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Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Tuesday 8 October 2024

Morning (Time: 1 hour 30 minutes)

Paper reference **WBI11/01**

Biology

International Advanced Subsidiary/Advanced Level
UNIT 1: Molecules, Diet, Transport and Health

You must have:
Scientific calculator, ruler, HB pencil

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- Calculators may be used.
- You must **show all your working out** with your answer **clearly identified** at the **end of your solution**.

Information

- The total mark for this paper is 80.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*
- In questions marked with an **asterisk** (*****), marks will be awarded for your ability to structure your answer logically, showing how the points you make are related or follow on from each other where appropriate.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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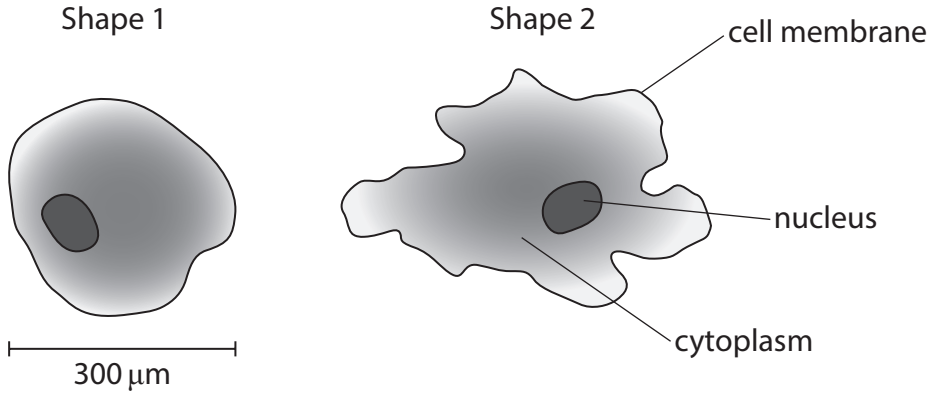
Answer ALL questions. Write your answers in the spaces provided.

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 ☒.

1 Amoeba are single-celled organisms that live in water. They are able to change their shape.

The diagram shows two different shapes that one amoeba can make.



(a) An amoeba changes shape by pushing cytoplasm against the cell membrane, forming long thin projections.

State the property of the cell membrane that enables the amoeba to change shape.

(1)

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(b) Gas exchange in an amoeba takes place across its cell membrane.

(i) The amoeba can be roughly spherical, as shown in Shape 1.

Which is the surface area of the amoeba in this shape?

Use the formula:

surface area of a sphere = $4\pi r^2$

(1)

☒ **A** $90\,000\pi\ \mu m^2$

☒ **B** $90\,000\pi\ \mu m^3$

☒ **C** $360\,000\pi\ \mu m^2$

☒ **D** $360\,000\pi\ \mu m^3$

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(ii) The mass of the amoeba stays the same when it changes from Shape 1 to Shape 2.

Which row of the table shows what happens to the surface area and volume of this amoeba when it changes to Shape 2?

(1)

		surface area	volume
☒	**A**	decreases	decreases
☒	**B**	increases	increases
☒	**C**	increases	stays the same
☒	**D**	stays the same	stays the same

(iii) Explain why an amoeba can rely on diffusion to supply the oxygen it needs.

(2)

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(Total for Question 1 = 5 marks)

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2 During the development of a human, the structure of haemoglobin changes.

In the developing fetus the main oxygen-carrying molecule is fetal haemoglobin.

Towards the end of fetal development, fetal haemoglobin is replaced by adult forms of haemoglobin.

(a) Blood may contain 5.3 million red blood cells in 1 mm^3 of blood.

One red blood cell can contain 270 million haemoglobin molecules.

Calculate the number of haemoglobin molecules in 1 mm^3 of blood.

Express your answer in standard form.

(1)

Answer .....

(b) Which of the following statements about the structure of haemoglobin are correct?

