Diploma Programme
Programme du diplôme
Programa del Diploma

Biology
Standard level
Paper 2

Thursday 5 November 2015 (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]**.

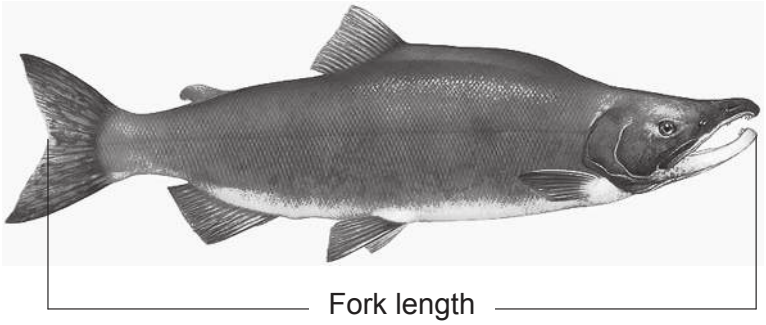
20 pages

8815 – 6005

Section A

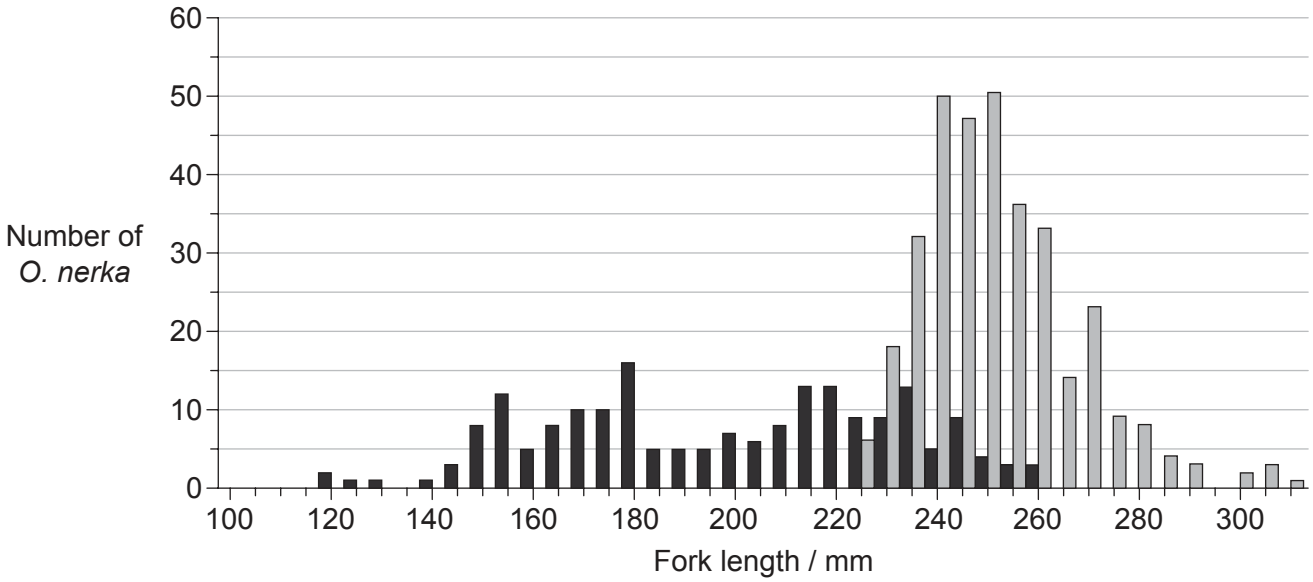
Answer **all** questions. Write your answers in the boxes provided.

1. Sockeye salmon (*Oncorhynchus nerka*) spend the first years of their lives in the freshwater lakes of Alaska before migrating to marine waters. Their first months in marine waters are spent foraging and growing near the shore line. They then move to offshore regions of the North Pacific Ocean for 2 to 3 years.



[Source: "Oncorhynchus nerka" by Timothy Knepp of the Fish and Wildlife Service. - US Fish and Wildlife Service. Licensed under Public Domain via Commons - https://commons.wikimedia.org/wiki/File:Oncorhynchus_nerka.jpg#/media/File:Oncorhynchus_nerka.jpg]

The graph shows fork length frequency of juvenile *O. nerka* caught during their first months in marine waters in autumn 2008 and ocean age one *O. nerka* caught 15 months later during winter 2009 in the North Pacific Ocean.



Key: ■ autumn 2008 (juvenile *O. nerka*) ▫ winter 2009 (ocean age one *O. nerka*)

[Source: Adapted from Edward V. Farley, Alexander Starovoytov, Svetlana Naydenko, Ron Heintz, Marc Trudel, Charles Guthrie, Lisa Eisner and Jeffrey R. Guyon (2011) 'Implications of a warming eastern Bering Sea for Bristol Bay sockeye salmon'. *ICES Journal of Marine Science*, **68** (6), pages 1138–1146, by permission of Oxford University Press.]

