

Biology 12

June 2000 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	CO	PLO	Q	K	C	CO	PLO
1.	B	K	1	A1	26.	D	H	3	J12; L1, 3
2.	A	U	1, 2	A1; G5	27.	D	H	3	K1; J5
3.	B	H	1, 2, 3	A1; G5; C11; I5	28.	C	U	3	K1; J6, 2
4.	B	H	1, 2	A1; C5, 8; H1	29.	D	K	3	K1
5.	D E L E T E D				30.	A	K	3	L1
6.	D	U	1	C2	31.	D	K	3	L1, 5
7.	D	H	1, 3	C5; I2, 4, 7	32.	A	U	3, 2	L3, 1; G8
8.	B	K	1	C9	33.	B	K	3	L1, 4
9.	A	U	1	C12; A1	34.	D	U	3	L6; N4
10.	D	U	1	C2, 7	35.	A	H	3, 1	L7, 8; B3
11.	B	H	2	E2, 4	36.	B	U	3	L8; J2, 4
12.	A	K	2	F1	37.	B	K	3	M1
13.	C	U	2	F2, 3, 4	38.	C	U	3	N2, 3; M7
14.	A	U	2	G3	39.	B	H	3	M6
15.	A	U	2	G4	40.	B	H	3	N3
16.	D	U	2	G6	41.	B	U	3	N4
17.	A	K	2	H1	42.	B	K	3	O1
18.	A	H	2	H6	43.	B	K	3	O2
19.	D	U	2	H7	44.	C	H	3	O3, 2
20.	C	K	3	I1, 4	45.	A	U	3	P1, 2
21.	B	U	3	I1	46.	D	K	3	P4
22.	D E L E T E D				47.	A	U	3	P7
23.	B	H	3, 1	I9; C9	48.	C	U	3	P10
24.	A	U	3	J1	49.	D	U	3	P10
25.	B	U	3	J5	50.	A	U	3	P11

Multiple Choice = 48 marks

Part B: Written Response

Q	B	C	S	CO	PLO
1.	1	K	4	1	D1
2.	2	U	4	2	E1
3.	3	K	3	2	G3
4.	4	H	5	1, 2, 3	H1, 6; B3; I2; G7
5.	5	U	6	3	I1, 2, 4, 5, 6, 7, 10
6.	6	U	6	3	J2, 4, 5
7.	7	U	5	3, 2	M3; F6
8.	8	K	4	3	M2, 4, 8
9.	9	U	7	3	O2
10.	10	U	6	3	P7

Written Response = 50 marks

Multiple Choice = 48 (48 questions)
Written Response = 50 (10 questions)
EXAMINATION TOTAL = 98 marks

LEGEND:

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

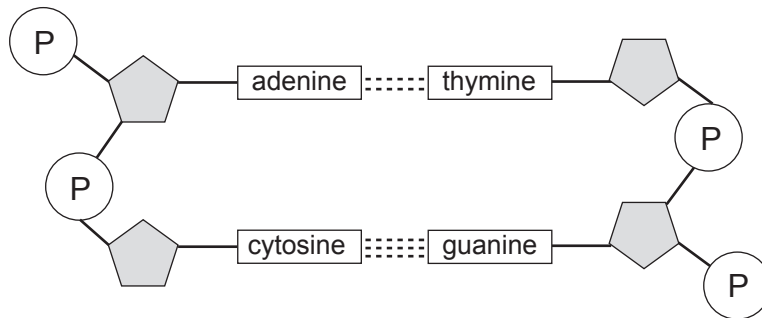
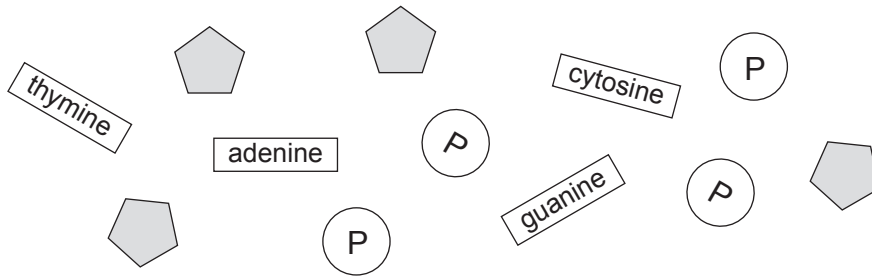
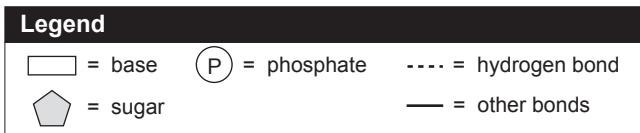
PART B: WRITTEN RESPONSE

