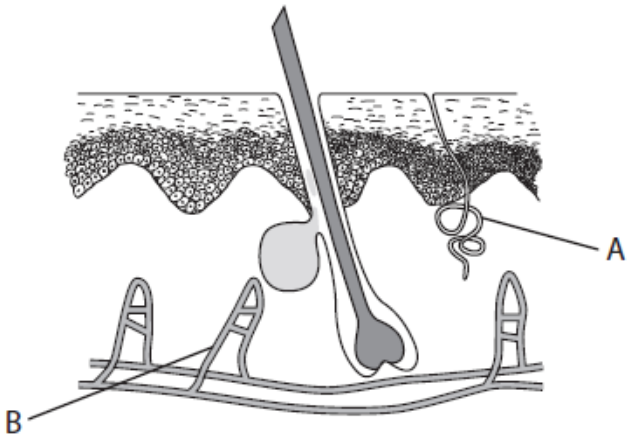
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(c) Humans use their skin to regulate their body temperature. The diagram shows a section through the skin with two structures labelled A and B.



Changes take place in the skin when a person moves from a warm environment to a cold environment.

(i) Explain the changes that take place in structure A as a person enters a cold environment.

(2)

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(ii) Explain the changes that take place in structure B as the person enters a cold environment.

(3)

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(d) Modern humans have less body hair than their ancestors.

Explain how this evolutionary change was brought about by natural selection.

(4)

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(Total for question = 14 marks)

Q9.

Scientists investigate the effect of salt (NaCl) concentration on the germination of maize seeds.

Batches of seeds are watered with different concentrations of salt solution.

They count the number of seeds that germinate in each batch 12 days after sowing. They then determined the percentage germination.

(a) (i) Describe how the scientists could tell if a maize seed had germinated.

(1)

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(ii) The scientists measured the germination after 12 days.

State two other abiotic variables that the scientists need to control in their investigation.

(2)

1 .....

2 .....

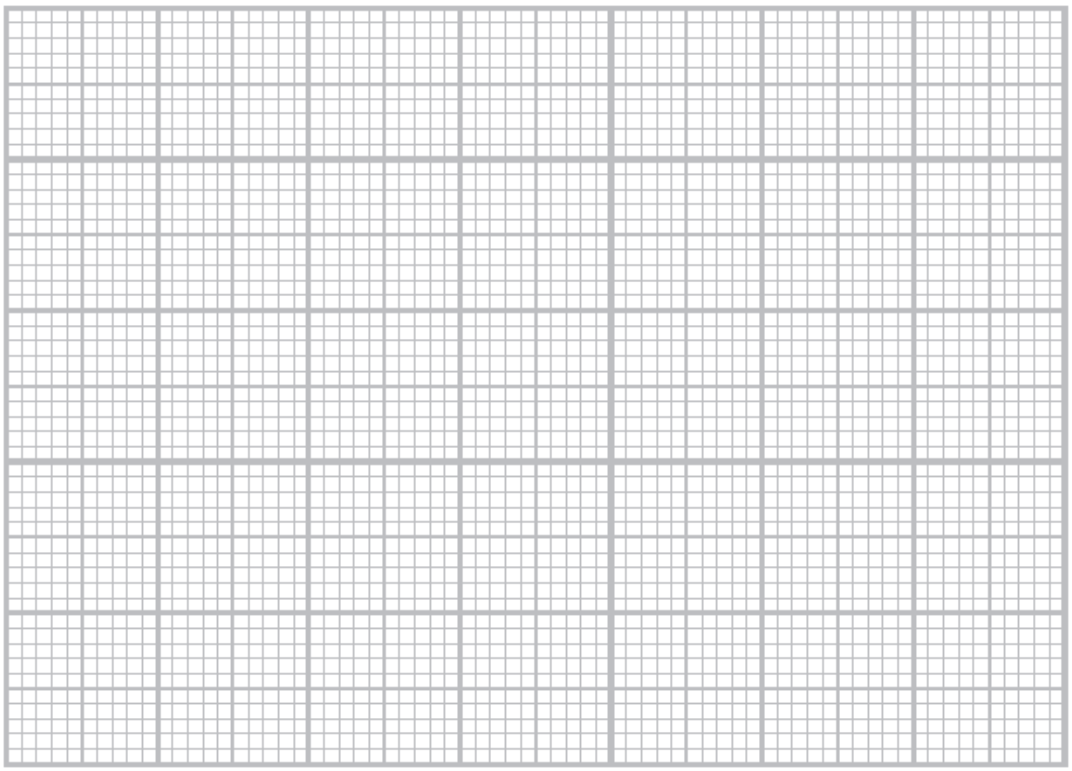
(b) The table shows the scientists' results.

