I have compiled for your learning and enjoyment a very comprehensive collection of Provincial Exam questions. Most of these are written-response questions, which will make up half of your provincial exam. I have also included a generous smattering of multiple choice questions. As you work through this booklet, I suggest that you do the following:

1. **MAKE SURE YOU UNDERSTAND THE QUESTION BEFORE RUSHING TO ANSWER IT!!** This is possibly the most important strategy in problem solving but also the one which many students tend to skip. Don’t be in such a hurry! If you immediately try to start answering the question without first carefully dissecting the information given before the question, I guarantee that you are just wasting your time. **Study graphs, experiments, and experimental data given in the questions carefully and fully before proceeding!!**

2. **Read every single question** in this booklet, and do all the questions that you can. Many of these will be **assigned for marks. My tests** contain many of these **exact same questions!** I repeat, **My tests** contain many of these **exact same questions!**

3. **Answer in point form** (this is the preferred format on the Provincial Exam)

4. **Use pen** (this is required for the Provincial Exam). Erasable pen is also acceptable.

5. **Read over your answer** and ask yourself “**Does this make sense to me?**” and “**Would this make sense to someone else, even a notoriously grumpy geezer like my teacher?**”

6. Where possible and appropriate, **draw sketches, charts, and/or tables** to present your answer, but always make sure that you **label and explain** your diagrams!

7. Many of these questions are **difficult** exam questions, and require extra thought and effort. **Don’t get discouraged. If you persevere, you can succeed!! ☺☺☺☺☺☺**

8. **Get help from your teacher and classmates.** Discuss different viewpoints about these questions. Get together after school and on weekends and work on these questions with your peers.

9. **Use this booklet!!** As these are **actual exam questions** (and you will see many questions that are very similar or even identical to each other), understanding the types of questions that are asked, as well as the sub-topics that get asked year after year after year, is sure to help you prepare for your own exam, and hopefully get a **very high mark**!

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Biological Molecules

1. The molecule above would be part of what type of biological molecule?

2. The diagram shows a molecule that is found in the
   a) liver  b) blood  c) pancreas  d) gall bladder

3. The solution in the beaker below has a pH of 7.

Which of the following diagrams correctly represents a solution with a pH less than 7?

A. \[
\begin{align*}
&\text{H}_2\text{O}^+ \\
&\text{OH}^- \\
&\text{H}^+ \\
&\text{OH}^- \\
\end{align*}
\]

B. \[
\begin{align*}
&\text{H}_2\text{O}^+ \\
&\text{OH}^- \\
&\text{H}^+ \\
&\text{Cl}^- \\
\end{align*}
\]

C. \[
\begin{align*}
&\text{H}^+ \\
&\text{Cl}^- \\
&\text{N}^+ \\
&\text{H}_2\text{O}^+ \\
\end{align*}
\]

D. \[
\begin{align*}
&\text{OH}^- \\
&\text{H}_2\text{O}^+ \\
&\text{Na}^+ \\
&\text{Cl}^- \\
\end{align*}
\]

4. Which of the following structures represents ATP?
5. The diagram illustrates a step in the  

Compared to saturated fats, unsaturated fats contain less  

6. Which of the molecules is a building block or monomer of RNA?

7. a) Identify the molecule to the right. (1 mark)  
b) What is the general term given to polymers formed from this molecule? (1 mark)  
c) List two biological functions of these polymers. (2 marks)

8. The chemical bond that will form between the molecules in the diagram is a(n)  
a) ionic bond  b) peptide bond  c) covalent bond  d) hydrogen bond

9. This molecule is part of a  
a) fat  b) protein  c) nucleic acid  d) carbohydrate

10. Which of the following molecules is a carbohydrate?  
A. C₂H₇O₂N  
B. C₈H₁₂O₆  
C. C₁₃H₂₈O₂  
D. C₂₀H₄₀O₂
11. For each of the following molecules, give one function and describe a characteristic of the molecule that aids this function. (6 marks: 2 marks each)
   a) ATP  b) Water  c) Phospholipid

12. Draw a generalized amino acid and label the amine, acid (carboxyl) and R groups. (4 marks)
   (You may use a pencil for your drawing.)

13. a) Which of the above is a product of the complete hydrolysis of cellulose?
   b) Identify each of the above by name and describe one function for each.

14. In the human body, steroid molecules can act as

15. The diagram above represents which level of protein structure?

16. This diagram indicates which level(s) of structure?
   A. Only primary.
   B. Primary and secondary.
   C. Primary, secondary and tertiary.
   D. Primary, secondary, tertiary and quaternary.

17. a) Which of the following molecules would be produced by the hydrolysis of an enzyme?
   b) The main difference between cellulose and starch molecules is
   A. the type of linkage between glucose subunits.
   B. that only cellulose contains ribose building blocks.
   C. that only starch is made from glucose building blocks.
   D. the type of monosaccharide used to form these polymers.
18. a) Organisms maintain pH at a constant level through the use of

b) An unsaturated fat could be changed into a saturated fat if
A. peptide bonds were broken.  B. hydrogen atoms were added.  C. glycerol molecules were added.  D. fatty acid chains were shortened.

c) Which of the following describes hydrolysis?
A. Taking up excess hydroxide ions.  B. Making a polymer by removing water.  C. Making water by combining an acid and a base.  D. Adding water to break a polymer into unit molecules.

d) The major component of a plant cell wall is a product formed from the dehydration synthesis of

e) A radioactive element is sometimes used to trace the pathway of chemical reactions in the cell. If newly synthesized proteins are radioactive, the radioactive element used could be

19. a) An example of a specific process that occurs from a to c in the diagram would be:
A. amino acids form a protein.  B. glycerol is formed from fats.
C. nucleotides are formed from nucleic acids.  D. egg white coagulates when acid is added to it.

An example of a specific process that occurs in a manner similar to c → a in the diagram is
A. dipeptides forming into polypeptides.
B. nucleotides joining together to form DNA.
C. glycerol and fatty acids forming a neutral fat.
D. glycogen molecules being converted into glucose molecules.

20. Complete the following table using your knowledge of biological molecules.
(4 marks: 1/2 mark each box)

<table>
<thead>
<tr>
<th>BIOLOGICAL MOLECULE</th>
<th>UNIT MOLECULE (Building Block)</th>
<th>EXAMPLE OF BIOLOGICAL MOLECULE</th>
</tr>
</thead>
<tbody>
<tr>
<td>nucleic acid</td>
<td></td>
<td>enzyme</td>
</tr>
<tr>
<td></td>
<td>fatty acid and glycerol</td>
<td></td>
</tr>
</tbody>
</table>

21. Using your knowledge of proteins, describe:
   a) the chemical and physical structure of protein molecules
   (4 marks)
   b) how two proteins with the same number of unit molecules can differ
   (1 mark)
   c) how enzymes are specific
   (2 marks)
   d) the causes and effect of denaturation in enzymes
   (3 marks)

22. Name four phosphate-containing organic molecules found in human cells.
   (1 mark each) Explain the structure and/or function of each of the molecules.
   (2 marks each) (Value = 12 marks)

23. Complete the following table comparing carbohydrates, proteins and lipids.
   (6 marks)

<table>
<thead>
<tr>
<th>Elements found in</th>
<th>Carbohydrates</th>
<th>Proteins</th>
<th>Lipids</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location in Cell</td>
<td>attached to the</td>
<td>as enzymes</td>
<td></td>
</tr>
<tr>
<td>Membrane</td>
<td>outside of the</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>One function in cells</th>
<th>Carbohydrates</th>
<th>Proteins</th>
<th>Lipids</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
24. Explain how homeostasis is involved in regulating temperature when the body becomes too hot as a result of heavy exertion. Your explanation should include a discussion of regulating mechanisms, body responses and the role of a negative feedback. (8 marks)

25. Homeostasis is involved in regulating temperature when the body becomes too hot as a result of heavy exertion. Explain why a positive feedback mechanism would be inappropriate in this situation. (2 marks)

DNA, Protein Synthesis, Recombinant DNA

1. Give the purpose of each of the following steps in the process of protein synthesis.
   a) Ribosome moving along a mRNA: (1 mark)
   b) Adenine bonding to thymine: (1 mark)
   c) An amino acid bonding to a specific tRNA: (1 mark)
   d) Forming of peptide bonds: (1 mark)

2. If adenine is located on strand Z as shown, then on strand X at the same location must be

3. Describe the structure of DNA. You may use a labeled diagrams to answer this question (4 marks).

4. Using the table below, list three differences between RNA and DNA.

   (3 marks: 1 mark for each contrasting pair)

<table>
<thead>
<tr>
<th></th>
<th>RNA</th>
<th>DNA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5. Given the DNA sequence **CACGTATGAAAAATT**, use the table above to describe the primary structure of the protein it would transcribe.

b) A strand of DNA has the following bases: **CACGGCC**

If the adenine base was deleted, which amino acids would be coded for?
A. valine, proline  B. glycine, alanine  C. proline, arginine  D. glycine, arginine

c) Determine the sequence of amino acids produced by this DNA sequence: **GGAGTTTTC**

d) A tRNA molecule with the anticodon GCU would be carrying the amino acid

e) If the code for an amino acid is AGC on the DNA molecule, the anticodon on the tRNA would be  A. AGC  B. TGC  C. UCG  D. UGC

f) If the triplet code on a DNA molecule changes from ACT to AGC, the result is called

g) Read the strand of DNA from left to right: **T G A G C G C T A A A T T**

a) Give the order of the bases in the m-RNA strand that would be transcribed from the above section of DNA. (1 mark)
b) Give the sequence of amino acids in the protein molecule that is synthesized from the above sequence of DNA. (2 marks)
c) If the underlined base C is deleted, what effect will this have on the protein being synthesized? (1 mark)

6. The molecule represented by the line labelled X is
A. DNA.  B. tRNA.  C. rRNA.  D. mRNA.

7. A section of DNA has the following sequence of nitrogenous bases:
**CGAT T ACAG**

Which of the following sequences would be produced as a result of transcription?
A. CGTUUTCTG  B. GCTAATGTC  C. CGAUUACAG  D. GCUAAUGUC
8. Demonstrate your understanding of the structure of DNA by describing the following features of the DNA molecule. You may use drawings in your answers.
   a) Describe the shape of the DNA molecule. (1 mark)
   b) Describe the structure of the strands (backbone) of DNA. (1 mark)
   c) Describe complementary base pairing. (1 mark)
   d) Describe the bonding that occurs between bases. (1 mark)

9. a) Define recombinant DNA. (1 mark)
    b) Describe two uses for recombinant DNA. (2 marks)

10. State one role for each of the following molecules in the process of protein synthesis. (3 marks)
    • DNA:
    • mRNA:
    • tRNA:

11. Complete the following table comparing DNA and RNA. (3 marks: 1 mark each)

<table>
<thead>
<tr>
<th></th>
<th>DNA</th>
<th>RNA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bases</td>
<td>C, G, A, T</td>
<td>nucleus and cytoplasm</td>
</tr>
<tr>
<td>Location in cell</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of strands</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

12. Give one role of each of the following in the process of translation. (3 marks: 1 mark each)
    • tRNA:
    • Ribosome:
    • mRNA:

13. The process shown in the diagram is

14. Give one role of each of the following in the production of a protein. (4 marks: 1 mark each)
    • DNA:
    • mRNA:
    • tRNA:
    • rRNA:

15. List three ways in which mRNA is different from DNA. (3 marks)
16. a) Under experimental conditions, cells grown in a medium containing thymine would incorporate thymine into their DNA. If cells grown for a number of generations in a medium containing radioactive thymine were removed from this medium and allowed to replicate once using thymine that was not radioactive, what percent of these cells would now be radioactive?

A. 0%  B. 25%  C. 50%  D. 100%

b) DNA replication involves the breaking of bonds between

c) When a foreign gene is incorporated into an organism’s nucleic acid, the resulting molecule is called

17. 1. Uracil bonds with adenine.
2. Complementary bonding between codon and anticodon.
3. DNA unzips.
4. mRNA joins with ribosome.

The correct order of the above during protein synthesis is
A. 1, 2, 4, 3  B. 1, 3, 2, 4  C. 3, 1, 4, 2  D. 3, 2, 1, 4

18. a) Describe DNA replication. (3 marks)

19. a) Name the molecule indicated by X. (1 mark)
b) Where in a human cell does the process shown above occur? (1 mark)
c) List two functions of molecule X. (2 marks: 1 mark each)

20. In paragraph form, explain how each of the following is involved in protein synthesis.
(6 marks)
- DNA
- ribosome
- mRNA
- peptide bond
- tRNA
- amino acid

21. The diagram above shows a part of the process of protein synthesis.
   a) Identify the following labelled structures. (4 marks)
   b) Name the part of protein synthesis represented by the diagram above. (1 mark)
   c) Where in the cell is X synthesized? (1 mark)

22. Describe the process of:
a) transcription. (1 mark)  b) translation. (1 mark)

23. a) Describe the three steps of DNA replication. (3 marks)
b) Where in the cell does DNA replication occur? (1 mark)
c) What is the purpose of DNA replication? (1 mark)
d) Which base is found in DNA but not in RNA? (1 mark)

24. a) Outline the function of each of the following during protein synthesis: i) DNA ii) mRNA ii) tRNA
   b) List two factors that could cause changes in the type of protein formed. Explain why each factor causes a change in the protein formed. (2 marks)

25. a) List the events which occur during the replication (copying) of DNA. (4 marks)
b) Why does DNA replication occur before cell division? (1 mark)

26. Discuss how the mutation of a single nucleotide base can cause the synthesis of an abnormal protein.
   Your answer should include a detailed explanation of protein synthesis. (8 marks)
27. a) Give the location of the following processes in the cell: i) transcription (1 mark) ii) translation (1 mark) 
b) What is the role of mRNA in transcription? (1 mark) 
c) What is the role of mRNA and tRNA in translation? (2 marks) 

28. Due to a mutation, one base pair is lost from a DNA molecule. Describe the effect this mutation has on 
the protein being synthesized. (1 mark) 

29. Describe the role of each of the following in protein synthesis: (5 marks) a) DNA b) mRNA c) tRNA d) 
ribosome e) peptide bond 

30. a) Name the process 
shown in the diagram. (1 
mark) b) Give the letter of 
the strand that is identical 
to strand A. (1 mark) c) 
Give the purpose of this 
process and give a location 
in the cell where this 
process occurs. 

