Diploma Programme
Programme du diplôme
Programa del Diploma

Biology
Standard level
Paper 2

Friday 4 November 2016 (morning)

Candidate session number

1 hour 15 minutes

Instructions to candidates

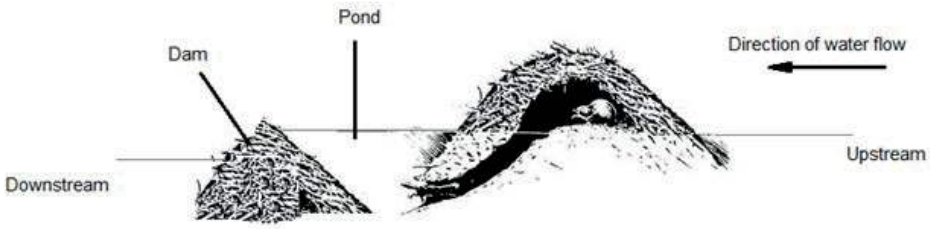
- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Section A: answer all questions.
- Section B: answer one question.
- Write your answers in the boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination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

8816 – 6005

Section A

Answer **all** questions. Write your answers in the boxes provided.

1. Beavers are large rodents that live in waterways throughout the northern hemisphere. Dams made by beavers change the temperature of the streams and affect the mayfly, *Baetis bicaudatus*. In the summer of 2008, beaver ponds in West Brush Creek and Cement Creek, Colorado, were studied to evaluate their impacts on mayflies. The study sites included streams flowing into (upstream) and out of (downstream) each beaver pond.



[Source: adapted from https://upload.wikimedia.org/wikipedia/commons/thumb/d/d4/Beaver_lodge.jpg/330px-Beaver_lodge.jpg]

Mayflies, including the species *B. bicaudatus*, are aquatic insects that hatch and spend their larval stages in water emerging from the water as adults. Larger females produce an increased number of better quality eggs.

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(Question 1 continued)

The table shows the mean temperature differences (downstream – upstream) and mean dry mass for female and male mayflies.

	Beaver pond	Relative height of dam	Mean temperature differences / °C	Mean dry mass / mg					
				Female			Male		
				Up-stream	Down-stream	Difference	Up-stream	Down-stream	Difference
West Brush Creek	1	low	+0.1	1.97	1.83	–0.14	1.39	1.37	–0.02
	2	high	–0.3	1.43	1.51	+0.08	1.15	1.18	+0.03
	3	high	–0.2	1.55	1.67	+0.12	1.19	1.23	+0.04
	4	low	+0.4	2.27	2.15	–0.12	1.53	1.51	–0.02
Cement Creek	5	low	0.0	2.12	2.07	–0.05	1.39	1.33	–0.06
	6	high	–0.1	1.79	1.76	– 0.03	1.34	1.31	–0.03
	7	high	–0.2	2.10	2.14	+0.04	1.53	1.49	–0.04
	8	low	+0.2	2.14	2.10	–0.04	1.49	1.53	+0.04
	9	high	–0.3	2.05	2.09	… **I** …	1.57	1.45	… **II** …

[Source: Fuller, M. R. and Peckarsky, B. L. (2011), Ecosystem engineering by beavers affects mayfly life histories. *Freshwater Biology*, 56: 969–979. doi:10.1111/j.1365-2427.2010.02548.x

(a) Calculate the difference in the mean dry mass of mayflies upstream and downstream of Cement Creek pond 9 for female and male mayflies. [1]

I. Female: . . . . . mg

II. Male: . . . . . mg

(b) Describe the effect dams have on water temperature. [2]

