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OXFORD CAMBRIDGE AND RSA EXAMINATIONS

A2 GCE

F224

HUMAN BIOLOGY

Energy, Reproduction and Populations

WEDNESDAY 25 JANUARY 2012: Morning

DURATION: 1 hour 15 minutes

SUITABLE FOR VISUALLY IMPAIRED CANDIDATES

Candidates answer on the Question Paper.

OCR SUPPLIED MATERIALS:

None

OTHER MATERIALS REQUIRED:

Electronic calculator


Ruler (cm/mm)

READ INSTRUCTIONS OVERLEAF

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes on the first page. 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.

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.

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Answer ALL the questions.

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

Fig. 1.1, ON THE INSERT, shows a drawing of a section through part of a human testis, as would be seen under the light microscope.

- (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.

[2]

- (c) The first stage of the fertilisation of an oocyte by a single spermatozoan involves the acrosome.**

Describe the role of the acrosome during the first stage of fertilisation.



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

- 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 opposite 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.**

_____ [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 _____

symptoms _____

[4]

[Total: 12]

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.

[2]

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

[1]

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

[1]

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QUESTION 4 STARTS ON PAGE 16

- 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 bisphosphate (RuBP) and glycerate 3-phosphate (GP) were measured at regular intervals.**

The results are shown in Fig. 4.1 on the opposite page.

- (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]

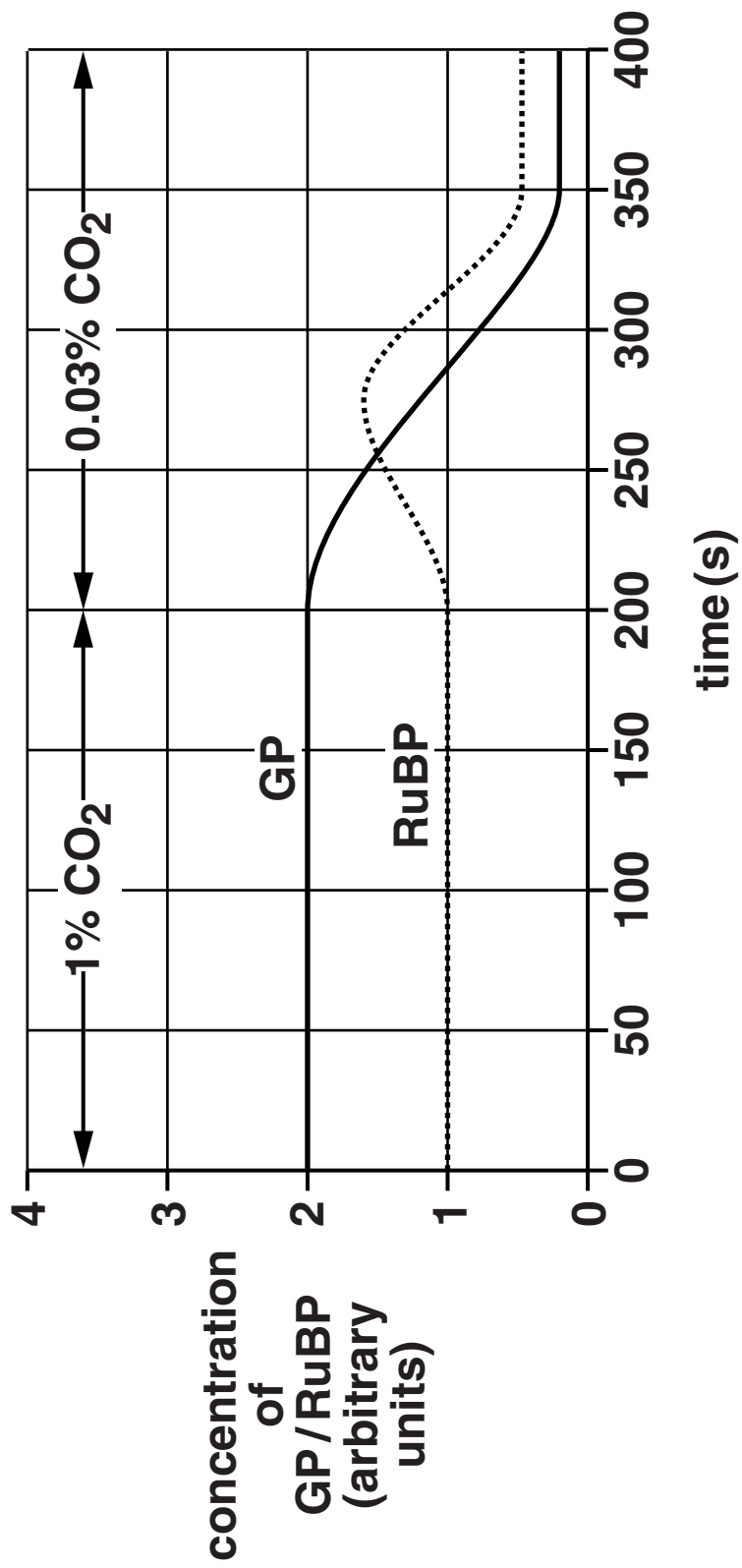


Fig. 4.1

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

[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]**

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QUESTION 5 STARTS ON PAGE 22

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.

