Diploma Programme
Programme du diplôme
Programa del Diploma

Biology
Standard level
Paper 2

14 May 2024

Zone A morning | **Zone B** morning | **Zone C** 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.
- 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]**.

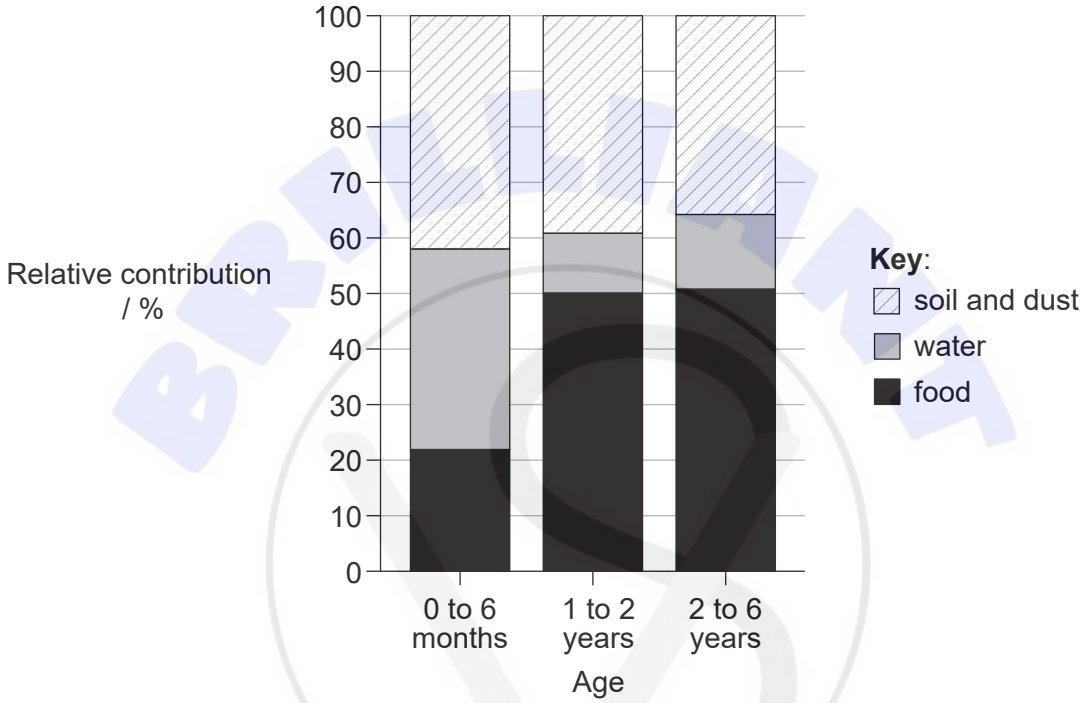
2224 – 6005

20 pages

Section A

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

1. Lead is a toxic heavy metal responsible for a range of developmental and physiological disorders in children, including behaviour and learning problems, slowed growth and anaemia. The blood lead level (BLL) is a reliable biological indicator of a child's lead exposure. Scientists of the Environmental Protection Agency (EPA) looked at all the available data to determine the pathways by which lead entered the blood of children in three age categories in the US. The chart summarizes their findings.



(a) State the pathway by which most lead enters the blood of children that are 0 to 6 months old. [1]

. . . . . .

(b) Estimate the relative contribution of water to lead in the blood of children that are 1 to 2 years old. [1]

. . . . . .

. . . . . .

