

**1** One factor that may affect body mass is *metabolic rate*.

(a) (i) What is meant by *metabolic rate* ?

---

---

**(1)**

(ii) Metabolic rate is affected by the amount of activity a person does.

Give **two** other factors that may affect a person's metabolic rate.

1. \_\_\_\_\_

---

2. \_\_\_\_\_

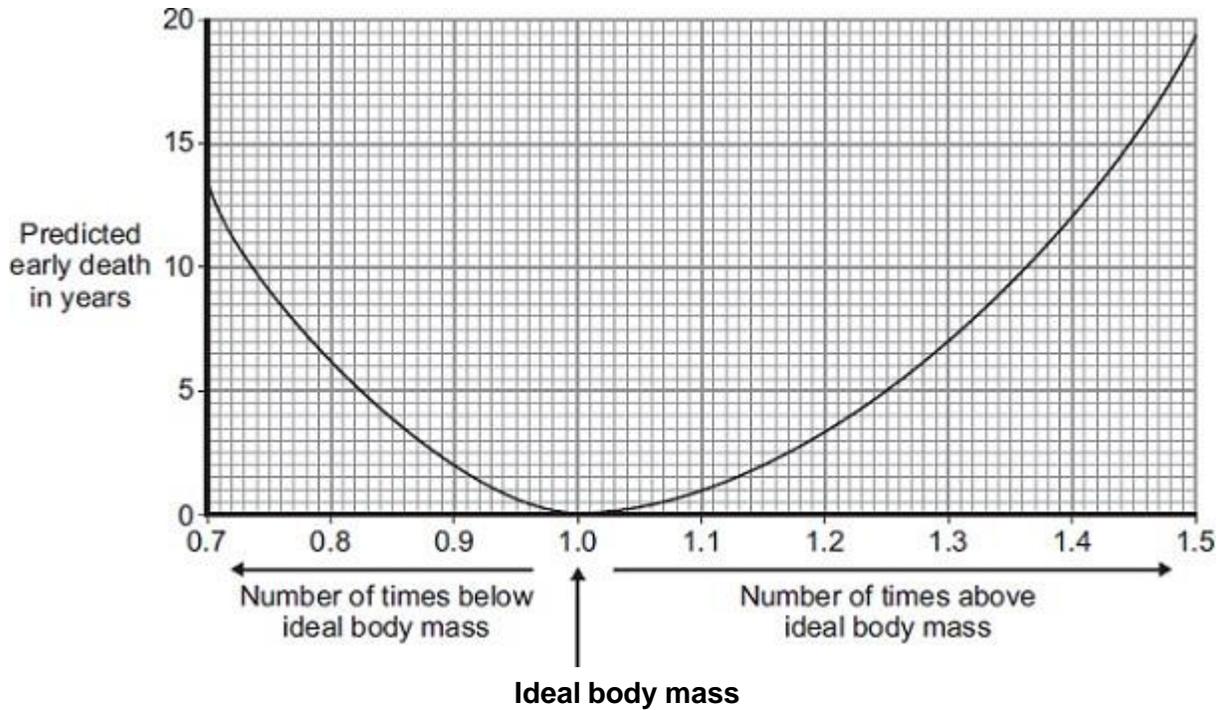
---

**(2)**

- (b) Predicted early death is the number of years that a person will die before the mean age of death for the whole population. The predicted early death of a person is affected by their body mass.

Scientists have calculated the effect of body mass on predicted early death.

The graph shows the results of the scientists' calculations.



The number of times above or below ideal body mass is given by the equation:

$$\frac{\text{Actual body mass}}{\text{Ideal body mass}}$$

In the UK the mean age of death for women is 82.

A woman has a body mass of 70 kg. The woman's ideal body mass is 56 kg.

- (i) Use the information from the graph to predict the age of this woman when she dies.

---



---



---

Age at death = \_\_\_\_\_ years

(2)

(ii) The woman could live longer by changing her lifestyle.

Give **two** changes she should make.

