

**OXFORD CAMBRIDGE AND RSA EXAMINATIONS**  
**A2 GCE**  
**F224/01**  
**HUMAN BIOLOGY**  
**Energy, Reproduction and Populations**  
**THURSDAY 16 JUNE 2016: Afternoon**  
**DURATION: 1 hour 15 minutes**  
**plus your additional time allowance**  
**MODIFIED ENLARGED 24pt**

<b>Candidate forename</b>						<b>Candidate surname</b>				
<b>Centre number</b>						<b>Candidate number</b>				

**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 page(s) 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.**

**Any blank pages are indicated.**



**Answer ALL the questions.**

- 1 (a) Respiration occurs in all living cells and requires a continuous supply of respiratory substrates.**

**Explain the meaning of the term ‘respiratory substrate’.**

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**[2]**

**(b) ATP is produced by oxidative phosphorylation in the mitochondria.**

**The terms listed below relate to oxidative phosphorylation.**

<b>NAD</b>	<b>water</b>	<b>ATP synthase</b>
<b>oxygen</b>	<b>protons (H<sup>+</sup> ions)</b>	<b>inner mitochondrial membrane</b>
<b>matrix</b>	<b>inorganic phosphate</b>	<b>intermembrane space</b>

**Identify the term from the list above that corresponds to each of the following features of oxidative phosphorylation.**

**A term can be used once, more than once or not at all.**

**(i) The final electron acceptor.**

\_\_\_\_\_ **[1]**

**(ii) The location of the electron transport chain complex.**

\_\_\_\_\_ **[1]**

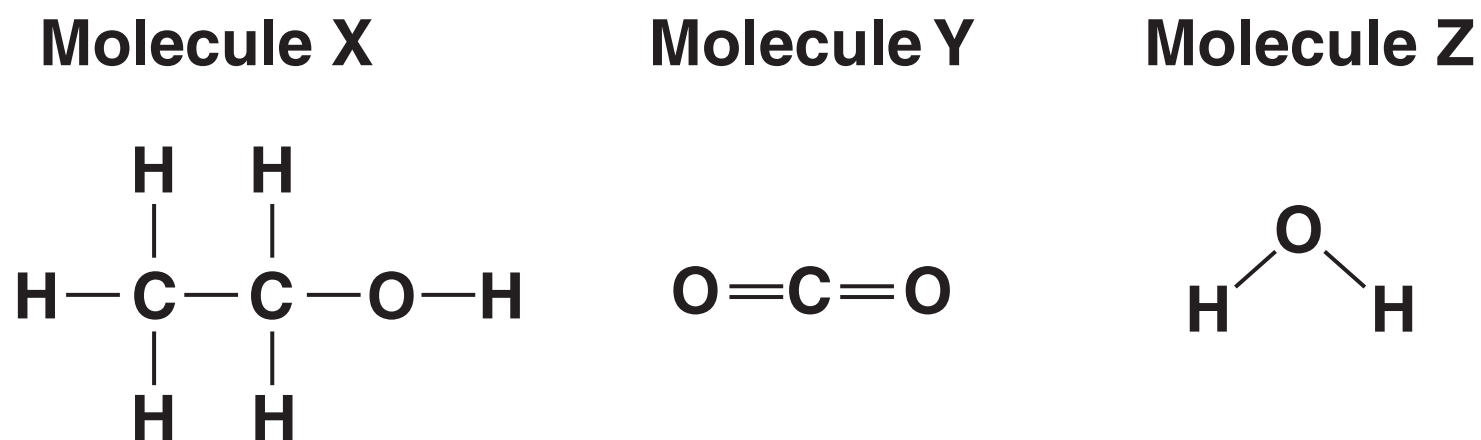
**(iii) The membrane-bound protein involved in the phosphorylation of ADP.**

\_\_\_\_\_ **[1]**

- (c) The energy content of a molecule is partly determined by the number of C–H bonds that the molecule contains.

Fig. 1.1 shows the molecular structures of three of the possible products of respiration in YEAST.

