



1 A 65-year-old woman suffers from emphysema. Emphysema causes the woman to be out of breath and she sometimes needs to use an oxygen tank.

The woman visits a clinic, where a healthcare professional measures her oxygen saturation.

1(a)(i) What is the normal range for oxygen saturation of the blood?

[1 mark]

.....%

1(a)(ii) Name **one** non-invasive method of measuring oxygen saturation.

[1 mark]

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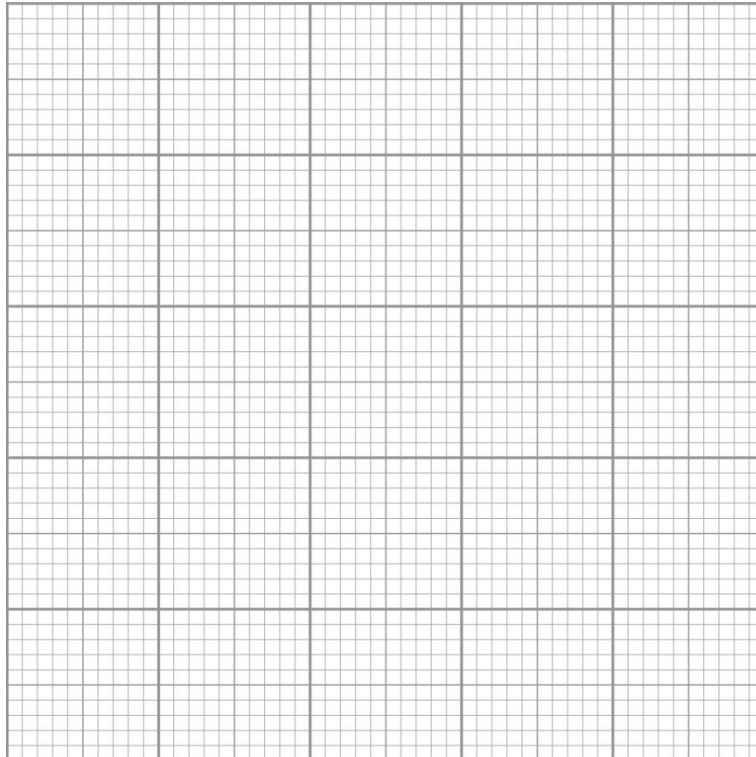
- 1(b)** Table 1 shows the oxygen saturation of the woman's blood at different partial pressures of oxygen in inhaled air, and the results for a person who does not have emphysema.

Table 1

Partial pressure of oxygen in inhaled air (mmHg)	Percentage oxygen saturation of blood (%)	
	Woman with emphysema	Person without emphysema
20	10	30
40	50	75
60	80	90
80	85	100
100	90	100

- 1(b)(i)** Plot the data in Table 1 on the grid below. Your graph should show the percentage oxygen saturation of blood for the woman with emphysema and the person without emphysema, at each partial pressure of oxygen.

[3 marks]



- 1(b)(ii)** Use your graph to predict the percentage oxygen saturation for the woman with emphysema, at a partial pressure of 50 mmHg.