1. \_\_\_\_\_

\_\_\_\_\_

2. \_\_\_\_\_

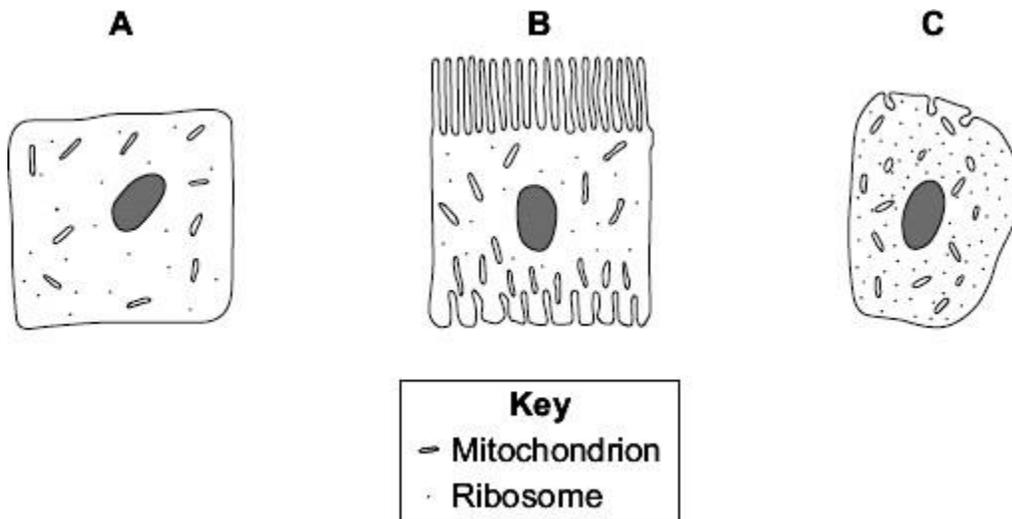
\_\_\_\_\_

(2)

(Total 7 marks)

2

Diagrams **A**, **B** and **C** show cells from different parts of the human body, all drawn to the same scale.



(a) Which cell, **A**, **B** or **C**, appears to have adaptations to increase diffusion into or out

of the cell?

Give **one** reason for your choice.

\_\_\_\_\_

\_\_\_\_\_

(1)

(b) (i) Cell **C** is found in the pancreas.

Name **one** useful substance produced by the pancreas.

\_\_\_\_\_

(1)

- (ii) Use information from the diagram to explain how cell **C** is adapted for producing this substance.

---

---

---

---

(2)

(Total 4 marks)

**3**

In diabetics blood glucose concentrations are sometimes abnormal.

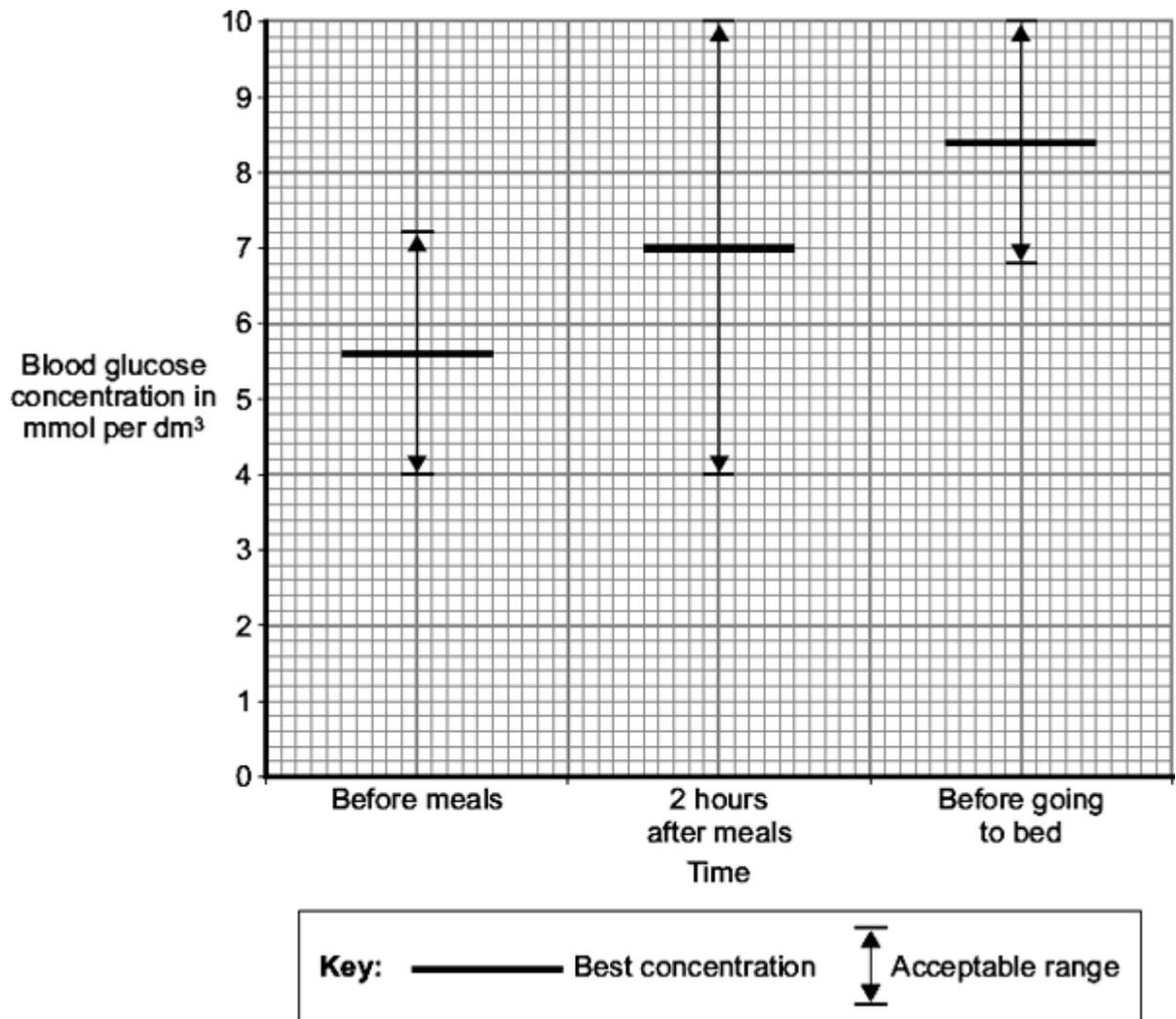
- (a) Name the organ that monitors the concentration of glucose in the blood.

