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Biology 12

NOVEMBER 2003

Course Code = BI

Student Instructions

1. Place the stickers with your Personal Education Number (PEN) in the allotted spaces above. **Under no circumstance is your name or identification, other than your Personal Education Number, to appear on this booklet.**
2. Ensure that in addition to this examination booklet, you have an **Examination Response Form**. Follow the directions on the front of the Response Form.
3. **Disqualification** from the examination will result if you bring books, paper, notes or unauthorized electronic devices into the examination room.
4. When instructed to open this booklet, **check the numbering of the pages** to ensure that they are numbered in sequence from page one to the last page, which is identified by **END OF EXAMINATION**.
5. At the end of the examination, place your Response Form inside the front cover of this booklet and return the booklet and your Response Form to the supervisor.

Question 1:

1. .

(2)

Question 2:

2. .

(2)

Question 3:

3. .

(5)

Question 4:

4. .

(4)

Question 5:

5. .

(4)

Question 6:

6. .

(4)

Question 7:

7. .

(2)

BIOLOGY 12

NOVEMBER 2003

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GENERAL INSTRUCTIONS

1. Electronic devices, including dictionaries and pagers, are **not** permitted in the examination room.
2. All multiple-choice answers must be entered on the Response Form using an **HB pencil**. Multiple-choice answers entered in this examination booklet will **not** be marked.
3. For each of the written-response questions, write your answer in **ink** unless otherwise instructed in the space provided in this booklet.
4. Ensure that you use language and content appropriate to the purpose and audience of this examination. Failure to comply may result in your paper being awarded a zero.
5. This examination is designed to be completed in **two hours**. *Students may, however, take up to 30 minutes of additional time to finish.*

BIOLOGY 12 PROVINCIAL EXAMINATION

	Value	Suggested Time
1. This examination consists of two parts:		
PART A: 67 multiple-choice questions	67 marks	80 minutes
PART B: 7 written-response questions	23 marks	40 minutes
	Total:	
	90 marks	120 minutes

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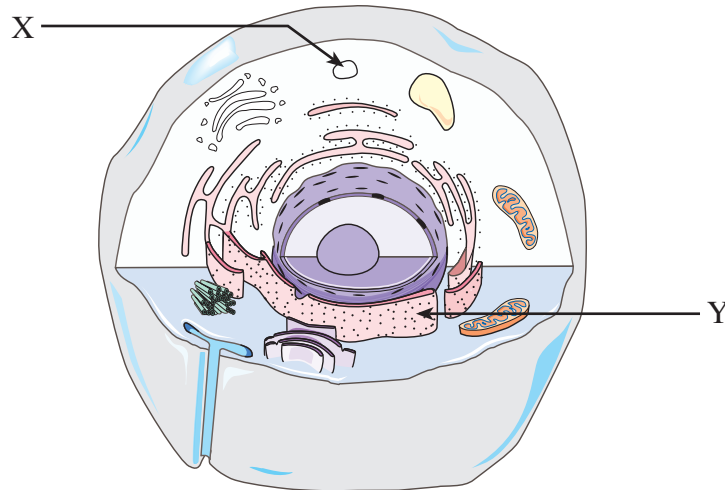
PART A: MULTIPLE CHOICE

Value: 67 marks

Suggested Time: 80 minutes

INSTRUCTIONS: For each question select the **best** answer and record your choice on the Response Form provided. Using an HB pencil, completely fill in the circle on the Response Form that has the letter corresponding to your answer.

Use the following diagram to answer questions 1 and 2.



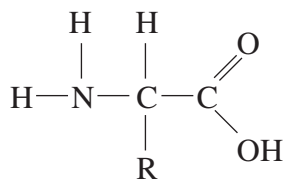
1. Which of the following best describes the function of the structure labelled X?
 - A. It produces ATP.
 - B. It produces lipids.
 - C. It produces ribosomal RNA.
 - D. It stores hydrolytic enzymes.

2. Which of the following could be produced at the structure labelled Y?
 - A. rRNA
 - B. tRNA
 - C. testosterone
 - D. hemoglobin

3. What is the function of the nucleolus?
 - A. It produces mRNA.
 - B. It produces ribosomal subunits.
 - C. It provides a site for transcription.
 - D. It provides a site for ATP production.

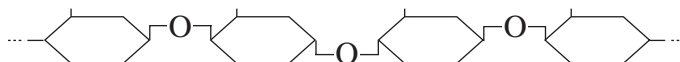
OVER

Use the following diagram to answer question 4.



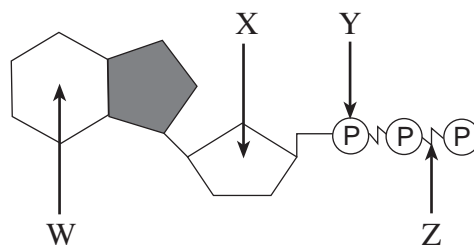
4. This unit molecule is a component of which of the following polymers?
- A. protein
 - B. fatty acid
 - C. nucleic acid
 - D. polysaccharide

Use the following diagram to answer question 5.



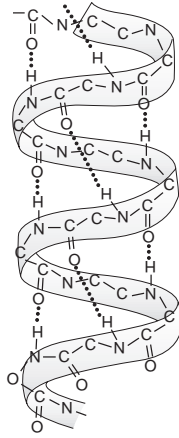
5. What is the molecule above?
- A. glucose
 - B. maltose
 - C. cellulose
 - D. glycogen

Use the following diagram to answer question 6.



