

SECTION A

Answer ALL questions in this section.

1. Read the passage below. Use the information in the passage and your own knowledge to answer the questions that follow.

Artificial Insemination

- 1 In cattle, artificial insemination (AI) enables genetic improvement of populations and represents 'big money' business. The first step is to collect and store semen from genetically superior bulls. The semen is then put into the uterus of a cow using a special tube (catheter) rather than by the natural method. The collected semen
5 can easily be frozen and then transported. This has led to extensive international exchanges of material between widely separated geographical areas, such as the USA, Europe and Australia.

The semen is diluted in a liquid before being stored. The dilution provides an appropriate concentration of sperm, allowing more inseminations from each sample.

- 10 A dilution of fifty times is usual. The liquid nourishes and protects the sperm during storage and distribution. The liquid contains a number of things: milk or egg yolk, glycerol, a buffer, glucose and antibiotics. The milk or egg yolk and the glycerol protect against cold shock, which would occur during freezing. The buffer prevents
15 pH changes due to lactic acid produced during sperm metabolism. The glucose provides an energy source for the sperm, and also the correct concentration for their survival.

The diluted semen is stored in plastic tubes or straws, each holding a volume of about 0.25 cm³. The straws are stored in liquid nitrogen at -196 °C. Each straw contains about twenty million sperm. Before being used for insemination, a straw is thawed

- 20 in warm water for a few seconds to reactivate the sperm. The straw is then put into the cow so that sperm are deposited beyond the cervix. Insemination is carried out at a time that ensures the sperm arrive at the site of fertilisation a few hours before ovulation.

AI is similar to selective breeding in that it allows farmers to use bulls of known
25 quality to improve the genetic make-up of their cattle population. In addition, there are many advantages of using AI compared to using selective breeding. For example, AI allows farmers to have access to genes from bulls of a quality which they may not be able to afford. The cost of an AI straw is cheap compared with the costs of buying or keeping a bull. For a variety of reasons, farmers may not wish all calves to be
30 sired by a single bull with the same characteristics. It may well be impracticable for a farmer to keep sufficient bulls to cover all possible requirements. Finally, frozen semen can be transported globally. As well as its use in domestic cattle populations, AI is of major importance to conservationists and zookeepers.



Leave
blank

(a) Suggest what is meant by the term 'genetically superior' (line 3).

.....
.....
(1)

(b) Calculate approximately how many sperm would be in a sample of 0.25 cm^3 of undiluted semen. Show your working.

Answer million
(2)

(c) (i) Why does the storage liquid contain glycerol (line 12)?

.....
.....
(1)

(ii) Why does the storage liquid contain antibiotics (line 12)?

.....
.....
(1)

(iii) Name the process that produces lactic acid during sperm metabolism (line 14).

.....
(1)

(iv) Suggest why it is important to maintain the correct concentration of the storage liquid (line 15).

.....
.....
.....
(2)



BLANK PAGE



Leave
blank

(d) Name the part of the reproductive system in which sperm are deposited beyond the cervix (line 21).

.....
(1)

(e) Describe how AI could be part of a selective breeding programme.

.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
(3)

(f) Suggest **two** ways in which it is important to zookeepers and conservationists that frozen sperm can be transported globally.

1
.....
2
.....
(2)

Q1

(Total 14 marks)



2. The table below shows the air pollution levels in selected cities during a period of three years.

City	Maximum levels in micrograms per m ³	
	Particulate matter	Sulphur dioxide
Developed countries		
Athens (Greece)	325	118
Brussels (Belgium)	97	205
Copenhagen (Denmark)	383	135
Frankfurt (Germany)	117	230
Hamilton (Canada)	261	131
London (UK)	77	171
New York City (USA)	121	116
Developing countries (less developed countries)		
Bangkok (Thailand)	741	48
Beijing (China)	1 307	625
Bombay (India)	468	85
Calcutta (India)	1 062	197
Jakarta (Indonesia)	551	197
Manila (Philippines)	579	198
Rio de Janeiro (Brazil)	230	383
Santiago (Chile)	402	188

(a) (i) Which city has the least sulphur dioxide pollution?

..... (1)

(ii) Give **one** source of sulphur dioxide pollution.

.....
 (1)



Leave
blank

(b) (i) Calculate the average maximum level of sulphur dioxide in developed and developing countries.

Developed countries

Developing countries

(2)

(ii) Suggest why comparing the average maximum levels of sulphur dioxide is not the best way of comparing the pollution levels in these cities.

.....
.....
.....
.....

(2)

(c) Suggest possible consequences of high sulphur dioxide pollution levels for the organisms living in the polluted cities.

