Part A: Definitions: Define the following terms, IN YOUR OWN WORDS, IN AS FEW WORDS AS CLARITY ALLOWS.

1. formed elements - solid part of blood consisting of erythrocytes, thrombocytes, leukocytes
2. oxyhemoglobin - HbO₂: hemoglobin that has formed a loose association with oxygen
3. reduced hemoglobin - HHb: hemoglobin that has given up its oxygen and picked up a H⁺
4. heme - the non-protein, iron-containing pigment in Hb that binds O₂
5. clotting - the process of sealing up injuries to CV system, requires plasma proteins and platelets
6. platelets - thrombocytes, formed elements that function in blood clotting
7. fibrinogen - inactive form of fibrin, a plasma protein needed for clotting
8. thrombin - enzyme that activates fibrinogen to fibrin in blood clotting
9. fibrin - protein fragments that join end to end to form framework of blood clots
10. serum - plasma that has had its fibrinogen removed
11. granulocytes - leukocytes with specks (lysosomes) in cytoplasm, includes neutrophils
12. agranulocytes - leukocytes without specks (lysosomes) in cytoplasm, includes lymphocytes
13. antigens - anything (esp. proteins) that can be recognized by antibodies
14. antibodies - immunoglobulins derived from lymphocytes that specifically bind to invading pathogens
15. inflammatory reaction - body response to injury, marshalls white blood cells to injured areas
16. mononucleosis - condition caused by infection by Epstein-Barr virus, causes excessive # of B-lymphocytes
17. phagocytosis - cell eating: endocytosis of large particles. Many leukocytes (e.g. neutrophils, monocytes) are phagocytes
18. macrophages - leukocytes formed from monocytes that act as scavangers for bacteria and debris
19. bradykinin - chemical released from injured cells that initiates release of histamine, sensation of pain
20. histamine - chemical released from mast cells that causes inflammation, enlargement of capillaries
21. pus - “battleground remants” of inflammatory response, made of dead bacteria, debris, leukocytes
22. agglutination - clumping of red blood cells due to antibodies binding antigens on the red blood cells
23. Rh factor - red blood cell antigen responsible for fetal erythroblastosis
24. fetal erythroblastosis - condition in which antibodies from a Rh- mother attack the RBC of a Rh+ fetus
25. blood - liquid connective tissue consisting of plasma and formed elements that transports wastes, nutrients, gases

Part B - Short Answers

1. The smallest of the white cells is the LYMPHOCYTE, which has a MONO nucleus and makes ANTIBODIES.
2. Oxygen is transported about the body in combination with HEMOGLOBIN.
3. At the arterial side of a capillary, BLOOD PRESSURE aids the passage of water out of the blood. At the venous side, OSMOTIC PRESSURE brings about the passage of water into the blood.
4. Small organic molecules such as glucose are transported in the PLASMA portion of blood.
5. Blood clotting is dependent on both a formed element, PLATELETS, and two proteins in the blood, FIBRINOGEN and THROMBIN.
6. White cells are divided into the **AGRANULOCYTES** and the **GRANULOCYTES**; the latter have **GRANULES** in the cytoplasm.

7. Antibodies are protein molecules, which combine with **ANTIGENS**.

8. Neutrophils function by **PHAGOCYTIZING** bacteria.

9. Blood type AB has **A** and **B** antigens on the red cells and **NO** antibodies in the plasma.

10. An Rh-negative woman may form **ANTIBODIES** that destroy her Rh-**POSITIVE** baby's **RED CELLS**.

11. Fill in the following table:

<table>
<thead>
<tr>
<th>Plasma Constituent</th>
<th>Function</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>Maintains blood <strong>VOLUME</strong> and <strong>TRANSPORTS</strong></td>
<td>Absorbed from <strong>LARGE</strong></td>
</tr>
<tr>
<td></td>
<td>molecules</td>
<td><strong>INTESTINE</strong></td>
</tr>
<tr>
<td>Plasma Proteins</td>
<td>All maintain blood <strong>OSMOTIC PRESSURE &amp; PH</strong></td>
<td><strong>LIVER</strong></td>
</tr>
<tr>
<td>a. Albumin</td>
<td>TRANSPORT</td>
<td></td>
</tr>
<tr>
<td>b. Fibrinogen</td>
<td>CLOTTING</td>
<td><strong>LIVER</strong></td>
</tr>
<tr>
<td>c. Globulins</td>
<td>Fight INFECTION</td>
<td><strong>LYMPHOCYTES</strong></td>
</tr>
<tr>
<td>Gases</td>
<td>CELLULAR RESPIRATION</td>
<td></td>
</tr>
<tr>
<td>a. Oxygen</td>
<td>End product of <strong>METABOLISM</strong></td>
<td></td>
</tr>
<tr>
<td>b. CO₂</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nutrients: Fats, glucose,</td>
<td><strong>FOOD</strong> for cells</td>
<td>Absorbed from <strong>INTESTINAL</strong></td>
</tr>
<tr>
<td>amino acids, etc.</td>
<td></td>
<td><strong>VILLI</strong></td>
</tr>
<tr>
<td>Salts</td>
<td>Maintain blood <strong>OSMOTIC PRESSURE/PH</strong>, aid</td>
<td>Absorbed from <strong>INTESTINAL</strong></td>
</tr>
<tr>
<td></td>
<td>METABOLISM</td>
<td><strong>VILLI</strong></td>
</tr>
<tr>
<td>Wastes</td>
<td><strong>END PRODUCTS OF METABOLISM</strong></td>
<td><strong>TISSUES</strong></td>
</tr>
<tr>
<td>Hormones, vitamins etc.</td>
<td><strong>AID METABOLISM</strong></td>
<td><strong>VARIED</strong></td>
</tr>
</tbody>
</table>

12. Life cycle of red blood cells: The red cells, scientifically called **ERYTHROCYTES**, are made in the **RED BONE MARROW**. Upon maturation, they are small, biconcave disks that lack a **NUCLEUS**, but they are filled with the complex protein called **HEMOGLOBIN**, which transports oxygen about the body. After about 120 days, the red cells are destroyed in **LIVER** or **SPLEEN**.