(This question continues on the following page)

(Question 1 continued)

(a) Identify the most frequent fork length for *O. nerka* caught during autumn 2008 and winter 2009. [1]

Autumn 2008: . . . . . .

Winter 2009: . . . . . .

(b) Distinguish between the fork lengths of *O. nerka* in autumn 2008 and winter 2009. [2]

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(c) Suggest a reason for the variation in fork length of ocean age one *O. nerka*. [1]

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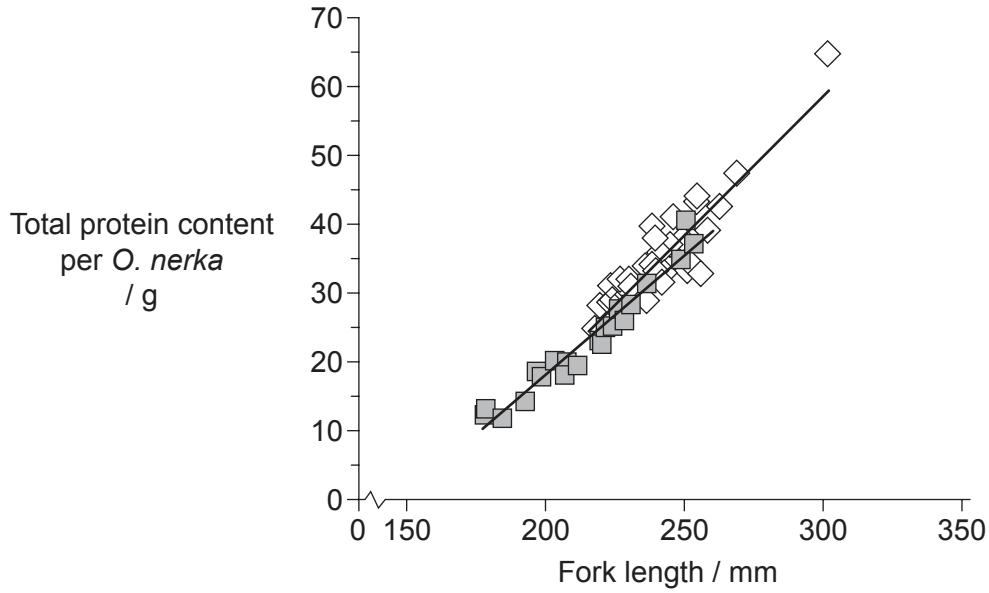
(Question 1 continued)

Protein content in *O. nerka* was measured to evaluate possible differences during their first 15 months at sea. The graph shows the relationship between fork length and total protein content per *O. nerka* caught during autumn 2008 and winter 2009.



Key: ■ autumn 2008 (juvenile *O. nerka*) ◇ winter 2009 (ocean age one *O. nerka*)

[Source: Adapted from Edward V. Farley, Alexander Starovoytov, Svetlana Naydenko, Ron Heintz, Marc Trudel, Charles Guthrie, Lisa Eisner and Jeffrey R. Guyon (2011) 'Implications of a warming eastern Bering Sea for Bristol Bay sockeye salmon'. *ICES Journal of Marine Science*, **68** (6), pages 1138–1146, by permission of Oxford University Press.]

(d) (i) Compare the protein content for *O. nerka* caught during autumn 2008 and winter 2009. [2]

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(ii) Outline the difficulty in predicting the age of *O. nerka* from fork length. [1]

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(Question 1 continued)

(e) Using the data, suggest **one** reason for the relationship between protein content and fork length. [1]

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(Question 1 continued)

(f) Scientists measured mercury levels in different fish. The table shows the results.

	Mercury / $\mu g\,g^{-1}$				
	Mean	**Standard deviation**	**Minimum**	**Maximum**	**Number of samples**
Cod	0.111	0.066	0.001	0.989	115
Monkfish	0.181	0.075	0.056	0.289	9
Shark	0.979	0.626	0.001	4.540	356
Trout	0.071	0.025	0.001	0.678	35

(i) Compare the results shown in the table for monkfish and shark. [2]

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(ii) Suggest additional information that would be helpful in evaluating these data. [1]

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(g) State which type of fish shows the most variation. [1]

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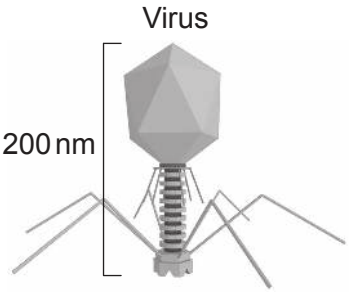
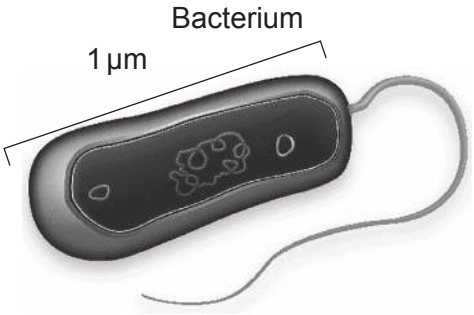
2. The diagrams show a virus and a bacterium.