31. | DNA | RNA |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Name of sugar</td>
<td></td>
</tr>
<tr>
<td>Nitrogen base present</td>
<td></td>
</tr>
<tr>
<td>Shape of the molecules</td>
<td></td>
</tr>
<tr>
<td>One function in the cell</td>
<td></td>
</tr>
</tbody>
</table>

Give the differences between DNA and RNA in terms of: a) name of sugar b) nitrogen base present c) 
shape of the molecules d) one function in the cell (4 marks: 1/2 mark for each box) 

32. | DNA | RNA |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of strands</td>
<td></td>
</tr>
<tr>
<td>Role in protein synthesis</td>
<td></td>
</tr>
<tr>
<td>Nitrogenous bases</td>
<td></td>
</tr>
</tbody>
</table>

Compare DNA and RNA by giving the differences for the following: (3 marks: 1/2 marks each) 

The Cell 

1. Identify structure X and describe its functions (3 marks). What organs 
of the body would have cells that would contain high concentrations of 
this organelle? (2 marks)
2. a) Identify structure X  b) a metabolic poison is given that prevents the functioning of structure X. Describe the effect on cellular processes (be specific)

3. Describe the process that occurs in the structure shown above in terms of reactants, products, and location in the cell.

4. Identify each part of the cell indicated and give one role for each structure in the secretion and/or synthesis of a protein. (6 marks: 1 2 mark for each name; 1 mark for each function)

The structure labelled X is composed mostly of A. glycogen and protein. B. nucleic acid and glycogen. C. protein and phospholipids. D. nucleic acid and phospholipids.

5. The cell produces, stores, packages and exports a steroid hormone. What is the correct order of structures involved in this process?
   A. Z, X, W
   B. V, W, X
   C. X, W, Y
   D. V, W, Y

6. Explain the functional relationship between rough endoplasmic reticulum, Golgi bodies, chromosomes and vesicles. (4 marks)
7. a) Identify the molecules labeled X. (1 mark)  
b) Name two processes by which these molecules function in order to move materials. (2 marks)

8. State one function of each of the following. (4 marks: 1 mark each)  
i) Vesicles:  
ii) Smooth endoplasmic reticulum:  
iii) Nuclear envelope:  
iv) Mitochondria:

9. A cell lining the digestive system produces and secretes an enzyme into the digestive tract. State the role of the following in these processes. (4 marks: 1 mark each)  
a) Ribosome:  
Endoplasmic reticulum:  
Golgi body:  
Vesicle:

10. In the cell above, where does cellular respiration occur?  
A. W  
B. X  
C. Y  
D. Z

11. State one function of each of these parts of a cell. (1 mark each)  
a) Cell membrane:  
b) Mitochondrion cristae:  
c) Vacuole:  
d) Microtubule:

12. Which of the following is correct?  

<table>
<thead>
<tr>
<th>EUKARYOTIC CELLS</th>
<th>PROKARYOTIC CELLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ribosomes</td>
<td>absent</td>
</tr>
<tr>
<td>Mitochondria</td>
<td>present</td>
</tr>
<tr>
<td>Cell membrane</td>
<td>present</td>
</tr>
<tr>
<td>Endoplasmic reticulum</td>
<td>absent</td>
</tr>
</tbody>
</table>

13. A mature wing muscle cell of a hummingbird is smaller than a mature leg muscle cell of an elephant. a) What are the advantages of having a smaller cell size? (3 marks)  
b) List two organelles that are likely to be present in different concentrations (number of organelles per unit volume) in the muscle cells of the two organisms. Explain why. (3 mark)

14. An electron microscopist took pictures of cells from four different tissues/organs of an adult patient. Each picture showed cells that had a higher than average concentration of one of the following organelles:  
CELL A: smoother endoplasmic reticulum  
CELL B: mitochondria  
CELL C: lysosomes  
CELL D: cilia
Give a probable tissue or organ that was the source of these cells. Include the function of each organelle in the tissue/organ you named. (8 marks: 1 mark per source, 1 mark per explanation)

15. Explain how structure is related to function for each of the following organelles:  
a) mitochondrion (3 marks)  
b) chloroplast (3 marks)  
c) rough endoplasmic reticulum (3 marks)

16. State one way in which the following organelles work together:  
a) lysosomes and pinocytic vesicles. (1 mark)  
b) microtubules and cilia (1 mark)  
c) golgi apparatus and endoplasmic reticulum (1 mark)  
d) nucleolus and ribosomes (1 mark)
17. Explain how the functions of the two organelles in the diagrams are related to each other. (6 marks)

18. State one function of each of the following organelles and explain how these functions are related to each other.
   a) mitochondria and chloroplasts
   b) golgi apparatus and vesicles
   c) ribosomes and endoplasmic reticulum
(6 marks: 1/2 mark for each function, 1 mark for relationship)

19. The cells illustrated above are from tissues located in various parts of the human body.
   a) State one location in the human body where each cell could be found. (3 marks)
   b) Explain how the structure of each cell is related to its function. (6 marks: 2 marks each)

20. Describe one way in which each of the following is involved in cell function: a) phospholipids (1 mark) b) vitamins c) carbohydrates (1 mark) d) amino acids (1 mark) e) messenger RNA (mRNA) (1 mark)

21. Relate structure to function for the following organelles: a) lysosomes b) cell membrane c) nucleus d) cytoskeleton e) smooth endoplasmic reticulum

22. Explain the following three phrases. (6 marks: 2 marks each)
   a) Many different proteins can be constructed from just a few amino acids.
   b) Larger organisms are made of more cells, NOT bigger cells.
   c) Mitochondria are the “power houses” of the cell.
Cell Membrane and Transport

1. An experiment was conducted to determine the concentration of molecules in the cytoplasm of potato cells. The following steps were taken:

   1. Five different sugar solutions were added to five numbered test tubes as shown in the data table below.
   2. Five potato discs (cut from the same potato) were weighed and one disc was added to each test tube.
   3. After 24 hours, the potato discs were removed, blotted dry, and weighed again.

<table>
<thead>
<tr>
<th>TEST TUBE</th>
<th>CONCENTRATION OF SUGAR SOLUTION (%)</th>
<th>INITIAL POTATO MASS (grams)</th>
<th>FINAL POTATO MASS (grams)</th>
<th>CHANGE IN MASS (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>30.0</td>
<td>5.0</td>
<td>4.0</td>
<td>– 20</td>
</tr>
<tr>
<td>2</td>
<td>20.0</td>
<td>4.8</td>
<td>4.3</td>
<td>– 10</td>
</tr>
<tr>
<td>3</td>
<td>10.0</td>
<td>5.2</td>
<td>5.5</td>
<td>+ 6</td>
</tr>
<tr>
<td>4</td>
<td>5.0</td>
<td>4.7</td>
<td>5.4</td>
<td>+15</td>
</tr>
<tr>
<td>5</td>
<td>0.0 (distilled water only)</td>
<td>5.1</td>
<td>6.1</td>
<td>+ 20</td>
</tr>
</tbody>
</table>

   a) Name and describe the process that allowed the potato cells to gain and lose mass when placed in the sugar solutions. (2 marks: 1 mark for name; 1 mark for description)
   b) Explain the change in mass of the potato disc in test tube 1. (2 marks)
   c) Draw a graph that compares the concentration of sugar solution (%) to the change in mass (%) of the potato discs. Label the x-axis as the concentration of sugar solution (%). (2 marks)
   d) Use your graph to determine the concentration of sugar solution (%) that would be isotonic to the cytoplasm of the potato cells. (1 mark)

2. Which of the following cells is the most efficient in terms of diffusion of wastes out of the cell?

<table>
<thead>
<tr>
<th>CELL</th>
<th>SURFACE AREA (μm²)</th>
<th>VOLUME (μm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>B</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>C</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>D</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>
3. The diagram above shows a thistle tube suspended in a solution. The initial concentrations of the solutions inside and outside the thistle tube are indicated. What will happen to the concentration of the salt solution surrounding the thistle tube?
   A. It will decrease as salt moves into the thistle tube.
   B. It will increase as salt moves out of the thistle tube.
   C. It will increase as water moves into the thistle tube.
   D. It will decrease as water and glucose move out of the thistle tube.

4. The diagrams illustrate that the membrane selects according to the
   A. size of the molecules  B. temperature of the solution.  C. concentration of the molecules.  D. electronic charge of the molecules.

5. The diagram shows a white blood cell ingesting a bacterium. The bacterium enters the white blood cell by

   Molecules in the cell membrane that function as receptors are

6. a) Identify the process shown in the diagram above. (1 mark)
   b) Give one example in which this process is used in the body. (1 mark)
   c) Describe the function of the molecule represented by P PP : (1 mark)
   d) What is the function of molecule X? (1 mark)

7. Which of the following cells is the most efficient in terms of diffusion of wastes out of the cell?

<table>
<thead>
<tr>
<th>CELL</th>
<th>SURFACE AREA (μ²)</th>
<th>VOLUME (μ³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>B</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>C</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>D</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>
8. An experiment was designed to determine the correct salinity of water (percentage of salt in water) required to successfully clone certain cells using tissue culture. Three cell samples were placed in three different salt solutions and their change in mass was recorded in the data table shown below.

<table>
<thead>
<tr>
<th>SALT IN WATER (%)</th>
<th>CHANGE IN MASS OF CELLS (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>+0.82</td>
</tr>
<tr>
<td>1.0</td>
<td>+0.40</td>
</tr>
<tr>
<td>1.5</td>
<td>−0.15</td>
</tr>
</tbody>
</table>

a) Use the grid provided to graph the data above. Label the x-axis as salt in water (%). (2 marks)

b) If the cells must be cultured in a solution that does not cause them to shrink or swell, estimate the percentage of salt in water that would be best for culturing the cells. (1 mark)

c) Why do the cells in the 1.5% salt solution lose mass? (1 mark)

d) Name the process and explain how each of the following nutrients, when added to any of the solutions, would enter the cells in the culture. (2 marks)
- Glucose
- Oxygen
9. Simple diffusion of molecules would occur most rapidly in which of the cells above?
A. Cell X, because it has a smaller volume.
B. Cell X, because it synthesizes proteins at a faster rate.
C. Cell Y, because it can move around more quickly.
D. Cell Y, because it has a larger surface area.

10. Two identical red blood cell samples were prepared for an experiment. The samples were placed in two different solutions and the percent change in mass was recorded and graphed over an eight hour period as shown below.

a) Account for the change in mass of the cells in Solution A during the first four hours. (2 marks)
b) What happened to the cells in Solution A after four hours? (1 mark)
c) A sample of cells from Solution B (at five hours) was examined under the microscope. Explain why they appear as in the diagram above. (2 marks)
d) Give one reason for the results obtained from the cells placed in Solution B between three and eight hours. (1 mark)

11. How many of the following factors would affect the permeability of the cell membrane?
- Size of molecules.
- Lipid solubility of molecules.
- Presence of transport channels.
- Presence of ATP inside the cell.

12. State how each of the following transport mechanisms functions to move materials into a cell. (4 marks: 1 mark each)
- Diffusion:
- Osmosis:
- Facilitated transport:
- Active transport:

13. Which of the following processes is represented in the diagram?
A. Osmosis.
B. Diffusion.
C. Hydrolysis.
D. Endocytosis.

14. b) Describe how the structure of the cell membrane permits molecules to enter the cell by the following processes. (3 marks: 1 mark each)
i) Osmosis:
ii) Facilitated Transport:
iii) Pinocytosis:
15. In the situation shown in the diagram above,
   A. water will enter A and the concentration of the protein solution will increase.
   B. water will enter A and the concentration of the protein solution will decrease.
   C. water will enter B and the concentration of the protein solution will increase.
   D. water will enter B and the concentration of the protein solution will decrease.

16. The diagram below is a student drawing of an onion cell before and after it was placed in a solution.
   
   The solution
   A. caused the cell to gain water by osmosis.
   B. increased the rate of active transport of ions.
   C. resulted in a hypertonic environment for the cell.
   D. ruptured the cell membrane, releasing cytoplasm.

17. Identify molecules X and Y in the diagram above.
   For each molecule, give one function and name its unit molecules (building blocks). (6 marks: 1 mark each)

18. a) Which of the following will be affected directly if the mitochondria in a cell are not functioning properly? 
   A. Absorption of alcohol by the cell. 
   B. The movement of water into and out of the cell. 
   C. The movement of oxygen across the cell membrane. 
   D. The movement of sugar from a low to a high concentration.

   b) A slice of potato placed in distilled water becomes firm after several hours because
   A. salt has passed into the potato cells. 
   B. cellulose synthesis in the cell wall has been stimulated. 
   C. water has passed into the potato cells causing the cells to swell. 
   D. water has passed out of the potato cells causing the cells to shrink.

   c) Which of these substances cannot pass through cell membranes?
   A. Starch. 
   B. Glycerol. 
   C. Amino acids. 
   D. Monosaccharides.

19. Living animal cells are added to a solution containing oxygen, carbon dioxide, amino acids and glucose.
   After four hours, the solution surrounding the cells is sampled and the concentration of each substance is measured.
   a) Predict the change in the concentrations of carbon dioxide and glucose in the solution surrounding the cells. (2 marks: 1 mark each)
   b) Using your knowledge of membrane structure, explain the mechanisms that account for these changes in carbon dioxide and glucose concentration. (4 marks)
20. Plant tissue was placed in a starch solution. The following data were gathered over an 80 minute period.

<table>
<thead>
<tr>
<th>Time (min.)</th>
<th>0</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
<th>60</th>
<th>70</th>
<th>80</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tissue mass (g)</td>
<td>20</td>
<td>17</td>
<td>15</td>
<td>13</td>
<td>10</td>
<td>8</td>
<td>5</td>
<td>9</td>
<td>12</td>
</tr>
</tbody>
</table>

a) Plot the data on the graph provided. (1 mark)

b) Explain the process occurring in the plant tissue between 0 and 60 minutes. (2 marks)
c) Name the substance that was added to the solution at 60 minutes and explain how this substance caused the change illustrated on the graph. (2 marks)

21. Explain any TWO of the following three phrases. Only your first two attempts will be marked. (4 marks: 2 marks each)
   a) Many different proteins can be constructed from just a few different amino acids.
   b) Larger organisms are made of more cells, NOT bigger cells.
   c) Mitochondria are the “power houses” of the cell.

