

Biology 12

June 2001 Provincial Examination

ANSWER KEY / SCORING GUIDE

CURRICULUM:

| Organizers | Sub-Organizers |
|------------------------------------|------------------------|
| 1. Cell Biology | A, B, C, D |
| 2. Cell Processes and Applications | E, F, G, H |
| 3. Human Biology | I, J, K, L, M, N, O, P |

Part A: Multiple Choice

| Q | K | C | S | CO | PLO | Q | K | C | S | CO | PLO |
|-----|---|---|---|------|---------------|-----|---|---|---|----|--------|
| 1. | C | U | 1 | 1 | A1 | 26. | A | U | 1 | 3 | K1 |
| 2. | C | K | 1 | 1 | A1 | 27. | A | K | 1 | 3 | L1 |
| 3. | C | H | 1 | 1, 2 | A2; C1; E1 | 28. | B | U | 1 | 3 | L1 |
| 4. | D | K | 1 | 1 | B1 | 29. | D | K | 1 | 3 | L7 |
| 5. | B | U | 1 | 1 | C1 | 30. | C | H | 1 | 3 | L8 |
| 6. | C | U | 1 | 1 | C1 | 31. | D | U | 1 | 3 | M2, 8 |
| 7. | A | U | 1 | 1 | C2 | 32. | B | H | 1 | 3 | M3 |
| 8. | C | K | 1 | 1 | C7 | 33. | C | K | 1 | 3 | M7 |
| 9. | A | U | 1 | 1 | C10 | 34. | D | H | 1 | 3 | N4 |
| 10. | D | U | 1 | 1 | D3 | 35. | A | U | 1 | 3 | N4 |
| 11. | B | K | 1 | 1 | D5 | 36. | C | H | 1 | 3 | O1, 2 |
| 12. | D | K | 1 | 2 | E1 | 37. | C | U | 1 | 3 | O2 |
| 13. | C | H | 1 | 2 | E1, 2, 4 | 38. | A | H | 1 | 3 | O2 |
| 14. | C | K | 1 | 2 | F1 | 39. | B | H | 1 | 3 | O2 |
| 15. | A | U | 1 | 2 | F1 | 40. | C | H | 1 | 3 | O2 |
| 16. | B | H | 1 | 2 | G6, 3, 2 | 41. | A | K | 1 | 3 | P1 |
| 17. | C | H | 1 | 2 | H6 | 42. | A | U | 1 | 3 | P1 |
| 18. | A | K | 1 | 3 | I1, 2 | 43. | B | U | 1 | 3 | P1 |
| 19. | D | K | 1 | 3 | I1 | 44. | C | U | 1 | 3 | P6 |
| 20. | B | K | 1 | 3 | J1 | 45. | C | K | 1 | 3 | P7 |
| 21. | D | H | 1 | 3, 2 | J2, 7; G6; I7 | 46. | D | H | 1 | 3 | P5, 6 |
| 22. | B | H | 1 | 3 | J8 | 47. | D | K | 1 | 3 | P7 |
| 23. | D | K | 1 | 3 | J9 | 48. | B | U | 1 | 3 | P8 |
| 24. | C | U | 1 | 3 | J11 | 49. | C | U | 1 | 3 | P9, 10 |
| 25. | C | H | 1 | 3 | J12 | 50. | A | H | 1 | 3 | P10 |

Multiple Choice = 50 marks

Part B: Written Response

| Q | B | C | S | CO | PLO |
|----------|----------|----------|----------|-----------|------------------|
| 1. | 1 | U | 5 | 1, 2 | D2, 3; F5 |
| 2. | 2 | U | 4 | 2 | E1 |
| 3. | 3 | K | 4 | 2 | G4, 3, 2, 1 |
| 4. | 4 | U | 5 | 2 | H1, 6 |
| 5. | 5 | U | 4 | 3 | I1, 2, 4 |
| 6. | 6 | U | 4 | 3 | I1, 2, 4, 6, 9 |
| 7. | 7 | H | 6 | 3, 1 | J9; L6, 7, 8; B3 |
| 8. | 8 | U | 6 | 3 | J7, 9 |
| 9. | 9 | U | 7 | 3 | M3 |
| 10. | 10 | K | 5 | 3 | O1, 2, 5 |

