

**BIOLOGY 12**

**EXAMINATION  
SPECIFICATIONS**

**SEPTEMBER 2004**

Assessment Department

The information in this booklet is intended to be helpful for both teachers and students.  
Teachers are encouraged to make this information available to all students.

# BIOLOGY 12

The intent of the *Examination Specifications* is to convey to the classroom teacher and student how the Biology 12 curriculum will be tested on the provincial examinations. The Table of Specifications provides percentage weightings for each of the curriculum organizers as well as the cognitive levels that are applied to questions. A detailed description of examinable material within each curriculum organizer will be found in the curriculum section of the *Biology 11 and 12 Integrated Resource Package (IRP), 1996* and in Appendix A of that package.

## Replaces All Previous Versions of Biology 12 Examination Specifications

1. The Biology 12 Provincial Examinations conform to the curriculum organizers of the *Biology 11 and 12 Integrated Resource Package, 1996*. Teachers should thoroughly familiarize themselves with the contents of this package.
2. As outlined in the Introduction of the IRP, an understanding of how the diverse body systems are integrated to maintain homeostasis is a fundamental part of Biology 12.
3. The prescribed learning outcomes O4 and O5 assume an understanding of negative feedback.
4. The following prescribed learning outcomes will **not** be assessed on the provincial examinations:
  - F1–5 cancer
  - I8 demonstrate the correct use of the dissection microscope
  - J3 demonstrate safe and correct dissection techniques
  - J10 demonstrate the correct use of the compound microscope
  - K5 demonstrate the measurement of blood pressure.
5. Electronic devices, including dictionaries and pagers, are **not** permitted in the examination room.

It is expected that there will be a difference between school marks and provincial examination marks for individual students. Some students perform better on classroom tests and others on provincial examinations. School assessment measures performance on all curricular outcomes, whereas provincial examinations may only evaluate performance on a sample of these outcomes.

The provincial examination represents 40% of the student's final letter grade and the classroom mark represents 60%.

## Acknowledgement

**The Assessment Department wishes to acknowledge the contribution of British Columbia teachers in the preparation and review of this document.**

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# BIOLOGY 12

## DESCRIPTION OF THE PROVINCIAL EXAMINATION

The Table of Specifications (page 2) outlines the curriculum organizers, sub-organizers, and the cognitive level emphases covered on the provincial examination. A detailed description of examinable material within each curriculum organizer may be found in the *Biology 11 and 12 Integrated Resource Package, 1996*.

The provincial examination is divided into **two** parts:

PART A: **Multiple-choice** questions worth **75%** of the examination (67 marks).

PART B: **Written-response** questions worth **25%** of the examination (23 marks).

The **number** of written-response questions may vary from one examination to the next depending on the value of each question; however, the total **marks** for the written-response section will remain the same.

Where appropriate, answers or part-answers, may be presented in point-form. Half marks may be awarded in the marking of written-response questions.

The time allowed for the provincial examination is **two hours**. *Students may, however, take up to 30 minutes of additional time to finish.*

## BIOLOGY 12

### TABLE OF SPECIFICATIONS FOR THE PROVINCIAL EXAMINATION

CURRICULUM		COGNITIVE LEVEL			TOTAL MARKS
ORGANIZERS	SUB-ORGANIZERS	Knowledge	Understanding and Application	Higher Mental Processes	
<b>Cell Biology</b>	A Cell Structure	←———— 5 —————→			16
	B/C Cell Compounds / Biological Molecules	←———— 7 —————→			
	D DNA	←———— 4 —————→			
<b>Cell Processes and Applications</b>	E Protein Synthesis	←———— 4 —————→			16
	F Cancer	←———— 0 —————→			
	G Transport Across Cell Membrane	←———— 6 —————→			
	H Enzymes	←———— 6 —————→			
<b>Human Biology</b>	I Digestive System	←———— 9 —————→			58
	J/K Circulatory System: Circulation and Blood / Heart Structure and Function	←———— 13 —————→			
	L Respiratory System	←———— 7 —————→			
	M/N Nervous System: Neuron, Impulse Generation and Reflex Arc / Divisions of the Nervous System and the Brain	←———— 10 —————→			
	O Urinary System	←———— 9 —————→			
	P Reproductive System	←———— 10 —————→			
<b>TOTAL</b>		20	52	18	90

The values shown in this table are approximate and may fluctuate.

