Diploma Programme
Programme du diplôme
Programa del Diploma

Biology
Higher level
Paper 2

Thursday 5 November 2015 (morning)

Candidate session number

2 hours 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 two questions.
- Write your answers in the boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is **[72 marks]**.

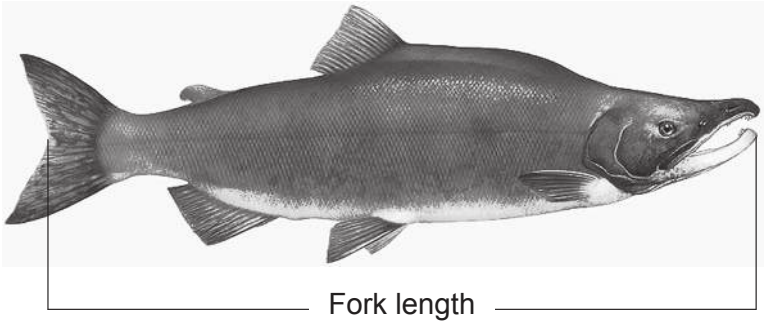
20 pages

8815 – 6002

Section A

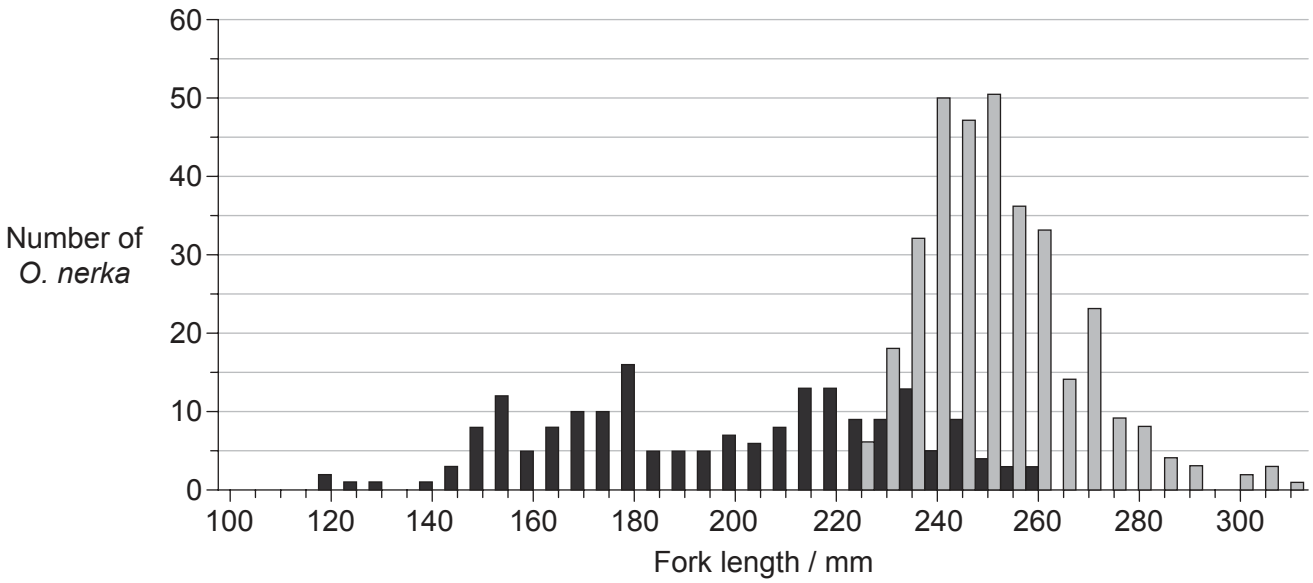
Answer **all** questions. Write your answers in the boxes provided.

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.



[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 **total** number of *O. nerka* with fork length from 240 to 245 mm caught in autumn 2008 and winter 2009. [1]

. . . . . .

(b) Compare the data in the graph for autumn 2008 and winter 2009. [3]