Written Response = 50 marks

Multiple Choice = 50 (50 questions)
Written Response = 50 (10 questions)
EXAMINATION TOTAL = 100 marks

LEGEND:

Q = Question Number **B** = Score Box Number **S** = Score
K = Keyed Response **C** = Cognitive Level **CO** = Curriculum Organizer
PLO = Prescribed Learning Outcome

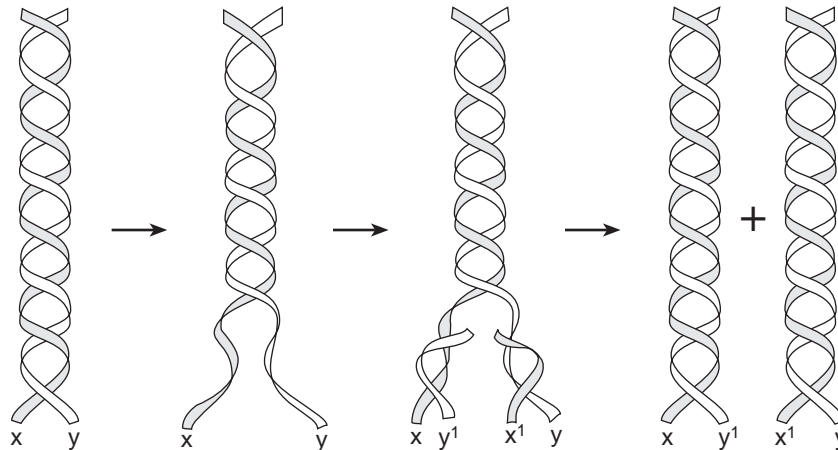
PART B: WRITTEN RESPONSE

Value: 50 marks

Suggested Time: 75 minutes

1. a) Name and describe the process shown below.

(4 marks: 1 mark for name; 3 marks for description)



Name:

- DNA duplication
 - (DNA) replication
- } either one
for 1 mark

Description:

Unzipping:

- The hydrogen bonds between the base pairs break (unzip).
- Helicase (enzyme) is involved in breaking hydrogen bonds.

Complementary base pairing:

- Complementary base pairing occurs.
- DNA polymerase acts as a “proof-reader” to ensure that there are no errors in base pairing.

2 new identical strands created:

- Sugar of one nucleotide joins with the phosphate of the adjacent nucleotide to form the sugar-phosphate backbone.
- The end result is the formation of two identical DNA molecules.

} 1 mark for each
part of the process

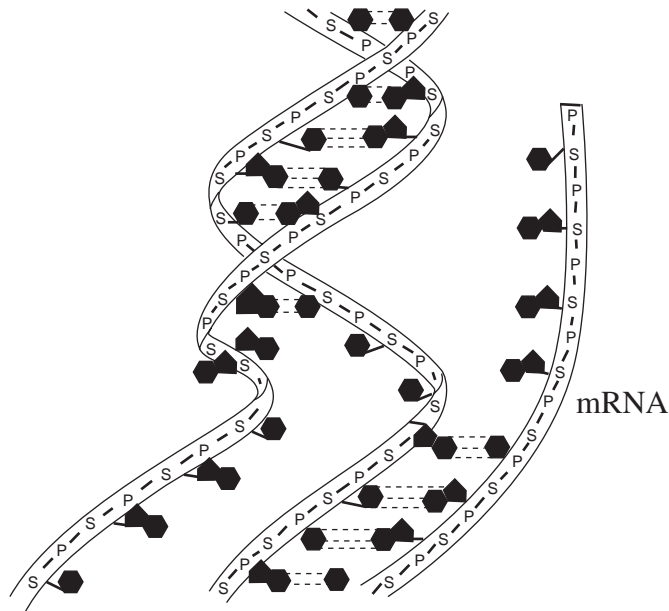
b) How could a virus affect the molecule shown in the diagram above?