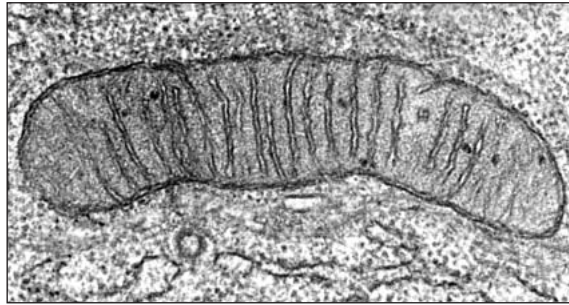
6. What part of the molecule above allows it to serve as the “energy currency” of cells?
- A. W
 - B. X
 - C. Y
 - D. Z

Use the following diagram to answer question 7.



7. What determines the level of protein structure in the molecule above?
- A. dehydration synthesis of amino acids
 - B. hydrogen bonding between amino acids
 - C. two or more polypeptides forming the molecule
 - D. covalent bonding between the R-groups of amino acids

Use the following diagram to answer question 8.



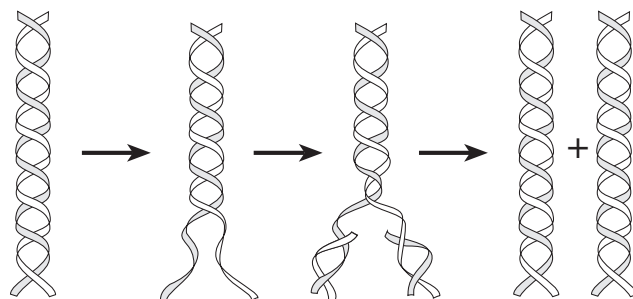
8. Which of the following molecules is a major structural component of the organelle above?
- A. starch
 - B. glucose
 - C. neutral fat
 - D. phospholipid
-

9. What property of water allows it to form hydrogen bonds?
- A. It has a neutral pH.
 - B. Its molecules are polar.
 - C. It is an excellent solvent.
 - D. Its molecules can dissociate.

OVER

10. What is the function of HCO_3^- (bicarbonate ion) when it helps to maintain the blood pH at about 7.4?
- to act as a base
 - to act as an acid
 - to buffer the blood
 - to catalyze reactions
11. During which process would adenine bond with thymine but not uracil?
- translation
 - replication
 - transcription
 - dehydration synthesis
12. Which of the following is found in RNA but **not** in DNA?
- ribose
 - adenine
 - maltose
 - phosphate
13. What is the percentage of guanine in a DNA sample containing 20% thymine?
- 10%
 - 20%
 - 30%
 - 40%

Use the following diagram to answer question 14.



14. In which organelle does the above process occur?
- nucleus
 - nucleolus
 - rough endoplasmic reticulum
 - smooth endoplasmic reticulum

15. Consider the following portion of an mRNA strand:

UAC GGG AUA

What are the anticodons that will be paired to this strand?

- A. ATG CCC TAT
- B. ATA GGG TAC
- C. AUG CCC UAU
- D. UAC GGG AUA

16. During transcription, hydrogen bonds form between which of the following?

- A. amino acid pairs
- B. mRNA and DNA
- C. mRNA and ribosomes
- D. sugar and phosphate molecules

17. Which of the following describes the fluid-mosaic model of a cell membrane?

- A. phospholipids floating in a layer of glycoproteins
- B. cholesterol embedded between a double layer of protein
- C. a layer of protein molecules between two layers of cellulose
- D. protein molecules embedded in a double layer of phospholipids

18. Which of the following is an example of osmosis?

- A. the absorption of water by the large intestine
- B. the absorption of amino acids by the small intestine
- C. the movement of carbon dioxide into the blood from the tissues
- D. the movement of fluids from the glomerulus to Bowman's capsule

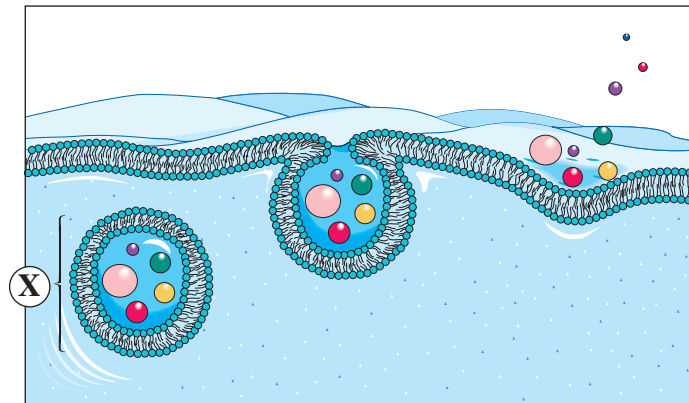
19. Which of the following processes results in the production of ADP and phosphate?

- A. the absorption of water by the large intestine
- B. the absorption of oxygen into the blood by the alveoli
- C. the movement of carbon dioxide from the tissues to the blood
- D. the re-absorption of glucose by the proximal convoluted tubule

OVER

20. What process allows chloride ions to move into a cell without the use of energy?
- A. osmosis
 - B. endocytosis
 - C. active transport
 - D. facilitated transport