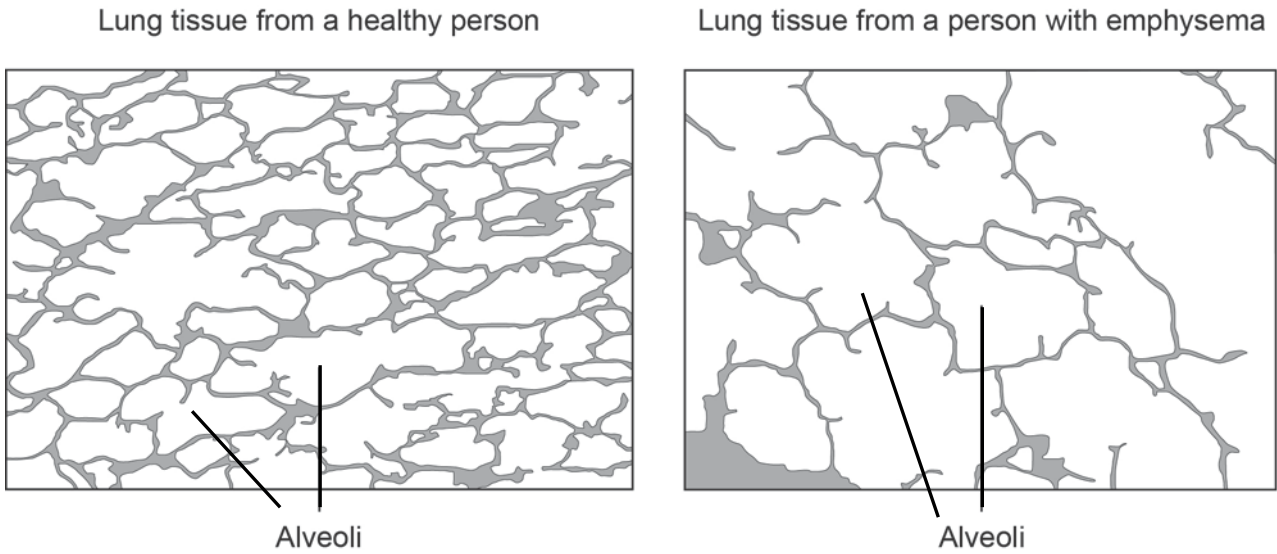
[1 mark]

Percentage oxygen saturation = .....%

QUESTION 1 CONTINUES ON THE NEXT PAGE

1(c) **Figure 1** shows lung tissue from a healthy person and lung tissue from a person with emphysema.

**Figure 1**



Use information from **Figure 1** to explain why emphysema causes the woman to be short of breath. **[3 marks]**

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1(d) Oxygen is carried by haemoglobin in red blood cells.

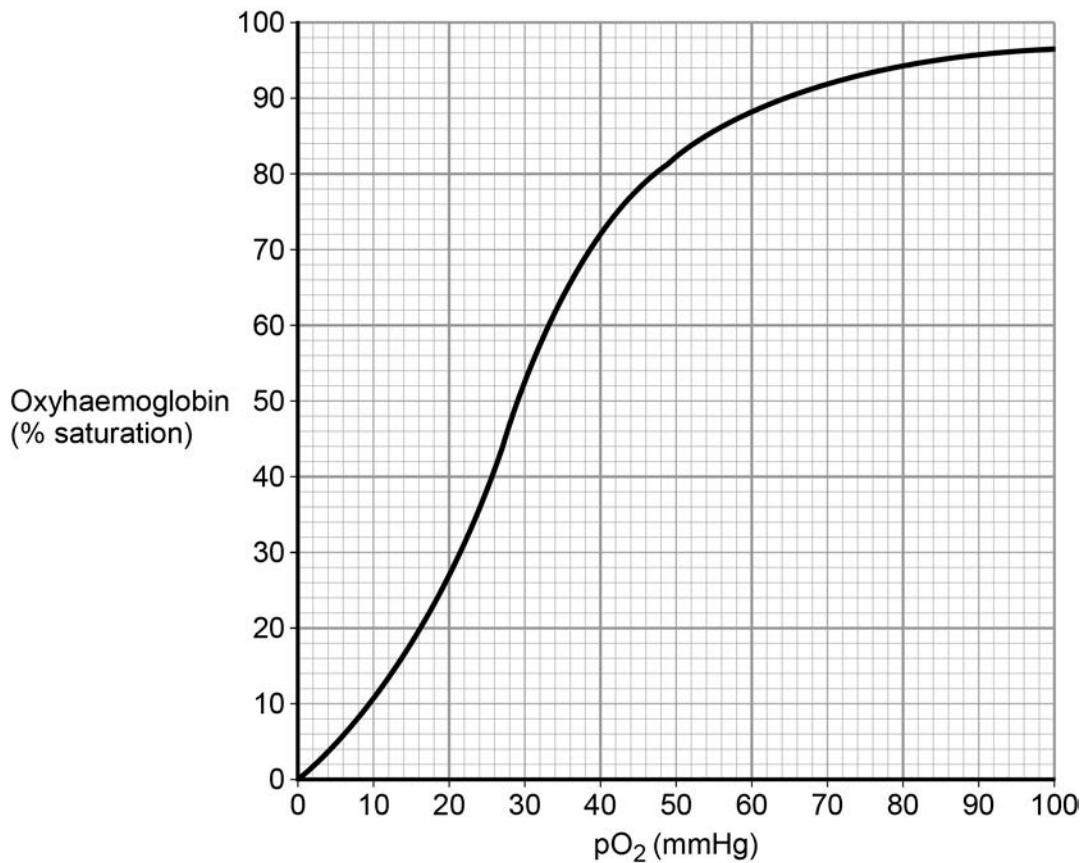
1(d)(i) What element is found in haemoglobin?  
Tick **one** box.