(1 mark)

- **It could cause a mutation by addition or deletion.**
- **It could change a proto-oncogene into an oncogene.**
- **It could add a new section of DNA from another organism.**

} **any one for
1 mark**

Use the following diagram to answer question 2.



2. Name the process shown above and explain how the molecule that is produced is used to determine the sequence of amino acids in a protein.

(4 marks: 1 mark for name; 3 marks for explanation)

Name:

- **transcription (1 mark)**

Explanation:

- **mRNA carries DNA code to the cytoplasm / ribosome**
- **each three bases on the mRNA (codon) codes for one specific amino acid**
- **tRNA brings amino acid to mRNA**
- **tRNA joins to mRNA through complementary base pairing**
- **amino acids join by peptide bonds in correct coded sequence to form a polypeptide**
- **mRNA has “start” and “stop” codons for polypeptide production**

} any three for
1 mark each

3. List **four** factors that would affect the rate of diffusion of molecules crossing a cell membrane.

(4 marks)

- **temperature / speed of molecules / kinetic energy**
- **size of molecule**
- **concentration gradient / tonicity / osmotic pressure***
- **mass of molecule diffusing**
- **chemical composition of the molecule (e.g., lipid solubility)**
- **chemical and physical properties of the cell membrane (permeability)**
- **number of protein pores / carriers**
- **electrical charge**
- **cytoplasmic streaming (cyclosis)**
- **specific hormonal effects (e.g., ADH, thyroxin, insulin)**
- **pressure (e.g., blood / atmospheric / hydrostatic)**

any four for
1 mark each

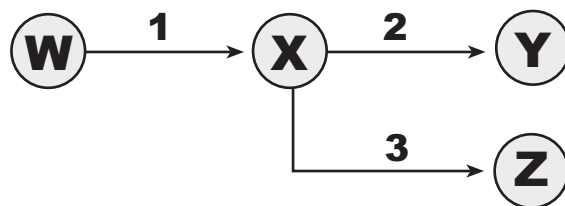
Notes to Markers:

* **Student must mention a difference between the two sides of the membrane.**

Not accepted as responses:

- **pH**
- **thickness of the membrane**
- **amounts of energy / ATP / active transport**

4. An experiment investigating enzyme activity is carried out. A test tube is prepared containing substrate solution **W** and enzyme solutions **1**, **2** and **3**. The reactions that occur in the test tube are summarized below.



- a) Describe **two** ways in which the rate of production of product **Y** can be increased.

(2 marks)

- add more of enzymes 1 and 2
- add a substance that denatures enzyme 3
- alter the temperature to achieve optimum conditions
- alter the pH to achieve optimum conditions for the reactions
- add more of substrate W
- denature enzyme 3

any two for
1 mark each

- b) A substance is added to the test tube. As a result, no product **Y** is formed, but product **Z** is still formed. Explain why.

(3 marks)

- A competitive inhibitor (1 mark) binds to the active site (1 mark) of enzyme 2, blocking active site access by the substrate (1 mark).

OR

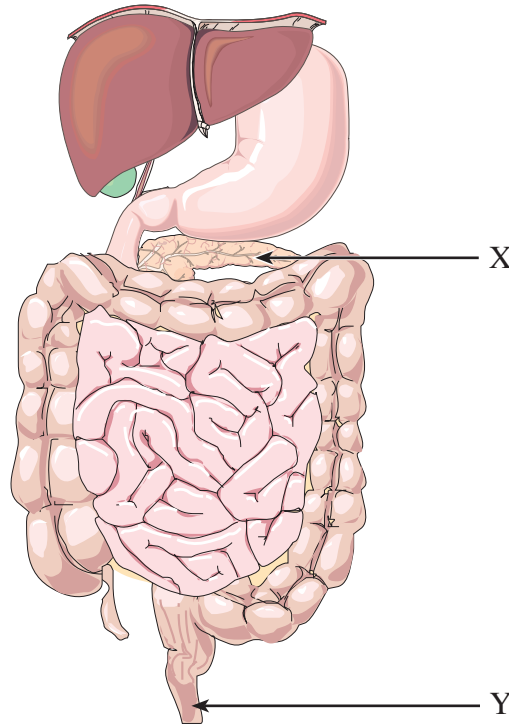
- A non-competitive inhibitor (1 mark) binds to another part of enzyme 2 (not the active site) (1 mark) altering the shape of the enzyme's active site and the substrate doesn't fit (1 mark).

