

# Biology 12

## August 2000 Provincial Examination

### ANSWER KEY / SCORING GUIDE

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#### 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	CO	PLO	Q	K	C	CO	PLO
1.	A	K	1	A1, 3	26.	B	K	3	I5
2.	C	U	1	A1, 3	27.	B	K	3	J2
3.	D	H	1	A1, 3; C2, C8	28.	C	U	3	J9
4.	C	U	1	A1	29.	D	K	3	J11
5.	C	H	1, 2	A1, 3; G1, 3	30.	D	H	3	J12
6.	B	U	1	B2	31.	B	H	3	K2
7.	B	H	1	B3	32.	A	K	3	L1
8.	A	U	1	C1, 5	33.	C	U	3	L6
9.	D	K	1	C9	34.	D	U	3	M1
10.	A	U	1	C1	35.	C	H	3	M3
11.	B	U	1	C2, 11	36.	C	U	3	M5, 1, 3
12.	C	H	1	C2, 7	37.	C	U	3	N2, 4
13.	C	H	1	D1	38.	D	K	3	N4
14.	B	U	1	C2; D1	39.	A	K	3	N4
15.	A	U	1	D1	40.	D	K	3	O1, 2
16.	D	U	2	F1	41.	B	U	3	O1, 2
17.	C	U	2	F2	42.	A	H	3	O2, 5
18.	A	K	2	F5	43.	D	U	3	O2
19.	C	H	2	G4, 6, 7	44.	D	K	3	P1, 2
20.	A	K	2	G6	45.	D	U	3	P1, 3
21.	A	K	2	H3	46.	B	K	3	P1
22.	D	H	2	H6	47.	C	U	3	P1, 5
23.	C	K	3	I1	48.	B	K	3	P7
24.	B	U	3	I2	49.	D	U	3	P7, 8, 9, 10
25.	B	U	3	I2, 4	50.	A	U	3	P8

**Multiple Choice = 50 marks**

## Part B: Written Response

<b>Q</b>	<b>B</b>	<b>C</b>	<b>S</b>	<b>CO</b>	<b>PLO</b>
1.	1	U	5	2, 1	E1; D1, 2
2.	2	U	4	2	G3
3.	3	U	5	2	H1, 3, 6
4.	4	U	6	3	I1, 2, 4, 9
5.	5	U	2	3	J1, 2
6.	6	U	8	3	K1
7.	7	H	5	3	L7, 8
8.	8	K	5	3	M3, 4, 6, 7, 8
9.	9	U	6	3	O2, 5
10.	10	H	4	3	P9, 10

**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

- INSTRUCTIONS:**
1. Use a **pen** for this part of the examination unless otherwise instructed.
  2. Write your answers in the space below the questions.
  3. Organization and planning space has been incorporated into the space allowed for answering each question.
  4. You may not need all of the space provided to answer each question.

1. a) In an experiment conducted to study protein synthesis, radioactive thymine and radioactive uracil were added to a culture of human cells. A few hours later, the culture was analyzed and radioactive mRNA was found.

i) Explain how an mRNA molecule is produced. (2 marks)

- The DNA molecule “unzips.”
- Complementary base pairing occurs between mRNA and DNA bases.
- Sugars and phosphates of adjacent mRNA nucleotides are joined together.

} any two for  
1 mark each

ii) Explain why the mRNA produced is radioactive. (1 mark)

- During transcription, radioactive uracil is used to produce mRNA. (1 mark)

b) In a different experiment, radioactive uracil was added to a culture of human cells undergoing DNA replication. What will be the characteristic of the resulting DNA in terms of radioactivity? Explain. (2 marks)

- No radioactive elements will be incorporated in the DNA molecule (1 mark)  
as adenine will bond only with thymine and not uracil during replication (1 mark).

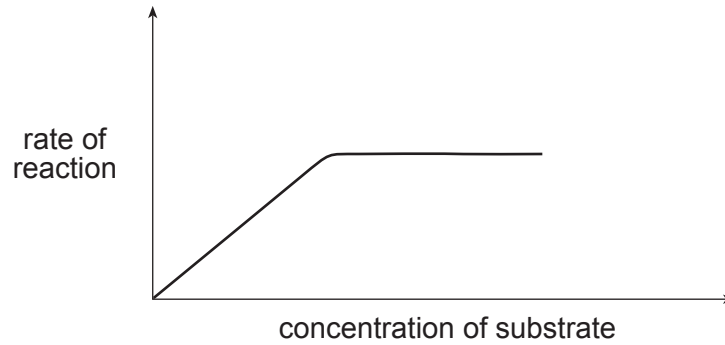
2. Materials move across the cell membrane either actively or passively. Complete the following table to compare and contrast these two ways of moving materials.

