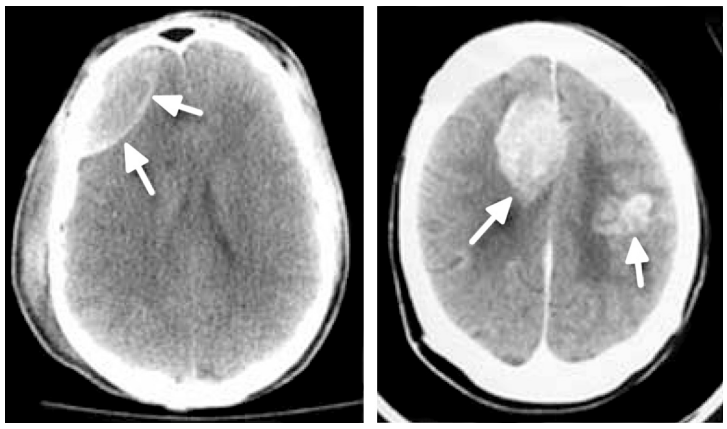
mock papers 1

1 Computed tomography (CT) and functional magnetic resonance imaging (fMRI) are used to investigate brain structure and function.
The CT scans below show two different human brains with abnormal areas. These areas are indicated by arrows.



Magnification × 0.2

(a) Describe how these images could help a doctor to determine appropriate treatment of the abnormalities.

(2)

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(b) Explain why the abnormalities in these two brains could cause different symptoms.

(2)

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(c) Describe how fMRI is used to investigate brain function.

(2)

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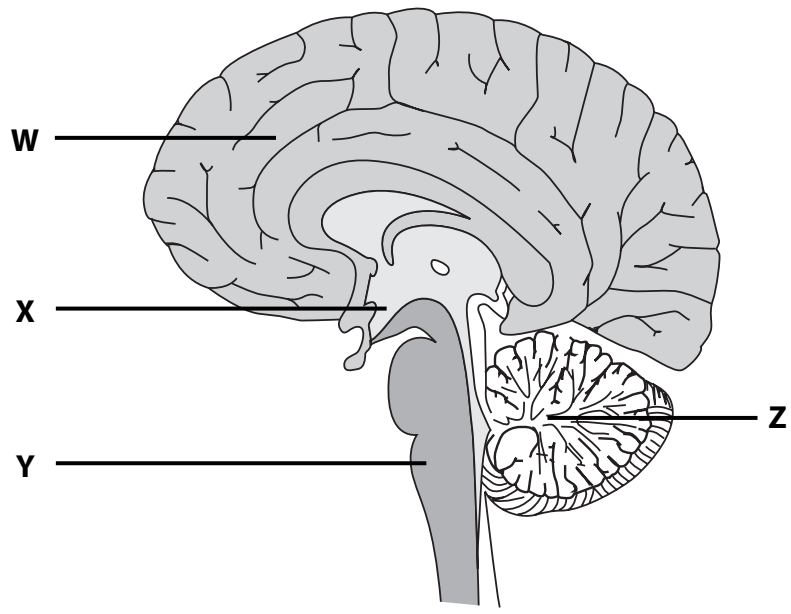
(d) The diagram below shows a section through the human brain.



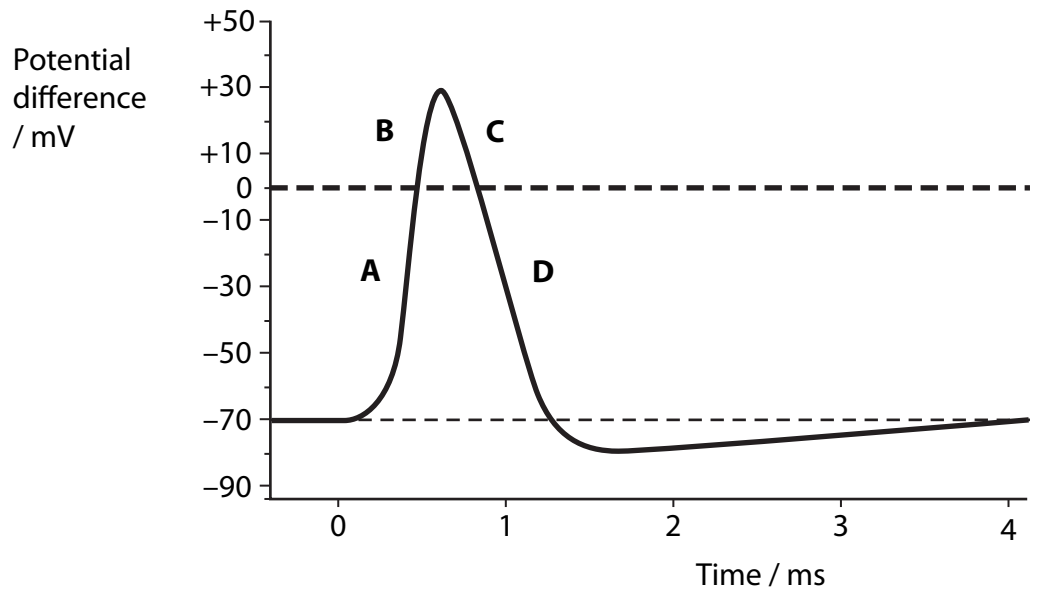
For each of the activities below, indicate the region of the brain **W**, **X**, **Y** or **Z** which will be most involved. Put a cross ☒ in the box corresponding to the correct letter.

(4)

Activity	Region of brain			
	W	**X**	**Y**	**Z**
Regulating core temperature	☒	☒	☒	☒
Climbing stairs	☒	☒	☒	☒
Regulating carbon dioxide in the blood	☒	☒	☒	☒
Choosing a gift	☒	☒	☒	☒

(Total for Question 1 = 10 marks)

2 The diagram below shows changes in potential difference across the membrane of a neurone during an action potential.



(a) Describe the events that begin the depolarisation of the membrane of a neurone.

(2)

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(b) Complete the table below to show which ions are able to move across the membrane at positions **A** and **D** shown in the diagram.

Put a cross ☒ in the box if the membrane is permeable to the ion.

(2)

Position on diagram	Permeable to sodium ions	Permeable to potassium ions
A	☒	☒
D	☒	☒

(c) Give an explanation for the movement of ions at position **C** on the diagram.

(3)

(d) Explain how the potential difference across the membrane is returned to the resting level in the time between 1.5 ms and 4.0 ms on the diagram.

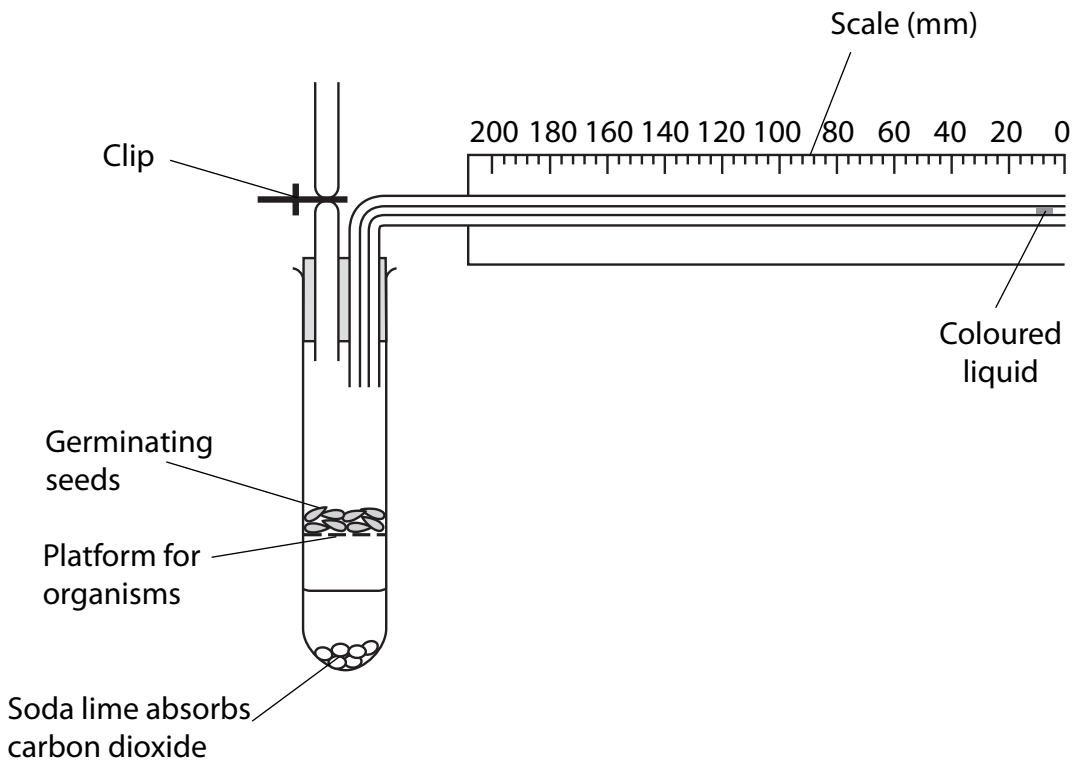
(3)

(Total for Question 2 = 10 marks)

3 The apparatus shown in the diagram below was used to measure the rate of respiration of germinating seeds in air. The distance moved by the coloured liquid was measured at 15-minute intervals for one hour.

This was repeated with the air replaced by nitrogen gas.

The rate of respiration of small insects in air was measured using the same apparatus.



(a) Suggest reasons for absorbing carbon dioxide in this apparatus.

(2)

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(b) The table below shows results recorded by a student using this apparatus.

Organism	Distance moved by liquid in 15-minute intervals / mm				Mean rate of respiration / mm min^{-1}
Germinating seeds	7	6	5	6	0.4
Germinating seeds in nitrogen gas	0	0	0	0	0
Insects	12	11	13	12	

(i) In the space below, calculate the mean rate of respiration for the insects, expressed as movement of liquid in millimetres per minute.
Show your working.

(2)

Answer ..... mm min^{-1}

(ii) The seeds in the experiment with nitrogen gas continued to germinate.
Suggest an explanation for the lack of movement of the liquid.

(2)

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(iii) Suggest **two** reasons why a valid comparison cannot be made between the mean rates of respiration of the germinating seeds in air and the insects.
For each reason, suggest a modification that would allow a valid comparison.