Note to Markers:

1 mark can be obtained for:

- The substance is an enzyme that converts W directly to Z.

Use the following diagram to answer question 5.



5. a) Describe **three** different ways that **X** aids in digestion.

(3 marks)

The pancreas produces:

- lipase to break down fats.
- nuclease to break down nucleic acids.
- trypsin(ogen) to break down proteins.
- pancreatic amylase to break down starch.
- NaHCO_3 (or HCO_3^-) to provide optimum pH / neutralize stomach acid.
- H_2O for hydrolysis / transport

} any four for
1 mark each

Notes to Markers:

$\frac{1}{2}$ mark → if student only gives the enzyme

$\frac{1}{2}$ mark → if student gives the wrong substrate for the enzyme

b) What is the role of **Y** in the digestive system?

(1 mark)

- to reabsorb water
 - to compact and store feces
- } either one for
1 mark

6. Describe the mechanisms involved in the digestion and absorption of fat.

(4 marks)

- **Bile from the liver / gallbladder emulsifies fats to increase surface area.**
 - **Mechanical digestion of fats occurs by chewing / biting.**
 - **Lipase from the pancreas hydrolyzes fats. (1 mark)**
 - **Fats hydrolyzed to fatty acids ($\frac{1}{2}$ mark) and glycerol ($\frac{1}{2}$ mark).**
 - **Fatty acids / glycerol are absorbed into the lacteals of the villi. (1 mark)**
- } either one for
1 mark

7. a) Mountaineers attempting to scale Mt. Everest encounter an environment that contains one-third the oxygen present at sea level. Describe how each of the following will change during the climb and how the change will compensate for the lower than normal oxygen levels.

rate of cell division in the bone marrow:

(2 marks)

- **The rate of cell division will increase thus increasing the number of hemoglobin / red blood cells. (1 mark)**
- **The increased number of red blood cells will allow more oxygen to be carried to the tissues. (1 mark)**

breathing rate:

(2 marks)

- **Breathing rate will increase.**
- **As the breathing rate increases the rate of gas exchange also increases.**
- **More O₂ is accepted by the hemoglobin.**
- **There is more external respiration.**

} any two for
1 mark each

b) During the climb, the blood pH decreases. Explain how the body compensates for this change.

(2 marks)

- **excretion of H⁺ by the kidneys**
- **excretion of NH₃ by the kidneys**
- **reabsorption of HCO₃⁻ by the kidneys**
- **the increased amount of H⁺ combines with hemoglobin producing more reduced hemoglobin (HHb)**
- **breathing rate increases to exhale more CO₂**
- **buffers maintain pH by accepting H⁺**

} any two for
1 mark each

8. Complete the following chart that describes the composition of blood.

(6 marks: 1 mark each)

