Biology
Standard level
Paper 2

Monday 14 May 2018 (afternoon)

Candidate session number

1 hour 15 minutes

Instructions to candidates

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Section A: answer all questions.
- Section B: answer one question.
- Answers must be written within the answer boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is **[50 marks]**.

20 pages

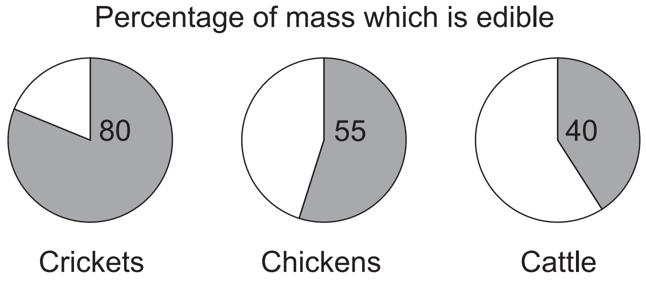
2218 – 6017

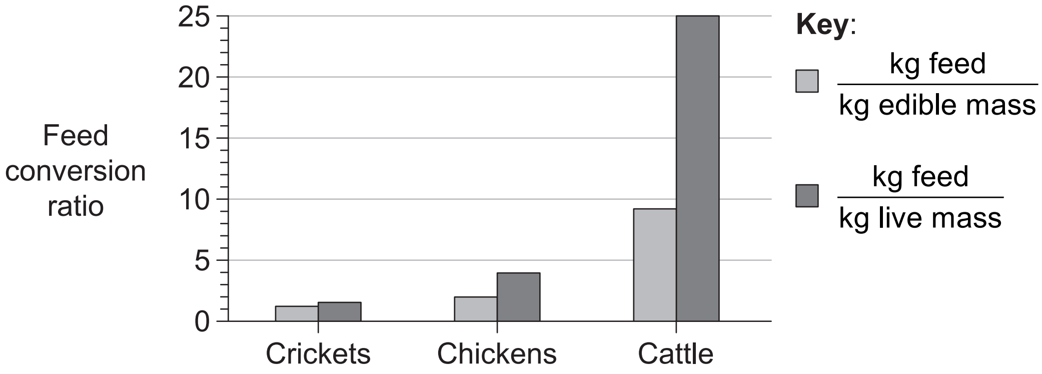
Section A

Answer **all** questions. Answers must be written within the answer boxes provided.

1. Edible insects have been a part of traditional human diets in many countries. For example, crickets are insects commonly eaten in Asia and Africa. Many studies have looked at the prospects of raising insects on a commercial scale for direct human consumption as food or indirectly by feeding insects to farm animals.

One factor to consider is which organisms are most efficient at converting the feed they eat into animal protein that can be consumed. A study compared the percentage of mass that was edible in two common farm animals and in crickets.





[Source: Food and Agriculture Organization of the United Nations. 2013. van Huis, *et al.*, *Forestry Paper* 171, page 60. http://www.fao.org/docrep/018/i3253e/i3253e00.htm. Reproduced with permission.]

(This question continues on the following page)

(Question 1 continued)

(a) (i) Identify which organism has the highest percentage of edible mass. [1]

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(ii) Calculate how much more feed is required by cattle than chickens to produce 1 kg of live mass. [1]

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(iii) Identify which organism requires the least feed to produce 1 kg of edible mass. [1]

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(This question continues on page 5)

Turn over

(Question 1 continued)

The yellow mealworm (*Tenebrio molitor*) is native to temperate regions of the world and has been studied as a possible means of producing food in countries with that type of climate. The amino acid content of yellow mealworms and cattle was analysed. The table shows the results for seven amino acids that are required in the human diet.

Amino acid	**Yellow mealworms / g kg^{-1} dry matter**	**Cattle / g kg^{-1} dry matter**
Isoleucine	25	16
Leucine	52	42
Lysine	27	45
Methionine	6	16
Phenylalanine	17	24
Threonine	20	25
Valine	29	20

[Source: Food and Agriculture Organization of the United Nations. 2013. van Huis, *et al.*, *Forestry Paper* 171, page 60. http://www.fao.org/docrep/018/i3253e/i3253e00.htm. Reproduced with permission.]

(b) (i) Distinguish between the amino acid contents of yellow mealworms and cattle. [1]

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(ii) Predict, with a reason, whether the amino acid composition of yellow mealworms **or** cattle is more suitable for a human diet. [1]