1. It is a fibrous protein
2. It has quaternary structure
3. It contains a non-protein haem group

(1)

☒ **A** 1 only

☒ **B** 3 only

☒ **C** 1 and 2 only

☒ **D** 2 and 3 only

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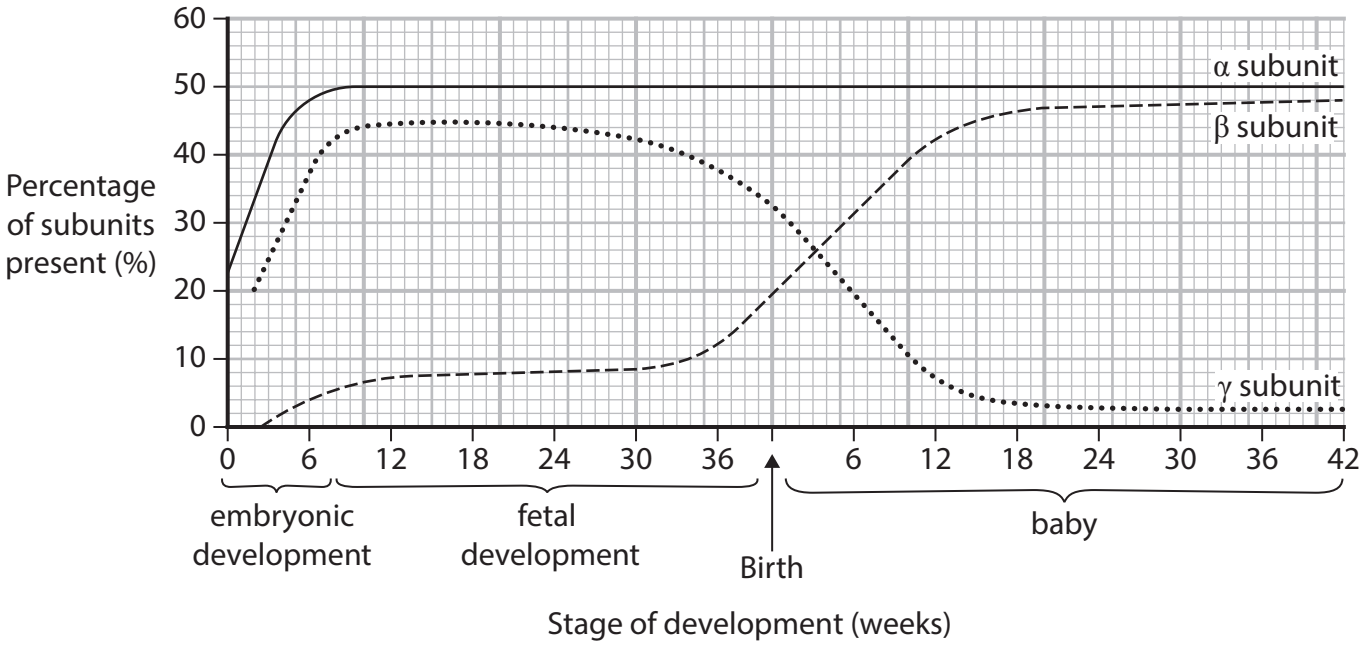
(c) The graph shows the changes for three types of haemoglobin subunits present during each stage of development.



(i) Describe the changes in these types of subunits present during each stage of development.

(3)

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(ii) The oxygen affinity of fetal haemoglobin is different from adult haemoglobin.

Explain why this difference ensures the fetus obtains enough oxygen during development.

