GCSE Biology Mock Paper 1
Max time allowed: 2 hours

Answer ALL questions. Write your answers in the spaces provided.

1 The diagram shows a pot containing yoghurt and fruit.

(a) Describe how a named bacterium produced this yoghurt from milk.

(3)

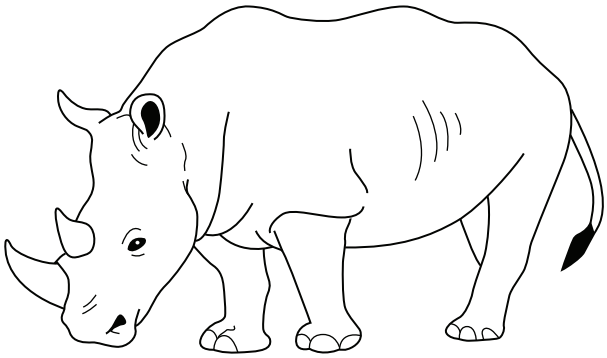
(b) Suggest the health benefits to a human of adding fruit to the yoghurt.

(2)

(Total for Question 1 = 5 marks)

2 A rhino is a large mammal that lives in hot parts of Africa.

The drawing shows a rhino.



(a) The rhino feeds on plants and rests in the shade during the day.

(i) Which of the following describes the trophic level of a rhino?

(1)

- ☐ **A** producer
- ☐ **B** primary consumer
- ☐ **C** secondary consumer
- ☐ **D** tertiary consumer

(ii) Which of the following explains why the rhino rests in the shade during the day?

(1)

- ☐ **A** it has a large surface area to volume ratio and needs to avoid overheating.
- ☐ **B** it has a large surface area to volume ratio and needs to gain heat.
- ☐ **C** it has a small surface area to volume ratio and needs to avoid overheating.
- ☐ **D** it has a small surface area to volume ratio and needs to gain heat.

(b) The horn of the rhino is valuable in some human cultures. This results in rhinos being killed just for their horn.

This species is at risk of extinction because the mean rate of killing is one rhino every six hours.

In 2016, there were an estimated 25 000 of one species of rhino in Africa.

Calculate the year in which this rhino species would become extinct, assuming the number of births equals the number of natural deaths.

(3)

year = ...

(c) In an effort to protect the rhino from extinction, scientists have produced a heart rate monitor.

The monitor is attached to the rhino. It sends an alarm signal to the nearest police station if the rhino is under stress.

This allows the police to respond quickly to save the rhino from being killed.

(i) Explain how stress affects the heart rate of a rhino.

(2)

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(ii) Describe the evidence the scientists need to find out if this method helps to protect the rhino from extinction.

(2)

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(Total for Question 2 = 9 marks)

3 A study investigates the effect of training on athletic performance.

In the study, the number of capillaries in the muscle tissue of a person is measured before and after a six-week period of training.

(a) The table shows the results.

Mean number of capillaries per mm²	
before training	after training
437	460

(i) Explain how training may affect the athletic performance of this person. Use information from the table to support your answer.

(5)

(ii) Give **two** ways in which the design of the study could be improved.

(2)

1 .....

.....

2 .....

.....

(b) The diameter of a capillary is 8.0 μm and the diameter of the aorta is 25.0 mm.
1000 μm = 1 mm.

(i) Calculate the ratio of the diameter of the aorta to the diameter of the capillary.
Show your working.

(2)

ratio = ...

(ii) Explain why the aorta has a thicker wall than the capillary.

(2)

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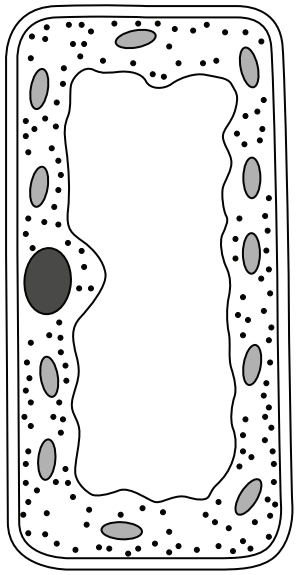
(Total for Question 3 = 11 marks)

4 The diagram shows a cell.



(a) (i) Which type of cell does the diagram show?

