OCR
Oxford Cambridge and RSA

Monday 12 June 2017 – Afternoon

A2 GCE BIOLOGY

F214/01 Communication, Homeostasis and Energy

Candidates answer on the Question Paper.

OCR supplied materials:
None

Other materials required:
- Electronic calculator
- Ruler (cm/mm)

Duration: 1 hour 15 minutes

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. If additional space is required, you should use the lined pages at the end of this booklet. The question number(s) must be clearly shown.
- Do **not** write in the barcodes.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **60**.
- Where you see this icon you will be awarded marks for the quality of written communication in your answer.
- You may use an electronic calculator.
- You are advised to show all the steps in any calculations.
- This document consists of **20** pages. Any blank pages are indicated.

Answer **all** the questions.

1 Between 1996 and 2012, the number of people diagnosed with diabetes in the UK increased from 1.4 million to 2.9 million. It is estimated that the condition will affect 5 million people by 2025.

(a) Table 1.1 lists a number of facts about diabetes.

Complete the table by using a **single tick** (✓) to indicate whether each fact relates to Type 1 diabetes only **or** Type 2 diabetes only **or** both types.

Fact	Type 1 diabetes only	Type 2 diabetes only	Both Type 1 and Type 2 diabetes
body cells no longer respond to insulin			
blood glucose concentration cannot be controlled			
insulin injections are required			
linked to obesity			

Table 1.1 **[4]**

(b) Cost is one important factor when considering how diabetes may be treated.

(i) Discuss the advantages, **other than cost**, of using insulin produced by genetically modified bacteria compared with using other sources of insulin.

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..... **[3]**

(ii) Discuss the advantage, **other than cost**, of the future use of stem cells to treat diabetes rather than using insulin injections.

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..... **[2]**

[Total: 9]

2 The kidney is very important for the correct functioning of the body as it has a vital role in excretion.

(a) Define the term *excretion*.

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..... **[1]**

(b) Fig. 2.1 is a diagram of the external view of a mammalian kidney. The diagram also shows the associated blood vessels and the ureter.

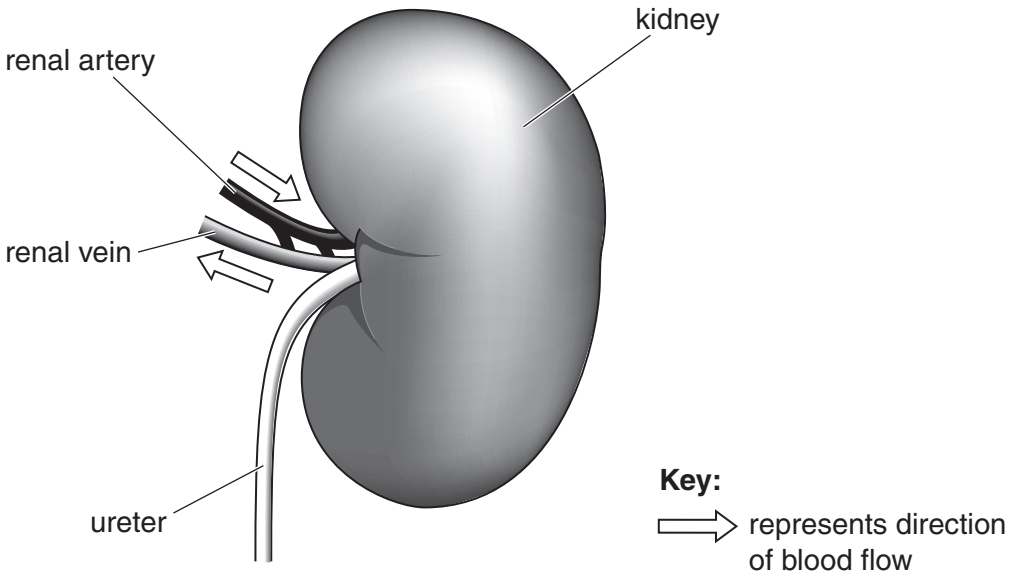

Fig. 2.1

Table 2.1 lists some of the components of blood. Table 2.1 also shows the amount of each component in the renal vein compared with the renal artery.