(2)

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(Total for Question 2 = 7 marks)

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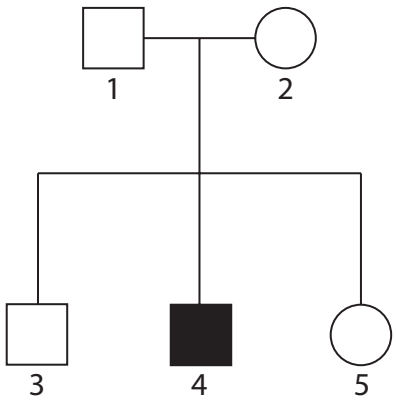
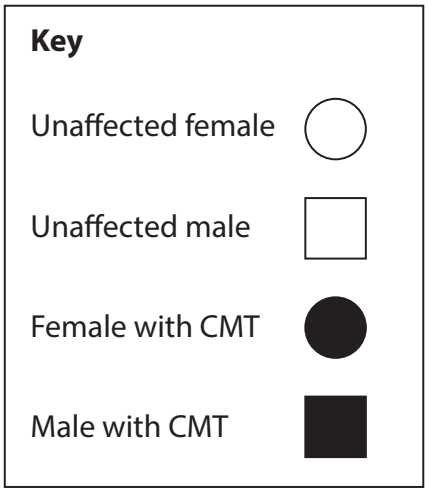
3 Charcot-Marie-Tooth (CMT) is an inherited disease that results in the gradual loss of function and sensation in the hands, arms, legs and feet.

Over 100 different gene mutations have been identified that cause CMT.

(a) The pedigree diagram shows the inheritance of one form of CMT in part of a family.

The allele for CMT can be represented by the letter c in this **recessive** pattern of inheritance.





(i) Which row of the table shows the genotype and phenotype for individual 1?

(1)

		genotype	phenotype
☒	**A**	CC	unaffected homozygous
☒	**B**	Cc	unaffected heterozygous
☒	**C**	unaffected heterozygous	CC
☒	**D**	unaffected homozygous	Cc

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(ii) Which allele combinations could individual 3 have?

(1)

- ☒ **A** CC only
- ☒ **B** cc only
- ☒ **C** CC or cc
- ☒ **D** CC or Cc

(iii) What is the probability that a fourth child would be a female with CMT?

(1)

- ☒ **A** 1 in 2
- ☒ **B** 1 in 4
- ☒ **C** 1 in 8
- ☒ **D** 1 in 16

(b) Other forms of CMT show a dominant pattern of inheritance.

(i) In the USA, 5% of people with CMT have one of these dominant forms of the disease.

In the USA, there are a total of 126 000 people with all forms of CMT.

Calculate the number of people in the USA who have one of these dominant forms of CMT.

(1)

Answer .....

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(ii) An individual with a dominant form of CMT will have the allele combination TT or Tt.

Draw a genetic diagram to show the possible allele combinations of the children of the following parents:

- parent 1 does not have CMT
- parent 2 has the allele combination Tt

Indicate whether each child will have CMT or be unaffected.

(3)

(c) Another form of CMT can be inherited as a sex-linked trait on the X chromosome.

Explain why a male with CMT **cannot** pass the disease on to his **sons**.

(2)

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(Total for Question 3 = 9 marks)

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4 The circulatory system and the cardiac cycle ensure that all the cells of the body are supplied with their requirements.

(a) The table shows the diameter of the lumens of an aorta and a capillary, and the thickness of their walls.

Type of blood vessel	Diameter of lumen	Thickness of wall / mm
aorta	2.5 cm	2.0
capillary	0.14 μm	0.001

(i) How many times greater is the diameter of the lumen of the aorta than the diameter of the lumen of the capillary?

(1)

- ☒ **A** 17 800
- ☒ **B** 17 900
- ☒ **C** 178 000
- ☒ **D** 179 000

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

(3)

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(b) The table shows the durations of ventricular diastole and ventricular systole at two different heart rates.

Heart rate / beats per minute	Duration of ventricular diastole / seconds	Duration of ventricular systole / seconds
75	0.53	0.27
200	0.14	0.16

Determine the relationship between heart rate and the duration of ventricular diastole and ventricular systole.