**(4 marks)**

ACTIVE TRANSPORT	PASSIVE TRANSPORT
<b>uses energy (ATP)</b>	<b>does not use energy (ATP)</b>
<b>moves against the concentration gradient</b>	<b>moves with the concentration gradient</b>
<b>uses carrier proteins</b>	<b>uses carrier proteins</b>
<b>active transport is used for ion movement</b>	<b>diffusion / osmosis is used for gas / water movement</b>
<b>endocytosis / exocytosis (phagocytosis / pinocytosis) uses vesicles</b>	<b>does not use vesicles</b>

any four pairs with  
1 mark for each pair

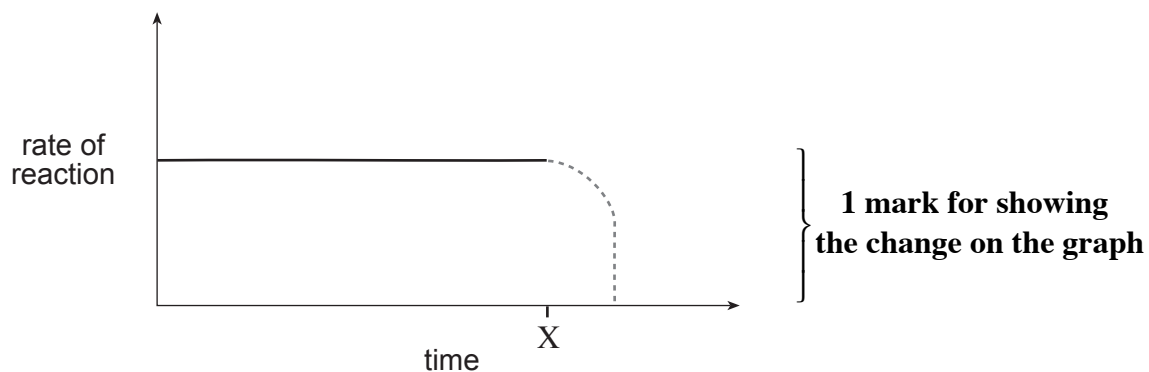
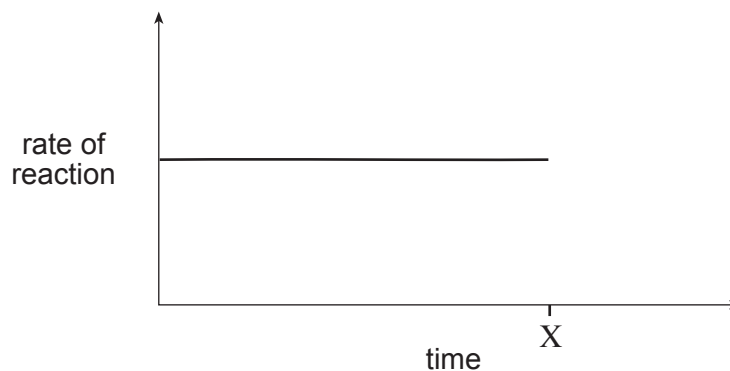
Use the following graph to answer question 3 a).



3. a) The graph represents data collected from an enzyme-catalyzed reaction in the small intestine. Explain the results. **(2 marks)**

