OXFORD
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AQA EXAMINATIONS

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

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INTERNATIONAL AS
BIOLOGY (9610)

Unit 2 Biological systems and disease

Wednesday 16 May 2018 07:00 GMT Time allowed: 1 hour 30 minutes

Materials
For this paper you must have:
- A ruler with millimetre measurements
- A scientific calculator, which you are expected to use where appropriate.

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- All working must be shown.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 75.

For Examiner's Use	
Question	Mark
1	
2	
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4	
5	
6	
7	
8	
TOTAL	

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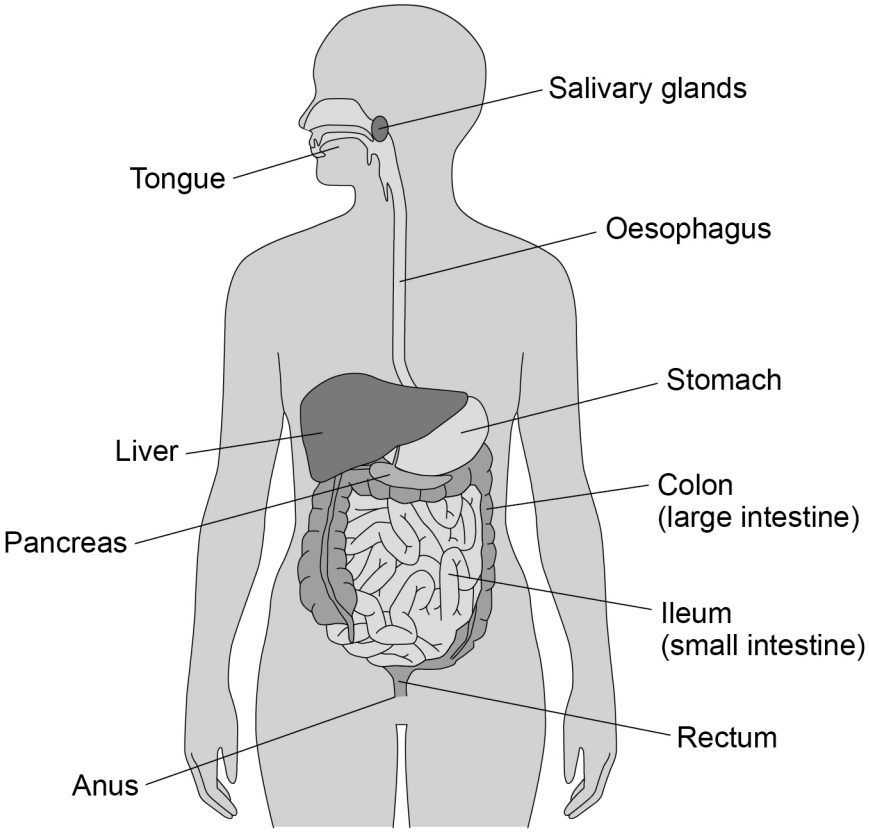
Answer **all** questions in the spaces provided.

0 1 Amylase is a digestive enzyme.

Figure 1 shows the human digestive system.

Figure 1



0 1 . 1 Name **two** organs that produce the enzyme amylase.

[1 mark]

1 _____

2 _____

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0 1 . 2 A student carries out an experiment to investigate the action of amylase on starch. Bread contains starch.

Volunteers chew a small piece of bread for 30 seconds. The chewed bread mixed with saliva is collected into a test tube. As a control, a piece of bread is also blended with distilled water and put in a test tube. Both test tubes are heated with Benedict's reagent.

The results are shown in **Table 1**.

Table 1

	Colour after heating with Benedict's reagent
Bread in saliva	Brick red
Bread in distilled water	Pale blue

The student concludes that starch must be directly broken down into glucose by salivary amylase.

Evaluate this conclusion.

[3 marks]

Do not write outside the box

0 1 . 3 Absorption occurs in the ileum.