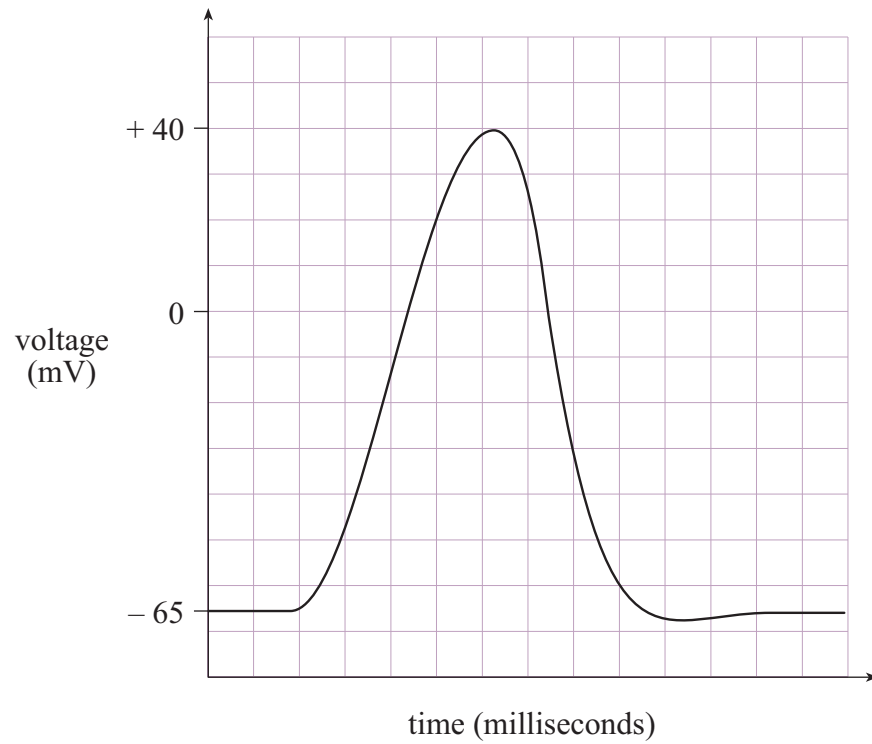
| PART OF THE BLOOD | COMPONENT NAME | SOURCE | FUNCTION |
|-------------------|---|---|---|
| plasma | water | absorbed by small / large intestine and kidneys OR environment | maintaining blood volume |
| plasma | urea OR plasma proteins* (e.g., fibrinogen, albumin) | liver | <ul style="list-style-type: none"> • maintaining blood volume, pressure and pH • clotting |
| formed elements | platelets | bone marrow | (initiating) clotting |
| formed elements | white blood cells | bone marrow OR lymphoid tissue (nodes / thymus) | fighting infection |
| plasma | glucose | absorbed by intestinal villi | cellular respiration OR ATP production OR food for cells |

Notes to Markers:

“Blood” proteins was not accepted, as many are made elsewhere.

9. a) On the following grid, draw a curve to represent an action potential.

(2 marks)