(1)

- ☐ **A** an animal
- ☐ **B** a bacterium
- ☐ **C** a fungus
- ☐ **D** a plant

(ii) The statements below describe conditions required for some molecules to move into this cell.

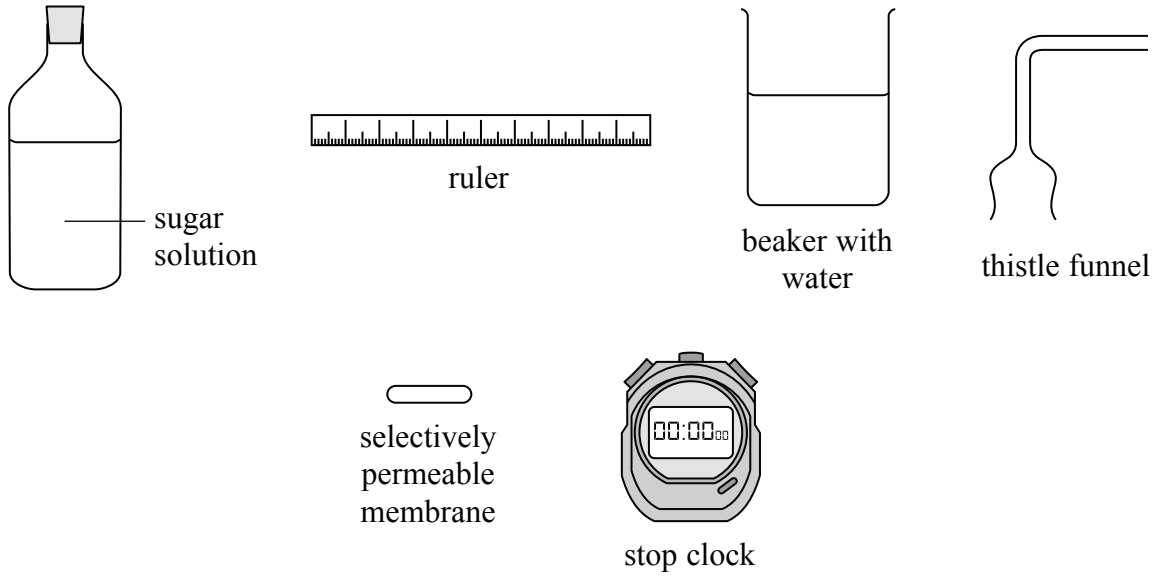
1. a concentration gradient
2. use of ATP

Which of these statements is correct for the process for osmosis?

(1)

- ☐ **A** 1 only
- ☐ **B** 2 only
- ☐ **C** 1 and 2
- ☐ **D** neither 1 nor 2

(b) The diagram shows some of the apparatus used to investigate the rate of osmosis.

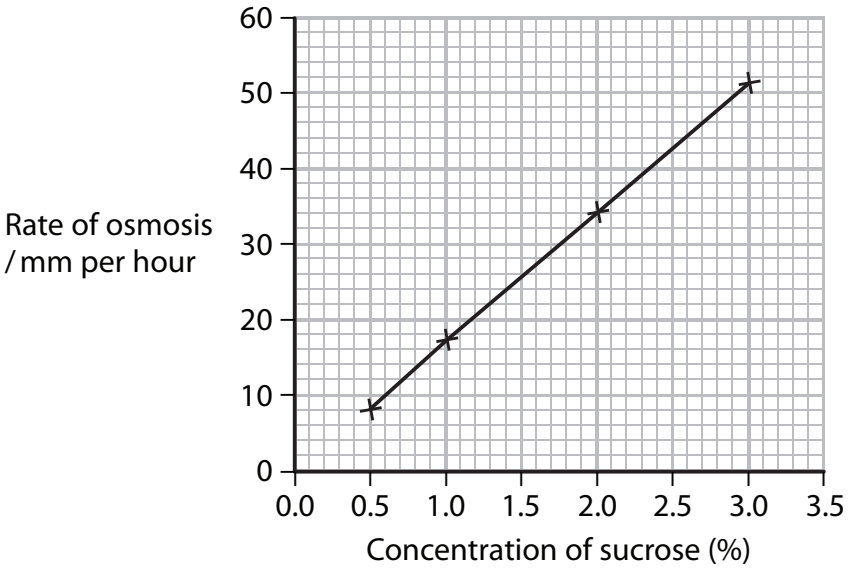


In the space below draw a labelled diagram to show how you would put this apparatus together to investigate the rate of osmosis.