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. The symbols shown below represent parts of a DNA molecule. Construct the DNA molecule by redrawing the parts to make a complete section. **(4 marks)**



two strands (1 mark)

correct base pairing (1 mark)

sugar-phosphate backbone (1 mark)

correct location of hydrogen bonding (1 mark) (**Note** Number of H bonds not critical to receiving mark.)

Note to Markers

Students may use letters to identify bases; e.g., $A \cdots T$ and $C \cdots G$.

Minus $\frac{1}{2}$ mark if base is attached to phosphate group.

2. a) What is the purpose of transcription during protein synthesis?

(1 mark)

- To assemble mRNA from a section of DNA (gene) that contains the code for one protein.
- To make mRNA.
- To carry complementary mRNA (codon) from DNA.

} any one for
1 mark

b) What occurs during translation?

(3 marks)

- mRNA binds to the ribosome.
 - tRNAs with specific amino acids attached, bind to the mRNA where the anticodon of the tRNA is complementary to the codon of the mRNA.
 - Adjacent amino acids undergo dehydration synthesis.
 - Ribosomes move along one codon and the process is repeated.
 - A polypeptide is produced (peptide bonds form).
 - Ribosomal subunits come together.
 - Stop codon indicates release of mRNA and polypeptide chain.
- Initiation, elongation and termination. (**Note** With no accompanying description this received $1\frac{1}{2}$ marks out of 3).

} any three for
1 mark each

3. Describe the following mechanisms of transport across cell membranes.

(3 marks: 1 mark each)

osmosis:

- The net diffusion of water from the area of high water concentration to the area of lesser concentration of water.
- The net diffusion of water from the area of lower solute concentration to the area of greater solute concentration.
- The movement of water according to osmotic pressure / gradient (or diffusion).

} any one for
1 mark

facilitated transport:

- The net movement of molecules, using a carrier protein, from an area of higher concentration to an area of lower concentration.
- The net movement of molecules down the concentration gradient, using a carrier protein.

} either one for
1 mark

active transport:

- The use of a carrier protein and an energy source to move molecules from an area of lower concentration to an area of higher concentration.
- The movement of molecules, against the concentration gradient, using a protein carrier and ATP as an energy source.

} either one for
1 mark

Note

Examples of exocytosis, endocytosis, pinocytosis or phagocytosis were not acceptable.

4. An experiment was carried out to measure the effect of pH on enzyme activity. The following steps were performed:

1. An equal volume of hydrogen peroxide was added to eight numbered test tubes at 20°C.
2. The contents of each test tube were maintained at a different pH.
3. An equal mass of liver was added to each test tube. Liver, which contains the enzyme catalase, catalyzes the following reaction:

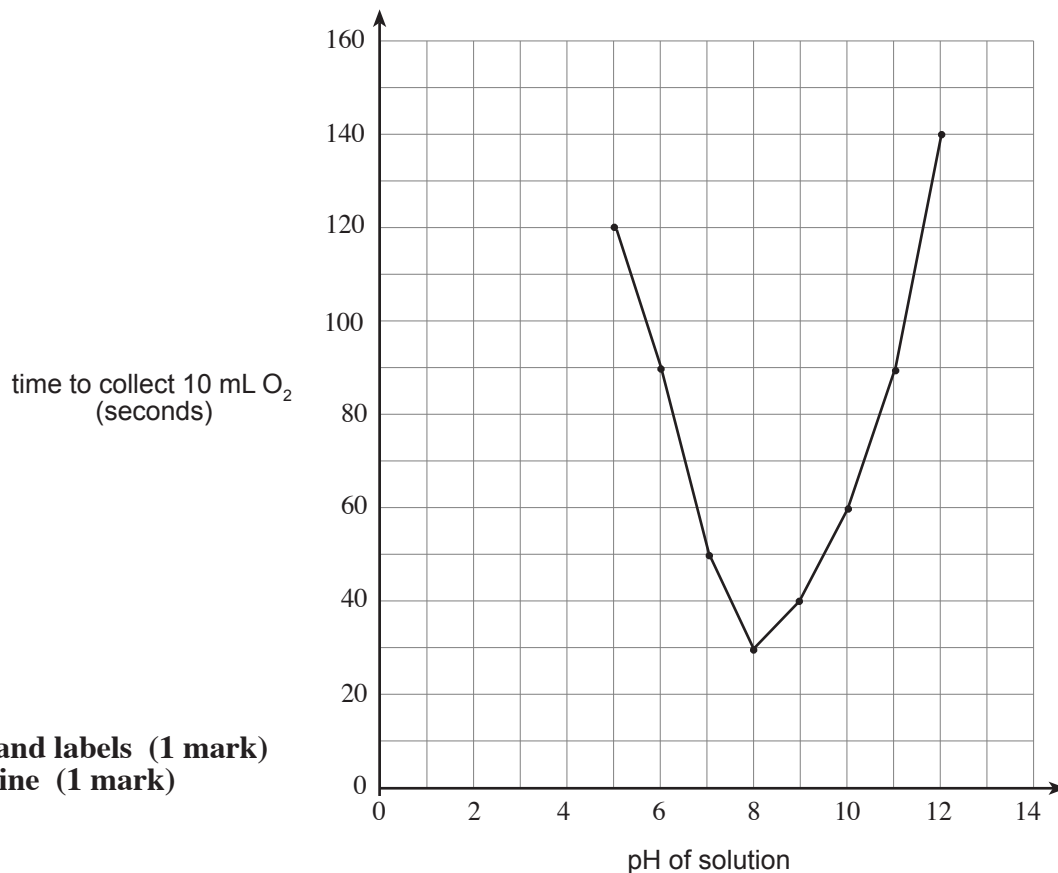


The time to collect 10 mL of oxygen gas (O₂) from each tube was measured and recorded in the table below.

TEST TUBE	pH OF SOLUTION	TIME TO COLLECT 10 mL of O ₂ (SECONDS)
1	5	120
2	6	90
3	7	50
4	8	30
5	9	40
6	10	60
7	11	90
8	12	140

- a) Draw a graph that compares the time taken to collect 10 mL of oxygen gas (O_2) produced to the pH of the solution. Label the x -axis as pH of solution. (2 marks)
(Use a pencil to graph the data.)

correct scale and labels (1 mark)
plotting and line (1 mark)



Note

Minus $\frac{1}{2}$ mark for: bar graph, “best fit” line, error in line, reversed axis, extra lines / data points.

- b) Using your graph, estimate the time it takes to collect 10 mL of oxygen gas (O_2) at pH 6.5. (1 mark)

- 70 seconds (1 mark)

Note

Accepted 60 seconds to 75 seconds if graph supported estimate.
No mark if no graph, bar graph or range of answers.

c) Explain what causes the results observed between pH 8 and pH 12.

