

Wednesday 25 January 2012 – Morning

A2 GCE HUMAN BIOLOGY

F224 Energy, Reproduction and Populations

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	
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Centre number							Candidate number				
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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 bar codes.

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 Male gametes or spermatozoa (sperm cells) are made in the testes by a process called spermatogenesis.

Fig. 1.1 shows a section through part of a human testis, as seen under the light microscope.

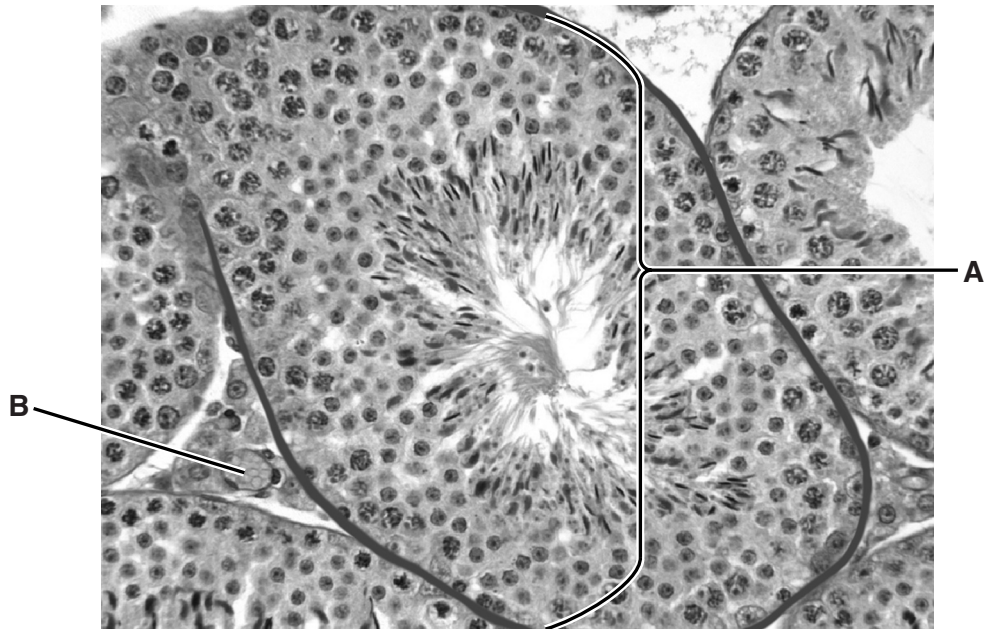


Fig. 1.1

- (a) Name structure **A** and cell **B**.

structure **A**

cell **B** [2]

- (b) (i) Spermatozoa leaving the testis will pass through, or near to, several male and female reproductive structures before they reach the oocyte.

Table 1.1 describes the roles and **features** of some of these structures.

Complete the table by naming a structure that corresponds to each description.

Table 1.1

description	structure
has an acidic environment with a pH of about 4.0
produces and secretes fluid which mixes with mature spermatozoa
the site of fertilisation
the site of storage of mature spermatozoa

[4]

- (ii) The fluid secreted by the male reproductive system contains fructose. Fructose is used by the mature spermatozoa.

Suggest and explain what the mature spermatozoa use this fructose for.

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..... [2]

5
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QUESTION 2 STARTS ON PAGE 6

- 2 (a) Regular exercise has beneficial effects on the body. It is suggested that a person should exercise for at least thirty minutes, three times a week.

The cardiovascular system, the respiratory system and skeletal muscle all benefit from regular exercise.

The passage below summarises some of the effects of regular exercise on skeletal muscle cells (muscle fibres).

Complete the passage by using the most appropriate term(s).

Skeletal muscle cells get bigger as a result of regular exercise due to an increase in their area. Muscle cells usually carry out aerobic respiration.

With regular exercise, there is an increase in the number and size of the organelles responsible for aerobic respiration. These organelles are called

Due to the development of more blood capillaries, more glucose and can be delivered to the muscle cells. This will enable the muscle cells to carry out more aerobic respiration and consequently produce more for the contraction of the cells. Exercise results in increased concentrations of a carbohydrate storage compound called and a muscle protein with a high affinity for oxygen called

[6]

(b) The haemoglobin molecule is made of four polypeptide chains, two alpha chains and two beta chains, linked together.

Sickle cell anaemia (SCA) is a genetic condition in which a person's haemoglobin differs in structure from that of normal haemoglobin.