---

(1)

(b) Diabetics can measure their blood glucose concentration.

The graph shows the best blood glucose concentration and the acceptable range of blood glucose concentration at different times.



What is the acceptable range for the blood glucose concentration before meals?

From \_\_\_\_\_ to \_\_\_\_\_ mmol per dm<sup>3</sup>

(1)

- (c) The amount of insulin a diabetic injects can be changed so that blood glucose concentration is kept near to the best level.

Two hours after eating breakfast a diabetic measures his blood glucose concentration. His blood glucose concentration is 13 mmol per dm<sup>3</sup>.

He reads these instructions:

- for every 2 mmol per dm<sup>3</sup> of blood glucose *above* the best concentration, inject 1 unit *more* of insulin
- for every 2 mmol per dm<sup>3</sup> of blood glucose *below* the best concentration, inject 1 unit *less* of insulin.

How should he change his normal insulin injection to bring his blood glucose level to the best concentration?

Show clearly how you work out your answer.

---

---

---

---

---

---

---

---

---

---

Answer = \_\_\_\_\_

(3)

(Total 5 marks)

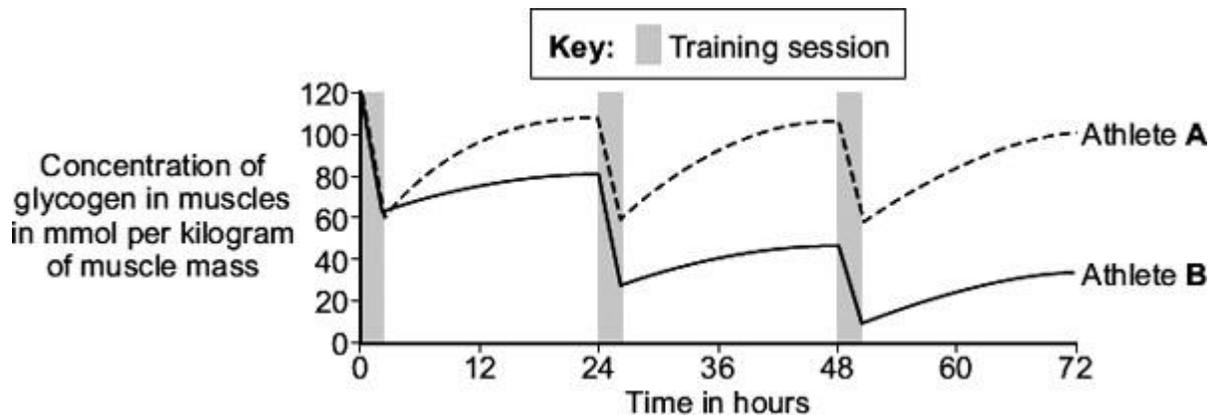
**4** Glycogen is stored in the muscles.

Scientists investigated changes in the amount of glycogen stored in the muscles of two 20-year-old male athletes, **A** and **B**.

Athlete **A** ate a high-carbohydrate diet. Athlete **B** ate a low-carbohydrate diet.

Each athlete did one 2-hour training session each day.

The graph shows the results for the first 3 days.



(a) (i) Give **three** variables that the scientists controlled in this investigation.

---

---

---

---

---

---

---

(3)

(ii) Suggest **two** variables that would be difficult to control in this investigation.

