

Biology 12

January 2002 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, 3 | 26. | C | H | 1 | 3 | I7; J12 | |
| 2. | C | H | 1 | 1 | A1, 2, 3 | 27. | D | U | 1 | 3 | I9, 1 | |
| 3. | D | H | 1 | 1, 3 | A1; O2; P4 | 28. | A | U | 1 | 3 | I9 | |
| 4. | C | U | 1 | 1 | B2 | 29. | A | U | 1 | 3 | J1 | |
| 5. | B | H | 1 | 1, 2 | C1, A1; E1 | 30. | D | U | 1 | 3 | J2 | |
| 6. | C | U | 1 | 1, 3 | C1, 2, 4; I2 | 31. | C | H | 1 | 3 | J2, 6 | |
| 7. | B | U | 1 | 1 | C3 | 32. | A | U | 1 | 3 | K6, 1 | |
| 8. | D | H | 1 | 1 | C5 | 33. | B | K | 1 | 3 | L2 | |
| 9. | B | U | 1 | 1 | C11 | 34. | B | U | 1 | 3 | L1 | |
| 10. | D | U | 1 | 1 | D1 | 35. | B | U | 1 | 3 | L5, 4 | |
| 11. | B | U | 1 | 1 | D2 | 36. | C | H | 1 | 3 | L7, 8 | |
| 12. | A | K | 1 | 2 | F1 | 37. | C | U | 1 | 3 | L8 | |
| 13. | B | K | 1 | 2 | F3, 4 | 38. | A | H | 1 | 3 | L8; J5 | |
| 14. | C | H | 1 | 2, 1 | F3, 4, 5; D1 | 39. | B | U | 1 | 3 | M3 | |
| 15. | C | U | 1 | 2 | G1, 3 | 40. | DELETED | | | | | |
| 16. | B | K | 1 | 2 | H1 | 41. | D | K | 1 | 3 | N4 | |
| 17. | B | U | 1 | 2 | H2 | 42. | D | K | 1 | 3 | O1, 2 | |
| 18. | B | U | 1 | 2 | H1, 6 | 43. | D | U | 1 | 3 | O2 | |
| 19. | D | U | 1 | 2 | H1, 6 | 44. | B | H | 1 | 3 | O2 | |
| 20. | B | K | 1 | 2 | H4 | 45. | C | U | 1 | 3 | O4, 5 | |
| 21. | C | K | 1 | 3 | I1 | 46. | C | K | 1 | 3 | P1 | |
| 22. | D | U | 1 | 3 | I1 | 47. | C | K | 1 | 3 | P4 | |
| 23. | A | U | 1 | 3 | O1 | 48. | B | U | 1 | 3 | P5 | |
| 24. | D | K | 1 | 3 | I5 | 49. | B | K | 1 | 3 | P7 | |
| 25. | A | K | 1 | 3 | I6 | 50. | B | H | 1 | 3 | P10, 9 | |

Multiple Choice = 50 marks

Part B: Written Response

| Q | B | C | S | CO | PLO |
|----------|----------|----------|----------|-----------|------------------|
| 1. | 1 | K | 4 | 1 | D3, 4; A1 |
| 2. | 2 | U | 4 | 2 | E1 |
| 3. | 3 | U | 6 | 2 | G3, 7 |
| 4. | 4 | U | 6 | 1, 3 | B3; I1, 9; P3, 7 |
| 5. | 5 | K | 6 | 3 | J9 |
| 6. | 6 | H | 4 | 3 | K1, 4 |
| 7. | 7 | U | 5 | 3 | M5, 6 |
| 8. | 8 | U | 2 | 3 | M8 |
| 9. | 9 | U | 7 | 3 | O2, 4, 5 |
| 10. | 10 | U | 6 | 3 | P3, 1 |

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) Define recombinant DNA.

(1 mark)

- **DNA having genes from two different sources / cells / organisms / species. (1 mark)**

b) Give **two** uses of recombinant DNA.