(2 marks)

- **As the pH increases and the solution becomes more basic, (the enzyme is denatured.) (1 mark)**

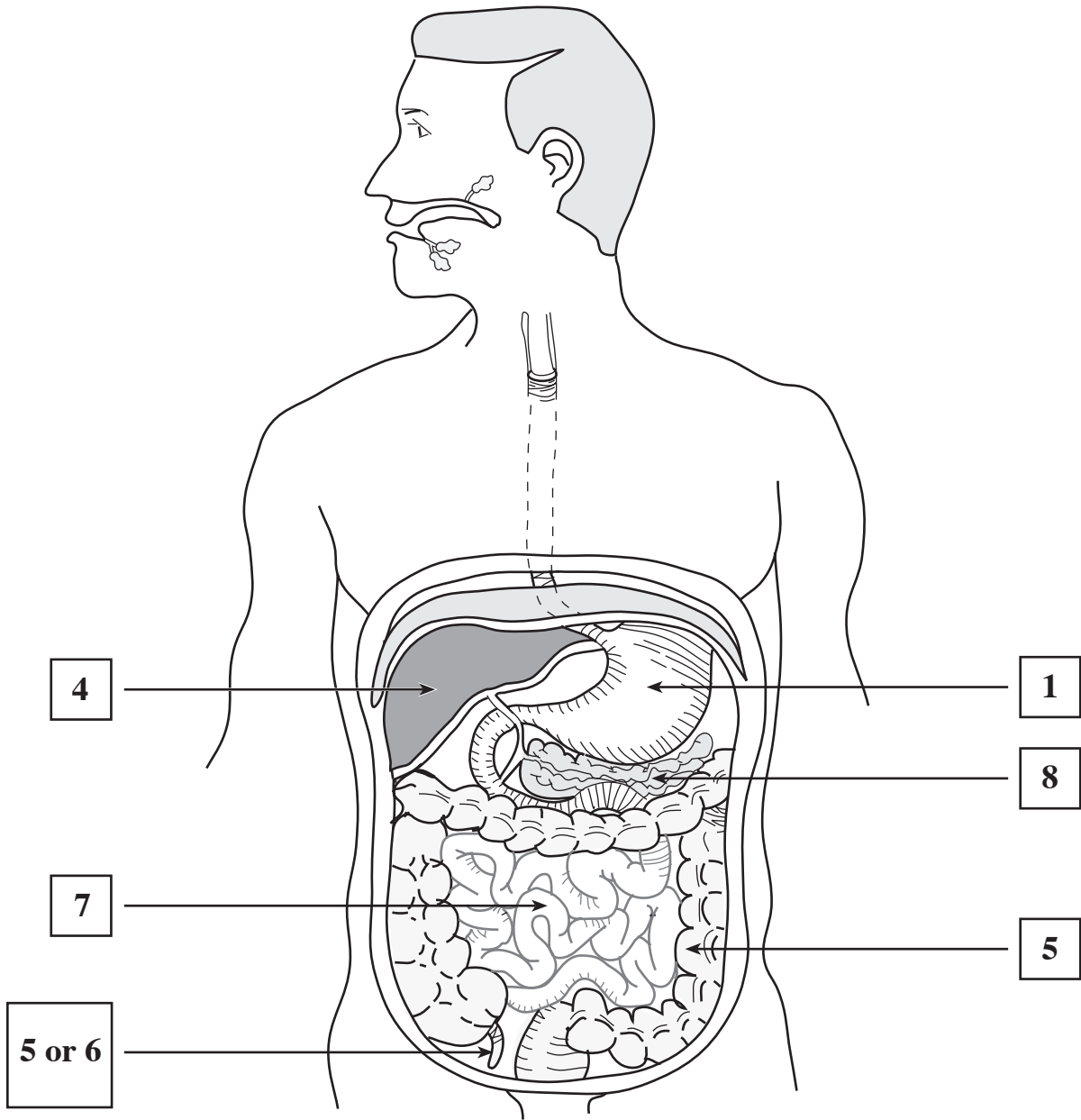
- **Fewer active sites are available for the reaction to occur.**

- **Fewer enzyme substrate complexes are formed.**

- **Loss of tertiary / 3-D structure of enzyme.**

} **any one for
1 mark**

Use the following diagram to answer question 5.