(4)

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(Total for Question 3 = 10 marks)

4 Electrical activity in heartbeats can be recorded using electrocardiograms (ECG). An ECG includes recording of the activity of the sinoatrial node (SAN).

(a) Describe the role of the SAN in controlling heartbeats.

(2)

(b) Describe how the cardiovascular centre, in the medulla oblongata, affects the SAN during exercise.

(2)

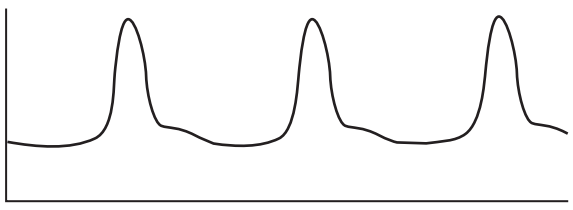
(c) ECGs can be used to diagnose abnormalities in the heartbeat. One such abnormality is a ventricular ectopic beat. This occurs when a region of the ventricle has a similar effect on the heart as the sinoatrial node (SAN).

The diagrams below show a normal ECG trace and a trace that shows a ventricular ectopic beat, labelled E. The traces were recorded from left to right. Changes in blood pressure in the pulmonary artery are shown over the same period of time.

Normal heart

ECG

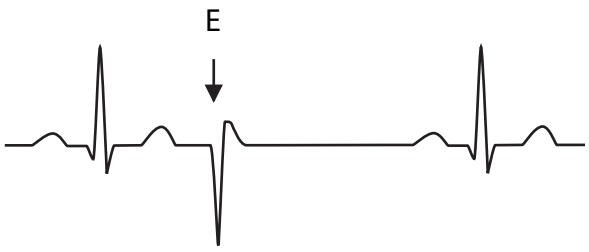
Change in blood pressure in pulmonary artery / kPa



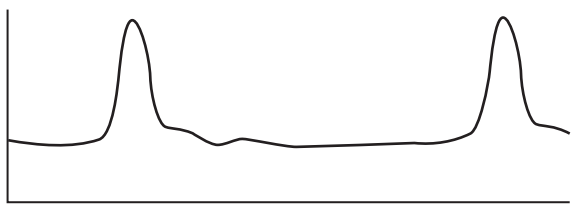
Time / seconds

Heart with ectopic beat

ECG



Change in blood pressure in pulmonary artery / kPa



Time / seconds

*Describe the effect of the ectopic beat on heart activity and suggest an explanation for this effect.

(5)

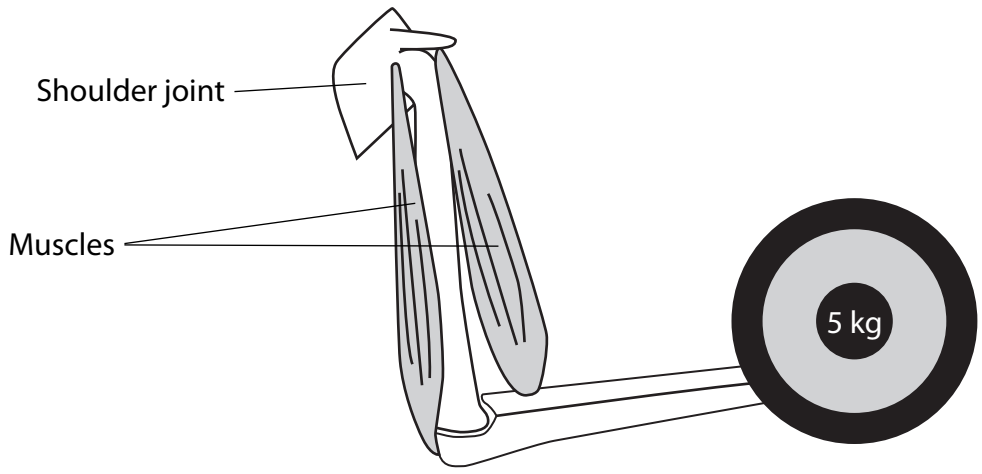
(d) Performance-enhancing drugs may affect heart activity. Outline **one** ethical position relating to whether these drugs should be banned.

(2)

(Total for Question 4 = 11 marks)

Turn over ▶

5 The diagram below shows the arrangement of muscles and bones in an arm.
A 5 kg mass was held steady in the position shown and then lifted upwards towards the body.



(a) In the table below, show which of the muscles are contracted when holding the mass steady and when lifting it. Put a cross ☒ in the box beside muscles that are **contracted**.

(2)

Muscle	**Muscle contracted when**	
	Holding steady	**Lifting upwards**
Extensor	☒	☒
Flexor	☒	☒

(b) Name the structures that connect muscles to bones.

(1)

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(c) Explain why muscles occur in antagonistic pairs.

(2)

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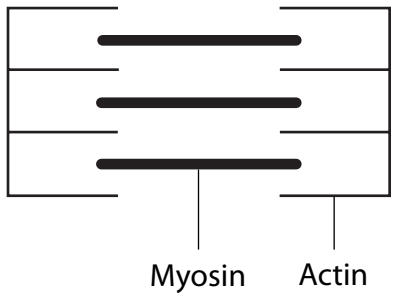
(d) The diagram below shows the arrangement of actin and myosin myofilaments in part of an extended muscle.



Complete the diagram below to show accurately the arrangement of actin and myosin when the muscle is contracted.

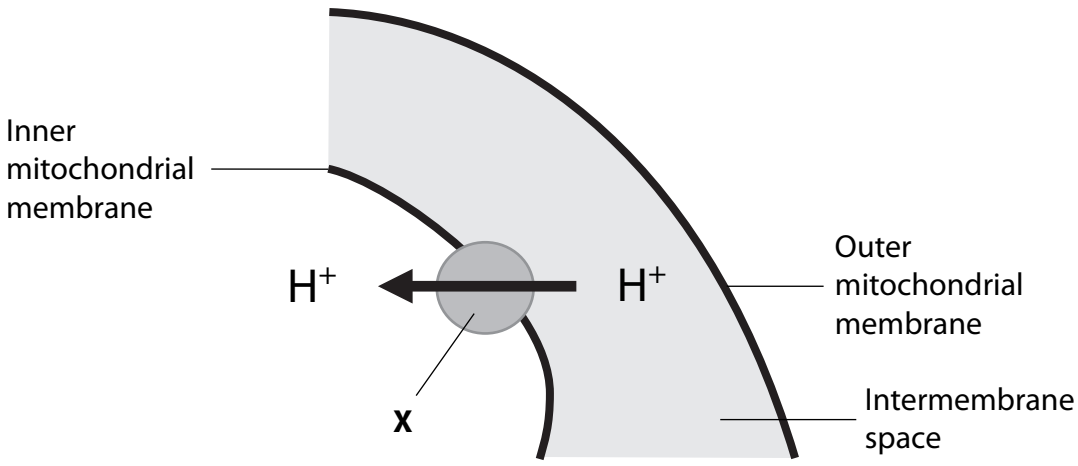
(3)

*(e) Describe and explain the role of calcium ions and ATP in muscle contraction.

(5)

(Total for Question 5 = 13 marks)

6 The diagram below shows part of the process of chemiosmosis in a mitochondrion.



(a) Name the enzyme labelled **X** involved in chemiosmosis.

(1)

(b) Explain how a high concentration of hydrogen ions (H^+) is maintained in the intermembrane space.

(3)

(c) Describe the role of the hydrogen ion concentration gradient in making available an accessible supply of energy for biological processes.

(2)

(Total for Question 6 = 6 marks)

7 The scientific document you have studied is adapted from articles in New Scientist. Use the information from the article and your knowledge to answer the following questions.

(a) Outline the process by which 'more molecules of the enzymes' are produced (last paragraph on page 7).

(4)

(b) Explain how the fluid mosaic model of membrane structure makes it possible to change the number of adrenoceptors (first paragraph on page 9).

(2)

(c) Explain, using examples from the text, how scientific opinion can be 'deeply divided' when based on the same evidence.

(3)

*(d) (i) Discuss the treatments for Parkinson's disease described in the article. Include particular benefits and any ethical issues and possible problems associated with these treatments.

(7)

(ii) Compare the changes in brain chemistry that are linked to Parkinson's disease with those that are linked to depression.

(2)

(e) Suggest similarities between nerve cells in *Caenorhabditis elegans* expressing the ChR2 gene and cells of the mammalian retina.

(3)

(f) Using an example from the text, explain how a virus can introduce genes into specific cells.

(3)

(g) Suggest how the presence of bradykinin could affect tissues.

(2)

(h) Suggest the factors that need to be accounted for in the design of drug trials of painkillers.

(4)

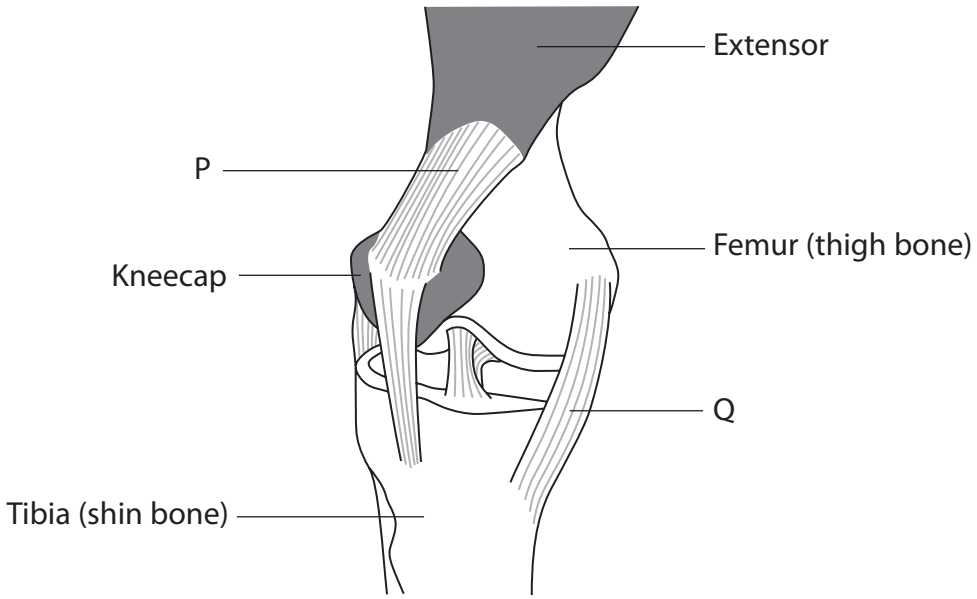
(Total for Question 7 = 30 marks)

TOTAL FOR PAPER = 90 MARKS

mock papers 2

1 Sports injuries can result in damaged human knee joints. The damaged joint can be repaired using keyhole surgery.

The diagram below shows a human knee joint.