.....
.....
.....
.....
.....
.....
.....
.....
.....

(4)

(Total 10 marks)

Q2

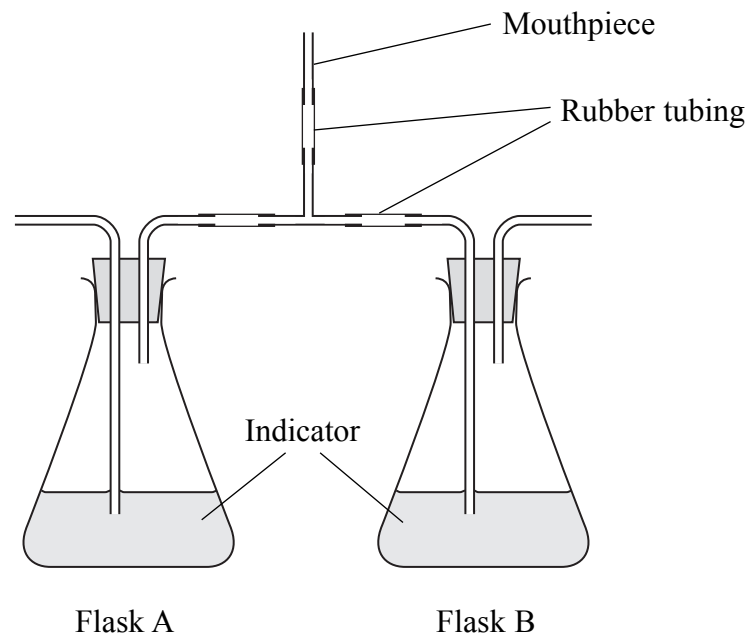
--	--

7

Turn over



3. Adam used the apparatus below to compare the concentration of carbon dioxide in inhaled and exhaled air. He breathed in and out through the apparatus several times for 2 minutes.



(a) Through which flask would the inhaled air pass? Give a reason for your answer.

.....
.....
.....
.....

(2)

(b) (i) Suggest a suitable indicator that could be used to compare the carbon dioxide content of the inhaled and exhaled gases.

.....

(1)

(ii) Describe the changes you would expect in each flask during the two minute period.

.....
.....
.....
.....

(2)



Leave blank

(c) (i) Explain why the air exhaled from the lungs differs in composition from inhaled air.

.....
.....
.....
.....

(2)

(ii) Other than changes in percentage composition, give **two** ways that exhaled air differs from inhaled air.

1

.....

2

.....

(2)

(d) Describe the mechanism by which air is drawn into the lungs.

.....
.....
.....
.....
.....
.....
.....
.....

(4)

(e) State **two** conditions affecting the human breathing system that are caused by smoking cigarettes.

1

2

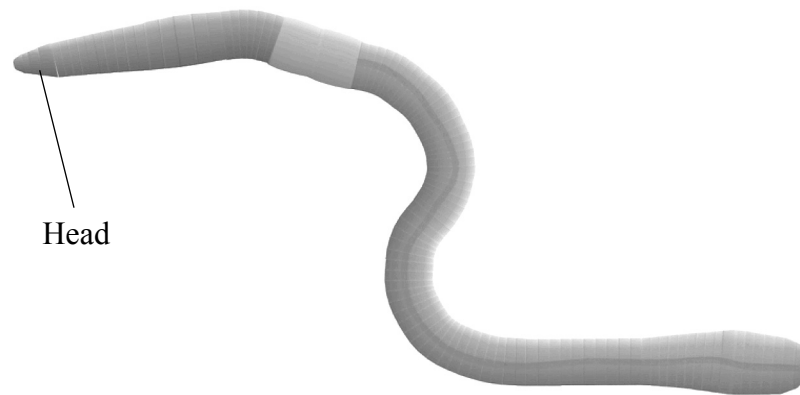
(2)

(Total 15 marks)

Q3



4. An earthworm is an animal that lives in soil and leaf litter. It feeds on dead and decaying plant material.



If an earthworm is placed in a metal dish containing a small amount of water in low light, its behavioural responses can be studied. When the worm is touched gently on its head using a blunt object it moves its head away from the object touching it.