22. Materials can enter cells by several different mechanisms. List four of these mechanisms. Explain the processes involved in two of the mechanisms that require energy. (6 marks)

23. In an experiment, cells of a unicellular alga (simple plant) are placed in two different salt solutions. Graph A and B indicate the water gained or lost by the cells in these two solutions. (8 marks)

   a) Describe how the tonicity (concentration) of the 0.05% salt solution (graph A) compares with the tonicity of the algal cells at the start of the experiment. Using data from the graph, give reasons to support your answer (2 marks)
   b) Describe what is happening to the algal cells in the 5% salt solution (graph B) after 4 minutes and explain why. (2 marks)
   c) Describe what would happen to red blood cells if they were immersed in the 0.05% solution (Graph A) and explain why. (2 marks)
   d) Explain why graph A levels off after about three minutes in the 0.05% solution. (2 marks)
24. A plant cell is placed in an unknown salt solution. The cell membrane is impermeable to salt. The graph represents the change in salt concentration within the cell. (8 marks)

![Graph of salt concentration change within the cell]

a) Describe the concentration (or tonicity) of the solution which surrounds the plant cell at 0.5 hours (1 mark)
b) Explain the results shown on the graph between 0.5 hours and 2.0 hours (2 marks)
c) Explain the results shown on the graph between 2.0 hours and 4.0 hours (2 mark)
d) If salt were added to the solution surrounding the cell at hour 4.0, describe how the graph would appear and explain your answer (3 marks)
e) Describe the appearance of the plant cell after salt was added to the solution (1 mark)

25. Using the fluid mosaic model of the cell membrane, explain how the following substances move into cells: a) water b) alcohol c) glucose d) sodium and potassium ions e) large protein molecules f) iodine g) estrogen h) amino acids (2 marks each)

26. 60 discs of raw potato were cut from the same potato. Groups of 10 discs were weighed and placed in sucrose solutions of known concentrations. The disc remained in the solutions for 24 hours; they were removed, lightly blotted dry and weighed again. The results are shown in the table.

<table>
<thead>
<tr>
<th>Group of Discs</th>
<th>Sucrose Concentration</th>
<th>Mass at Start of Experiment</th>
<th>Mass at End of Experiment</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1.5%</td>
<td>21.5 g</td>
<td>23.0 g</td>
</tr>
<tr>
<td>B</td>
<td>2.0%</td>
<td>22.0 g</td>
<td>22.5 g</td>
</tr>
<tr>
<td>C</td>
<td>2.5%</td>
<td>21.0 g</td>
<td>21.0 g</td>
</tr>
<tr>
<td>D</td>
<td>3.0%</td>
<td>23.0 g</td>
<td>22.5 g</td>
</tr>
<tr>
<td>E</td>
<td>3.5%</td>
<td>22.5 g</td>
<td>21.5 g</td>
</tr>
<tr>
<td>F</td>
<td>4.0%</td>
<td>23.5 g</td>
<td>22.0 g</td>
</tr>
</tbody>
</table>

a) Which solution is isotonic to the potato? (1 mark) b) Why are the potato discs blotted dry before the second weighing? (1 mark) c) After 24 hours, the potato discs in group F were sectioned: these sections were placed in 4% sucrose solution and viewed under a microscope. Describe the appearance of these group F cells as viewed under the magnification and explain the reason for this appearance.

27. Four thistle tubes are partially filled with salt solutions of various concentrations and sealed with membranes that are permeable to water but impermeable to salt. Each thistle tube is then placed in a beaker containing a 2% salt solution. The experiment is left for two hours. The diagrams show the appearance of each thistle tube at the start of the experiment and at the end of two hours. For each tube, explain what caused the differences in levels observed after two hours. Give reasons to support your answer. (4 marks)
28. Three experiments were set up according to the data table below. The membranes of the blood cells are impermeable to the solute. In each experiment the cells from column A, which were resting in isotonic solutions, were then placed in the solution in column B.

<table>
<thead>
<tr>
<th>Experiment</th>
<th>A Solute Concentration Inside the Blood Cell</th>
<th>B Solute Concentration In Extracellular Fluid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experiment 1</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>Experiment 2</td>
<td>0.5%</td>
<td>1%</td>
</tr>
<tr>
<td>Experiment 3</td>
<td>1%</td>
<td>0.5%</td>
</tr>
</tbody>
</table>

a) Describe what will happen to the cells in each experiment when they are placed in the solutions in column B. Give reasons for your answers. (6 marks)
b) Which experiment could be considered the control? Why? (2 marks)

29. The following experimental steps were used to determine the tonicity of potato cells:
1) five different sugar solutions were added to five numbered test tubes as shown by the data table.
2) five discs of potato (cut from the same potato) were weighed and added to each test tube.
3) after 24 hours, the potato discs were again weighed to determine their change in mass.

<table>
<thead>
<tr>
<th>Test Tube</th>
<th>% Sugar Solution</th>
<th>Initial Potato Mass</th>
<th>Final Potato Mass</th>
<th>% Change In Mass</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>30.0</td>
<td>3.0 g</td>
<td>2.2 g</td>
<td>-27</td>
</tr>
<tr>
<td>2</td>
<td>20.0</td>
<td>3.3 g</td>
<td>2.8 g</td>
<td>-12</td>
</tr>
<tr>
<td>3</td>
<td>10.0</td>
<td>3.2 g</td>
<td>3.4 g</td>
<td>+ 6</td>
</tr>
<tr>
<td>4</td>
<td>5.0</td>
<td>3.1 g</td>
<td>3.6 g</td>
<td>+ 16</td>
</tr>
<tr>
<td>5</td>
<td>distilled water</td>
<td>2.9 g</td>
<td>3.6 g</td>
<td>+ 24</td>
</tr>
</tbody>
</table>

a) Account for the change in mass of the potato disc in test tube number 1. (2 marks)
b) Account for the change in mass of the potato disc in test tube number 5. (1 mark)
c) Estimate the percentage sugar solution that would be isotonic to the potato cytoplasm. **Draw a graph** to assist you. Give an explanation for your estimate (5 marks)

30. Explain the following observation: Wilted celery becomes rigid again when placed in cold water. (2 marks)

31. a) Describe or draw a labeled diagram of the fluid mosaic model of membrane structure. (4 marks)
b) Describe the process of active transport across a cell membrane. (2 marks)
Enzymes

1. An experiment was conducted to measure the effect of temperature on an enzyme isolated from the small intestine. Data was collected and graphed as shown below.

   Explain why the following temperatures change the activity rate of the enzyme.
   O °C to 30 °C (1 mark)
   30 °C (1 mark)
   40 °C to 50 °C (2 marks)

2. Identify X in the above diagram, as well as all the other parts of this enzyme-catalyzed reaction.

3. The arrow labelled X in the graph above indicates the

4. The structure labelled X in the diagram is a(n)

5. The structure labelled X in the reaction above is
   A. a vitamin.  B. the substrate.  C. the active site.  D. a competitive inhibitor.

6. a) Explain the “lock and key” model of enzymatic action. (2 marks)
   b) Explain how denaturation stops enzymatic action. (1 mark)
7. The two digestive enzymes shown in the graph have the same substrate. What would the substrate be?

8. Draw a labeled diagram to illustrate the "lock and key" model of enzymatic action. (4 marks)

9. The following graph shows an enzyme catalyzed reaction.

Which of the following might explain the change in the rate of reaction at temperatures greater than 50 °C
A. More enzyme was added.  B. More substrate was added.  C. Coenzymes compete for the enzyme’s active site.  D. The tertiary shape of the enzyme has been altered.

10. The following data show the rate of an enzyme-catalyzed reaction at various temperatures.

<table>
<thead>
<tr>
<th>Temperature (°C)</th>
<th>Grams of product/minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>0.25</td>
</tr>
<tr>
<td>28</td>
<td>0.9</td>
</tr>
<tr>
<td>35</td>
<td>3.0</td>
</tr>
<tr>
<td>38</td>
<td>3.7</td>
</tr>
<tr>
<td>43</td>
<td>1.0</td>
</tr>
</tbody>
</table>

a) Graph the data on the grid provided. (1 mark)

b) Use the graphed data to describe the effect of temperature on the rate of enzyme activity. (4 marks)

11. An experiment investigating enzyme activity was carried out. A test tube was prepared containing substrate solution W and enzyme solutions 1 and 2.
   - The reactions that occur in the test tube are summarized below:

\[
\begin{align*}
W & \rightarrow X \rightarrow Y \\
1 & \rightarrow 2
\end{align*}
\]

   - The letters represent substrates and products and the numbers represent enzymes.
   a) State two ways to increase the rate of production of product Y. (2 marks)
   b) A substance is added to the test tube containing substrate W. As a result, no product is formed. Suggest what this substance may be and explain how it achieves these results. (2 marks)

12. Describe the effect that the following would have on enzyme action: (8 marks)
   a) temperature  b) pH  c) substrate concentration  d) competitive inhibitors

13. Explain how the following changes affect an enzyme-catalyzed reaction:
   a) the pH is changed from 3 to 8 (2 marks)
   b) the temperature is increased from 20 °C to 30 °C (2 marks)
   c) a competitive inhibitor is added (2 marks)
14. a) Explain the change in reaction rate for the graph (2 marks)
b) Identify and explain how three other factors could decrease the
reaction rate of the enzyme-catalyzed reaction. For each factor
give reasons to support your answer. (6 marks)

15. In the cell, enzymes act as

**Digestive System**

1. Label the parts on the diagram and give one function for each during
the digestion of a protein.

2. Secretions from which of the following would have the effect
shown in the diagram?
A. liver  B. mouth  C. stomach  D. large intestine

3. The graph shows the activity of two different enzymes in the digestive tract that have the same
substrate. What is enzyme Y?
A. pepsin  B. trypsin  C. amylase  D. peptidase
4. The to the left is found lining the walls of the

   Label the following on this drawing: lacteal, capillary network, columnar cells, interstitial gland

5. The following substances were isolated from organs found in the digestive system. Name the organ in which each substance was produced and give one function of the substance.  
   (4 marks)

<table>
<thead>
<tr>
<th>SUBSTANCE</th>
<th>ORGAN WHERE PRODUCED</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>pepsin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>nuclease</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6. Which organ releases an enzyme that digests fats?
   A. W  B. X  C. Y  D. Z

Which organ functions to kill bacteria, store food and digest protein?
   A. W  B. X  C. Y  D. Z

7. In the following reaction, product X could be a(n)
   X + Y lipase fat + H 2 O

fat + H_2O \xrightarrow{\text{lipase}} X + Y
8. In an experiment designed to test the effects of environmental conditions on the ability of enzymes to digest food, the following steps are carried out:

- Four test tubes are labelled A, B, C and D.
- All tubes contain distilled water and a small amount of egg white (protein).
- Individual tubes have additional contents as shown in the table below.
- All tubes are to be incubated at 37°C for one hour.

For each tube, explain what will happen and why.

(8 marks: 1 mark each for result; 1 mark each for explanation)

<table>
<thead>
<tr>
<th>TUBE</th>
<th>INITIAL CONTENTS</th>
<th>ADDITIONAL CONTENTS</th>
<th>RESULT AND EXPLANATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>distilled water</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td></td>
<td>+ egg white</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>distilled water</td>
<td>pepsin</td>
<td></td>
</tr>
<tr>
<td></td>
<td>+ egg white</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>distilled water</td>
<td>pepsin +</td>
<td></td>
</tr>
<tr>
<td></td>
<td>+ egg white</td>
<td>hydrochloric acid</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(at pH 3)</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>distilled water</td>
<td>hydrochloric acid</td>
<td></td>
</tr>
<tr>
<td></td>
<td>+ egg white</td>
<td>(at pH 3)</td>
<td></td>
</tr>
</tbody>
</table>

9. Graph 1 represents the rate of reaction between lipase and its substrate. In graph 2, what occurred at time X that caused the change in the reaction?
A. Fat was added. B. The pH was changed from 5 to 8. C. A competitive inhibitor was added. D. The temperature of the reaction was raised to 100°C.
10. a) The diagrams illustrate a reaction that occurs in the small intestine. Give the specific name for each of the following.
   - Molecule X: (1 mark)
   - Molecule Y: (1 mark)

b) In a laboratory experiment, substance Y was added in increasing amounts until it eventually had no effect on the rate of the reaction. Explain why. (1 mark)

c) A solution containing lead ions was added to the reaction. How will the addition of this solution affect the reaction? Explain why. (2 marks)

11. Which of the following substances is absorbed into the structure labelled X?

12. The reaction shown below is catalyzed by secretions from which organs?
   \[ \text{protein} + \text{H}_2\text{O} \rightarrow \text{peptides} \]
   A. pancreas and liver  B. liver and duodenum  C. stomach and pancreas  D. duodenum and stomach

13. a) State two functions of structure Z. (2 marks)
    b) For each of the following structures, list one enzyme it secretes and the substrate that the enzyme acts upon. (4 marks: 1 mark each for enzyme; 1 mark each for substrate)
14. Complete the following table for the digestive system. (4 marks: 1/2 mark each)

<table>
<thead>
<tr>
<th>SOURCE OF ENZYME</th>
<th>ENZYME</th>
<th>SUBSTRATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stomach</td>
<td>Lipase</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Trypsin</td>
<td>Maltose</td>
</tr>
</tbody>
</table>

15. Complete the table below by giving one enzyme produced by each of the following glands and by stating the digestive product of that enzyme. (6 marks: 1 mark each)

<table>
<thead>
<tr>
<th>GLANDS</th>
<th>ENZYME PRODUCED</th>
<th>DIGESTIVE PRODUCT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salivary glands</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gastric glands</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intestinal glands</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

16. a) The breakdown of some poisonous substances found in the blood occurs in organ
   A. W  B. X  C. Y  D. Z

   b) Amylase is synthesized at the

   c) A role of water in cells of the human body is to

   d) Which of the following is composed of nucleotides?

   e) Which of the following is a polymer?
17. An experiment was conducted to determine the effects of pH on pepsin. The following steps were performed:
   1. Five test tubes were numbered and equal amounts of egg white and water were added to each.
   2. A buffer was added to each test tube to maintain its pH at the level given in the table below.
   3. An equal amount of pepsin was added to each test tube.