(4)

(c) The apparatus is used to find out the effect of different sucrose concentrations on the rate of osmosis.

The graph below shows the results.



Calculate, using information from the graph, the rate of osmosis in mm per minute that would occur for a sucrose concentration of 2.5%.
Show your working.

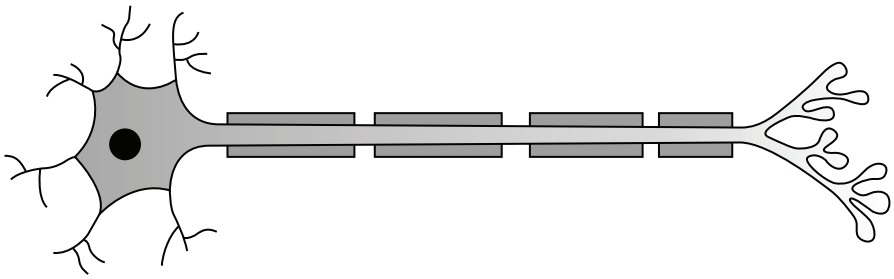
(2)

rate of osmosis = ... mm per minute

(Total for Question 4 = 8 marks)

5 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)

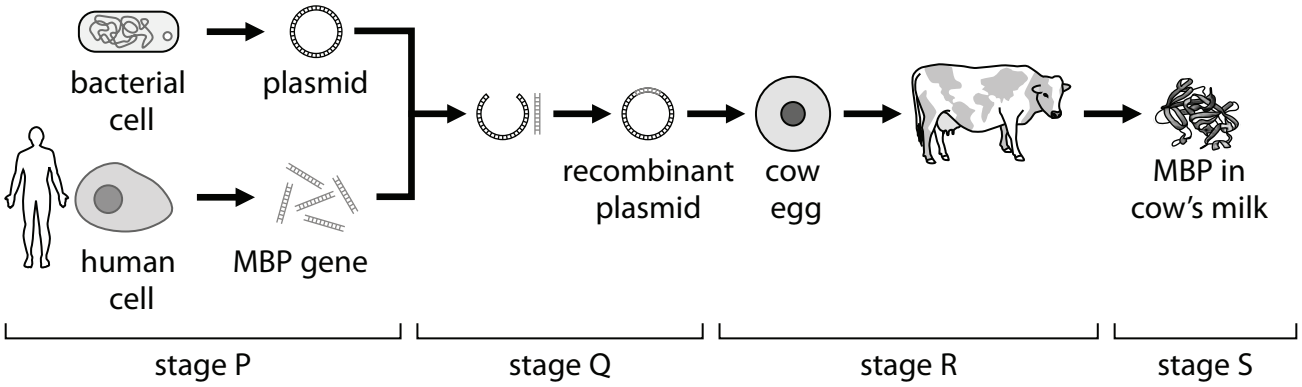
.....

(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 5 = 8 marks)

6 Car exhaust fumes contain air pollutants including carbon monoxide and sulfur dioxide.

(a) Explain why carbon monoxide is a harmful air pollutant.

(2)

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(b) Which of the following is a direct consequence of sulfur dioxide pollution?

(1)

☒ **A** production of acid rain

☒ **B** soil erosion

☒ **C** production of ozone

☒ **D** eutrophication

(c) A species of plant does not grow by the side of roads.

One hypothesis to explain this observation is that sulfur dioxide inhibits seed germination.

