Write your name here

Surname	Other names

Pearson Edexcel Level 3 GCE

Centre Number	Candidate Number

Biology A (Salters Nuffield)

Advanced

Paper 2: Energy, Exercise and Co-ordination

Sample Assessment Material for first teaching September 2015

Time: 2 hours

Paper Reference

9BN0/02

You may need a ruler, a pencil and a calculator.

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.
- Show your working in any calculation questions and include units in your answer where appropriate.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- You may use a scientific calculator.
- In questions marked with an asterisk (*), marks will be awarded for your ability to structure your answer logically showing how the points that you make are related or follow on from each other where appropriate.

Information

- The total mark for this paper is 100.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*

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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PEARSON

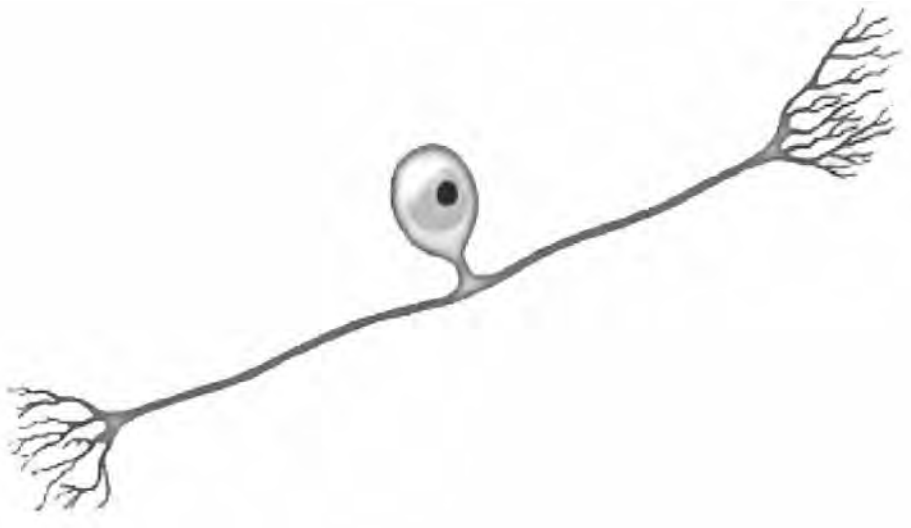
Answer ALL questions.

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 The nervous system contains myelinated and unmyelinated neurones.

The diagram below shows a myelinated sensory neurone.



(a) Give **one** feature, shown in the diagram, that identifies this cell as a sensory neurone.

(1)

.....

.....

(b) The table shows the conduction velocity of a nerve impulse along a myelinated and an unmyelinated neurone, each with a diameter of 5 μm.

Conduction velocity / ms^{-1}	
Myelinated neurone	**Unmyelinated neurone**
24.9	5.1

Explain why there is a difference in the conduction velocity of these neurones.

(5)

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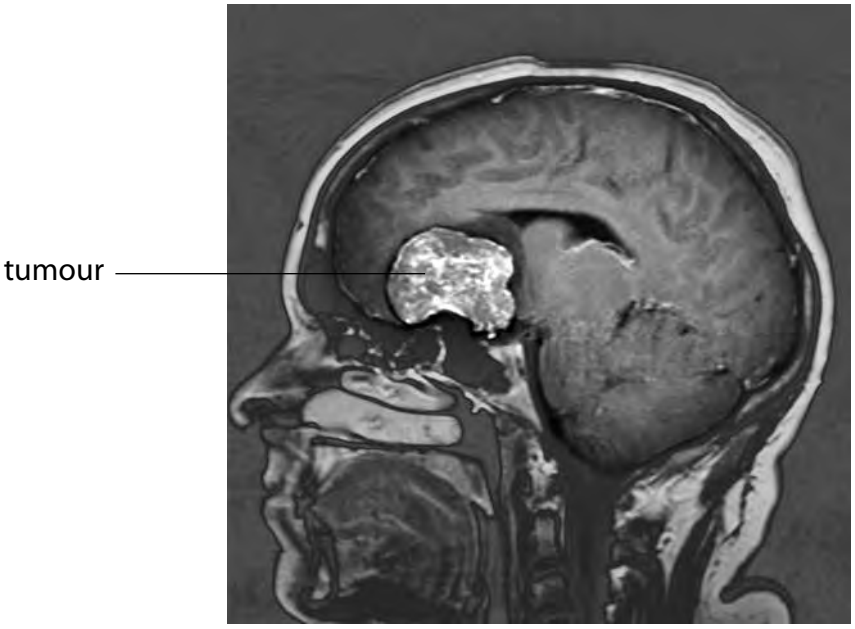
(Total for Question 1 = 6 marks)

2 Magnetic resonance imaging (MRI) can be used to study brain structure.

The MRI scan shows a human brain with a tumour.