   After one hour, the mass of egg white remaining in each test tube was determined. The results are recorded below:

<table>
<thead>
<tr>
<th>TEST TUBE</th>
<th>pH</th>
<th>MASS OF EGG WHITE (in grams)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>2.8</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>1.3</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>2.7</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>3.9</td>
</tr>
<tr>
<td>5</td>
<td>7</td>
<td>5.8</td>
</tr>
</tbody>
</table>

   a) Draw a graph that compares the pH to the amount of egg white remaining in each test tube. Label the x-axis (horizontal axis) as pH. (2 marks)

   b) What appears to be the optimum pH for pepsin? (1 mark)

   c) Explain what happens to pepsin at a pH of 7, and why this affects its activity. (2 marks)

18. Describe how the small intestine is specialized for digestion and absorption.

   - Digestion: (2 marks)
   - Absorption: (2 marks)

19. a) Name the **three** glands that secrete enzymes that digest carbohydrates. (3 marks)

   b) Name the structure in the small intestine that absorbs the products of carbohydrate digestion. (1 mark)

   c) Where does the body store the excess products of carbohydrate digestion? (1 mark)

20. Which of the following would be produced in a reaction catalyzed by enzymes known as nucleases?

   ![Chemical structures](image)

   A. ![Chemical structure](image)
   B. ![Chemical structure](image)
   C. ![Chemical structure](image)
   D. ![Chemical structure](image)

21. In paragraph form, describe the chemical breakdown of starch to a monosaccharide in the human body. (7 marks)
22. a) Name the components of pancreatic juice and state how each aids in the digestion of food. (4 marks) 
   b) What is the function of water in pancreatic juice? (1 mark)

23. Digested polysaccharides are taken in by cells in the presence of a hormone secreted from the gland labelled 
   A. W  
   B. X  
   C. Y  
   D. Z

24. In the diagram below, amino acids are transported into structure A. W.  B. X.  
   C. Y.  D. Z.

25. Complete the following table summarizing digestive enzyme activity. 
   (4 marks: 1/2 mark each)

<table>
<thead>
<tr>
<th>ENZYME</th>
<th>SUBSTRATE</th>
<th>SITE OF ACTIVITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>pepsin</td>
<td>fat droplets</td>
<td></td>
</tr>
<tr>
<td>peptidase</td>
<td></td>
<td>starch</td>
</tr>
</tbody>
</table>

26. Describe the mechanisms involved in the digestion and absorption of fat. (4 marks)

27. The concentration of glucose in the blood was recorded over a set period of time and the following pattern was observed.

   a) Does the above graph represent positive or negative feedback? (1 mark) 
   b) Explain the hormonal response when the 
      i) blood glucose concentration is high. (2 marks) 
      ii) blood glucose concentration is low. (2 marks)
28. In an experiment, three different pancreatic enzymes were placed in separate test tubes. Temperature was maintained at 37°C. Vegetable oil, egg white and starch were added to each test tube and the contents were analyzed after 30 minutes.
   a) Test tube A was found to contain glycerol and fatty acids. What was the enzyme added? (1 mark)
   b) Test tube B contained trypsin. Which product of digestion would it contain? (1 mark)
   c) Test tube C was found to contain a disaccharide. Identify the enzyme and product of digestion contained in test tube C. (2 marks)
   d) Predict the effect on the speed of the reaction in test tube A if bile were added and give a reason for your answer. (2 marks)

29. Describe 4 ways in which surface area is maximized in the digestive system. (4 marks: 1 mark each)

30. The following procedure was conducted to observe the effect of pH on the rate of enzyme activity.
   - 10 mL of a starch solution was added to each of 5 lettered test tubes.
   - A different pH buffer was added to each tube resulting in the pH shown in the table below.
   - An equal amount of a starch-digesting enzyme was added to each tube.
   - Fresh samples were taken from each tube every minute and tested with IKI, an indicator that turns from yellow to black when mixed with starch.
   Results are recorded in the table below:

```
<table>
<thead>
<tr>
<th>Test tube</th>
<th>pH of the solution</th>
<th>Colour of a sample when IKI was added after:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1 minute</td>
</tr>
<tr>
<td>V</td>
<td>5</td>
<td>black</td>
</tr>
<tr>
<td>W</td>
<td>6</td>
<td>black</td>
</tr>
<tr>
<td>X</td>
<td>7</td>
<td>black</td>
</tr>
<tr>
<td>Y</td>
<td>8</td>
<td>black</td>
</tr>
<tr>
<td>Z</td>
<td>9</td>
<td>black</td>
</tr>
</tbody>
</table>
```
   a) What do the results indicate is present in all the test tubes at one minute? (1 mark)
   b) What new substance is present in test tube X at three minutes? (1 mark)
   c) Which test tube has the optimal pH for the enzyme? Explain your choice. (2 marks)
   d) After one hour, a sample from test tube Z still turned black. Using the lock and key model of enzyme action, explain these results. (2 marks)

31. Explain how digestion would be affected if the digestive functions of each of the following organs did not occur. (6 marks)
   a) Salivary glands (1 mark)
   b) Stomach (2 marks)
   c) Pancreas (3 marks)

32. Give one role for each of the following in the digestive system. (4 marks: 1 mark each)
   a) Pyloric sphincter:  
   b) Villi:  
   c) Peristalsis:  
   d) E. coli:

33. A student set up the experiment illustrated above and kept it at 37°C. After five minutes, the distilled water in the beaker was tested and found to contain a sugar but no starch.
   a) What had occurred inside the tube? (1 mark)
   b) What statement can you make about the permeability of the membrane? (1 mark)
   c) An identical experiment was set up and kept at 5 degrees C. After five minutes, how would the amount of sugar found in the water differ between the two beakers? Explain your answer. (2 marks)

34. Explain the following observations: (2 marks each)
   a) For two cells of equal volume, it is more effective for a cell that is actively metabolizing to be long and thin rather than short and fat.
   b) Human cells, when placed in saturated (5%) salt solution, will die.
   c) Human enzymes cannot break down cellulose.

35. State SIX functions of the liver. (3 marks: ½ mark each)

36. Describe how the removal of each of the following structures would affect the chemical digestion of food: a) salivary glands (1 mark) b) pancreas (4 marks)

37. Name 3 structures which provide digestive chemicals but through which food does not pass. (3 marks)
38. Complete the table by filling in the blank spaces with an appropriate word or phrase. (4 marks)

<table>
<thead>
<tr>
<th>ENZYME</th>
<th>SOURCE OF ENZYME</th>
<th>SITE OF ACTIVITY</th>
<th>PRODUCT OF DIGESTION</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>salivary glands</td>
<td>mouth</td>
<td>neutral</td>
<td></td>
<td></td>
</tr>
<tr>
<td>pepsin</td>
<td>gastric glands</td>
<td>peptides</td>
<td></td>
<td></td>
</tr>
<tr>
<td>trypsin</td>
<td>pancreas</td>
<td>alkaline</td>
<td></td>
<td></td>
</tr>
<tr>
<td>lipase</td>
<td>duodenum</td>
<td>fatty acid and glycerol</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

39. Describe how each of the following is involved in the chemical digestion of a protein:
   a) stomach (2 marks) b) pancreas (3 marks) c) small intestine (2 marks)

40. People suffering from severe obesity may have part of their small intestine removed or a section of their stomach surgically closed. From your knowledge of digestion, explain the theory behind this type of surgery.
   a) Removal of a portion of the small intestine (beyond the duodenum) (3 marks)
   b) Section of the stomach surgically closed. (2 marks)

41. A meal high in fats is consumed. Explain the activity of secretin and CCK (cholecystokinin) and GIP in the digestion of fats. (5 marks)

42. What is a function of each of the following in the digestive system? a) peristalsis (1 mark) b) hydrochloric acid (1 mark) c) large intestine (1 mark)

43. What effect will the pancreatic duct being blocked have on the normal body functions in humans? (4 marks)

44. Explain why the following may be considered non-essential organs of the digestive system.
   (8 marks: 2 marks each) a) stomach b) gall bladder c) large intestine d) mouth

45. Describe four ways the small intestine is specialized for its function. (4 marks)

46. Explain how gastric juice affects the digestive process in the stomach and small intestine. (6 marks)

47. Fill in the following table on the digestive system (4 marks: 1/2 mark each)

<table>
<thead>
<tr>
<th>ORGAN</th>
<th>SECRETION</th>
<th>pH</th>
<th>ENZYME(S) CONTAINED</th>
<th>FOOD ACTED UPON</th>
</tr>
</thead>
<tbody>
<tr>
<td>mouth</td>
<td>saliva</td>
<td></td>
<td>amylase</td>
<td>none</td>
</tr>
<tr>
<td>pancreas</td>
<td></td>
<td></td>
<td>lipase</td>
<td>trypsin</td>
</tr>
<tr>
<td>gall bladder</td>
<td>basic</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ENZYME SOURCE OF ENZYME SITE OF ACTIVITY PRODUCT OF DIGESTION pH
salivary glands mouth neutral
pepsin gastric glands peptides neutral
trypsin pancreas alkaline
lipase duodenum fatty acid and glycerol alkaline

48. If an individual were exposed to a liver toxin, such as a weed killer, the liver would gradually stop functioning. Even though the liver has stopped functioning, the individual may still live for two or three days. Using five examples explain problems this individual would have, now that the liver is no longer functioning. (10 marks)

49. Four test tubes were placed in a water bath for 15 minutes. The table below presents the contents, pH, kind of enzyme, temperature and appearance after 15 minutes.

<table>
<thead>
<tr>
<th>CONTENTS</th>
<th>pH</th>
<th>ENZYME</th>
<th>TEMPERATURE</th>
<th>APPEARANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tube 1</td>
<td>7</td>
<td>present (unboiled)</td>
<td>55º C</td>
<td>cloudy</td>
</tr>
<tr>
<td>Tube 2</td>
<td>2</td>
<td>present (unboiled)</td>
<td>37º C</td>
<td>cloudy</td>
</tr>
<tr>
<td>Tube 3</td>
<td>2</td>
<td>present (boiled)</td>
<td>15º C</td>
<td>cloudy</td>
</tr>
<tr>
<td>Tube 4</td>
<td>2</td>
<td>present (unboiled)</td>
<td>37º C</td>
<td>clear</td>
</tr>
</tbody>
</table>

a) In which tube has digestion taken place? (1 mark)
b) List and explain the reasons for your choice? (3 marks)
c) Which part of the human body produces the enzyme that is responsible for the digestion that is observed? (1 mark)
Circulatory System and Blood

1. Identify the arteries in the diagram and give one function for each.

2. The heart shown is in the process of
   A. atrial and ventricular systole. B. atrial and ventricular diastole. C. atrial systole and ventricular diastole. D. atrial diastole and ventricular systole.

3. Identify the structures in the diagram below and describe one function for each. (12 marks).
   The blood vessel found in adults that contains oxygen levels similar to the blood vessel labelled Y is the A. renal vein. B. pulmonary vein. C. pulmonary artery. D. hepatic portal vein.
4. In the table, contrast the structure and/or function of the hepatic vein versus the hepatic portal vein (4 marks).

<table>
<thead>
<tr>
<th>BLOOD VESSEL</th>
<th>LETTER FROM DIAGRAM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iliac artery</td>
<td></td>
</tr>
<tr>
<td>Aorta</td>
<td></td>
</tr>
<tr>
<td>Carotid artery</td>
<td></td>
</tr>
<tr>
<td>Subclavian artery</td>
<td></td>
</tr>
</tbody>
</table>

5. In the table, contrast the structure and/or function of the hepatic vein versus the hepatic portal vein (4 marks).

<table>
<thead>
<tr>
<th>CONTRAST 1</th>
<th></th>
<th>CONTRAST 2</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
6. The structure labelled $X$ is the
A. iliac vein.
B. renal vein.
C. subclavian vein.
D. posterior vena cava.

7. Identify the blood vessels in the diagram above (4 marks), give a function for each (4 marks), and list 3 differences in the composition of blood in blood vessels $X$ and $Y$ (3 marks).

8. The reading taken at $X$ would be at the
a) renal artery  b) pulmonary vein  c) posterior vena cava  d) peritubular capillaries

9. In the fetus, the function of the structure labelled $X$ is to
A. take blood to the lungs.
B. ensure adequate blood flow to the brain.
C. return blood from the placenta to the heart.
D. direct some of the blood away from the lungs. (1 mark)

What would be the consequences of this structure persisting after childbirth. (2 marks)
10. The graph illustrates how the body consumes stored nutrients during a prolonged period of starvation. After eight weeks, A. blood pressure will increase. B. fluids will accumulate in tissues. C. glycogen production will increase. D. hemoglobin will not release oxygen.

11. Which area indicated in the diagram is the location of the AV node? A. W  B. X  C. Y  D. Z

12. Describe how the structure of each of the following aids in its function (3 marks)
   a) artery  b) semi-lunar valve  c) capillary

13. The structure labelled X is the
   A. iliac artery.
   B. hepatic vein.
   C. carotid artery.
   D. posterior vena cava.

14. In the diagram above, the blood pressure is highest at
   A. W  B. X  C. Y  D. Z
15. Which of the following blood vessels is represented by the diagram?

   Blood capillaries and lymph capillaries both
   A. filter bacteria. B. have one-way valves. C. contain red blood cells. D. have walls which are one-cell thick.

   • one-way valves
   • thin elastic layer
   • near skeletal muscle

   The characteristics above describe which type of vessel?
   A. vein B. artery C. arteriole D. capillary

16. The graph above shows the temperature and level of oxyhemoglobin in the blood as it moves from point A to point B in the body. The shaded area on the graph would represent the

17. Blood vessel U is a(n)

18. a) Describe one function of each of the following. (3 marks)
   - Red blood cells:
   - White blood cells:
   - Platelets:
   b) Where are red blood cells produced?

19. Name structures X, Y and Z and provide a function of each. (6 marks: 1 mark for each name; 1 mark for each function)

20. The blood cells shown in the diagram above function to
   A. clot the blood. B. fight infection. C. buffer the blood. D. transport oxygen.
21. The function of the structure labelled X is to
A. initiate heartbeat.  B. channel blood to the ventricles.  
C. carry blood to the heart muscle.  D. prevent the valves from inverting.

The anterior (superior) vena cava is labelled
A. V  B. W  C. Y  D. Z

22. The graph shows blood pressure and cross-sectional area of vessels in various parts of the circulatory system. What kind of blood vessel would have the characteristics found in area Z?
A. Vein.  B. Artery.  C. Arteriole.  D. Capillary.

23. The blood cells shown in the diagram would not be able to
A. carry oxygen.  
B. fight infection.  
C. initiate a blood clot.  
D. carry carbon dioxide.

24. Systole of the ventricles is occurring at
A. W  B. X  C. Y  D. Z
25. Lymph fluid is returned to the circulatory system in the vessel labeled

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

26. Identify each blood component indicated in the diagram below and give one function of each.

(6 marks: 1 mark each for name and 1 mark each for function)

27. a) Which blood vessel in the diagram above directly supplies the heart tissue with oxygen and nutrients?

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

b) The sequence of structures through which the nerve impulse passes to cause contraction of the heart is

A. AV node – SA node – Purkinje fibres.
B. Purkinje fibres – AV node – SA node.
C. Purkinje fibres – SA node – AV node.
D. SA node – AV node – Purkinje fibres.

28. An experiment was performed to determine the effect of changing temperature on the speed of blood clotting. Whole blood was placed in labelled test tubes. The tubes were then placed in water baths of various temperatures. Time required for a clot to form was then measured. The results are graphed below. (6 marks: 2 marks each)

Give the clotting times observed at 10°C, 40°C, and 50°C and explain why these clotting times occur.

a) 10°C  b) 40°C  c) 50°C
29. The blood vessel shown carries blood between organs at locations X and Y. Blood flow through the vessel would be from the
A. heart at X to the kidneys at Y. B. intestine at Y to the liver at X. C. heart at Y to the kidneys at X. D. intestine at X to the liver at Y.