**[1 mark]**

- Calcium
- Iron
- Sodium
- Potassium

1(d)(ii) Figure 2 shows an oxygen dissociation curve.

Figure 2



The Bohr Effect causes the oxygen dissociation curve to shift to the right.

Describe the Bohr Effect.

[2 marks]

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1(d)(iii) The oxygen carried by haemoglobin is used in respiration. Aerobic respiration uses oxygen to release energy. Sports scientists can measure basal metabolic rate (BMR) to give an indication of the amount of energy used whilst the body is at rest.

Describe how BMR is measured using direct calorimetry.

[2 marks]

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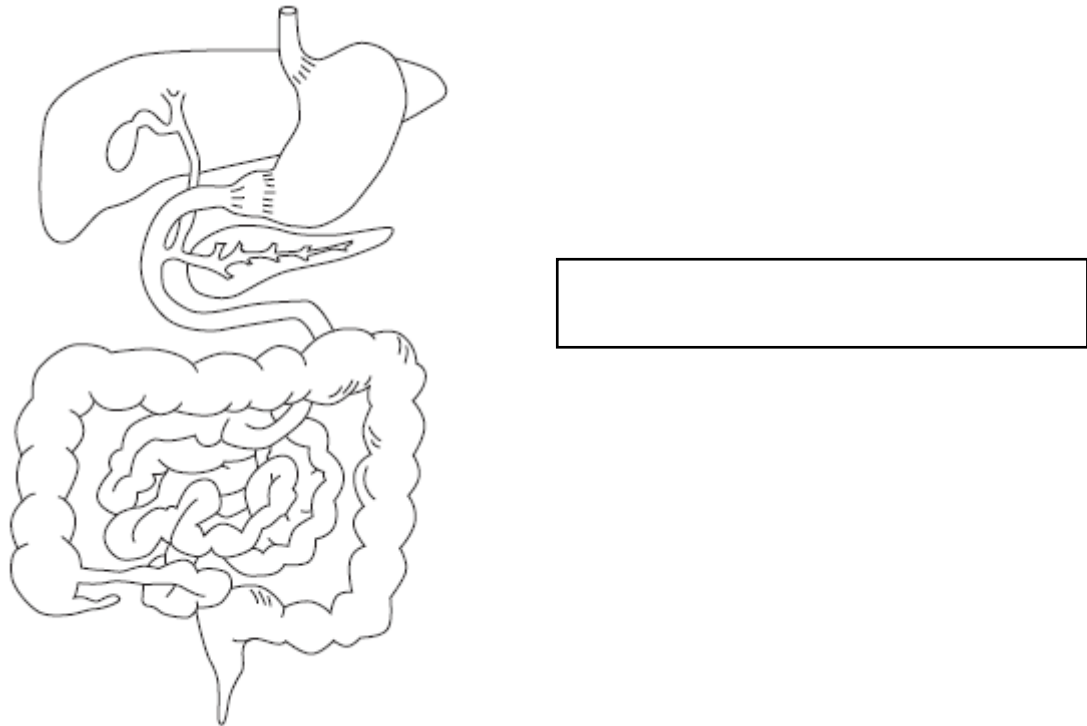
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Total 14 marks

- 2 A girl attended a clinic because she had diarrhoea. Diarrhoea is a condition in which the faeces become very watery.