(a) Place a cross ☒ in the box to identify each of the following structures.

(i) Structure P

(1)

☒ **A** Cartilage

☒ **B** Ligament

☒ **C** Muscle

☒ **D** Tendon

(ii) Structure Q

(1)

☒ **A** Cartilage

☒ **B** Ligament

☒ **C** Muscle

☒ **D** Tendon

(b) Describe the function of structure Q.

(2)

(c) Structure Q may become torn during some sporting activities. It may not be possible to join the torn parts together. Material can be removed from structure P without causing any damage. This material can be used to join the damaged pieces of Q together.

Suggest why the use of material from structure P will mean that recovery will be quite slow and require careful physiotherapy.

(2)

(d) The operation to repair the damage can be done using keyhole surgery.
Suggest the benefits of this technique.

(3)

(Total for Question 1 = 9 marks)

2 Plants can detect and respond to environmental cues.

Cocklebur is a plant that flowers after it has been exposed to a sufficiently long period of darkness. The minimum length of time in darkness needed to stimulate flowering is called the critical period.

An investigation was carried out into the effect of light and dark periods on cocklebur flowering. Four plants, A, B, C and D, were exposed to light and dark periods of different length. The presence or absence of flowers was recorded after several weeks.

The diagram below shows the pattern of light and dark periods for these plants and the effect on flowering.

Plant	Time / hours						Flowers present
	0	4	8	12	16	20	
A							Yes
B							No
C							No
D							No

key

Light

Dark

(a) (i) Using the information in the diagram, give the critical period for flowering of cocklebur plants.

(1)

.....

(ii) Using the information in the diagram and your own knowledge of photoreceptors, explain why plant B has not flowered.

(2)

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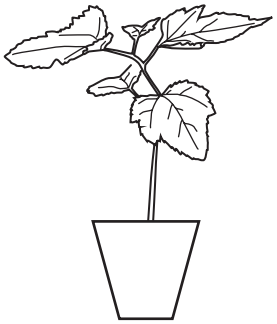
.....

(b) In a further investigation, plants E and F were exposed to six hours of darkness each day. Part of a leaf on plant F was covered so that the leaf experienced eight hours of darkness each day.

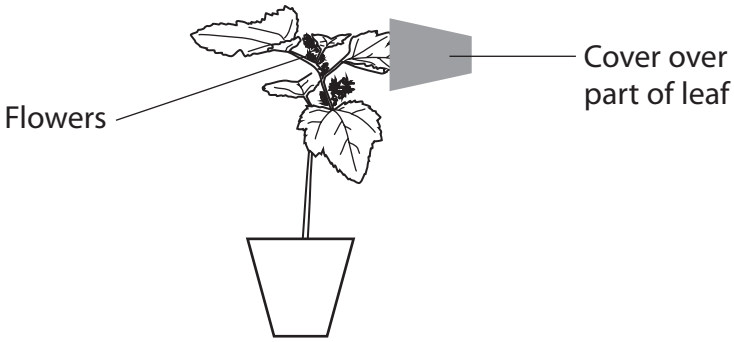
The diagram below summarises the results of this investigation.

Plant E



No flowers present

Plant F



Flowers present

Explain the purpose of plant E in this investigation.

(2)

(c) Using your own knowledge of photoreceptors, explain the results of these investigations. What do they suggest about the control of flowering in cocklebur plants?

(4)

(d) Suggest benefits to plants of being able to respond to changes in day length.

(3)

(Total for Question 2 = 12 marks)

3 L-Dopa can be used to treat people with Parkinson's disease. Using L-Dopa for a long period of time can have side effects that include uncontrolled movement of limbs.

It is possible that increasing the levels of serotonin in the brain could be an effective treatment for these side effects. It has been suggested that MDMA (ecstasy) could be used to increase levels of serotonin.

(a) Explain why L-Dopa is used to treat people with Parkinson's disease.

(2)

(b) Explain how MDMA could affect levels of serotonin in the brain.

(3)

(c) In trials of this treatment, marmosets (small monkeys) were given a drug to reduce dopamine production. They were then treated with L-Dopa until they showed the side effects observed in the treatment of people with Parkinson's disease.

(i) Suggest a reason why the marmosets were treated with a drug to reduce dopamine production.

(1)

(ii) Describe the ethical issues involved in the use of animals in a trial of this kind.

(3)

(d) The results of the study showed that MDMA did reduce the side effects in the marmosets.

Describe the steps that would need to be taken before a similar treatment could be used in humans.

(3)

(Total for Question 3 = 12 marks)

4 According to the sliding filament theory of muscular contraction, force is produced when myosin molecules change shape.

Myosin molecules can generate a force of 1.7×10^{-6} N per million molecules when they change shape.

Measurements of a single muscle fibre showed that a force of 3.5×10^{-3} N was produced when it contracted.

(a) Use this information to calculate the number of myosin molecules changing shape during the contraction of this muscle fibre. Show your working.

(2)

Answer .....

(b) Examination of this muscle fibre found that there were only a few mitochondria present.

(i) Name this type of muscle fibre.

(1)

.....

(ii) The energy required for contraction of muscle fibres is provided by ATP. Describe how enough ATP is made available for contraction of this muscle fibre, despite there being only a few mitochondria.

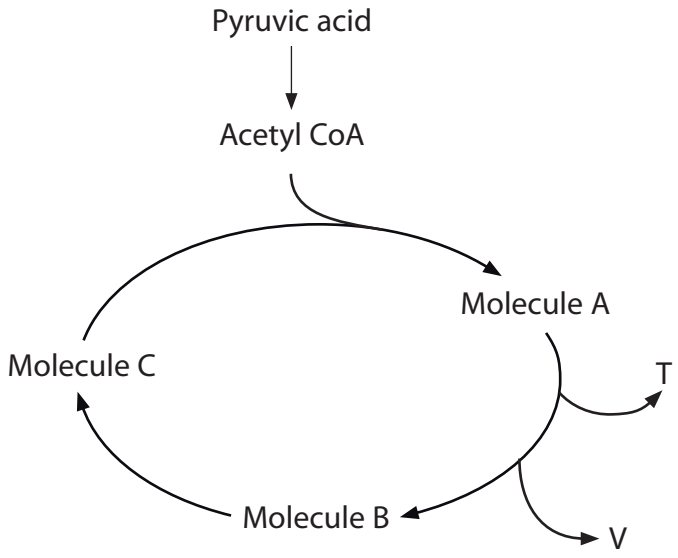
(5)

(iii) Explain why you would expect this type of muscle fibre to fatigue quickly.

(2)

(Total for Question 4 = 10 marks)

5 The diagram below summarises some of the reactions in aerobic respiration.



(a) Name the process that produces pyruvic acid.

(1)

.....

(b) Place a cross ☒ in the box that correctly identifies each of the following.

(i) The waste product V

(1)

☒ **A** ATP

☒ **B** Carbon dioxide

☒ **C** Lactic acid

☒ **D** Water

(ii) The molecule T that becomes reduced during the process

(1)

☒ **A** ADP

☒ **B** Oxygen

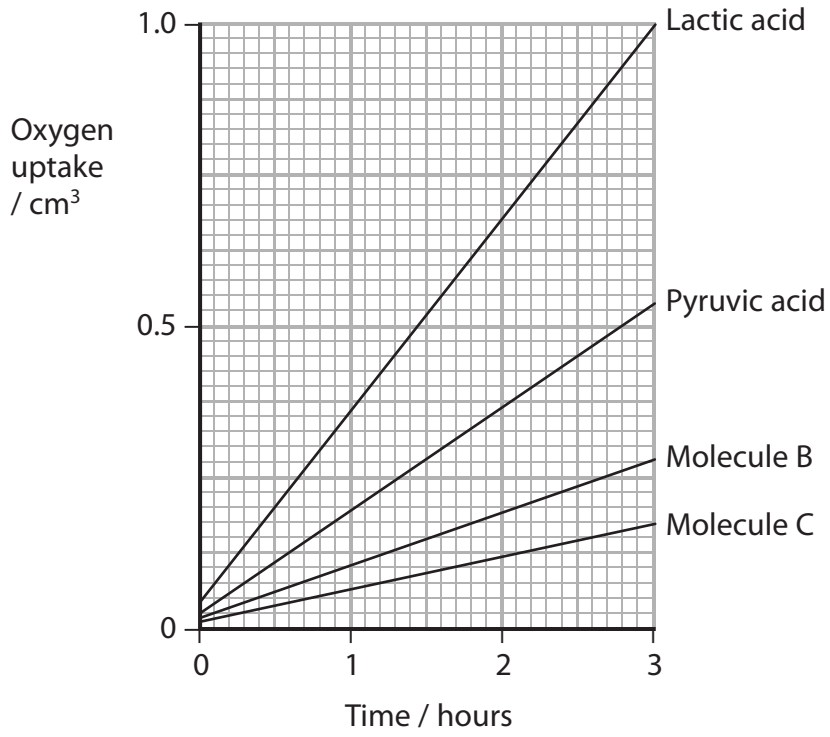
☒ **C** NAD

☒ **D** Water

(c) An investigation was carried out into the ability of bacteria to use different substances as substrates for aerobic respiration.

Cultures of bacteria were grown separately in media containing lactic acid or one of the substances shown in the diagram (pyruvic acid, molecule B or molecule C). The initial concentration of each of these substances in the media was the same. The oxygen uptake of each culture was measured over a period of time.

The results are shown in the graph below.



(i) Using the information in the diagram and the graph, suggest an explanation for the differences in oxygen uptake between bacteria using pyruvic acid, molecule B and molecule C as a substrate.

(4)

(ii) Suggest **one** reason for the rapid oxygen uptake by bacteria in a medium containing lactic acid. Give an explanation for your answer.