(2 marks)

- **producing vaccines / antibodies / antibiotics**
- **determining sex of the fetus**
- **diagnosis of infections and genetic diseases**
- **production of human proteins (e.g., insulin and growth hormone, interferon)**
- **genetically-modified organisms**
- **improving crops / livestock for superior yields**

} **any two for
1 mark each**

Note:

Did not accept DNA fingerprinting / medicine / biotechnology.

c) In which organelle of a human cell would recombinant DNA be found?

(1 mark)

- **nucleus**
 - **mitochondria**
- } **either one for
1 mark**

2. Give a role of each of the following nucleic acids in the production of an enzyme.
(4 marks: 1 mark each)

DNA:

- Contains sequence of bases that codes for the enzyme.
 - Contains triplet code / blueprint / recipe / genetic code.
 - Transcription.
 - Produces mRNA.
- } any one for
1 mark

mRNA:

- Transcribes DNA sequence A=U, G=C and travels to the site of enzyme production in the cytoplasm.
 - Involved in translation.
 - Carries triplet code / genetic code / codon from nucleus to ribosome / endoplasmic reticulum.
- } any one for
1 mark

rRNA:

- Involved in translation as a component of ribosomes (along with protein).
 - Attaches to tRNA / mRNA.
 - Reads mRNA.
 - Site of codon / anticodon matching.
- } any one for
1 mark

tRNA:

- Carries specific amino acids to rRNA.
 - Translation.
 - Attaches to ribosome / rRNA.
 - Contains anticodon.
 - Matches mRNA codon.
- } any one for
1 mark

3. In an experiment, 10 cubes of potato each weighing 10 grams and cut from the same potato were placed in 10 different numbered beakers. Each beaker contained a different concentration of sucrose solution as shown in the table below. After 24 hours, the potato cubes were removed, blotted dry and their weights entered into the data table.

| Beaker | Concentration of Sucrose (%) | Weight of Potato Cube After 24 Hours (grams) | Percent Change in Mass (%) |
|--------|------------------------------|--|----------------------------|
| 1 | 0.0 | 13.4 | 34 |
| 2 | 0.5 | 12.5 | 25 |
| 3 | 1.0 | 11.2 | 12 |
| 4 | 1.5 | 10.3 | 3 |
| 5 | 2.0 | 9.2 | -8 |
| 6 | 2.5 | 8.5 | -15 |
| 7 | 3.0 | 8.0 | -20 |
| 8 | 3.5 | 7.7 | -23 |
| 9 | 4.0 | 7.5 | -25 |
| 10 | 4.5 | 7.4 | -26 |

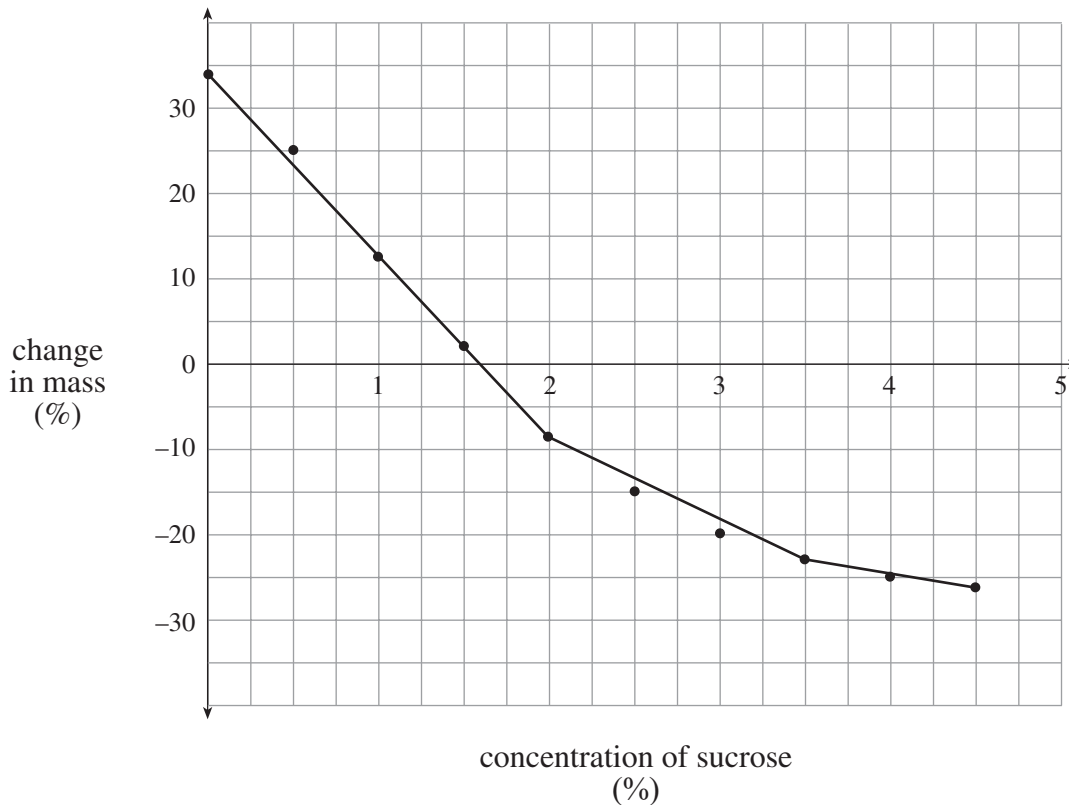
a) Why were all the pieces cut from the same potato?