(This question continues on the following page)

(Question 1 continued)

(c) Suggest how a change in the habits of children as they grow older may affect the relative contribution of the three pathways by which lead enters the blood. [1]

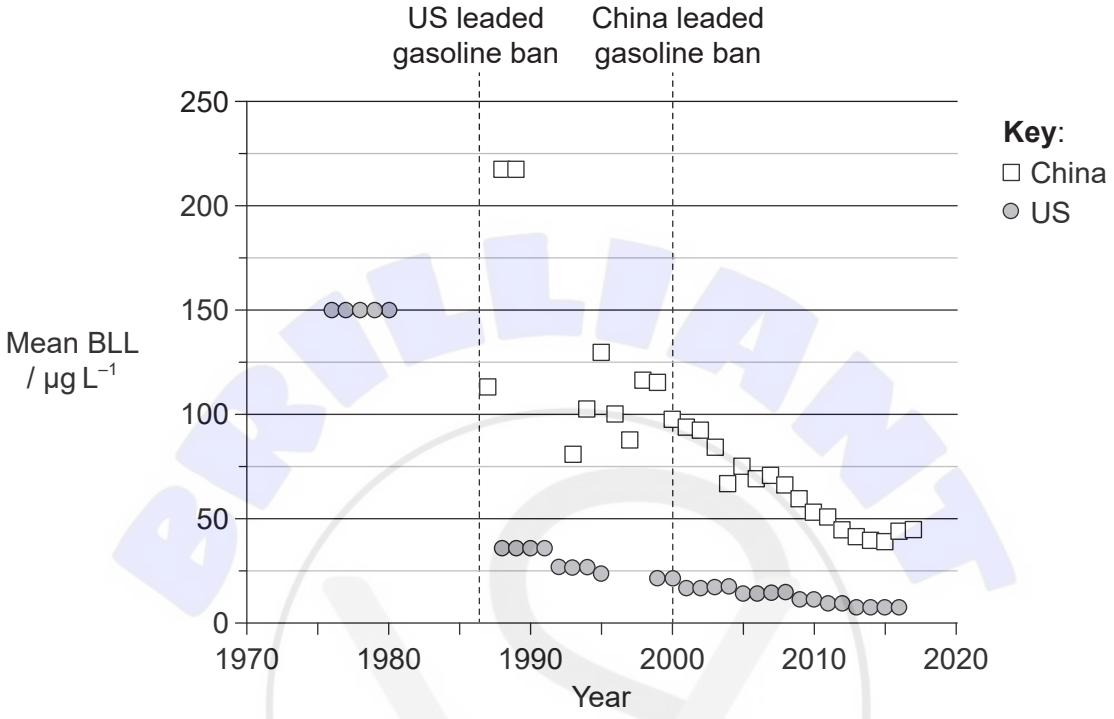
. . . . . .

. . . . . .

(This question continues on the following page)

(Question 1 continued)

A second study showed that one of the main sources of lead in the environment was known to be the combustion of gasoline in motor vehicles. This led the government in the US to ban lead in gasoline in 1986 and the Chinese government to make a similar ban in the year 2000. The graph shows the mean BLL of children aged 0 to 6 years from 1975 to 2018.



(d) State the mean BLL of US children from age 0 to 6 years in 1980. [1]

. . . . . .

(e) Compare and contrast the effect of the leaded gasoline ban on the mean BLL of children in the US and in China. [2]

. . . . . .

. . . . . .

. . . . . .

. . . . . .

(This question continues on the following page)

(Question 1 continued)

(f) The Centers for Disease Control and Prevention (CDC) in the US recommended that children with a BLL of more than 35 μg L^{-1} have treatment to remove lead from the blood. Outline the need for treatment for the children in both countries from 2000 onwards. [2]

. . . . . .

. . . . . .