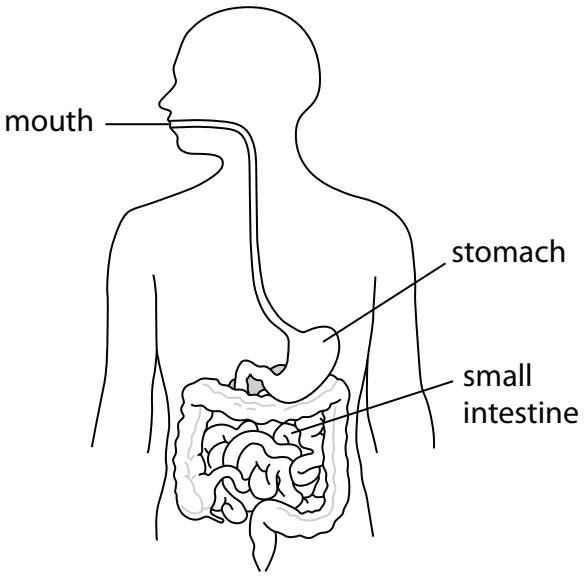
Design an investigation to test this hypothesis.

Your answer should include experimental details and be written in full sentences.

(6)

(Total for Question 6 = 9 marks)

7 The diagram shows parts of the human digestive system.



(a) Describe how food passes from the mouth to the stomach.

(2)

(b) Explain what happens to protein in the stomach.

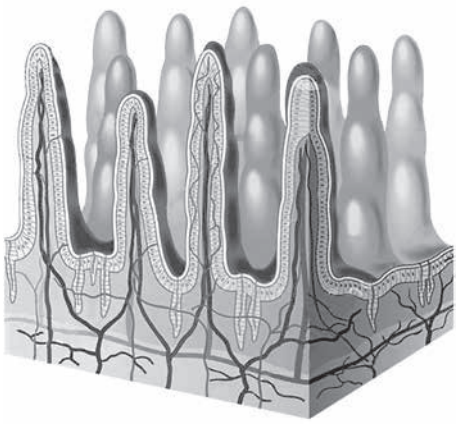
(4)

(c) Gluten is a protein found in wheat.

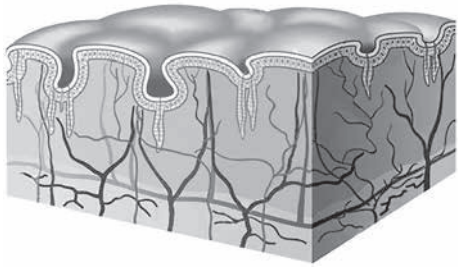
In some people, the lining of the small intestine can be damaged by gluten. This causes a condition called coeliac disease.

The diagram shows the lining of the small intestine of a child unaffected by gluten and a child with coeliac disease.

Unaffected



Coeliac disease



Suggest how coeliac disease could affect the growth of a child.

(4)

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(Total for Question 7 = 10 marks)

8 Male infertility can be caused by reduced sperm production and reduced sperm movement.

Scientists investigated the effect of a drug called letrozole on male infertility.

A large group of infertile men was divided into two smaller groups.

Group 1 received 2.5 mg of letrozole per day for six months and Group 2 received no treatment.

The scientists measured the following at the start of the investigation and after six months:

- sperm concentration
- percentage of moving sperm
- blood testosterone level
- blood oestrogen level
- side effects such as hair loss and skin rash

The table below shows the results.

Factors measured	Group 1 (letrozole)		Group 2 (no treatment)	
	start	after 6 months	start	after 6 months
sperm concentration / number per cm^3	450	1.4×10^6	475	450
percentage of moving sperm	2	18	2	2
blood testosterone level / arbitrary units	249	1198	266	266
blood oestrogen level / arbitrary units	44	0	44	48
number of men with side effects	0	8	0	0

The scientists concluded that letrozole is a safe and effective treatment for male infertility.

Evaluate this conclusion.

(6)

(Total for Question 8 = 6 marks)

