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BIOLOGY
STANDARD LEVEL
PAPER 2

Monday 17 May 2010 (afternoon)

1 hour 15 minutes

Candidate session number

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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 of Section A in the spaces provided.
- Section B: answer one question from Section B. Write your answers on answer sheets. Write your session number on each answer sheet, and attach them to this examination paper and your cover sheet using the tag provided.
- At the end of the examination, indicate the numbers of the questions answered in the candidate box on your cover sheet and indicate the number of sheets used in the appropriate box on your cover sheet.

0109

SECTION A

*Answer **all** the questions in the spaces provided.*

1. Male Lepidoptera (butterflies and moths) commonly drink from pools of water or from moist soil. This behaviour, called puddling, was investigated in an undisturbed area where male tiger swallowtails, *Papilio glaucus*, had been seen puddling.

Four successive sets of experiments were performed under similar conditions of temperature and humidity. In each set, equal samples of sand were spread out evenly on trays and then treated differently. Except for one dry sample (in the first set), all others were saturated with a different liquid. Results of the observations are given in the table below.

Numbers of visits (V) and time in minutes (T) spent puddling by male *Papilio glaucus* adults on sand treated in different ways.

Experiments	Visits and times on sand plus substance:									
	V	T	V	T	V	T	V	T	V	T
1	*Dry sand alone*		*Distilled H_2O*		*Casein hydrolyzate*		*5% Sucrose*		*NaCl (0.17 M)*	
	26	0	47	0.5	27	205.5	60	0.5	74	320.5
2	*KCl (0.1 M)*		*$MgCl_2$ (0.1 M)*		*$CaCl_2$ (0.1 M)*		*Na_3PO_4 (0.1 M)*		*NaCl (0.1 M)*	
	33	0	36	0	48	1.5	43	79.5	65	362.0
3	*NH_4Cl (0.1 M)*		*KNO_3 (0.1 M)*		*K_3PO_4 (0.1 M)*		*Na_3PO_4 (0.1 M)*		*$NaNO_3$ (0.1 M)*	
	9	0	6	0	6	0	3	0.5	86	279.5
4	*Distilled H_2O*		*NaCl (10^{-5} M)*		*NaCl (10^{-4} M)*		*NaCl (10^{-3} M)*		*NaCl (10^{-2} M)*	
	2	0	7	1.5	16	27.5	32	172.5	22	195.5

[Source: adapted from K Arms et al. "Sodium: Stimulus for Puddling Behaviour by Tiger Swallowtail Butterflies, Papilio glaucus" (1974) *Science*, **185**: 5 (5 July–27 Sept) #4148, pp. 372–374. Reprinted with permission from AAAS]

(a) Identify the dissolved element always present in the three samples with most puddling time. *[1]*

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(Question 1 continued)

(b) Discuss the relationship between sampling visits (V) and puddling time (T) in experiments 1, 2 and 3. *[2]*

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(c) Analyse the results for experiment 4. *[2]*

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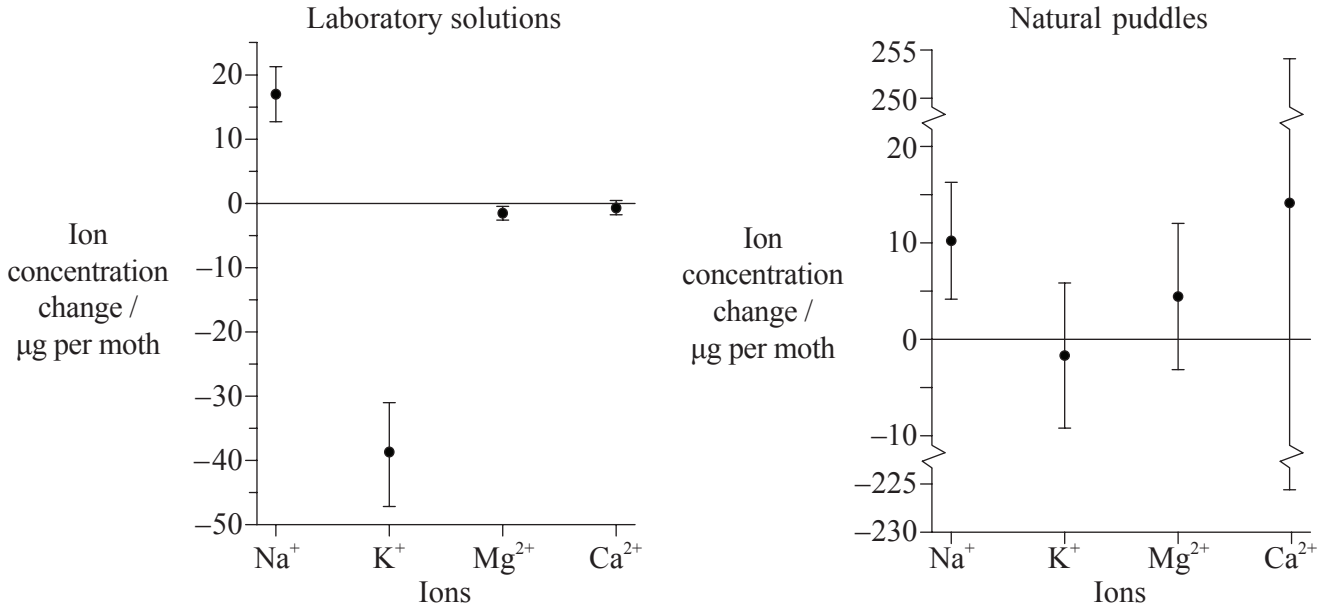
(Question 1 continued)