(2)

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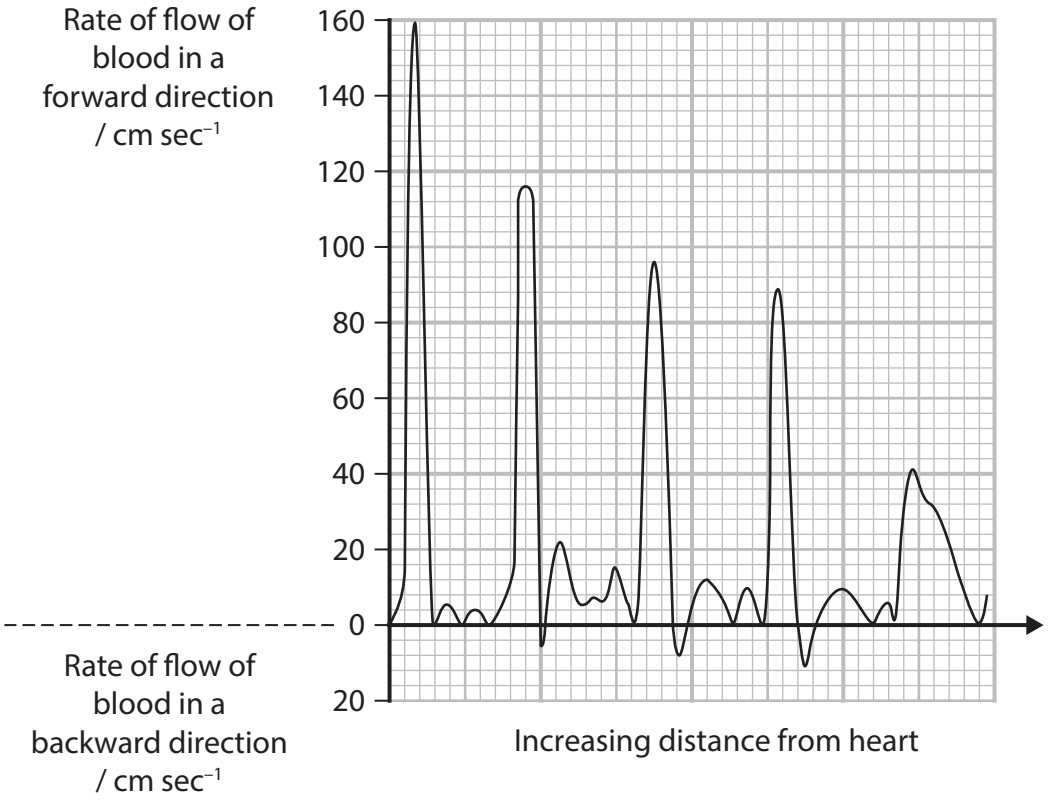
(c) The graph shows the rate of flow of blood through the aorta of a dog with increasing distance from the heart.



Explain the changes in rate and direction of flow of blood through this aorta.

Use the information in the graph to support your answer.

(3)

(Total for Question 4 = 9 marks)

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5 Warfarin is used as an anticoagulant to treat some patients.

Patients respond differently to this drug. This makes it difficult for doctors to select a safe but effective dose of warfarin to give to each patient.

Factors that affect the response of a patient to warfarin include age, body mass, liver function and genetic makeup.

(a) Explain why a safe but effective dose of warfarin needs to be given to a patient.

(2)

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(b) There are two genes that code for proteins that affect warfarin and the blood clotting process.

Gene M:

- codes for enzyme M that breaks down warfarin into inactive molecules
- has many alleles and two of these code for much slower breakdown of warfarin.

Gene V:

- codes for enzyme V that converts vitamin K into an active form that triggers the blood clotting process
- one version of this gene results in a decreased production of the messenger RNA (mRNA) needed for the synthesis of enzyme V.

(i) Describe the role of mRNA in the production of enzymes.

(2)

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*(ii) Pharmacogenomics analyses the genetic profile of individuals.

This analysis is used to determine the appropriate doses of a drug for individual patients.

Discuss the possible use of pharmacogenomics in selecting appropriate doses of warfarin for individual patients.