Magnification ×0.3

(a) The part of the brain in which the tumour has grown is the

(1)

- ☒ **A** cerebellum
- ☒ **B** cerebral hemisphere
- ☒ **C** hypothalamus
- ☒ **D** medulla oblongata

(b) Explain the advantages of using MRI scanning to identify tumours compared to using CT scanning.

(3)

(c) fMRI scanning is another way of collecting information about the brain.

Explain how fMRI scanning would help neuroscientists to identify the part of the brain involved in controlling a voluntary action such as picking up a pen to write on paper.

(3)

(Total for Question 2 = 7 marks)

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3 The cardiac output of the heart changes during exercise.

(a) During exercise, a person had a pulse rate of 140 beats per minute and a cardiac output of 17.0 dm^3 min^{-1}.

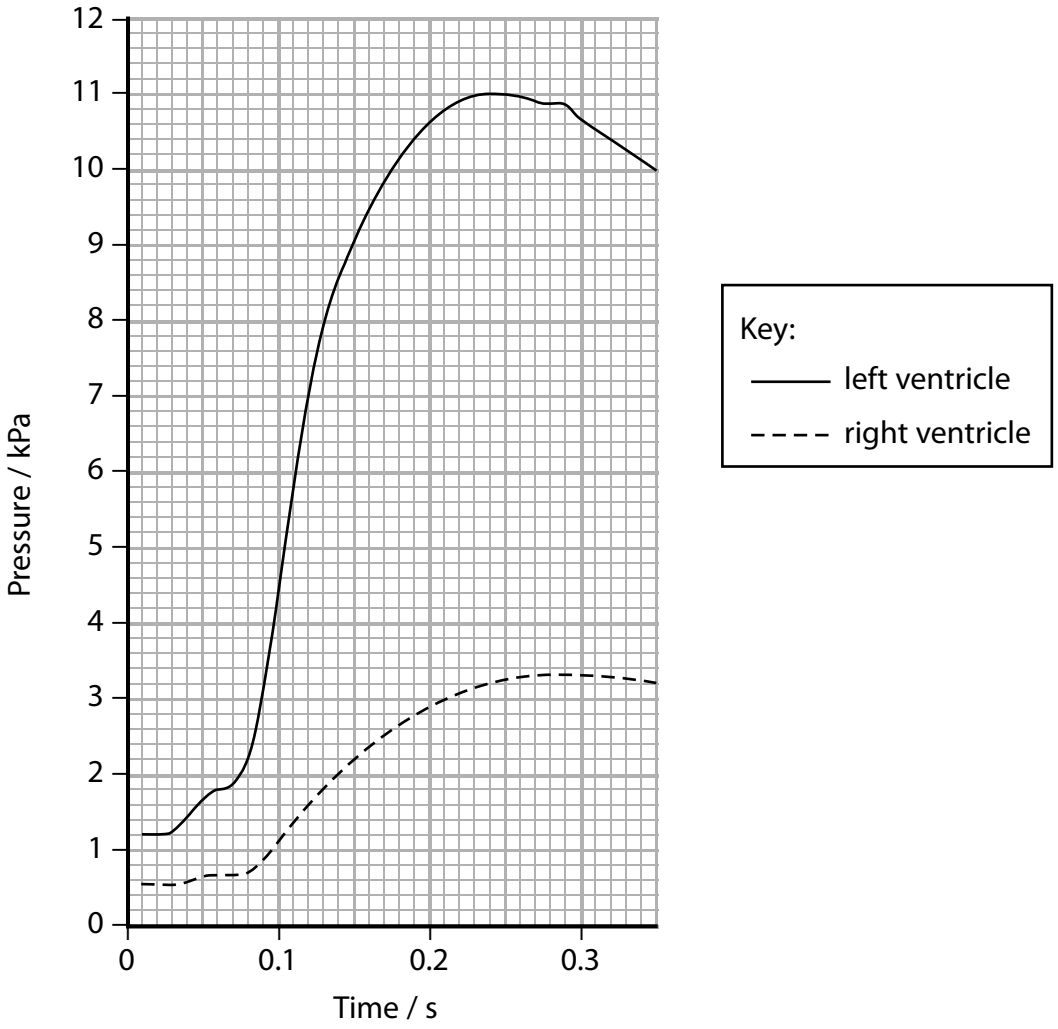
Calculate the stroke volume of the heart of this person.

(2)

Answer .....

(b) The maximum pressure in the left ventricle is 11.0 kPa and in the right ventricle 3.3 kPa.

The graph below shows the pressure changes in the two ventricles of the heart during part of the cardiac cycle.



(i) Explain why there is a difference in pressure in these two ventricles.

(3)

(ii) Which row of the table shows the correct stage in the part of the cardiac cycle shown at 0.25 s in the graph?