Concentration of salt solution in mmol	Percentage germination (%)
0	89
20	83
40	81
80	73
120	68
160	55
200	52
240	49
280	43
320	38

(i) Plot a line graph to show the effect of concentration of salt solution on germination.

Use a ruler to join your points with straight lines.

(5)



(ii) Explain the effect of increasing the concentration of salt solution on germination.

(4)

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(c) As plants grow, they produce roots and stems.

(i) Compare the responses of roots and stems to gravity.

(2)

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(ii) Compare the responses of roots and stems to light.

(2)

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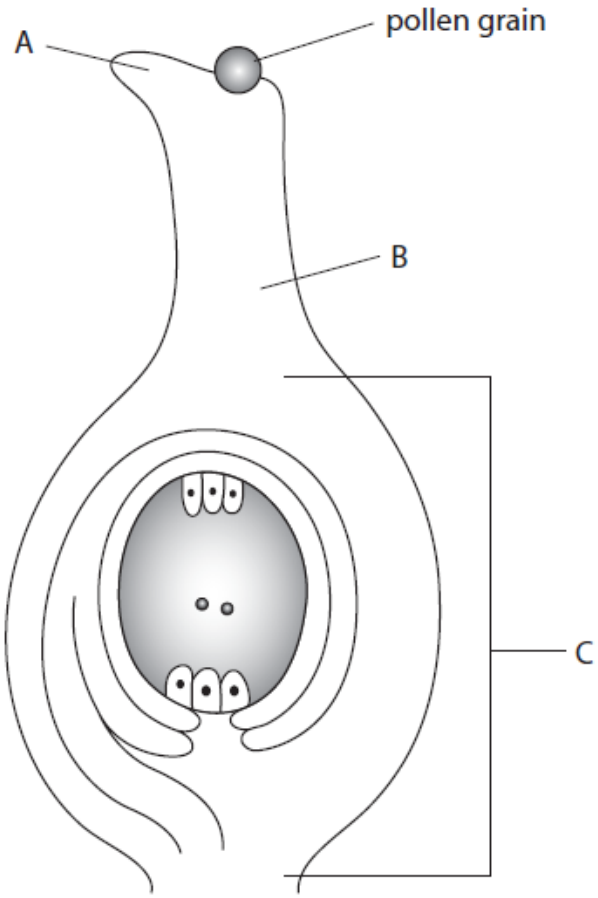
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(Total for question = 16 marks)

Q10.

(a) The diagram shows some of the structures involved in fertilisation in a flowering plant.



(i) Name the parts labelled A, B and C.

(3)

A .....

B .....

C .....

(ii) On the diagram, draw the path the pollen tube takes after the pollen grain has germinated.

(2)

(iii) Describe what happens to the structures in part C after fertilisation.

(2)

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(b) A scientist investigates the effect of four different storage conditions on the germination of grass seeds.

She stores 500 seeds in each storage condition for two months.

She then counts the number of seeds that germinate when planted.

The table shows her results.

Storage condition	Number of seeds that germinate
wet and cold	476
dry and cold	444
dry and warm	440
wet and warm	432

(i) Calculate the percentage increase in the number of seeds that germinate in wet and cold conditions compared to the number of seeds that germinate in wet and warm conditions.

(2)

percentage increase = ... %

(ii) Suggest why fewer seeds germinate when they are stored in wet and warm conditions than in the other conditions.

(2)

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(iii) Give one observation that shows a seed has germinated.

(1)

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(Total for question = 12 marks)

Q11.

Sickle cell anaemia is a condition in which some of the person's red blood cells develop abnormally.

The diagram shows red blood cells from a healthy person and red blood cells from a person with sickle cell anaemia.



cells from a healthy person



cells from a person with sickle cell anaemia

(Source: © solar22/Shutterstock)

(a) A person with sickle cell anaemia often suffers pain as some of their blood vessels become blocked by the sickle cells.