Give **three** ways in which the walls of the ileum are adapted for absorption of glucose.
[3 marks]

1 _____

_____

_____

2 _____

_____

_____

3 _____

_____

_____

7

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Turn over for the next question

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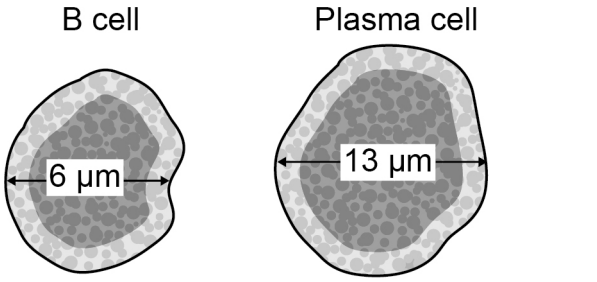
0 2 B cells are white blood cells. Once activated they can develop into plasma cells which produce large numbers of antibodies. Plasma cells are larger than the original B cells they are derived from.

Figure 2 shows a B cell and a plasma cell.

Figure 2



not to scale

0 2 . 1 Calculate the ratio of the volume of the plasma cell to the volume of the B cell in **Figure 2**. Assume that both cell types are spheres.

Volume of a sphere = $\frac{4}{3}\pi r^3$

[2 marks]

Ratio = _____

0 2 . 2 Give **one** way that antibodies cause the destruction of bacterial cells.

[1 mark]

_____

_____

_____

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Patients with common variable immunodeficiency (CVID) suffer from recurrent infections. One of the causes of CVID is a reduced number of plasma cells resulting in low antibody production.

Diagnosis of CVID can be difficult. One way is to measure the number of antibodies a patient produces in response to a vaccination. This value is compared with the minimum amount of antibody needed to provide immunity.

0 2 . 3 Define the term 'vaccination'.

[1 mark]

0 2 . 4 **Table 2** shows information about two different vaccines.

Table 2

	Tetanus vaccine	**BCG vaccine**
Vaccine contains	Cell-free purified toxin	Live, weakened bacteria

Not all vaccines are suitable for use in CVID diagnosis.

Suggest why the BCG vaccine is unsuitable for CVID diagnosis testing.
Use information in **Table 2**.

[1 mark]

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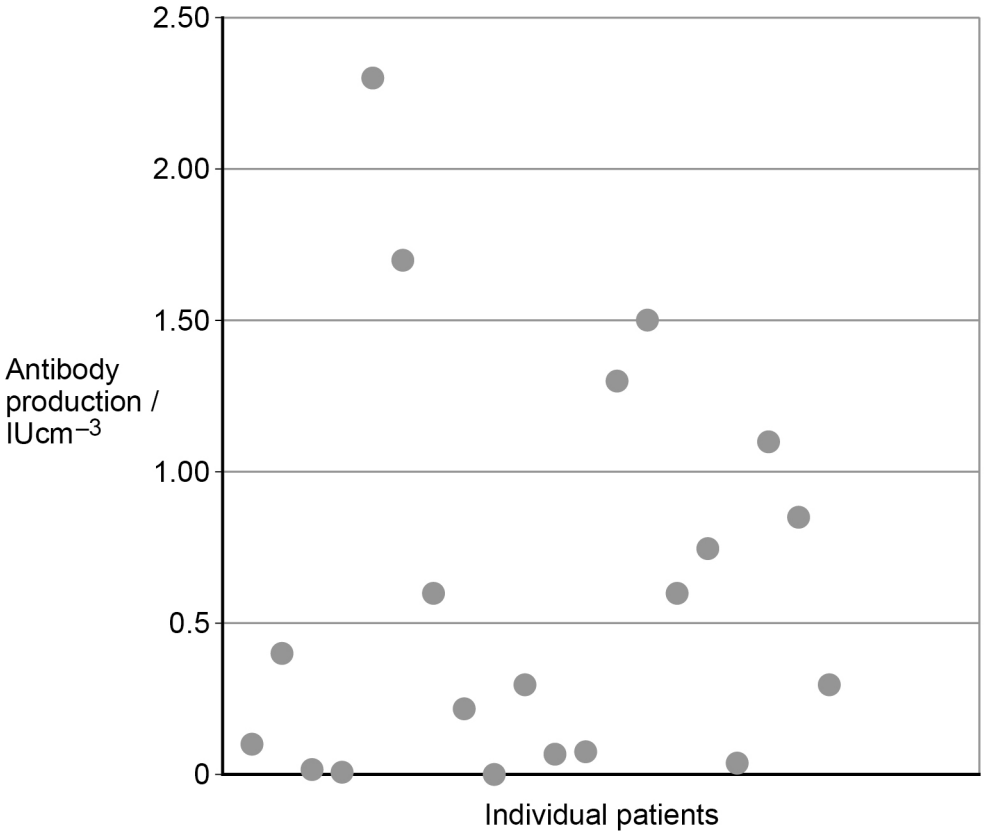
Twenty patients with suspected CVID were injected with the same batch of tetanus vaccine.