Figure 3 shows the human digestive system.

Figure 3



- 2(a) In the box in **Figure 3**, write the name of the structure where water is reabsorbed from faeces, and draw a line to the structure you have named. [2 marks]

- 2(b) In normal conditions, the muscles help to move food through the gut.

Describe how the muscles work to move food along the gut.

[2 marks]

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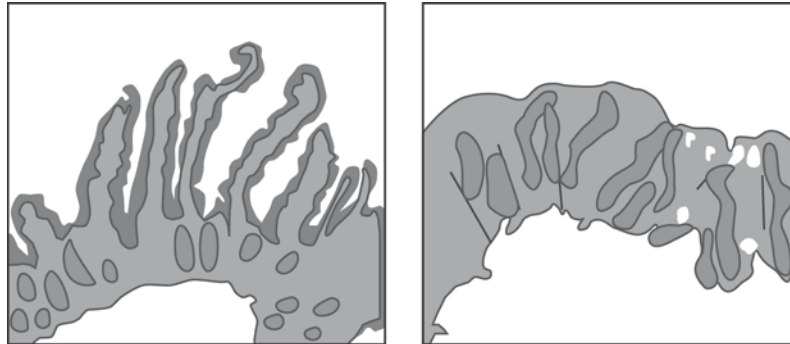
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2(c) A nurse suspected that the girl had coeliac disease.

One of the symptoms of coeliac disease is that sufferers often do not grow as quickly as other children of the same age. This is due to lack of nutrient uptake.

Figure 4 shows a micrograph of the intestinal villi from a healthy person and from the girl with coeliac disease.

Figure 4



Intestinal villi from healthy person

Intestinal villi from girl with coeliac disease

2(c)(i) Use information from Figure 4 to explain why nutrient uptake is low in the girl with coeliac disease.

[3 marks]

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2(c)(ii) Coeliac disease symptoms are caused by gluten in the diet and so people with coeliac disease eat a gluten-free diet. Gluten is found in wheat.

Name **two** foods that the girl should avoid to ensure that her diet is gluten-free.

[2 marks]

1.....

2.....

QUESTION 2 CONTINUES ON THE NEXT PAGE

**2(c)(iii)** People with coeliac disease should eat more calcium than people without coeliac disease.  
A nutritionist advises the girl to increase her calcium intake.

Give **two** ways in which the girl can increase her calcium intake.

**[2 marks]**

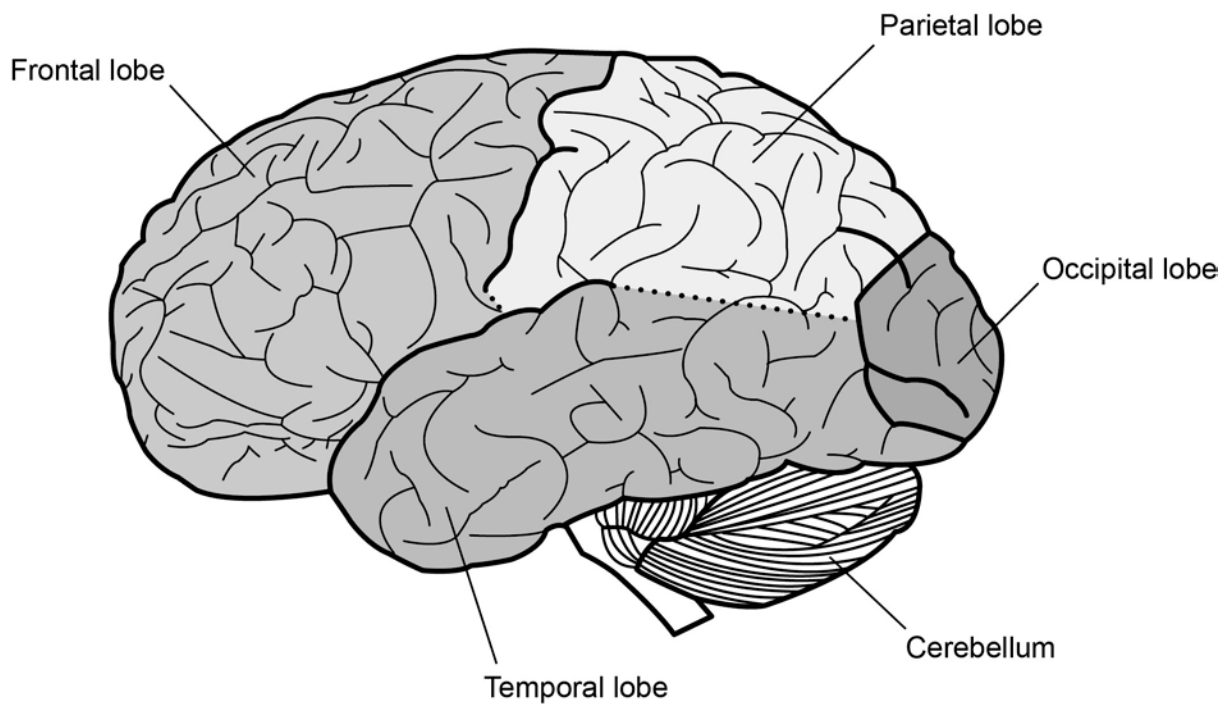
- 1.....  
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- 2.....  
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**Total 11 marks**



