Write your name here

Surname	Other names

Pearson Edexcel GCE

Centre Number	Candidate Number

Biology

Advanced

Unit 5: Energy, Exercise and Coordination

Tuesday 20 June 2017 – Morning
Time: 1 hour 45 minutes

Paper Reference
6BI05/01

You must have:
A copy of the scientific article modified from *New Scientist* (enclosed), calculator, HB pencil, ruler

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.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*

Information

- The total mark for this paper is 90
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- Questions labelled with an **asterisk** (*) are ones where the quality of your written communication will be assessed.
  – *you should take particular care with your spelling, punctuation and grammar, as well as the clarity of expression, on these questions.*
- Candidates may use a calculator

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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P 4 8 1 7 8 A 0 1 2 4

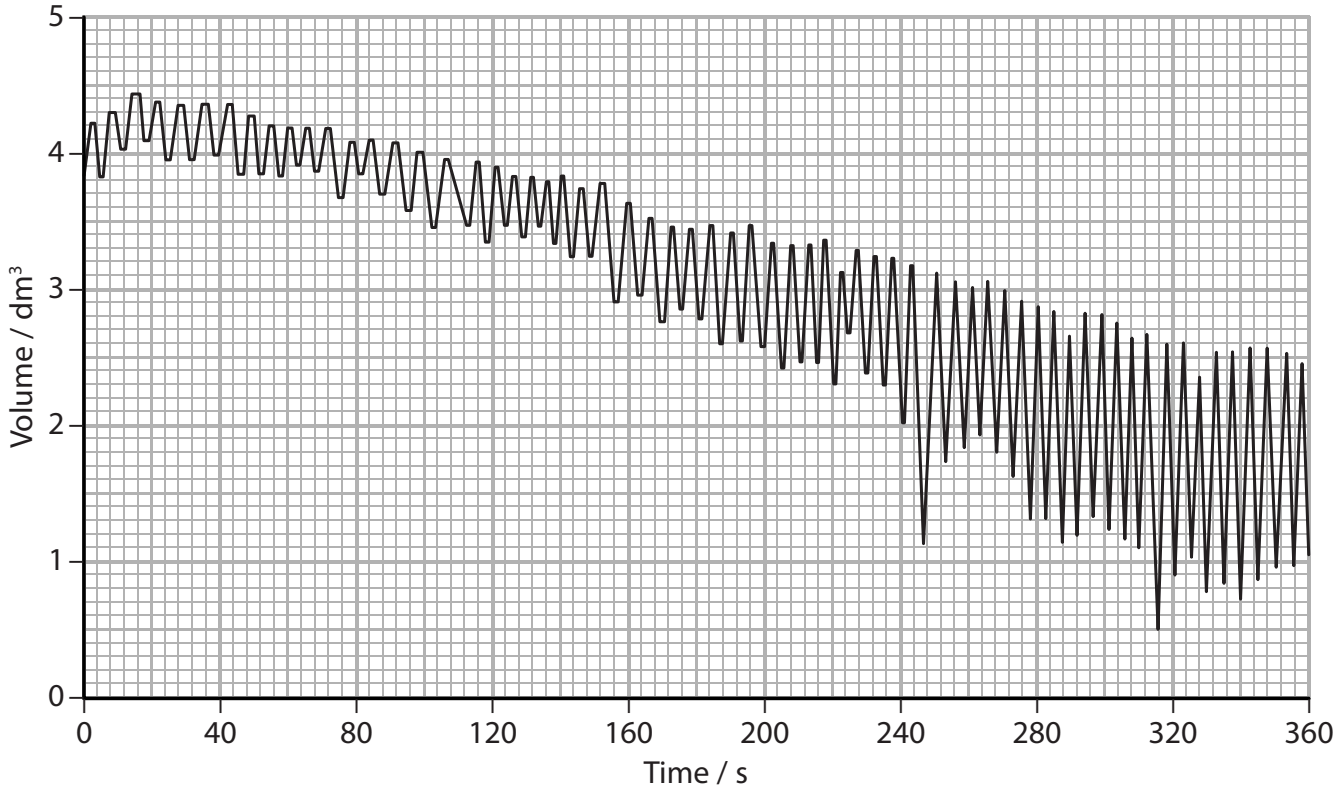
Pearson

Answer ALL questions.