13. Life cycle of white cells: Most white cells, scientifically called **LEUKOCYTES**, are made in the **BONE MARROW**, but lymphocytes are also made in the **LYMPH NODES**. White cells are divided into two types, the **AGRANULOCYTES** and the **GRANULOCYTES**. Leukocytes with many-lobed nuclei are called **POLYMPHONUCLEAR**.

14. Fill in the following table with the contrasting word or phrase:

<table>
<thead>
<tr>
<th>Neutrophil</th>
<th>Lymphocyte</th>
</tr>
</thead>
<tbody>
<tr>
<td>polymorphonuclear</td>
<td><strong>MONONUCLEAR</strong></td>
</tr>
<tr>
<td><strong>GRANULAR</strong></td>
<td>agranular</td>
</tr>
<tr>
<td>phagocytic</td>
<td><strong>MAKES ANTIBODIES</strong></td>
</tr>
<tr>
<td><strong>MADE IN RED BONE MARROW</strong></td>
<td>made in lymphoid tissue</td>
</tr>
</tbody>
</table>

15. The two ways that white cells fight infection are:

**PHAGOCYTIZING INVADERS**

**MAKING ANTIBODIES AGAINST FOREIGN ANTIGENS**

16. Blood clotting: These are the reactions that occur when blood clots. Put a check ✓ beside those substances that are always present in the blood. Put an X beside those substances that arise after blood begins the process of clotting. Put a star beside those substances that act as enzymes. **Underline** the words that indicate the actual clot.

✓ platelets  X  X  thromboplastin
✓ prothrombin X  X  thrombin
✓ fibrinogen  X  fibrin threads

17. The capillaries are the most important part of the circulatory system because **EXCHANGE OCCURS AT CAPILLARIES**.

18. Blood typing is based on antigen-antibody reaction, which takes place when an antigen is brought into contact with an antibody of the same type letter. The antigen-antibody reaction causes clumping or
agglutination of the red cells. In the plasma, the antibodies present will not be of the same type letter as the antigen. Why not? **BECAUSE AGGLUTINATION WOULD OCCUR**

19. Fill in the following table:

<table>
<thead>
<tr>
<th>Blood Type of Antigen</th>
<th>Antibody</th>
<th>Can Receive From</th>
<th>Can Donate To</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>b</td>
<td>A,O</td>
<td>A,AB</td>
</tr>
<tr>
<td>B</td>
<td>a</td>
<td>B,O</td>
<td>B,AB</td>
</tr>
<tr>
<td>AB</td>
<td></td>
<td>A,B,AB,O</td>
<td>AB</td>
</tr>
<tr>
<td>O</td>
<td>a,b</td>
<td>O</td>
<td>A,B,AB,O</td>
</tr>
</tbody>
</table>

20. Which combination can lead to fetal erythroblastosis? Rh **NEGATIVE** mother and Rh **POSITIVE** father.

21. Which of the following is NOT a blood protein?  
a) collagen  
b) prothrombin  
c) albumin  
d) fibrinogen  
e) globulin.  **A**

22. Plasma is  
a) the same as tissue fluid  
b) the liquid remaining after blood clots  
c) the liquid part of blood  
d) all of these  **C**

23. In which way is a neutrophil like a lymphocyte?  
a) they both produce antibodies  
b) they are both phagocytic  
c) they are both made in lymphoid tissue  
d) they both have a many-lobed nucleus  
e) they are both white cells  
f) all of these  **E**

24. Water leaves capillaries at their arterial ends because  
a) osmotic pressure gradients are in opposite directions  
b) blood pressure is greater than the osmotic pressure  
c) a gradient is established for passive diffusion  
d) osmotic pressure is always greater than blood pressure  
e) b and d  **B**

25. Water reenters capillaries at their venule ends because of  
a) active transport from interstitial fluid  
b) a protein concentration gradient  
c) increasing blood pressure  
d) increasing hemoglobin production  **B**

26. An Rh-positive fetus being carried by an Rh-negative mother  
a) develops antibodies to the mother’s blood  
b) develops antigens to the mother’s blood  
c) may have its red cells attacked by antibodies made by the mother  
d) may have its red cells attacked by antigens made by the mother  **C**

27. The agglutination of red blood cells occurs whenever  
a) appropriate antibodies bind with antigens on red cells  
b) a person receives a blood transfusion from someone with an incompatible blood type  
c) complementary antibodies combine  
d) blood cells are destroyed by leukocytes  
e) a and b  **E**

**Critical Thinking Questions**

1. 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.
   i) Reddish Colour
   ii) Swelling
   iii) Warmth

2. A student is injured and loses 800 ml of blood. Explain how the following would respond to maintain blood pressure:
   i) Heart rate:
   ii) Diameter of Arterioles
   iii) Capillary Beds

3. Why would you expect edema when blood pressure rises but not when it decreases?
Injured tissues and platelets release Prothrombin Activator (an enzyme) (vitamin K required for the production of Prothrombin).

Prothrombin Activator catalyzes the conversion of Prothrombin to Thrombin. (Ca++ is necessary for this step)

Thrombin is an enzyme that acts like a pair of scissors, cutting short amino acid ends off Fibrinogen molecules.

Fibrinogen molecules join together end-to-end to form long fibers. Fibrin fibers form the framework of the clot.