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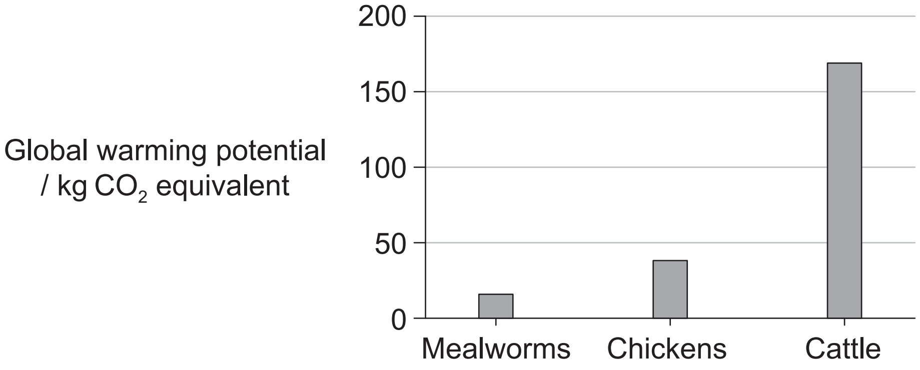
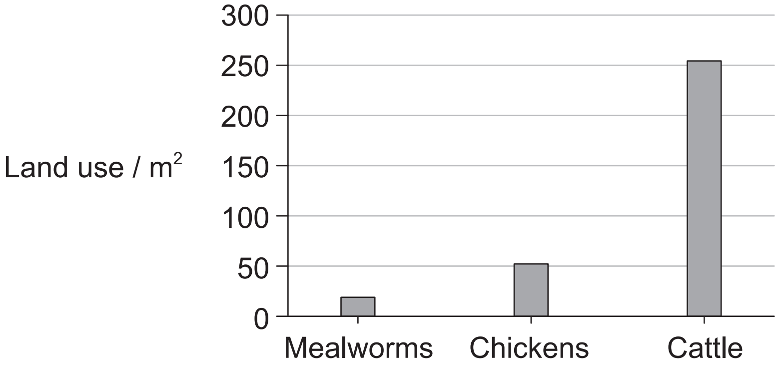
(Question 1 continued)

The environmental impact of producing protein from mealworms was compared with the impact of producing traditional protein sources. The graphs show the greenhouse gas production (global warming potential) and land use due to the production of 1 kg of protein from mealworms, chickens and cattle.





[Source: Food and Agriculture Organization of the United Nations. 2013. van Huis, *et al.*, *Forestry Paper* 171, page 60. http://www.fao.org/docrep/018/i3253e/i3253e00.htm. Reproduced with permission.]

(c) Outline the differences between the environmental impact of using mealworms and traditional farm livestock for protein production. [2]

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(This question continues on the following page)

(Question 1 continued)

(d) Birds and mammals maintain constant body temperature despite considerable losses of body heat to the environment. In insects such as mealworms, body temperature is variable and is often the same as the temperature of the environment or only slightly above it. Analyse the data in the bar charts, using this information. [2]

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(e) Using all the relevant data in this question, discuss the use of insects as a major food source for humans. [3]

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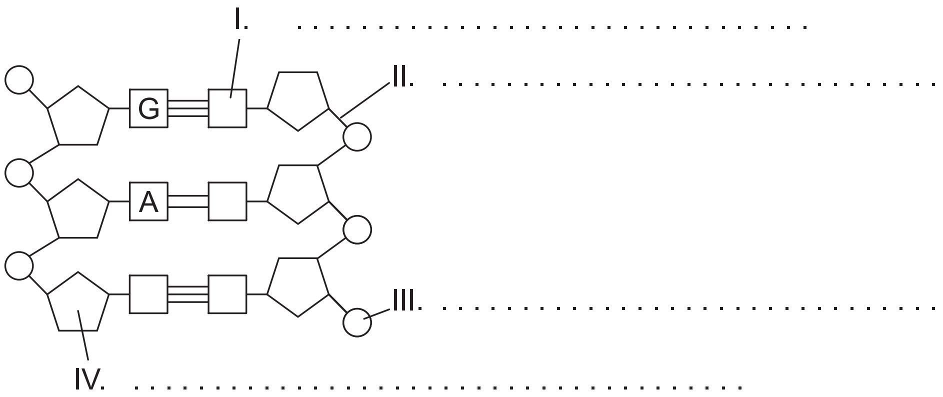
2. (a) Label the parts of the DNA diagram indicated by I, II, III and IV. [2]



[Source: © International Baccalaureate Organization 2018]

(b) (i) Explain how model making helped Watson and Crick to establish the structure of DNA. [2]

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(ii) Distinguish between the chromosomes of eukaryotic cells and prokaryotic cells. [1]

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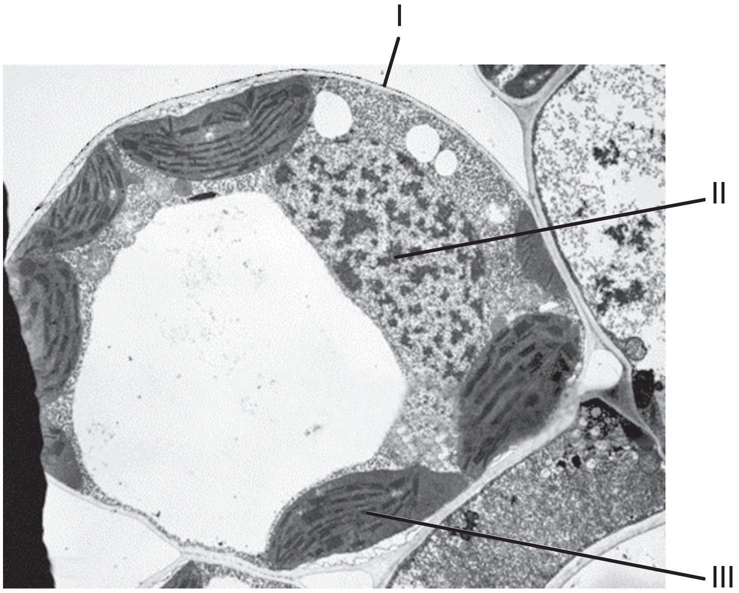
(Question 2 continued)

(c) Outline the role of the following enzymes in replication.