30. The chordae tendineae are indicated by the letter
A. W  B. X  C. Y  D. Z

31. Each of four Biology 12 students carries out the following procedures to determine his/her blood type. Each student is provided with a prepared card with four squares:
- Square W is prepared with anti-A solution which causes agglutination in blood containing
  the A antigen.
- Square X is prepared with anti-B solution which causes agglutination in blood containing
  the B antigen.
- Square Y is prepared with anti-Rh solution which causes agglutination in blood containing
  the Rh antigen. Blood which contains the Rh antigen is said to be Rh+, while blood without
  the Rh antigen is said to be Rh-.
- Square Z is a control (no solutions added).

Each student adds a drop of his/her own blood to each square on his/her card. The results are shown below:

<table>
<thead>
<tr>
<th></th>
<th>W anti-A</th>
<th>X anti-B</th>
<th>Y anti-Rh</th>
<th>Z control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a) What is the blood type of Student 2? (1 mark)
b) Which student(s) may receive a transfusion of A blood (A-type blood that is Rh+) with no ill effect? (1 mark)
c) Which student has made an error in his/her exercise? Explain how you know an error was made. (2 marks)
d) If Student 1 is a female, what condition should her doctor alert her to if she becomes pregnant? (1 mark)

32. State one function of each of the following heart structures.
a) SA node: (1 mark)  b) Coronary arteries: (1 mark)  c) Atrioventricular valves: (1 mark)
d) Right ventricle: (1 mark)
33. a) Explain why people with “O” type blood are termed universal donors, yet are limited in the blood they can receive. (2 marks)
   b) If an Rh negative mother has a second Rh positive child, there may be fetal erythroblastosis.
   i) Explain the cause of erythroblastosis. (2 marks)
   ii) State one way that erythroblastosis could be prevented. (1 mark)

34. In the table below, state one function of each vessel and describe the vessel’s structure that facilitates this function. (6 marks: 1 mark for function, 1 mark for structure)
   a) Arteries  b) Veins  c) Capillaries

35. Which letter represents a graph indicating the total cross-sectional area of the body’s blood vessels?
   A. W  B. X  C. Y  D. Z

36. a) The graph above shows changes in arterial blood pressure over time. Which letter would indicate ventricular systole? A. W  B. X  C. Y  D. Z
   b) Which of the following is a characteristic of systemic circulation?
      A. Highly oxygenated arterial blood.  B. Increased blood pressure in the veins.  C. Low carbon dioxide concentration in the veins.  D. Increased concentration of reduced hemoglobin (HHb) in the arterial blood.

37. Under what conditions would:
   a) more blood sugar be found in the hepatic portal vein than in the hepatic vein? (2 marks)
   b) more blood sugar be found in the hepatic vein than in the hepatic portal vein? (2 marks)
   c) blood sugar levels decrease below normal levels? (1 mark)

38. Trace the flow of red blood cells through the heart of a mature human, naming all the valves, vessels and chambers, starting with venous blood entering the heart and arterial oxygenated blood leaving the heart. (7 marks: 1/2 mark for each item, 1/2 mark for proper sequence)

39. a) Name two structures that exist in the human fetal circulation system that are non-functional in the adult. Outline their function in the fetal circulatory system and explain why they are unnecessary in the adult. (5 marks)
   b) What effect will the foramen ovale (oval opening) not closing after birth have on the normal body functions in humans? (2 marks)

40. Describe the structure of each one of the following blood vessels and explain how it is related to its function: a) artery (2 marks) b) vein (2 marks) c) capillary (2 marks)
41. Hypoxia refers to the condition in which the availability or utilization of oxygen is depressed. The data in the chart was obtained from 5 different subjects: one with normal condition and four having different types of hypoxia caused by various problems.

<table>
<thead>
<tr>
<th>Subject</th>
<th>Haemoglobin (g Hb/100 mL of blood)</th>
<th>O₂ content of arterial blood</th>
<th>O₂ content of venous blood</th>
<th>Cardiac output (L/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>15</td>
<td>19</td>
<td>15</td>
<td>5.0</td>
</tr>
<tr>
<td>Hypoxia A</td>
<td>15</td>
<td>15</td>
<td>12</td>
<td>6.6</td>
</tr>
<tr>
<td>Hypoxia B</td>
<td>8</td>
<td>9.5</td>
<td>6.5</td>
<td>7.0</td>
</tr>
<tr>
<td>Hypoxia C</td>
<td>15</td>
<td>19</td>
<td>10</td>
<td>3.0</td>
</tr>
<tr>
<td>Hypoxia D</td>
<td>15</td>
<td>18</td>
<td>no info</td>
<td></td>
</tr>
</tbody>
</table>

a) Which subject may be suffering from an iron deficiency? Support your answer with a reason. (2 marks)
b) Which subject may be suffering from heart failure and poor circulation? Why? (2 marks)
c) Which subject may have been recently exposed to carbon monoxide gas? Why? (2 marks)
d) Which subject may be suffering from poisoning which prevents the cells from taking up oxygen? Why? (2 marks)
e) Subject B has an increased breathing rate. Suggest a possible physiological reason for this. (2 marks)

42. a) Explain why there is a sharp drop in pressure as blood moves from arteries to capillaries. (1 mark)
b) Give an advantage of having low pressure in capillaries. (1 mark)

43. Certain tissues of the heart are responsible for its rhythmic contraction. Name these tissues and explain how they work to regulate and co-ordinate a rhythmic contraction of the heart. (4 marks)

44. A blood pressure reading 120/80 mm of Hg is considered normal.  
   a) Explain what could cause an individual to have a resting systolic pressure reading 160 mm of Hg (2 marks)  
   b) Is it possible to have a blood pressure reading 120/140 mm of Hg? Explain. (2 marks)

45. Give one function of each of the following in the circulatory system: (7 marks) a) red blood cells  
   b) platelets  
   c) pulmonary artery  
   d) hepatic portal vein  
   e) S-A node  
   f) arterial duct  
   g) hemoglobin

46. Name and give one function for each of the indicated parts: (10 marks)

47. A person’s arm was scraped. Within a few minutes, the region became inflamed. The area became reddish in colour (not due to bleeding), slightly swollen and warm to the touch. Explain the physiological cause of each symptom. a) reddish colour (1 mark)  
   b) swelling (2 marks)  
   c) warmth (1 mark)

48. Outline the physiological responses which occur in a human during the first hours following an accident which caused severe bleeding. (10 marks)
49. | **BODY PARTS** | **AT REST** mL\(^3/\text{min}\) | **LIGHT EXERCISE** mL\(^3/\text{min}\) | **FAIRLY STRENUEOUS EXERCISE** mL\(^3/\text{min}\) | **MAXIMUM EXERTION** mL\(^3/\text{min}\) |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart muscles</td>
<td>250</td>
<td>350</td>
<td>750</td>
<td>1000</td>
</tr>
<tr>
<td>skeletal muscles</td>
<td>1200</td>
<td>4500</td>
<td>12500</td>
<td>22000</td>
</tr>
<tr>
<td>kidneys</td>
<td>1100</td>
<td>900</td>
<td>600</td>
<td>250</td>
</tr>
<tr>
<td>gut</td>
<td>1400</td>
<td>1100</td>
<td>600</td>
<td>300</td>
</tr>
<tr>
<td>skin</td>
<td>500</td>
<td>1500</td>
<td>1900</td>
<td>600</td>
</tr>
<tr>
<td>brain</td>
<td>750</td>
<td>750</td>
<td>750</td>
<td>750</td>
</tr>
<tr>
<td>all other regions</td>
<td>600</td>
<td>400</td>
<td>400</td>
<td>100</td>
</tr>
<tr>
<td>TOTAL</td>
<td>5800</td>
<td>9500</td>
<td>17500</td>
<td>25000</td>
</tr>
</tbody>
</table>

The table above shows the blood flow for different parts of the human body, at rest during different levels of physical activity. Explain and give reasons for the figures for each of the following:

a) kidneys (2 marks)  
b) brain (1 mark)  
c) skin (2 marks)  

Compare and contrast the blood flow to the heart and skeletal muscles.  (3 marks)

50. a) Name two structures that exist in the human fetal circulation system that are non-functional in the adult. Outline their function in the fetal circulatory system and explain why they are unnecessary in the adult. (5 marks)  
b) What effect will the foramen ovale (oval opening) not closing after birth have on the normal body functions in humans? (2 marks)

51. Describe the structure of each one of the following blood vessels and explain how it is related to its function: a) artery (2 marks)  
b) vein (2 marks)  
c) capillary (2 marks)

52. a) Explain why there is a sharp drop in pressure as blood moves from arteries to capillaries. (1 mark)  
b) Give an advantage of having low pressure in capillaries. (1 mark)

53. Certain tissues of the heart are responsible for its rhythmic contraction. Name these tissues and explain how they work to regulate and co-ordinate a rhythmic contraction of the heart. (4 marks)

54. A blood pressure reading 120/80 mm of Hg is considered normal.

a) Explain what could cause an individual to have a resting systolic pressure reading 160 mm of Hg (2 marks)  
b) Is it possible to have a blood pressure reading 120/140 mm of Hg? Explain. (2 marks)

55. Give one function of each of the following in the circulatory system: (7 marks)  
a) red blood cells  
b) platelets  
c) pulmonary artery  
d) hepatic portal vein  
e) S-A node  
f) arterial duct  
g) hemoglobin

56. Both diagrams are drawn to the same scale and represent the heart at the end of the ventricular systole.  
a) Explain two physiological problems this subject will immediately face as result of the damage to the A-V valves. (2 marks)  
b) Explain two major changes that will occur to the heart during the year to help it re-establish homeostasis. (2 marks)  
c) Explain two further changes that are likely to have occurred in the rest of the circulatory system to help it re-establish homeostasis. (2 marks)
Respiratory System

1. A function of the structure labelled X is to
   A. produce sound.  B. exchange gases.  C. carry air into and out of the lung.  D. stimulate the breathing centre in the brain.

2. Identify structure X in the above diagram and relate its structure to its function (3 marks)

3. Describe how the upper respiratory tract is specialized to keep the lungs free of debris (3 marks)

4. Which of the following would cause the effect shown?
   A. increased oxygen in the blood  B. increased numbers of red blood cells  C. increased carbon dioxide in the blood  D. decreased concentration of hydrogen ions

5. Which of the following reactions occurs in a capillary of the leg?
   A. Hb + H⁺ \rightarrow HHb  B. HbCO₂ \rightarrow Hb + CO₂  C. Hb + oxygen \rightarrow HbO₂  D. H⁺ + HCO₃⁻ \rightarrow H₂CO₃

6. Identify three substances transported by hemoglobin in the blood and give the name of each form of hemoglobin. (3 marks: ½ mark each)

7. Describe the interaction of the lungs, pleural membranes, ribs, and diaphragm during inhalation. (4 marks)

8. a) Explain how each of the following structures functions in the process of inhalation. (2 marks)
   • Diaphragm:
   • Ribs:
   b) What role does each of the following have in breathing? (2 marks)
   • Medulla oblongata:
   • Pleural membranes:
9. a) Label structures W, X, Y and Z on the diagram. (4 marks: 1 mark each)  
b) Describe the roles of structures W, X and Z in the process of inhalation. (3 marks)  
c) Why are the pleural membranes important to the inhalation process? (1 mark)

10. How is the structure of the alveoli ideally suited to the exchange of gases with the blood? (4 marks)

11. The structure that increases thoracic volume when it contracts is A. W  B. X  C. Y  D. Z

Alveoli would not be characterized as A. muscular.  B. thin-walled.  C. vascularized.  D. secreting a lipoprotein.

12. The structure labelled X is held open by A. cartilage. B. vocal cords. C. a lipoprotein layer. D. a pleural membrane.

Which of the following is the site of external respiration? A. Alveoli. B. Bronchioles. C. Mitochondria. D. Muscle tissue.

13. The graph shows changes in air pressure in the thoracic cavity during breathing. Which of the following occurs between times X and Y?  
A. Rib muscles relax and diaphragm relaxes.  
B. Rib muscles relax and diaphragm contracts.  
C. Rib muscles contract and diaphragm relaxes.  
D. Rib muscles contract and diaphragm contracts.
14. An experiment was carried out to determine factors affecting human blood’s ability to carry oxygen. The results are shown in the graph above. Which of the following may have caused the change at time X? A. Water was removed from the plasma. B. More platelets were added to the blood. C. Stimulation of the medulla oblongata increased breathing rate. D. A competitive inhibitor of hemoglobin was added to the blood.

15. The following reaction takes place in the blood:

\[ \text{CO}_2 + \text{H}_2\text{O} \xrightarrow{X} \text{H}_2\text{CO}_3 \rightarrow \text{H}^+ + \text{HCO}_3^- \]

Substance X would be A. thrombin. B. calcium ions. C. carbonic anhydrase. D. prothrombin activator.

16. How is the structure of the alveoli ideally suited to their function? (3 marks)

17. Which of the following represents the composition of blood at X shown in the diagram on the right?

<table>
<thead>
<tr>
<th>A.</th>
<th>B.</th>
<th>C.</th>
<th>D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>low</td>
<td>high</td>
<td>high</td>
<td>high</td>
</tr>
<tr>
<td>high</td>
<td>low</td>
<td>low</td>
<td>low</td>
</tr>
<tr>
<td>low</td>
<td>low</td>
<td>high</td>
<td>high</td>
</tr>
<tr>
<td>high</td>
<td>high</td>
<td>low</td>
<td>low</td>
</tr>
</tbody>
</table>

18. Give one function of each of the following. (3 marks: 1 mark each)
   a) Cilia in the trachea:
   b) Pleural membranes:
   c) Hemoglobin:

19. a) In the diagram, structure W is a bronchiole. Name structure X. (1 mark)
   b) List two characteristics structure X and explain how these characteristics facilitate (assist) the function of the whole structure (4 marks: 1 mark for each characteristic, 1 mark for each explanation.)
   c) Describe two processes that occur at structure X. (2 marks)

20. High concentrations of bicarbonate ion (\(\text{HCO}_3^-\)) in the blood will result in A. increased rate of breathing. B. decreased rate of breathing. C. increased pressure in the chest cavity. D. decreased nervous stimulation of the diaphragm.