(2)

(Total for Question 5 = 9 marks)

6 Cardiac muscle is myogenic.
The rhythmic contraction of the heart, in a particular sequence, is a feature of the cardiac cycle.

(a) Explain what is meant by the term **myogenic**.

(2)

*(b) Describe how the sequence of muscular contraction in the heart is coordinated and how the movement of blood through the heart is controlled.

(6)

(Total for Question 6 = 8 marks)

7 The scientific article you have studied is adapted from articles in New Scientist. Use the information from the article and your own knowledge to answer the following questions.

(a) Name one 'retinal photoreceptor protein' (second paragraph on page 2) and describe its function.

(2)

(b) Explain what is meant by 'The human genome project could help to change that' (fourth paragraph on page 2).

(2)

(c) Suggest why genes are only partly responsible for the development of cancer and heart disease.

(3)

(d) Attempts to treat cystic fibrosis with gene therapy have not yet been successful.

Use information in the article to suggest reasons why inserting the correct gene into a cell may not be all that is required.

(3)

*(e) Explain how RNA templates are used to specify the chemical structure of a protein.

(6)

(f) Explain how a transcription factor might 'recognise a particular stretch of DNA' (first paragraph on page 4).

(2)

(g) Use the information in the article to describe ways in which new genes can arise.

(5)

(h) Explain how NF-k B might have a role in the development of atherosclerosis.

(2)

(i) Explain why a DNA strand is not read 'in six different ways' (eighth paragraph on page 8).

(2)

(j) About 10 million years ago, an event led to the production of antifreeze protein in one Antarctic fish. Explain why almost all Antarctic fish now contain antifreeze protein.

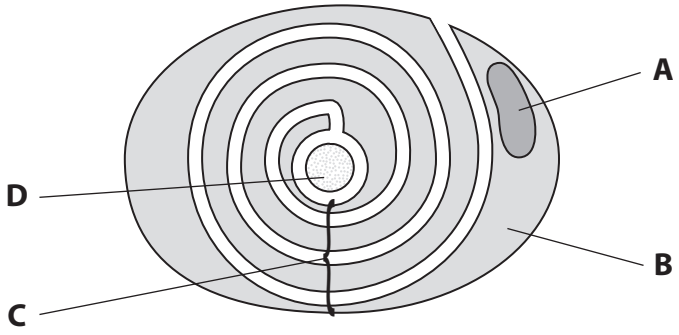
(3)

(Total for Question 7 = 30 marks)

TOTAL FOR PAPER = 90 MARKS

mock papers 3

1 The diagram below shows a section through a motor neurone.



(a) Identify structures A, B, C and D by placing a cross ☒ in the correct box in the table below.

(4)

Structure	A	B	C	D
Axon	☒	☒	☒	☒
Cytoplasm of Schwann cell	☒	☒	☒	☒
Myelin sheath	☒	☒	☒	☒
Nucleus of Schwann cell	☒	☒	☒	☒

(b) Describe the role of the structure labelled **C** in the conduction of nerve impulses.

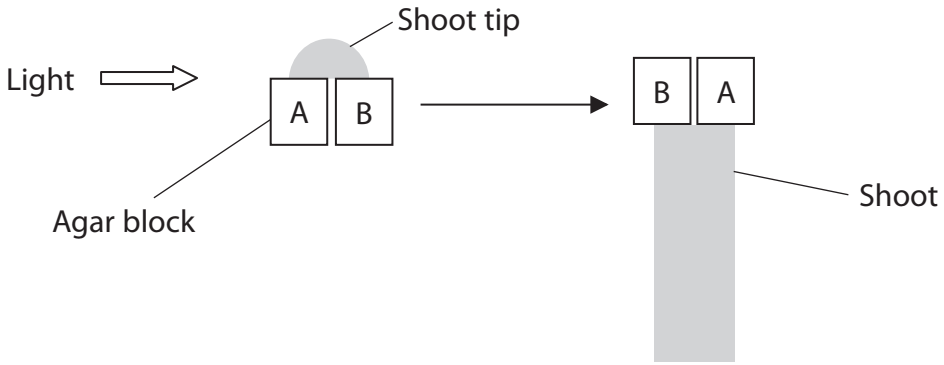
(4)

(c) Explain how the structure of the axon cell membrane is related to the conduction of nerve impulses.

(3)

(Total for Question 1 = 11 marks)

2 The tip of a plant shoot was placed on two agar blocks and light was shone from one side. The tip was removed and the agar blocks were then placed on a shoot without a tip, as shown in the diagram below.



(a) In the space below, draw a diagram to show the shoot as it would appear several hours later.

(1)

*(b) Describe the mechanism that causes the change you have drawn.

(4)

(c) Compare this response of a shoot to light with hormonal coordination in animals.

(4)

(Total for Question 2 = 9 marks)

3 When exercise begins, both ventilation rate and heart rate increase. This supplies more oxygen to muscles.

(a) (i) Describe how breathing rate and tidal volume can be determined from a spirometer trace.

(3)

(ii) Explain how you would use breathing rate and tidal volume to calculate ventilation rate.

(1)

(b) An investigation was carried out to study the changes in oxygen uptake by the blood in the lungs after the first ten seconds of exercise.

Men with artificial pacemakers agreed to exercise with their heart rate controlled at 50 beats per minute. The ventilation rate and the oxygen uptake at rest were measured. These were also measured, after the first ten seconds of exercise and the differences recorded.

This was repeated with the heart rate controlled at 100 beats per minute.

The results are shown in the table below.

Heart rate / beats per minute	**Increase in ventilation rate / $dm^3\ min^{-1}$**	**Increase in oxygen uptake by the blood / $cm^3\ min^{-1}$**
50	4.3	87
100	3.9	190

(i) State **one** factor, other than heart rate, that could have affected the rate at which blood passed through the heart.

(1)

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(ii) Using the information in the table, describe the effect of an increase in heart rate on both the ventilation rate and oxygen uptake by the blood, after the first ten seconds of exercise.

(3)

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(iii) Explain how an increased heart rate results in increased uptake of oxygen by the blood in the lungs.

(3)

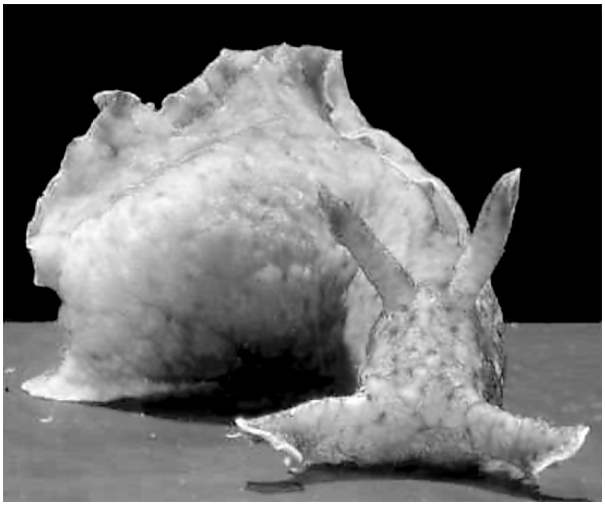
(iv) What conclusions could be drawn from the results of this investigation?

(2)

(Total for Question 3 = 13 marks)

4 In some organisms, the nervous response to a stimulus can reduce as a result of repetition. This is known as habituation.

Sea slugs are marine animals which have gills for the uptake of oxygen from seawater.

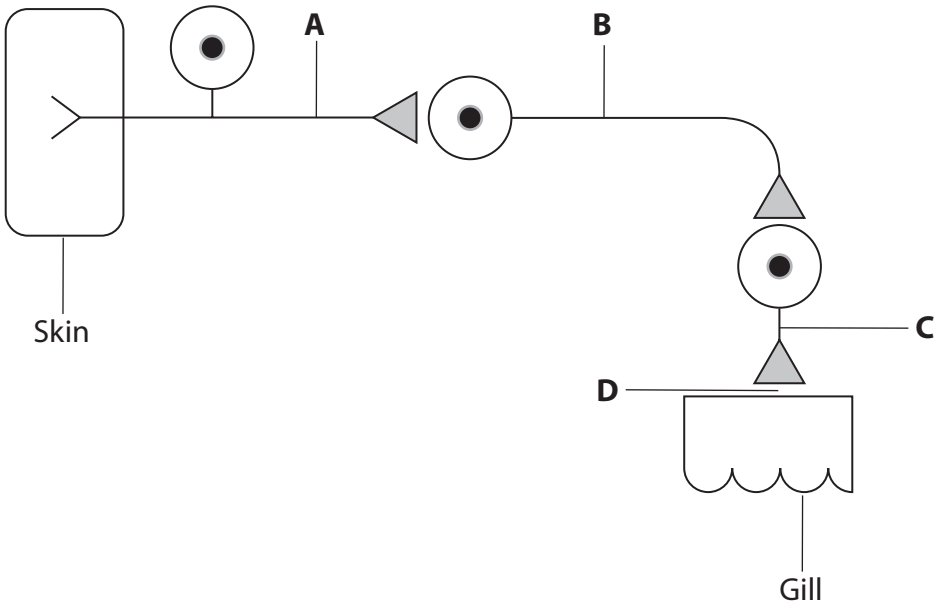


Sea slug

Magnification × 1

A sea slug withdraws its gill when its skin is touched. After some time, the gill is exposed again. With repeated touches, the time taken for it to expose the gill decreases. When the skin is touched frequently, the gill is not withdrawn.

The diagram below shows some of the neurones (nerve cells) involved in this response.



(a) Place a cross ☒ in the correct box in the table below to identify where structures **A**, **B**, **C** and **D**, listed in the table, are shown on the diagram.

(3)

Structure	A	B	C	D
Motor neurone	☒	☒	☒	☒
Sensory neurone	☒	☒	☒	☒
Synapse	☒	☒	☒	☒

(b) (i) Suggest how a repeated stimulus could result in less response from the gill.

(3)

(ii) Suggest how this habituation may be of benefit to a sea slug.

