1 Read the passage below. Use the information in the passage and your own knowledge to answer the questions that follow.

Glucose control

Many years ago some scientists wanted to find out more about the role of the pancreas in digestion. They used surgery to remove the pancreas from dogs to see what would happen. During this investigation a laboratory assistant noticed that flies collected around the dogs' urine. This urine was later found to contain large amounts of glucose. Urine from dogs with a pancreas does not contain glucose.

Another scientist used string to tie a knot around the pancreatic duct of rabbits, which closed the duct. This meant that no pancreatic enzymes could reach the small intestine. It was noticed that when this was done, the cells in the pancreas that made enzymes died, but no glucose appeared in the rabbit urine.

Other scientists made pancreas extract by crushing up a pancreas in water. They injected this extract into dogs that had their pancreas removed. They found that the blood glucose level in these dogs was much reduced.

These investigations and observations suggest that the pancreas has two different functions. Some of the cells produce enzymes needed for digestion. Other parts of the pancreas are not involved in digestion but are important in controlling blood glucose levels.

We now know that pancreas extract contains two hormones involved with the regulation of blood glucose levels – insulin and glucagon. High blood glucose levels are detected by the pancreas. This stimulates the pancreas to release insulin. The role of insulin is to lower blood glucose levels. The insulin is released from specialised cells directly into the blood. The insulin travels in the blood to target cells that are in the liver and in large muscles. Insulin causes these cells to absorb glucose and use it to make an insoluble storage carbohydrate called glycogen.

The second hormone called glucagon is released by different cells in the pancreas when the blood glucose level falls too low. Glucagon causes liver and muscle cells to change glycogen into soluble glucose.

(a) Explain what is meant by the term **digestion** (line 2).

(2)

(b) Explain why dogs that had their pancreas removed produced urine that contained glucose (lines 4 and 5).

(3)

(c) Name two enzymes produced by cells in the pancreas (lines 8 and 9).

(2)

1 .....

2 .....

(d) Suggest why rabbits that have had their pancreatic duct tied can still regulate their blood glucose levels (lines 10 and 11).

(1)

(e) The scientists who injected pancreas extract into dogs should have carried out a control experiment (line 13).

Explain the control experiment they should have carried out.

(2)

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(f) Name the blood vessel that transports hormones into the liver (line 24).

(1)

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(g) Suggest one advantage of storing glycogen in cells rather than storing glucose in cells (lines 25 and 26).

(1)

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(h) A number of different substances and structures are involved in the control of blood glucose.

(i) Describe the stimulus.

(1)

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(ii) Name the structure that acts as a receptor.

(1)

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(iii) Name a structure that acts as an effector.

(1)

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(iv) Describe the response.

(1)

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(Total for Question = 16 marks)

2 The table shows the results of an investigation into the rate of sweating of a person when resting or running at different air temperatures.

Air temperature in °C	Relative rate of sweating in arbitrary units	
	when resting	when running
31.5	2	3
32.0	2	5
33.0	2	8
34.5	4	17
35.0	5	20
36.0	8	34

(a) Suggest why the investigation was carried out with the same person resting and running.

(1)

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(b) Compare the effect of increasing air temperature on sweat production when resting and when running.

(3)

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(c) Suggest why the rate of sweating changes when a person does exercise, such as running.

(4)

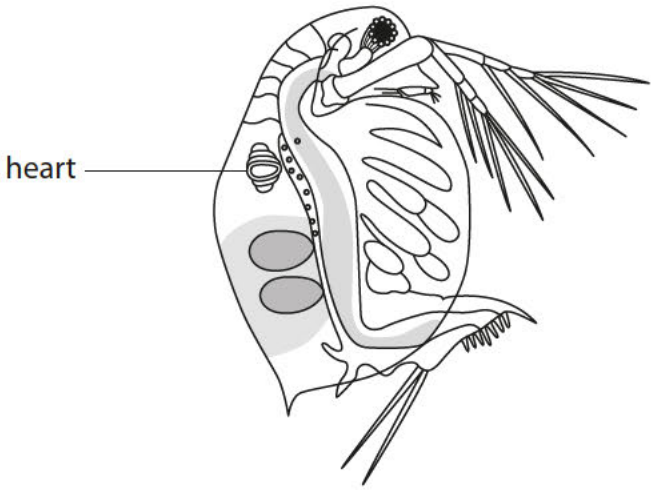
(d) Suggest a method that you could use to measure the rate of sweating.