3(a) Figure 5 shows different parts of the human brain.

Figure 5



A man has an accident, so he goes to the accident and emergency department of his local hospital. His symptoms are:

- staggering when walking
- not recognising his wife when she arrives at the hospital.

Which part of the man's brain is likely to have been damaged in the accident?

Tick **one** box.

[1 mark]

- Frontal lobe
- Occipital lobe
- Parietal lobe
- Temporal lobe

QUESTION 3 CONTINUES ON THE NEXT PAGE

**3(b)** The autonomic nervous system is divided into the sympathetic nervous system and the parasympathetic nervous system.

Tick **two** boxes to show the effects that are caused by the sympathetic nervous system.

**[2 marks]**

Bladder contracts

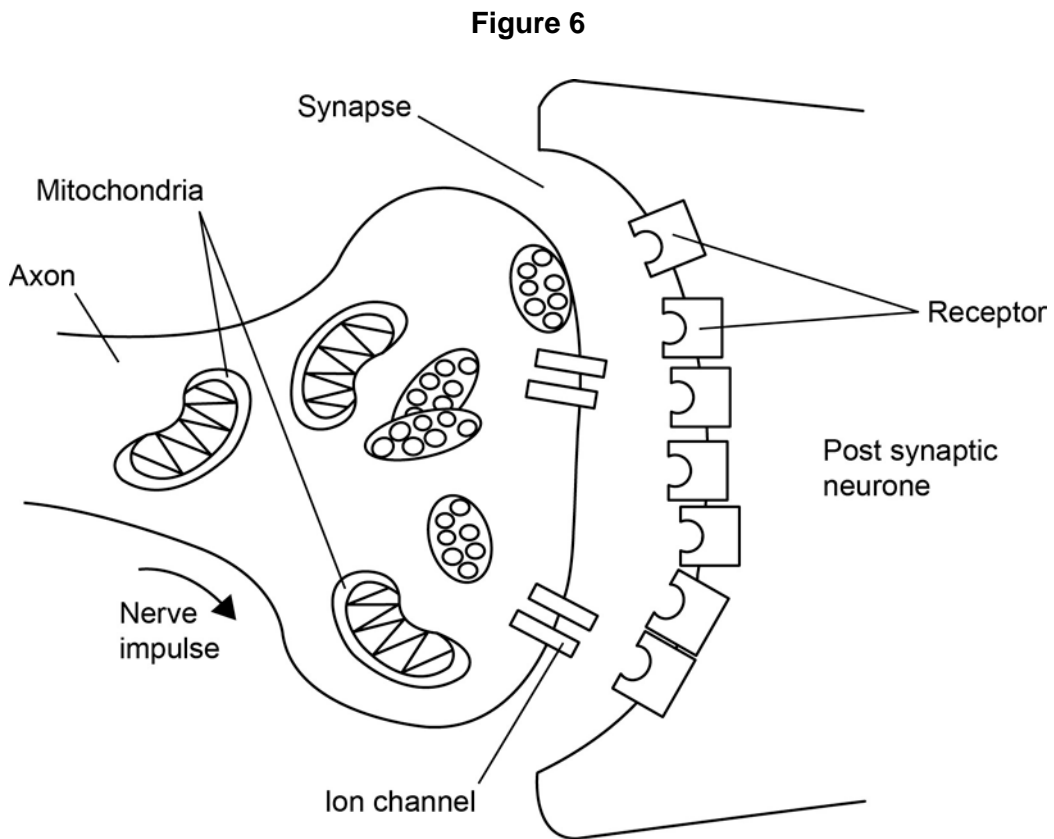
Digestive activity increases

Heart rate increases

Pupils constrict

Bronchi dilate

3(c) Figure 6 shows a normal synapse.



Describe how a nerve impulse is transmitted across the synapse in **Figure 6**, once the action potential has arrived at the presynaptic knob.

[6 marks]

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**QUESTION 3 CONTINUES ON THE NEXT PAGE**

**3(d)** Many people in the UK suffer from disorders affecting the nervous system.

Some disorders arise from problems with the transmission of nervous impulses across synapses. Alzheimer's disease is one of these disorders and affects approximately 850 000 people in the UK.

Alzheimer's disease is caused by a lack of acetylcholine.

Describe how drugs currently used to treat Alzheimer's disease help to reduce the symptoms caused by the lack of acetylcholine.