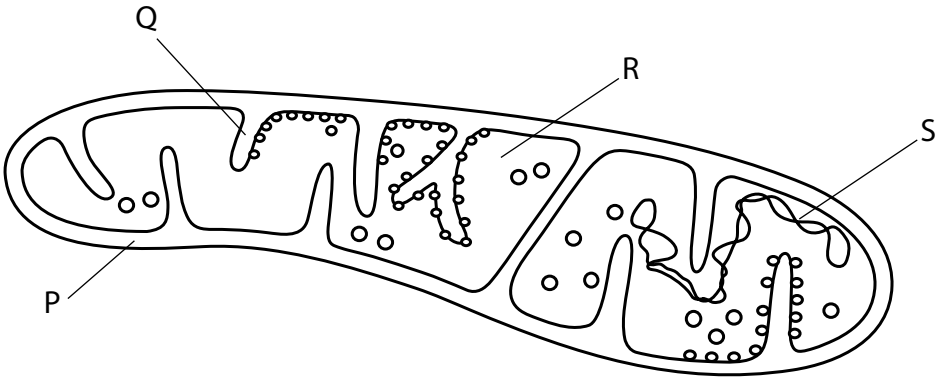
(1)

		Stage in cardiac cycle	
		left ventricle	**right ventricle**
☒	**A**	diastole	diastole
☒	**B**	diastole	systole
☒	**C**	systole	diastole
☒	**D**	systole	systole

(Total for Question 3 = 6 marks)

4 Aerobic respiration is a series of reactions that occur in the cytoplasm and mitochondria of animal and plant cells.

(a) The diagram shows a mitochondrion.



Which row of the table shows where each process takes place in a mitochondrion?

(1)

	Diffusion of hydrogen ions / production of ATP in chemiosmosis	Production of reduced NAD
☒ **A**	P	Q
☒ **B**	Q	R
☒ **C**	R	S
☒ **D**	S	P

(b) The link reaction takes place in mitochondria.

Which row of the table shows the correct substances produced by the link reaction?

(1)

	Carbon dioxide	ATP	Reduced NAD
☒ **A**	no	no	no
☒ **B**	no	yes	no
☒ **C**	yes	yes	yes
☒ **D**	yes	no	yes

(c) The number of ATP molecules synthesised in mitochondria from one molecule of acetyl CoA is

(1)

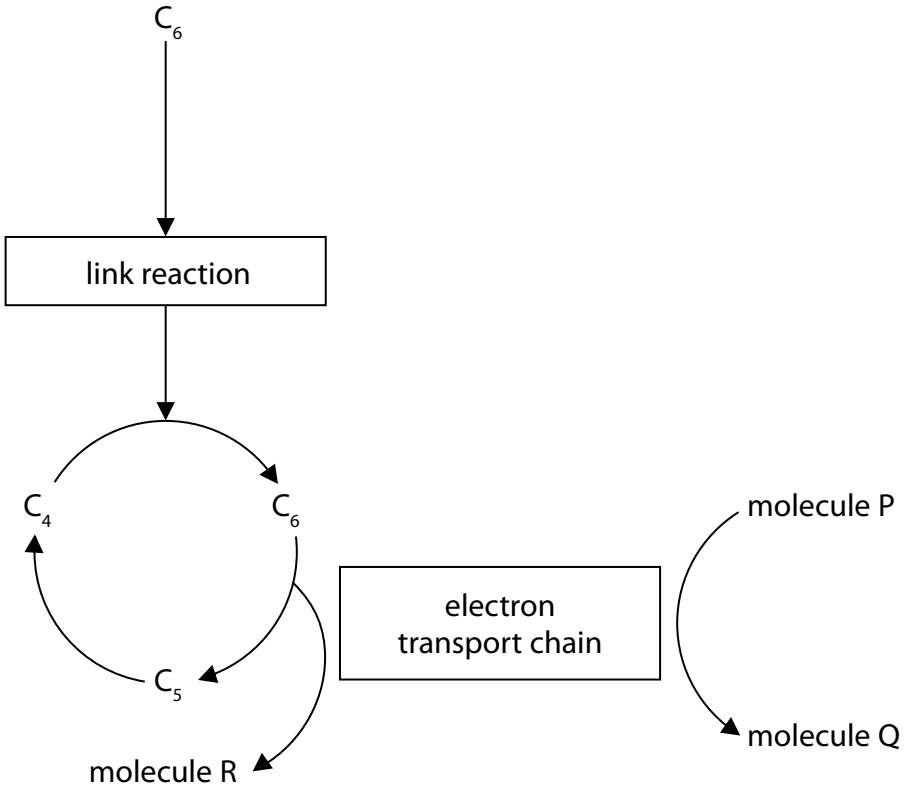
☒ **A** 11

☒ **B** 12

☒ **C** 22

☒ **D** 24

(d) The diagram shows some of the stages of aerobic respiration.



(i) Which row of the table correctly describes molecule R and molecule Q?