The differences or similarities shown in Table 2.1 result from the blood passing through the kidney.

Complete Table 2.1 by providing an explanation for the difference or similarity in the amount of each component. The first explanation has been completed for you.

Component of blood	Amount in renal vein compared with that in renal artery	Explanation
urea	much less	When the blood enters the glomerulus, most of the urea gets filtered out of the blood. But some of it is reabsorbed as it goes through the nephron, so there is still a small amount in the renal vein.
ions	slightly less	
glucose	slightly less	
oxyhaemoglobin	less	
red blood cells	the same	

Table 2.1 **[4]**

(c) Anti-diuretic hormone (ADH) helps to regulate the water potential of the blood.

(i) State where ADH is **produced**.

..... **[1]**

(ii) On which region of a kidney nephron are the ADH receptors found?

..... **[1]**

(d) Drugs, known as diuretic drugs, are often given to patients with high blood pressure.

Suggest how the action of these drugs results in a lowering of blood pressure.

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..... **[2]**

[Total: 9]

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Question 3 begins on page 8

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3 Respiration is a key process within cells, providing them with energy in the form of ATP.

The potential energy values of three different types of biological molecules used as respiratory substrates are shown in Table 3.1.

Respiratory substrate	Mean energy value ($kJ\,g^{-1}$)
Carbohydrate	15.8
Protein	17.0
Lipid	39.4

Table 3.1

(a) The main respiratory substrate is glucose.

Calculate, using the information in Table 3.1, how many grams of glucose have the same mean energy value as 1 g of lipid.

Give your answer to **one decimal place**.

Answer = ... g **[1]**

(b) Lipid is a respiratory substrate but it needs to be hydrolysed into its constituent molecules so that these can then enter the respiratory pathway.

(i) The hydrolysis of lipid molecules will produce fatty acids.

State the other product of the hydrolysis of lipid molecules.

..... **[1]**

(ii) The fatty acids are further broken down into 2-carbon molecules which form acetyl coenzyme A. This results in large numbers of hydrogen ions being produced.

How do these hydrogen ions contribute to the production of a large amount of ATP?

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..... **[2]**

(c) Protein is only used as a respiratory substrate when all other available substrates have been used up. Protein yields less energy per gram than lipid.

A protein molecule cannot enter the respiratory pathway directly and so is converted into a compound that is able to enter the respiratory pathway.

Describe the changes that convert a protein molecule into a compound able to enter the respiratory pathway **and** explain why this substrate yields less energy per gram than lipid.

In your answer, you should use appropriate technical terms, spelled correctly.

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..... **[4]**

[Total: 8]

4 Plasma membranes are very important for many processes involved in the functioning of cells, both in animals and plants.

(a) Fig. 4.1 represents part of the plasma (cell surface) membrane of an axon.

Structures labelled **A** to **D** represent the involvement of proteins in the movement of ions during **depolarisation** of the membrane.

D represents a voltage-gated protein.