Examination configuration: 67 marks in multiple-choice format

23 marks in written-response format

## DESCRIPTION OF COGNITIVE LEVELS

*The following three cognitive levels are based on a modified version of Bloom's taxonomy (Taxonomy of Educational Objectives, Bloom et al., 1956). Bloom's taxonomy describes six cognitive categories: Knowledge, Comprehension, Application, Analysis, Synthesis, and Evaluation. For ease of classification, the six cognitive categories have been collapsed into three.*

### **Knowledge**

*Knowledge* is defined as including those behaviours and test situations that emphasize the remembering, either by recognition or recall, of ideas, material, or phenomena. Incorporated at this level is knowledge of terminology, specific facts (dates, events, persons, etc.), conventions, classifications and categories, criteria, methods of inquiry, principles and generalizations, theories and structures.

### **Understanding and Application**

*Understanding* refers to responses that represent a comprehension of the literal message contained in a communication. This means that the student is able to interpret or extrapolate. Interpretation involves the reordering of ideas (inferences, generalizations, or summaries). Extrapolation includes estimating or predicting based on an understanding of trends or tendencies.

*Application* requires the student to apply an appropriate abstraction (theory, principle, idea, method) to a new situation.

### **Higher Mental Processes**

Included at this thought level are the processes of analysis, synthesis, and evaluation.

*Analysis* involves the ability to recognize unstated assumptions, to distinguish facts from hypotheses, to distinguish conclusions from statements that support them, to recognize which facts or assumptions are essential to a main thesis or to the argument in support of that thesis, and to distinguish cause-effect relationships from other sequential relationships.

*Synthesis* involves the production of a unique communication, the ability to propose ways of testing hypotheses, the ability to design an experiment, the ability to formulate and modify hypotheses, and the ability to make generalizations.

*Evaluation* is defined as the making of judgments about the value of ideas, solutions, and methods. It involves the use of criteria as well as standards for appraising the extent to which details are accurate, effective, economical, or satisfying. Evaluation involves the ability to apply given criteria to judgments of work done, to indicate logical fallacies in arguments, and to compare major theories and generalizations.

Questions at the *higher mental processes* level subsume both *knowledge* and *understanding and application* levels.

## TERMINOLOGY

The following is a list of terms which may be used in the construction of items for the Biology 12 examinations in order to increase clarity and brevity. While the terms are not specifically stated in the Prescribed Learning Outcomes, they are considered central to both the instruction and examination of Biology 12.

### Biological Molecules

ADP	hydrolysis	phosphate
covalent bond	ion	polar molecule
dehydration synthesis	ionic bond	polymer
deoxyribose	maltose	peptide bond
dipeptide	monomer	polypeptide
fats	nitrogenous base	specific heat capacity
glycerol	oils	

*In addition, students will be expected to be able to recognize, but not draw, the following structural diagrams:*

ATP	hemoglobin	polysaccharide
DNA	monosaccharide	ribose
disaccharide	neutral fat	RNA
glucose	phospholipid	steroids

### Cell Structure and Function

cell wall	cytoplasm	polysome
cellular respiration	flagella	secretion
chloroplasts	nuclear membrane	
chromatin	nuclear pores	

### Cell Membrane Function

bilayer	hydrophilic	plasmolysis
concentration gradient	hydrophobic	solute
crenation	lysis	solvent
facilitated diffusion	permeable	tonicity
glycolipids	plasma membrane	turgor
glycoproteins	osmotic pressure	