Study of the male moth *Gluphisia septentrionis* revealed that their puddling behaviour can last for hours. Though drinking results in the uptake of hundreds of gut-loads of fluid, this fluid becomes rapidly expelled from the digestive system through frequent anal ejections. In this experiment, the ion concentration change was calculated by subtracting ions ejected from ions taken in. The following data was collected from males drinking laboratory solutions and from natural puddles.



[Source: adapted from SR Smedley and T Eisner "Sodium Uptake by Puddling in a Moth" (1995) *Science*, **270** (15 Dec) #5243, pp. 1816–1818. Reprinted with permission from AAAS]

(d) (i) Identify which ion the moths are retaining in their body from the laboratory solutions. *[1]*

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(ii) Compare the gain and loss of ions in the male moths which have drunk from laboratory solutions with the changes in those that have drunk from natural puddles. *[3]*

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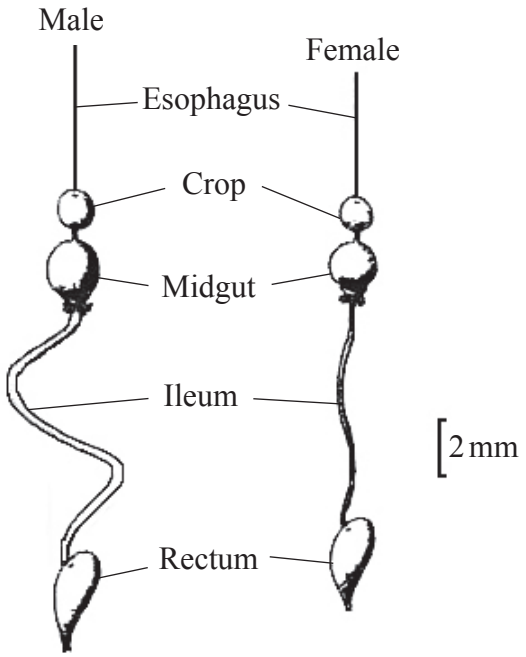
(Question 1 continued)

The diagram below shows the digestive system anatomy of the male and female moth.



[Source: adapted from SR Smedley and T Eisner "Sodium Uptake by Puddling in a Moth" (1995) *Science*, **270** (15 Dec) #5243, pp. 1816–1818. Reprinted with permission from AAAS]

(e) Using the diagram above, evaluate the hypothesis that male moths are better adapted than female moths to benefit from puddling behaviour. *[2]*

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(f) Suggest **one** reason for puddling behaviour in male Lepidoptera. *[1]*

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2. (a) Outline the bonding between DNA nucleotides. *[2]*

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(b) Explain how chemical bonding between water molecules makes water a valuable coolant in living organisms. *[2]*

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(c) Describe the movement of water across membranes. *[2]*

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(d) State the role of water in photosynthesis. *[2]*

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3. (a) Define the term *allele* as used in genetics. *[1]*

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(b) List the possible genotypes for blood group B. *[1]*