21. The graph represents the uptake of \(\text{O}_2\) by the blood during external respiration. a) Give a reason for the oxygen concentration in the arteriole. (1 mark) b) Explain why there is a steady increase between 45 and 104 mm Hg pressure. (2 marks) c) Account for the leveling off of the graph. (2 marks)

22. Give THREE roles of hemoglobin in the circulatory system. (3 marks: 1 mark each)
23. Describe the changes that occur to the ribs, the muscles between the ribs and the diaphragm during inspiration (breathing in). (4 marks)

24. Describe the chemical process that occurs as oxygen and carbon dioxide are exchanged at the lung alveoli. (2 marks)

25. What is the relationship between the following terms as they related to respiratory function?
   a) medulla oblongata and diaphragm (2 marks)
   b) intercostal muscles and inspiration (2 marks)
   c) cigarette smoke and trachea (2 marks)
   d) alveoli and pulmonary capillaries (2 marks)
   e) hemoglobin and carbon dioxide (2 marks)

26. Describe the characteristics of an alveolus and explain how these characteristics are related to its function. (4 marks)

27. What effect will the wall of the chest cavity being punctured have on the normal body functions in humans? (2 marks)

28. Explain a mechanism by which debris in the bronchi is eliminated. (2 marks)

29. Describe the role of each of the following in the normal functioning of the respiratory system: (5 marks)
   a) alveoli
   b) diaphragm
   c) pleural membranes
   d) chemoreceptors in carotid arteries
   e) cilia

30. Use your knowledge of respiration to answer the following questions.
   a) In what three forms is carbon dioxide carried in the blood? (3 marks)
   b) Describe the reaction whereby H₂O and CO₂ are produced in the lung capillaries. (1 mark)
   c) What is the function of carbonic anhydrase in the above reaction? (1 mark)

31. Describe the role of carbonic anhydrase, hydrogen ions and hemoglobin in the exchange of gases at the tissue level (internal respiration). (5 marks)

32. A person was brought to the emergency room unconscious. Breathing was shallow and irregular. A blood sample showed the blood pH to be 7.8 (normal pH = 7.4). A mechanical respirator, which increases breathing rate, was inserted and sodium bicarbonate was administered intravenously.
   a) Explain why the lowered breathing rate lowers the blood pH. (3 marks)
   b) How does the respirator help return the blood pH to normal? (1 mark)
   c) What was the reason for administering the sodium bicarbonate? (1 mark)

33. a) What substance(s) stimulate(s) the breathing centre to stimulate inspiration? (1 mark)
   b) Give the location in the brain of the breathing center. (1 mark)
   c) Give two characteristics of alveoli (2 marks)

34. The following table shows the relative amount of oxygen consumed by the major organs in an adult human.

<table>
<thead>
<tr>
<th>OXYGEN CONSUMPTION</th>
<th>REST</th>
<th>HEAVY WORK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skeletal Muscles</td>
<td>0.30</td>
<td>6.95</td>
</tr>
<tr>
<td>Digestive Organs</td>
<td>0.25</td>
<td>0.20</td>
</tr>
<tr>
<td>Heart</td>
<td>0.11</td>
<td>0.40</td>
</tr>
<tr>
<td>Kidneys</td>
<td>0.07</td>
<td>0.70</td>
</tr>
<tr>
<td>Brain</td>
<td>0.20</td>
<td>0.20</td>
</tr>
<tr>
<td>Skin</td>
<td>0.20</td>
<td>0.08</td>
</tr>
<tr>
<td>Other</td>
<td>0.05</td>
<td>0.06</td>
</tr>
</tbody>
</table>

Explain the change in the uptake of oxygen between rest and heavy work by each of the following:
   a) skeletal muscles (2 marks)
   b) skin (2 marks)
   c) heart (1 mark)
   d) digestive organs (2 marks)
   e) brain (1 mark)
35. Hypoxia refers to the condition in which the availability or utilization of oxygen is depressed. The data in the chart was obtained from 5 different subjects: one with normal condition and four having different types of hypoxia caused by various problems.

<table>
<thead>
<tr>
<th>Subject</th>
<th>Haemoglobin (g Hb/100 mL of blood)</th>
<th>O₂ content of arterial blood</th>
<th>O₂ content of venous blood</th>
<th>Cardiac output (L/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>15</td>
<td>19</td>
<td>15</td>
<td>5.0</td>
</tr>
<tr>
<td>Hypoxia A</td>
<td>15</td>
<td>15</td>
<td>12</td>
<td>6.6</td>
</tr>
<tr>
<td>Hypoxia B</td>
<td>8</td>
<td>9.5</td>
<td>6.5</td>
<td>7.0</td>
</tr>
<tr>
<td>Hypoxia C</td>
<td>15</td>
<td>19</td>
<td>10</td>
<td>3.0</td>
</tr>
<tr>
<td>Hypoxia D</td>
<td>15</td>
<td>19</td>
<td>no info</td>
<td></td>
</tr>
</tbody>
</table>

a) Which subject may be suffering from an iron deficiency? Support your answer with a reason. (2 marks)
b) Which subject may be suffering from heart failure and poor circulation? Why? (2 marks)
c) Which subject may have been recently exposed to carbon monoxide gas? Why? (2 marks)
d) Which subject may be suffering from poisoning which prevents the cells from taking up oxygen? Why? (2 marks)
e) Subject B has an increased breathing rate. Suggest a possible physiological reason for this. (2 marks)

---

**Excretory System**

1. a) Label the parts indicated above and give one function for structures Y and Z

b) Which of the following is not a function of the organ shown?
A. to produce urea  B. to excrete metabolic wastes  C. to regulate the acidity of the blood  D. to maintain a constant blood volume

2. The process that occurs at W is

The permeability of which structure is altered by secretions from the adrenal cortex?
A. W  B. X  C. Y  D. Z

3. The structure labelled X is the

The function of the structure labelled Y is to
4. Demonstrate your understanding of negative feedback by describing how the kidneys and the hypothalamus work together to regulate blood volume (5 marks)

5. 
   a) Identify the parts of the nephron in the following diagram.

   b) Compare and contrast the composition of blood in V with Z

   c) In a healthy person, the sequence of structures through which most glucose molecules pass is

6. Plasma from a student was analyzed before and after a ten kilometer cross-country run. During the run, the student became dehydrated. Explain how the resulting lowered blood volume is detected by the body and describe a homeostatic mechanism by which it is returned to normal. (6 marks)

7. Describe the process by which each of the following affects the composition of filtrate in the nephron (4 marks, 2 marks each)  a) proximal tubule  b) Loop of Henle

8. 
   a) Using the following diagram, label the parts of a nephron in the blanks provided. (3 marks)

   b) Identify one hormone that responds to a decrease in blood volume and explain how this hormone functions to return blood volume to normal levels. (4 marks: 1 mark for name; 3 marks for explanation)

9. In a healthy person, the following substances enter the kidneys via the renal arteries in the amounts shown:

<table>
<thead>
<tr>
<th>UREA (grams/day)</th>
<th>GLUCOSE (grams/day)</th>
<th>WATER (litres/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>54</td>
<td>180</td>
<td>180</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>UREA (grams/day)</th>
<th>GLUCOSE (grams/day)</th>
<th>WATER (litres/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. 10</td>
<td>100</td>
<td>170</td>
</tr>
<tr>
<td>B. 24</td>
<td>180</td>
<td>178</td>
</tr>
<tr>
<td>C. 54</td>
<td>178</td>
<td>177</td>
</tr>
<tr>
<td>D. 70</td>
<td>180</td>
<td>180</td>
</tr>
</tbody>
</table>

10. 8. Give two functions of each of the following urinary system structures. (6 marks)
    a) Kidney b) Collecting duct c) Proximal tubule
11. a) At which location would the greatest concentration of glucose be found?
   A. W  B. X  C. Y  D. Z

   b) The inability to regulate the concentration of sodium ions in the blood could be due to improper functioning of the
   A. adrenal cortex, since it produces ADH.
   B. adrenal cortex, since it produces aldosterone.
   C. adrenal medulla, since it produces ADH.
   D. adrenal medulla, since it produces aldosterone.

12. Identify the structures on the diagram and give a different function of each structure.
   (8 marks: 1 mark each for name; 1 mark each for function)

13. Demonstrate your understanding of negative feedback by describing how the kidneys and the hypothalamus work together to regulate blood volume. (5 marks)

14. Give three functions of the bicarbonate ion HCO$_3^-$ in the body and identify one specific location of each function. (6 marks: 2 marks each)

15. The maintenance of optimum pH is essential to living systems. Give three different locations in the body where pH is regulated and explain how it is maintained.
   (6 marks: 1 mark each for locations; 1 mark each for explanations)

16. Describe the process by which each of the following affects the composition of filtrate in the nephron. (4 marks: 2 marks each)
   a) Proximal Tubule
   b) Loop of Henle

17. State one function of each of the following. (8 marks: 1 mark each)
   i) Glomerulus:
   ii) Aldosterone:
   iii) Ureter:
   iv) Distal convoluted tubule:
   v) Urinary bladder:
   vi) Peritubular capillary network:
   vii) Renal pelvis:

18. a) List two substances that are selectively reabsorbed at the proximal convoluted tubule of a nephron. (1 mark: 1/2 mark each)
   b) List two substances that are excreted at the distal convoluted tubule of a nephron. (1 mark: 1/2 mark each)
   c) What effect does increased antidiuretic hormone (ADH) have on urine production? (1 mark)

20. a) On the diagram on the right, indicate and label the appropriate location for each of the following terms associated with urine formation. (3 marks)
   • Selective Reabsorption
   • Pressure Filtration
   • Tubular Excretion (Augmentation)

   b) State what happens during each of the following processes.
   (3 marks: 1 mark each)
   • Selective Reabsorption:
   • Pressure Filtration:
   • Tubular Excretion:

21. a) High concentrations of ADH (antidiuretic hormone) in the blood will result in
   A. increased excretion of H₂O. B. decreased pressure filtration. C. decreased reabsorption of glucose. D. increased solute concentration of the urine.

   b) Which of the following describes the tissues surrounding the loop of Henle?
   A. High H⁺ concentration, high K⁺ concentration. B. Low water concentration, low salt concentration. C. High salt concentration, low water concentration. D. High water concentration, low K⁺ concentration.

   c) If the blood is excessively acidic, it will likely lead to urine
   A. of increased pH. B. of decreased pH. C. with increased Na⁺ concentration. D. with decreased NH₃ concentration.

   d) Which of the following symptoms might be an indication of kidney failure?

22. The inner portion (labelled X) of the endocrine gland above secretes
   A. insulin.
   B. cortisol.
   C. adrenalin.
   D. aldosterone.
23. Use the following list to answer the next question.

Proximal tubule  Loop of Henle  Distal tubule
Bowman’s capsule  Collecting duct  Glomerulus

a) Label the structures indicated on the following diagram using the terms given above.
(3 marks: ½ mark each)
b) Give ONE role of each of the following in the production of urine. (3 marks: 1 mark each)
i) Glomerulus:
ii) Proximal tubule:
iii) Distal tubule:

24. a) Distinguish between positive and negative feedback. (2 marks)
b) Choose a negative feedback system and explain how it operates to maintain homeostasis. (4 marks)

25. a) Name the parts X and Y in the diagram
b) List three ways that the blood in vessel Y differs from the blood in vessel X

26. The table shows the amounts of substances present in human blood plasma, glomerular filtrate and urine. All are measured in grams per 100 cm$^3$ of fluid.

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>PLASMA</th>
<th>FILTRATE</th>
<th>URINE</th>
</tr>
</thead>
<tbody>
<tr>
<td>glucose</td>
<td>0.10</td>
<td>0.10</td>
<td>nil</td>
</tr>
<tr>
<td>amino acids</td>
<td>1.05</td>
<td>1.05</td>
<td>nil</td>
</tr>
<tr>
<td>proteins</td>
<td>8.00</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>inorganic salts</td>
<td>0.72</td>
<td>0.72</td>
<td>1.50</td>
</tr>
<tr>
<td>urea</td>
<td>0.03</td>
<td>0.03</td>
<td>2.00</td>
</tr>
<tr>
<td>uric acid</td>
<td>0.004</td>
<td>0.004</td>
<td>0.05</td>
</tr>
</tbody>
</table>

a) Account for the differences in the levels of proteins in the plasma and filtrate. (1 mark)
b) The concentration of inorganic salts in urine is approximately double that present in the filtrate. Explain this difference. (3 marks)

27. Alcohol appears to inhibit the secretion of anti-diuretic hormone (ADH). Predict the results of alcohol intake on the following. Include in your answer a description of the mechanism responsible for the resulting concentration.
a) solute concentration of the blood plasma (3 marks)
b) urine production (2 marks)

28. Explain the role of the following in the excretory system: a) proximal tubule (2 marks) b) collecting duct (2 marks) c) bladder (1 mark)
29. Assume that a bacterial infection results in large perforations in the glomerulus and the Bowman’s capsule of a patient.
   a) How will the glomerular filtrate in the diseased person compare to the glomerular filtrate of a healthy person? (2 marks)
   b) What effect will this have on the level of antidiuretic hormone (ADH) circulating in the bloodstream? (1 mark)
   c) A person with this disease would experience swelling of the body tissues. Using your knowledge of kidney function and the blood tonicity, explain the mechanism that accounts for this swelling. (3 marks)

30. What effect will anti-diuretic hormone (ADH) not being produced in the hypothalamus have on the normal body functions in humans? (2 marks)

31. Trace the flow of urine from the kidney to the outside of the body by listing the following structures in the correct order and state a function of each: urethra, ureter, urinary bladder. (2 marks each)

32. | SUBSTANCE | CONCENTRATION IN PLASMA g/100 mL | CONCENTRATION IN FILTRATE g/100 mL | CONCENTRATION IN URINE g/100 mL |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Glucose</td>
<td>0.100</td>
<td>0.100</td>
<td>0.000</td>
</tr>
<tr>
<td>b. Protein</td>
<td>8.00</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>c. Ammonia</td>
<td>0.004</td>
<td>0.004</td>
<td>0.07</td>
</tr>
</tbody>
</table>

   a) Account for the filtrate and urine concentrations in each of the above substances by stating the part of the nephron and the process or processes responsible for producing each of the concentration values. (9 marks)
   b) Explain what could cause high levels of glucose in the urine. (2 marks)

33. Give one function for each of the following parts of the excretory system. (4 marks: 1 mark each)
   a) ureter  b) glomerulus  c) distal tubule  d) bladder  e) proximal tubule

34. What are the three possible routes through the kidney of a glucose molecule after it enters the renal artery? (4 marks)
   b) Which one of the routes through the kidney would a urea molecule NOT take? (1 mark)
   c) How does the kidney respond when the blood is too acidic? (4 marks)

35. Explain how aldosterone helps to maintain blood volume. Detail the steps associated with the release of aldosterone, as well as the feedback loop associated with the control of its release. (8 marks)

36. The anterior pituitary gland has been called the “master gland.” Justify this claim using two specific examples. (4 marks)

37. A woman with a malfunctioning adrenal gland has excess facial hair. All other glands function normally.
   a) Describe the location of the adrenal gland (1 mark)
   b) Which part of the adrenal gland has malfunctioned? (1 mark)
   c) Explain how the malfunctioning has caused this excess facial hair. (1 mark)

38. What effect will each of the following have on the quantity and the composition of urine? Give an explanation for each effect. (6 marks)
   a) Low arterial blood pressure. (3 marks)
   b) Impaired function of the posterior lobe of the pituitary gland. (3 marks)

39. Describe how the brain and the endocrine system work together to maintain homeostasis when the osmotic pressure (high solute concentration) of the blood increases. (8 marks)

40. Using human subjects, an investigation was carried out to look at the effect of drinking distilled water on the production and composition of the urine. At the start of the experiment the subjects emptied their bladders and then rapidly drank 800 mL of distilled water. The subjects then emptied their bladders at regular intervals and the volume of urine and the salt concentration were recorded. The results are shown on the chart below.