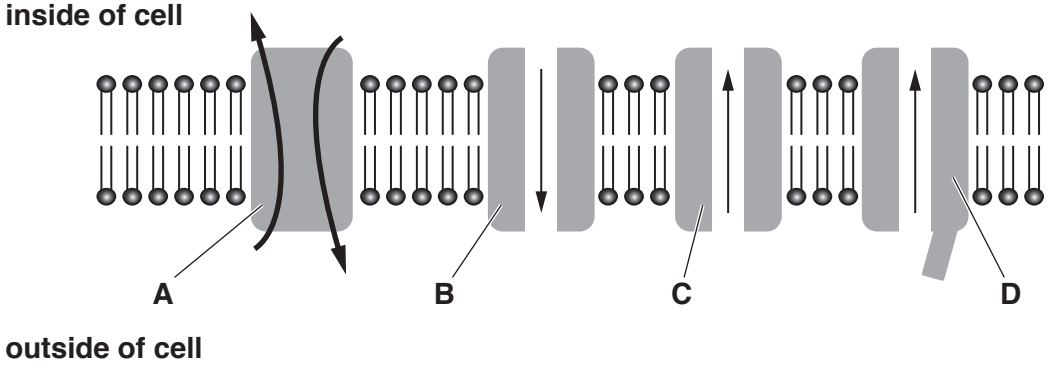

Fig. 4.1

Identify, using the appropriate letter(s), which of the proteins **A**, **B**, **C** or **D**:

(i) need(s) ATP to function

..... **[1]**

(ii) transport(s) potassium ions (K^+) **into** the cell

..... **[1]**

(iii) allow(s) potassium ions (K^+) **out of** the cell

..... **[1]**

(iv) allow(s) or transport(s) sodium ions (Na^+) **into or out of** the cell.

..... **[1]**

(b) Fig. 4.2 represents part of the plasma (cell surface) membrane of a cell that responds to adrenaline.

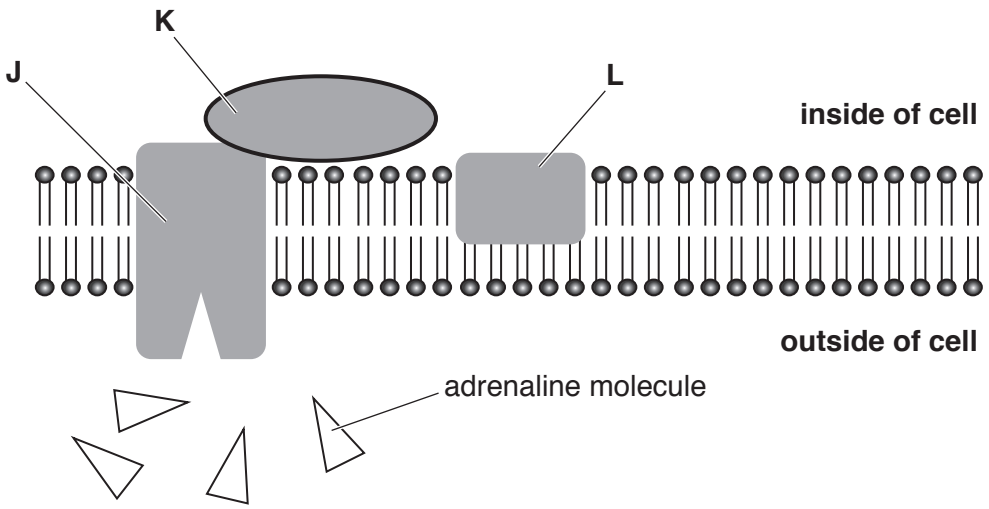

Fig. 4.2

Describe the involvement of **J**, **K** and **L** in the cell's response to adrenaline.

In your answer, you should use appropriate technical terms, spelled correctly.

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..... **[5]**

(c) Fig. 4.3 represents part of the **inner** membrane of a cell organelle. The letters represent substances involved in one stage of aerobic respiration.