**[3 marks]**

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**Total 12 marks**

4 The human skeleton has many different functions, including movement.

4(a) Give **two** other functions of the human skeleton.

[2 marks]

1.....

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2.....

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4(b) Bone remodelling is a process that continually happens in the human body. It consists of two main processes: resorption and ossification.

Define resorption and ossification.

[2 marks]

Resorption.....

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Ossification.....

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**QUESTION 4 CONTINUES ON THE NEXT PAGE**

4(c) An elderly man has osteoarthritis which affects some of his joints. **Figure 7** shows an X-ray of the man's knees.

**Figure 7**



Right knee

Left knee

The man's left knee is healthy.

Use information from **Figure 7** and your own knowledge to describe the damage caused by osteoarthritis in the man's right knee joint.

**[2 marks]**

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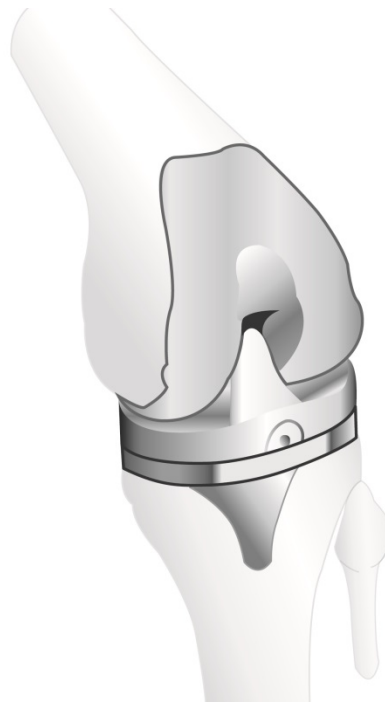
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4(d) A physiotherapist tells the man that he should have knee replacement surgery.

Figure 8 shows an artificial knee.

Figure 8



4(d)(i) What type of joint is the knee joint?

[1 mark]

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4(d)(ii) Describe the range of movement in a knee joint.

[2 marks]

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4(d)(iii) Name **two** other types of joint found in the human skeleton.