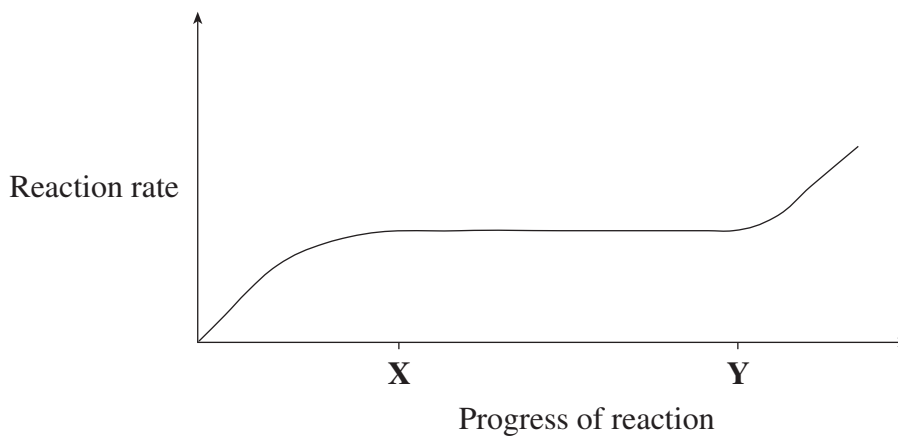
Use the following diagram to answer question 21.



21. What is the structure labelled **X**?
- A. a vesicle
 - B. a glycoprotein
 - C. a phospholipid
 - D. a channel protein
-
22. What occurs when a cell is placed in a solution that has a higher concentration of solute than its cytoplasm?
- A. The volume of the cell increases.
 - B. More solute diffuses out of the cell.
 - C. More water leaves the cell than enters the cell.
 - D. The concentration of solute in the cell decreases.
23. How do enzymes increase the rate of a reaction?
- A. They produce energy.
 - B. They become denatured.
 - C. They produce coenzymes.
 - D. They decrease the energy of activation.

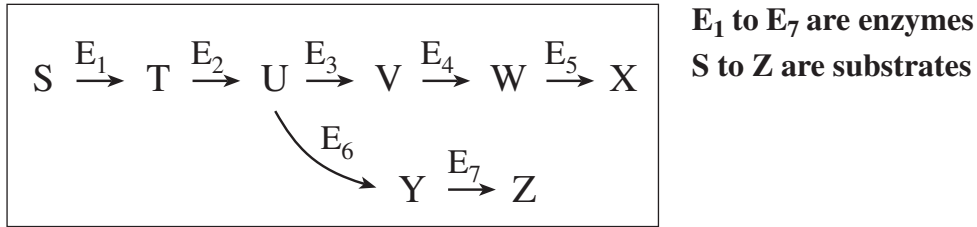
24. Why does maltase hydrolyze maltose but not starch?
- Maltose is a vitamin.
 - Starch denatures the tertiary structure of maltase.
 - The active site of maltase is complementary to maltose.
 - Maltose provides activation energy and starch does not.
25. How are coenzymes involved in enzymatic reactions?
- They provide atoms for the reaction.
 - They increase enzyme concentration.
 - They provide energy for the reaction.
 - They increase substrate concentration.
26. What is the function of thyroxin?
- to cause ovulation
 - to increase metabolic rate
 - to decrease the rate of digestion
 - to control the concentration of sodium ions in the blood

Use the following graph to answer question 27.



27. The graph shows changes in the reaction rate of an enzyme-catalyzed reaction. What accounts for the shape of the graph between X and Y?
- There is not enough substrate.
 - All the active sites are occupied.
 - More coenzyme has been added.
 - Heavy metal ions have been added.

Use the following diagram to answer question 28.



28. In an experiment, substrate **S** was added to a beaker containing equal amounts of enzymes **E₁** to **E₇**. The metabolic pathway in the diagram shows the reactions that occurred. After 15 minutes a competitive inhibitor for **E₃** is added to the beaker and the reactions continue to completion. What would occur?

- A. The rate of production of **T** would increase.
 - B. The rate of production of **Z** would increase.
 - C. The rate of production of **X** would increase.
 - D. The rate of production of **E₄** would decrease.
-

29. What two structures produce chemicals that digest proteins?

- A. the liver and the pancreas
- B. the salivary and intestinal glands
- C. the gastric glands and the pancreas
- D. the gastric glands and the gall bladder

Use the following list to answer question 30.

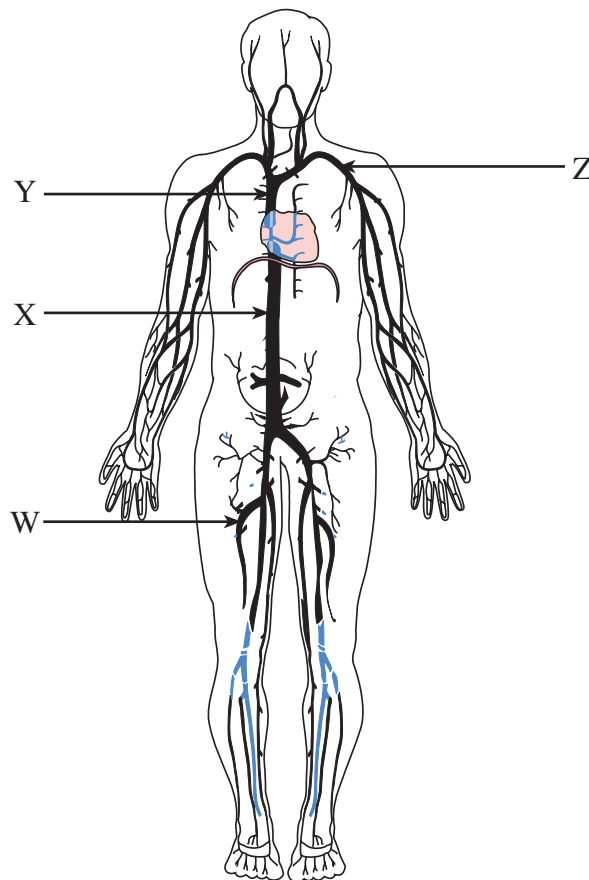
- emulsification by bile
- chewing in the mouth
- churning in the stomach
- nucleic acid digestion by nuclease
- production of vitamins by bacteria

30. How many of the above are examples of physical digestion?

- A. 2
- B. 3
- C. 4
- D. 5

31. Which of the following is **not** produced in the liver?
- A. bile
 - B. urea
 - C. lipase
 - D. glycogen
32. When the liver is unable to break down red blood cells, which of the following would be produced in decreased amounts?
- A. maltose
 - B. peptides
 - C. fat droplets
 - D. nucleotides

Use the following diagram to answer question 33.