(2)

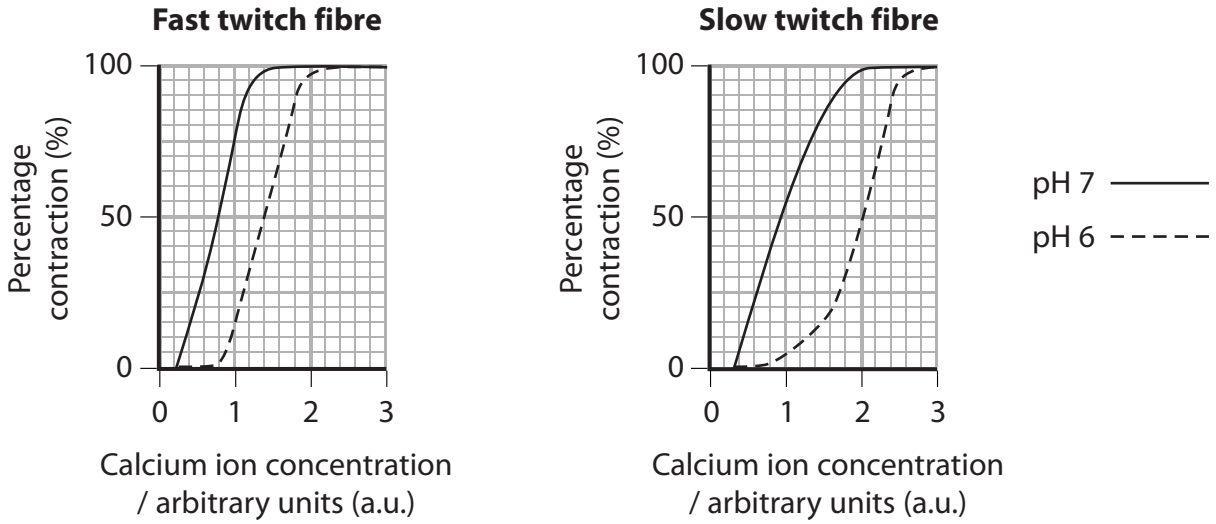
(Total for Question 4 = 8 marks)

5 An investigation was carried out into the effect of pH on the contraction of muscle fibres.

Single muscle fibres were used with their surrounding membranes removed. These fibres will contract when exposed to calcium ions in solution.

Isolated slow twitch and fast twitch fibres were tested at pH 7 and pH 6, in a range of calcium ion concentrations.

Results for both types of fibre are shown in the graphs below.



(a) The sensitivity of a muscle fibre is defined as the concentration of calcium ions required to cause 50% of full contraction.

Using the information in the graphs, complete the table below.

(2)

Type of fibre	Sensitivity		Change in sensitivity / a.u.
	Calcium ion concentration at pH 7 / a.u.	Calcium ion concentration at pH 6 / a.u.	
Fast twitch	0.8	1.4	
Slow twitch			

(b) Using the information in the graphs, compare the effect of pH on slow twitch and fast twitch fibres.

(2)

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(c) (i) Describe a circumstance that could cause a fall in pH in living muscle.

(1)

(ii) Suggest how the different responses of these two types of fibre to pH may be related to their different functions in muscle.

(2)

(d) It is possible to replace the troponin in fast twitch fibres with troponin from slow twitch fibres. Fast twitch fibres that have been treated in this way have the same sensitivity as slow twitch fibres.

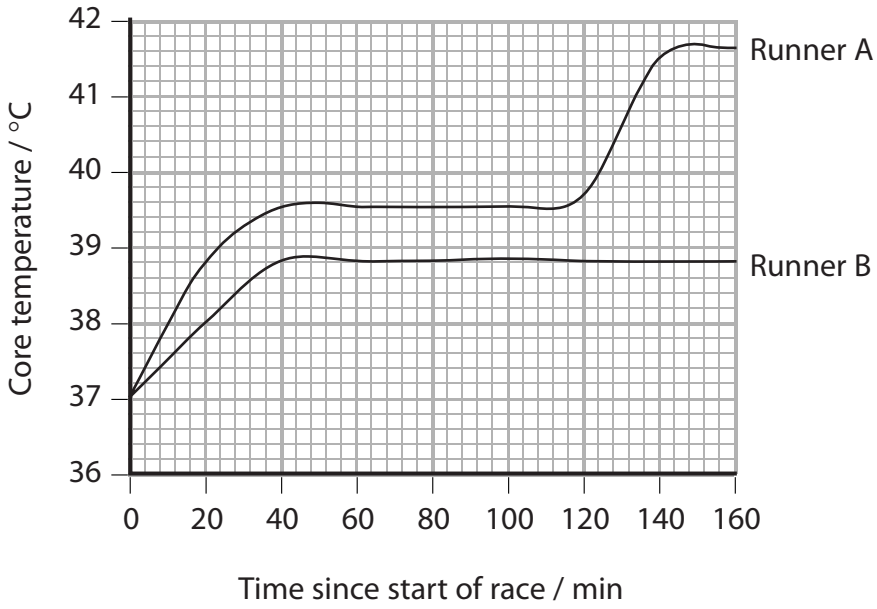
Use your knowledge of the sliding filament theory of muscle contraction to explain why this might have been predicted.

(3)

(Total for Question 5 = 10 marks)

6 Marathon runners can have difficulty with thermoregulation over the course of a 26 mile race, particularly on a hot day. Two marathon runners, A and B, had their core temperatures recorded during a race.

The graph below shows the core temperatures recorded during the race.



(a) Suggest an explanation for the change in core temperatures of both runners in the first 30 minutes of the race.

(2)

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(b) Suggest an explanation for the constant core temperatures of both runners between 60 and 100 minutes of this race.

(5)

(c) During this race, runner A lost 3.02 kg of water and runner B lost 2.43 kg of water.

Using the information in the question and your own knowledge, suggest reasons for the change in core temperature of runner A after 120 minutes.

(2)

(Total for Question 6 = 9 marks)

7 The scientific article you have studied is adapted from articles in New Scientist. Use information from the article and your own knowledge to answer the following questions.

(a) Suggest how erythropoietin (epo) production might be shut down when oxygen levels in the blood are normal (page 2, paragraph 6).

(3)

*(b) Describe how adenoviruses in the blood 'are recognised and destroyed by the immune system' (page 3, paragraph 4).

(5)

(c) 'A single injection elevated hematocrits for over a year in the mice and for 12 weeks in the monkeys.' (page 3, paragraph 5)

Suggest why the injection of genes into body cells does not have a permanent effect.

(2)

(d) 'Sludge blood' (page 4, paragraph 1) can lead to high blood pressure and atherosclerosis.

Explain the connection between high blood pressure and atherosclerosis.

(3)

(e) Name the 'small vessels' (page 4, paragraph 1) that have the greatest effect in producing high blood pressure.

(1)

(f) Suggest **one** way in which one gene could result in the production of several different proteins.

(1)

(g) Use information in the article to describe **three** ways in which athletes might artificially enhance their performance.

(3)

(h) Explain why the governing bodies of sports ban the artificial enhancement of performance.

(2)

(i) A proteasome is 'a barrel-shaped multi-protein complex that chops proteins down into their component amino acids for reuse'.

Explain how muscle protein can be chopped into amino acids inside a cell.

(2)

(j) Explain what is meant by repolarisation of a cardiac muscle cell or a nerve cell.

(2)

(k) Suggest why large numbers of mitochondria are found in muscle cells.

(2)

(l) 'Schuelke discovered that the boy had a mutation in both copies of the gene coding for the muscle growth inhibitor myostatin.' (page 10, paragraph 1)

Suggest how this boy could have inherited this condition. Use a genetic diagram to illustrate your answer.

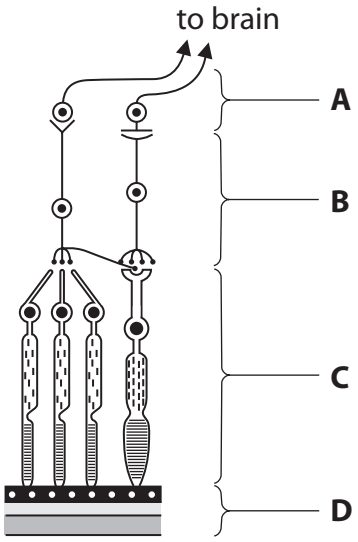
(4)

(Total for Question 7 = 30 marks)

TOTAL FOR PAPER = 90 MARKS

mock papers 4

1 The diagram below shows the position of some of the cells in the retina of the eye.



(a) Place a cross in the box ☒ next to the correct letter to complete each of the following statements.

(i) Rod cells are found in the layer labelled

(1)

☒ **A** ☒ **B** ☒ **C** ☒ **D**

(ii) The neurones of the optic nerve begin in the layer labelled

(1)

☒ **A** ☒ **B** ☒ **C** ☒ **D**

(iii) In this diagram of the retina, the light would pass through from

(1)

☒ **A** bottom to top

☒ **B** left to right

☒ **C** right to left

☒ **D** top to bottom

(b) The macula is the central part of the retina in the eye.
Macular degeneration is a common cause of blindness.

Recent research has shown that macular degeneration in adult mice can be successfully treated. This involves injecting embryonic stem cell-derived photoreceptors into their retinas.

(i) Suggest why this sort of treatment might not restore vision in people with macular problems who have been blind from an early age.

(3)

(ii) Suggest why this type of treatment for blindness in humans could be regarded as controversial.

(2)

(c) A group of scientists proposed to investigate a treatment for people who have been blind from an early age.

This investigation involves kittens having their eyes kept shut immediately after birth. After 12 weeks, their eyes will be opened and stem cells injected into the cerebral hemispheres of their brains.

These kittens will then be raised for two years in a constant environment and the development of their retinas will be compared with a control group.

(i) Suggest why the stem cells will be injected into the cerebral hemispheres.

(2)

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(ii) Suggest why the environment should be kept constant in this investigation.

(2)

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(Total for Question 1 = 12 marks)

2 Florence (Flo-Jo) Griffith-Joyner's world record of 10.49 seconds for the 100 m women's sprint in 1988 is unbeaten.

In this short time, a sprinter such as Flo-Jo could not deliver enough oxygen to her muscles to maintain aerobic respiration.

* (a) Describe how a sprinter is able to release sufficient energy for the 100 m sprint without having enough oxygen available for her muscles.

(6)

(b) (i) Lactate (lactic acid) can build up in the muscles of a sprinter.
Suggest why the build-up of lactate may prevent any further increase in speed.