(1 mark)

- to ensure consistent results
- as a control (same amount of solute)
- different potatoes may contain different quantities of water and solutes and therefore gain or lose more or less water by osmosis

} any one for
1 mark

b) Graph the data that compares the concentration of sucrose to the percent change in mass.
(2 marks: 1 mark for plotting points; 1 mark for drawing line)



Mark distribution:

1 mark for plotting the points correctly
1 mark for drawing the line

c) Use your graph to estimate at what point the concentration of sucrose in the potato is equal to the sucrose concentration in the beaker. **(1 mark)**

- **accept a range of 1.5 to 1.9 (1 mark)**

d) Explain why some of the potato cubes gained mass. **(2 marks)**

- **Water moved into the cells by osmosis. (1 mark)**

AND

- **The potato cytoplasm has a higher sucrose concentration.**
- **The potato cubes were in a hypotonic solution.**
- **The potato cytoplasm was hypertonic to the surrounding solution.**
- **The solution had a lower solute concentration.**

} **any one for 1 mark**

4. For each of the following, indicate whether the optimum pH is acidic, basic or neutral and explain why that pH is needed for normal functions.
(6 marks: 1 mark each for optimum pH; 1 mark each for explanation)

stomach:

Optimum pH:

- **acidic**
 - **between 2.0 and 3.0**
- } either one for
1 mark

Note:

any pH less than 7.0 accepted

Explanation:

- **acid environment kills bacteria**
 - **acid environment needed to convert pepsinogen into pepsin**
- } either one for
1 mark

small intestine:

Optimum pH:

- **basic**
 - **alkaline**
 - **between 7.5 and 9.0**
- } any one for
1 mark

Note:

any pH greater than 7.0 accepted

Explanation:

- **neutralizes acid chyme**
 - **alkaline environment needed for optimum enzyme function for any enzyme activated in the small intestine**
- } either one for
1 mark

seminal fluid:

Optimum pH:



- **basic**
 - **alkaline**
- } either one for
1 mark

Explanation:

- **counteracts acidity of the vagina**
 - **sperm are more viable in a basic solution**
- } either one for
1 mark

5. Complete the following table describing components of the blood.

(6 marks: 1 mark each)

| | Red Blood Cells | Platelets |
|------------------------|---|---|
| Structural Description | <ul style="list-style-type: none"> • no nuclei OR • biconcave disks OR •  | <ul style="list-style-type: none"> • cell fragments OR •  |
| Function | <ul style="list-style-type: none"> • to carry oxygen, hydrogen ions and carbon dioxide | <ul style="list-style-type: none"> • to initiate clotting |
| Site of Production | <ul style="list-style-type: none"> • bone marrow OR • stem cells | <ul style="list-style-type: none"> • bone marrow OR • mega karyocytes |