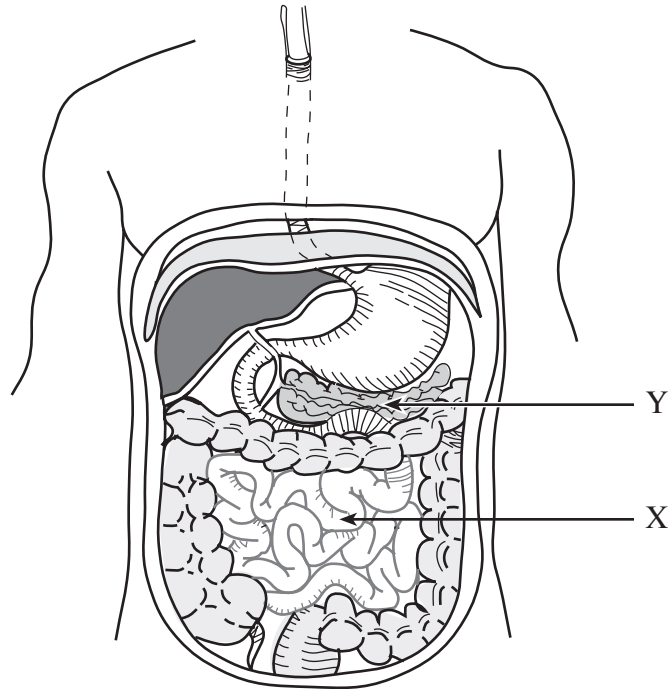
- **At first, the rate of reaction increases because more collisions occur between substrate and enzyme molecules to produce enzyme-substrate complexes which makes more product. (1 mark)**
- **Eventually the rate of reaction will level off because the active sites are filled. (1 mark)**

- b) How would the shape of the graph below change if a large amount of concentrated acid were added to the enzyme-catalyzed reaction at time **X**? **Draw** the change on the graph and explain your answer. (3 marks)






- The acid denatures (changes the shape of) the enzyme, therefore no product is produced. (1 mark)
- The substrate and enzyme are unable to form enzyme-substrate complexes, therefore no product is produced. (1 mark)

Use the following diagram to answer question 4.



4. Secretions from glands in the walls of structure **X** and secretions from structure **Y** are collected and added to test tubes containing three substrates as shown below. The test tubes are allowed to stand for one hour. Blue litmus paper, which turns red in the presence of an acid, is used as an indicator.

	 1	 2	 3
Substrate	starch	fats	protein
Secretions from	X and Y	X and Y	X and Y

a) The test tubes were sampled during a one hour period. Identify any new substances produced in the following test tubes and account for their presence.

Test tube 1:

(2 marks)

- **Maltose is present — amylase breaks down starch into maltose. (1 mark)**
- **Glucose is present — maltase breaks down maltose into glucose. (1 mark)**

Test tube 2:

(2 marks)

- **Fatty acids are present — lipase breaks fats down into fatty acids and glycerol. (1 mark)**
- **Glycerol is present — lipase breaks fats down into fatty acids and glycerol. (1 mark)**

b) Each test tube was tested with litmus paper at the beginning of the experiment and after one hour. In test tube 3, the litmus paper changed from blue at the beginning of the experiment to red after one hour. Explain what occurred in the test tube to cause the litmus paper to turn red.

(2 marks)

- **The protein was digested into peptides by trypsin.**
- **The peptides were broken down by peptidases to form amino acids.**
- **The amino acids created an acidic environment which caused the litmus paper to turn red.**