## **Experimental Design**

conclusion	experimental group	sample size
control	hypothesis	theory
control group	independent variable	validity
dependent variable	procedure	
experiment	reliability	

## **DNA and Protein Synthesis**

adenine	gene mutation	sugar-phosphate backbone
anticodon	genetic code	template
carcinogen	guanine	termination
chromosome mutation	initiation	thymine
cytosine	radiation	uracil
deoxyribose	semiconservative replication	virus
elongation	start / stop codons	X ray

## **Human Biology**

endocrine gland	homeostatic mechanism	tissue
homeostasis	negative feedback	tissue fluid

## **Digestion**

chemical digestion	lacteal	pepsinogen
digestive tract	microvilli	physical digestion
hydrochloric acid	mucus	surface area
hydrolytic enzymes		

## **Blood and Circulation**

albumin	elastic fibres	net pressure
arterial	fibrin	pacemaker
capillary bed	formed elements	pulse
cardiac cycle	globulin	stem cell
cardiac output	lymph	systole
cross-sectional area	lymphocytes	thoracic
diastole	macrophage	venous

## Respiration

aortic bodies  
carbonic anhydrase  
carotid bodies  
expiration

inspiration  
intercostal (rib) muscles  
internal / external respiration  
equations

nasal cavity  
respiratory centre  
stretch receptors

## Excretion

antidiuretic  
diuretic  
excretion

metabolic waste  
nitrogenous wastes  
osmotic gradient

reabsorption  
tubular excretion

## Nervous System

acetylcholine  
acetylcholinesterase  
axomembrane  
contractile proteins  
cranial nerves  
dorsal-root ganglion  
downswing

excitatory neurotransmitters  
inhibitory neurotransmitters  
integration  
meninges  
nodes of Ranvier  
noradrenalin  
polarity

refractory period  
saltatory transmission  
Schwann cells  
spinal nerves  
synaptic ending  
threshold value  
upswing

## Reproduction

ejaculation  
endometrium  
erectile tissue  
follicle-stimulating  
hormone (FSH)  
follicular phase  
gonadotropic releasing  
hormone (GnRH)

human chorionic  
gonadotropin (HCG)  
luteal phase  
luteinizing hormone (LH)  
menstruation  
oögenesis  
ovulation  
progesterone

proliferative phase  
prostaglandins  
scrotum  
secretory phase  
spermatogenesis

## System-related Words

cardiac  
cerebral  
endocrine  
gastric

hepatic  
neural  
pulmonary  
renal

respiratory  
vascular

## Process Words

compare (similarities and  
differences)  
contrast (differences only)

explain  
facilitate (help)  
describe

relative (relatively high  
or low)

## EXPERIMENTAL DESIGN QUESTION FOR THE 2004/05 SCHOOL YEAR

Past provincial examinations have included items which require students to “collect, display and interpret data,” (learning outcome G7). Learning outcome H7, “devise an experiment using the scientific method,” has not yet been examined. Beginning in the **2004/05 school year**, students should expect to be examined on this topic.

The K–12 Science Curriculum implicitly assumes that most modern scientific knowledge has been obtained through empirical experimentation. The scientific method assumes the following sequential steps:

1. Observing natural phenomena which leads to the clear statement of a question.
2. Researching information related to the question.
3. Using knowledge, experience, insight and imagination to formulate a hypothesis to serve a testable answer to the question.
4. Designing and carrying out a controlled, repeatable experiment to test the hypothesis.
5. Determining whether the data obtained support or reject the hypothesis.
6. Reporting the results to others.

In order to demonstrate comprehension of learning outcome H7, students should be able to:

1. Indicate how the above steps are applied to a scientific inquiry.
2. Design a controlled experiment where:
  - a hypothesis is produced (given a question)
  - procedures are implemented to test the hypothesis
  - a control is included which will serve as a known comparison to the resulting data.

Students should expect that this learning outcome may be applied to any of the concepts covered in the Biology 12 curriculum.