   By referring to the charts and by using your knowledge of kidney function, answer the following:
   a) Explain why the volume of urine has changed between 30 and 90 minutes. (2 marks)
   b) Explain why the volume of urine has changed between 90 and 150 minutes. (2 marks)
   c) In another similar experiment the subjects consumed 200 mL of isotonic saline, but the volume of urine remained normal. Explain why. (2 marks)
   d) Explain why the salt concentration of urine changed between 30 and 90 minutes (2 marks)
   e) State two factors (regarding human subjects) that would have to be kept constant during this experiment. (2 marks)
Nervous System

1. Identify structures X, Y and Z and give one function of each. (6 marks: 1 mark each for name; 1 mark each for function)

2. Which processes are involved in the movement of molecule Y from point X to point Z? A. exocytosis and diffusion  B. endocytosis and diffusion  C. exocytosis and facilitated transport  D. endocytosis and facilitated transport

3. The structure labeled X is the A. cerebrum. B. cerebellum. C. hypothalamus. D. corpus callosum

4. The structure labelled X is a(n) A. node.  B. axon.  C. synapse.  D. dendrite.
   If an impulse started at V, it would travel to A. W and X.  B. W and Z.  C. X and Z.  D. Y and Z.
5. Describe, in correct order, the events that occur during the transmission of a nerve impulse from point X to point Y. (8 marks)

6. Describe the process which occurs at the circled area labelled X when a nerve impulse travels through this area. (6 marks)

7. | NEURON | TYPE OF NEURON | AMOUNT OF NEUROTRANSMITTER RELEASED |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>Inhibitory</td>
<td>100 units</td>
</tr>
<tr>
<td>W</td>
<td>Inhibitory</td>
<td>50 units</td>
</tr>
<tr>
<td>X</td>
<td>Excitatory</td>
<td>100 units</td>
</tr>
<tr>
<td>Y</td>
<td>Excitatory</td>
<td>75 units</td>
</tr>
<tr>
<td>Z</td>
<td>Excitatory</td>
<td>25 units</td>
</tr>
</tbody>
</table>

In order for a nerve impulse to be transmitted across the synapse, the amount of excitatory neurotransmitter must exceed that of inhibitory neurotransmitter by an amount called the “threshold.” Which of the following combinations will result in the firing of a neuron whose threshold is 120 units?
A. Y and Z  B. V and W  C. V, X and Y  D. W, X and Y

A pesticide that destroys an enzyme found in the synaptic cleft may cause
A. denaturation of the presynaptic contractile proteins.
B. an increased rate of diffusion across the synaptic cleft.
C. continued depolarization of the postsynaptic membrane.
D. alteration of the receptors on the presynaptic membrane.
8. Label and give a function for the following parts of the brain.

9. Name each of the neurons on the diagrams and for each give its role in a reflex arc (6 marks)

   X

   Y

   Z
10. Distance

<table>
<thead>
<tr>
<th>Distance</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fibre Y</td>
<td></td>
</tr>
<tr>
<td>Fibre X</td>
<td></td>
</tr>
</tbody>
</table>

a) In an experiment to investigate the speed of nerve impulse transmission along two types of nerve fibres, the data produced are summarized in the above graph.
   i. Which of the two nerve fibres (X or Y) would have a myelin sheath (1 mark)  b) explain your choice (2 marks)
   ii. It is found that after continuous stimulation for extended periods of time, it becomes difficult to conduct a nerve impulse along a fibre. Suggest TWO reasons for this (2 marks, 1 mark each)

b) Explain each of the following:
   i. slices of potato placed in concentrated salt water lose mass (2 marks)
   ii. decreased concentration of salt in the blood may lead to decreased blood pressure (2 marks)
   iii. Substances containing bicarbonate ions (HCO₃⁻) are used as a remedy for heartburn or an upset stomach. Explain why HCO₃⁻ may be effective (2 marks)
   iv. If the nucleus of a cell is destroyed, the cell does not die immediately (1 mark)

c) In the diagram above, If an action potential was initiated at neuron X, an impulse would be generated in  A. X only.  B. X and Y  C. X and Z.  D. Y and Z.
11. Describe two ways in which a drug could block transmission of an impulse at the synapse (2 marks).

12. Describe two ways in which a drug could block transmission of an impulse at the synapse (2 marks).

13. Dilation of the pupils is initiated by secretions from
   A. W
   B. X
   C. Y
   D. Z

14. The diagram below represents a section of an axon.

   **outside the axon:** increased concentration of potassium ions (K⁺)

   **inside the axon:** increased concentration of sodium ions (Na⁺)

   Given the conditions in the diagram, what will occur next?
   A) repolarization b) depolarization c) recovery period d) synaptic transmission
15.

a) If molecule X causes depolarization at Y, what could X be?
A. sodium ions  B. calcium ions  C. acetylcholine  
D. acetylcholinesterase

b) The molecules labelled X function to: A. open sodium ion gates.  
B. speed up the transmission of impulses.  
C. provide an energy source for the resting potential.  
D. tell the brain the kind of stimulus that is being received.

c) How does the molecule indicated by X move across the space above?

d) Which of the following is a true statement about the sympathetic and parasympathetic nervous systems?
A. Sympathetic system causes increased rates of digestion while the parasympathetic system causes decreased rates of digestion.  
B. Sympathetic system causes decreased breathing rate while the parasympathetic system causes increased breathing rate.  
C. Sympathetic system causes constriction of the iris while the parasympathetic system causes dilation of the iris.  
D. Sympathetic system causes increased heart rate while the parasympathetic system decreases heart rate.

16.

Name all of the structures in the above diagram (4 marks). Which letter indicates a structure that speeds the transmission of nerve impulses?
A. W  B. X  C. Y  D. Z

17.

The structure labelled X represents a(n)  A. effector.  B. receptor.  C. interneuron.  D. sensory neuron.

18. Explain how an action potential is generated in a neuron. (4 marks)

19. Describe the transmission of a nerve impulse through a neuron. (8 marks)
20. An axon was stimulated at one place and the voltage changes across the membrane were recorded as shown in the following graph.

What would be the effect if the intensity (amount) of stimulus was increased?
A. The frequency of impulses would increase.  B. The resting potential would increase from $-60\text{mV}$ to $-40\text{mV}$.  C. Each action potential would increase from $+40\text{mV}$ to $+60\text{mV}$.  D. Polarity changes would occur during the recovery (refractory) period.

21. The diagram represents a simple reflex arc. Identify structures V, W, X, Y and Z and give one function of each structure. (5 marks: 1/2 mark for each name, 1/2 mark for each function)

22. The function of structure X is to
A. control the breathing and heart rate.
B. secrete hormones that control organs of the body.
C. channel nerve impulses to the appropriate part of the brain.
D. exchange information between right and left cerebral hemispheres.

23. Explain how a nerve impulse travels from one neuron to another. (4 marks)

24. Describe two ways in which a drug could block transmission of an impulse at the synapse. (2 marks)

25. Identify each part of the brain indicated in the diagram below and give one function of each. (6 marks: 1 mark each for name and 1 mark each for function)
26. A certain drug inhibits the action of a neurotransmitter. The effects of the drug are shown in the table below.

<table>
<thead>
<tr>
<th></th>
<th>BEFORE DRUG</th>
<th>AFTER DRUG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breathing rate</td>
<td>40</td>
<td>30</td>
</tr>
<tr>
<td>(breaths/minute)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heart rate</td>
<td>90</td>
<td>63</td>
</tr>
<tr>
<td>(beats/minute)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blood flow to small</td>
<td>1 400</td>
<td>1 800</td>
</tr>
<tr>
<td>intestine (mL/minute)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This drug affected the

27. 

a) A chemical produced by the puffer fish prevents the opening of sodium gates in neurons but has no effect on chemical synapses. In which location on a sensory neuron would impulse transmission initially be stopped when this chemical is injected into the foot?

b) The cerebral lobe of the brain that contains areas responsible for the sensations of touch, temperature, pressure and pain, and for the understanding of speech is the

28. The average heart rate (beats per minute) of a group of figure skaters was calculated every two minutes over a 14 minute period which included a ten minute skating exercise. Heart rates were recorded at both the beginning and end of the skating season. The results appear in the data table below.

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>TIME (minutes)</th>
<th>BEGINNING OF SEASON</th>
<th>END OF SEASON</th>
</tr>
</thead>
<tbody>
<tr>
<td>At rest</td>
<td>0</td>
<td>76</td>
<td>64</td>
</tr>
<tr>
<td>(before skating)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skating</td>
<td>2</td>
<td>84</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>100</td>
<td>72</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>120</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>134</td>
<td>84</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>156</td>
<td>92</td>
</tr>
<tr>
<td>At rest</td>
<td>12</td>
<td>110</td>
<td>70</td>
</tr>
<tr>
<td>(after skating)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>90</td>
<td>64</td>
</tr>
</tbody>
</table>

a) Construct a graph of the data given above. Use a solid line for heart rates at the beginning of the season and a broken line for heart rates at the end of the season.

(2 marks)

b) State two reasons for the change in heart rate during the skating exercise.
(2 marks: 1 mark each)

c) Explain the difference in the time required for heart rates to return to resting levels at the beginning and at the end of the skating season. (2 marks)

29. Give one function of each of the following parts of the nervous system.
(5 marks: 1 mark each)

a) Autonomic nervous system:
b) Somatic nervous system:
c) Thalamus:
d) Cerebrum:
e) Corpus callosum:
30. Which diagram below represents the path taken by an action potential in a reflex arc as shown by the arrows?

A. 

B. 

C. 

D. 

Which diagram below represents the path taken by an action potential in a reflex arc as shown by the arrows?

31. Give one role of each of the following in the transmission of a nerve impulse.

(3 marks: 1 mark each)

a) Na⁺ K⁺ pump:

b) Sodium gate:

c) Myelin sheath:

32. Give one function of each of the following.

a) Cell membrane: (1 mark)

b) Ribosome: (1 mark)

c) Nucleolus: (1 mark)

d) Smooth endoplasmic reticulum: (1 mark)

e) Motor neuron: (1 mark)

f) Myelin sheath: (1 mark)

33. On the following graph, which letters indicate the areas in which the sodium/potassium pump is operating?

A. V and W  B. W and Y  C. X and Y  D. V and Z

At a synapse, the neurotransmitters move to the receptor sites by


34. In the diagram below, the action potential at X is moving

A. from an interneuron towards a muscle located at Y.  B. towards an interneuron from a muscle located at Y.  C. towards an interneuron from a receptor located at Y.  D. from an interneuron towards a receptor located at Y.
35. What would be the effect of cutting the neuron at point X?

A. The organism would die.  B. Some sensation would be lost.  C. The ability to move would be lost.  D. An interneuron would take over the lost function.

36. The reflex arc consists of five distinct components. List each one and give one function for each component.  
   (5 marks: ½ mark for component and ½ mark for function)

37. Describe the effect of the following on blood sugar levels in the human body and explain why they have this effect: a) eating a meal high in carbohydrates (2 marks) b) secretion of adrenaline (2 marks) c) secretion of insulin (2 marks)

38. Describe, using a valid example, a reflex arc. (5 marks)

39. Explain the importance of the following in nerve physiology: (10 marks) a) sodium pump (sodium-potassium pump) b) refractory period c) synapse d) threshold e) dendrite

40. In an experimental situation, a motor neuron stimulated midway along the axon will carry impulses in both directions, but only one of the impulses will be passed on to another neuron or muscle. From your knowledge of neurophysiology: a) Explain why impulses are carried in both directions. (3 marks) b) Explain how the impulse crosses the synapse. (3 marks)

41. a) Name the two divisions of the autonomic nervous system and, using any appropriate body structure as an example, explain how each division regulates that structure. (3 marks)

42. Name one structural feature of the neuron and explain how it relates to the neuron’s function. (2 marks)

43. Describe the mechanism by which an action potential passes from one neuron to another. (6 marks)

44. Assume that the action of pain killers interferes with the normal transmission from one neuron to another. Suggest two different mechanisms that would result in the brain detecting less pain. (4 marks)

45. a) Give a description of the myelin sheath found on some neurons. (2 marks) b) How does the structure of myelinated nerve increase its efficiency of conduction? (2 marks)

46. Identify the four areas of the brain shown in the diagram and give one function for each area. (1/2 mark for name, 1 mark for function. Total - 6 marks.)

47. Identify the four structures shown in the diagram and give one function for each area. (1/2 mark for name, 1 mark for function. Total - 6 marks.)
48. On the diagram, shade in the frontal, parietal, temporal, and occipital lobes, and give two functions for each (6 marks)

49. Give ONE function for each part of the following areas of the brain: (3 marks: 1 mark each) 
a) Cerebrum 
b) Occipital lobe 
c) Hypothalamus

50. Predict and explain the effects of the following on the function of the nervous system.
a) Administration of a drug which mimics the action of noradrenalin. (2 marks) 
b) Removal of a portion of the cerebellum. (1 mark) 
c) Introduction of a respiratory chain inhibitor. (2 marks) 
d) Destruction of the myelin sheath. (2 marks)

51. Describe the effect of a drug that 
a) blocks the release of noradrenalin 
b) increases the effectiveness of GABA 
c) prevents the reuptake of serotonin 
d) prevents the functioning of acetylcholinesterase 
e) blocks the receptor sites for GABA

52. In a study of people with an underactive thyroid gland, oxygen use data was collected and summarized on the above graph. Included in the study were people whose thyroids is functioning normally. Data were collected when the subjects were at rest (basal), during mild exercise and during strenuous exercise. (7 marks)
a) Which group (A or B) has normal thyroid function? (1 mark) 
b) Explain why the results were different for both groups. (2 marks) 
c) The following symptoms were noted among those in the experimental group. For each, explain why the symptoms appear. (3 marks: 1 mark each) 
i) lethargy (sluggishness) 
ii) decreased body temperature 
iii) weight gain 
d) Suggest a possible treatment for those in the experimental group. (1 mark)

53. After a severe drop in blood pressure, how will each of the following respond to maintain homeostasis? (10 marks) 
i) urine formation 
ii) aldosterone 
iii) sympathetic nervous system 
iv) tissue-capillary fluid exchange 
v) cardiac output

54. Blood samples from a figure skater were analyzed before and after a competition as shown in the following chart.

<table>
<thead>
<tr>
<th>BLOOD COMPONENT</th>
<th>BEFORE COMPETITION</th>
<th>AFTER COMPETITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>glucose</td>
<td>1.010%</td>
<td>0.09%</td>
</tr>
<tr>
<td>pH</td>
<td>7.40</td>
<td>7.38</td>
</tr>
<tr>
<td>pressure</td>
<td>120/180 mm Hg</td>
<td>150/180 mm Hg</td>
</tr>
<tr>
<td>temperature</td>
<td>37º C</td>
<td>39º C</td>
</tr>
</tbody>
</table>

Explain how internal homeostasis mechanisms would help return each blood component of the figure skater to the same levels that existed before the competition began. (12 marks: 3 marks each)
The diving women of Korea and Japan collect shellfish without the aid of any special equipment. Sometimes they can reach a depth of 25 metres and hold their breath for up to two minutes while working in a water temperature of 10º C. Explain how each of the following would help them perform their tasks.

a) They take several deep breaths before they dive. (2 marks)
b) The blood flow to their kidneys and most of their bodies’ muscles is reduced during the dive. (1 mark)
c) There is a decrease in their normal heart rate after they have been submerged for 40 seconds (1 mark)
d) There is an increase from their normal heart rate immediately after the dive. (1 mark)
e) Blood flow to their skin is reduced during the dive. (1 mark)

Cancer

1. a) The diagrams were made from samples of epithelial cells taken from healthy tissue and cancerous tissue. Which tissue sample is from the cancerous tissue? (1 mark)
b) Give two reasons for your answer in a) above. (2 marks)

2. An experiment was carried out to study the carcinogenic effects of certain chemicals on mice. Similar amounts of these chemicals were applied to their skins over a 6-month period. The results are shown below.