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

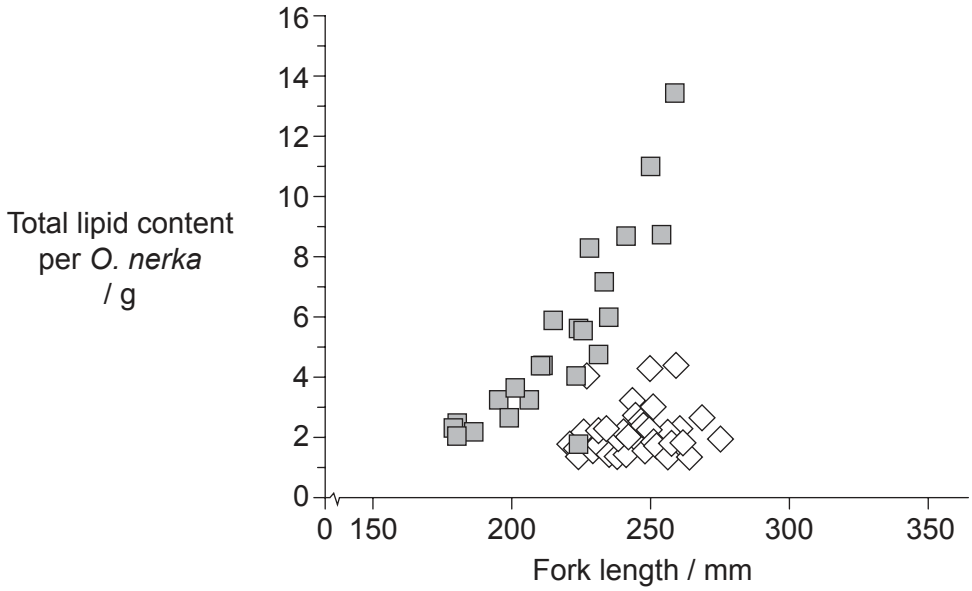
(c) Suggest **two** factors that could affect the distribution of *O. nerka* in the North Pacific Ocean. [2]

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

(This question continues on the following page)

(Question 1 continued)

Lipid in *O. nerka* was measured to evaluate possible differences in energy status during their first 15 months at sea. The graph shows the relationship between fork length and lipid content for *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) State the range of lipid content measured in *O. nerka* caught during autumn 2008. [1]

. . . . . g

(e) Outline any correlation between total lipid content and fork length in autumn 2008 and in winter 2009. [2]

Autumn 2008: . . . . . .

Winter 2009: . . . . . .

(This question continues on the following page)

(Question 1 continued)

(f) Suggest reasons for the differences in lipid content. [2]

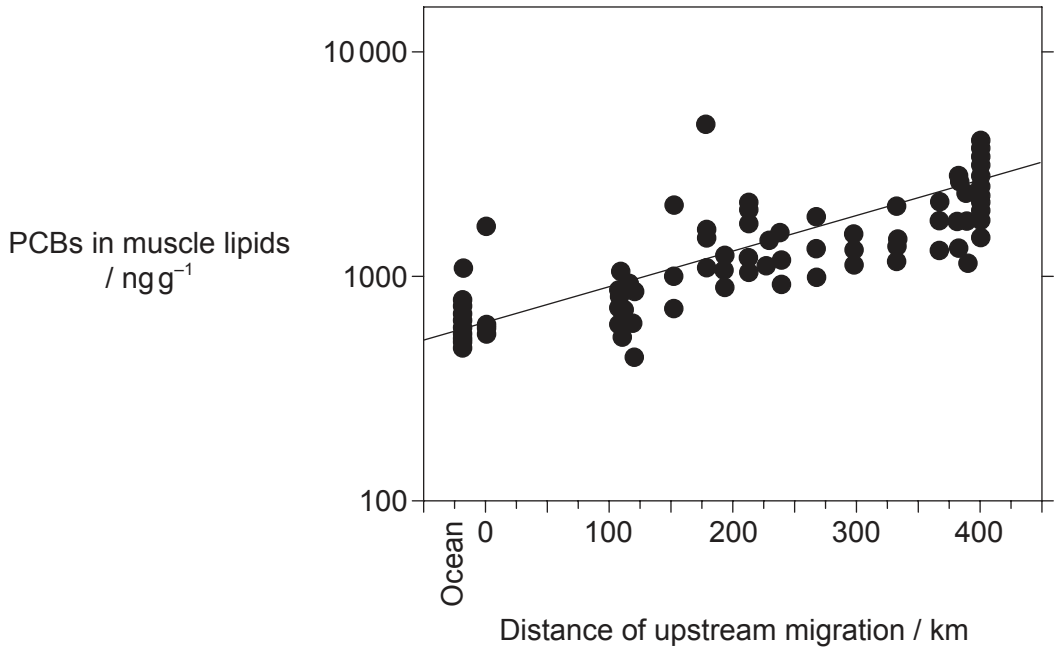
. . . . . .
. . . . . .
. . . . . .
. . . . . .

(This question continues on the following page)

(Question 1 continued)

Persistent organic pollutants, such as polychlorinated biphenyls (PCBs), have been shown to reach unpolluted arctic areas by air currents. Another method of transport of these pollutants into these ecosystems is provided by migrating *O. nerka*.

Pollutant transport was studied in a population of *O. nerka* in the Copper River (Alaska). The graph shows concentration of PCBs in muscle lipids of *O. nerka* in relation to the distance of upstream migration.