Fig. 1.1



- (i) Name molecule X.

\_\_\_\_\_ [1]

- (ii) Using the information in Fig. 1.1, explain why anaerobic respiration is less efficient than aerobic respiration in the breakdown of  $\text{C}_6\text{H}_{12}\text{O}_6$  (glucose) in yeast.

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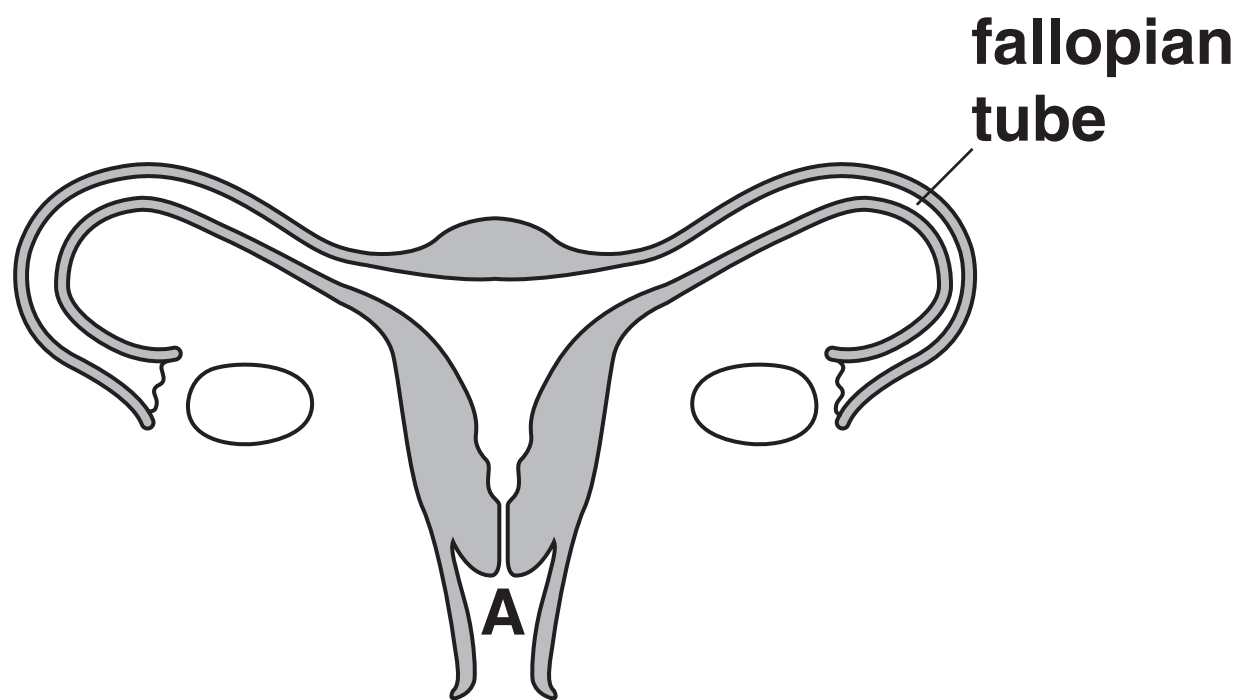
\_\_\_\_\_

\_\_\_\_\_ [3]

[TOTAL: 9]