(i) Suggest why the person's blood vessels may become blocked.

(1)

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(ii) People with sickle cell anaemia have symptoms of tiredness and joint pain that get worse if

they are exposed to cold temperatures and high altitudes.

Suggest why these symptoms get worse.

(3)

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(b) Sickle cell anaemia is caused by a single recessive allele.

(i) State what is meant by the term **recessive**.

(1)

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(ii) A man and a woman who are both heterozygous for the sickle cell allele have a child.

Calculate the probability that the child will be female and **not** have sickle cell anaemia.

(2)

probability = ...

(c) Sickle cell anaemia is more common in countries where malaria is found. This is because having an allele for sickle cell anaemia can reduce the likelihood of developing malaria.

Which type of organism causes malaria?

(1)

☒ **A** bacterium

☒ **B** fungus

☒ **C** plant

☒ **D** protoctist

(d) What is the name of the pigment found in red blood cells?

(1)

☒ **A** chlorophyll

☒ **B** haemoglobin

☒ **C** iron

☒ **D** magnesium

(e) Give two differences in structure between red blood cells and white blood cells.

(2)

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2 .....

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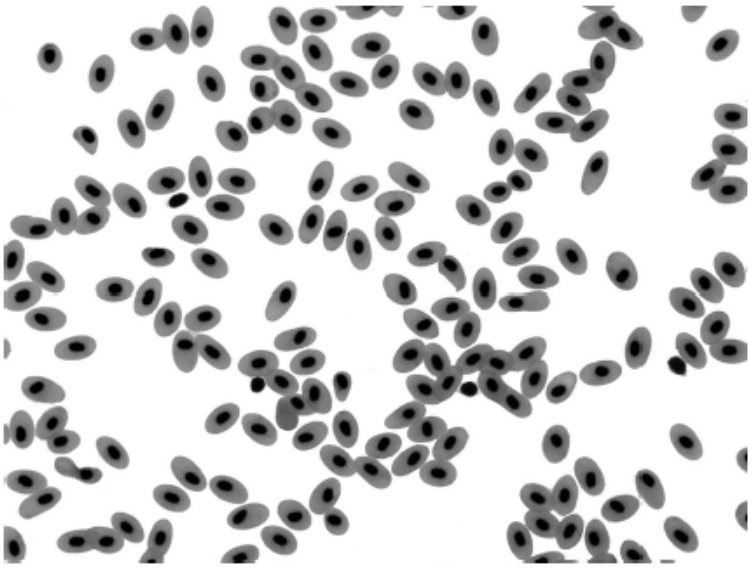
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Q12.

Red blood cells and white blood cells are two components of blood.

(a) The diagram shows some red blood cells from a fish.

Human red blood cells have a biconcave shape. Fish red blood cells have a more rounded, sphere-like shape.



(Source: © STEVE GSCHMEISSNER/SCIENCE PHOTO LIBRARY)

(i) Give a difference, other than shape, between the structure of fish red blood cells and human red blood cells.

(1)

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(ii) Explain why fish red blood cells transport oxygen less efficiently than human red blood cells.

(2)

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(b) Llamas are large mammals that have evolved to live at high altitude where there is less oxygen in the atmosphere.

The red blood cells of llamas can absorb more oxygen than the red blood cells of animals that live at low altitude.

Explain how llamas have evolved by natural selection to live at high altitude.

(4)

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(c) Phagocytes are white blood cells that are transported in the blood.

Describe the role of phagocytes in the body.

(3)