The following item (and key) is an example of a possible examination question based on this learning outcome. This item is worth **7 marks**, covers curricular areas H6 / H7 / I2 / I4, and is an “understanding” level question.

1. a) State a hypothesis which could be used to design an experiment determining the effect of pH on the function of the digestive enzyme trypsin. **(1 mark)**

**Response:**

- **Trypsin is more effective at hydrolyzing protein at a pH of 9.0 than at other pH levels. (1 mark)**

b) Using any of the materials listed below, design an experimental procedure which could be used to test the hypothesis. **(3 marks)**

- A bottle containing trypsin solution.
- Five bottles, each containing solutions buffered to maintain the following pH levels (pH 3, 5, 7, 9 and 11).
- A bottle containing a protein solution of a known concentration.
- Test tubes and test tube rack.
- A device capable of measuring the concentration of protein in a solution.
- A water bath capable of maintaining the bottles at a constant temperature.

**Response:**

- **Fill five of the test tubes with equal amounts of protein solution and trypsin.**
- **Add one of the five buffered solutions to each of the test tubes.**
- **Maintain the test tubes at 37°C for one hour (times may vary).**
- **Measure the resulting concentration of protein in each of the tubes.**

c) What could be used as a control for this experiment? **(1 mark)**

**Response:**

- **Test a second set of test tubes with protein and pH solutions but without trypsin. (1 mark)**

d) What is the purpose of the control? **(1 mark)**

**Response:**

- **To make sure that no other variables are causing the digestion of the protein. (1 mark)**

e) What new substances will be found in the test tubes? **(1 mark)**

**Response:**

- **peptide molecules (1 mark)**

## SAMPLE QUESTIONS

### A: Cell Structure

#### *Knowledge*

1. What are chromosomes composed of?

- A. tRNA and DNA
- B. tRNA and lipids
- \* C. DNA and proteins
- D. RNA and ribosomes

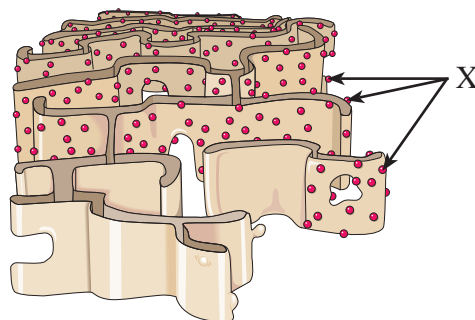
#### *Understanding*

2. How do the inner membrane of the mitochondria and the nuclear envelope differ?

- A. The nuclear envelope has pores and the mitochondrial membrane does not.
- B. The mitochondrial membrane is not permeable and the nuclear envelope is.
- \* C. The mitochondrial membrane has many folds and the nuclear envelope does not.
- D. The nuclear envelope has two phospholipid layers and the mitochondrial membrane does not.

#### *Higher Mental Processes*

Use the following diagram to answer question 3.



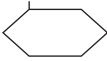
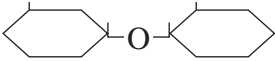
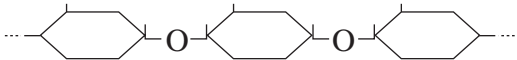
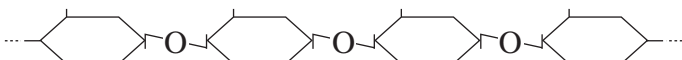
3. What produces the molecules of which structure **X** is composed?

- A. nucleus
- B. vesicles
- \* C. nucleolus
- D. lysosomes

## B / C: Cell Compounds / Biological Molecules

### Understanding

4. Which of the following diagrams represents glucose?

- \* A. 
- B. 
- C. 
- D. 