**2 Fig. 2.1 shows a diagram of the female urinogenital system.**

**Fig. 2.1**



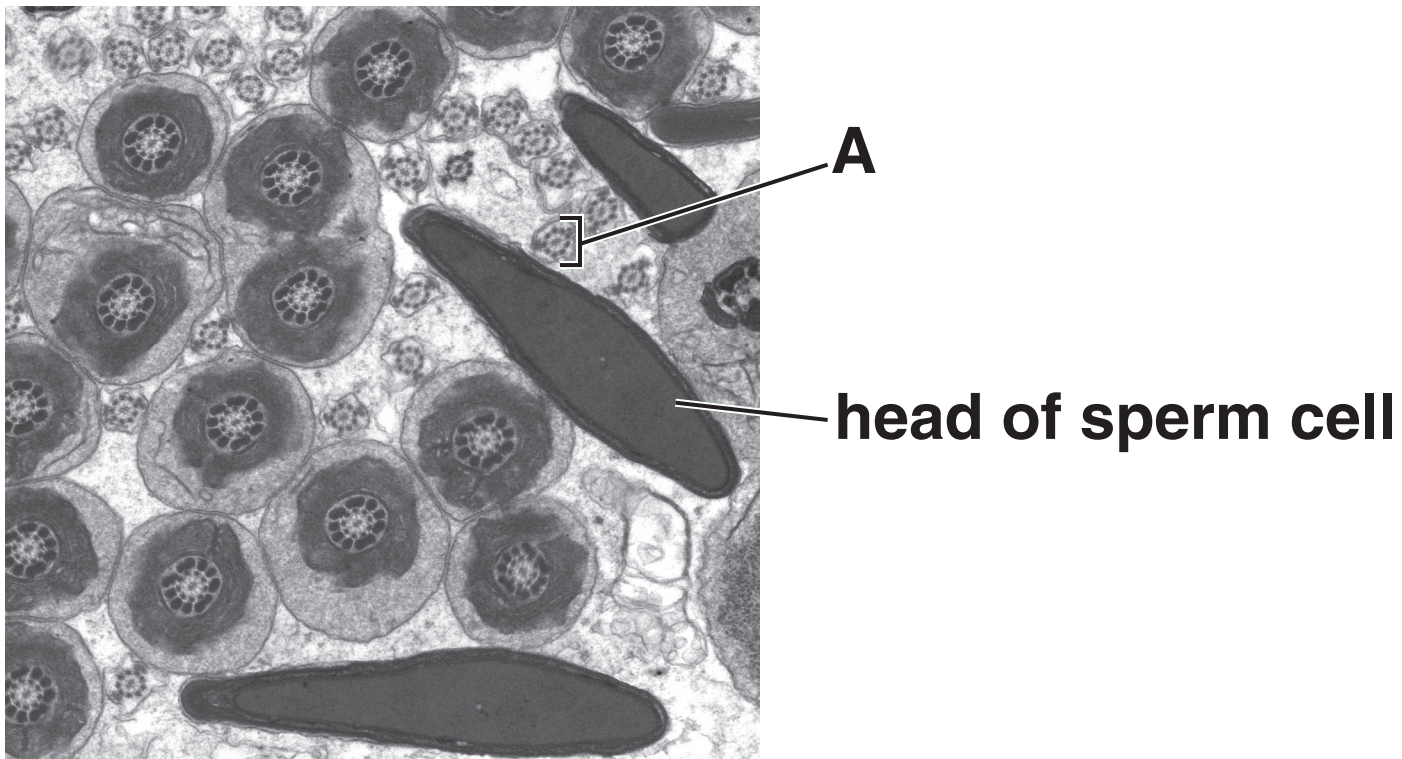
- (a) Draw a line ON FIG. 2.1, starting at the region labelled A, to indicate the path that sperm travel before meeting a secondary oocyte.**

**This question should be answered on Fig. 2.1.**

**[1]**

- (b) Fig. 2.2 is a photomicrograph of sperm cells in the testes. Some of the sperm cells are seen in cross-section.