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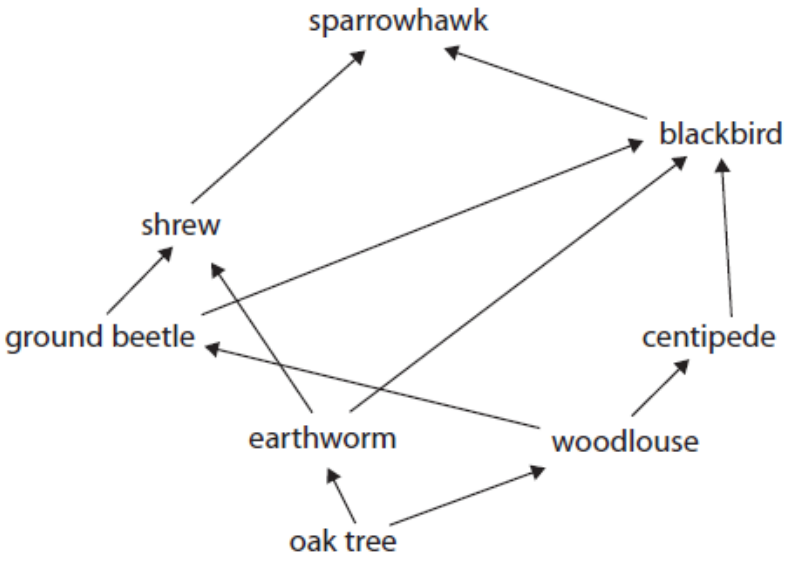
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(Total for question = 10 marks)

Q13.

The diagram shows a food web from a woodland ecosystem.



(a) (i) Which organism in the food web is the producer?

(1)

☒ **A** blackbird

☒ **B** centipede

☒ **C** earthworm

☒ **D** oak tree

(ii) Which organism acts as both a secondary consumer and a tertiary consumer in the food web?

(1)

☒ **A** blackbird

☒ **B** earthworm

☒ **C** ground beetle

☒ **D** sparrowhawk

(b) The amount of energy transferred changes as you move along a food chain.

The data comes from an ecosystem containing producers, primary consumers and secondary consumers.

Level	Energy in each level in kJ per m^2 per year
producers	8.7×10^5
primary consumers	1.4×10^4
secondary consumers	1.6×10^3

(i) The light energy reaching the producers is 7.1×10^6 kJ per m^2 per year.

Explain why the plants cannot absorb all of this energy.

(2)

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(ii) The table shows that energy is transferred between producer and primary consumer and between primary consumer and secondary consumer.

A student states that the energy transfer between producer and primary consumer is the most efficient.

Determine whether the student's statement is correct.

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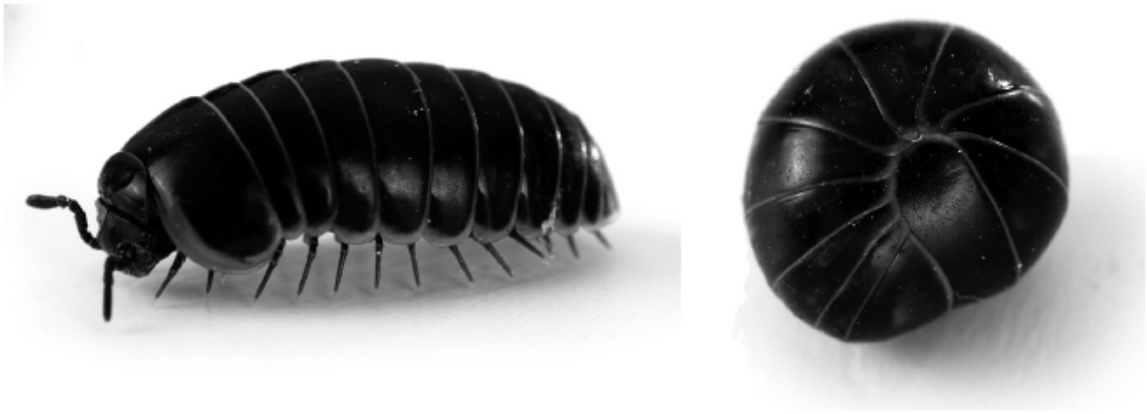
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(c) Woodlice feed on dead and decaying plant material in the soil.
The photographs show how a woodlouse can curl up into a ball.

This behaviour is an example of a reflex response.



(Source: © StellaNature Alamy Stock Photo)

(i) State what is meant by a reflex response.

(1)

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(ii) Give a reason why this reflex response benefits the woodlouse.

(1)

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(iii) Describe how this reflex response could have evolved by natural selection.

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(Total for question = 12 marks)

Q14.

Genetic conditions can be controlled by dominant alleles or by recessive alleles.

(a) Explain **one** difference between a dominant allele and a recessive allele.

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(b) Sickle cell anaemia is a genetic condition that results in the formation of abnormal red blood cells.