The minimum amount of antibody needed to provide immunity against tetanus is 1.0 $IUcm^{-3}$.

After three days, a sample was taken to measure the antibody levels in their blood. The results are shown in **Figure 3**. Each spot represents the antibody level in the blood of one patient.

Figure 3



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0 2 . 5 A student concluded that five of the patients did not have CVID.

Evaluate this conclusion.

[5 marks]

10

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0 3 Oral rehydration solution (ORS) is an effective treatment for the dehydration caused by cholera and other diarrhoeal diseases.

0 3 . 1 Name **two** substances that are dissolved in water to form an oral rehydration solution.

[2 marks]

1 _____

2 _____

Although standard ORS is effective there is ongoing research to try to improve it. Scientists investigated the addition of soluble fibre to standard ORS using a large sample of malnourished children who had watery diarrhoea.

The children were treated with either standard ORS (control) or standard ORS plus soluble fibre PHGG (study).

The mean duration (**Figure 4**) and mean mass of watery diarrhoea (**Figure 5**) were measured. Standard deviation bars are shown on the graphs.

Figure 4

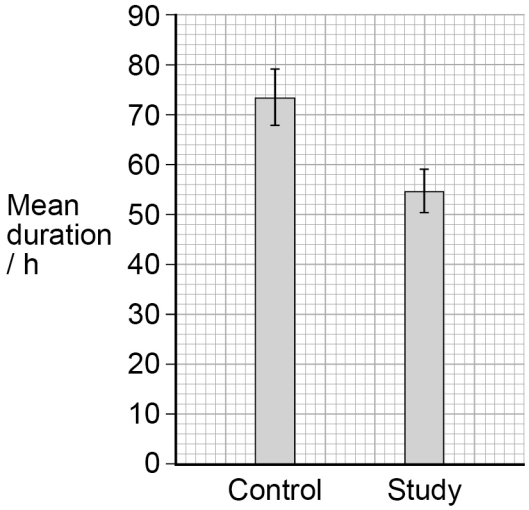
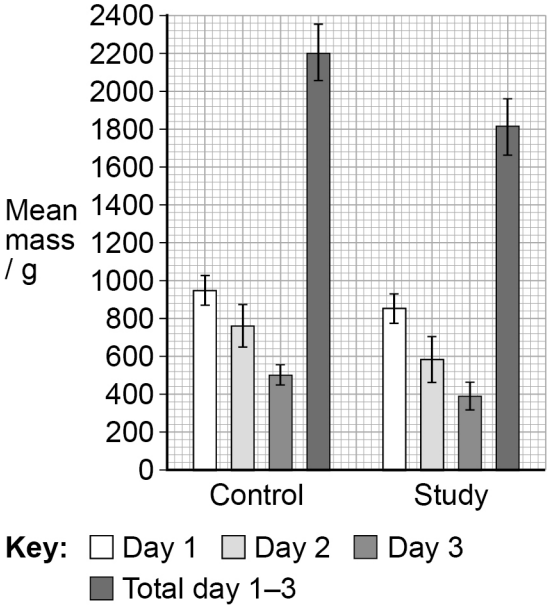


Figure 5



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0 3 . 2 Describe the data in **Figure 4** and **Figure 5**.

[4 marks]

0 3 . 3 Soluble fibre increases sodium ion uptake in the large intestine (colon).

Explain how this would help reduce watery diarrhoea.

[2 marks]

0 3 . 4 The control group was given standard ORS instead of pure water.

Suggest **one** ethical reason why.

[1 mark]

9

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0 4 Prokaryotic cells divide by binary fission. Eukaryotic cells divide by mitosis.

0 4 . 1 Complete the table to compare these two processes.

Put a tick (✓) if the statement is true **or** a cross (**X**) if it is untrue.

[2 marks]

	Binary fission	**Mitosis**
Genetically identical cells are produced		
Nuclear membrane breaks down		
Chromosomes are arranged on the spindle		

0 4 . 2 During interphase of the cell cycle, DNA is replicated.

A mutation may occur spontaneously during DNA replication.

What is a mutation?