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 A spirometer, filled with oxygen, was used to record the breathing of a student.
The student was sitting at rest and was instructed to breathe normally.

The spirometer trace is shown below.



(a) Put a cross ☒ in the box next to the correct description of the changes shown in this spirometer trace.

(1)

☒ **A** the breathing becomes faster and deeper

☒ **B** the breathing becomes slower and deeper

☒ **C** the breathing becomes faster and less deep

☒ **D** the breathing becomes slower and less deep

(b) Put a cross ☒ in the box next to the mean tidal volume during the first minute of this spirometer trace.

(1)

☒ **A** 0.25 dm^3

☒ **B** 0.45 dm^3

☒ **C** 4.5 dm^3

☒ **D** 8.0 dm^3

(c) Put a cross ☒ in the box next to the mean breathing rate for the first two minutes of this spirometer trace.

(1)

☒ **A** 6 breaths min^{-1}

☒ **B** 9 breaths min^{-1}

☒ **C** 18 breaths min^{-1}

☒ **D** 36 breaths min^{-1}

(d) During this six-minute period, the volume of oxygen in the spirometer decreased from 4.0 dm^3 to 1.0 dm^3.

Put a cross ☒ in the box next to the mean rate of oxygen consumption by the student.

(1)

☒ **A** 0.5 dm^3 min^{-1}

☒ **B** 1.0 dm^3 min^{-1}

☒ **C** 1.2 dm^3 min^{-1}

☒ **D** 3.0 dm^3 min^{-1}

(e) Describe the role of oxygen in aerobic respiration.

(4)

(Total for Question 1 = 8 marks)

2 Ptarmigan are birds that live in Arctic regions where the winters are long and cold and very little food is available. They move about by running and fly occasionally.

Magnification ×0.15

Just before the winter, these birds put on weight as stored fat. This increases their body mass by approximately 50%.

(a) The mean energy consumption per day for ptarmigan varies during the year.

Give **one** reason for each of the following suggestions.

(i) The daily energy consumption of the birds might be higher in winter.

(1)

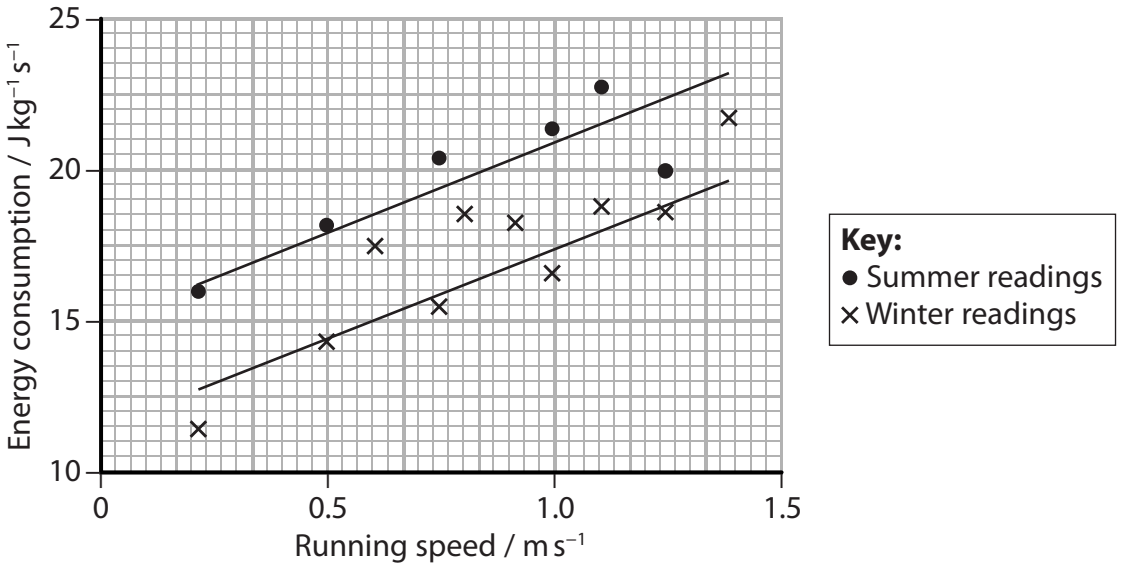
(ii) The daily energy consumption of the birds might be lower in winter.