Sickle cell anaemia is controlled by a gene with two alleles. The allele (N) produces normal red blood cells and the allele (n) produces abnormal red blood cells.

Two parents who are both heterozygous plan to have children.

Use a genetic diagram to show the parent genotypes, the gametes produced and all the possible genotypes and phenotypes of their offspring.

(3)

Parent genotypes

Gametes

Offspring genotypes

Offspring phenotypes

(c) Individuals who are heterozygous for sickle cell anaemia are protected from malaria.

Suggest how this would affect the number of individuals born with sickle cell anaemia in parts of the world where malaria is common.

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(Total for question = 9 marks)

Q15.

Genetic conditions can be controlled by dominant alleles or by recessive alleles.

(a) Explain **one** difference between a dominant allele and a recessive allele.

(2)

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(b) Sickle cell anaemia is a genetic condition that results in the formation of abnormal red blood cells.

Sickle cell anaemia is controlled by a gene with two alleles. The allele (N) produces normal red blood cells and the allele (n) produces abnormal red blood cells.

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(3)

Parent genotypes

Gametes

Offspring genotypes

Offspring phenotypes

(c) Individuals who are heterozygous for sickle cell anaemia are protected from malaria.

Suggest how this would affect the number of individuals born with sickle cell anaemia in parts of the world where malaria is common.

(4)

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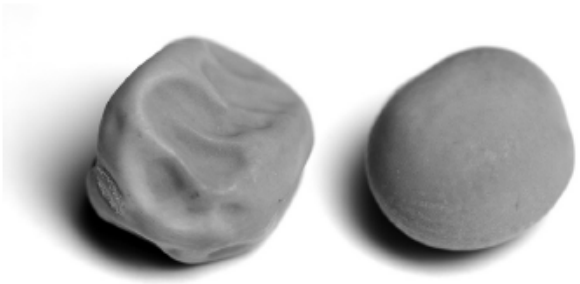
(Total for question = 9 marks)

Q16.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Pea plants can grow from seeds that are wrinkled or seeds that are round.

A scientist carried out a number of crosses using pea plants.



wrinkled round

(Source: © Martin Shields/Alamy Stock Photo)

(a) In the first cross, the scientist takes pollen from a flower of a plant grown from a wrinkled seed. She transfers the pollen to a flower of a plant grown from a round seed.

All the seeds produced by pollinating the plant are round.

In pollination, pollen is transferred from

(1)

☒ **A** anther to petal

☒ **B** anther to stigma

☒ **C** filament to ovary

☒ **D** stigma to style

(b) The scientist grows the round seeds produced from the first cross into adult plants.

In the second cross, she allows these adult plants to self-pollinate so that each flower

self-fertilises.

She then collects and observes all the seeds produced from the second cross.

(i) Suggest how the scientist could ensure that flowers only self-pollinate.

(1)

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(ii) Draw a genetic diagram to represent the second cross.

Include the genotypes of the self-pollinating plants, the gametes they produce and the ratio of the genotypes and phenotypes in the offspring.

(4)

(c) Plants can reproduce sexually and asexually.

Give three differences between sexual and asexual reproduction.

(3)

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2 .....

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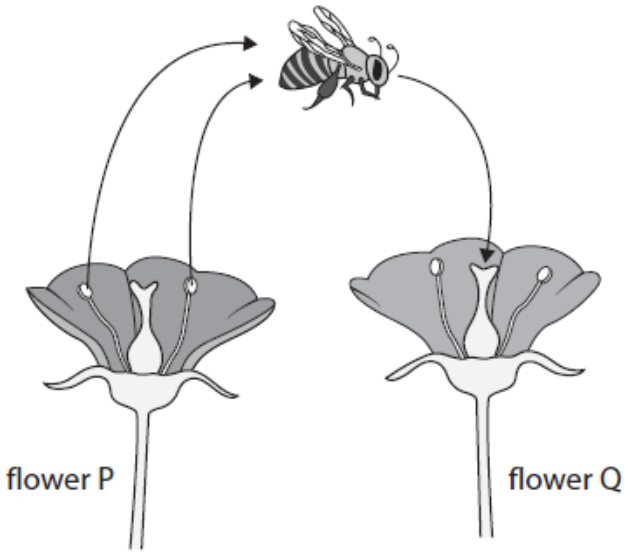
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(Total for question = 9 marks)

Q17.