[1 mark]

_____

_____

_____

Do not write outside the box

0 4 . 3 Mutation is one way that bacteria can gain antibiotic resistance. Another way is by conjugation.

Which statement best describes conjugation?

[1 mark]

Tick (✓) **one** box.

- Asexual reproduction ☐
- Horizontal and vertical gene transmission ☐
- Horizontal gene transmission ☐
- Vertical gene transmission ☐

0 4 . 4 The rate of mutation in *E.coli* bacteria is 1×10^{-3} per generation.

The generation time is 30 minutes.

The conjugation rate is 10^5 times faster than the rate of mutation.

Calculate the conjugation rate per minute.
Give your answer to 2 significant figures.

[2 marks]

Answer = _____ per minute

Do not write outside the box

0 4 . 5 The spread of antibiotic resistance in bacteria is a concern. Bacteriophage M13 could be used to reduce this spread. Bacteriophage M13 is a virus that infects bacterial cells and produces large amounts of a protein called g3p. This protein builds up and blocks tubes in the infected bacteria.

Evaluate the use of bacteriophage M13 to prevent the spread of antibiotic resistance. Use the information and your own knowledge.

[3 marks]

9

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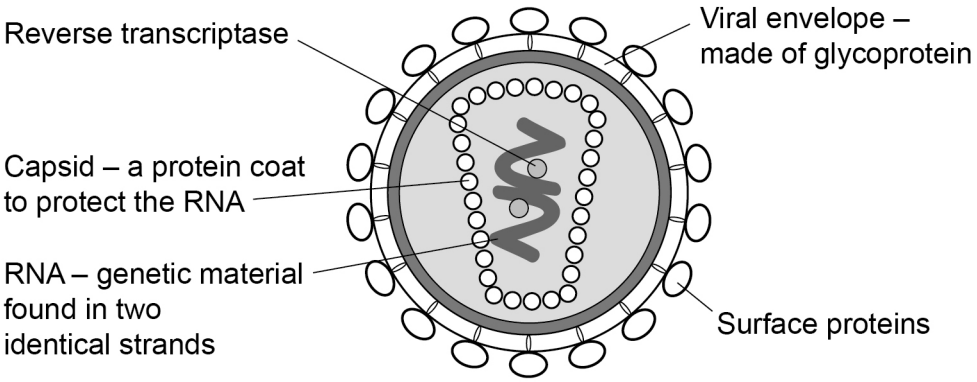
0 5 **Figure 6** shows the structure of the HIV virus.

Figure 6



0 5 . 1 HIV is described as a retrovirus.

Give the reason why.

[1 mark]

_____

_____

_____

0 5 . 2 Describe the function of the surface proteins.

[1 mark]

_____

_____

_____

0 5 . 3 Which type of white blood cell has CD4 receptors on its cell membrane?

[1 mark]

_____

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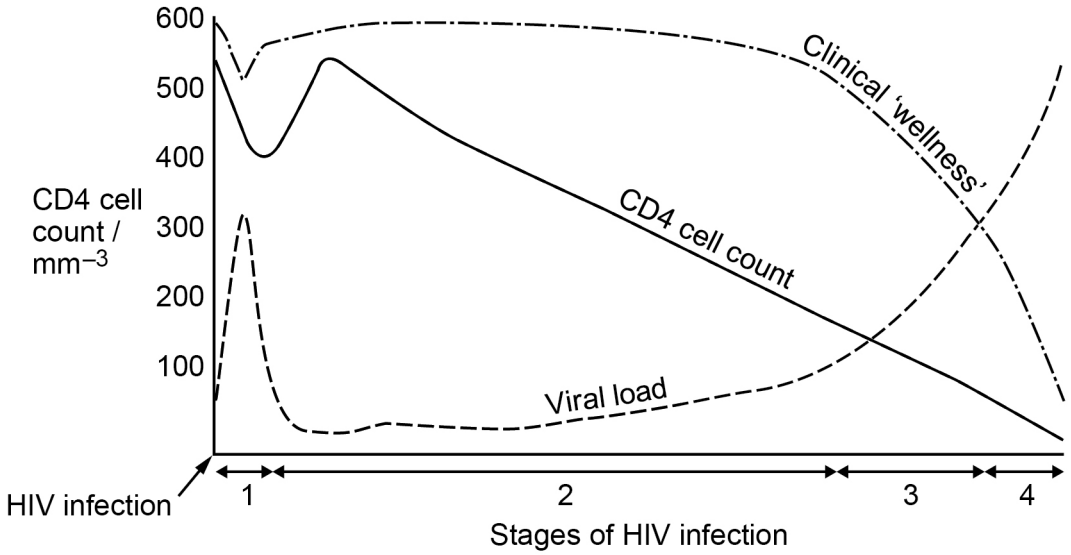
Figure 7 shows typical progress of an HIV infection. Clinical wellness and viral load are in arbitrary units.