9 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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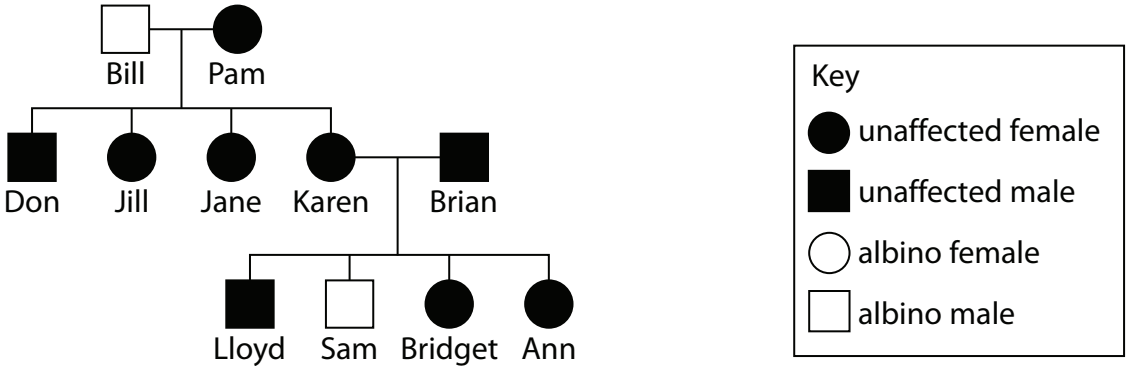
(b) Pedigree analysis can be used to find out if characteristics are controlled by dominant or recessive alleles.

The diagram below shows a family pedigree for albinism.



Explain, using information in the pedigree, whether albinism is controlled by a recessive allele or a dominant allele.

(3)

(c) 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

(d) 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)

(Total for Question 9 = 12 marks)

10 Plants make sugars by the process of photosynthesis.

(a) (i) Which of the following factors is least likely to limit the rate of photosynthesis?

(1)

- ☐ **A** carbon dioxide concentration
- ☐ **B** light intensity
- ☐ **C** oxygen concentration
- ☐ **D** temperature

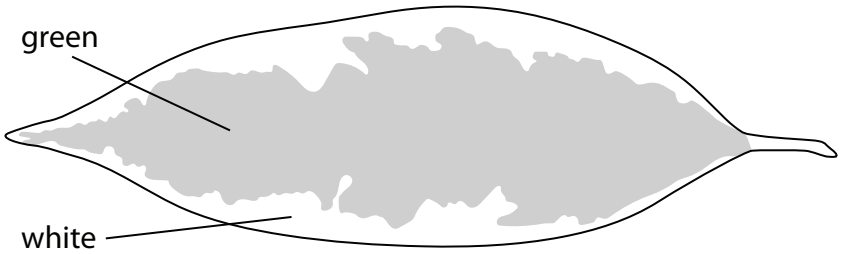
(ii) Which combination of factors is most likely to limit the rate of photosynthesis in the early morning?

(1)

- ☐ **A** carbon dioxide concentration and soil pH
- ☐ **B** temperature and light intensity
- ☐ **C** water content of soil and soil pH
- ☐ **D** water content of soil and light intensity

(b) A student carries out an experiment to investigate the need for chlorophyll in photosynthesis.

He uses a variegated leaf as shown.



The green part of the leaf has cells that contain chlorophyll. The white part of the leaf has cells that do not contain chlorophyll.

(i) Describe the procedure used to test this leaf for starch.

(4)

(ii) Draw a labelled diagram of the leaf to show its appearance after the student has completed the test for starch.

(2)

(c) Suggest a method the student could use to measure the area of the green part of the leaf.

(2)

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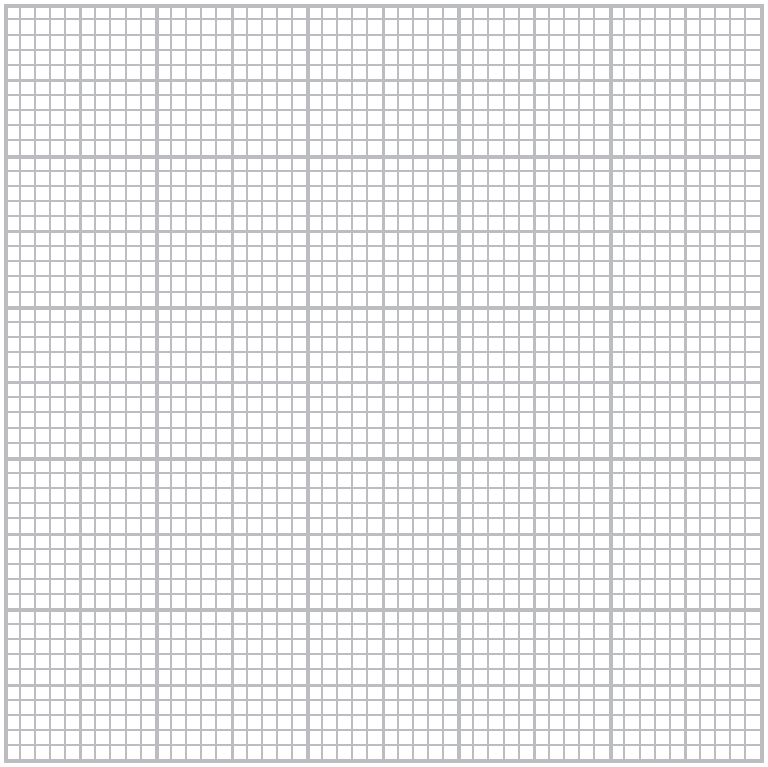
(Total for Question 10 = 10 marks)