Use the information in the question and your own knowledge of the blood clotting process and genetic screening to support your answer.

(6)

(Total for Question 5 = 10 marks)

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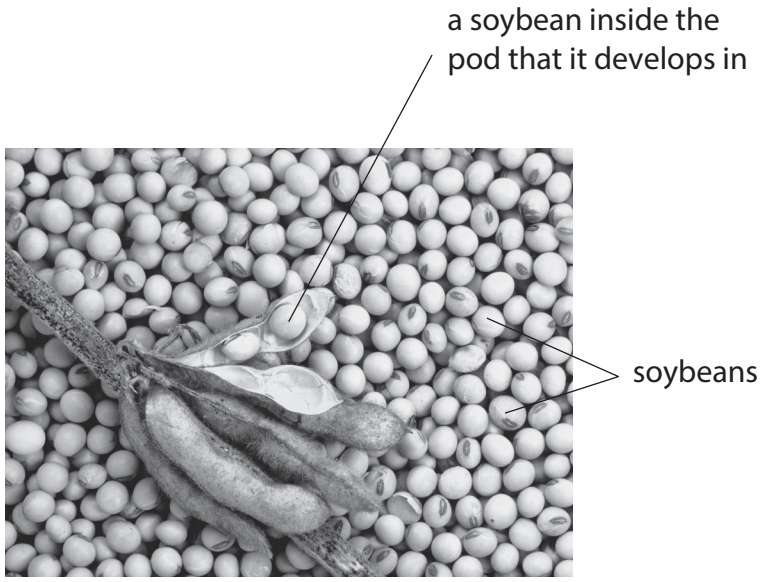
6 The photograph shows some soybeans.



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(a) Eating soybeans may reduce cholesterol and low-density lipoproteins (LDLs) in the blood.

Explain why eating soybeans may reduce the risk of heart disease.

(3)

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(b) The extent to which soybeans reduce cholesterol depends on the variety of soybeans. This reduction is influenced by two proteins found in soybeans, glycinin and β-conglycinin.

Give **two** ways that the primary structure of two proteins could differ from each other.

(1)

1 .....

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2 .....

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(c) The effect of soybean extracts on cholesterol production by liver cells growing in culture was investigated.

Scientists produced fat-free soybean flour and digested it with enzymes, in a way that copied digestion in the human digestive system.

The diagram shows some of the steps used.

Step 1 (mouth): soybean flour mixed with saliva to form a moist ball of flour

↓

Step 2 (stomach): ball of flour from step 1 incubated with stomach enzymes at 37°C for 2 hours

↓

Step 3 (intestines): suspension from step 2 incubated with enzymes from the pancreas at 37°C for 2 hours

↓

Step 4 (end of process): suspension from step 3 heated for 5 minutes at 100°C

↓

Step 5: heated suspension from step 4 used to make an extract containing soybean peptides.

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(i) Explain why the scientists used digested soybeans to make the extract for this investigation.

(2)

(ii) Suggest why the soybean flour was incubated with different enzymes in steps 2 and 3.

(1)

(iii) Explain why the soybean flour and enzymes were incubated at 37 °C for 2 hours in steps 2 and 3.

(2)