(1)

	Molecule R	Molecule Q
☒ **A**	ATP	oxygen
☒ **B**	carbon dioxide	water
☒ **C**	reduced NAD	carbon dioxide
☒ **D**	ATP	reduced NAD

*(ii) The last carrier in the electron transport chain is the enzyme cytochrome oxidase . Cyanide attaches permanently to the active site of this enzyme.

Explain why cyanide is a lethal metabolic poison.

(6)

(Total for Question 4 = 10 marks)

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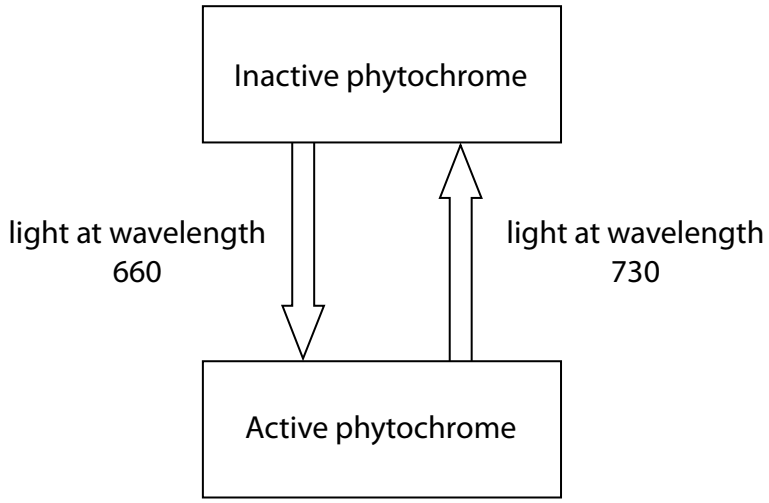
5 Phytochromes are photoreceptors found in many plants.

The diagram below shows the interconversion of inactive phytochrome (Pr / P660) and active phytochrome (Pfr / P730).



(a) Which row of the table correctly shows the light conditions that convert the active form of phytochrome back to the inactive form?

(1)

	Light condition		
	exposed to red light	**exposed to far red light**	**exposed to darkness**
☒ **A**	yes	no	yes
☒ **B**	no	yes	no
☒ **C**	no	yes	yes
☒ **D**	yes	no	no

(b) A study was carried out to investigate the effect of red light and far red light on the growth of flowers in a plant.

Plants were kept under two different light regimes, A and B. Regime A used red light and far red light at the same intensity. Regime B used red light and far red light but the red light was at a lower intensity. The intensity of the far red light was unchanged.

When the plants were fully grown, the dry mass of the flowers produced was measured.

This study was repeated using a new group of plants.

The results for the original study and the repeat study are shown in the table.

Study	**Mean dry mass of the flowers / g**	
	Regime A	**Regime B**
Original	58	45
Repeat	43	38

(i) Calculate the percentage difference between the mean dry mass of flowers in regime A with that in regime B in the original study.

(2)

Answer .....

(ii) Compare and contrast the results of regime A with regime B for both the original and repeat studies.

(2)

(c) The ability to grow long stems is important in woodland plants because longer stems increase the chance of the plant receiving light for photosynthesis.

Any plant in the shade of other plants will be exposed to more far red light than red light because other plants absorb most of the red light.

A student wrote the hypothesis:

'The length of a plant stem depends on the amount of red light or far red light they receive'.

Design an investigation the student could use to test this hypothesis.

(4)

(Total for Question 5 = 9 marks)

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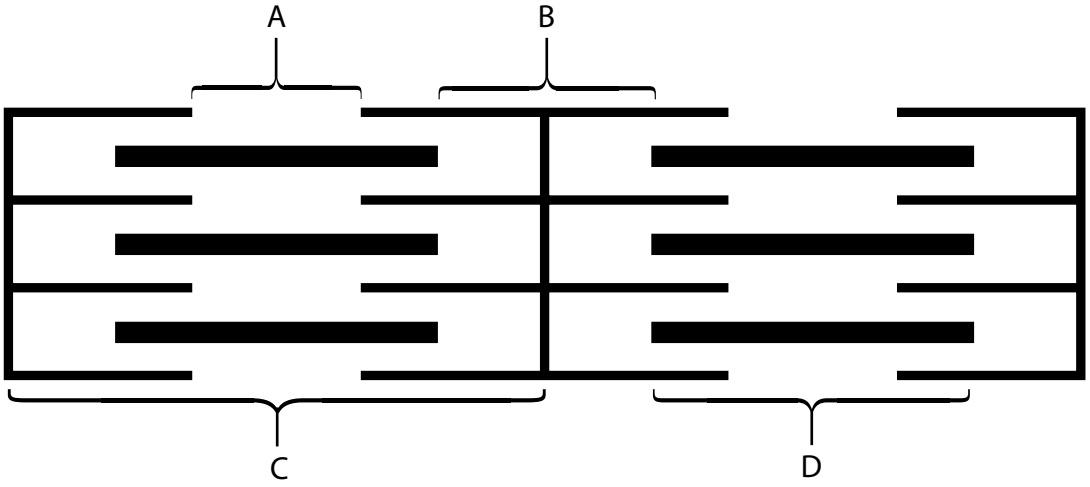
6 Muscles enable movement to take place.