(2)

(ii) Explain the fate of lactate following a sprint.

(4)

(Total for Question 2 = 12 marks)

3 The table below shows information about the top ten fastest men and women in both the 100 m sprint and the marathon race of 42.2 km.

Race	Mean speed / m s^{-1}	Standard deviation
Men's 100 m sprint	10.22	0.10
Women's 100 m sprint	9.35	0.08
Men's marathon	5.65	0.02
Women's marathon	5.06	0.05

(a) (i) Give reasons why the data in the table may be considered to be reliable.

(2)

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(ii) For the marathon, the women's mean speed is 89.6% of the men's mean speed.

For the 100 m sprint, calculate the women's mean speed as a percentage of the men's mean speed.
Show your working.

(2)

Answer = ...%

(iii) Using the information in the table, describe the difference between the mean speeds for men and women for the 100 m sprint.
Suggest a reason for the difference.

(2)

(b) Suggest why the mean speeds for the marathon are less than the 100 m sprint for both men and women.

(3)

(Total for Question 3 = 9 marks)

4 A study examined the risk of developing a mental disorder.
This study determined the risk for both the population as a whole and for those who had a close relative (parent, brother, sister or child) with the same disorder.

The results are shown in the table below.

Mental disorder	Risk of developing mental disorder (%)		
	Population as a whole		Those with a close relative with the same disorder
	Males	Females	
Alcoholism	7.0	2.0	15
Anxiety	3.0	6.0	15
Manic depression	2.0	3.0	15
Neurotic depression	6.0	12.0	11
Obsessive compulsive	0.1	0.1	10
Schizophrenia	1.0	1.0	10

(a) (i) People with obsessive compulsive disorder (OCD) have symptoms such as repeated washing, checking, touching, counting or arranging.

Using the data in this table, give the evidence that OCD is an inherited condition.

(2)

(ii) Using the data in the table, explain the validity of the statement that 'OCD is an inherited condition'.

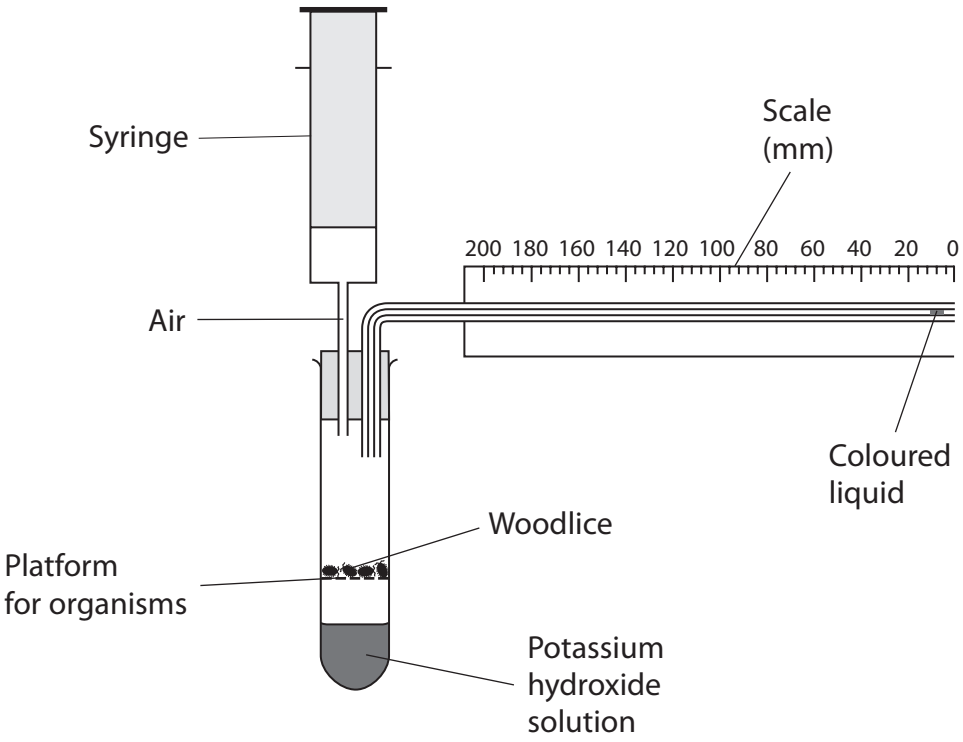
(2)

(iii) Using the data in the table, state which disorder is least likely to be an inherited condition.
Give a reason for your answer.

(2)

(Total for Question 4 = 6 marks)

5 The apparatus shown in the diagram below can be used to measure the rate of respiration of small animals such as woodlice.



(a) (i) Potassium hydroxide solution absorbs carbon dioxide.
Suggest a reason for absorbing carbon dioxide in this apparatus.

(1)

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(ii) Suggest what the syringe is used for in this apparatus.

(2)

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*(b) Describe how this apparatus could be used to find the mean rate of respiration of woodlice.

(6)

(Total for Question 5 = 9 marks)

6 Muscles, bones and joints allow movement of the skeleton.

(a) Place a cross in the box ☒ next to the correct word to complete each of the following statements.

(i) Muscles are attached to bones by

(1)

☒ **A** cartilage

☒ **B** ligaments

☒ **C** synapses

☒ **D** tendons

(ii) In a joint, bones are joined to each other by

(1)

☒ **A** cartilage

☒ **B** ligaments

☒ **C** synapses

☒ **D** tendons

(iii) Muscles that work in pairs across a joint are known as

(1)

☒ **A** agonists

☒ **B** antagonists

☒ **C** extensors

☒ **D** flexors

(iv) In key-hole surgery, cruciate ligaments are repaired using tissue from

(1)

☒ **A** bones

☒ **B** cartilage

☒ **C** ligaments

☒ **D** tendons

(v) Fast twitch muscle fibres have

(1)

☒ **A** few capillaries

☒ **B** high myoglobin content

☒ **C** low glycogen content

☒ **D** many mitochondria

(vi) Slow twitch muscle fibres

(1)

☒ **A** fatigue quickly

☒ **B** have no myoglobin

☒ **C** have low glycogen content

☒ **D** have few mitochondria

(Total for Question 6 = 6 marks)

7 In an investigation into dieting and obesity, mice were fed a restricted quantity of food. It has been found that the stress of having less food causes the release of the hormone noradrenaline. This causes the mice to hunt for food.
These food-restricted mice will tolerate electric shocks in order to eat.

(a) Suggest why this investigation might be regarded as unacceptable.

(2)

(b) Noradrenaline acts by increasing blood flow to the muscles.

(i) Suggest how this increase in blood flow is brought about.

(2)

(ii) Suggest why this increase in blood flow would be of advantage to the food-restricted mice.

(2)

(Total for Question 7 = 6 marks)

8 The scientific document you have studied is adapted from an article in 'The Biologist'.

Use the information from the scientific article and your own knowledge to answer the following questions.

(a) Describe **two** symptoms of Parkinson's disease.

(2)

(b) Patients with Parkinson's disease have little of the neurotransmitter dopamine in the motor cortex of their brains.

Explain how 'dopamine agonists' might be a useful treatment for Parkinson's disease (paragraph 10).

(2)

(c) Dopamine is not given to the patients as it is not effective.
However, the precursor L-Dopa (levadopa) can be given to patients.

Suggest why L-Dopa might be a useful treatment for patients with Parkinson's disease.

(3)

(d) Describe the advantages of deep brain stimulation (DBS) to patients with Parkinson's disease who do not respond to treatment with drugs.

(3)

(e) Suggest why the 'stereotactic frame' has proved to be so useful in DBS (paragraph 22).

(2)

(f) Suggest how DBS affects the cell membranes of brain cells (paragraph 22).

(3)

(g) Explain why Jamie is able to stay awake during the operation without feeling any associated pain (paragraph 22).

(2)

(h) Suggest the advantage of Jamie being conscious during the operation.

(1)

(i) Explain how the experimental model for Parkinson's disease in monkeys was created (paragraphs 54 to 56).

(2)

(j) The subthalamic nucleus and the external segment of the globus pallidus (Table 1, paragraph 62) are connected to each other.

Suggest why this might be relevant for the DBS treatment of Parkinson's disease.

(2)

(k) Describe how fMRI can be used to monitor the activity of different areas of the brain (paragraph 62).

(3)

(l) fMRI can produce four images per second.
Explain why this is unlikely to monitor the effects of DBS (paragraph 62).

(2)

(m) Explain what is meant by the phrase 'placebo responders' (paragraph 64).

(2)

(n) Explain what is meant by the 'causal' nature of DBS (paragraph 73).

(1)

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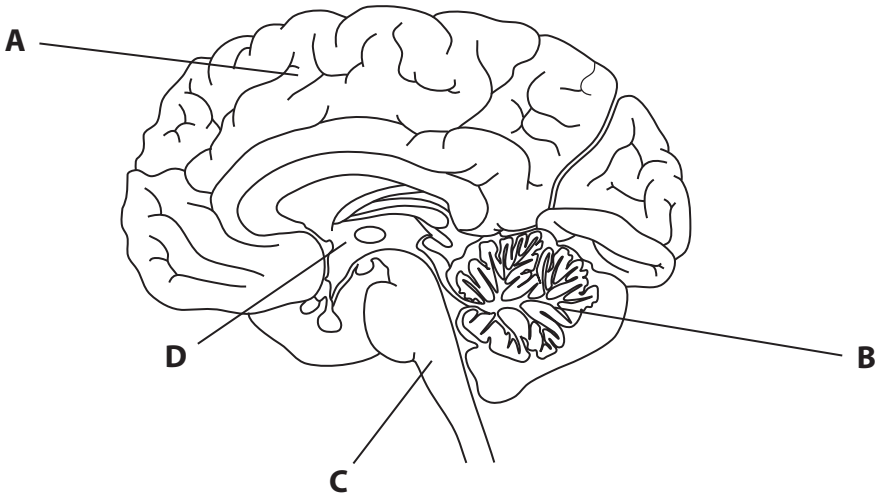
(Total for Question 8 = 30 marks)

TOTAL FOR PAPER = 90 MARKS

mock papers 5

1 (a) The brain acts as the main coordinating centre for nervous activity. It receives information, interprets it and responds accordingly.