[Source: Ewald, Göran, Per Larsson, Henric Linge, Lennart Okla, & Nicole Szarzi. "Biotransport of Organic Pollutants to an Inland Alaska Lake by Migrating Sockeye Salmon (Oncorhynchus nerka)." *ARCTIC*, **51**.1 (1998): 40–47. Used with permission from the Arctic Institute of North America.]

(g) Describe the relationship between the distance of upstream migration and the concentration of PCBs in *O. nerka*. [1]

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

(h) State the concentration of PCBs in muscle lipids at 125 km from the ocean estimated by the correlation line. [1]

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

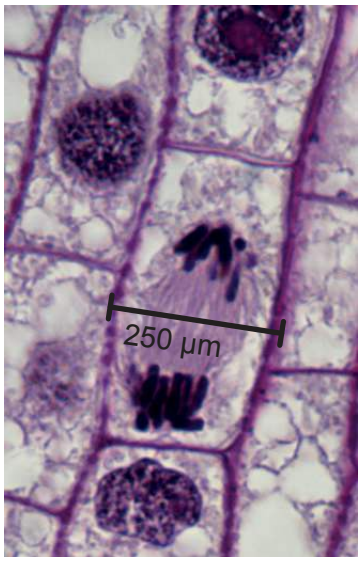
(This question continues on the following page)

(Question 1 continued)

(i) As the *O. nerka* migrate upstream they no longer feed. Suggest a reason for the relationship of distance of upstream migration and concentration of PCBs in muscle lipids. [1]

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

2. (a) The micrograph shows a cell from the root of an onion (*Allium cepa*) during mitosis.



[Source: © Ed Reschke used with permission by Getty Images]

(i) Calculate the magnification of the image. [1]

. . . . . .

(ii) Deduce the stage of mitosis shown in the micrograph. [1]

. . . . . .

(iii) The onion (*Allium cepa*) is an angiospermophyte. The honey bee (*Apis mellifera*) is an arthropod. State **three** structural differences between the cells of an onion and a honey bee. [2]

1. . . . . .

2. . . . . .

3. . . . . .

(This question continues on the following page)

(Question 2 continued)

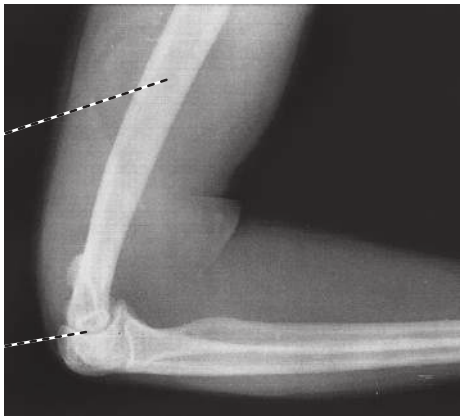
(b) State what is indicated by the presence of polysomes in a cell. [1]

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

3. (a) (i) Label the structures indicated on the X-ray of a human elbow. [2]

X: . . . . . .

Y: . . . . . .



[Source: © International Baccalaureate Organization 2016]

(ii) State the role of tendons. [1]

. . . . . .

(b) Explain the role of calcium in muscle contraction. [3]

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

(This question continues on the following page)

(Question 3 continued)

(c) One of the stages of aerobic respiration is called the link reaction.

(i) Label the diagram to indicate where the link reaction occurs. [1]

(ii) Outline the role of coenzyme A in aerobic respiration. [2]

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

4. In the pea plant (*Pisum sativum*), the allele for tall plants is A and the allele for short plants is a. The allele for green plants is B and the allele for yellow plants is b.

(a) Determine the phenotype of Aabb. [1]

. . . . . .

(b) Compare the information that could be deduced when the genotypes are presented as AaBb or $\frac{A\ B}{a\ b}$. [2]

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

(c) Deduce **one** possible recombinant offspring of individual $\frac{A\ B}{a\ b}$ after a test cross. [1]

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

Section B

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

5. (a) Draw a labelled diagram of a mature human egg. [5]

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

(c) Explain how evolution may happen in response to environmental change with evidence from examples. [8]

6. (a) Draw a labelled diagram to show the structure of a sarcomere. [5]

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

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

7. (a) The leaves of plants are adapted for photosynthesis. Draw a labelled plan diagram of a leaf to show the distribution of tissues in a leaf. [5]

(b) Explain how abiotic factors affect the rate of transpiration in terrestrial plants. [8]

(c) Describe the importance of water to living organisms. [5]

8. (a) Draw a labelled diagram to show the structure of the heart. [5]

(b) Outline how the human body responds to high blood glucose levels. [5]

(c) Explain the role of the nephron in maintaining the water balance of the blood in the human body. [8]