(a) The diagram shows part of a muscle fibre.

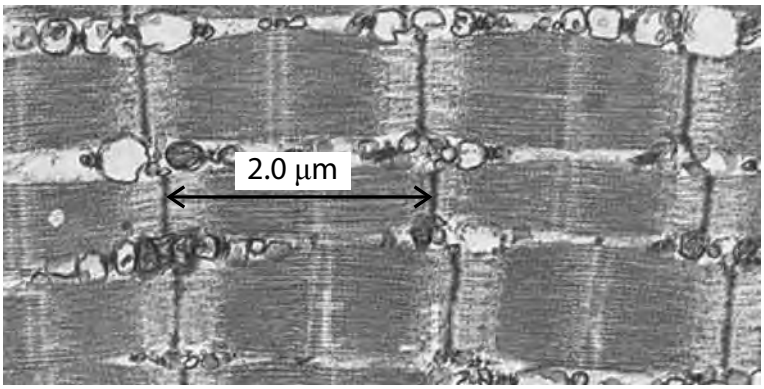


Which label on the diagram shows a sarcomere?

(1)

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(b) The electron micrograph shows the arrangement of protein filaments in the contractile units of muscle myofibrils.



(i) Calculate the magnification of this electron micrograph.

(2)

Answer .....

(ii) The number of myofibrils in this electron micrograph is

(1)

- ☒ **A** one
- ☒ **B** three
- ☒ **C** six
- ☒ **D** nine

(iii) The electron micrograph shows the myofibrils in a relaxed muscle.

Explain how the appearance of this myofibril changes when a muscle contracts.

(2)

(c) Muscle tissue contains fast twitch and slow twitch fibres.

The table below shows the percentage of these fibres in two different people.

Person	Percentage of muscle fibre	
	Fast twitch	Slow twitch
A	80	20
B	50	50

Explain which person has muscles that are more resistant to fatigue.

(4)

(Total for Question 6 = 10 marks)

7 The response of an animal to a stimulus can change if the stimulus is repeated.

The photograph shows the head and part of the body of a marine worm that lives in a chalky tube.

© Johner Images / Alamy

The worm moves its head out of the tube to feed. The worm will withdraw into its tube if it senses danger and any change in length of the worm can be measured.

An investigation was carried out to study the response of ten worms to a moving shadow and to touch. Five of the worms were kept in their tubes and the other five were removed from their tubes. A shadow was moved over the worms and the decrease in length of each worm was recorded.

The investigation was repeated with another 10 worms but the stimulus used was touch instead of a moving shadow.

The results are shown in the table below.

Worms	**Mean decrease in length / cm**	
	Moving shadow	**Touch**
In tube	1.08	2.03
Not in tube	0.01	1.53

(a) Calculate the percentage difference in the response of the worms to touch.

(2)

Answer .....

(b) Analyse the data to explain the difference in the withdrawal response of the worms to the different stimuli.

(3)

(c) When the touch stimulus is applied several times to the worms, they learn to reduce the withdrawal response.

(i) Give **two** advantages for worms with this type of learning behaviour.

(2)

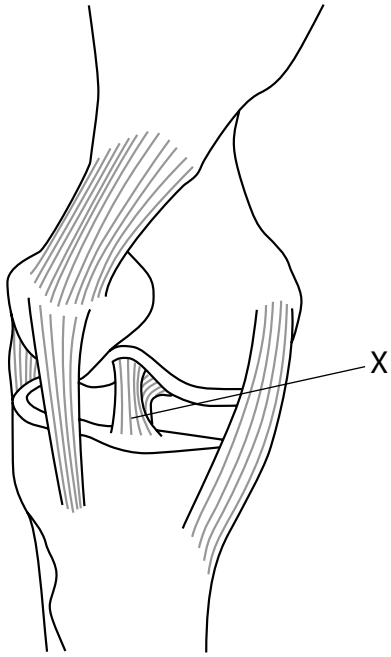
(ii) Explain how repeated touch stimulation reduces the withdrawal response.

(5)

(Total for Question 7 = 12 marks)

8 Movement at a joint is brought about by the contraction of antagonistic muscles which contain slow and fast twitch fibres.

The diagram shows a knee joint.



Lateral view of the knee

(a) Which tissue is used to repair structure X using keyhole surgery?

(1)

- ☒ **A** bone
- ☒ **B** cartilage
- ☒ **C** ligaments
- ☒ **D** tendon

(b) Explain why muscles occur in antagonistic pairs.