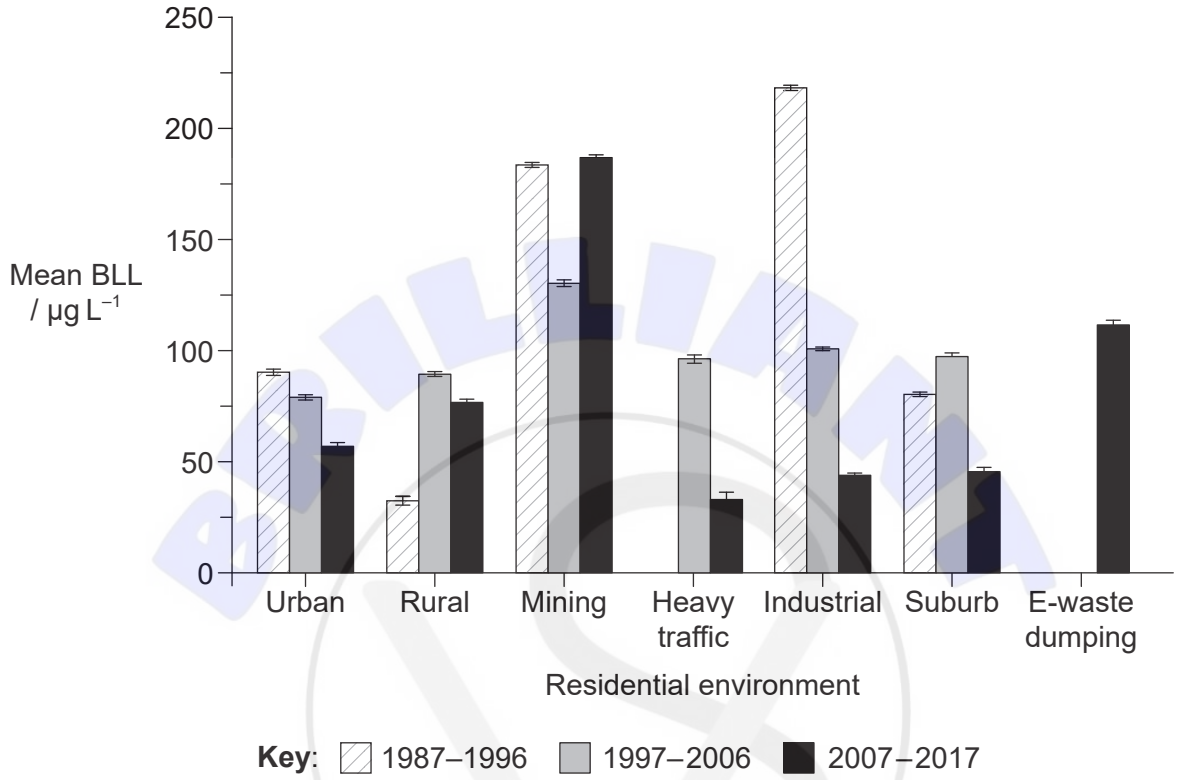
. . . . . .

. . . . . .

(This question continues on the following page)

(Question 1 continued)

The chart shows the mean BLL of children in China living in residential environments associated with conditions such as mining, heavy traffic, industry and e-waste dumping sites from 1987 to 2017. Lead pollution from disposal of e-waste including televisions, computers and cell phones is a relatively new occurrence.



(g) State the residential environment where children had the highest BLL from 1997 to 2006. [1]

. . . . . .

(h) No data was recorded for heavy traffic environments from 1987 to 1996. Predict with a reason how the mean BLL for heavy traffic environments in this period would compare to the BLL for 1997 to 2006. [1]

. . . . . .

. . . . . .

(This question continues on the following page)

(Question 1 continued)

(i) Using all the data, discuss the potential effect of e-waste dumping on the BLL of children. [3]

. . . . . .

. . . . . .

. . . . . .

. . . . . .

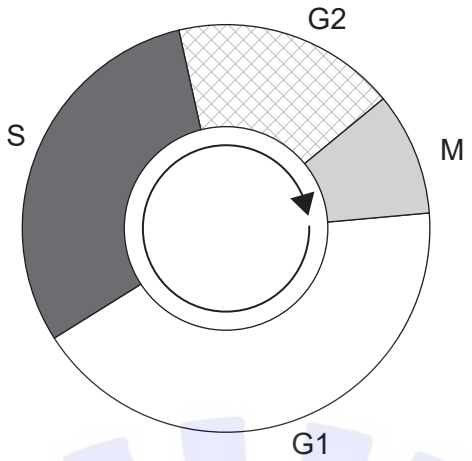
. . . . . .

. . . . . .

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

Answers written on this page
will not be marked.