_____ [2]

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

[2]

(b) Other than using biodiesel, suggest TWO ways in which people can reduce their carbon emissions.

[2]

[Total: 7]

- 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 opposite shows the pregnancy rate for both ICI and IUI compared to the sperm count of the donor.

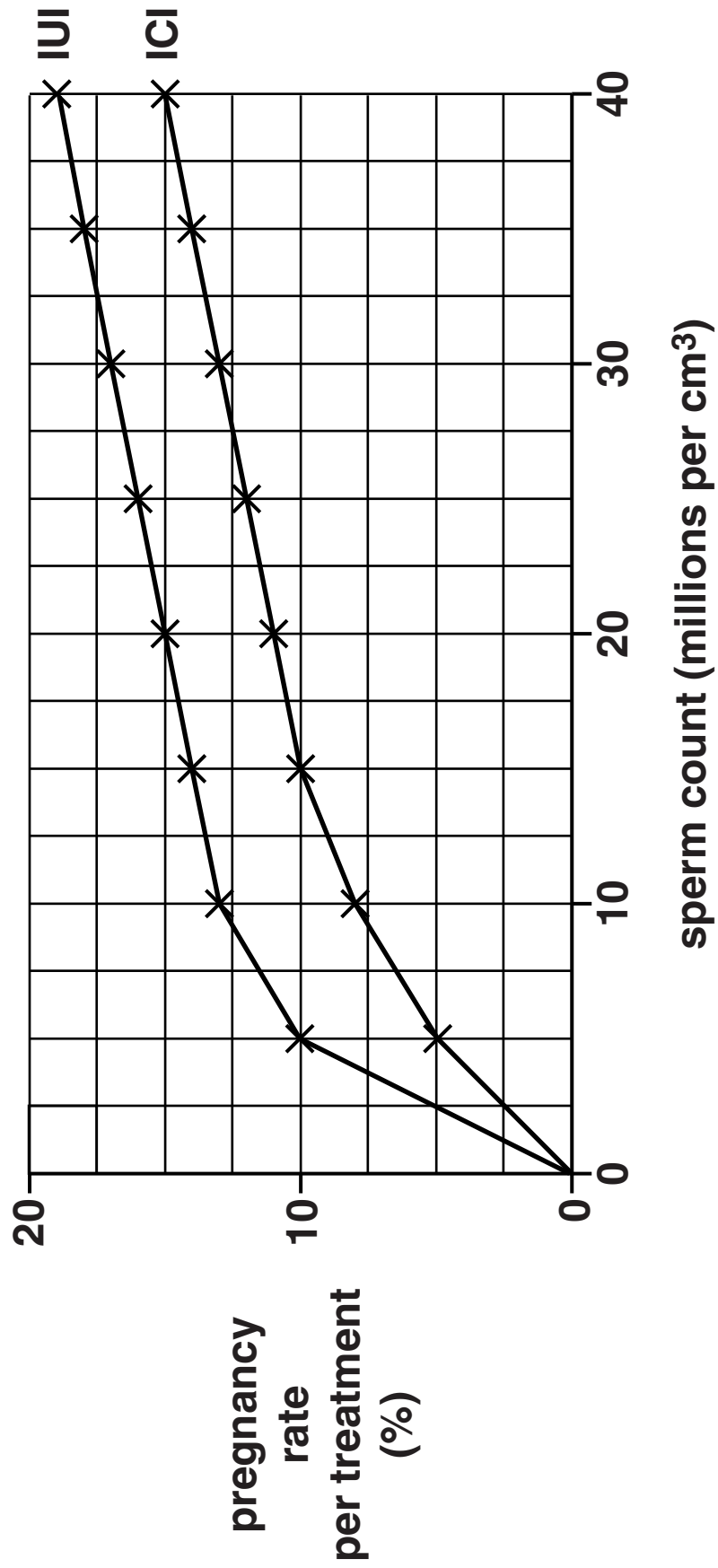


Fig. 6.1

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

[2]

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

[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.

_____ [1]

[Total: 6]

END OF QUESTION PAPER