5. Place the correct number for each of the following descriptions in the appropriate box at the location in the diagram where it occurs. **Not all the descriptions will be used.** (6 marks)

1. kills bacteria
2. lined with cilia
3. produces thyroxin
4. lipid emulsifier produced here
5. contains bacteria that produce vitamins
6. has no known digestive function in adults
7. where maltose is broken down into glucose
8. hormone that controls blood sugar produced here

Note

Student could have 5 in both the positions indicated.
If two numbers were written in the **same** box no mark was awarded.

6. Describe the concentration of dissolved gases in the following pairs of vessels and explain why the concentrations are different.

pulmonary vein / pulmonary artery:

(2 marks)

- **The pulmonary vein returns blood from the lungs to the heart and therefore contains a higher concentration of oxygen and a lower concentration of carbon dioxide. (1 mark)**
- **The pulmonary artery carries blood, which has returned from the systemic circulation, from the heart to the lungs, and therefore contains a higher concentration of carbon dioxide and a lower concentration of oxygen. (1 mark)**

posterior vena cava / aorta:

(2 marks)

- **The blood in the posterior vena cava has picked up carbon dioxide and dropped off oxygen at the tissues. (1 mark)**
- **The blood in the aorta has picked up oxygen and dropped off carbon dioxide at the lungs. (1 mark)**

umbilical vein / umbilical artery:

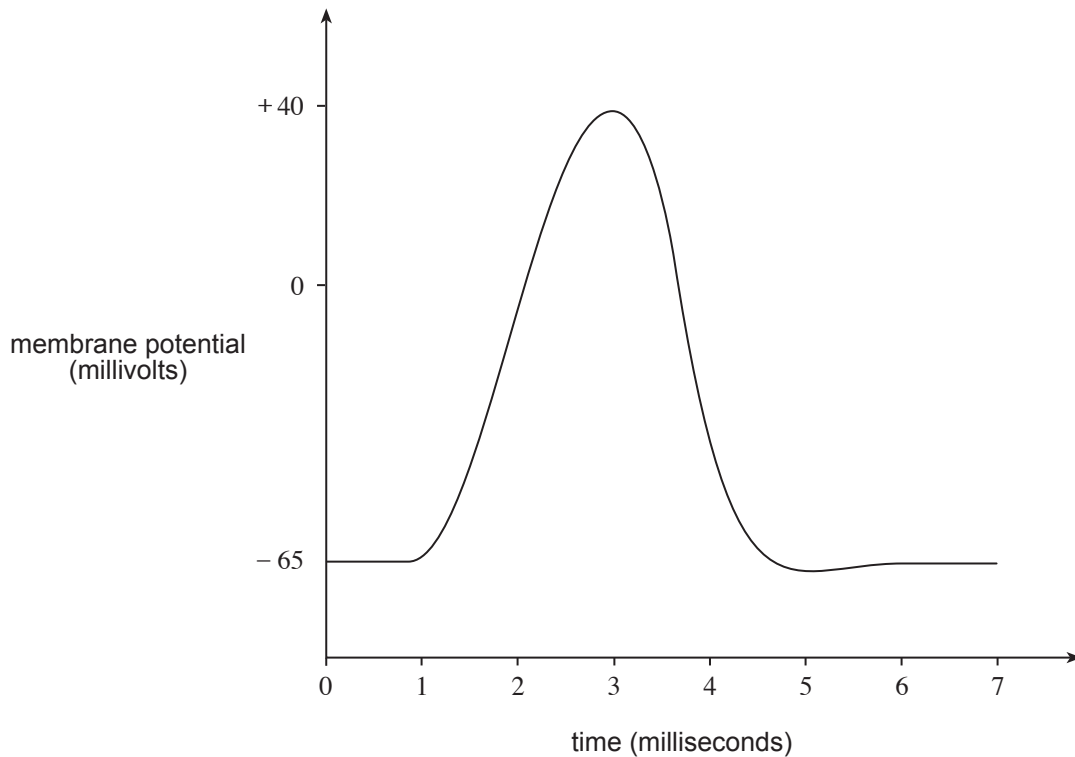
(2 marks)

- **The blood in the umbilical vein has picked up oxygen and dropped off carbon dioxide at the placenta. (1 mark)**
- **The blood in the umbilical artery has picked up carbon dioxide and dropped off oxygen at the fetal tissues. (1 mark)**

Note

“From heart” was **not** accepted, unless correct side (left / right) was mentioned.