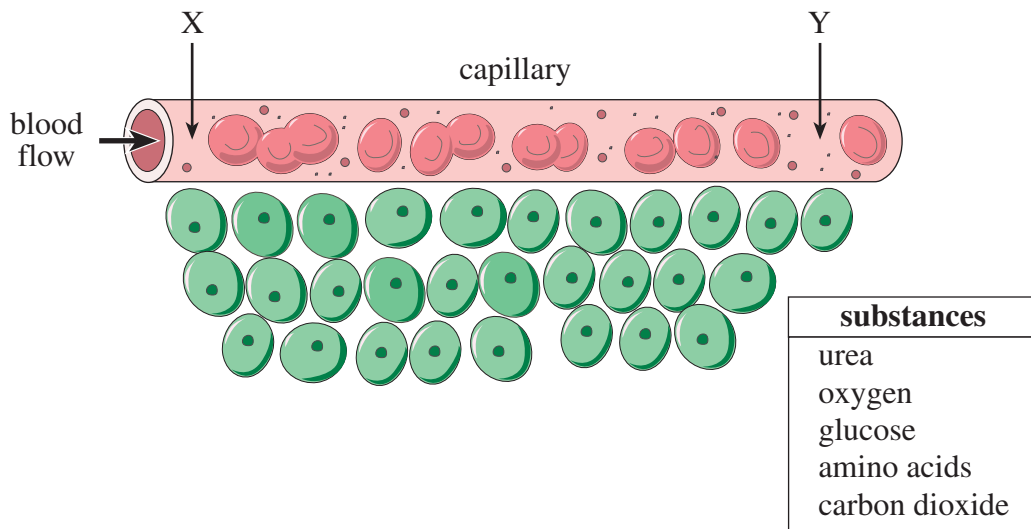


33. Which of the labelled structures is the anterior vena cava?
- A. W
 - B. X
 - C. Y
 - D. Z

OVER

34. What blood vessel supplies blood directly to the heart muscle?
- the aorta
 - the carotid artery
 - the coronary artery
 - the pulmonary artery
35. Where does lymphatic fluid enter the bloodstream?
- the aorta
 - the jugular vein
 - the subclavian vein
 - the pulmonary vein
36. Which vessel contains blood with the lowest concentration of dissolved carbon dioxide?
- the aorta
 - the carotid artery
 - the pulmonary vein
 - the inferior vena cava

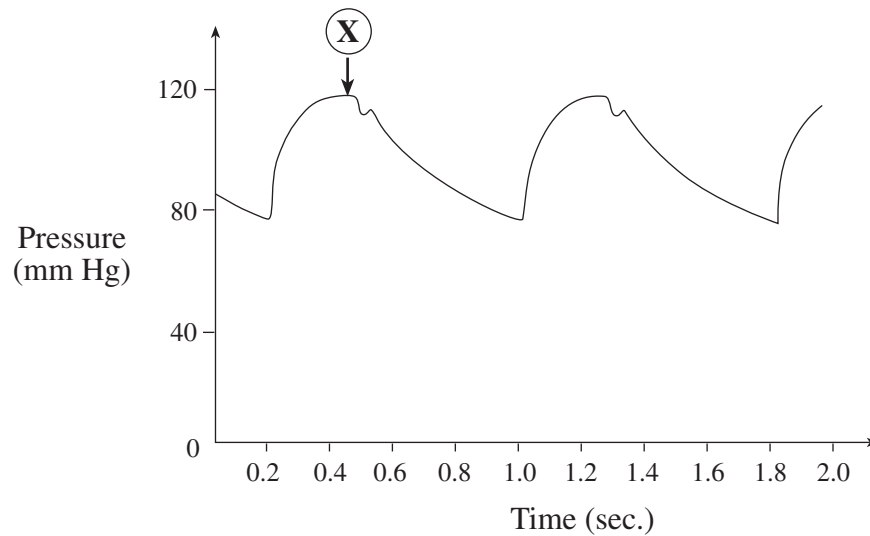
Use the following diagram and list of substances to answer question 37.



37. How many of the substances would be found in relatively higher concentrations at point **Y** when compared to point **X**?
- 1
 - 2
 - 3
 - 4