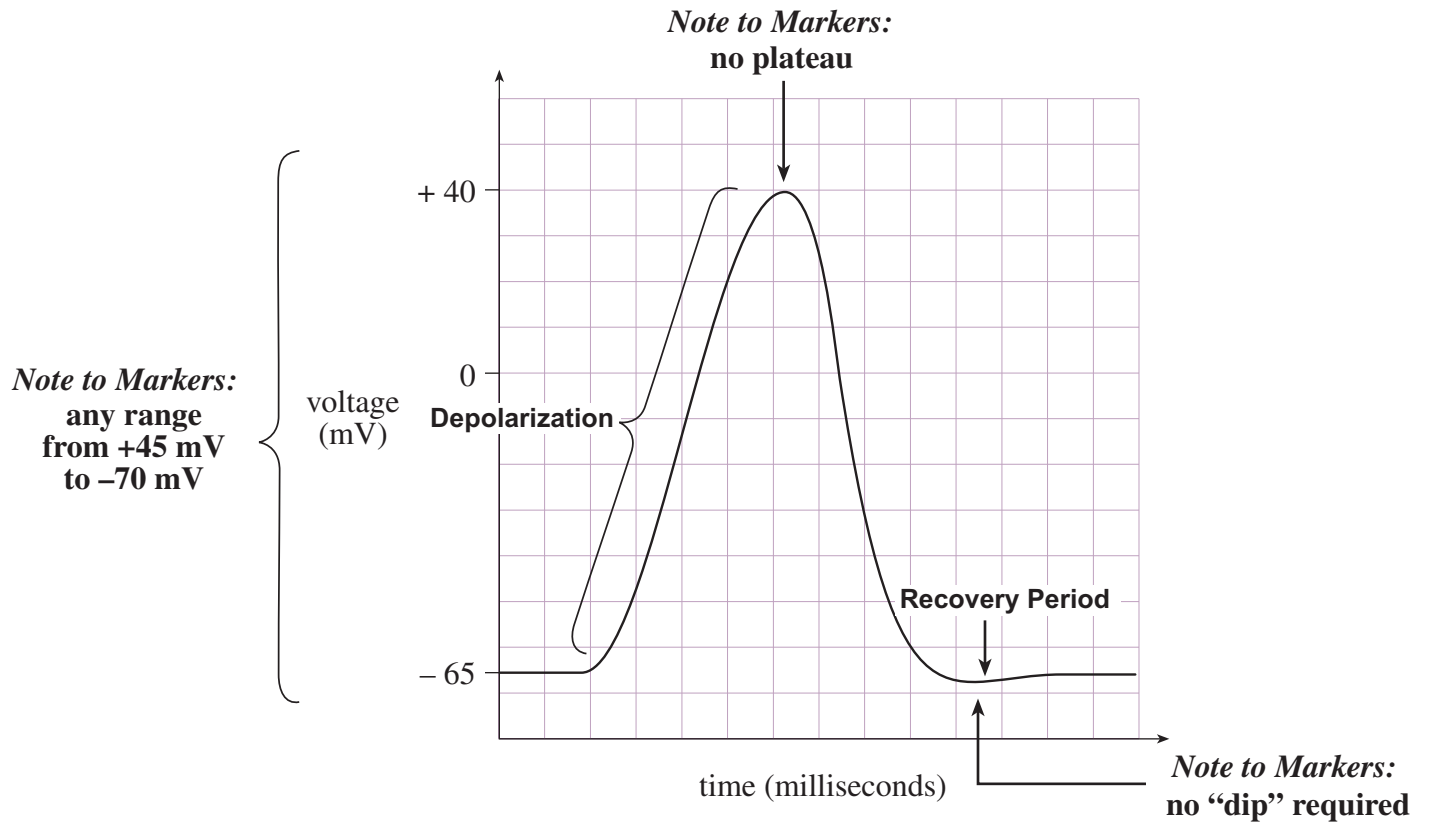


Mark distribution:

shape=1 mark; range=1 mark

b) Label the “depolarization” and the “recovery period” of your graph.

(1 mark: $\frac{1}{2}$ mark each)



c) Describe what happens to the axon during repolarization.

(3 marks)

- sodium gates close
 - potassium gates open
 - potassium ions (K^+) diffuse out of the axon
 - membrane potential difference of -65 mV is re-established
- OR
- inside of the axon gains a net negative charge while the outside gains a net positive charge

any three for
1 mark each

d) Describe what happens to the axon during the recovery period.

(1 mark)

- Sodium-potassium pump actively transports sodium ions (Na^+) out of the axon and potassium ions (K^+) are moved into the axon. This re-establishes the ion concentration across the membrane.
- Resting potential is re-established.

either one for
1 mark

10. State **one** function of each of the following.

(5 marks: 1 mark each)

ureter:

- carries urine from the kidney
 - carries urine to the bladder
- } either one for
1 mark

collecting duct:

- collects urine from the nephron and transports it to the renal pelvis
 - reabsorbs water from the urine into the tissues / blood
 - adjusts blood volume
- } any one for
1 mark

antidiuretic hormone (ADH):

- increases blood volume
 - makes walls of the distal tubule and collecting duct more permeable to water
 - causes increased reabsorption of water from the distal convoluted tubule into the blood
 - decreases urine output
 - maintains water balance
- } any one for
1 mark

renal pelvis:

- transports urine from the nephron to the ureter
 - collects and temporarily stores urine from several nephrons
- } either one for
1 mark

glomerulus:

- pressure filtration
 - separates large molecules (e.g., blood cells and proteins) from small molecules (e.g., water, glucose, urea and ions)
 - transports blood from the afferent arteriole to the efferent arteriole
 - monitors blood pressure
- } any one for
1 mark

END OF KEY