---

---

---

---

(2)

(iii) Describe **one** way in which the results of Athlete **B** were different from the results of Athlete **A**.

---

---

(1)

(b) Both athletes were training to run a marathon.

Which athlete, **A** or **B**, would be more likely to complete the marathon?

Use information from the graph to explain your answer.

---

---

---

---

---

---

---

---

---

---

(4)

(Total 10 marks)

**5**

It is important that the concentration of glucose (sugar) in the blood is controlled.

(a) (i) Which hormone controls the concentration of glucose in the blood?

---

(1)

(ii) Which organ produces this hormone?

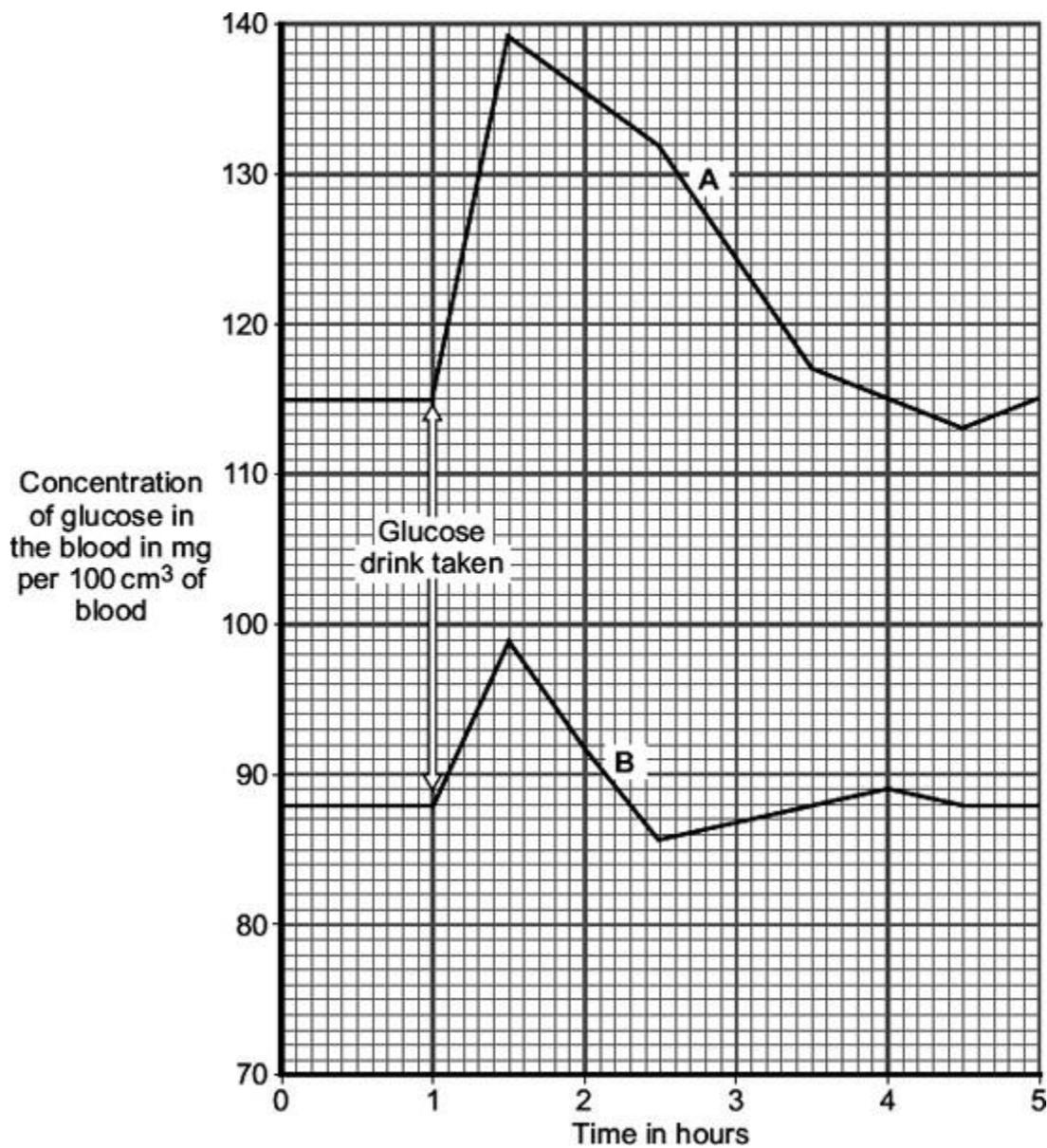
---

(1)

- (b) The concentration of glucose in the blood of two people, **A** and **B**, was measured every half an hour.