(i) Helicase [1]

(ii) DNA polymerase [2]

3. (a) The electron micrograph shows a palisade mesophyll cell.



[Source: BIOPHOTO ASSOCIATES/Getty Images]

(i) State the name of the structures labelled I and II. [1]

I. . . . .

II. . . . .

(ii) Outline the function of the structure labelled III. [2]

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(iii) The plant from which this cell was taken is in the group angiospermophyta. State **one** characteristic that is unique to this group of plants. [1]

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(Question 3 continued)

(b) Distinguish between autotrophic nutrition and heterotrophic nutrition. [2]

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(c) Explain how energy and nutrients are transferred in ecosystems. [3]

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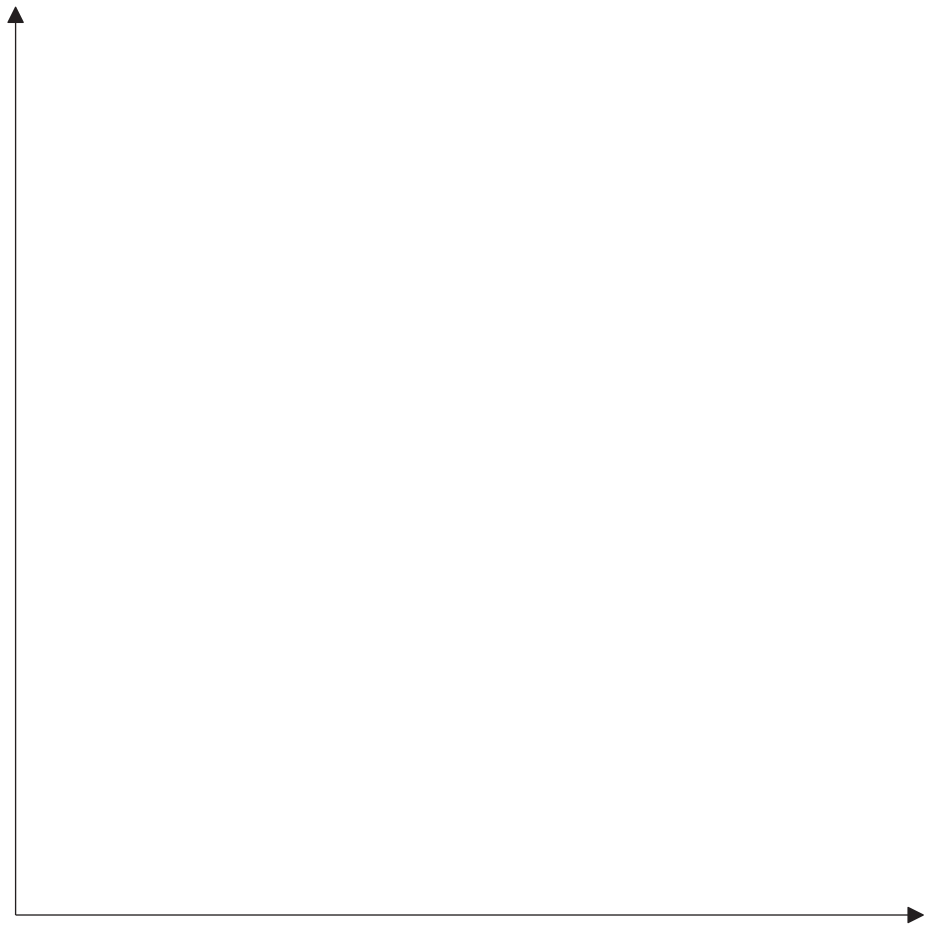
4. (a) Sketch a graph to show the effect of temperature on the activity of enzymes. [2]



(b) Explain enzyme–substrate specificity. [3]

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Section B

Answer **one** question. Up to one additional mark is available for the construction of your answer. Answers must be written within the answer boxes provided.

5. Every cell is surrounded by a cell surface membrane which regulates the movement of materials into and out of the cell.

(a) Draw an annotated diagram of the fluid mosaic model of membrane structure. [4]

(b) Describe the processes involved in absorbing different nutrients across the cell membrane of villus epithelium cells lining the small intestine. [4]

(c) Explain the events that occur during a nerve impulse and how the impulse is propagated along an axon. [7]

6. Although simple in structure, bacteria as a group show a wide range of diversity.

(a) Outline the roles bacteria play in the carbon cycle. [3]

(b) Describe the evolution of antibiotic resistance in bacteria. [4]

(c) Explain the process of genetically modifying bacteria. [8]