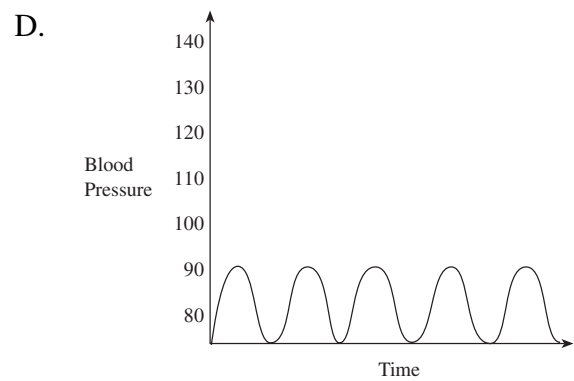
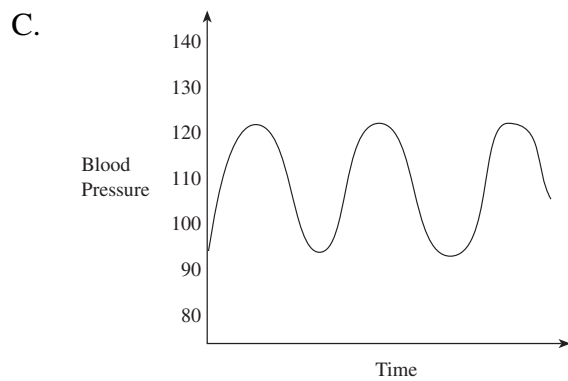
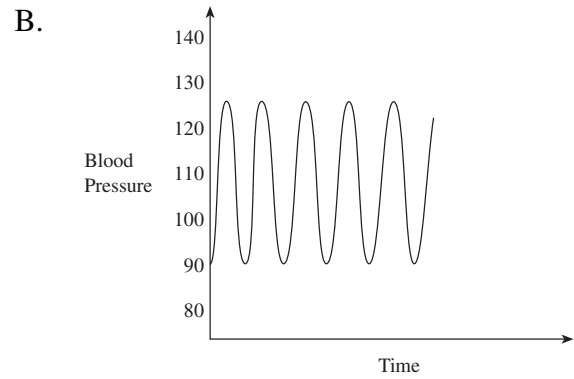
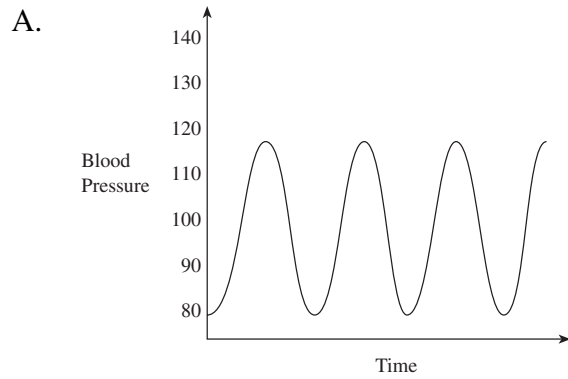
38. What structure does blood flow through immediately after leaving the right ventricle?
- A. the aorta
 - B. the AV valve
 - C. the pulmonary vein
 - D. the pulmonary trunk

Use the following graph to answer question 39.



39. What accounts for the blood pressure recorded at **X**?
- A. The AV valves are opening.
 - B. The ventricles are in diastole.
 - C. The ventricles are contracting.
 - D. Blood is entering the ventricles.

40. Which of the following graphs illustrates how blood pressure changes during sympathetic nervous system stimulation?



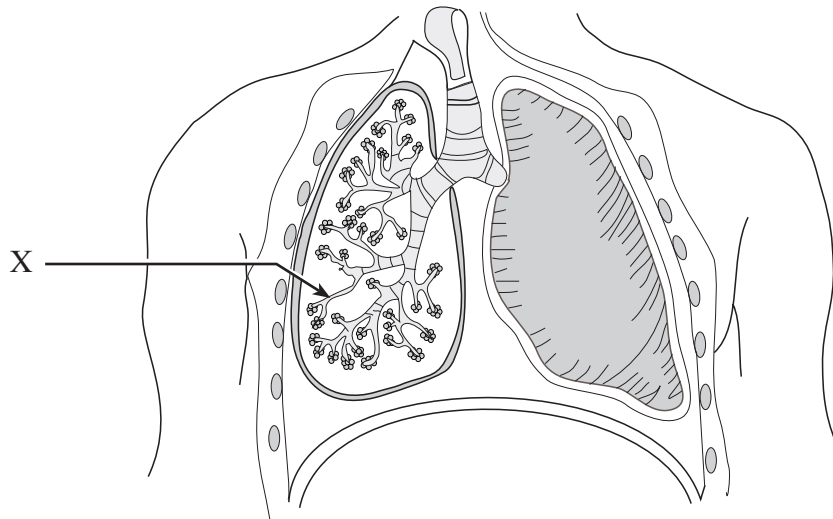
Use the following list to answer question 41.

1. atria contract
2. Purkinje fibres conduct
3. SA node stimulates
4. AV node stimulates
5. ventricles contract

41. Which of the following describes a correct sequence?

- A. 1 → 4 → 2 → 5
- B. 2 → 5 → 4 → 1
- C. 3 → 5 → 4 → 1
- D. 4 → 1 → 2 → 5

Use the following diagram to answer question 42.



42. What is the structure labelled **X**?

- A. the trachea
 - B. a bronchus
 - C. the pharynx
 - D. a bronchiole
-

43. Which of the following directs mucus towards the pharynx?

- A. cilia in the trachea
- B. cartilage in the bronchi
- C. elastic fibres in the larynx
- D. lipoprotein layer in the alveoli

OVER

Use the following list to answer question 44.

- Air rushes into the lungs.
- The rib cage moves up and out.
- The thoracic cavity increases in volume.
- The diaphragm becomes dome shaped.
- Pressure in the thoracic cavity decreases.