One hour after the start, both people drank a solution containing 50 g of glucose.

The graph shows the result.



- (i) By how much did the blood glucose concentration in person **B** rise after drinking the glucose drink?

\_\_\_\_\_ mg per 100 cm<sup>3</sup> of blood

(1)

(ii) A doctor suggests that person **A** has diabetes.

Give **two** pieces of evidence from the graph to support this suggestion.

1. \_\_\_\_\_

\_\_\_\_\_

2. \_\_\_\_\_

\_\_\_\_\_

**(2)**

(iii) Give **one** reason for the fall in blood glucose concentration in person **B**, shown in the graph.

\_\_\_\_\_

**(1)**

**(Total 6 marks)**

6

(a) **List A** gives the names of three stages in trialling a new drug.

**List B** gives information about the three stages.

Draw a line from each stage in **List A** to the correct information in **List B**.

**List A**  
**Stage**

Tests on humans  
including a placebo

Tests on humans using  
very small quantities of  
the drug

Tests on animals

**List B**  
**Information**

Used to find if the drug is toxic

The first stage in the clinical trials  
of the drug

Used to find the optimum dose  
of the drug

Used to prove that the drug is  
effective on humans

(3)

(b) Read the passage.

**Daily coffee dose delays development of Alzheimer's in humans.**

Alzheimer's is a brain disease that causes memory loss in elderly people. Scientists studied 56 mice that had been genetically engineered to develop Alzheimer's.

Before treatment all the mice did badly in memory tests.

Half the mice were given a daily dose of caffeine in their drinking water. The dose was equivalent to the amount of caffeine in six cups of coffee for a human.

The other mice were given ordinary water.

After two months, the caffeine-drinking mice did better in memory tests than the mice drinking ordinary water.

The headline for the passage is not justified.

Explain why as fully as possible.

---

---

---

---

---

---

---

---

---

---

(3)

(Total 6 marks)

**7** The human body produces many hormones.

(a) (i) What is a *hormone*?

---

---

(1)

(ii) Name an organ that produces a hormone.

---

(1)

(iii) How are hormones transported to their target organs?

---

(1)

(b) Describe how the hormones FSH, oestrogen and LH are involved in the control of the menstrual cycle.

---

---

---

---

---

---

---

---

---

(3)

**(Total 6 marks)**

8

Diabetes is a disease in which a person's blood glucose concentration may rise.

Doctors give people drugs to treat diabetes.

The table shows some of the side effects on the body of four drugs, **A**, **B**, **C** and **insulin**, used to treat diabetes.

| Drug           | Side effects on the body  |
|----------------|---|
| <b>A</b>       | Weight loss<br>Liver, kidney and heart damage<br>Feeling of sickness                        |
| <b>B</b>       | Weight gain<br>Damage to some cells in pancreas   |
| <b>C</b>       | More water is kept in the body<br>Weight gain<br>Increased chance of bone breakage in women |
| <b>Insulin</b> | A little more water is kept in the body<br>Weight gain<br>Increased risk of lung damage     |

- (a) Which drug, **A**, **B**, **C** or **insulin**, is most likely to result in an increase in blood sugar concentration in some people?

Explain your answer.

Drug \_\_\_\_\_

Explanation

\_\_\_\_\_  
\_\_\_\_\_

(2)

- (b) (i) Drugs **A**, **B** and **C** can be taken as tablets.

The chemicals in the tablets are absorbed into the blood from the digestive system.

Insulin is a protein.

Insulin **cannot** be taken as a tablet.

Why?

\_\_\_\_\_

(1)

(ii) Other than using drugs, give **two** methods of treating diabetes.

