



HERITAGE COLLEGE  
A CHRISTADELPHIAN SCHOOL  
ADELAIDE, AUSTRALIA

# Biology Mid-Year Trial Exam

## Question booklet 2

- **Part B of Section 2** (Questions 22 to 28) 50 marks
- Answer ***all*** questions in Part B
- Write your answers in this question booklet
- You may write on final lined page (p. 10) if you need more space
- Allow approximately 50 minutes

**SECTION 2: Part B (Questions 22-28)**

(50 marks)

*Answer all questions in this part.*

22. Beckwith-Wiedemann syndrome (BWS) is a rare disorder in which individuals have abnormal growth and an increased risk of childhood cancer.

Cyclin-dependent kinase inhibitor 1C (CDKN1C) is a protein that inhibits cell division. In human beings, this protein is coded by the CDKN1C gene. In some patients with BWS, there is more DNA methylation of the CDKN1C gene than there is in individuals who do not have BWS.

- (a) State the name of the DNA nucleotide that is most often methylated. \_\_\_\_\_ (1 mark)

- (b) State the effect of increased DNA methylation of the *CDKN1C* gene on its expression.  
\_\_\_\_\_  
\_\_\_\_\_ (1 mark)

- (c) Explain how altering the expression of the *CDKN1C* gene could lead to cancer.  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ (3 marks)

- (d) Explain one other way in which DNA expression can be altered.  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ (2 marks)

23. The Pyrenean ibex was as subspecies of the mountain goat. In the year 2000, Celia, the last individual of this subspecies was killed by a falling tree, resulting in the extinction of the Pyrenean ibex.

A team of scientists removed the nucleus from a goat egg cell. They then injected the nucleus from one of Celia’s preserved somatic cells into the enucleated (*has had nucleus removed*) goat egg cell. The resulting embryo was implanted into a surrogate goat that gave birth to a clone of Celia in 2003. The clone died shortly after birth.



(a) Explain why the nucleus of a somatic cell and not the nucleus of an egg cell must be injected into a donor egg cell in order to produce a clone.

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(2 marks)

(b) Name the type of cell division that produces baby ibex from an embryo that has been implanted into a surrogate goat.

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(1 mark)

(c) State **two** features of the daughter cells that are produced by the division of a somatic cell.

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(2 marks)

(d) Explain **one** reason why the subspecies Pyrenean ibex could not be preserved by producing many clones of Celia.

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(2 marks)

(e) State **two** conditions that are necessary in order for animal cells to be cloned in a laboratory.

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(2 marks)

(f) (i) Identify one other contemporary application of cell culture.

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(1 mark)

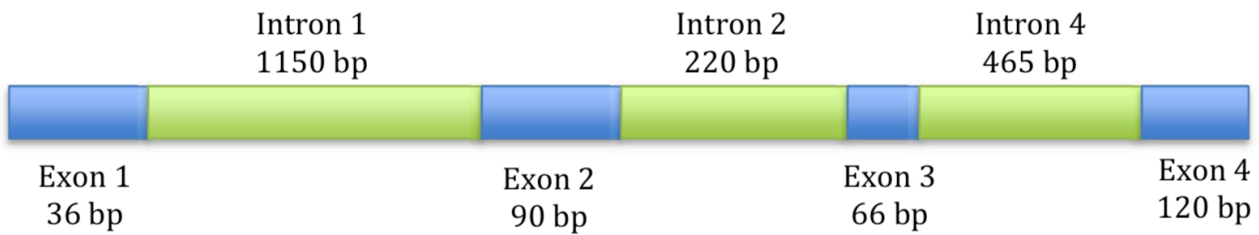
(ii) State **one** limitation of this application.

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(1 mark)

24. Refer to the following diagram of the EF23A gene from the genome of an individual human named Tim Badger. The EF23A gene is found in all humans. The numbers listed are base pairs for the intron (above) and exons (below).



(a) State how long (in bases) the mRNA transcript will be that is produced from this sequence.

\_\_\_\_\_ (1 mark)

(b) What is the maximum number of amino acids that could make up the protein product from this gene?

\_\_\_\_\_ (1 mark)

(c) The introns in this gene represent the individual's VNTRs that are present in his copy of this gene. Explain how VNTRs can be used to identify unique individuals in a population.

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\_\_\_\_\_ (3 marks)

25. Refer to the false-colour transmission electron micrograph (TEM) of an organelle taken from a plant leaf cell.



(a) State the name of the structure labelled 'X'.

\_\_\_\_\_ (1 mark)

(b) Explain how this structure increases the rate of reactions in the organelle.

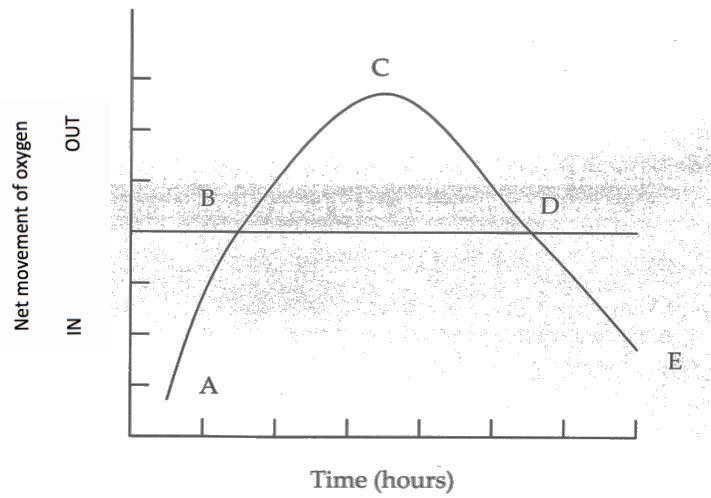
\_\_\_\_\_  
\_\_\_\_\_ (2 marks)

(c) It has been found that this organelle has its own DNA, but that it differs from the DNA found in the nucleus of its host cell.

**Discuss** the **advantages** of DNA located in this organelle and how it **differs** from that found in the nucleus.

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\_\_\_\_\_ (4 marks)

26. The *net* movement of oxygen into and out of a leaf was measured over a six-hour period, and the results are shown graphically below.



(a) At what point in the graph is the light intensity likely to be greatest? **Justify** your answer.

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(3 marks)

(b) At what point(s) on the graph is the rate of photosynthesis equal to the rate of respiration? **Justify** your answer.

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(3 marks)