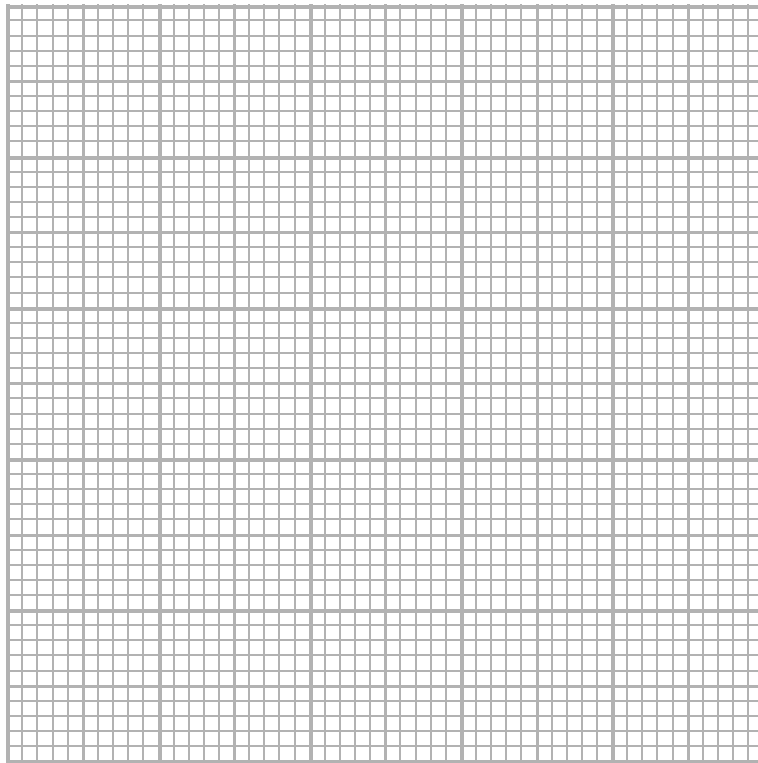
An earthworm was touched on the head every minute for a period of 10 minutes. The size of the response was recorded in arbitrary units where 10 is the maximum response and 0 is no response. The results are recorded in the table below.

Time of touch in minutes	Size of response
1	10
2	8
3	8
4	5
5	4
6	5
7	2
8	2
9	1
10	0



Leave blank

(a) (i) On the grid below plot a graph of these results. Join the points using straight lines.



(5)

(ii) Describe the effect of repeated touches on the size of the withdrawal response in the earthworm.

.....
.....
.....

(1)

(b) (i) Suggest an advantage to the earthworm of the response to the first touch.

.....
.....
.....
.....
.....

(2)



Leave blank

(ii) Suggest why the response changed as it is repeatedly touched.

.....
.....

(1)

(iii) Name the stimulus that the earthworm is responding to.

.....

(1)

(c) Humans show a number of reflex responses. Describe the pathway involved in the human reflex shown when a hand is withdrawn from a hot object.

.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....

(5)

Q4

(Total 15 marks)



Leave blank

SECTION B

Answer TWO questions in this section. If you change your mind, put a line through the box (~~☒~~) and then indicate your new question with a cross (☒).

If you answer Question 6, put a cross in this box ☒ .

- 6. (a)** Explain the effect on plant growth of an increase in availability of carbon dioxide in low light and in high light intensities.

.....
.....
.....
.....
.....
.....
.....
.....
.....

(4)

- (b)** Explain how a leaf is adapted to maximise plant growth.

.....
.....
.....
.....
.....
.....
.....
.....

(4)

(Total 8 marks)

Q6



Leave blank

If you answer Question 7, put a cross in this box .

7. (a) Explain the effect of each of the following changes on the rate of a reaction controlled by an enzyme.

(i) A reduction in temperature

.....
.....
.....
.....

(2)

(ii) An increase in enzyme concentration

.....
.....
.....
.....

(2)

(b) Explain why a particular enzyme only acts on a particular substrate.

.....
.....
.....
.....
.....
.....

(4)

(Total 8 marks)

Q7



Leave
blank

If you answer Question 8, put a cross in this box .

8. (a) Describe the differences between xylem and phloem.

.....
.....
.....
.....
.....
.....
.....

(4)

(b) Explain how transpiration would be affected by the following.

(i) A hot and windy environment

.....
.....
.....
.....

(2)

(ii) A cloudy and still environment

.....
.....
.....
.....

(2)

Q8

(Total 8 marks)

TOTAL FOR SECTION B: 16 MARKS



BLANK PAGE

TURN OVER FOR SECTION C





Leave blank

SECTION C

Answer TWO questions in this section. If you change your mind, put a line through the box (☒) and then indicate your new question with a cross (☒).

If you answer Question 9, put a cross in this box ☒ .

9. Describe and explain how bacteria can be genetically modified and then grown to enable production of human insulin in large quantities.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....





Leave
blank

If you answer Question 10, put a cross in this box ☒ .

10. Describe and explain the stages of digestion that occur following a meal containing meat, bread and butter.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....



BLANK PAGE