The diagram shows an insect transferring pollen grains from flower P to flower Q.



(a) Which structure in flowers contains pollen grains?

(1)

- ☒ **A** anther
- ☒ **B** ovary
- ☒ **C** petal
- ☒ **D** sepal

(b) (i) Pollen grains are deposited on the stigma and grow tubes down the style.

Suggest how style tissue helps the tube to grow.

(2)

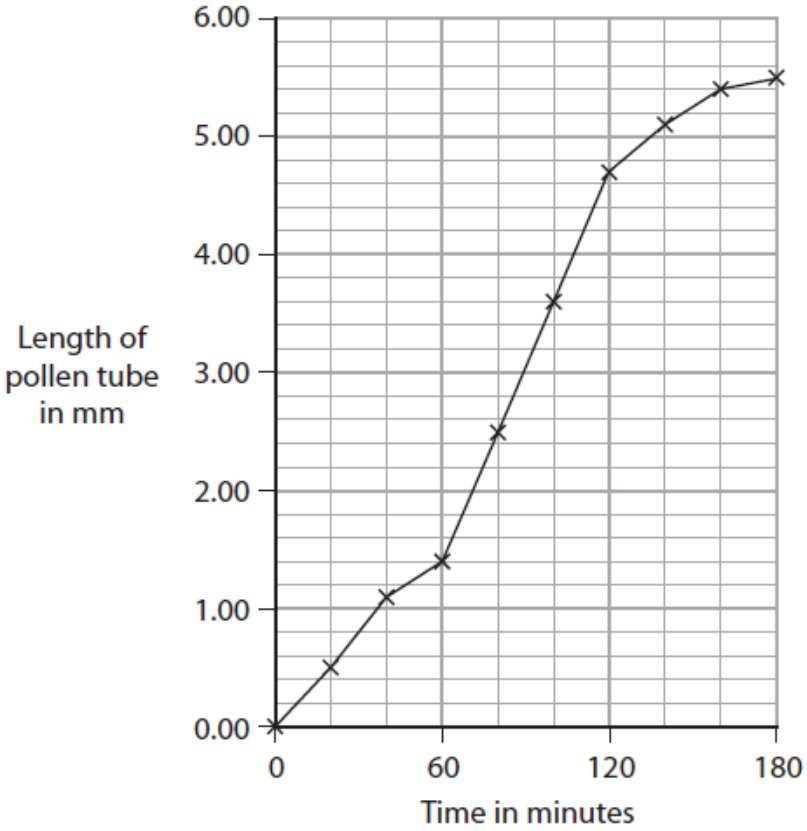
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(ii) The graph shows the change in the length of a pollen tube over a 180 minute period.



Calculate the fastest rate of pollen tube growth in mm per minute.

(3)

fastest rate of growth: ..... mm per minute

(c) A farmer grows apple trees.

The flowers on the apple trees must be pollinated by insects to produce an apple crop.

The farmer is concerned that the use of pesticides may affect the yield of apples.

Design an investigation to find out if pesticides reduce the yield of apples.

Include experimental details in your answer and write in full sentences.

(6)

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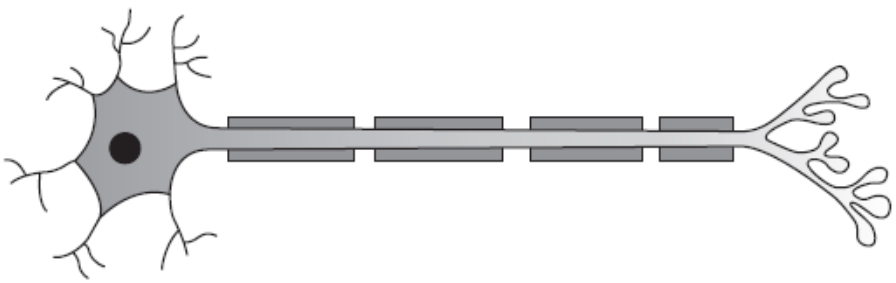
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(Total for question = 12 marks)

Q18.

Electrical impulses pass along motor neurones to effectors.

(a) The diagram shows a motor neurone.