**Fig. 2.2**



**Identify the precise part of the sperm cell labelled A in the photomicrograph.**

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[2]

- (c) **Fertilisation is the fusion of a male and female gamete.**  
**Outline how fertilisation increases genetic variation.**

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[2]



**(d) Implantation is the first stage of pregnancy.**

- (i) Name the stage of embryo development that consists of a few dozen cells, which form approximately five days after fertilisation.**

\_\_\_\_\_ **[1]**

- (ii) State the precise location where implantation usually occurs.**

\_\_\_\_\_  
\_\_\_\_\_ **[2]**

- (iii) The implantation of a fertilised egg in the fallopian tube is known as an ectopic pregnancy.**

**Suggest why the symptoms of an advanced ectopic pregnancy may be low blood pressure and a high pulse rate.**

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ **[2]**

**[TOTAL: 10]**

**3 Monitoring the changes in the body brought about by reproductive hormones is an important part of fertility treatment.**

**Hormones control the production of mucus by cells of the cervix.**

**Cervical mucus contains water and glycoproteins known as mucins.**

**The mucus changes from a thick, sticky consistency to a thin, watery consistency in response to changing levels of reproductive hormones.**

**(a) Describe how the protein molecules that form mucins are modified and secreted from mucus-secreting cells. [5]**



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

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**(b) Prior to ovulation cervical mucus is thin in consistency as it has an increased ion content.**

**(i) Suggest how ions leave the cells of the cervix.**

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[2]

**(ii) Explain how an increased ion content results in mucus of a thinner consistency.**

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[2]

**(iii) Cervical mucus can affect the movement of sperm.**

**Suggest the advantage of cervical mucus becoming thinner in consistency after ovulation.**

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**[1]**

**(c) Clomiphene is a fertility drug. It binds to oestrogen receptors in the hypothalamus preventing oestrogen from binding.**

**Clomiphene stimulates more follicles to mature in the ovaries. This increases the chances of a successful pregnancy.**

**Suggest how clomiphene increases the chances of a successful pregnancy.**

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**[3]**

**[TOTAL: 13]**

**4 Anabolic steroids, such as testosterone, are steroid hormones. Steroid hormones have a chemical structure similar to that of cholesterol.**

**(a) Anabolic steroids are transported in the blood plasma.**

**Suggest how anabolic steroid molecules in the blood plasma reach and enter the nucleus of a cell so that they can interact with the DNA.**

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[2]

- (b) The illegal use of anabolic steroids has been well documented. In 1969, an elite female athlete was found to have taken an anabolic steroid for 21 weeks.**

**Fig. 4.1 opposite shows the change in the athlete's performance over 20 weeks. The athlete, a shot-putter, broke the world record for this event during this time.**

- (i) Calculate the percentage increase in the athlete's performance from week 1 to week 20.**