44. How many of the events listed occur during inhalation?

- A. 2
 - B. 3
 - C. 4
 - D. 5
-

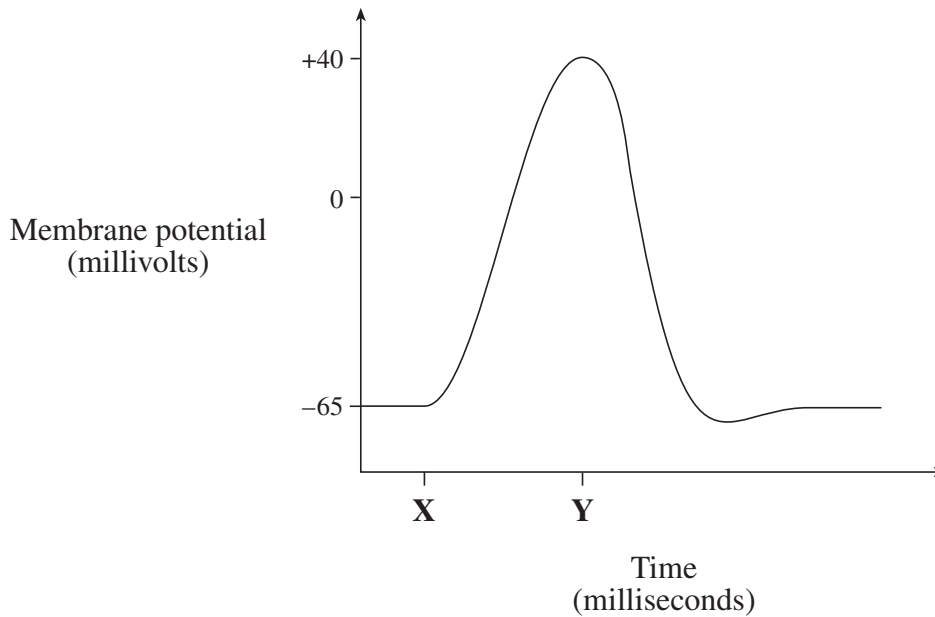
45. Which reaction occurs at the pulmonary capillaries and alveoli?

- A. $\text{H}^+ + \text{Hb} \rightarrow \text{HHb}$
- B. $\text{HbO}_2 \rightarrow \text{O}_2 + \text{Hb}$
- C. $\text{CO}_2 + \text{Hb} \rightarrow \text{HbCO}_2$
- D. $\text{H}^+ + \text{HCO}_3^- \rightarrow \text{CO}_2 + \text{H}_2\text{O}$

46. Which of the following structures is found only in the central nervous system?

- A. the axon of an interneuron
- B. the axon of a motor neuron
- C. the dendrite of a sensory neuron
- D. the cell body of a sensory neuron

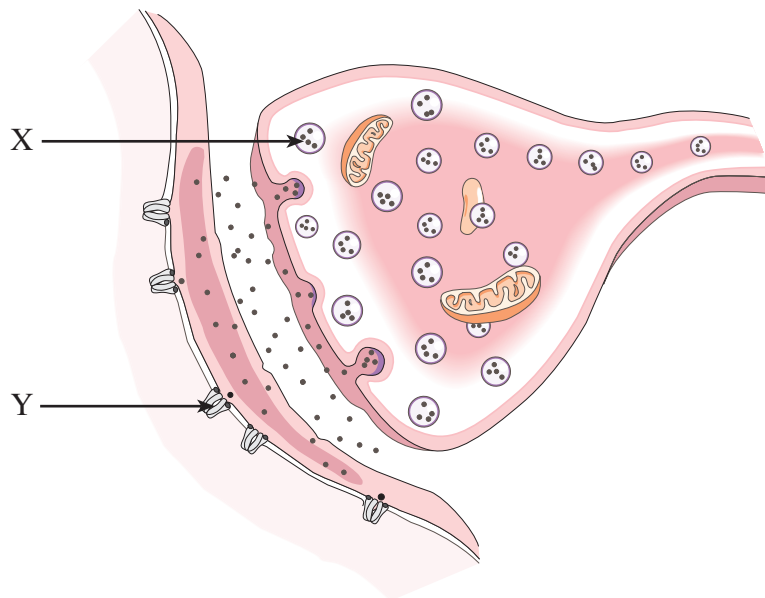
Use the following graph to answer question 47.



47. Which of the following occurs between time X and time Y?
- A. repolarization
 - B. depolarization
 - C. resting potential
 - D. refractory period
-
48. What does the term “threshold” refer to during synaptic transmission?
- A. the number of impulses in a given unit of time
 - B. the amount of stimulus required to cause depolarization
 - C. the maximum number of sodium ions that can exit the axon
 - D. the maximum time neurotransmitters spend in the synaptic cleft
49. What process ensures that a greater concentration of sodium ions is maintained outside the axon relative to the inside of the axon?
- A. diffusion through sodium channels
 - B. transport by carriers and the use of ATP
 - C. exocytosis due to infolding of the membrane
 - D. facilitated transport by sodium-potassium carriers

50. What structure insulates nerve fibres and speeds up the conduction of a nerve impulse?
- A. the cell body
 - B. the dendrites
 - C. the myelin sheath
 - D. the nodes of Ranvier

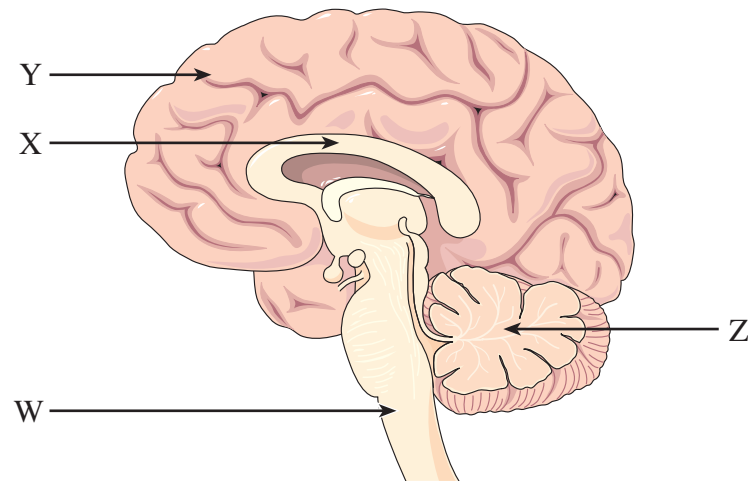
Use the following diagram to answer questions 51 and 52.