- In a person with SCA, there is a single base substitution in the DNA that codes for the beta chain of haemoglobin.
- The beta chain will have a different amino acid at just one point in its polypeptide chain.

(i) State the amino acid which replaces one glutamate in the beta chains of haemoglobin in a person with SCA.

..... [1]

(ii) Suggest why normal haemoglobin and SCA haemoglobin both remain soluble in red blood cells (erythrocytes) in the pulmonary vein.

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..... [1]

(iii) A person with SCA may experience severe symptoms of this condition. This is known as a 'sickle cell crisis'.

Describe what happens to red blood cells containing SCA haemoglobin during a sickle cell crisis **and** suggest symptoms that may be experienced.

description

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symptoms

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..... [4]

[Total: 12]

Turn over

3 (a) The chemiosmotic theory was first demonstrated by Peter Mitchell in 1961.

- (i)
- In some of his experiments, Peter Mitchell used mitochondria that had been isolated from cells.
 - The mitochondria were then kept in a liquid in glass dishes to which ADP, Pi (inorganic phosphate) and other substances were added.
 - After a period of time he checked the dishes for the presence of ATP.

The contents of some of the dishes are shown in Table 3.1 below.

Complete the table using a tick (✓) if you think that ATP was produced or a cross (X) if you think that no ATP was produced.

Table 3.1

contents of dishes	ATP produced
mitochondria + ADP + Pi + acetyl CoA + oxygen
mitochondria + ADP + Pi + acetyl CoA
mitochondria + ADP + Pi + low concentration of protons (H ⁺)
mitochondria + ADP + Pi + high concentration of protons (H ⁺)

[2]

- (ii) All of the dishes contained approximately the same number of mitochondria.

Suggest **one** other condition that needed to be kept constant **and** give a reason for your answer.

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..... [2]

(iii) State the specific role of oxygen in the mitochondrion.

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..... [1]

(iv) Name the enzyme used to produce ATP in chemiosmosis.

..... [1]

(v) Describe the role of the inner mitochondrial membrane (crista) in chemiosmosis.

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..... [3]

(b) Pyruvate is produced by glycolysis. Mitochondria take up pyruvate by active transport.

Outline the mechanism of active transport, including the role of ATP.

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..... [2]

[Total: 11]

- 4 (a) *Chlorella* is a green alga that can be used as a food supplement and it is also used in investigations on photosynthesis.

A cell suspension of *Chlorella* was used to investigate the effects of varying the carbon dioxide concentration on photosynthesis.

- The algae were illuminated with a bench lamp and kept at a temperature of 25 °C.
- The algae were initially supplied with carbon dioxide at a concentration of 1% for 200 seconds.
- The concentration of carbon dioxide was then reduced to 0.03% for a further 200 seconds.
- The concentrations of ribulose biphosphate (RuBP) and glycerate 3-phosphate (GP) were measured at regular intervals.

The results are shown in Fig. 4.1.

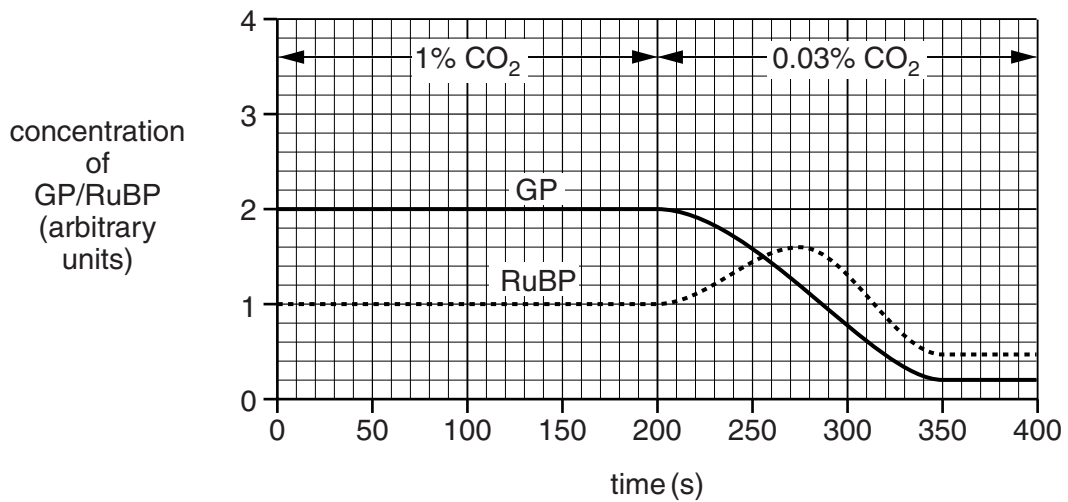


Fig. 4.1

- (i) Name the stage of photosynthesis that involves the compounds RuBP and GP.
 [1]
- (ii) State **precisely** where in the chloroplast RuBP and GP are used.
 [1]

(iii) Explain why the concentration of RuBP changed between 200 and 275 seconds.