**Show your working. Give your answer to 2 SIGNIFICANT FIGURES.**

**Answer = \_\_\_\_\_ % [2]**

- (ii) Anabolic steroids increase muscle mass and strength.**

**Suggest TWO OTHER ways that the use of anabolic steroids may result in improved athletic performance.**

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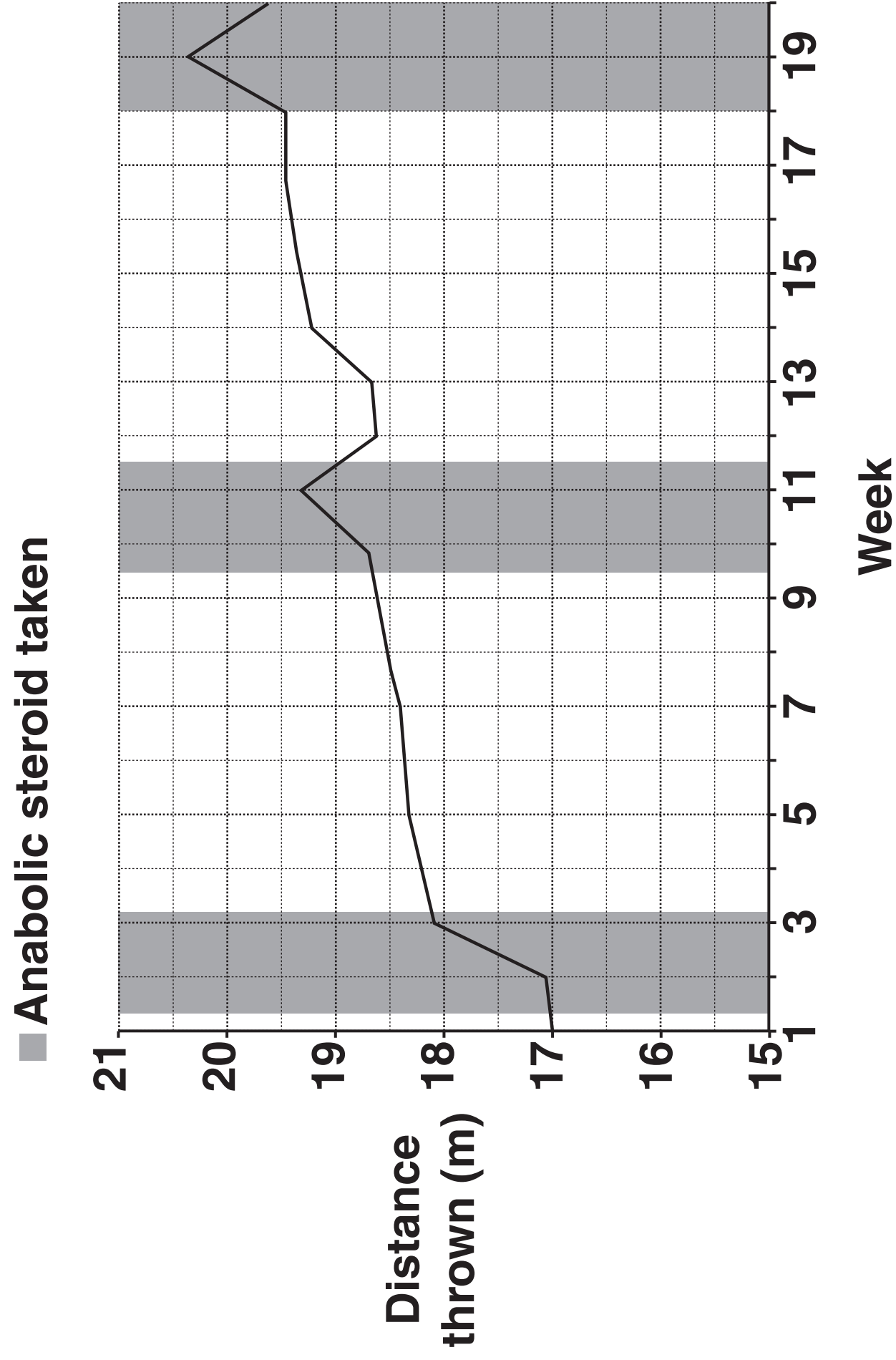
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**[2]**