6. When people are involved in an exercise program, changes in the circulatory system occur.

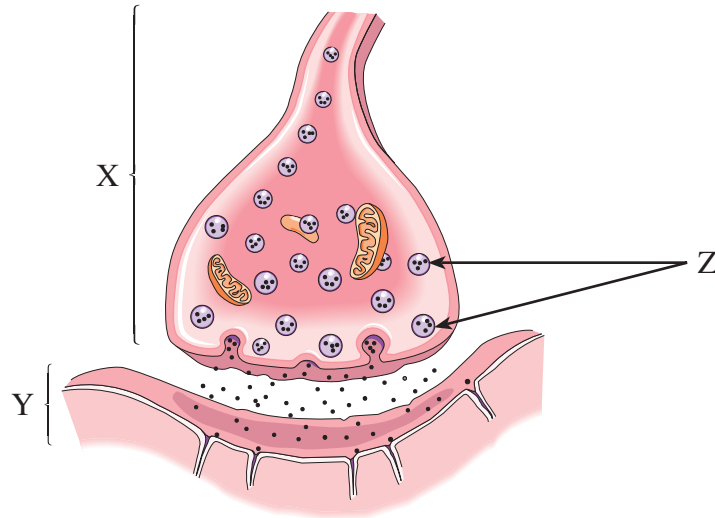
a) Explain why the number of capillaries in the skeletal muscle tissue increases. **(2 marks)**

- to increase oxygen delivery to the cells
 - to increase nutrient delivery to the cells
 - to increase removal of carbon dioxide / heat / lactic acid / hydrogen ions / bicarbonate ions / wastes produced
- } any two for
1 mark each

b) Explain why the maximum heart rate is lower for the same amount of exercise. **(2 marks)**

- The left ventricle is larger due to increased contractions / hypertrophy of the heart muscle results.
 - The heart is more efficient at pumping blood.
 - The cardiac output has increased; therefore, more blood moves out of the heart per beat (increased stroke volume).
 - The heart has become stronger.
 - An increased red blood cell concentration means greater oxygen delivery, and fewer heart beats are required.
- } any two for
1 mark each

Use the following diagram to answer question 7.



7. a) Identify each of the following structures.

(2 marks: 1 mark each)

Structure X:

- synaptic knob
- synaptic ending
- synaptic button
- terminal end bulb
- presynaptic membrane / axon

} any one for
1 mark

Structure Y:

- postsynaptic membrane
- dendrite / cell body / muscle cell
- gland
- effector

} any one for
1 mark

b) Identify the substance stored and released by structure **Z** and describe its function.
(2 marks: 1 mark for substance; 1 mark for function)

Substance:

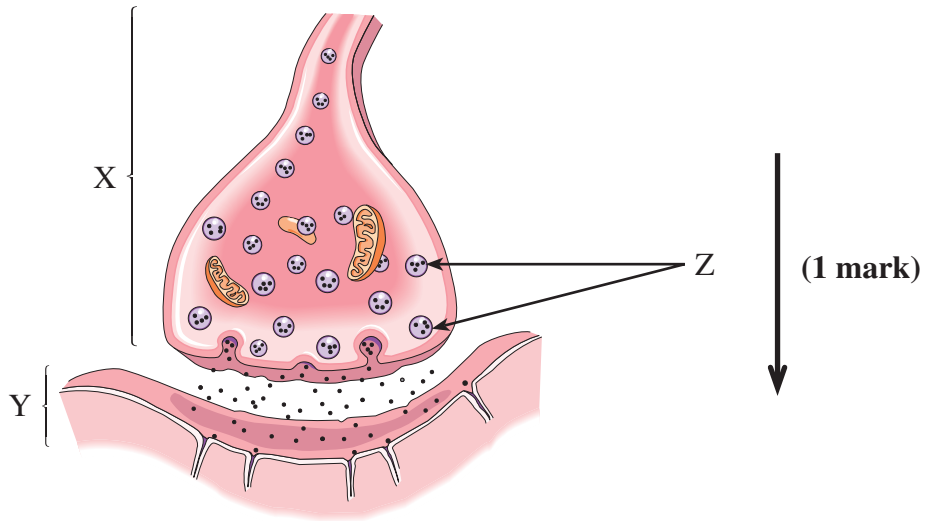
- neurotransmitter
 - name of a specific neurotransmitter
- } either one for
1 mark

Function:

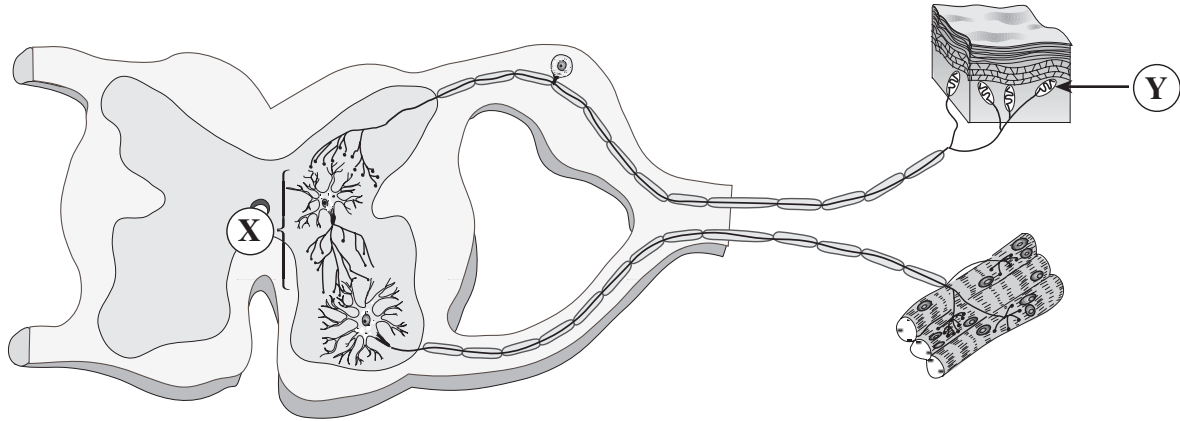
- diffuse across the synapse and fit into receptor sites
 - cause depolarization of the postsynaptic membrane which continues the nerve impulse
 - cause the sodium gates to open
 - cause hyperpolarization
 - transport impulse
 - excitatory effects
 - inhibitory effects
- } any one for
1 mark

c) Draw an arrow on the diagram above to indicate the direction of the nerve impulse.

(1 mark)



Use the following diagram to answer question 8.



8. a) Identify structure X.

(1 mark)

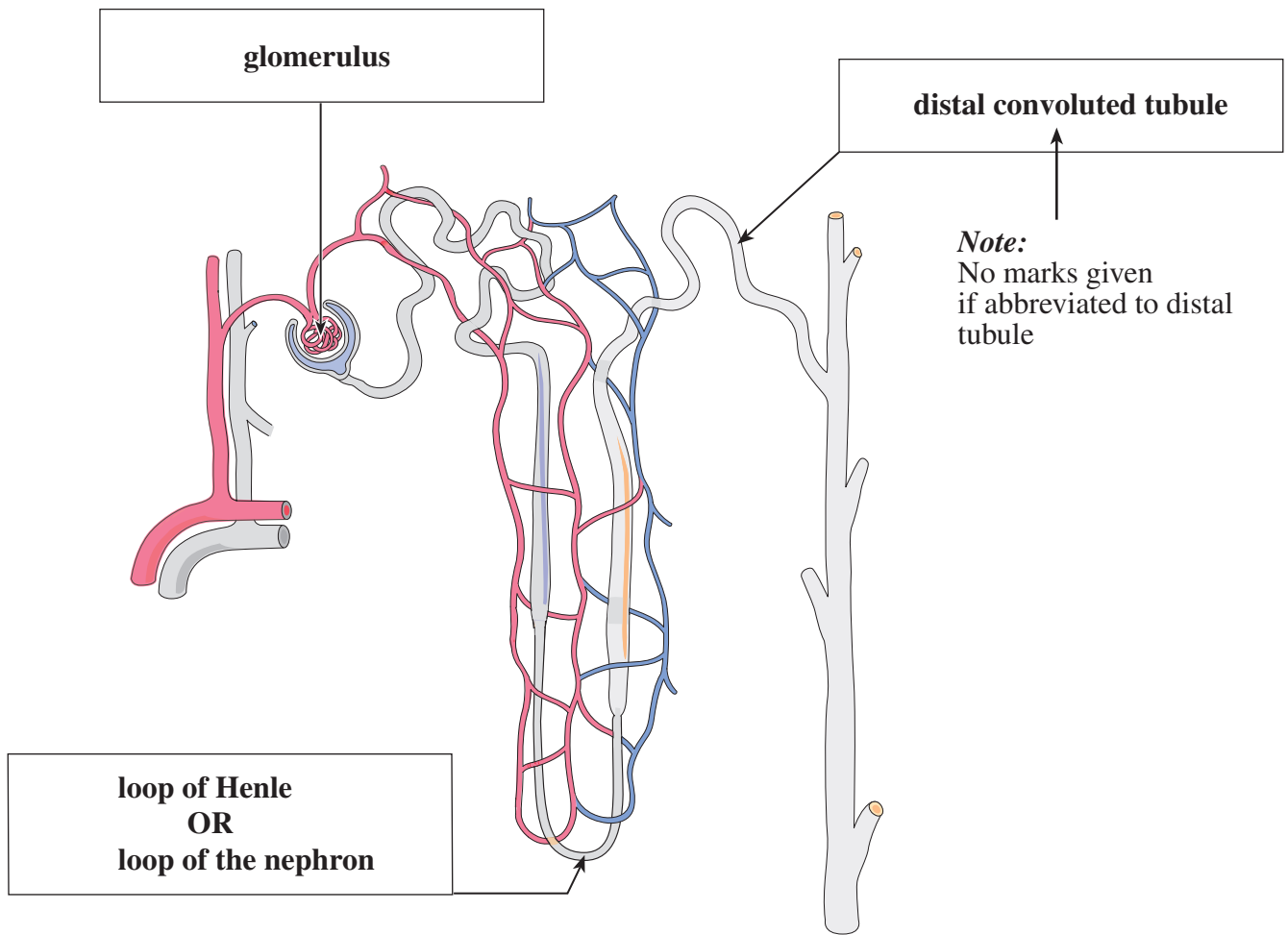
- interneuron
 - association neuron
 - relay neuron
- } any one for
1 mark