11 The data in the table shows how the mean maximum lung volume changes with age for males and females.

Age / years	Mean maximum lung volume / dm^3	
	males	females
7	2.10	2.05
16	4.50	3.70
25	5.20	3.80
50	4.80	3.40
70	3.90	2.80

(a) (i) Plot a bar graph to show this data.

(5)



(ii) Calculate the increase in mean maximum lung volume for males between the ages of 7 and 25.

(1)

increase = ... dm^3

(iii) Explain why the mean maximum lung volume for males and females is similar at age 7 but is different at age 25.

(3)

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(b) The data shows the mean maximum lung volume at each age.

(i) Which of the following would improve the reliability of these mean values?

(1)

☒ **A** using a larger range of ages

☒ **B** measuring more people at each age

☒ **C** measuring lung volume in cm^3

☒ **D** measuring lung volumes in other mammals

(ii) Variation in maximum lung volume exists between males at each age.

Suggest **two** factors that could cause this variation.

(2)

1 .....

2 .....

(Total for Question 11 = 12 marks)

12 Selective breeding has been used by farmers to improve the quality of their animals.

(a) (i) Describe how selective breeding could be used to improve the volume of milk produced by cows.

(3)

(ii) In recent years farmers have used artificial insemination to fertilise their cows.

In this technique many samples of semen are collected from one bull.

These samples can be used to fertilise cows.

Suggest the advantages of using artificial insemination in selective breeding.

(3)

(b) Farmers use a variety of methods to improve the growth of their crops.

One method is the use of a glasshouse.

Describe how the use of a glasshouse improves the growth of crops.

(4)

(Total for Question 12 = 10 marks)

TOTAL FOR PAPER = 110 MARKS

Question number	Answer	Mark
1(a)	A description that makes reference to the following three points: • *Lactobacillus* (1) • lactose (1) • lactate/lactic acid (1)	**3**

Question number	Answer	Mark
1(b)	An answer that makes reference to the following points: • fruit provides vitamin C to prevent scurvy (1) • roughage/fibre to help peristalsis (1)	**2**

Total for Question 1 = 5 marks

Question number	Answer	Mark
2(a)(i)	B	1

Question number	Answer	Mark
2(a)(ii)	C	1

Question number	Answer	Additional guidance	Mark
2(b)	Division • 25 000 ÷ 4 = 6250 days (1) Division • 6250 ÷ 365 = 17.1 years (1) Addition • 2017 + 17.1 years = 2034 (1)	award full marks for correct numerical answer without working	3

Question number	Answer	Mark
2(c)(i)	An explanation that makes reference to the following two points: • heart rate increases (1) • because adrenaline is released (1)	2

Question Number	Answer	Mark
2(c)(ii)	A description that makes reference to the following two points: • one area where rhino are monitored and one area where they are not/monitored and unmonitored rhinos in same area (1) • count/compare the number of deaths (1)	2

Total for Question 2 = 9 marks

Question number	Answer	Mark
3(a)(i)	An explanation that makes reference to the following five points: • training improves performance by increasing the number of capillaries (1) • better supply of oxygen/aerobic (1) • better supply of glucose (1) • respiration/energy/ATP (1) • muscle contraction (1) • better removal of lactic acid/carbon dioxide (1) • can run for longer/equivalent (1)	**5**

Question number	Answer	Mark
3(a)(ii)	An answer that makes reference to two of the following points: • use more people (1) • extend training period (1) • compare different ages/genders (1)	**2**