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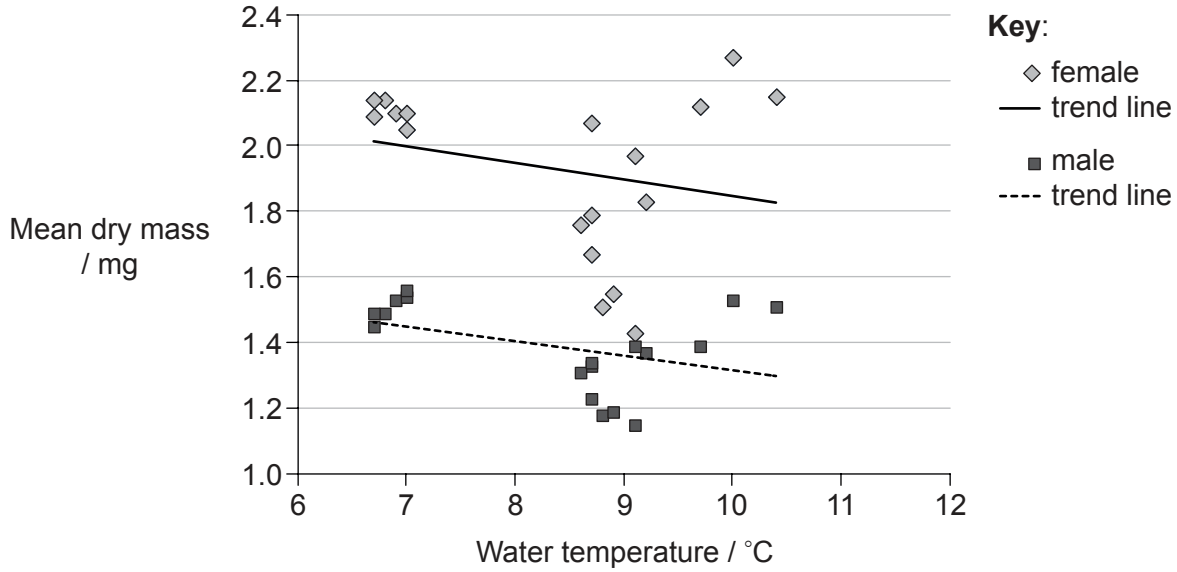
(Question 1 continued)

The graph shows the mean dry mass of mayflies relative to the water temperature in their habitats.



[Source: Fuller, M. R. and Peckarsky, B. L. (2011), Ecosystem engineering by beavers affects mayfly life histories. *Freshwater Biology*, 56: 969–979. doi:10.1111/j.1365-2427.2010.02548.x
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(c) Using the graph, discuss evidence for the hypothesis that mayflies grow to greater dry mass in cooler water. [2]

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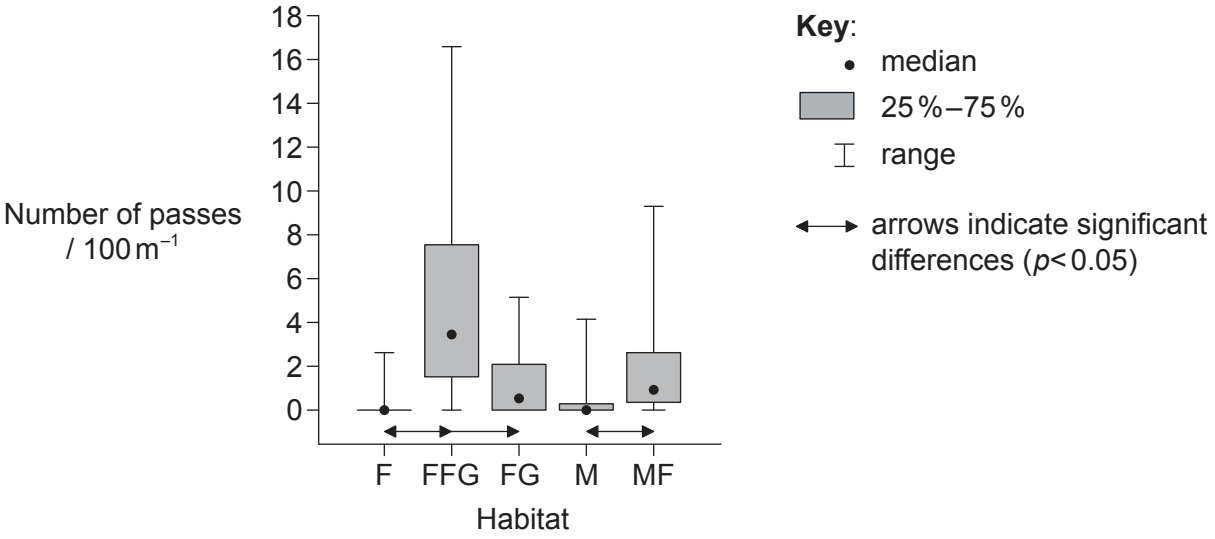
(Question 1 continued)

The bat, *Pipistrellus nathusii*, feeds on insects including mayflies. A study was undertaken in Poland to see the effect of European beavers (*Castor fiber*) on the activity of bats. Beaver activity can affect forests that are covered by trees and meadows that are covered by grasses and have no trees. The following habitats were studied:

- forest (F)
- flooded forest with canopy gaps created by beavers and flooding due to the presence of beaver dams (FFG)
- forest with canopy gaps created by beavers but no flooding (FG)
- meadow (M)
- meadow with flooding due to the presence of beaver dams (MF).

As bats feed they fly through the air catching insects. The number of feeding passes made by bats was counted. The graph shows differences in the bat activity between particular habitats.