b) What is the function of structure Y?

(1 mark)

- receive sensory information from the external environment
 - initiates the electrical impulse
- } either one for
1 mark

9. a) Write the names of the structures indicated by each of the arrows in the boxes provided. (3 marks)



b) Give a function of each of the following in the excretory system.

(4 marks: 1 mark each)

carrier proteins:

- **Specific carriers actively transport amino acids / glucose / penicillin / histamines / bicarbonate ion / creatinine out of the filtrate. (1 mark)**

peritubular capillary network:

- **Returns water and nutrients entering the nephron to the circulatory system.**
- **Excretion of wastes.**

} either one for
1 mark

sodium bicarbonate:

- **Used to regulate blood pH at the distal tubule. (1 mark)**

aldosterone:

- **Causes re-absorption of sodium ions increasing blood plasma levels.**
- **Causes excretion of potassium ions.**
- **Promotes water reabsorption.**

} any one for
1 mark

10. Identify **three** components of seminal fluid and give **one** function of each component.
(6 marks: 1 mark each for name; 1 mark each for function)

| Component | Function |
|--|--|
| <ul style="list-style-type: none"> • bicarbonate ion (HCO_3^-) | <ul style="list-style-type: none"> • to neutralize the acidity of the vagina OR • buffers acidic vagina |
| <ul style="list-style-type: none"> • sugar (i.e., glucose / fructose) OR • nutrients OR • carbohydrates | <ul style="list-style-type: none"> • for energy OR • for the production of ATP required for propulsion |
| <ul style="list-style-type: none"> • prostaglandins | <ul style="list-style-type: none"> • to stimulate uterine contractions to propel the sperm to the oviduct |
| <ul style="list-style-type: none"> • mucus | <ul style="list-style-type: none"> • to lubricate OR • protect sperm |
| <ul style="list-style-type: none"> • water | <ul style="list-style-type: none"> • to provide a medium for sperm to swim in OR • to lubricate |
| <ul style="list-style-type: none"> • amino acids OR • proteins | <ul style="list-style-type: none"> • coagulation in female reproductive tract |
| <ul style="list-style-type: none"> • sperm | <ul style="list-style-type: none"> • carries chromosomes OR • fertilizes egg |

END OF KEY