(3)

(Total for Question = 11 marks)

3 A student wanted to investigate the effect of the drug caffeine on heart rate. She decided to look at the effect by using a small water animal called *Daphnia*.

Daphnia



- She put a *Daphnia* on a microscope slide in a drop of water.
- She looked at the *Daphnia* under low power and counted the number of heartbeats in 15 seconds.
- She did this for 10 *Daphnia*.
- She then repeated the method for 10 *Daphnia* in a caffeine solution.

Her results are shown in the table.

Daphnia	**Heartbeats in 15 seconds**	
	Water	**Caffeine solution**
1	23	36
2	27	37
3	25	29
4	24	40
5	23	38
6	25	37
7	26	39
8	23	36
9	26	39
10	23	28

(a) (i) Name the dependent variable in this investigation.

(1)

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(ii) Name a variable that the student should control in her experiment.

(1)

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(iii) Suggest why the student counted the heartbeats in 15 seconds rather than a minute.

(1)

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(b) Describe the effect of caffeine on *Daphnia* heart rate.

(1)

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(c) Are the student's results reliable?

Give a reason for your answer.

(1)

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(d) Caffeine causes the same change in human heart rate as it does in *Daphnia*.

In humans this is because caffeine stimulates the release of a hormone.

Name this hormone.

(1)

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(Total for Question = 6 marks)

4 An investigation was carried out to find out the effect of fear on human heart rate.

Ten students measured their heart rate under normal conditions. The students were then given a fright and asked to measure their heart rate again.

The table shows their results.

Student number	Heart rate in beats per minute	
	Normal conditions	When frightened
1	70	80
2	65	85
3	59	66
4	66	75
5	57	66
6	60	68
7	63	67
8	72	72
9	62	74
10	70	77

(a) (i) Identify the student whose result was anomalous.

(1)

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(ii) Describe and explain the results of this investigation.

(2)

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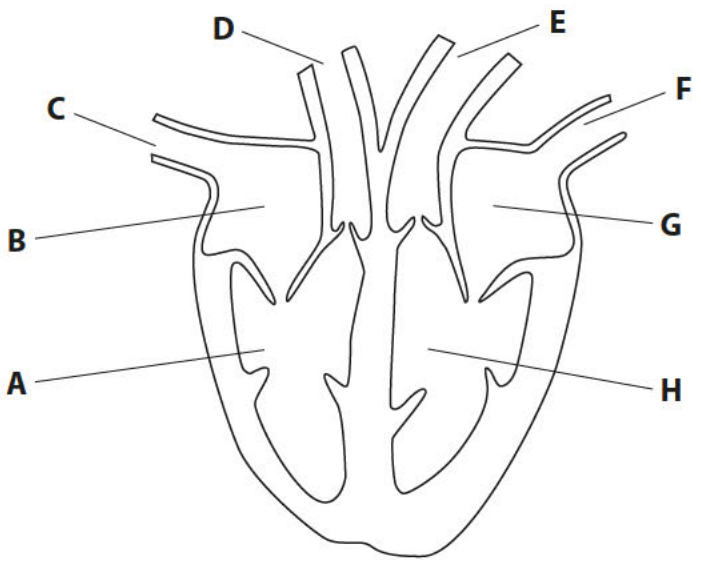
(iii) State, with a reason, whether the results of this investigation are reliable.

(1)

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(b) The diagram shows the human heart with four chambers and four blood vessels labelled **A** to **H**.



Complete the table by writing in the label letter that matches the description of the structure.
The first one has been done for you.

(4)

Structure	Labe letter
the right atrium	**B**
the chamber that pumps blood to the lungs	
the chamber with the thickest muscle wall	
the blood vessel containing blood at the highest pressure	
the blood vessel carrying blood with the least oxygen to the heart	

(Total for Question = 8 marks)