[Source: adapted from Ciechanowski, M., Kubic, W., Rynkiewicz, A. et al. (2011), "Reintroduction of beavers *Castor fiber* may improve habitat quality for vespertilionid bats foraging in small river valleys". *European Journal of Wildlife Research*, Volume 57, Number 4, Page 737.]

(d) Analyse the data to find the effect of flooding and tree felling by beavers on the activity of bats. [2]

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Please **do not** write on this page.

Answers written on this page
will not be marked.

(Question 1 continued from page 5)

(e) The trout, *Oncorhynchus mykiss*, that live in West Brush Creek and Cement Creek also feed on the mayflies. Fishermen come to Colorado to catch and eat trout. Draw a diagram of part of a food web for the creeks in Colorado, including mayflies, humans, trout and bats. [2]

(f) Identify an example of competition between organisms in this food web. [1]

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(g) The North American beaver (*Castor canadensis*) was introduced to islands adjacent to Argentina and Chile where they have become an invasive species. Discuss **one** ecological criterion (a basis for deciding) whether beavers are harmful **or** helpful to the ecosystems there. [2]

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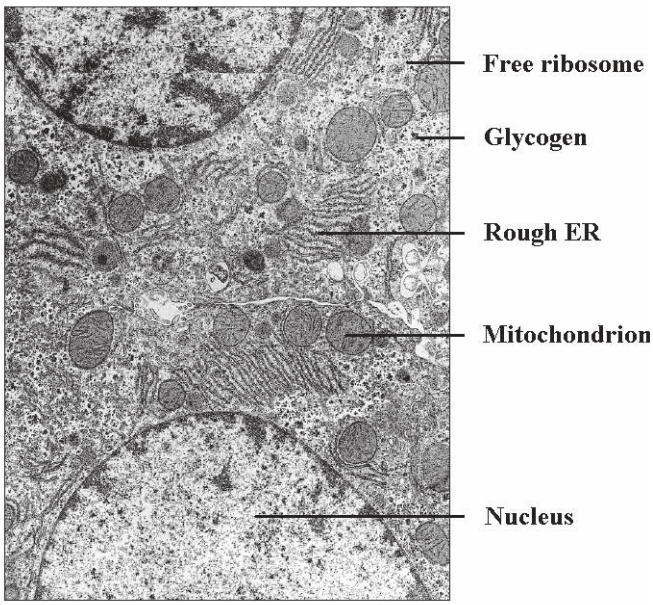
2. The image is an electron micrograph.



[Source: http://image.wikifoundry.com/image/2/H1jghtjAjTutprovXh4VCA200205/GW720H652]

(a) Determine, with a reason, whether the image is of a prokaryotic cell **or** eukaryotic cell. [1]

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(b) (i) State the process that divides one nucleus into two genetically identical nuclei. [1]

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(This question continues on the following page)

(Question 2 continued)

(ii) Explain how the cell cycle is controlled. [4]

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3. (a) Define metabolism. [1]

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(b) Identify the following processes as **either** anabolism **or** catabolism by placing a tick (✓) in the correct box. [2]

Process	Anabolism	Catabolism
Photosynthesis	☐	☐
Glycolysis	☐	☐

(c) Describe cell respiration in terms of metabolism. [2]

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4. The diploid number of chromosomes in horses (*Equus ferus*) is 64 and the diploid number in donkeys (*Equus africanus*) is 62. When a male donkey and a female horse are mated, the result is a mule which has 63 chromosomes.

(a) State the haploid number for horses. [1]

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(b) Explain reasons that mules cannot reproduce. [2]

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(c) Discuss whether or not horses and donkeys should be placed in the same species. [2]

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(d) A mule was born at the University of Idaho in the USA with 64 chromosomes. Suggest a mechanism by which this could happen. [1]

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5. (a) Living organisms have been placed in three domains: archaea, eubacteria and eukaryote. Distinguish archaea from eubacteria. [3]

Archaea	Eubacteria

(b) List **two** types of evidence used to determine which species belong in the same clade. [2]

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Section B

Answer **one** question. Up to one additional mark is available for the construction of your answer. Write your answers in the boxes provided.

6. The human circulatory system is structured to serve the organs and tissues of the body efficiently.

(a) Outline the exchange of materials between capillaries and tissues. [3]

(b) Explain the structures and functions of arteries and veins. [8]

(c) Describe what happens in alveoli. [4]

7. In ecosystems, energy is used to convert inorganic compounds into organic matter. Energy enters ecosystems through producers.

(a) Explain the processes by which energy enters and flows through ecosystems. [8]

(b) Producers extract phosphates and nitrates from soil. Outline how these ions are used in the synthesis of organic molecules. [3]

(c) Draw a labelled diagram of a pyramid of energy. [4]