### Higher Mental Processes

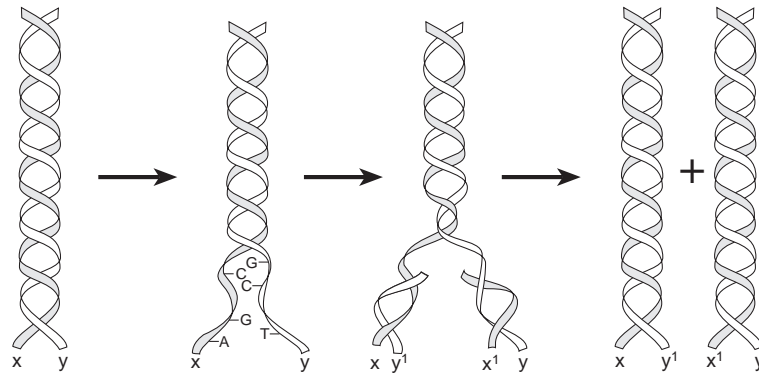
5. Why do neutral fats **not** dissolve in water?

- A. Water is non-polar.
- \* B. Water is polar and neutral fats are non-polar.
- C. Neutral fats are polar and form hydrogen bonds with water.
- D. Neutral fats break down into ions when combined with water.

## D: DNA

### Understanding

Use the following diagram to answer question 6.



6. What does the diagram above represent?

- \* A. DNA replication
- B. mRNA translation
- C. mRNA elongation
- D. DNA transcription

### Higher Mental Processes

7. If 20% of the base molecules are guanine, how many thymine molecules are present in a DNA molecule with 1000 bases?

- A. 200
- \* B. 300
- C. 400
- D. 600

## E: Protein Synthesis

### Knowledge

8. What is the role of ribosomes in protein synthesis?

- A. to split the two strands of DNA apart
- B. to check for and replace the faulty codons
- C. to carry amino acids to the site of translation
- \* D. to provide a site for mRNA and tRNA to join together

*Understanding*

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

DNA: \_\_\_\_\_

mRNA: \_\_\_\_\_

rRNA: \_\_\_\_\_

tRNA: \_\_\_\_\_

**Response:**

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 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

Use the following table to answer question 10.

mRNA Codon	Amino Acid Coded for
CCU	proline
CCC	proline
CCA	proline
CCG	proline

10. Which of the following mutations will **not** result in the incorporation of the amino acid proline in a protein?
- A. a mutation of the DNA from G A A to G G A
  - B. the use of a G G U anticodon during translation
  - C. a substitution error changing the DNA from G G G to G G T
  - \* D. the substitution of the first base in the DNA triplet for proline

### G: Transport Across Cell Membrane

#### Knowledge

11. List **four** factors that would affect the rate of diffusion of molecules crossing a cell membrane. **(4 marks)**

#### Response:

- size of molecule
  - electrical charge
  - mass of molecule diffusing
  - cytoplasmic streaming (cyclosis)
  - number of protein pores / carriers
  - pressure (e.g., blood / atmospheric / hydrostatic)
  - temperature / speed of molecules / kinetic energy
  - concentration gradient / tonicity / osmotic pressure
  - specific hormonal effects (e.g., ADH, thyroxin, insulin)
  - chemical composition of the molecule (e.g., lipid solubility)
  - chemical and physical properties of the cell membrane (permeability)
- } any four for 1 mark each