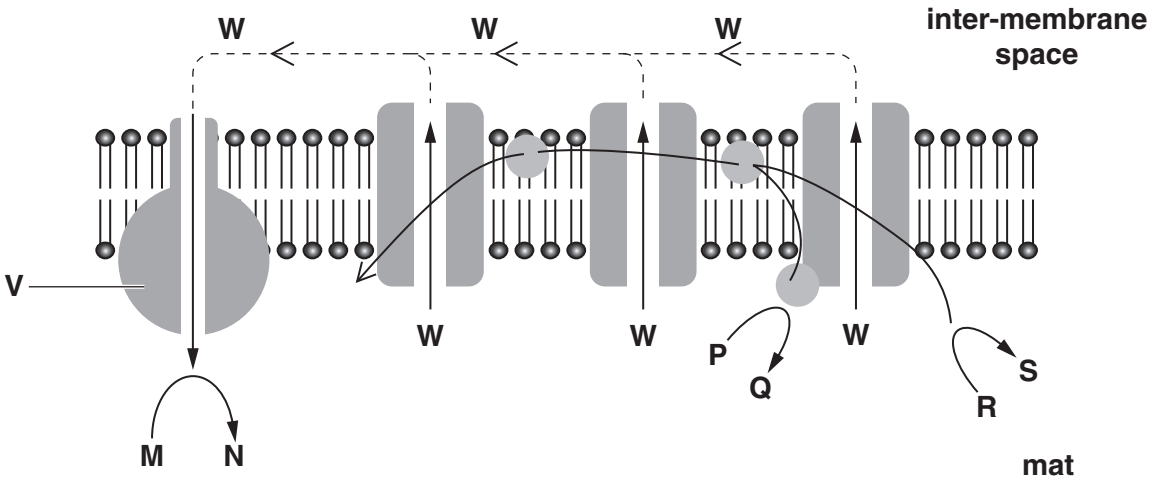

Fig. 4.3

(i) In which organelle would this inner membrane be found?

..... **[1]**

(ii) Identify **V**.

..... **[1]**

(iii) Identify **W**.

..... **[1]**

(iv) Which letter **from Fig. 4.3** represents a reduced coenzyme?

..... **[1]**

(v) Which letter **from Fig. 4.3** represents ATP?

..... **[1]**

[Total: 14]

5 Our knowledge of the process of photosynthesis in green plants has been informed by work carried out by scientists who used a variety of techniques.

One of these techniques involved the use of purple sulfur bacteria, belonging to the Kingdom Prokaryotae. These bacteria can photosynthesise and so were used as a model for the process taking place in green plants.

(a) **With respect to photosynthesis**, how would the **cellular structure** of purple sulfur bacteria differ from that of plant cells?

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..... **[1]**

(b) The photosynthesis carried out by purple sulfur bacteria was investigated.

- These bacteria use hydrogen sulfide (H_2S) to supply the electrons needed to synthesise reduced NADP and ATP.
- These bacteria carry out the light-dependent reaction using only photosystem I.

Photosynthesis in these bacteria may be summarised in the following equation:

$$2H_2S + CO_2 \rightarrow (CH_2O)_n + H_2O + 2S$$

(i) Photosynthesis in **green plants** produces oxygen gas. State which of the reactants in photosynthesis by green plants is the origin of the oxygen produced **and** provide supporting evidence from the information above.

reactant .....

evidence .....

.....

..... **[1]**

(ii) Evaluate whether the purple sulfur bacterium was an appropriate model organism to use to investigate photosynthesis in green plants.

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..... **[2]**

(c) An investigation was carried out in which single-celled photosynthetic eukaryotes were supplied with CO_2 containing radioactive carbon atoms for a 24 hour period.

The organisms were exposed to light for the first 12 hours, after which they were kept in the dark.

The concentrations of three compounds, glycerate 3-phosphate (GP), ribulose bisphosphate (RuBP) and glucose, which had incorporated the radioactive carbon atoms, were measured at intervals during the investigation.

The results are shown in Fig. 5.1.