(i) Coordination of movement is controlled by the part of the brain labelled

(1)

☒ **A** Cerebral hemisphere

☒ **B** Cerebellum

☒ **C** Medulla oblongata

☒ **D** Hypothalamus

(ii) During exercise, chemoreceptors in the carotid artery detect a decrease in pH due to increased carbon dioxide.
This results in nerve impulses being sent to the

(1)

☒ **A** Cerebral hemisphere

☒ **B** Cerebellum

☒ **C** Medulla oblongata

☒ **D** Hypothalamus

(b) At the start of depolarisation, the ions that move into the axon causing the action potential are

(1)

- ☒ **A** Calcium
- ☒ **B** Chloride
- ☒ **C** Potassium
- ☒ **D** Sodium

(c) When an impulse arrives at a synapse, the ions that enter the pre-synaptic membrane are

(1)

- ☒ **A** Calcium
- ☒ **B** Chloride
- ☒ **C** Potassium
- ☒ **D** Sodium

(d) Acetylcholine is a chemical which acts as

(1)

- ☒ **A** an enzyme
- ☒ **B** a hormone
- ☒ **C** a neurotransmitter
- ☒ **D** a receptor

(e) The drug MDMA (ecstasy) changes behaviour by

(1)

- ☒ **A** decreasing the concentration of adrenaline in brain synapses
- ☒ **B** decreasing the concentration of serotonin in brain synapses
- ☒ **C** increasing the concentration of adrenaline in brain synapses
- ☒ **D** increasing the concentration of serotonin in brain synapses

(Total for Question 1 = 6 marks)

2 The Human Genome Project is helping in the design of new drugs to treat a variety of human diseases and in the development of synthetic tissues.

(a) (i) Explain the meaning of the term **Human Genome**.

(1)

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(ii) Describe **one** ethical implication associated with the use of information obtained from the analysis of the human genome.

(1)

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(b) Melanoma is an aggressive form of skin cancer.

Very few patients with this cancer survive for more than five years. Some melanomas are associated with a genetic mutation identified by the Human Genome Project.

Drug R (R05185426) has been developed to treat patients with these melanomas. In clinical trials, drug R has been shown to cause a 50% shrinkage of melanomas in only a few months.

(i) Suggest how work on the Human Genome Project helped in the development of drug R.

(3)

(ii) Suggest how drug R may have caused the melanoma to shrink in only a **few months**.

(4)

(iii) Drug R needs one more round of testing, in a phase III trial, before it can be approved for use.

Explain what is meant by a **phase III trial**.

(2)

(c) Yeast cells were genetically modified, using human DNA, to produce collagen. This collagen can be used to make synthetic corneas.

Ten patients who were blind were each given a synthetic cornea. They were all able to see with no reported complications due to tissue rejection.

Suggest why these synthetic corneas were not rejected.

(2)

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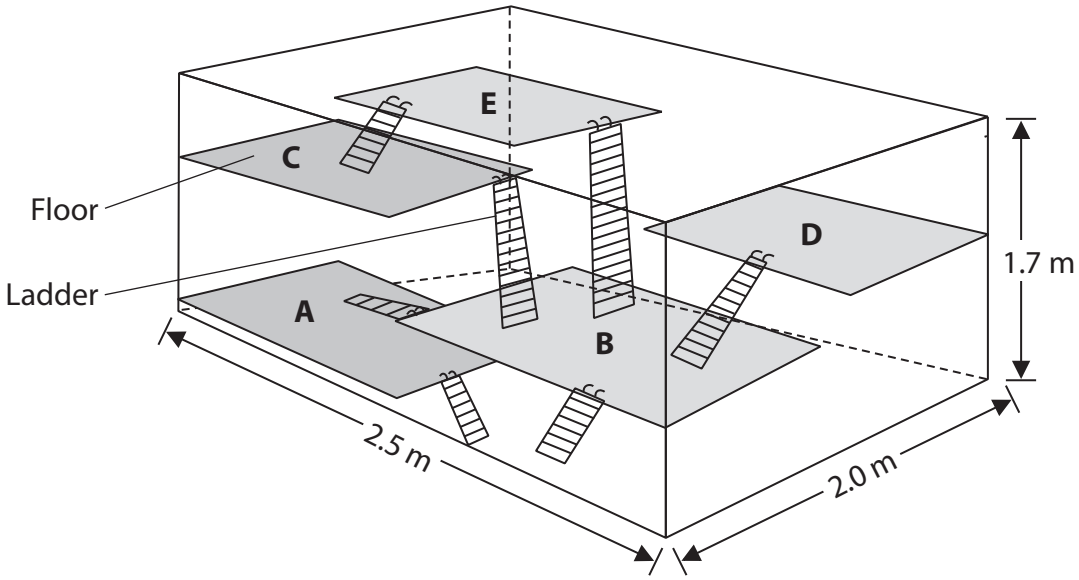
(Total for Question 2 = 13 marks)

3 (a) An investigation was carried out to study the ability of rats to learn. A number of rats were divided into two groups, P and Q.

The rats in group P were deprived of food for twenty hours and then released into a cage. The cage contained hidden food and the rats were left in this cage for four hours each day.
This was repeated each day for fourteen days.

The diagram below shows the cage.
In the cage, the floors A, B, C, D and E had hidden food, water, wooden blocks, freshly cut wood chips, branches, fresh leaves, plastic containers and paper bags.



(i) The rats in group Q were used as a control.
Describe how the rats in control group Q would have been treated.

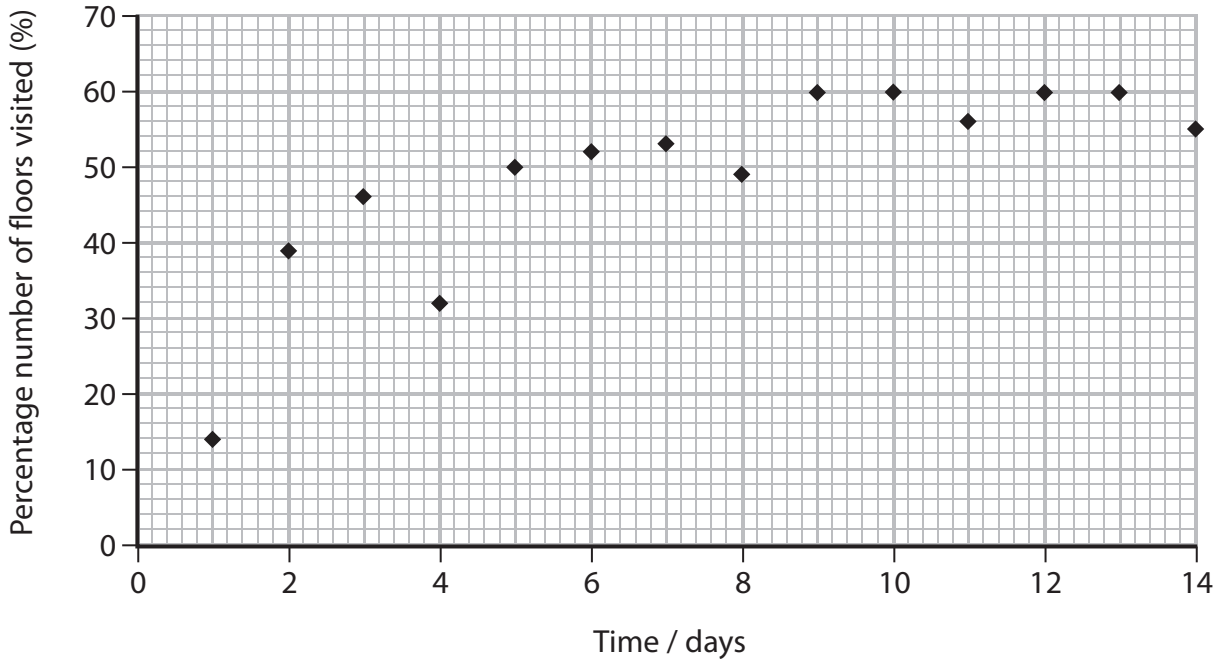
(2)

(ii) Explain why the rats were not fed for twenty hours each day.

(1)

(b) During each four-hour period in the cage, the number of floors visited by the rats in group P was recorded as a percentage of the total number of floors.

The graph below shows the results of this experiment.



Using the information in the graph, describe the behaviour of the rats in group P over the fourteen-day period during this investigation.

(3)

(c) In a second experiment, the two groups of rats were placed in a maze containing hidden food.
The percentage of rats from each group that found the food in a short period of time was recorded.

The results are shown in the table below.

Group	Percentage of rats finding food (%)
P	85
Q	0

Explain the effect of the first experiment on the ability of rats to find food in a short period of time.

(2)

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(d) The brains of both groups of rats were examined.
The mean spine density per neurone for each group was calculated.

Spine density represents a measure of the number of synapses per neurone.

The results are shown in the table below.

Group	Mean spine density / arbitrary units
P	1.96
Q	1.78

Suggest how these results explain the effect of the first experiment on the ability of rats to find food using the cage.

(2)

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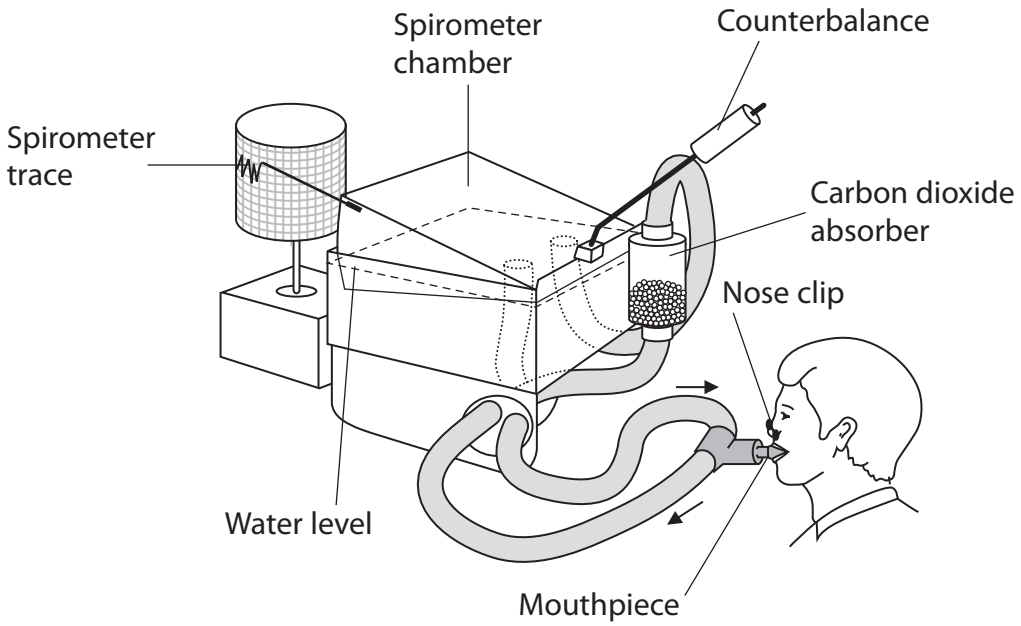
(Total for Question 3 = 10 marks)

4 *(a) A spirometer can be used to measure tidal volumes and breathing rates.