2. The diagram shows the stages of the cell cycle.



(a) (i) List the stages when the cell is in interphase. [1]

. . . . . .

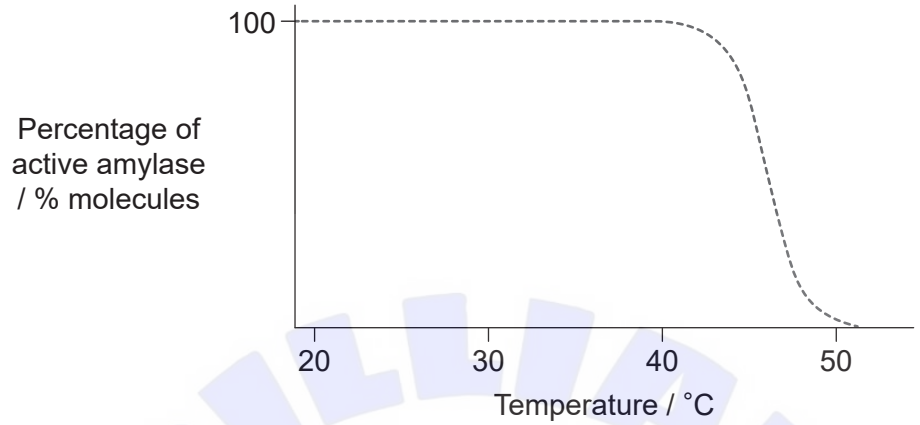
(ii) Distinguish between the quantity of DNA of the cell at G1 and G2. [1]

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

(b) Explain the properties of phospholipids that allow bilayers to form in cell membranes. [3]

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

3. In an experiment, starch was hydrolysed with human amylase. The graph shows the percentage of active amylase molecules as the temperature was raised from 20 to 50 °C.



(a) (i) Label with an A the point on the graph where the rate of hydrolysis would be highest. [1]

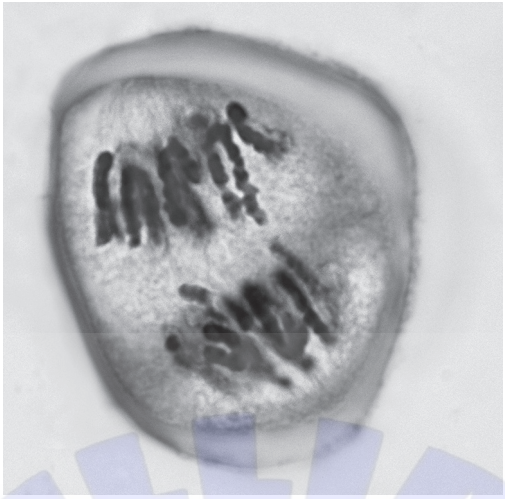
(ii) Outline the reason for the decrease in the percentage of active amylase after 40 °C. [1]

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

(b) Explain how the small intestine is adapted to absorb the products of starch digestion. [2]

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

4. The image shows a cell in the anther of a lily (*Lilium sp.*) plant during the first division of meiosis.



(a) Identify the stage of meiosis shown in the image. [1]

. . . . . .

(b) Outline the reason for diploid organisms producing haploid cells by meiosis. [2]

. . . . . .

. . . . . .

. . . . . .

. . . . . .

(c) Explain how non-disjunction during meiosis can lead to Down syndrome. [3]

. . . . . .

. . . . . .