37 °C

2 hours

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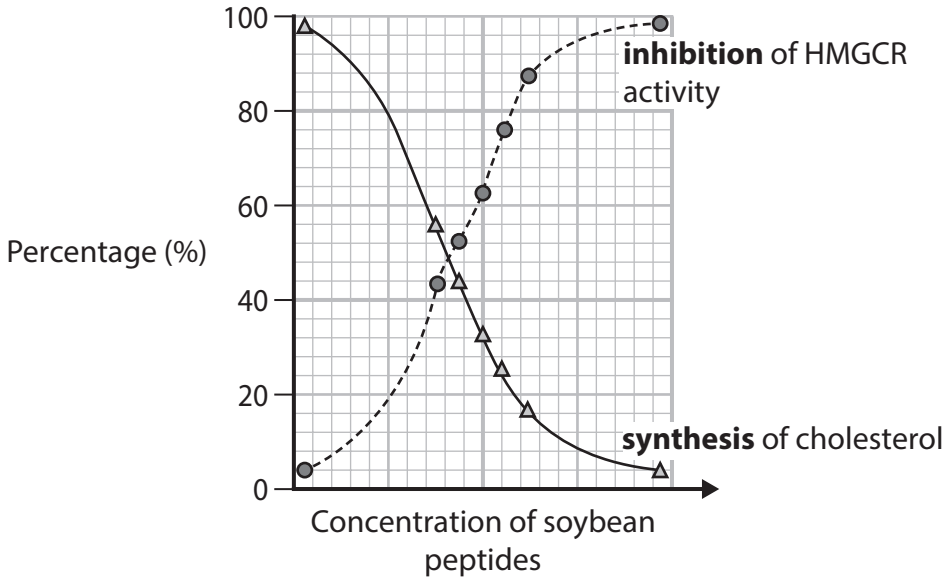
(d) The soybean peptides, at different concentrations, were incubated with the liver cells growing in culture.

The enzyme HMGCR is involved in the synthesis of cholesterol.

The effect of soybean peptides on the activity of this enzyme and the synthesis of cholesterol was measured.

The graph shows the results.



Explain why eating soybeans may reduce cholesterol levels in the blood.

Use the information in the graph to support your answer.

(3)

(Total for Question 6 = 12 marks)

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QUESTION 7 BEGINS ON THE NEXT PAGE.

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7 Scientists investigated the numbers and types of mutations in different species of animal.

Samples of tissue were collected from living animals of each species and the types of mutation determined.

(a) The types of mutation were classed as either substitution mutations or insertion and deletion mutations.

The table shows the results of this investigation.

Species of animal	Number of animals sampled	Range of number of mutations per cell	
		Substitution	Insertion and deletion
Naked mole rat	3	100 to 850	10 to 50
Mouse	10	300 to 2 000	50 to 400
Dog	3	1 000 to 3 000	50 to 300
Human	8	200 to 350	10 to 200

(i) Describe how these types of mutation affect the **DNA base sequence** of a gene.

(2)

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(ii) Explain why these animals can survive with a greater number of substitution mutations than insertion and deletion mutations.

(4)

(iii) Suggest which set of data is the most valid.

Give a reason for your answer.

(1)