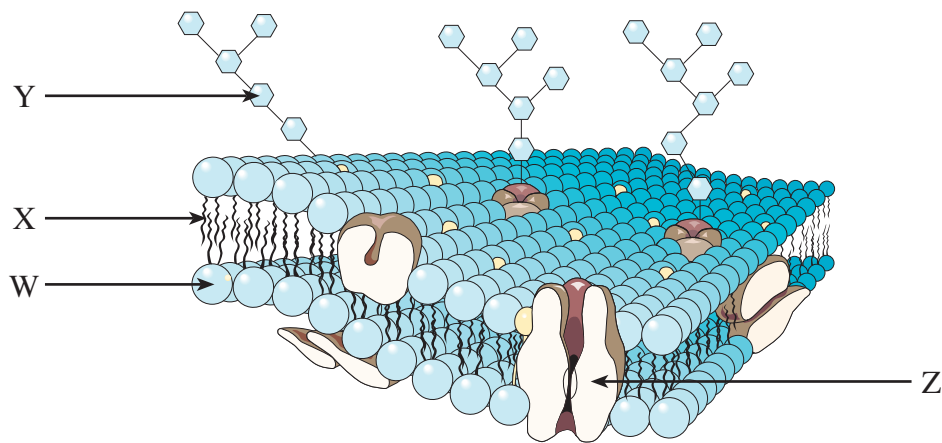
*Understanding*

12. If a 0.9% solution is isotonic to a certain type of animal cell, the cell will lose mass if it is placed in which of the following liquids?

- A. 0.5% salt solution
- B. 0.9% salt solution
- \* C. 1.2% salt solution
- D. distilled (pure) water

*Higher Mental Processes*

Use the following diagram to answer question 13.



13. Which of the following represents the part of a cell membrane that requires the breakdown of ATP for the transport of sodium ions?

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

**H: Enzymes**

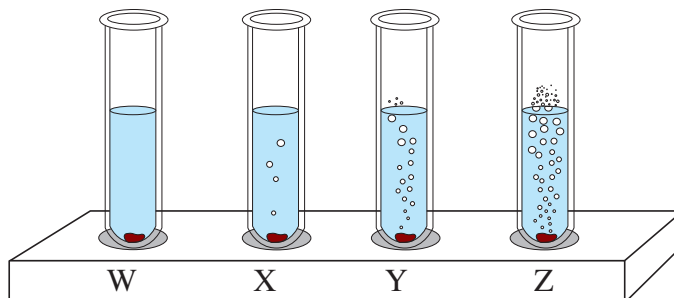
*Understanding*

14. Which hormone increases the rate at which cells release energy from carbohydrates?

- A. ATP
- B. ADH
- \* C. thyroxin
- D. aldosterone

*Higher Mental Processes*

15. An experiment was set up to measure the effect of temperature on catalase, an enzyme found in the liver that breaks down hydrogen peroxide into water and oxygen gas. Four labelled test tubes, each containing similar amounts of catalase and 2 mL of hydrogen peroxide, were incubated at different temperatures.



Which of the following matches each test tube with its correct temperature?

	W	X	Y	Z
A.	70° C	37° C	20° C	5° C
B.	5° C	20° C	37° C	70° C
* C.	70° C	5° C	20° C	37° C
D.	5° C	70° C	37° C	20° C

**I: Digestive System**

*Knowledge*

16. Which structure secretes digestive enzymes and bicarbonate ions?
- A. liver
  - B. stomach
  - \* C. pancreas
  - D. small intestine

*Understanding*

17. A bacterial infection inhibits the absorption of water in the digestive system. Where is the infection located?
- A. liver
  - B. stomach
  - C. duodenum
  - \* D. large intestine

*Higher Mental Processes*

**Use the following information to answer question 18.**

- Bacteria cells are destroyed.
- Amylase becomes denatured.
- Pepsinogen becomes activated.
- Trypsinogen changes into trypsin.