51. What is the function of the structure labelled X?
- A. It produces ATP.
 - B. It produces thyroxin.
 - C. It carries sodium and potassium ions to the receptors.
 - D. It carries neurotransmitters to the presynaptic membrane.
52. What does structure Y represent?
- A. a sodium-potassium pump at an axon
 - B. a receptor on a postsynaptic membrane
 - C. a binding site for neurotransmitters on an axon
 - D. an attachment site for calcium ions at a dendrite

53. The autonomic nervous system includes
- A. the brain and spinal cord.
 - B. the somatic nervous system.
 - C. the cerebellum and the medulla oblongata.
 - D. the sympathetic and parasympathetic divisions.

Use the following diagram to answer questions 54 and 55.

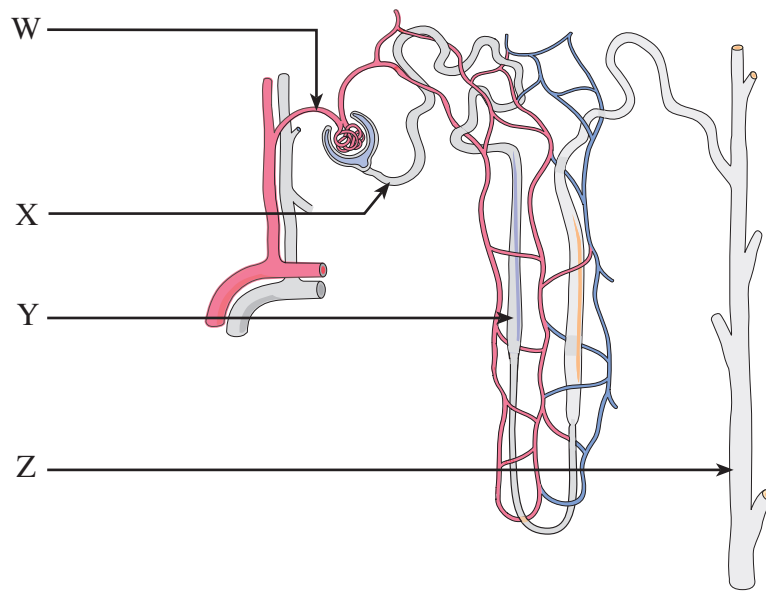


54. Reflex actions, such as sneezing and vomiting, are controlled by which labelled region?
- A. W
 - B. X
 - C. Y
 - D. Z
55. Which labelled region is responsible for fine motor co-ordination and balance?
- A. W
 - B. X
 - C. Y
 - D. Z

56. Where is the loop of Henle located?

- A. in the renal cortex
- B. in the renal medulla
- C. in the collecting duct
- D. in the Bowman's capsule

Use the following diagram to answer questions 57 and 58.



57. At which labelled point would the concentration of glucose in the filtrate be highest?

- A. W
- B. X
- C. Y
- D. Z

58. Which labelled structure is affected by antidiuretic hormone (ADH)?

- A. W
- B. X
- C. Y
- D. Z

59. Which of the following correctly compares the relative concentrations of the given substances in the loop of Henle and the collecting duct?

	Loop of Henle		Collecting duct	
	Amino acids	Histamine	Amino acids	Histamine
A.	low	low	low	high
B.	high	low	low	high
C.	high	high	low	low
D.	low	high	high	low

60. Where do large amounts of Na^+ and Cl^- enter into the renal medulla?

- A. at the loop of Henle
- B. at the collecting duct
- C. at the Bowman's capsule
- D. at the proximal convoluted tubule

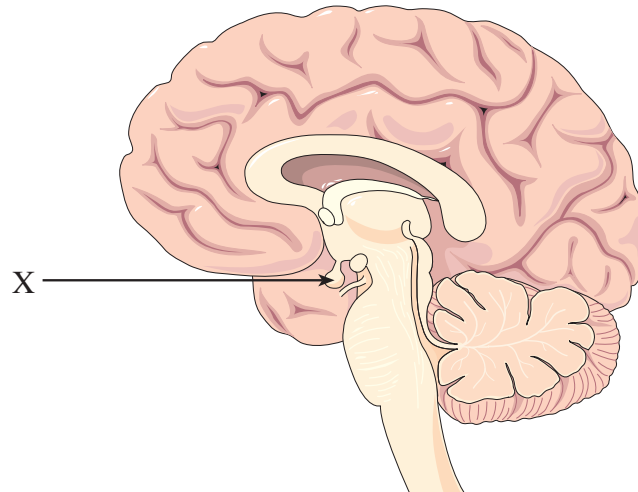
61. What structure transfers sperm to the female?