1. \_\_\_\_\_

2. \_\_\_\_\_

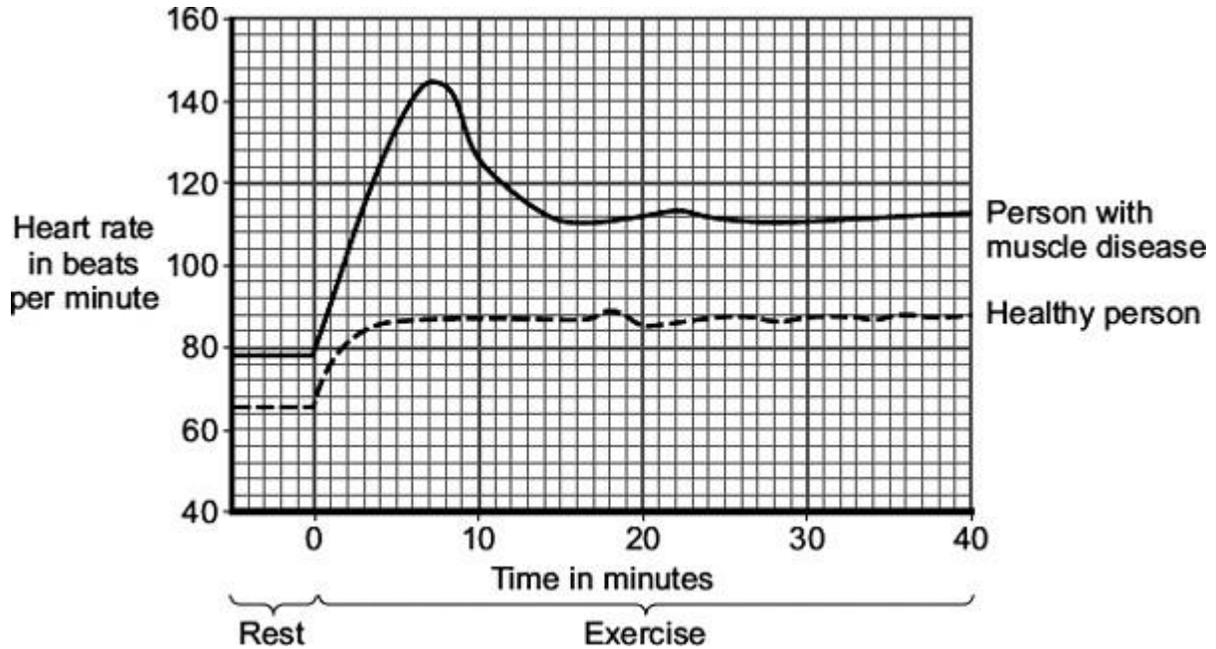
(2)

(Total 5 marks)

9

Two people did the same amount of gentle exercise on an exercise cycle. One person had a muscle disease and the other had healthy muscles.

The graph shows the effect of the exercise on the heart rates of these two people.



(a) Describe **three** ways in which the results for the person with the muscle disease are different from the results for the healthy person.

To gain full marks in this question you need to include data from the graph in your answer.

1. \_\_\_\_\_

\_\_\_\_\_

2. \_\_\_\_\_

\_\_\_\_\_

3. \_\_\_\_\_

\_\_\_\_\_

(3)

(b) The blood transports glucose to the muscles at a faster rate during exercise than when a person is at rest.

(i) Name **one** other substance that the blood transports to the muscles at a faster rate during exercise.

\_\_\_\_\_

(1)

(ii) People with the muscle disease are not able to store glycogen in their muscles.

The results shown in the graph for the person with the muscle disease are different from the results for the healthy person.

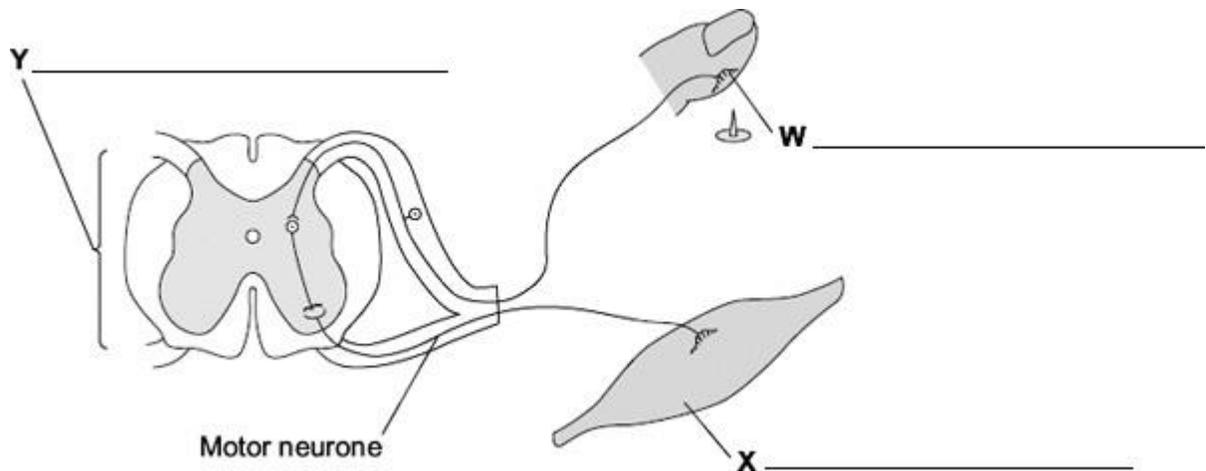
Suggest an explanation for the difference in the results.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(3)

(Total 7 marks)

10 The diagram shows the structures involved in a reflex action.



(a) On the diagram, name the structures labelled **W**, **X** and **Y**.