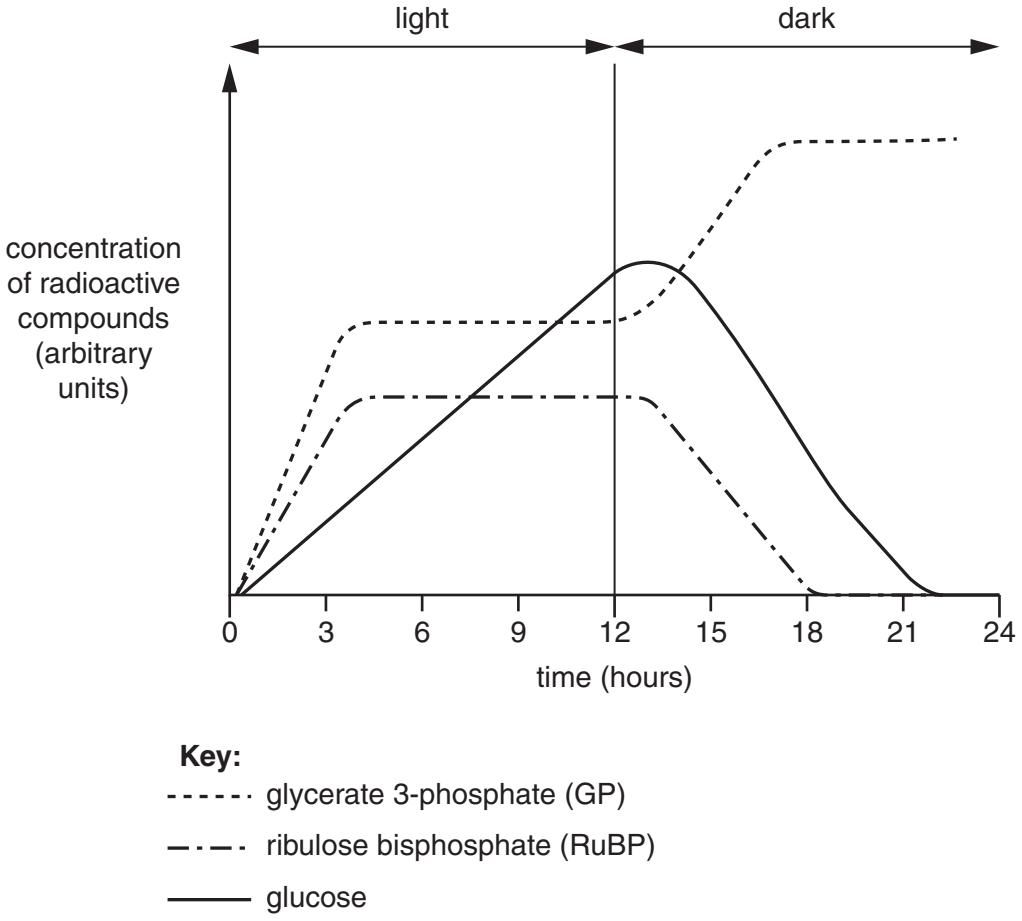

Fig. 5.1

(i) Explain why the concentration of radioactive GP increased initially.

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..... **[1]**

(ii) Explain why the concentration of RuBP decreased in the last 12 hours of the investigation.

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..... **[2]**

(iii) Explain why the concentration of GP increased and then remained constant in the last 12 hours of the investigation.

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..... **[2]**

(iv) Explain why the concentration of glucose decreased in the last 12 hours of the investigation.

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..... **[1]**

[Total: 10]

Question 6 begins on page 16

6 Coordination and control, using electrical and chemical methods, are vital in the correct functioning of multicellular organisms.

(a) Complete the following paragraphs by writing the **most suitable** word or term in each case.

Multicellular organisms need to monitor and ..... to changes in both their external and internal environments. Organisms also need to co-ordinate the activities of different ..... in the body. The way in which cells communicate with each other is known as .... and this is achieved by the nervous and hormonal systems.

A regulatory mechanism known as .... is used to maintain the internal environment at a relatively constant level despite changes in the environment. This maintenance of a stable internal environment is known as ..... . **[5]**

(b) Identify the following:

(i) an organ that has both endocrine and exocrine functions.

..... **[1]**

(ii) the cells that form the myelin sheath around an axon.

..... **[1]**

(iii) the hormone produced by the α–cells in the Islets of Langerhans.

..... **[1]**

(iv) the nerve that stimulates cardiac muscle and has the opposite effect to the accelerator nerve.

..... **[1]**

(v) an effector in the skin that is involved in temperature regulation.

..... **[1]**

[Total: 10]

END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional answer space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margins.