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..... [2]

(iv) Calculate the rate of the fall in concentration of **GP** between 200 and 350 seconds.

Give your answer to **two decimal places**.

Show your working.

Answer = (arbitrary units per second) [2]

QUESTION 4(b) STARTS ON PAGE 12

13
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QUESTION 5 STARTS ON PAGE 14

5 The 'carbon footprint' is a measure of the amount of carbon dioxide, a greenhouse gas, produced by human activities. Many people are trying to reduce their own carbon footprints by changing the way they live.

(a) Biodiesel is a fuel for cars that is made from used vegetable oils.

- Biodiesel is biodegradable and non-toxic.
- Biodiesel contains mainly saturated hydrocarbons.
- Vegetable oil contains triglycerides with unsaturated hydrocarbons.

(i) What part of a triglyceride molecule contains an unsaturated hydrocarbon chain?

..... [1]

(ii) Describe how unsaturated hydrocarbons, such as those found in vegetable oil, differ in structure from the saturated hydrocarbons found in biodiesel.

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..... [2]

(iii) Suggest why the production and use of biodiesel as an alternative fuel may help to reduce the carbon footprint.

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..... [2]

- 6 (a) Couples who have difficulty conceiving a child may try artificial insemination using donor sperm.

Semen is collected from a donor and is injected, using a small plastic tube:

- near the cervix (intra-cervical insemination or **ICI**)
- OR**
- into the uterus (intra-uterine insemination or **IUI**).

Fig. 6.1 shows the pregnancy rate for both **ICI** and **IUI** compared to the sperm count of the donor.

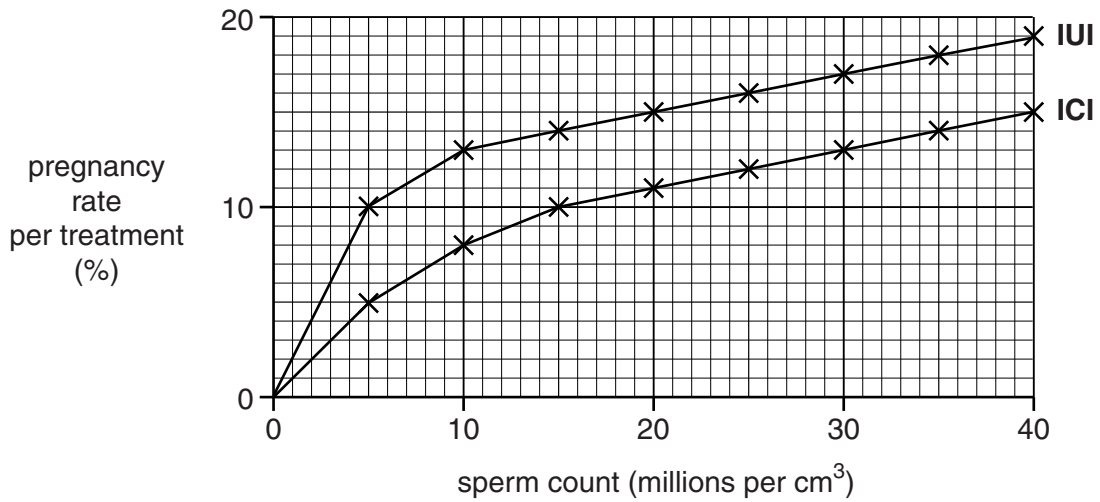


Fig. 6.1

- (i) With reference to Fig.6.1, describe the relationship between the pregnancy rate (per treatment) and the donor sperm count for **IUI** treatment.

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..... [2]

(ii) Suggest reasons why **ICI** is less successful than **IUI**.

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..... [2]

(b) Another treatment for infertility is in-vitro fertilisation (IVF). This treatment aims to produce embryos that may be implanted immediately or stored for future use.

(i) What method is used to store embryos?

..... [1]

(ii) Suggest why embryos can only be stored for a limited period of time.

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..... [1]

[Total: 6]

END OF QUESTION PAPER