Use the following graph to answer question 7.



7. The graph shows the change in an axon's polarity before, during and after an action potential.

a) Explain what occurs in the axon at the following times. **(3 marks: 1 mark each)**

From 1 to 3 milliseconds:

- **Na⁺ enters.**
- **Depolarization occurs.**
- **The sodium gates open, causing a positive charge inside the axon.**

} any one for
1 mark

From 3 to 5 milliseconds:

- **K⁺ exits.**
- **Repolarization occurs.**
- **The potassium gates open which restores the positive charge on the outside of the axon.**
- **Beginning of refractory period.**

} any one for
1 mark

From 5 to 7 milliseconds:

- **Resting potential is re-established.**
- **The sodium-potassium pump restores the ion distribution.**
- **The sodium-potassium pump moves Na^+ ions out of and K^+ ions into the axon.**
- **Hyperpolarization is corrected.**
- **Active transport restores ion concentrations.**

} any one for
1 mark

b) What would be the effect of increasing the stimulation of the neuron?
Give reasons to support your answer.

(2 marks)

- **There would be no change in the action potential (1 mark) because of the all-or-none response of neurons (1 mark).**

OR

- **There would be an increase of frequency of action potentials (1 mark) because stimulus is present immediately after refractory period (1 mark).**

8. Give **one** function of each of the following parts of a reflex arc.

(4 marks: 1 mark each)

myelin sheath:

- **The myelin sheath speeds the transmission of nerve impulses.**
- **It insulates / protects the axon.**
- **Saltatory neural transmission.**

} **any one for
1 mark**

effector:

- **An effector, a gland or muscle, reacts to the nerve impulse.**
- **Carries out reflex action.**
- **Receives impulse from motor neuron. (**Note** Only receives $\frac{1}{2}$ mark.)**

} **either one for
1 mark**

interneuron:

- **An interneuron relays the impulse between a sensory and a motor neuron. (1 mark)**

receptor:

- **The receptor generates a nerve impulse that moves along the dendrite of a sensory neuron toward the cell body and then the central nervous system.**
- **Detects stimulus (or specific stimulus mentioned).**

} **either one for
1 mark**

Note

Receives message **not** accepted.

9. Explain how each of the following structures contributes to the formation of urine.

Bowman's capsule:

(1 mark)

- **Through pressure filtration, small molecules are forced from the glomerulus into Bowman's capsule.**
- **Glomerulus filtration.**

} either one for
1 mark

proximal convoluted tubule:

(2 marks)

- **Site of selective reabsorption where nutrients, such as amino acids, salts and glucose are reabsorbed / active transport of nutrients into the peritubular capillary network (out of the tubule) occurs.**
- **Water is reabsorbed, concentrating the urine.**
- **pH adjustment of blood by movement of H^+ / HCO_3^- .**

} any two for
1 mark each

loop of Henle:

(2 marks)

- **As plasma enters the descending loop of Henle, water is reabsorbed osmotically out of the filtrate by the hypertonic salt environment in the medulla.**
- **The ascending portion of the loop of Henle is impermeable to water, but sodium ions are actively extruded to produce the hypertonic environment.**
- **There is a counter-current exchange with salt creating a hypertonic environment.**

} any two for
1 mark each

distal convoluted tubule:

(1 mark)