Fig. 4.1

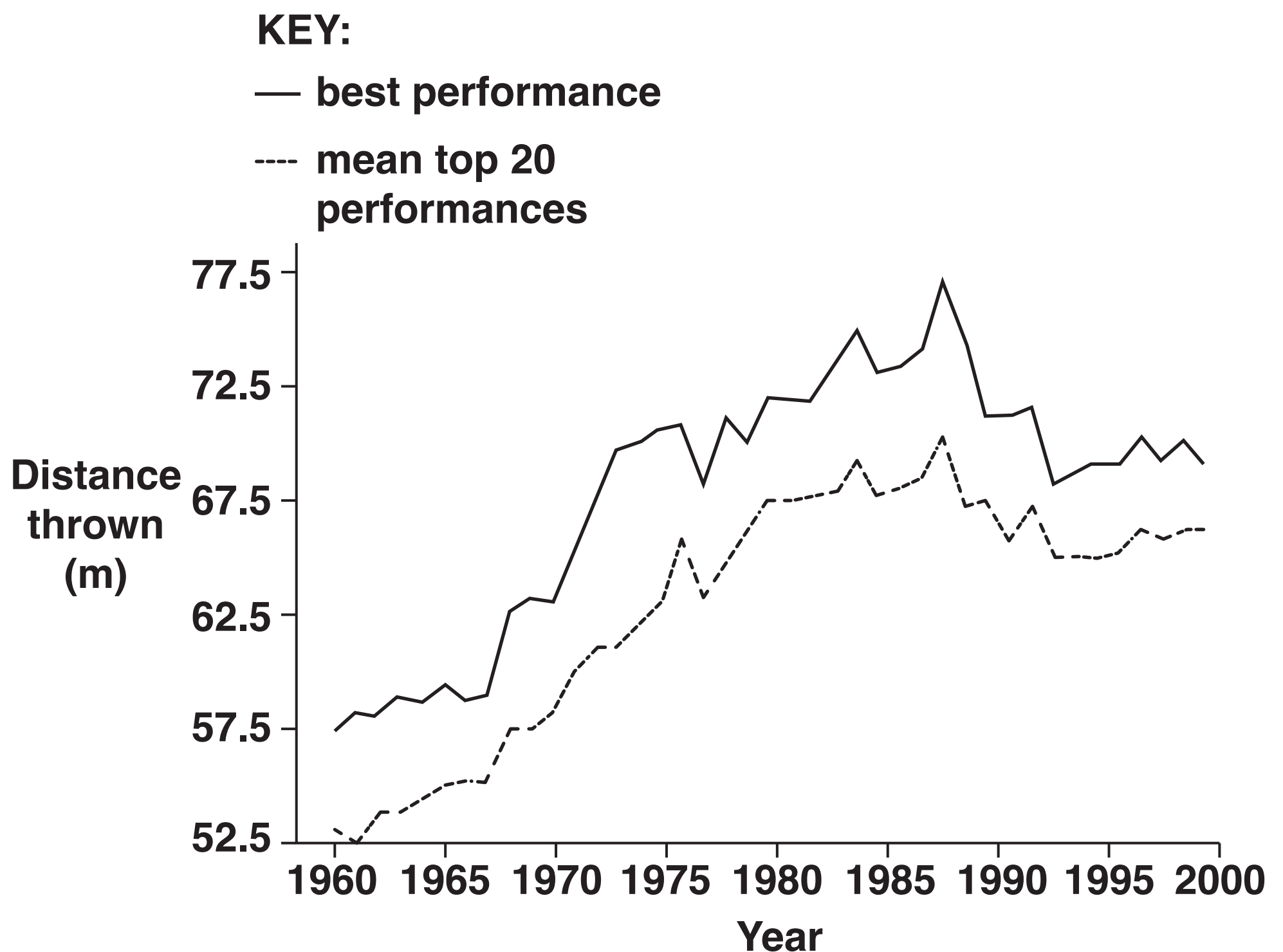


(c) Selected athletes are tested for drugs during sports competitions.

‘Out-of-competition’ drug testing, introduced in the late 1980s, is carried out randomly on all athletes. It is believed that steroid use declined at about the same time as out-of-competition drug testing was introduced.

Fig. 4.2 shows the changes in performance in another Olympic throwing event, the women’s discus, from 1960 to 2000.

Fig. 4.2





**A student stated the following:**

**“Previous improvements in performance before the introduction of out-of-competition drug testing must have been due to the illegal use of steroids.”**

**Evaluate whether the evidence shown in Fig. 4.2 supports the student’s conclusion.**

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**[2]**

**[TOTAL: 8]**

- 5 The greenhouse effect is caused by particular gases in the atmosphere including water vapour. These gases absorb infrared radiation from the Earth's surface and re-emit it. This process ensures that the surface of the Earth is 20 °C to 30 °C warmer than it would be otherwise.