[Source: Adapted from http://cronodon.com. Used with permission.]



[Source: Image courtesy of the Microbiology Society.]

(a) Calculate the magnification of the bacterium. [1]

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(b) State the method that bacteria use to divide. [1]

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(Question 2 continued)

(c) Outline the effectiveness of antibiotics against viruses and bacteria. [1]

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(d) Saprotrophic organisms, such as *Mucor* species, are abundant in soils.

(i) Define *saprotrophic organisms*. [1]

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(ii) State **one** role of saprotrophic organisms in the ecosystem. [1]

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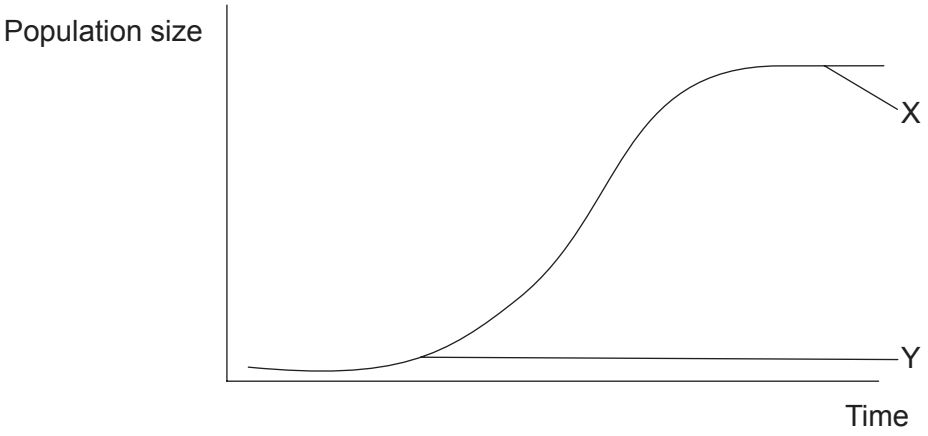
3. The graph shows a sigmoid population growth curve.



(a) Identify the phases labelled X and Y. [1]

X: . . . . . .

Y: . . . . . .

(b) Outline how fossil records can provide evidence for evolution. [2]

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(Question 3 continued)

(c) The table summarizes the genome size of several organisms.

Organism type	Organism	Genome size / base pairs
Bacterium	*Helicobacter pylori*	1 667 867
Fruit fly	*Drosophila melanogaster*	130 000 000
Rice	*Oryza sativa*	420 000 000
Human	*Homo sapiens*	3 200 000 000

(i) Distinguish between the terms genotype and phenotype. [1]

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(ii) Outline a structural difference between the chromosomes of *Helicobacter pylori* and *Homo sapiens*. [1]

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(iii) Deduce the percentage of adenine in *Oryza sativa* if the proportion of guanine in that organism is 30 %. [1]

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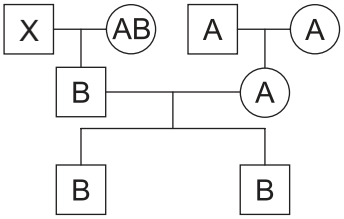
(Question 3 continued)

(d) The figure shows a pedigree chart for the blood groups of three generations.



(i) Deduce the possible phenotypes of individual X. [1]

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(ii) Describe ABO blood groups as an example of codominance. [1]

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4. (a) Draw a labelled diagram showing the **interconnections** between the liver, gall bladder, pancreas and small intestine. [2]

(b) Outline the role of glucagon in homeostasis of glucose. [2]

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(c) List **two** examples of polysaccharides. [1]

1. . . . . .

2. . . . . .

Section B

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

5. (a) Draw a labelled diagram of a section of DNA showing four nucleotides. [5]

(b) Outline a technique used for gene transfer. [5]

(c) Explain how evolution may happen in response to an environmental change. [8]

6. (a) Outline the stages of the cell cycle. [5]

(b) Explain the process of translation in cells. [8]

(c) Outline the production of a dipeptide by a condensation reaction, showing the structure of a generalized dipeptide. [5]

7. (a) Draw a labelled diagram of a motor neuron. [5]

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

(c) Describe the process of endocytosis. [5]