(3)

(b) The control of blood sugar level is an example of an action controlled by hormones.

Give **two** ways in which a reflex action is different from an action controlled by hormones.

1. \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

2. \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

(2)  
(Total 5 marks)

## Mark schemes

- 1** (a) (i) rate of chemical reactions (in the body) 1
- (ii) any **two** from:
- heredity / inheritance / genetics
  - proportion of muscle to fat **or** (body) mass  
*allow (body) weight / BMI*
  - age / growth rate
  - gender  
*accept hormone balance or environmental temperature*  
*ignore exercise / activity*
- 2
- (b) (i) 77  
*correct answer with or without working gains 2 marks*  
*allow 1 mark for 70 / 56 **or** 1.25 **or** 5*
- 2
- (ii) increase exercise  
*accept a way of increasing exercise*
- 1
- reduce food intake  
*accept examples such as eat less fat / sugar*  
*allow go on a diet **or** take in fewer calories*  
*ignore lose weight*  
*ignore medical treatments such as gastric band / liposuction*
- 1
- [7]**
- 2** (a) B  
*no mark for "B", alone*
- large(r) surface / area **or** large(r) membrane  
*accept reference to microvilli*  
*accept reasonable descriptions of the surface*  
*do **not** accept wall / cell wall*  
*ignore villi / hairs / cilia*
- 1

- (b) (i) any **one** from:
- insulin / hormone  
*if named hormone / enzyme must be correct for pancreas*
  - enzyme / named enzyme
- 1

- (ii) many ribosomes
- 1

(ribosomes) produce protein  
*accept insulin / hormone / enzyme named is (made of) protein*

**or**

allow many mitochondria (1)

provide energy to build protein **or** to make protein (1)

*accept ATP for energy*

1

[4]

- 3** (a) pancreas
- allow phonetic spelling*
- 1

- (b) 4(.0) to 7.2 **or** 7.2 to 4(.0)
- 1

- (c)  $13 - 7 = 6$
- working shows 6 = 1 mark*
- 1

$6/2 = 3$  units

*accept the correct answer to the calculation, 3 units, for 2 marks, irrespective of working*

1

increase (dose)

*accept indication of increase, eg extra / more / + could be in working lines*

1

[5]

- 4** (a) (i) any **three** from:  
*if diet given as answer = max 2*
- age (of athlete)
  - gender (of athlete)
  - starting concentration of glycogen
  - type / intensity of exercise
  - length of exercise period
  - number of training sessions
- if none of these points gained amount of exercise = 1 mark*
- time interval between exercise sessions
  - exercise at same time of day
- if last four points not awarded allow time (for exercise) for 1 mark  
ignore references to amount of energy  
ignore they are both athletes*

3

- (ii) any **two** from:
- intensity of exercise
  - amount of exercise between sessions
  - starting concentration of glycogen
  - fitness / health
  - metabolic rate / respiration rate
  - amount / mass of muscle / physique
  - aspects of diet qualified, eg amount of food eaten
- do **not** accept amount of carbohydrate  
if no other marks awarded allow height / mass / weight for 1 mark*

2

(iii) (B has) less glycogen

*he = B*

**or** (B's glycogen) fell more

*accept use of approximate figures*

**or** (B's glycogen) built up less

*allow other correct observations from graph eg A is lower at end of first session*

*ignore rate of fall*

1

(b) athlete **A** (no mark)

*to gain full marks 'more' must be given at least once*

athlete **A** had more glycogen / **B** has less (only if A chosen to complete marathon)

*accept converse argument for **B***

1

(glycogen / glucose) used in respiration

*ignore anaerobic*

1

(more) energy released / available in athlete **A**

*allow 'energy made'*

1

**and either** energy used for movement / muscle action / to run

**or**

(extra) glycogen → (more) glucose

1

[10]

5

(a) (i) insulin

*accept glucagon (correct spelling only)*

1

(ii) pancreas

*accept phonetic spelling*

*allow pancrease*

1

(b) (i) 11(.0)

*accept in range 10.5-11 (.0)*

1

(ii) any **two** from:

*ignore numbers unless comparative*

- high(er) concentration (of blood glucose) (anywhere / any time)  
*accept 115 not 88*  
*139 not 99*
- large(r) increase (in concentration after the drink)  
*accept increase by 24 not 11 / their b(i)*
- fast(er) / steep(er) rise  
*accept it takes 3 hours not 1 ¼ hours to get back to original level*  
*accept it takes a long time to get back to normal*
- slow(er) fall