- **Water is reabsorbed, concentrating urine.**
- **Tubular excretion occurs where toxins, such as penicillin and ammonia, are added to the filtrate.**
- **The pH of the blood is adjusted by the movement of hydrogen and bicarbonate ions.**
- **ADH causes greater H₂O resorption.**

} any one for
1 mark

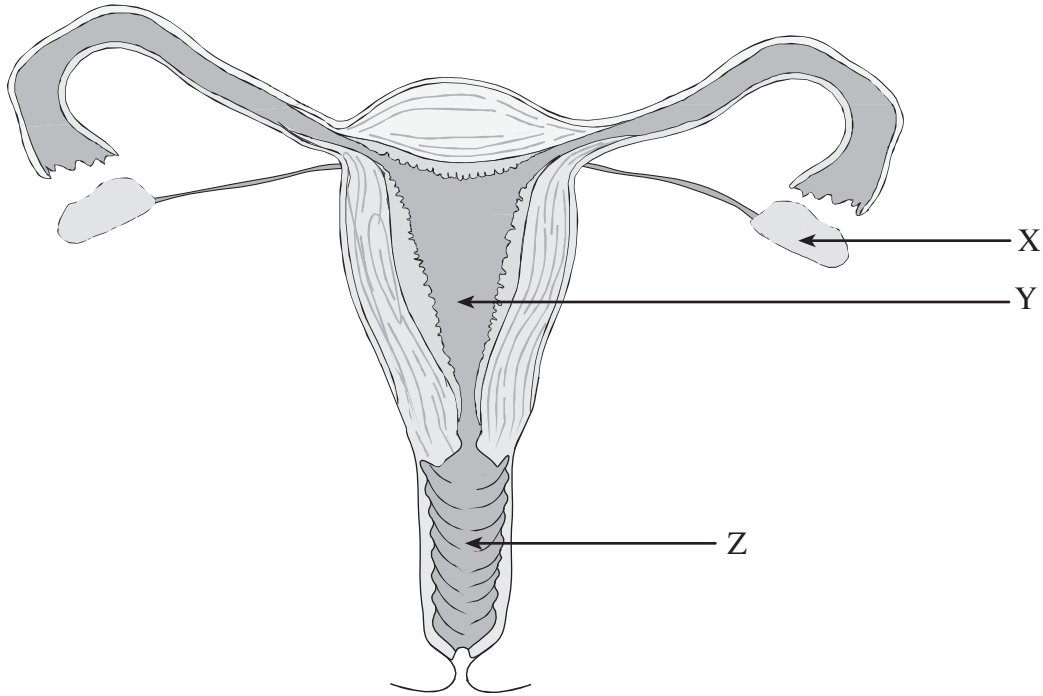
collecting duct:

(1 mark)

- **Water continues to be reabsorbed in the collecting duct to concentrate urine.**
- **The pH of the blood is adjusted by the movement of hydrogen and bicarbonate ions.**
- **ADH causes greater H₂O resorption.**

} any one for
1 mark

Use the following diagram to answer question 10.



10. Identify the following structures indicated in the diagram and give **one** function of each.
(6 marks: 1 mark each for structure; 1 mark each for function)

Structure **X**:

Name: **ovary (1 mark)**

- Function:
- **secretes estrogen**
 - **secretes progesterone**
 - **egg production and maturation**
 - **releases egg**
 - **corpus luteum development**

} **any one for
1 mark**

Structure Y:

Name: • **uterus**
• **womb** } either one for
1 mark

Function: • **contains developing fetus**
• **acts as the site of fetal development**
• **pathway for sperm**
• **contracts to expel fetus**
• **site of implantation** } any one for
1 mark

OR

Name: • **uterine wall**
• **endometrium** } either one for
1 mark

Function: • **contracts to expel fetus**
• **site of implantation** } either one for
1 mark

Structure Z:

Name: • **vagina**
• **birth canal** } either one for
1 mark

Function: • **serves as birth canal**
• **receives penis during copulation**
• **creates an acidic environment**
• **pathway for sperm** } any one for
1 mark

END OF KEY