The diagram below shows a spirometer.

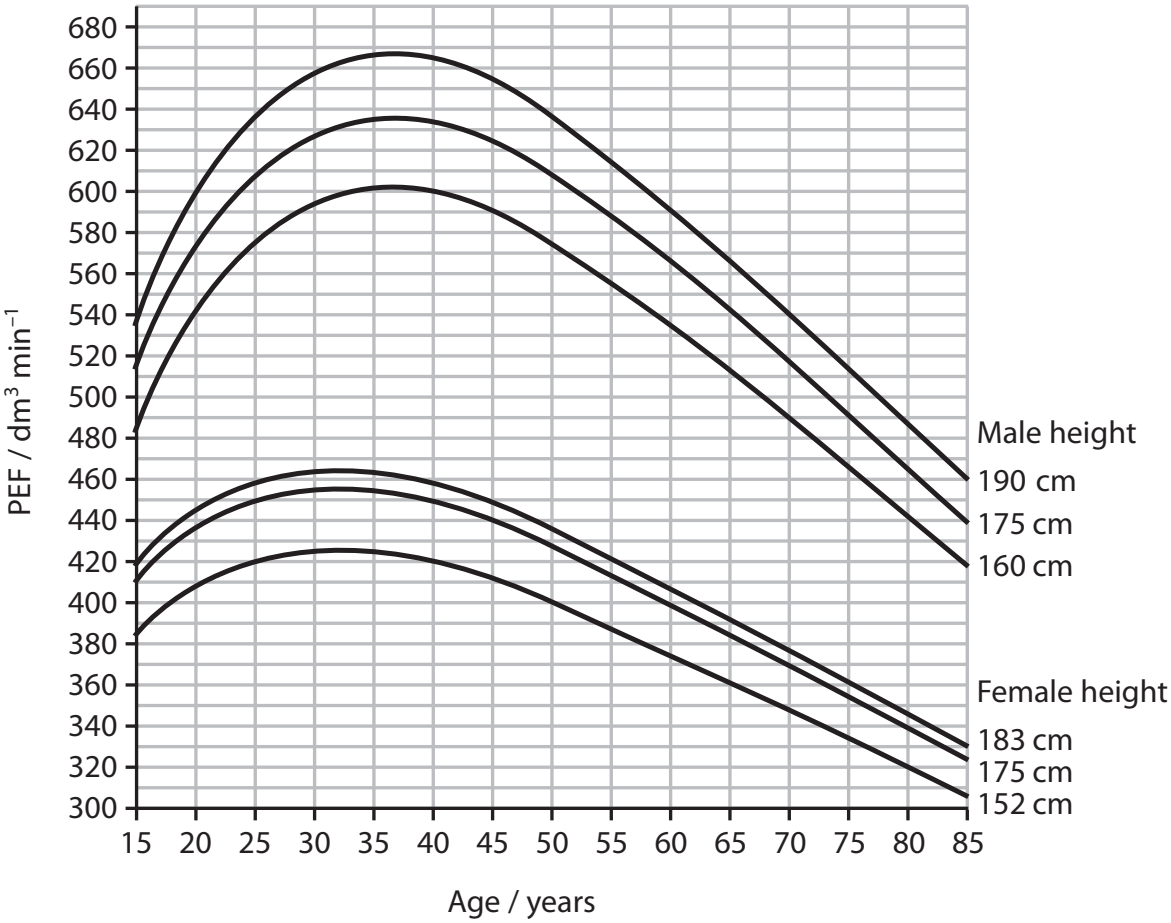


Explain how you would use the traces from this spirometer to compare the tidal volumes and breathing rates of male and female human subjects.

(6)

(b) The peak expiratory flow (PEF) is a measure of how fast a person can breathe out. This can indicate any obstruction in the airways of the lungs. It is measured using a peak flow meter.

The graph below shows the expected PEF values for people aged 15 to 85 years of various heights.



(i) Using the information in the graph, describe the effect of age on PEF.

(4)

(ii) Using the information in the graph, give one reason for the difference in PEF values between ages 35 years and 85 years.

(1)

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(iii) If a person with asthma has a PEF 30% below the expected value, it may indicate that their asthma is not under control.
A 52-year old man with asthma has a PEF reading of 350 $dm^3\ min^{-1}$.

Using the information in the graph, state whether or not his asthma is being kept under control. Give a reason for your answer.

(2)

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(iv) Give one other piece of information that is needed before an accurate diagnosis of his asthma can be made.

(1)

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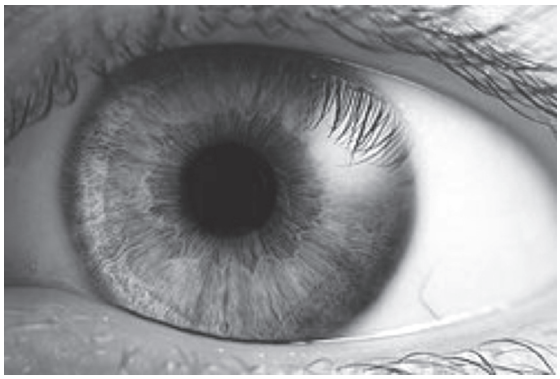
(Total for Question 4 = 14 marks)

5 (a) The picture below shows the human eye with the black pupil in the centre.
The pupil can change size to allow either more or less light into the eye.
Its size is controlled by the iris muscles surrounding it.



Magnification ×2

(i) Suggest why the pupil appears black.

(1)

(ii) There are two sets of iris muscles, the radial muscles and the circular muscles.
They work antagonistically to alter the size of the pupil.

Explain why these two sets of muscles need to be antagonistic.

(3)

(iii) The pupil increases in diameter in dim light.
Explain how neurones enable this response to occur.

(3)

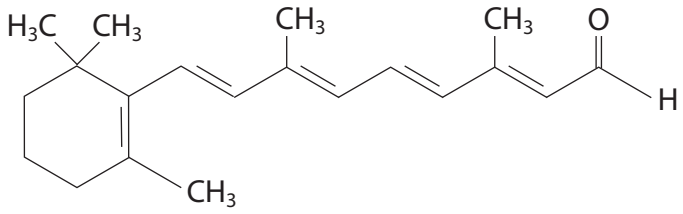
(b) Tropicamide is a drug used in eye drops.
Tropicamide has an effect on the diameter of the pupil in the eye.
This makes it easier for the doctor to examine the retina or lens in the eye of a patient.

Suggest how tropicamide in the eye drops makes it easier to examine the retina.

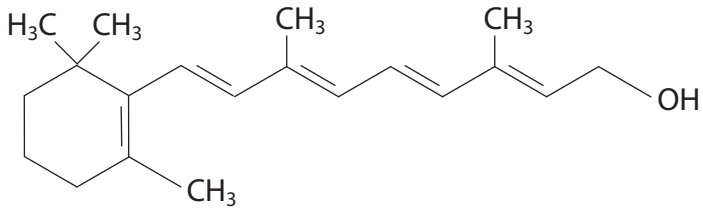
(3)

(c) The diagrams below show the structure of two molecules, retinal and retinol.

Retinal



Retinol



Retinol is the most common form of dietary vitamin A and retinal is part of the structure of rhodopsin.

Suggest how a deficiency of vitamin A would adversely affect a person's vision.

(3)

(Total for Question 5 = 13 marks)

6 The table below shows some statements relating to photoreceptors (phytochromes) in plants.

Complete the table with a tick (✓) if the statement is correct or a cross (×) if the statement is not correct.

(4)

Statement	Tick (✓) or cross (×)
Cause cell depolarisation	
Affected by all wavelengths of light	
Involved in plant growth and development	
Affected by darkness	

(Total for Question 6 = 4 marks)

7 The scientific article you have studied is adapted from articles in The Biologist. Use the information from the article and your own knowledge to answer the following questions.

(a) Explain why obesity is 'a big problem' for society (paragraph 2).

(2)

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(b) Describe the structure of triglyceride fat found in white adipose tissue (WAT).

(2)

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(c) Calculate the percentage increase in deaths for young girls with anorexia (paragraph 6).

(2)

Answer = ... %

(d) State the evidence supporting the idea that specific parts of the brain are responsible for the gender differences in the processing of information related to body image (paragraphs 8 to 14).

(4)

(e) Explain why the raised cortisol levels due to dieting in females, may be a long term risk factor (paragraph 18).

(2)

(f) Suggest why it may be an advantage to have lipids stored in 'many small droplets rather than in a large mass' in brown adipose tissue (BAT) (paragraph 28).

(2)

(g) Suggest how the uncoupling agent UCP-1 might affect the production of ATP and heat (paragraph 28).

(3)

(h) Suggest why 18F-fluorodeoxyglucose (18FFDG) becomes 'trapped' in the cells, unlike glucose which is rapidly metabolised (paragraph 32).

(3)

(i) Explain why the seaweed pigment fucoxanthin caused a reduction in abdominal fat in rats (paragraph 38).

(3)

*(j) Give the scientific evidence for the protein PRDM16 being responsible for potential weight loss (paragraphs 40 and 41).

(5)

(k) Give **two** pieces of evidence showing that environmental factors can alter gene expression (paragraphs 45 to 47).

(2)

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(Total for Question 7 = 30 marks)

TOTAL FOR PAPER = 90 MARKS