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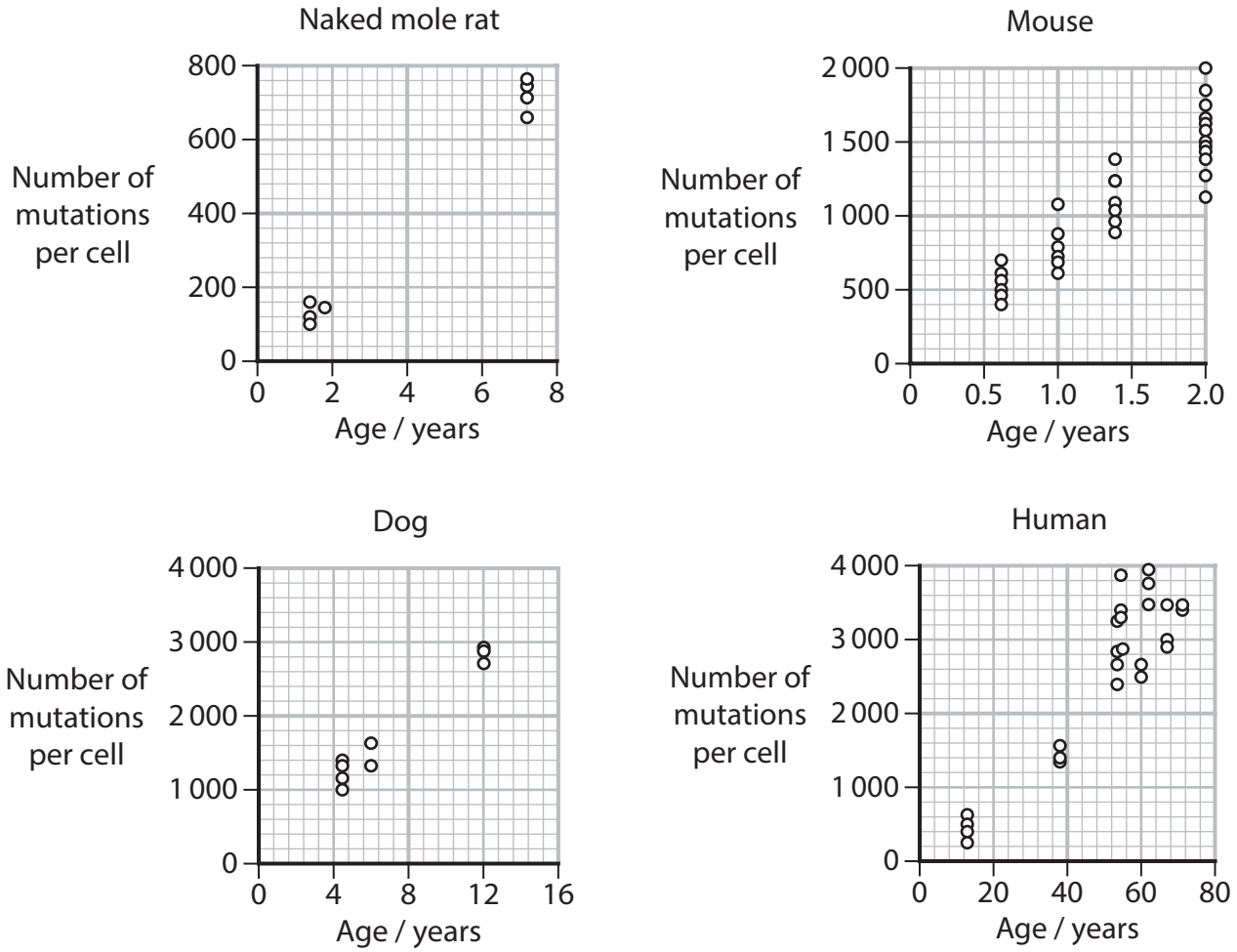
(b) The graphs show the number of mutations per cell during the lifespans of these four animals.



(i) Calculate the mean mutation rate for the mouse.

Draw a line of best fit onto the graph to help you.

(2)

Answer ..... number of mutations per cell year^{-1}

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(ii) Describe **three** conclusions that can be made from these graphs.

(3)

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3 .....

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(iii) Suggest **two** reasons for the differences in the number of mutations per cell of these species of animal.

(2)

1 .....

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2 .....

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(Total for Question 7 = 14 marks)

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8 The photograph shows two avocados.



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(a) Avocados are high in unsaturated fatty acids and low in saturated fatty acids.

Compare and contrast the structure of an unsaturated fatty acid and the structure of a saturated fatty acid.

(3)

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(b) The effect of eating avocados each week on the risk of coronary heart disease (CHD) was investigated.

A group of men and women who had no signs of cardiovascular disease (CVD) or stroke were selected. They were all between the ages of 30 and 75.

The group ate avocados each week to replace animal products in their diet whenever possible.

The group all completed a questionnaire about the food they ate at the start of the investigation and every four years after that for over 30 years.

(i) There were 41 701 men and 68 786 women in the group.

Which is the ratio of men to women?

(1)

☒ **A** 0.6 : 1

☒ **B** 1 : 0.6

☒ **C** 1 : 2

☒ **D** 2 : 1

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*(ii) Describe the questions that need to be in the questionnaire so that appropriate information can be gathered for this investigation.

Give reasons for choosing these questions.

(6)

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(iii) Comment on the validity of the methods used in this investigation.

(4)

(Total for Question 8 = 14 marks)

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