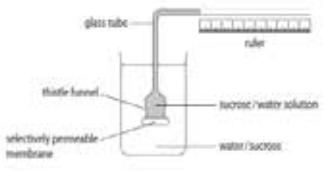
Question number	Answer	Additional guidance	Mark
3(b)(i)	Multiplication • 0.008 (1) Division • 25 ÷ 0.008 = 3125 = 3100 (1)	award full marks for correct numerical answer without working accept 3125 the final answer should reflect the precision of the least precise data (in this case two sig figs)	**2**

Question number	Answer	Additional guidance	Mark
3(b)(ii)	An explanation that makes reference to two of the following points: • wall contains muscle/elastic tissue (1) • blood is under high pressure from the left ventricle (1) • aorta needs to expand (1) • need to transport more blood (1)	allow converse	**2**

Total for Question 3 = 11 marks

Question number	Answer	Mark
4(a)(i)	D	1

Question number	Answer	Mark
4(a)(ii)	A	1

Question number	Answer	Additional guidance	Mark
4(b)	An answer that makes reference to the following four points: • beaker containing water/sucrose/thistle funnel containing sucrose/water (1) • selectively permeable membrane separating sucrose from water (1) • ruler by tube of thistle funnel (1) • level of liquid shown in the tube (1)		4

Question number	Answer	Additional guidance	Mark
4(c)	Identification • 42 (1) Division • 42 ÷ 60 = 0.70 (1)	award full marks for correct numerical answer without working	2

Total for Question 4 = 8 marks

Question number	Answer	Mark
5(a)(i)	Circle around dendrites/cell body and dendrites	1

Question number	Answer	Additional guidance	Mark
5(a)(ii)	Multiplication • 1.20 × 102 = 120 (1) Multiplication • 1.3 ÷ 120 = 0.0108/1.08 × 10^{-2} (1)	award full marks for correct numerical answer without working	2

Question number	Answer	Mark
5(a)(iii)	Mitochondria	1

Question number	Answer	Additional guidance	Mark
5(b)(i)	An answer that makes reference to the following points: • chromosome (1) • plasmid (1)	allow nucleoid	2

Question number	Answer	Mark
5(b)(ii)	Stage Q	1

Question number	Answer	Mark
5(b)(iii)	Stage R	1

Total for Question 5 = 8 marks

Question number	Answer	Mark
6(a)	An explanation that makes reference to the following two points: • attaches to haemoglobin (1) • therefore less oxygen transport (1)	**2**

Question number	Answer	Mark
6(b)	A	**1**

Question number	Answer	Mark
6(c)	An answer that makes reference to the following six points: • plus and minus sulphur dioxide (1) • same species of seed/equivalent (1) • more than one seed per treatment/equivalent (1) • number of seeds germinated/calculate percentage germination (1) • air tight container used (1) • same time period (1) • same water/same temperature/equivalent (1)	**6**

Total for Question 6 = 9 marks

Question number	Answer	Mark
7(a)	A description that makes reference to two of the following points: • softened by saliva/bolus (1) • muscle contraction in oesophagus (1) • peristalsis (1)	**2**

Question number	Answer	Mark
7(b)	An explanation that makes reference to four of the following points: • churning/equivalent (1) • digested/broken down (1) • protease/pepsin (1) • amino acids (1) • hydrochloric acid/low pH/optimum pH (1)	**4**

Question number	Answer	Mark
7(c)	An explanation that makes reference to four of the following points: • growth reduced (1) • lack of villi (1) • fewer capillaries/fewer lacteals/less surface area (1) • less absorption of named food molecule (1) • function of named food molecule linked to growth (1)	**4**

Total for Question 7 = 10 marks

Question number	Answer	Additional guidance	Mark
8	An evaluation that makes reference to the following points: • letrozole does improve male fertility (1) • sperm concentration increases/sperm motility increases (1) • letrozole increases testosterone levels/ decreases oestrogen levels (1) • letrozole causes side effects/equivalent (1) • need to know group size (1) • matched groups (1) • need to know other factors controlled (1)	e.g. age, diet, smoking, drugs	**6**