- A. penis
- B. testes
- C. prostate
- D. epididymis

62. What substance causes the secretion of both testosterone and progesterone?

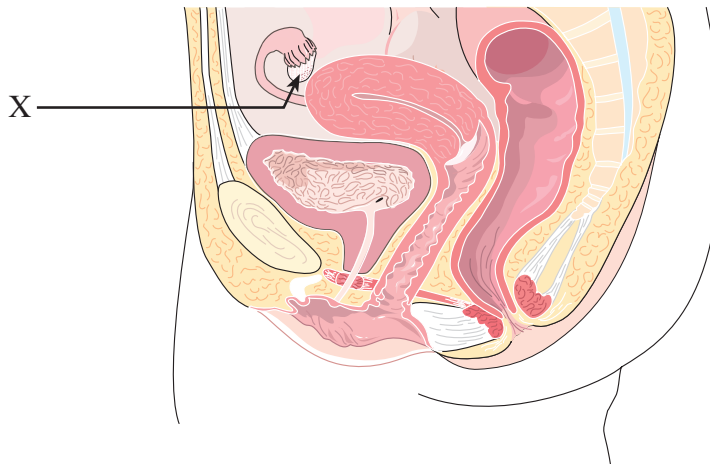
- A. luteinizing hormone
- B. antidiuretic hormone
- C. follicle-stimulating hormone
- D. human chorionic gonadotropic hormone

Use the following diagram to answer question 63.



63. What is the effect of secretions produced by structure **X** during days 15 to 28 of the uterine cycle?
- A. The endometrium disintegrates and blood vessels rupture.
 - B. The follicle matures producing large amounts of estrogen.
 - C. A sudden rise in luteinizing hormone causes the follicle to release an egg.
 - D. Increased amounts of progesterone are produced causing the endometrium to become secretory.

Use the following diagram to answer question 64.



64. What do secretions from the structure labelled **X** cause?
- A. menstruation and follicle maturation
 - B. ovulation and genital growth at puberty
 - C. thickening of the endometrium and breast development
 - D. development of the corpus luteum and contraction of the uterus

65. What are days 5 to 13 of the uterine cycle called?
- A. the luteal phase
 - B. the follicular phase
 - C. the secretory phase
 - D. the proliferation phase
66. What is an effect of oxytocin?
- A. release of an egg
 - B. development of breasts
 - C. loss of the endometrium
 - D. contraction of the uterus
67. What is a function of estrogen on the female reproductive system?
- A. rupturing of the follicle
 - B. thickening of the uterine lining
 - C. maturation of the corpus luteum
 - D. degeneration of the endometrium

This is the end of the multiple-choice section.
Answer the remaining questions directly in this examination booklet.

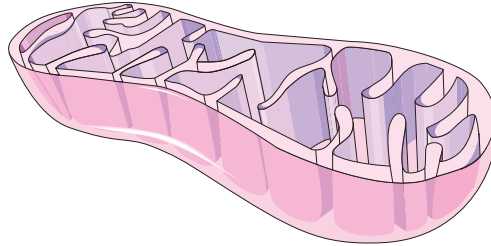
PART B: WRITTEN RESPONSE

Value: 23 marks

Suggested Time: 40 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. You may not need all of the space provided to answer each question.

Use the following diagram to answer question 1.



1. Name the product of this organelle that is required in the transport of materials across a cell membrane. Explain the product's role in this process. **(2 marks)**

product: _____

explanation: _____

Use the following chart of mRNA codons to answer question 2.

Three-letter codons of messenger RNA and the amino acids specified by the codons			
AAU } Asparagine AAC }	CAU } Histidine CAC }	GAU } Asparatic acid GAC }	UAU } Tyrosine UAC }
AAA } Lysine AAG }	CAA } Glutamine CAG }	GAA } Glutamate GAG }	UAA } Stop UAG }
ACU } ACC } Threonine ACA } ACG }	CCU } CCC } Proline CCA } CCG }	GCU } GCC } Alanine GCA } GCG }	UCU } UCC } Serine UCA } UCG }
AGU } Serine AGC }	CGU } CGC } Arginine CGA } CGG }	GGU } GGC } Glycine GGA } GGG }	UGU } Cysteine UGC }
AUU } AUC } Isoleucine AUA }	CUU } CUC } Leucine CUA } CUG }	GUU } GUC } Valine GUA } GUG }	UUU } Phenylalanine UUC }
AUG – Methionine			UUA } Leucine UUG }

2. Consider the following DNA base sequence read from left to right:

C C A G G A A T A C C T

Determine the amino acid sequence that results from this DNA strand.

(2 marks)

3. The following procedure demonstrates the effect of pH on the activity of the enzyme trypsin.

- 10 ml of a protein solution is added to each of five numbered test tubes, each of which is buffered at a different pH.
- The pH of each of the test tubes is maintained.
- An equal amount of a trypsin solution is added to each test tube.
- The temperature is maintained at 37°C.
- Each test tube is analyzed after three hours.

The results are recorded in the table below:

Test Tube	pH	Amount of product (g)
1	2.0	0.3
2	3.5	0.8
3	7.0	1.7
4	8.5	3.5
5	10.0	2.1

a) Use the data from the table to produce a line graph which illustrates the “Amount of product vs. pH” (plot the pH on the *x*-axis).

(2 marks)



b) Name the chemical product found in each test tube. **(1 mark)**

c) Explain why less product is found in test tubes **1** and **2** than in the others. **(1 mark)**

d) Name an enzyme that could further digest the product found in each of the test tubes. **(1 mark)**

4. Compare the chemical composition of the blood in the right atrium of a fetus to the blood in the right atrium of an adult. Give reasons for these differences. **(4 marks: 2 marks for the comparisons; 2 marks for the reasons)**

5. Describe the process of exhalation. **(4 marks)**

6. Many substances are moved by active transport in the nephron. Using **four** examples, explain how active transport is involved in urine production. **(4 marks)**

7. Describe how the hypothalamus increases testosterone levels in the blood. **(2 marks)**

END OF EXAMINATION