} any two for  
1 mark each



5. Explain how the structure of arteries is related to their function.

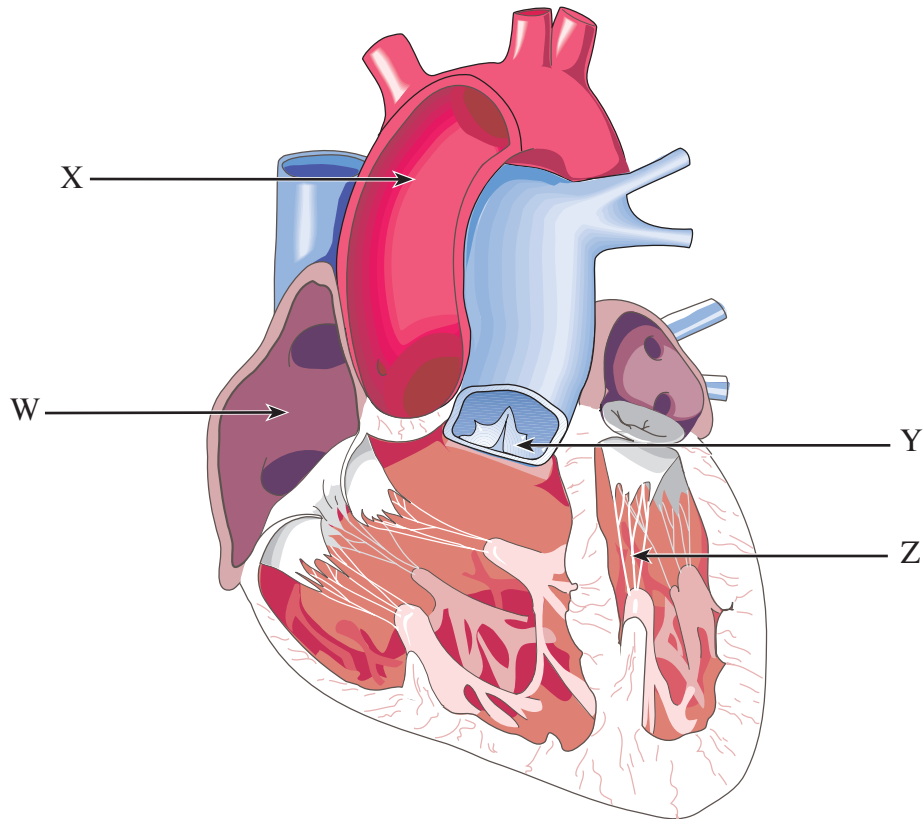
**(2 marks)**

**Arteries have:**

- **thick walls to resist pressure.**
- **muscle fibers to pump / give pulse.**
- **elastic fibers to allow stretching / recoil of pulse.**
- **a large bore which permits rapid blood flow to the arterioles.**

} **any two for  
1 mark each**

Use the following diagram to answer question 6.



6. Identify and give **one** function of each of the following structures.  
(8 marks: 1 mark each for name; 1 mark each for function)

Structure **W**:

Name: **right atrium (1 mark)**

Function:

- **receives deoxygenated blood (low in oxygen and high in carbon dioxide) returning from the body**
- **sends blood through an atrioventricular valve to the right ventricle**

} **either one for  
1 mark**

Structure **X**:

Name: **aorta (1 mark)**

Function:

- **carries oxygenated blood to the systemic circulation (1 mark)**

Structure **Y**:

Name: **semi-lunar valve (1 mark)**

Function:

- **prevents the back flow of blood into the ventricles (1 mark)**

Structure **Z**:

Name: **chordae tendinae (1 mark)**

Function:

- **prevent the heart valves from inverting during the heartbeat (1 mark)**

7. a) Describe internal respiration.

(3 marks)

- $\text{H}_2\text{O} + \text{CO}_2$  (diffuse into the blood from the tissues)  $\rightarrow \text{H}_2\text{CO}_3$   
(carbonic acid)  $\rightarrow \text{H}^+$  and  $\text{HCO}_3^\pm$
- $\text{Hb} + \text{H}^+ \rightarrow \text{HHb}$  (the excess H ions produced from the water and carbon dioxide are taken up by the hemoglobin forming reduced hemoglobin)
- $\text{HbO}_2 \rightarrow \text{Hb} + \text{O}_2$  (the oxygen diffuses into the tissues)
- Occurs in a warm, acidic environment (relative to the lung capillaries)
- $\text{Hb} + \text{CO}_2 \rightarrow \text{HbCO}_2$

} any three for  
1 mark each

**Note to Markers**

Students may answer using an equivalent description in words.