(1)

(b) The energy consumption of ptarmigan running at different speeds was investigated.

Measurements were made at the start of the winter and then again during the summer.

The graph below shows the energy consumption at different running speeds.



(i) Explain why the energy consumption at each running speed on the graph is shown per kg of body mass.

(2)

(ii) Compare the effects of running speed on energy consumption, for winter and summer.

(3)

(iii) Scientists suggested that ptarmigan muscles might have more slow twitch muscle fibres in the winter.

Describe the effect this might have on the behaviour of the ptarmigan.

(2)

(iv) Scientists suggested that elastic tissue in the legs of the ptarmigan could help the birds conserve energy by running more efficiently.

Name a part of the leg joint that contains this elastic tissue.

(1)

(c) When ptarmigan run fast, there is a temporary build-up of lactate (lactic acid) in their leg muscles.

Describe what happens to the lactate produced in these muscles.

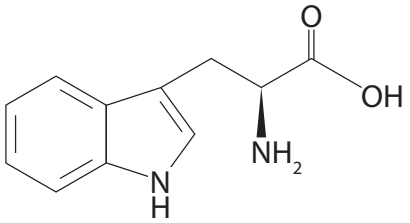
(3)

(Total for Question 2 = 13 marks)

3 IAA (auxin) is a chemical substance that occurs naturally in plant cells. IAA controls and coordinates the growth of plants.

There are several pathways for synthesising IAA. One pathway involves the amino acid tryptophan.

(a) The diagram below shows the structure of tryptophan.



tryptophan

(i) Draw a circle around the parts of this molecule that are present in all amino acids.

(1)

(ii) Proteins are formed from amino acids. A number of different types of bond are found in proteins.

Put a cross ☒ in the box next to the phrase that correctly completes the following sentence.

The bonds found in proteins include

(1)

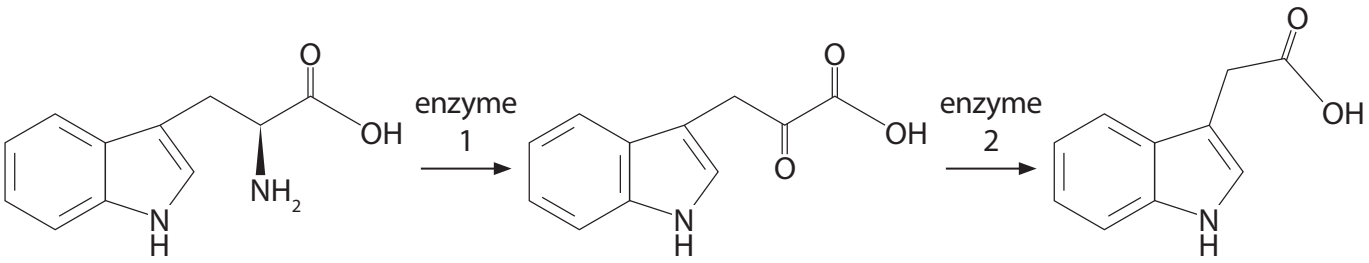
☒ **A** ester, disulfide and glycosidic bonds

☒ **B** disulfide, hydrogen and ionic bonds

☒ **C** glycosidic, ionic and peptide bonds

☒ **D** hydrogen, peptide and phosphodiester bonds

(b) The pathway for the synthesis of IAA from tryptophan is shown below.



tryptophan intermediate IAA

Suggest how enzyme 2 is involved in the synthesis of IAA.