Figure 7



0 5 . 4 Describe the effect of HIV on the CD4 cell count through stages 1–2. Use the data in **Figure 7**.

[2 marks]

Do not write outside the box

0 5 . 5 Clinical wellness is a measure of AIDS symptoms.

Explain how HIV reduces the clinical wellness value during stages 3 and 4 in **Figure 7**.

[3 marks]

8

Turn over for the next question

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0 6 A student investigates the effect of caffeine on heart rate on a group of students using the following procedure:

1. Counts the pulse rate, by pressing two fingers against an artery and records the number of beats per minute.
2. Drinks a can of caffeinated soft drink as quickly as possible.
3. Records the pulse rate immediately.
4. 5 minutes after drinking the soft drink, measures the pulse rate again.
5. Continues to measure pulse every 2 minutes for 35 minutes.

0 6 . 1 The experiment was carried out on a group of 20 students.

Give **three** control variables that should have been considered.

[3 marks]

1 _____

2 _____

3 _____

0 6 . 2 The experiment was repeated after two hours with a control drink.

State the composition of this control drink.

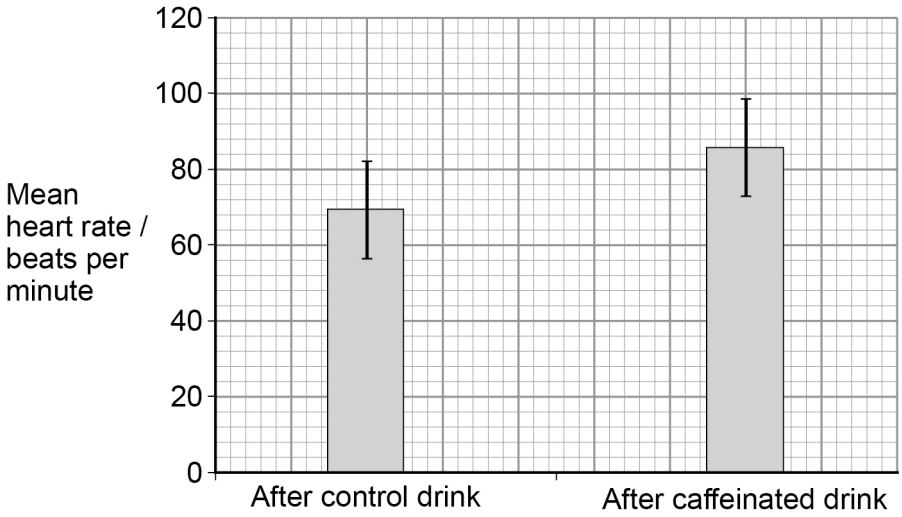
[1 mark]

_____

The mean heart rate after 20 minutes was calculated.

Figure 8 shows the results. The lines on the bars represent standard deviations.

Figure 8



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0 6 . 3 What can you conclude about the effect of caffeine on heart rate?

[3 marks]

7

Turn over for the next question

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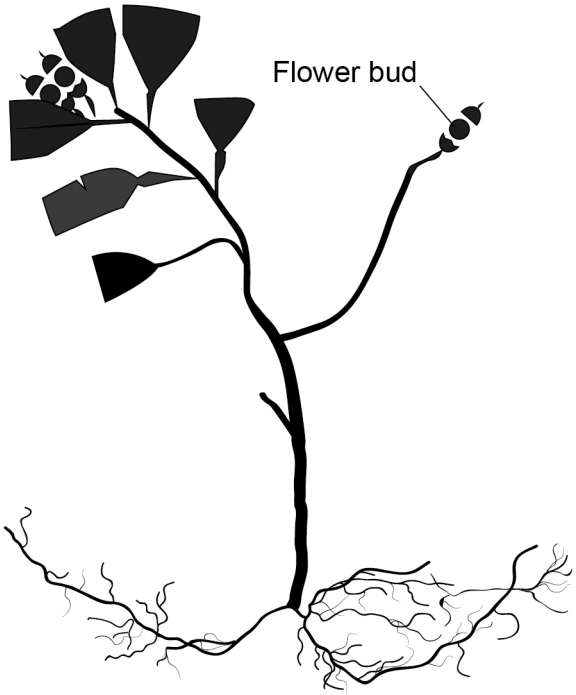
0 7 Radioactive tracers have been used for investigating transport of sugars in plants.