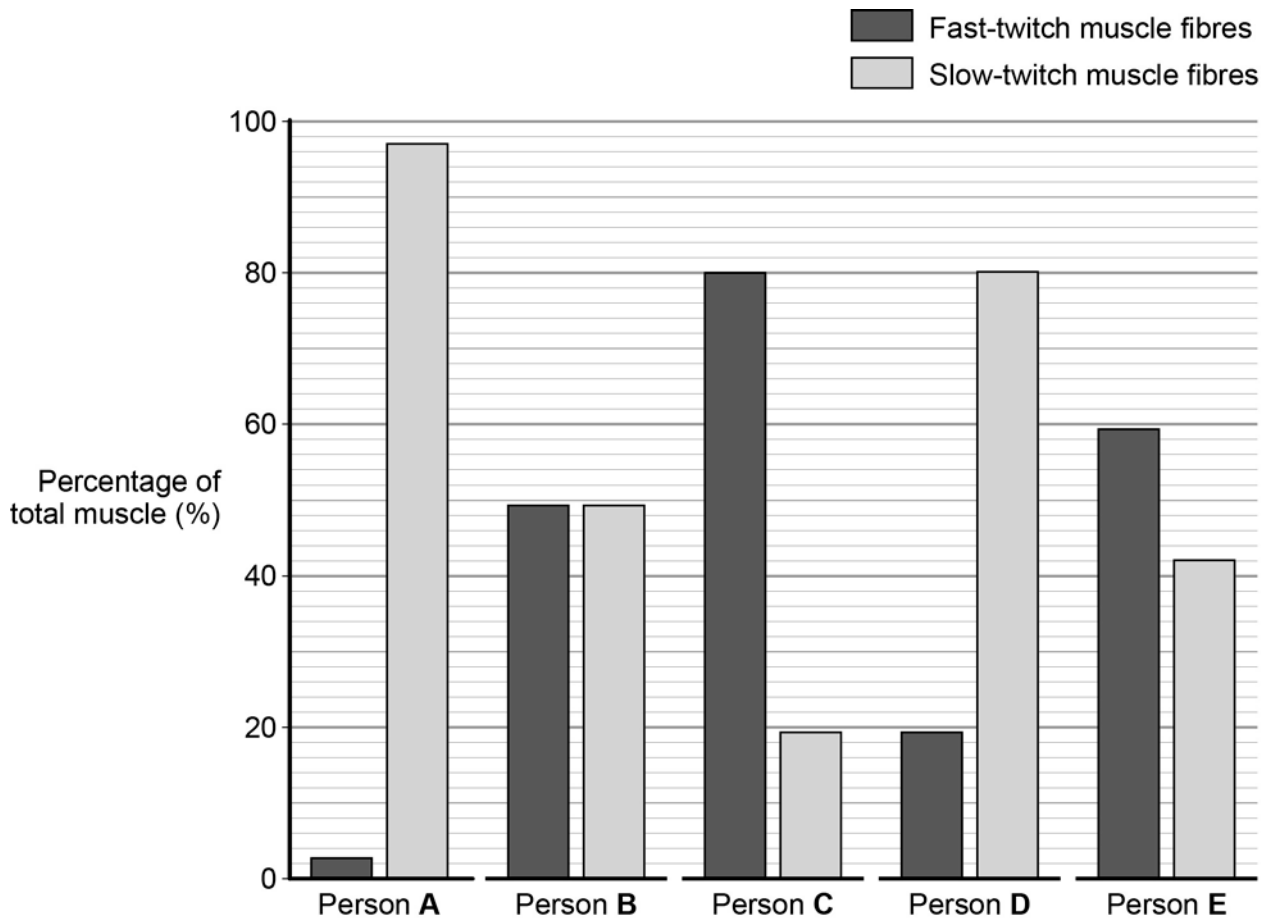
[2 marks]

1.....  
2.....

**Total 11 marks**

5 **Figure 9** shows the proportions of fast-twitch and slow-twitch muscle fibres in five different people.

**Figure 9**



5(a) Person **A** has a spinal injury.

Use information from **Figure 9** to decide which person, **B**, **C**, **D** or **E** is a long-distance marathon runner.

Tick **one** box.

[1 mark]

Person **B**

Person **C**

Person **D**

Person **E**