(2)

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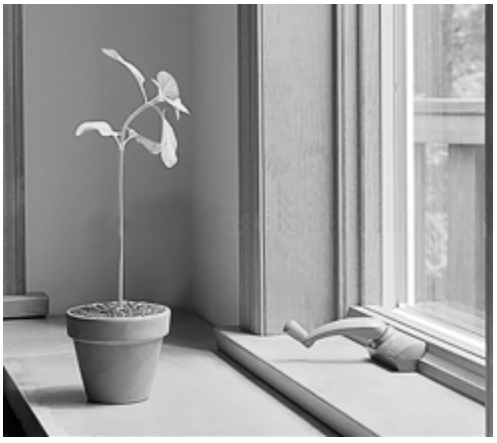
(c) The photograph below shows a plant that has been left near the window for a week.



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(i) Put a cross ☒ in the box next to the response shown by this plant.

(1)

☒ **A** light dependent reaction

☒ **B** photolysis

☒ **C** photophosphorylation

☒ **D** phototropism

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

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(ii) Explain the role of IAA in the response shown by the plant in the photograph.

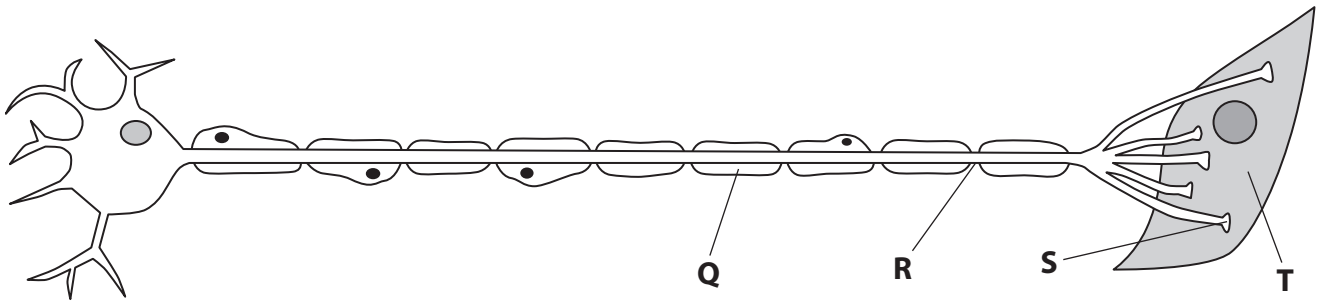
(4)

(Total for Question 3 = 9 marks)

4 The diameter of the pupil in the eye is controlled by a nerve pathway.

(a) This nerve pathway contains several neurones.

The diagram below shows a motor neurone and a cell labelled **T**.



(i) Put a cross ☒ in the box next to the correct statement about motor neurones in this pathway.

(1)

☒ **A** motor neurones transmit action potentials towards the central nervous system

☒ **B** motor neurones are the only type of neurone to have a cell body

☒ **C** all motor neurones terminate on effector cells

☒ **D** motor neurones have shorter axons than relay neurones

(ii) Put a cross ☒ in the box next to the name of the main substance found in the part labelled **Q**.

(1)

☒ **A** amylose

☒ **B** myelin

☒ **C** myosin

☒ **D** thylakoid

(iii) The membrane of the neurone is exposed at the point labelled **R**.

Put a cross ☒ in the box next to the correct statement about this part of the membrane.

(1)

☒ **A** it can become depolarised

☒ **B** it has a resting potential of +70 mV

☒ **C** it is part of an inhibitory synapse

☒ **D** it is thinner at this point

(iv) Explain the role of the part labelled **S** in the stimulation of cell **T**.

(3)

(b) The table below shows the mean pupil diameter at two different light levels for people of different ages.