The neurone is stimulated by a neurotransmitter to pass an electrical impulse along its length.

(i) Draw a circle around the part of the neurone that is stimulated by the neurotransmitter.

(1)

(ii) The longest motor neurone in the human body passes electrical impulses from the base of the spinal cord to muscle in the big toe. This neurone can be up to 1.3 m in length.

An impulse passes along this neurone at a speed of 1.20×10^2 metres per second.

Calculate the time taken, in seconds, for an impulse to pass along this neurone.

(2)

time = ... s

(iii) All neurones need a supply of energy from respiration.

Name the organelle in this motor neurone that supplies energy.

(1)

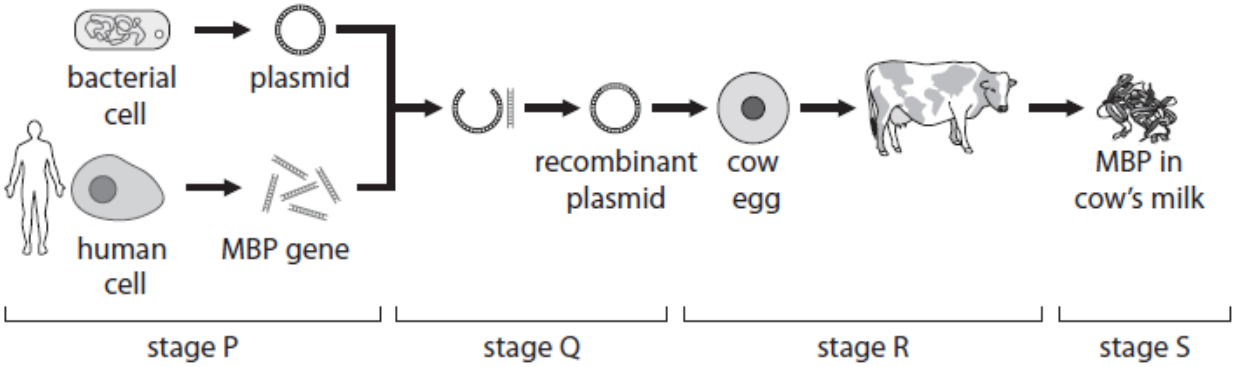
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(b) Multiple sclerosis is a disorder in which the insulating layer that surrounds a neurone is gradually destroyed. This prevents the passage of electrical impulses.

Scientists hope to treat multiple sclerosis using a protein called myelin basic protein (MBP).

Transgenic cows can produce large quantities of MBP in their milk.

The diagram shows four stages in the process of creating transgenic cows.



(i) Name the **two** structures in the bacterium that contain DNA.

(2)

1 .....

2 .....

(ii) Name the stage that involves the use of ligase.

(1)

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(iii) Name the stage that involves placing a transgenic embryo into a uterus.

(1)

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(Total for question = 8 marks)

Q19.

The photograph shows a giraffe with normal coat colour and an albino giraffe.

Albino giraffes have less pigment in their fur.