(2)

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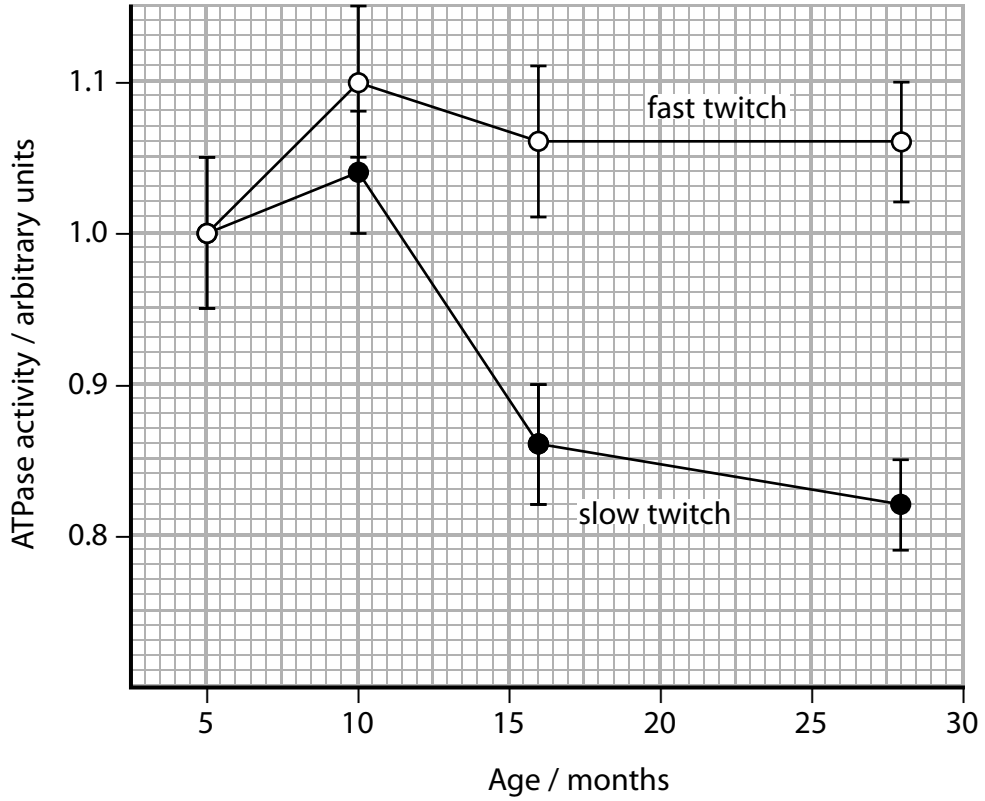
(c) A group of scientists investigated the effect of aging on the Ca-ATPase activity in fast and slow twitch muscle fibres obtained from rats.

The results are shown in the graph.



The membranes in these fibres contain the enzyme Ca-ATPase which is involved in the transport of calcium ions.

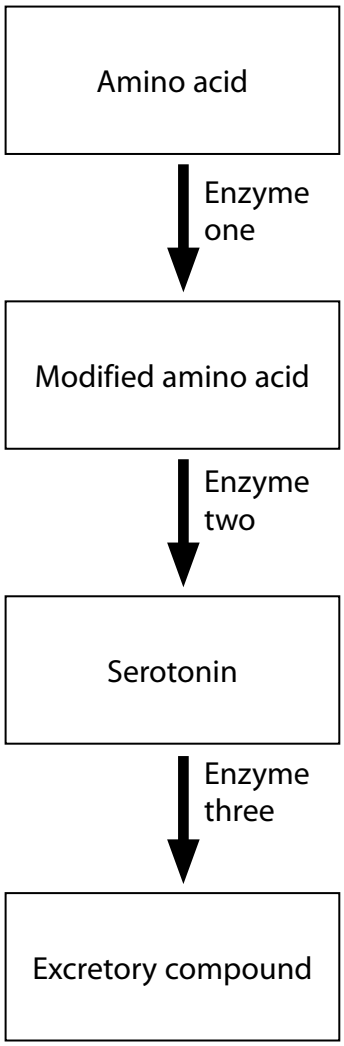
The scientists concluded that in older muscle it takes longer to restore the calcium ion balance.

Analyse the data to evaluate whether these results support the scientists' conclusion.

(6)

(Total for Question 8 = 9 marks)

9 Serotonin is a neurotransmitter. It is kept at optimum levels to maintain a feeling of well-being. Serotonin is involved in the metabolic pathway shown in the flow chart.



(a) Explain how the level of activity of these enzymes, in this metabolic pathway, will ensure that optimum levels of serotonin are maintained.

(3)

(b) Drugs called selective serotonin re-uptake inhibitors (SSRIs) are used to reduce depression. They work by inhibiting the reabsorption of serotonin at a synapse.

Explain how SSRIs help to maintain a feeling of well-being.