Total for Question 8 = 6 marks

Question number	Answer	Additional guidance	Mark
9(a)	An explanation that makes reference to two of the following points: • dominant allele always expressed (1) • dominant expressed in heterozygote (and homozygote)/recessive allele not expressed in heterozygote (1) • recessive allele only expressed in phenotype of homozygote/equivalent (1)	allow seen/visible	**2**

Question number	Answer	Mark
9(b)	An explanation that makes reference to three of the following points: • Karen and Brian unaffected (1) • they both are heterozygous/carriers/have a recessive allele (1) • Sam is albino (1) • Sam is aa/homozygous recessive (1)	**3**

Question number	Answer	Additional guidance	Mark
9(c)	A genetic diagram including: • parents Nn and Nn (1) • gametes N or n (1) • genotypes of offspring NN Nn Nn nn and phenotypes correctly assigned (1)	allow max 3 for transfer error allow all marks from Punnett square	**3**

Question number	Answer	Additional guidance	Mark
9(d)	An answer that makes reference to the following points: • Nn not affected/killed by malaria/survive (1) • reproduce (1) • so number of Nn individuals increase (1) • so number of nn individuals increases/frequency of (n) allele increases (1)	allow converse for NN	**4**

Total for Question 9 = 12 marks

Question number	Answer	Mark
10(a)(i)	C	**1**

Question number	Answer	Mark
10(a)(ii)	B	**1**

Question number	Answer	Mark
10(b)(i)	A description that makes reference to four of the following points: • place leaf in boiling water (1) • place leaf in boiling ethanol (1) • use water bath/safe heating/no naked flame (1) • place leaf in water (1) • place leaf in iodine solution (1) • blue/black indicates starch; orange/yellow indicates no starch (1)	**4**

Question number	Answer	Additional guidance	Mark
10(b)(ii)	A drawing showing the following: • white part labelled orange/yellow/no starch (1) • green part labelled blue/black/starch (1)	allow approximate shape	**2**

Question number	Answer	Mark
10(c)	A method that includes two of the following points: • trace around the leaf/use transparent paper/equivalent (1) • trace around the green part (1) • put onto squared paper (1) • count the number of squares (1) • reference to both sides of leaf being measured (1)	**2**

Total for Question 10 = 10 marks

Question number	Answer	Mark
11(a)(i)	A graph showing: • y-axis scale half grid and linear (1) • bars drawn with lines (1) • x-axis labelled age and y-axis labelled mean maximum, and x-axis units as years and y-axis units as dm^3 (1) • bars plotted correctly (1) • key males/females (1)	**5**

Question number	Answer	Mark
11(a)(ii)	Subtraction 5.2 − 2.1 = 3.1 (1)	**1**

Question number	Answer	Mark
11(a)(iii)	An explanation that makes reference to three of the following points: • mean maximum lung volume for males is greater than females for 16 and 25 (1) • males grow more than females (1) • greater difference from puberty/equivalent (1) • males continue to grow from 16 to 25 (1)	**3**

Question number	Answer	Mark
11(b)(i)	B	**1**

Question number	Answer	Mark
11(b)(ii)	An explanation that makes reference to two of the following points: • different body mass/size (1) • taking more exercise/equivalent (1) • smoking (1) • asthma/lung disease/equivalent (1) • genetics/inheritance (1)	**2**

Total for Question 11 = 12 marks

Question number	Answer	Mark
12(a)(i)	A description that makes reference to three of the following points: • use information about milk yield of daughters/mothers (1) • to select bulls as male parents (1) • mate with cows with high milk yield (1) • repeat over generations (1)	**3**

Question number	Answer	Mark
12(a)(ii)	An answer that makes reference to three of the following points: • cheaper/quicker to transport sperm than live bulls (1) • can use semen to mate with many cows (1) • can store semen after bull has died (1) • safer (for cows) (1)	**3**

Question number	Answer	Additional guidance	Mark
12(b)	A description that makes reference to four of the following points: • control light intensity/use artificial lighting (1) • use heaters to increase temperature (1) • provide additional carbon dioxide (1) • provide additional minerals (1) • control water supply (1) • reduce damage by pests/use biological control (1)	ignore nutrients	**4**

Total for Question 12 = 10 marks

TOTAL FOR PAPER = 110 MARKS