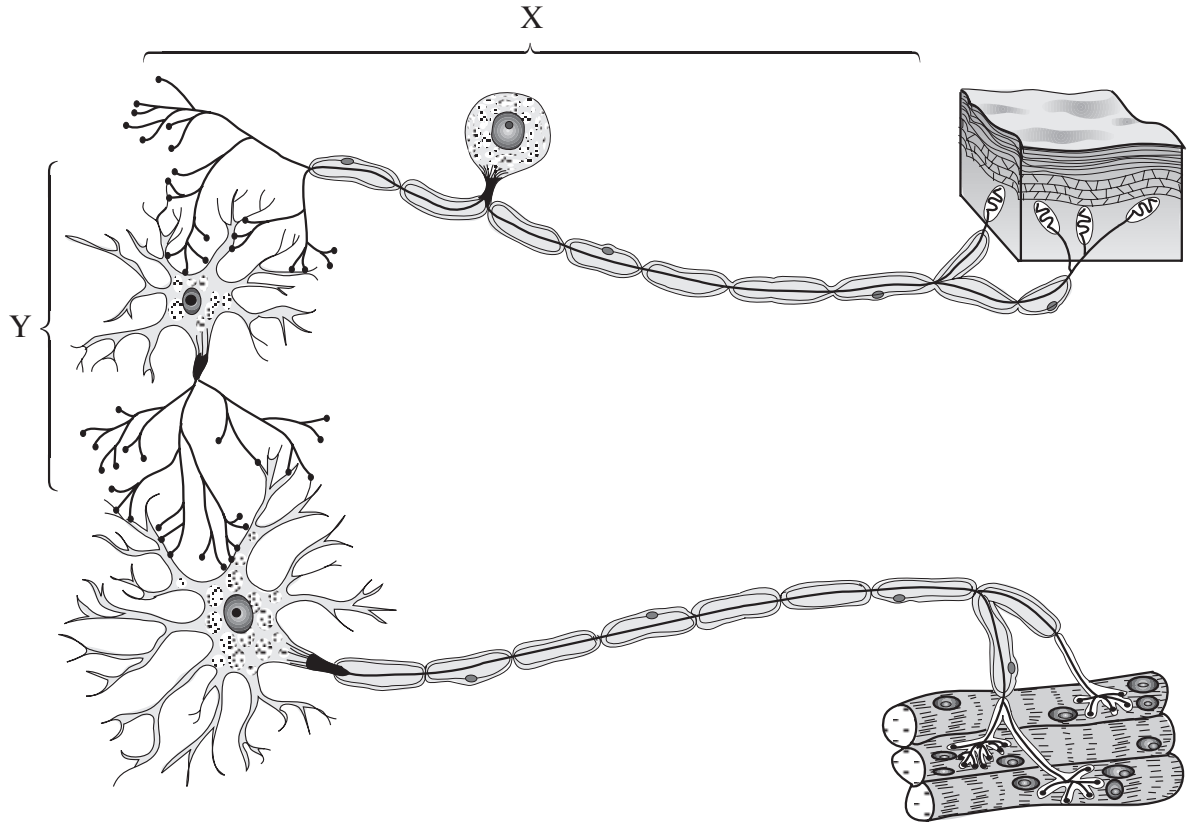
b) Explain why the pH of the blood in the lung capillaries and in the body-tissue capillaries is similar.

(2 marks)

- Hemoglobin takes up excess  $\text{H}^+$  ions forming reduced hemoglobin at the tissues.
- Bicarbonate ions take up excess  $\text{H}^+$  ions at the lungs forming water and carbon dioxide.
- Blood is buffered by a variety of substances (including Hb,  $\text{HCO}_3^\pm$ ,  $\text{HPO}_4^{2\pm}$ , etc.) which reduces the amount of  $\text{H}^+$  ions and keeps the pH relatively constant.

} any two for  
1 mark each

Use the following diagram to answer question 8.



8. a) Identify each of the following structures and give one function of each.  
(4 marks: 1 mark each for name; 1 mark each for function)

Structure X:

Name: **sensory neuron (1 mark)**

Function:

- **receives impulses from sensory organs (receptors)**
- **carries impulses towards the central nervous system**
- **carries impulses from a receptor to the spinal cord**

} any one for  
1 mark

Structure Y:

Name: **interneuron (1 mark)**

Function:

- **carries impulses within the spinal cord (central nervous system)**
- **receives impulses from a sensory neuron**
- **transmits action potentials between sensory and motor neuron**