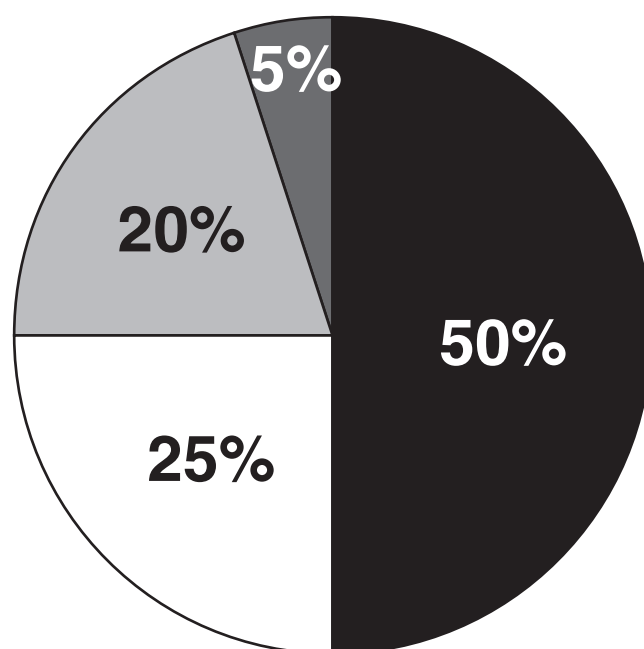
A simplified summary of the contribution of different gases to the greenhouse effect is shown in Fig. 5.1.

Fig. 5.1

### Contribution of different gases to the greenhouse effect

**KEY:**

- water vapour
- clouds
- carbon dioxide
- other gases



- (a) Suggest why water vapour is NOT considered a cause of global warming.

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[1]

- (b) Greenhouse gases vary in their contribution to global warming. Each greenhouse gas lasts for a different length of time in the atmosphere.**

**Carbon dioxide equivalents (CO<sub>2</sub>e) are used to express the relative global warming potentials of different greenhouse gases.**

- (i) Suggest the advantage of converting greenhouse gas emissions into carbon dioxide equivalents.**

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[1]

- (ii) Carbon dioxide has a global warming potential (GWP) of 1.

Methane has a GWP of 25, meaning that 1 kg of methane emitted is equivalent to 25 kg of carbon dioxide being emitted.

Table 5.1 shows the GWP of some greenhouse gases.

Table 5.1

GREENHOUSE GAS	GWP
Carbon dioxide	1
Methane	25
Nitrous oxide	298
Hydrofluorocarbon-23	22 800

Using the information in Table 5.1, calculate the mass of carbon dioxide that is equivalent to 0.5 kg of nitrous oxide.

Answer = \_\_\_\_\_ kg [2]

**(c) Hydrofluorocarbons are used as coolants in refrigeration and air conditioning units.**

**Hydrofluorocarbons were introduced to replace ozone-destroying chlorofluorocarbons (CFCs).**

**Explain, using information from Table 5.1, why even a small increase in the use of hydrofluorocarbons could act against the benefits gained from the reduction of other greenhouse gases.**

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**[2]**

- (d) A large supermarket chain has started to use eCO<sub>2</sub> as the coolant in their refrigeration systems.**

**This eCO<sub>2</sub> refrigerant is obtained during the production of bioethanol from waste sugar beet. Other CO<sub>2</sub> based refrigerants are produced from hydrocarbons derived from fossil fuels.**

- (i) How is carbon dioxide converted to organic molecules in the palisade mesophyll cells of sugar beet plants?**



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**(ii) Suggest why using eCO<sub>2</sub> is more efficient in reducing the carbon footprint of the supermarket chain than using CO<sub>2</sub> based refrigerants produced from fossil fuels.**

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**[2]**

**[TOTAL: 12]**

- 6

(a)

Cereals and legumes are frequently grown in crop rotation.
- (i)

Explain the advantage to farmers of growing legumes.

[3]
- (ii)

Explain how nitrogen-containing compounds are returned to the soil.

[3]



- (b) The stubble left after harvesting cereal crops provides a habitat during the winter and spring for birds such as Stone curlews and Pink-footed geese.**

**Changes in farming practices have led to a decline in numbers in both of these species since the end of the nineteenth century.**

**Discuss briefly the role of cereal crop stubble in the conservation of some bird species.**

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**[2]**

**[TOTAL: 8]**

**END OF QUESTION PAPER**

### ADDITIONAL ANSWER SPACE

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

[illegible]






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