18. How many of the above result from the action of gastric juice?
- A. one
  - B. two
  - \* C. three
  - D. four

**J / K: Circulatory System: Circulation and Blood / Heart Structure and Function**

*Knowledge*

19. What blood vessels have thin, permeable walls?
- A. veins
  - B. venules
  - C. arterioles
  - \* D. capillaries

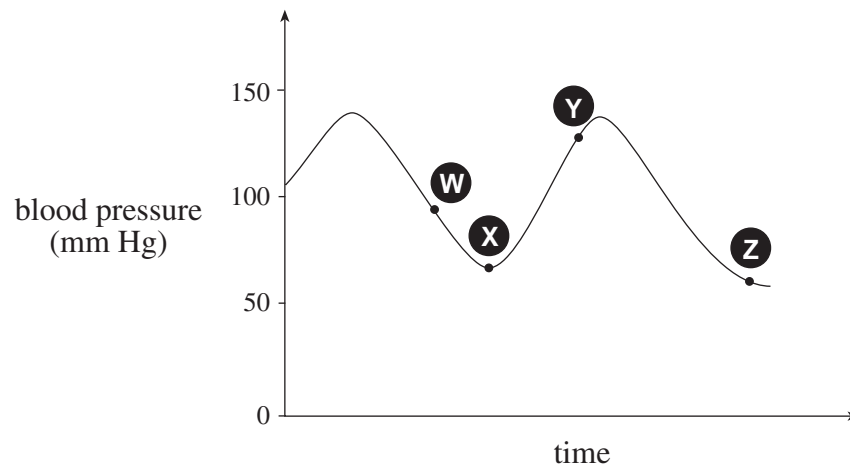
*Understanding*

20. What structure prevents blood from moving back into the left ventricle?

- A. the cardiac sphincter
- B. the chordae tendineae
- C. the atrioventricular valve
- \* D. the aortic semilunar valve

*Higher Mental Processes*

Use the following graph to answer question 21.



21. The graph shows changes in blood pressure in the aorta over time. Which letter would indicate when ventricular systole is occurring?

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

**L: Respiratory System**

*Knowledge*

22. What traps particles and moves them up the trachea?

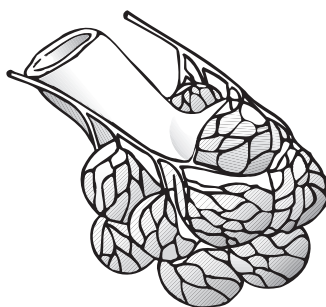
- A. villi and mucus
- \* B. mucus and cilia
- C. alveoli and villi
- D. cilia and alveoli

*Understanding*

23. Which of the following substances, formed during internal respiration, counteracts a decrease in blood pH?
- A. oxyhemoglobin
  - B. carbonic anhydrase
  - \* C. reduced hemoglobin
  - D. carbaminohemoglobin

*Higher Mental Processes*

Use the following diagram to answer question 24.



24. Which of the following pairs of reactions occurs most frequently in the blood surrounding the structure shown?
- \* A.  $\text{Hb} + \text{O}_2 \rightarrow \text{HbO}_2$  **and**  $\text{HHb} \rightarrow \text{Hb} + \text{H}^+$
  - B.  $\text{HbO}_2 \rightarrow \text{Hb} + \text{O}_2$  **and**  $\text{Hb} + \text{H}^+ \rightarrow \text{HHb}$
  - C.  $\text{H}^+ + \text{Hb} \rightarrow \text{HHb}$  **and**  $\text{H}_2\text{CO}_3 \rightarrow \text{HCO}_3^- + \text{H}^+$
  - D.  $\text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{CO}_3$  **and**  $\text{H}_2\text{CO}_3 \rightarrow \text{HCO}_3^- + \text{H}^+$

**M / N: Nervous System: Neuron, Impulse Generation and Reflex Arc / Divisions of the Nervous System and the Brain**

*Knowledge*

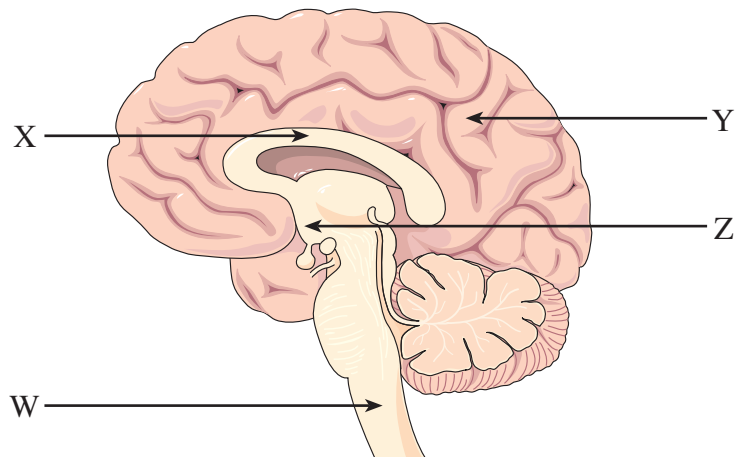
25. How do neurotransmitters move across the synaptic cleft?
- A. by osmosis
  - \* B. by diffusion
  - C. by active transport
  - D. by facilitated transport