(3)

(c) Extracts of the plant St John's wort have also been used to treat depression.

A double blind trial compared the effectiveness of treating depression using a SSRI, an extract of St John's wort, and a placebo.

Depression was measured using the Hamilton Rating Scale for Depression (HRSD). The higher the HRSD score the greater the depression.

The table shows the results of this trial.

Time / weeks	HRSD score		
	SSRI	St John's wort	Placebo
0	16	16	17
1	14	15	15
2	13	14	12
3	12	13	12
4	10	13	12
5	9	12	11
6	8	12	11
7	7	11	12
8	6	12	12

(i) State what is meant by the term **double blind**.

(1)

.....

.....

(ii) Analyse the data in the table to compare the effectiveness of these three treatments for depression.

(3)

(iii) Double blind trials give scientists confidence in the results collected.

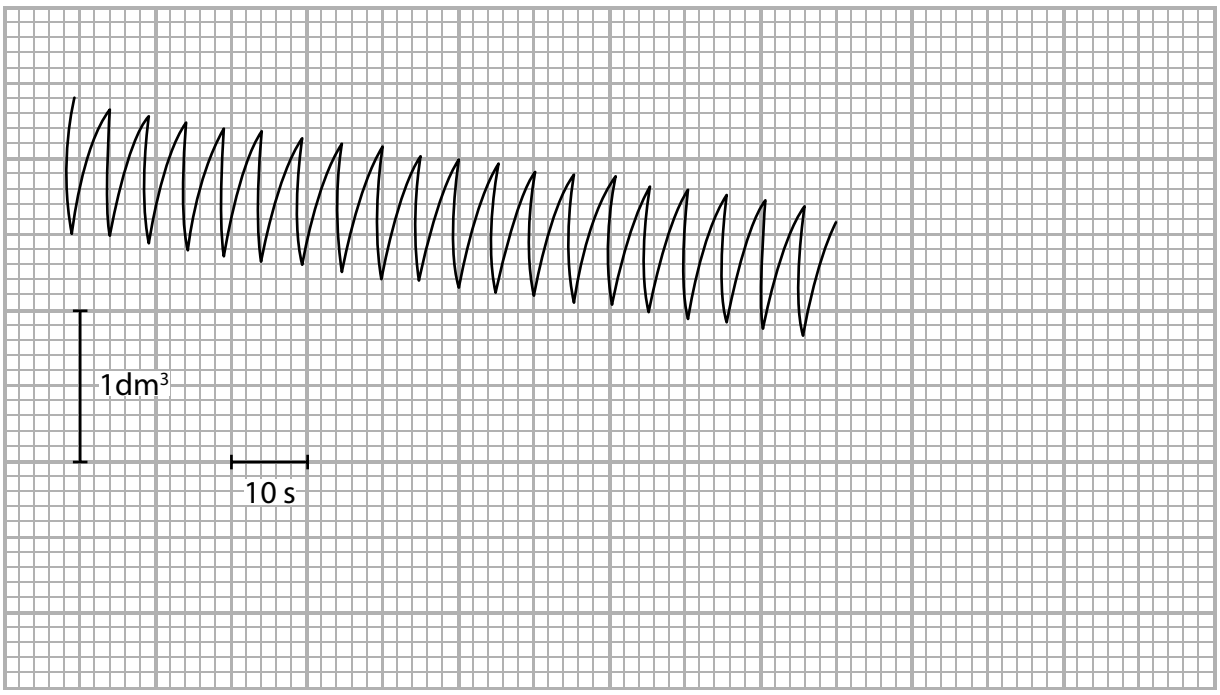
Explain **two** ways the design of this trial could be improved in order to increase confidence in the results.

(4)

(Total for Question 9 = 14 marks)

10 Exercise has an effect on oxygen consumption, the efficiency of ventilation and the risk of type 2 diabetes.

(a) A spirometer can be used to study oxygen consumption. The spirometer trace shown was obtained for a 90 kg male human at rest.



Calculate the mean rate of oxygen consumption at rest for this person.

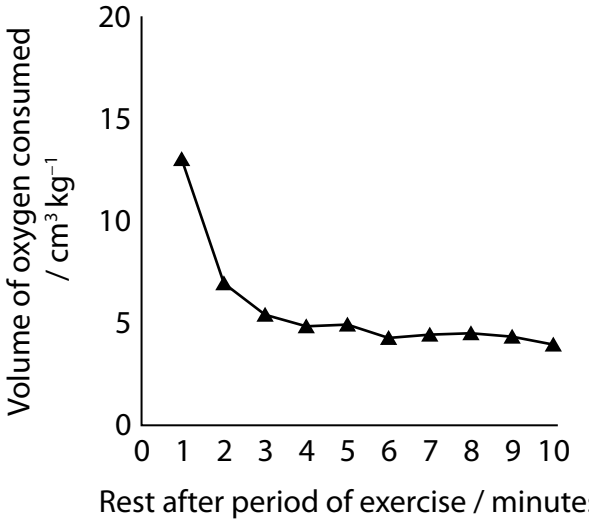
(3)

Answer ..... $cm^3\ kg^{-1}min^{-1}$

(b) A spirometer trace was used to measure the total volume of oxygen consumed by an athlete at rest. The oxygen consumed at rest was 4.0 $cm^3\ kg^{-1}min^{-1}$.