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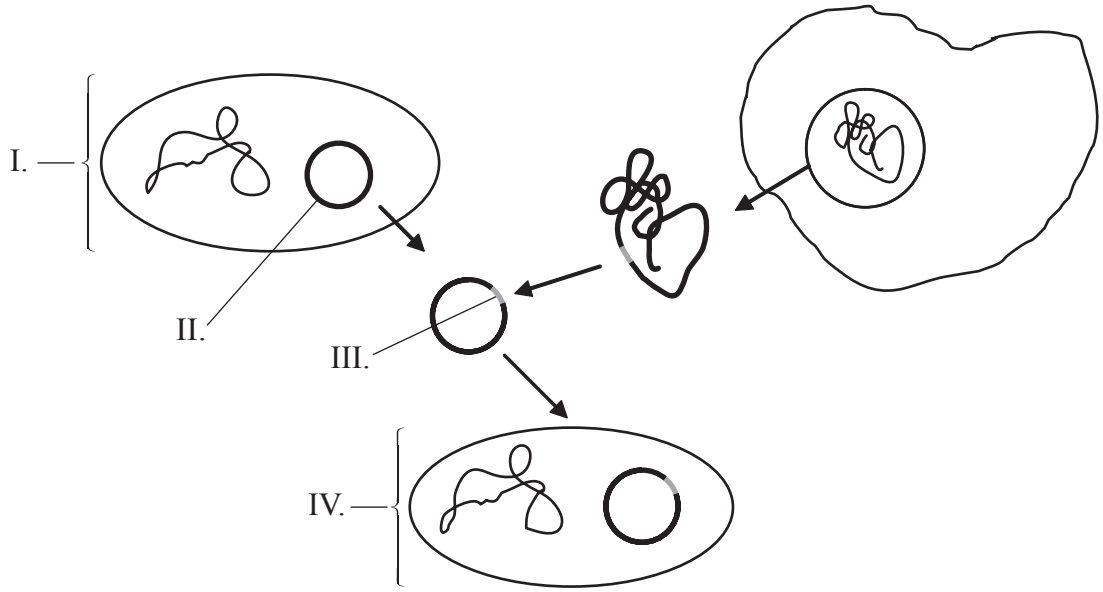
(c) Label the diagram below which shows a basic gene transfer. *[2]*



I. . . . . .

II. . . . . .

III. . . . . .

IV. . . . . .

(d) State **two** general types of enzymes used in gene transfer. *[1]*

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4. (a) State a word equation for anaerobic cell respiration in humans. *[1]*

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(b) Describe the need for a ventilation system in humans. *[2]*

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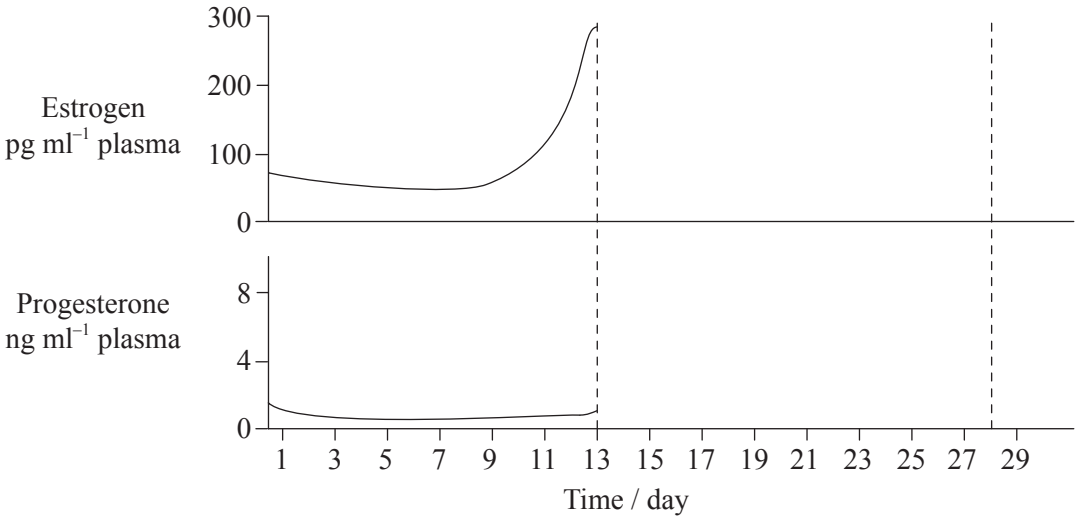
(c) Sketch the hormone changes between days 13 and 28 on the graphs below for a woman in her normal menstrual cycle. *[2]*



[Source: adapted from www.mivf.com.au/ivf/infertility/images/cyclediagram.GIF]

SECTION B

*Answer **one** question. Up to two additional marks are available for the construction of your answer. Write your answers on the answer sheets provided. Write your session number on each answer sheet, and attach them to this examination paper and your cover sheet using the tag provided.*

5. (a) Outline the role of hydrolysis in the relationships between monosaccharides, disaccharides and polysaccharides. *[4]*

(b) Describe the use of biotechnology in the production of lactose-free milk. *[6]*

(c) Explain the importance of enzymes to human digestion. *[8]*

6. (a) Describe the movement of energy and nutrients in an ecosystem. *[6]*

(b) Explain how sexual reproduction can eventually lead to evolution in offspring. *[8]*

(c) Using simple external recognition features, distinguish between the plant phyla bryophyta and angiospermophyta. *[4]*

7. (a) Compare simple diffusion with facilitated diffusion as mechanisms to transport solutes across membranes. *[5]*

(b) Describe the process of endocytosis. *[5]*

(c) Explain how an impulse passes along the membrane of a neuron. *[8]*