*Understanding*

26. What results from stimulation of the parasympathetic nervous system?
- A. the pupils to dilate
  - B. peristalsis to decrease
  - C. the bronchioles to dilate
  - \* D. the heart rate to decrease

*Higher Mental Processes*

Use the following diagram to answer question 27.



27. Which labelled structure is responsible for increasing body temperature as a result of infection?
- A. W
  - B. X
  - C. Y
  - \* D. Z

**O: Urinary System**

*Knowledge*

28. The collecting ducts are located in which of the following structures?
- A. ureter
  - B. urethra
  - C. renal pelvis
  - \* D. renal medulla

*Understanding*

29. Which structure absorbs glucose by active transport?

- A. glomerulus
- B. collecting duct
- C. Bowman's capsule
- \* D. proximal convoluted tubule

*Higher Mental Processes*

30. Which of the following results from damage to the glomeruli?

- A. excess glucose in the urine
- \* B. red blood cells in the filtrate
- C. an increase of urea in the renal cortex
- D. a decrease of nitrogenous waste in the filtrate

**P: Reproductive System**

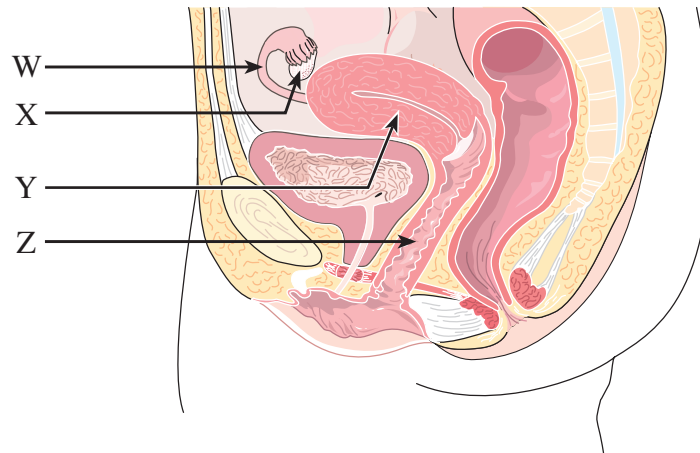
*Knowledge*

31. Where does spermatogenesis occur?

- A. interstitial cells
- B. seminal vesicles
- \* C. seminiferous tubules
- D. ductus (vas) deferens

*Understanding*

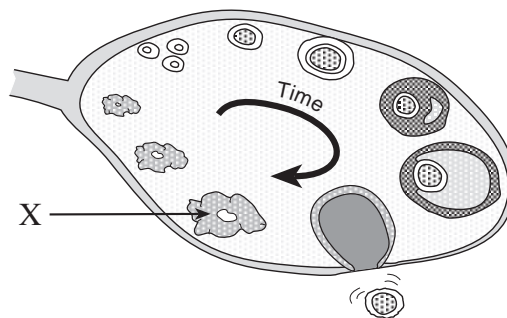
Use the following diagram to answer question 32.



32. Which labelled structure secretes hormones that cause the changes that occur in the female body during puberty?

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

Use the following diagram to answer question 33.



*Higher Mental Processes*

33. What do the secretions from structure X cause?

- A. uterine lining to slough off
- B. ovaries to produce a mature egg
- \* C. uterine lining to produce a thick mucus
- D. production of human chorionic gonadotropin (HCG)