Age / years	Mean pupil diameter / mm	
	Bright light	Low light
20	4.7	8.0
40	3.9	6.0
60	3.1	4.1
80	2.3	2.5

(i) Calculate the percentage difference in pupil diameter in bright light between people aged 20 years and people aged 80 years.

Show your working.

(2)

Answer..... %

(ii) Some older people see less clearly in low light conditions.

Using the information in the table, suggest how age-related changes in the iris cause these visual problems.

(2)

(Total for Question 4 = 10 marks)

5 Dogs have several ways of maintaining a stable body temperature. In warm conditions or after exercise, a dog will often pant.

When a dog is panting, it breathes rapidly with its mouth open, as shown in the photograph below.

(a) Suggest how panting enables dogs to maintain a stable body temperature.

(4)

(b) Body temperature in dogs is controlled by the thermoregulatory centre in the brain.

(i) Name the part of the brain that contains the thermoregulatory centre.

(1)

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*(ii) The panting response in dogs keeps the body temperature within narrow limits.

Explain the role of negative feedback in the control of the panting response.

(5)

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(c) When a dog pants, it generates a small amount of heat in its body.

Explain why panting generates heat.

(2)

(Total for Question 5 = 12 marks)

6 The effect of day length on the eyes of rats was investigated.

Some of the results are shown in the table below.

Day length / hours of daylight	Total amount of light entering each eye per day / au	Amount of rhodopsin present in each eye / nmol	Mean number of rod cells per eye / × 10^6
8	99	2.30	25
12	107	1.40	16
16	93	0.51	12

(a) Rhodopsin is a visual pigment found in rod cells.

(i) Rhodopsin molecules split into two substances when a rod cell is stimulated by light.

Name the **two** substances formed.

(2)

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(ii) Describe the relationship between day length and the amount of rhodopsin present in each eye.

(2)

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(b) Suggest why day length has little effect on the total amount of light entering the eye each day.

(1)

(c) The number of rod cells per eye increases when the day length is short.

Explain the advantages to the rat of this increase.

(3)

(Total for Question 6 = 8 marks)

7 The scientific article you have studied is adapted from articles from New Scientist.

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

(a) Explain why the control group in Kramer's investigation should have a planned programme of non-exercise activities, such as playing cards (paragraph 6).

(2)

(b) The results of a study lasting 20 years are summarised in paragraph 8.

Explain why 'confounding factors' needed to be taken into account in this study.

(2)

(c) Sketch a line graph to show the general trend of the results of the Swedish study referred to in paragraph 9.

(2)

(d) Pase found that high blood pressure 'can lead to a slump in cognitive performance' (paragraph 12).

(i) Name the part of the brain that is most closely associated with 'cognitive performance'.

(1)

*(ii) Explain how high blood pressure could lead to a decrease in cognitive performance (paragraph 12).

(5)

(e) Ritalin (paragraph 14) is a dopamine re-uptake inhibitor.

Explain why exercise could have a similar effect to taking Ritalin.

(3)

(f) It has been suggested that the fossil record shows there is a relationship between exercise and brain size in humans. It is not certain whether the exercise is causing this effect, or whether it is just a correlation.

Experiments were conducted on mice to help find out more about this.

Discuss how the results of the experiment on mice (paragraph 19) may provide extra information on the relationship between brain size and exercise in humans.

(3)

(g) Suggest how exercise could increase the number of cells in the brain (paragraph 26).

(4)

(h) Explain how the new cells become specialised and develop into neurones in the brain (paragraph 26).

(4)

(i) A substance called insulin-like growth factor-1 (IGF-1) can affect communication between brain cells (paragraph 33).

Suggest **one** change that might occur in brain cells that could increase communication with other brain cells.

(1)

(j) Describe how fMRI could have been used in Hillman's investigation (paragraph 39).

(3)

(Total for Question 7 = 30 marks)

TOTAL FOR PAPER = 90 MARKS

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