<table>
<thead>
<tr>
<th>CHEMICAL X</th>
<th>CHEMICAL Y</th>
<th>CHEMICALS X AND Y</th>
<th>CONTROL (NO TREATMENT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>18% developed skin tumours</td>
<td>0% developed skin tumours</td>
<td>84% developed skin tumours</td>
<td>1% developed skin tumours</td>
</tr>
</tbody>
</table>

Given the results, which of the following statements is correct?
A. Chemical Y is a promoter. B. Chemical X can act only as a promoter. C. Chemical Y can act only as an initiator. D. Neither X nor Y is an initiator or a promoter.

3. Describe the process of carcinogenesis (4 marks)

4. Give three ways in which cancer cells differ from normal cells. (3 marks)

5. The process by which new blood vessels supply a growing tumour is

Which of the following is a characteristic of cancer cells?
A. Cellular differentiation. B. Loss of contact inhibition. C. Decreased oxygen uptake. D. Inability to actively transport molecules.
6. Which of the following is the correct sequence for the development of cancer?
   A. 1, 4, 3, 2
   B. 3, 4, 2, 1
   C. 4, 1, 3, 2
   D. 4, 3, 2, 1

   Which of the following might indicate the presence of a developing skin cancer?
   A. Persistent coughing.
   B. Change in bowel habits.
   C. Difficulty in swallowing.
   D. A sore that does not heal.

7. a) Give one example of an environmental mutagen. (1 mark)
   b) Explain how a mutagen could change the mRNA produced in a cell. (2 marks)

8. Describe the development of cancer in the body. (5 marks which includes 1 mark for correct sequence)

9. a) Initiator: (1 mark)
   b) Promoter: (1 mark)

10. | COLUMN A          | COLUMN B                        |
     |-------------------|---------------------------------|
     | contact inhibition| a) characteristic of non-cancerous cells |
     | vascularization    | b) causes cells to make DNA from RNA |
     | monoclonal antibody| c) carries drugs to tumor       |
     | neoplasia          | d) a tumor that does not spread  |
     | benign             | e) DNA that causes cancer       |
     | retrovirus         | f) new growth of cancer cells   |
     | carcinoma          |                                 |
     | oncogene           |                                 |

11. | COLUMN A            | COLUMN B                            |
     |---------------------|-------------------------------------|
     | oncogene            | a) a compound which changes DNA     |
     | macrophage          | b) new growth of non-differentiating cells |
     | initiator           | c) describes a tumour which does not spread |
     | neoplasia           | d) epithelial cancer                |
     | anaplasia           | e) spreading of cancer cells through the body |
     | metastasis          | f) a body defence against cancer cells |
     | benign              |                                     |
     | carcinoma           |                                     |

12. Protooncogenes and mutagens all play a role in carcinogenesis. Explain the relationship between: a) protooncogenes and oncogenes b) mutagens and oncogenes.

13. a) Distinguish between an initiator and a promoter in carcinogenesis. (2 marks)
    b) Distinguish between a protooncogene and an oncogene. (2 marks)
14. a) Arrange the following terms in the correct sequence for the development of cancer. (1 mark)

PROMOTION
1. ____________
INITIATION
2. ____________
METASTASIS
3. ____________
IN SITU TUMOR
4. ____________

b) Through what two body systems does metastasis occur? (1 mark)

15. a) What is the role of promoters in carcinogenesis? (1 mark)

b) Give an example of an initiator and explain how initiators function in carcinogenesis. (2 marks)

16. Match each of the numbered items with the correct lettered term. Write down the letter of that term in the space at the right. (2 marks)

A. benign
B. initiator
C. malignant
D. promotor

1. metastatic
2. an irritant
3. a mutagen
4. non-spreading

17. a) Of the seven danger signs for cancer, which two might indicate the presence of colon (colo-retcal) cancer? (2 marks)

b) Give a danger sign that would be a characteristic for each of the following types of cancer: (2 marks: 1/2 mark each) a) skin b) lung c) breast

18. Explain two ways in which viruses may be involved in causing some cancers. (2 marks)

19. Describe two ways that a protooncogene could be changed into an oncogene. (4 marks)

20. The following events occur during carcinogenesis. Arrange them in the correct order. (2 marks)

A) Proto-oncogenes are transformed into oncogenes. 1st ___
B) Some cancer cells break loose and are carried to other organs in the blood. 2nd ___
C) Disorganized growth occurs in cells that perform no function for the body. 3rd ___
D) A growth factor causes neighboring blood vessels to branch into the cancer tissue 4th ___

Reproductive System

1. For each of the number parts, give the name and function.

2. For each of the number parts, give the name and function.
3. Which of the labelled structures is the Cowper’s gland?
A. W  B. X  C. Y  D. Z


Which of the following is **not** a function of seminal fluid?
A. provides a suitable pH  B. supplies an energy source  C. causes the uterus to contract  D. constricts the urethra during ejaculation

4. The structure labelled X is the

Which of the following, if present in urine samples, would indicate pregnancy?
A. estrogen  
B. progesterone  
C. luteinizing hormone (LH)  
D. human chorionic gonadotropin (HCG)

5. The structure labelled X is the

When testosterone levels in a man’s bloodstream decrease,
A. the hypothalamus shuts down.  B. more progesterone is secreted.  C. luteinizing hormone (LH) secretion is increased.  D. follicle-stimulating hormone (FSH) secretion is blocked.
6. a) Label the following diagram in the blanks provided. (4 marks)
b) Most birth-control pills work by preventing egg maturation. These pills contain which of the following hormones?
   A. estrogen  B. testosterone  C. luteinizing hormone (LH)  D. follicle-stimulating hormone (FSH)

7. a) Give two functions of each of the following hormones.
   - Estrogen: (2 marks)
   - LH (luteinizing hormone): (2 marks)
b) Describe two hormonal changes that occur in the mother as a result of implantation. (2 marks)

8. Identify the labelled structures in the diagram above and give one function of each.
   (8 marks: 1 mark for each name; 1 mark for each function)

9. Which letter indicates the seminal vesicle?
   A. W  B. X  C. Y  D. Z
   Label the other parts on the diagrams, and give one function for each.
   The duct that is used by both the reproductive and excretory systems in males is the

10. Which structure would contain the greatest concentration of mitochondria?
    A. W  B. X  C. Y  D. Z

11. State the effects that each of the following hormones has on the body during puberty.
    (8 marks)
    - Testosterone: (three effects)
    - Estrogen: (three effects)
    - Follicle stimulating hormone: (two effects)
12. a) Give two functions for each of the following structures. (4 marks: 2 marks each)
   - Testes:
   - Ovaries:
   b) Name the hormone that is involved in a positive feedback loop and explain one of its functions. (2 marks)

13. [Diagram: Uterine Cycle]

Relate the development of the follicle to the observed changes in the thickness of the endometrium: (6 marks: 2 marks each)
   a) Days 1-3  b) Days 7-14  c) Days 15-27

14. Which of the following describes the hormonal levels on day one of a 28-day uterine cycle?

A. low  high
B. high  high
C. low  low
D. high  low

15. a) Complete this summary table of the ovarian cycle. (4 marks)

<table>
<thead>
<tr>
<th>Phase 1</th>
<th>Phase 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Days 1 to 14</td>
<td>Days 15 to 28</td>
</tr>
</tbody>
</table>

b) i) What is the event that occurs on Day 14? (1 mark)
   ii) What causes this event to occur? (1 mark)

c) What causes Phase 2 to end? (1 mark)

d) Describe the effects of implantation (pregnancy) on the ovarian cycle. (2 marks)

16. | COLUMN A | COLUMN B |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>acrosome</td>
<td>a hollow ball of cells</td>
</tr>
<tr>
<td>corpus luteum</td>
<td></td>
</tr>
<tr>
<td>follicle</td>
<td>b) site of embryonic development</td>
</tr>
<tr>
<td>blastula</td>
<td>c) initial stage of cellular differentiation in embryo</td>
</tr>
<tr>
<td>neurula</td>
<td>d) produces progesterone</td>
</tr>
<tr>
<td>uterus</td>
<td>e) contains enzymes that dissolve the membrane of the egg</td>
</tr>
<tr>
<td>epididymis</td>
<td>f) site where sperm mature</td>
</tr>
<tr>
<td>seminiferous tubules</td>
<td></td>
</tr>
</tbody>
</table>

17. List all the constituents of seminal fluid (including the gland that produced the constituent). Give two functions of seminal fluid. (10 marks)
18. a) What gland is the source of luteinizing hormone (LH)? (1 mark)
b) What is the function of luteinizing hormone (LH) during the last half of the ovarian cycle (days 15 to 28)? (1 mark)

19. | COLUMN A            | COLUMN B                                      |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>prostate gland</td>
<td></td>
</tr>
<tr>
<td>ovary</td>
<td>a) location for spermatogenesis</td>
</tr>
<tr>
<td>epididymis</td>
<td>b) has enzymes used to penetrate egg</td>
</tr>
<tr>
<td>seminiferous tubule</td>
<td>c) sperm mature here</td>
</tr>
<tr>
<td>uterus</td>
<td>d) secretes progesterone</td>
</tr>
<tr>
<td>fallopian tube</td>
<td>e) location of the developing fetus</td>
</tr>
<tr>
<td>ductus (vas) deferens</td>
<td>f) provides nutrients for sperm</td>
</tr>
<tr>
<td>acrosome</td>
<td></td>
</tr>
</tbody>
</table>

20. | COLUMN A             | COLUMN B                                      |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>acrosome</td>
<td></td>
</tr>
<tr>
<td>corpus luteum</td>
<td>a) stimulates secretions from the corpus luteum</td>
</tr>
<tr>
<td>luteinizing hormone</td>
<td>b) causes the endometrium to thicken</td>
</tr>
<tr>
<td>estrogen</td>
<td>c) an organ of copulation</td>
</tr>
<tr>
<td>vagina</td>
<td>d) contains enzymes necessary to penetrate egg</td>
</tr>
<tr>
<td>urethra</td>
<td>e) area for maturation of sperm</td>
</tr>
<tr>
<td>epididymis</td>
<td>f) secretes testosterone</td>
</tr>
<tr>
<td>interstitial cell</td>
<td></td>
</tr>
</tbody>
</table>

21. If the ovaries of a pregnant women are removed before three months, the pregnancy will end. If however they are removed after three months, the pregnancy will not end. With specific references to the reproductive physiology explain why this is the case. (3 marks)

22. List, in correct order, the structures through which human sperm pass as they travel from the testes until they leave the body. Name and indicate the location of any glands which contribute fluids to the process. (4 marks)

23. The female reproductive system is carefully regulated by hormones produced by the brain and some of the sex organs. Explain the effect the following would have on the reproductive system:
a) A failure of the corpus luteum to degenerate 20 days after ovulation. (2 marks)
b) A lack of FSH production during the first 15 days of the menstrual cycle. (2 marks)

24. Name the source and describe the function of FSH (follicle stimulating hormone) in the female reproductive system. (3 marks)

25. Describe the effects of estrogen in the female body (4 marks)

26. Describe the hormone changes in a female that occur as a result of implantation of the embryo. (2 marks)

27. Fill in the blanks in the table below. (2 marks)

<table>
<thead>
<tr>
<th>STRUCTURE</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>urethra</td>
<td></td>
</tr>
<tr>
<td>epididymus</td>
<td>sperm production</td>
</tr>
<tr>
<td></td>
<td>male organ of copulation</td>
</tr>
</tbody>
</table>
28. State what happens to the numbered items with the correct lettered term. Write the letter of that term in the space at the right. (2 marks: 1/2 mark each)
   A. acrosome 1. sperm mature here 1.____
   B. epididymus 2. location of spermatogenesis 2.____
   C. mid-piece 3. contains enzymes needed for fertilization 3.____
   D. seminiferous tubules 4. contains energy producing mitochondria 4.____

29. a) What is seminal fluid? (1 mark)
    b) List two glands that contribute to the formation of seminal fluid? (1 mark)

30. Name the source of progesterone and describe its role in the uterine cycle. (4 marks)

31. a) What structure secretes luteinizing hormone (LH)? (1 mark)
    b) What is the function of the luteinizing hormone during the menstrual cycle? (2 marks)

32. a) Name the process which results in the production of “D” in the diagram (1 mark)
    b) What is the function of “C” in the diagram (1 mark)

33. Describe the role of a positive feedback loop in childbirth (4 marks)

34. The birth control pill contains estrogen and progesterone. Explain how the birth control pill prevents pregnancy (6 marks).

35. Describe how testosterone and sperm levels are controlled by feedback loops (6 marks)

36. Relate the roles of GnRH, FSH, LH, estrogen, and progesterone to the uterine and ovarian cycles (10 marks)
37. a) Complete this summary table of the ovarian cycle.  

<table>
<thead>
<tr>
<th>Phase 1</th>
<th>HORMONE WHICH INITIATES PHASE</th>
<th>HORMONE PRODUCED BY OVARY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Days 1 to 14</td>
<td></td>
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<tr>
<td>Phase 2</td>
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<tr>
<td>Days 15 to 28</td>
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</tbody>
</table>

b) i) What is the event that occurs on Day 14?  

ii) What causes this event to occur?  

c) What causes Phase 2 to end?  

d) Describe the effects of implantation (pregnancy) on the ovarian cycle.