The athlete then did a period of intense exercise.

The graph shows the values for the 10 minutes of rest after the period of exercise.



(i) Explain the change in the oxygen consumption during the 10 minutes of rest after exercise.

(5)

(ii) Explain how the respiratory centre is involved in the control of ventilation rate in the 10 minutes of rest after exercise.

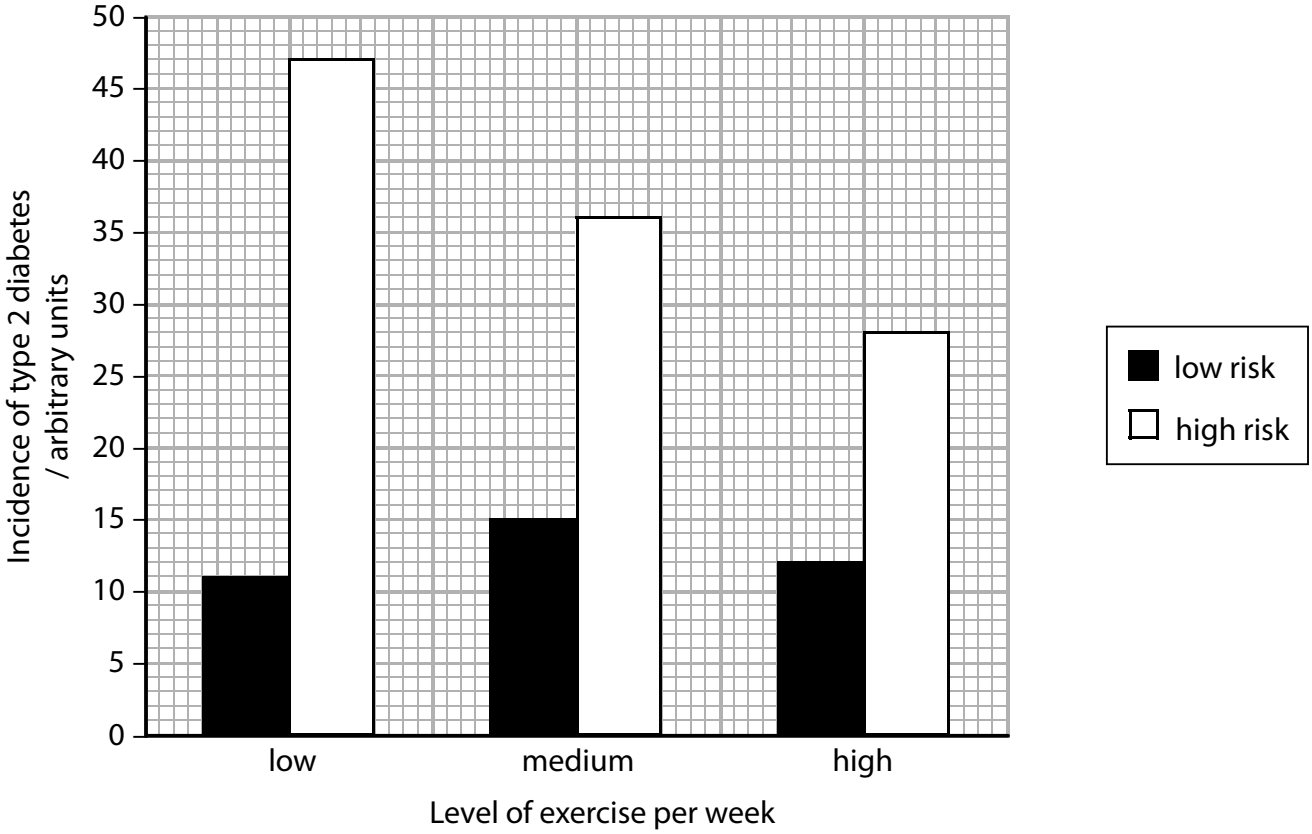
(5)

(c) The development of type 2 diabetes may be linked to lack of exercise.

The graph below shows the effect of exercise on the incidence of type 2 diabetes in two groups of men.

Men at low risk had no family history of developing type 2 diabetes. Men at high risk had a family history of developing type 2 diabetes.

The men were grouped according to their level of exercise per week.



Analyse the data to discuss possible correlation and causation in the relationship between the incidence of type 2 diabetes and the level of weekly exercise.

(4)

(Total for Question 10 = 17 marks)

TOTAL FOR PAPER = 100 MARKS