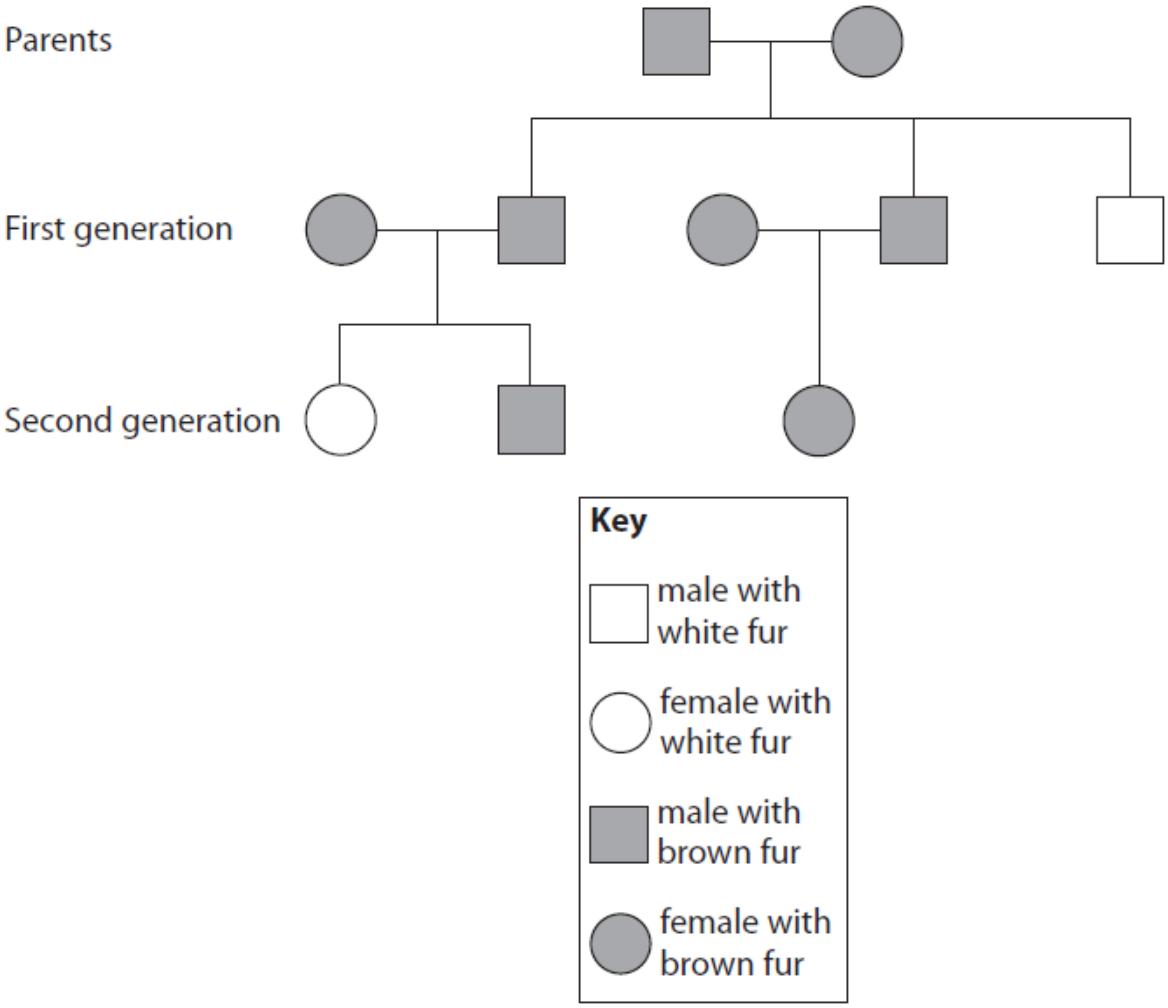


(Source: © superstock.co.uk/Superstock)

The fur colour in giraffes is controlled by a gene with two alleles.

The allele (B) for brown fur is dominant to the allele (b) for white fur.

The diagram shows the inheritance of fur colour in a family of giraffes.



(a) (i) Use information from the diagram to deduce the genotype of each parent.

(2)

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(ii) State the maximum number of giraffes in this family that could be homozygous dominant.

(1)

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(b) Two heterozygous giraffes have one offspring.

Determine the probability that this offspring is male and has white fur.

(1)

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(c) Explain why there are only a few giraffes with white fur in the wild.

(4)

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(Total for question = 8 marks)

Q20.

Cell division can be by meiosis or by mitosis.

(a) (i) Where are cells dividing by meiosis found in a human?

(1)

☒ **A** kidney

☒ **B** penis

☒ **C** skin

☒ **D** testis

(ii) Which part of a flowering plant is usually used to demonstrate cells dividing by mitosis?

(1)

☒ **A** anther

☒ **B** cotyledon

☒

C root tip

☒ **D** xylem

(b) The table lists features comparing the processes of meiosis and mitosis in human cells.

Complete the table by giving the missing information.

(6)

Feature	Meiosis	Mitosis
number of chromosomes in each original cell	46	
number of daughter cells produced from each original cell		2
number of chromosomes in each daughter cell		
ploidy level of daughter cells produced		diploid
genetic differences in daughter cells	present	
type of cell produced		body cell

(c) Cell division can cause variation in offspring.

(i) Describe other causes of variation in offspring.

(3)

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(ii) Scientists investigating a drug treatment use rats that are homozygous for many genes.

Suggest the advantages of using rats that are homozygous for many genes.

(2)

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(Total for question = 13 marks)