2

(iii) any **one** from:

- insulin present / produced  
*accept glucagon not produced*
- (used in) respiration  
*allow exercise*
- taken into cells  
*allow converted to glycogen*  
*allow taken into liver (cells) / muscle (cells)*  
*allow produce / make energy*

1

[6]



(b) any **three** from:

*Students have been informed that the headline is not justified*

- reference to reliability, eg only a small number of mice tested  
**or** trial too short  
**or** investigation not repeated
- reference to control, eg mice given caffeine not coffee  
**or** 6 cups (equivalence) is more than 1 dose
- (and) the effect on mice might not be same as on humans  
*allow only tested on mice*
- (also) text suggests that the treatment improves memory loss (rather than delays it)  
*accept text suggests disease cured*

**or** mice already have memory loss or experiment only showed improvement in memory

**or** does not show **delays** Alzheimer's

**or** experiment not done on old mice

*allow reference to the fact that mice engineered to have it*

3

[6]

7

(a) (i) any **one** from:

- chemical messenger / message  
*allow substance / material which is a messenger*
- chemical / substance produced by a gland  
*allow material produced by a gland*
- chemical / substance transported to / acting on a target organ
- chemical / substance that controls body functions

1

(ii) gland / named endocrine gland

*brain alone is insufficient*

*allow phonetic spelling*

1

(iii) in blood / plasma **or** circulatory system **or** bloodstream

*accept blood vessels / named*

*do **not** accept blood cells / named*

1

- (b) *each hormone must be linked to correct action*  
*apply list principle*  
*ignore the gland producing hormone*

FSH stimulates oestrogen (production) / egg maturation / egg ripening  
*ignore production / development of egg*

1

oestrogen inhibits FSH

*allow oestrogen stimulates LH / build up of uterine lining*

1

LH stimulates egg / ovum release / ovulation

*accept LH inhibits oestrogen*  
*accept LH controls / stimulates*  
*growth of corpus luteum*  
*ignore production of egg*

1

[6]

8

- (a) B

1

less / no insulin (produced) **or** insulin produced in pancreas

*allow pancreas can't monitor (blood) sugar (level)*  
*ignore pancreas can't control (blood) sugar (level)*  
*allow increased glucagon production*

*allow A as liver stores less glucose / sugar for **2** marks only*

1

- (b) (i) (it / protein / insulin) digested / broken down

*if ref to specific enzyme must be correct (protease / pepsin)*  
*ignore denatured*

*do **not** accept digested in mouth / other incorrect organs*

1

- (ii) any **two** from:

*ignore injections*

- (attention to) diet  
*accept examples, eg eat less sugar(y food) **or** eat small regular meals*

*allow eat less carbohydrate / control diet*

*ignore cholesterol or balanced / healthy diet*

- exercise

*ignore keep fit / healthy*

- (pancreas) transplant / stem cells / genetic engineering

2

[5]

9

(a) person with muscle disease:

*allow reverse argument for healthy person*

any **three** from:

*NB all points are comparative except peak (point 3)*

*allow use of **two** approximate figures as a comparison*

- higher resting rate **or** higher at start
- when exercise starts / then increases more / more rapidly  
*accept description eg rise .... fall*
- peaks (then falls)
- levels off later than healthy person
- higher rate during exercise  
*if no other marks awarded allow 1 mark for 'it's higher'*
- greater range

3

(b) (i) oxygen

*accept adrenaline*

*accept O<sub>2</sub>*

*do **not** accept O, O<sub>2</sub> or O<sup>2</sup>*

1

(ii) cannot release sugar / glucose (from glycogen)

**or**

cannot store glucose / sugar (as glycogen)

1

need to receive glucose / sugar (from elsewhere)

*ignore oxygen*

1

for energy / respiration / cannot store energy

*ignore aerobic / anaerobic*

1

[7]

10

(a) Y - spinal cord / central nervous system / CNS

*do **not** accept spine*

*ignore nerve / nervous system / coordinator*

*ignore grey / white matter*

1

W - receptor / nerve ending

*ignore sensory / neurone / stimulus*

1

X - effector / muscle

*allow gland*

1

(b) any **two** from: eg

*accept reverse argument for each marking point*

- reflex action quicker
- effect of reflex action over shorter period
- hormone involves blood system and reflex involves neurones / nerve cells  
*ignore nervous system / nerves*
- reflex involves impulses and hormone involves chemicals
- reflex action affects only one part of the body  
*ignore involves brain*  
*ignore outside / inside stimuli*

2

[5]