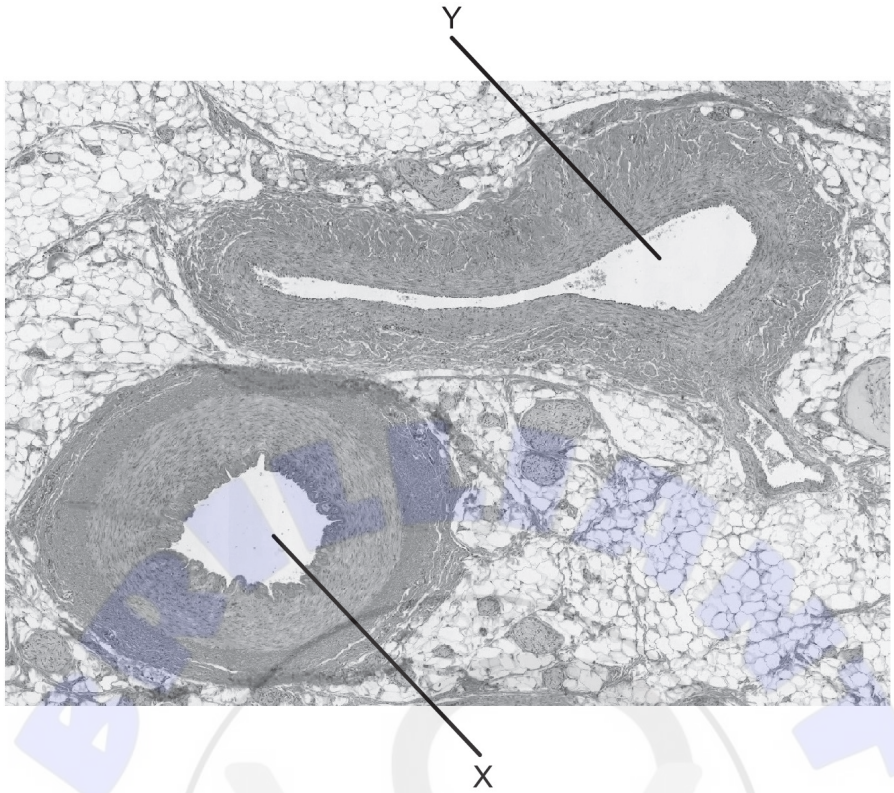
. . . . . .

. . . . . .

. . . . . .

. . . . . .

5. The diagram shows a cross section through an artery and a vein.



(a) Identify which of the two labelled blood vessels is the artery, giving a reason for your answer. [1]

. . . . . .

. . . . . .

(b) Outline **two** ways in which the human body can increase the heart rate during exercise. [2]

. . . . . .

. . . . . .

. . . . . .

. . . . . .

(This question continues on the following page)

(Question 5 continued)

(c) Explain how platelets prevent infection from cuts in the skin. [3]

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

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.

6. Compounds of carbon, hydrogen and oxygen are used to supply and store energy.

(a) Outline the use of lipids to store energy in humans. [4]

(b) Describe how a concentration gradient of oxygen is maintained between the lungs and blood capillaries. [4]

(c) Explain how the energy supply in an ecosystem is dependent on sunlight. [7]

7. Genetic information is contained in chromosomes.

(a) Describe the importance of mRNA during the synthesis of polypeptides. [3]

(b) Describe the reason that red-green colour blindness is more common in human males than in females. [5]

(c) Explain how changes in chromosomes can lead to evolution. [7]

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

References:

1. (a) U.S. National Institutes of Health, 2017. "Children's Lead Exposure: A Multimedia Modeling Analysis to Guide Public Health Decision-Making." *Environmental Health Perspectives* (Vol. 125, No. 9). Available at: https://ehp.niehs.nih.gov/doi/10.1289/ehp1605 [Accessed 7 July 2024]. Source adapted.

1. (d)(g) Zhang, Y., O'Connor, D., Xu, W., Hou, D., 2020. Blood lead levels among Chinese children: The shifting influence of industry, traffic, and e-waste over three decades. *Environ Int*. 135:105379. [e-journal] Available at: https://pubmed.ncbi.nlm.nih.gov/31841805/ [Accessed 14 April 2023]. Source adapted.

4. Reschke, E., n.d. [*Lilium - Lily 400X*.] [image online] Available at: https://www.gettyimages.com.mx [Accessed 13 April 2023]. Source adapted.

5. Comparison of Artery and Vein, n.d. Available at: https://commons.wikimedia.org/wiki/File:2102_Comparison_of_Artery_and_Vein.jpg. Licensed under CC BY 3.0: https://creativecommons.org/licenses/by/3.0/deed.en.