Figure 9 shows a plant. The leaves labelled **A** were provided with radioactive carbon dioxide ($^{14}CO_2$) to be used in photosynthesis.

Figure 10 is an autoradiograph image produced by pressing the plant against photographic film one day after the radioactive carbon dioxide was supplied to the plant. Areas which contain radioactive substances appear dark.

Figure 9

Figure 10



0 7 . 1 Name **one** radioactive organic substance which causes the dark areas in **Figure 10**.

[1 mark]

_____

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0 7 . 2 Describe the distribution of radioactive organic substances in **Figure 10**.

[3 marks]

0 7 . 3 Explain the pattern of radioactive organic substances in **Figure 10**.

[3 marks]

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0 7 . 4 Aphids are insects with mouthparts called stylets. They feed by inserting the stylets into phloem sieve tubes. Once the vessel is punctured, sap enters the aphid's gut under pressure.

Explain how this pressure is generated in the phloem sieve tubes.

[3 marks]

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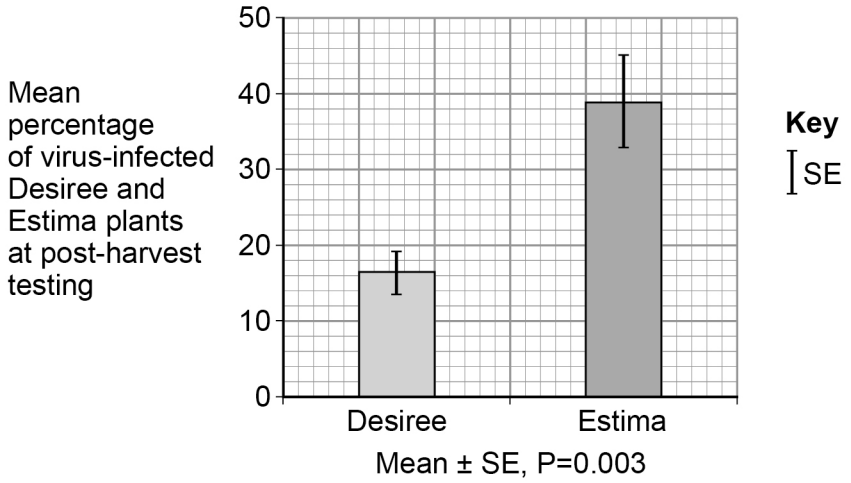
Aphids act as vectors for many plant viruses.

Figure 11 shows the percentage of two varieties of potato plants, Desiree and Estima, infected with a virus.

The figure shows the means from four years' data.

Figure 11



0 7 . 5 State why standard error and 95% confidence limits would be the most appropriate statistical test for this investigation.

[1 mark]

0 7 . 6 The P-value obtained from the statistical analysis was 0.003 (0.3%).

Explain what this shows.
Use the terms probability and chance in your answer.

[2 marks]

13

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0 8 During exercise, the blood supply to the skeletal muscles is increased.

0 8 . 1 Give the equation which links cardiac output, stroke volume and heart rate.