} any one for  
1 mark

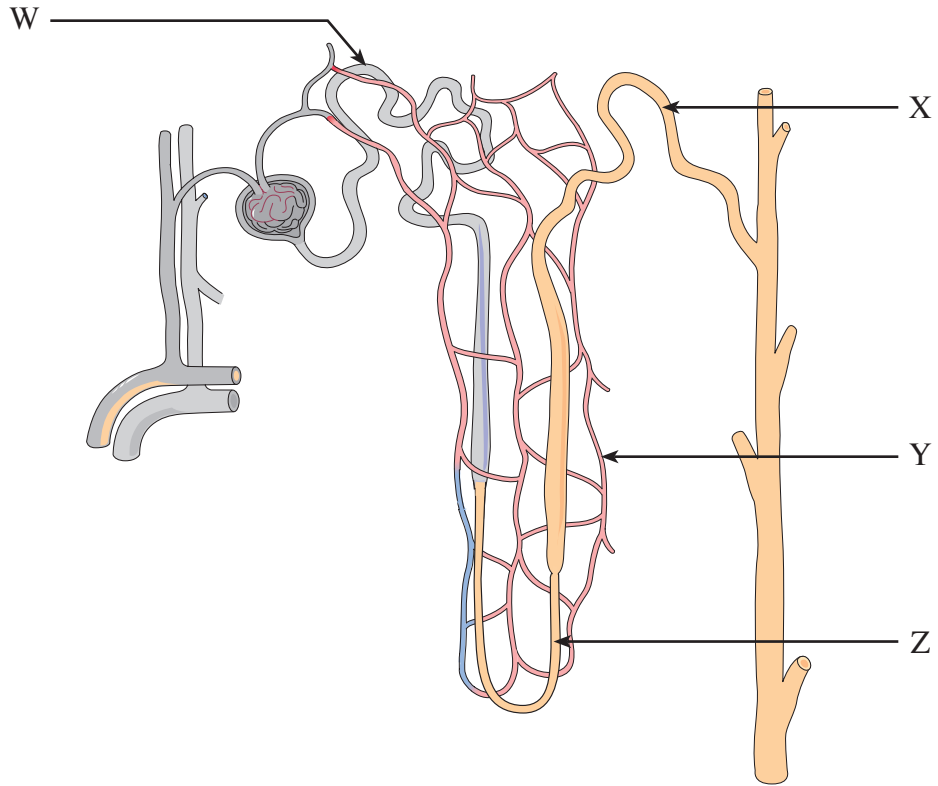
b) A substance disrupts communication between structures **X** and **Y**. Give an explanation of how a substance could do this. **(1 mark)**

**The substance could:**

- **block receptor sites on the post-synaptic membranes preventing the continuation of the transmission.**
- **destroy the neurotransmitters before they reach the receptor sites, (thus causing depolarization).**
- **destroy the enzymes that break down the neurotransmitters (allowing for an abnormally long impulse).**
- **prevent the movement of  $\text{Ca}^{2+}$  into the presynaptic ending, (thus stopping the release of neurotransmitters).**

**any one for  
1 mark**

Use the following diagram to answer question 9 a).



9. a) Give **one** different function of each of the following structures. (4 marks: 1 mark each)

Structure W:

- selective reabsorption
  - actively transports material out of the proximal tubule
- } either one for 1 mark

Structure X:

- carries out tubular excretion / secretion
  - excretes penicillin and histamines
  - secretes  $H^+$  and  $NH_3$  to regulate the acidity of the blood
- } any one for 1 mark

Structure Y:

- absorbs and excretes specific ions
- excretes materials from the blood to the filtrate
- receives material reabsorbed from the nephron
- transports blood from renal artery to renal vein

} any one for  
1 mark

Structure Z:

- reabsorbs water
- extrudes  $\text{Na}^+$  ions
- counter-current exchange

} any one for  
1 mark

Use the following table to answer question 9 b).

Filtrate	Urine
95% water	50% water

- b) Provide an explanation that accounts for the difference in the water content as shown in the table above. (2 marks)

- Water is absorbed because ADH causes the distal convoluted tubule and the collecting duct to become more permeable to water. The loop of Henle causes a hypertonic environment by excreting  $\text{Na}^+$ . Aldosterone causes the distal convoluted tubule to transport  $\text{Na}^+$  into the blood. (2 marks)



10. a) Describe any **two** events that occur during days 15 to 28 of the ovarian or uterine cycles.

**(2 marks)**

- **Endometrium thickens and becomes secretory.**
- **Luteinizing hormone (LH) is secreted by the anterior pituitary gland.**
- **The corpus luteum develops as a result of LH secretions.**
- **The corpus luteum secretes progesterone.**

} **any two for  
1 mark each**

b) During days 1 to 13 of the ovarian cycle, what would occur if follicle-stimulating hormone (FSH) was **not** secreted?

**(2 marks)**

- **The follicle would not mature.**
- **The follicle would not secrete estrogen.**
- **The lack of estrogen would not exert negative feedback on the anterior pituitary gland.**
- **The endometrium would not thicken.**

} **any two for  
1 mark each**

**END OF KEY**