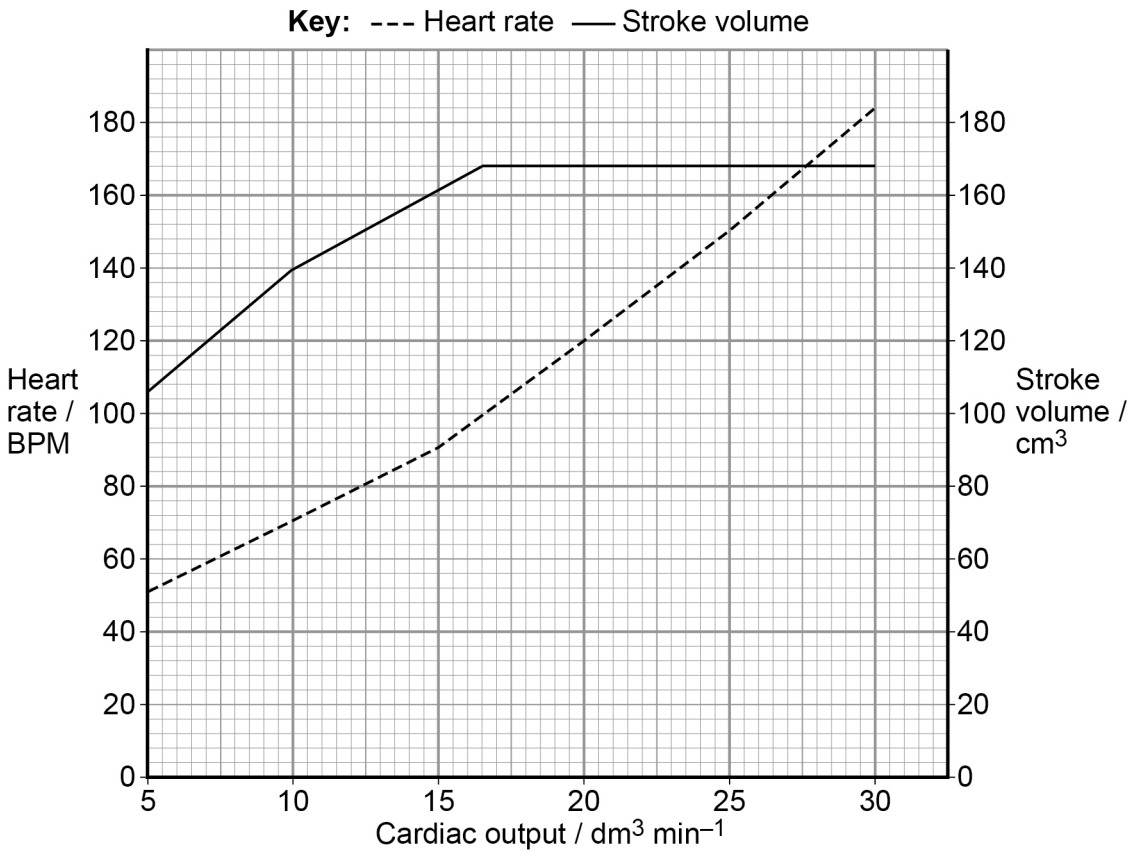
[1 mark]

_____

_____

Figure 12 shows the effect of exercise on cardiac output, stroke volume and heart rate for an athlete.

Figure 12



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0 8 . 2 Use information from **Figure 12** to explain how stroke volume and heart rate can produce a cardiac output of approximately 20 dm^3 min^{-1}.

[2 marks]

Question 8 continues on the next page

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0 8 . 3 Describe the events in the cardiac cycle.

Include in your answer references to:

- pressure and volume changes
- role of the heart valves.

[6 marks]

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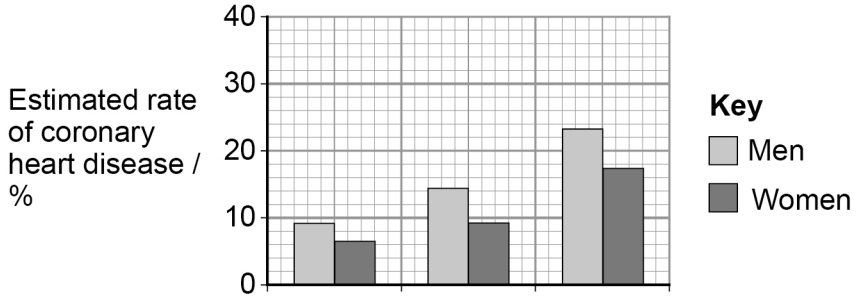
Figure 13 shows the rate of coronary heart disease according to various risk factors.

Figure 13

Coronary heart disease rate according to various combinations of risk factors over 10 years



Maximum blood pressure / mm Hg	120	160	160
Cholesterol / mg dm^{-3}	220	220	259
HDL cholesterol / mg dm^{-3}	50	50	35

Risk factors

0 8 . 4 Describe and explain the rate of coronary heart disease in people who have:

- a maximum blood pressure of 160 mm Hg
- and a cholesterol concentration of 259 mg dm^{-3}
- and a HDL concentration of 35 mg dm^{-3}

[3 marks]

12

END OF QUESTIONS

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