Chapter 17 – Blood

Please list four delivery functions of blood, two regulatory functions, and two protection functions.

Delivery (distribution) functions

1. ________________________________ 3. ________________________________
2. ________________________________ 4. ________________________________

Regulatory functions

1. ________________________________
2. ________________________________

Protection functions

1. ________________________________ 2. ________________________________

Please list three classes of substances normally found dissolved in plasma.

1. ________________________________ 2. ________________________________ 3. ________________________________

Please complete the following table relating to the proteins found in plasma.

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Description / Importance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fibrinogen</td>
<td>60% of plasma proteins; important for osmotic balance</td>
</tr>
<tr>
<td></td>
<td>____ % of plasma proteins Important in ______________________</td>
</tr>
<tr>
<td></td>
<td>36% of plasma proteins</td>
</tr>
<tr>
<td></td>
<td>transport proteins</td>
</tr>
<tr>
<td></td>
<td>antibodies</td>
</tr>
<tr>
<td>Nonprotein Nitrogenous Substances</td>
<td>(list 5)</td>
</tr>
<tr>
<td></td>
<td>Organic Chemicals absorbed from the digestive tract</td>
</tr>
<tr>
<td>Respiratory Gases</td>
<td></td>
</tr>
</tbody>
</table>

What is the normal life span of erythrocytes? _____________ days

What three food nutrients (other than normally required proteins and carbohydrates) are essential for erythropoiesis?

1. ________________________________ 2. ________________________________ 3. ________________________________

What is the fate of aged or damaged red blood cells?

What is the fate of the released hemoglobin?

Please check (✓) all the factors that would serve as stimuli for erythropoiesis.

_____ Hemorrhage

_____ Insufficient hemoglobin per RBC

_____ Living at a high altitude

_____ Breathing pure oxygen
The figure below depicts (in incomplete form) the erythropoietin mechanism for regulating the rate of erythropoiesis. Several statements are incomplete. Complete the statements that have answer blanks and then choose colors (other than yellow) to identify the structures with color coding circles. Color all arrows on the diagram yellow.

- The kidney
- Red bone marrow
- RBCs

Please provide the information requested to fully characterize each structural aspect of red blood cells.

Cell shape ______________________________

Nucleate or anucleate? ______________________________

Organelles present? __________________________________________

Major molecular content of the cytoplasm __________________________________________

Substance that accounts for the flexibility of the membrane ______________________________

Please provide the information requested to fully describe each functional characteristic of red blood cells.

Type of metabolism, aerobic or anaerobic? ______________________________

Explain why the RBC metabolism is of this type. __________________________________________

Molecular makeup of hemoglobin ______________________________

The portion of hemoglobin that binds oxygen ______________________________

The portion of hemoglobin that binds carbon dioxide ______________________________

Site of oxygen loading ______________________________

Site of carbon dioxide loading ______________________________
Please match the terms indicating specific types of anemias with the appropriate descriptions:

A. Aplastic anemia
B. Hemolytic anemia
C. Hemorrhagic anemia
D. Iron-deficiency anemia
E. Pernicious anemia
F. Sickle-cell anemia

_____ A genetic disorder in which abnormal hemoglobin is produced and becomes spiky under hypoxic conditions
_____ A common occurrence after transfusion error
_____ The bone marrow is destroyed or severely inhibited
_____ A consequence of acute blood loss
_____ A possible consequence of sickle-cell anemia
_____ Results from inadequate intake of iron-rich foods or conditions involving chronic types of bleeding (gastric ulcers)
_____ A common problem of individuals who have a portion of their stomach removed to manage bleeding ulcers

Please rank the following lymphocytes in order of their relative abundance (in the blood of a healthy person) from 1 (most abundant) to 5 (least abundant).

_____ Lymphocytes
_____ Basophils
_____ Neutrophils
_____ Eosinophils
_____ Monocytes

Using the choices below, please identify the cell types or blood elements that fit the following descriptions.

A. Basophil
B. Eosinophil
C. Formed elements
D. Lymphocyte
E. Megakaryocyte
F. Monocyte
G. Neutrophil
H. Platelets
I. Red blood cell

_____ Granulocyte with the smallest granules
_____ _____ _____ Granular leukocytes
_____ Also called an erythrocyte, anucleate
_____ _____ Phagocytic leukocytes that avidly engulf bacteria
_____ _____ Agranular leukocytes
_____ Fragments to form platelets
_____ Increases in number during allergy attacks
_____ Releases histamine during inflammatory reactions

Using the choices below, correctly complete the following brief description of the blood clotting process.

Break Erythrocytes Fibrin Fibrinogen Phosphatidylserine Platelets Prothrombin Serotonin Thrombin Thromboxane

Clotting begins when a ______________ occurs in a blood vessel wall. Almost immediately, ______________ cling to the blood vessel wall and release ______________ and ______________ which help decrease blood loss by constricting the vessel. ______________ on the platelet surface promotes the pathway leading to formation of prothrombin activator, which causes ______________ to be converted to ______________. Once present, thrombin acts as an enzyme to attach ______________ molecules together to form long, threadlike strands of ______________ which then traps ______________ flowing by in the blood.
Please match the terms with their correct description.

A. Activated clotting factors inhibited by heparin and antithrombin III
B. Activated factor XII
C. Coagulation factors washed away by flowing blood
D. Embolus
E. Hemophilia A
F. Hemophilia B
G. Intact endothelium
H. Plasmin
I. Endothelial cell secretions (prostacyclin and others)
J. Thrombin
K. Thrombocytopenia
L. Thrombus

_____ _____ Two circumstances that prevent unnecessary enlargement of blood clots
_____ Natural "clot-buster" chemical; causes fibrinolysis
_____ Hereditary bleeder's disorder resulting from a lack of factor VIII
_____ _____ Two factors that prevent undesirable clotting in an unbroken blood vessel
_____ Free-floating blood clot
_____ _____ Plasmin activators
_____ Clot formed in an unbroken blood vessel
_____ Bleeder's disease that is a consequence of too few platelets
_____ Hereditary disease resulting from a deficiency of factor IX

Four leukocytes are diagrammed in the figure below. First, follow the directions for coloring each leukocyte as it appears when stained with Wright's stain. Then, identify each leukocyte type by writing the correct name in the blank below each illustration.

A. Color the granules pale violet, the cytoplasm pink, and the nucleus dark purple
B. Color the nucleus deep blue and the cytoplasm pale blue
C. Color the granules bright red, the cytoplasm pale pink, and the nucleus red-purple
D. For this smallest white blood cell, color the nucleus deep purple-blue and the sparse cytoplasm pale blue-green

A ________________________________ B ________________________________
C ________________________________ D ________________________________
Please complete the following table concerning ABO blood groups.

<table>
<thead>
<tr>
<th>Blood type</th>
<th>Antigens</th>
<th>Antibodies in plasma</th>
<th>Can donate blood to type</th>
<th>Can receive blood from type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type A</td>
<td>A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type B</td>
<td></td>
<td>Anti-A</td>
<td>AB</td>
<td></td>
</tr>
<tr>
<td>Type AB</td>
<td></td>
<td></td>
<td>AB</td>
<td></td>
</tr>
<tr>
<td>Type 0</td>
<td>None</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Ms. Pratt is claiming that Mr. X is the father of her child. Ms. Pratt's blood type is 0 negative. Her baby boy has type A positive blood. Mr. X's blood is typed and found to be type B positive. Could he be the father of her child? If not, what blood type would the father be expected to have?

When a person is given a transfusion of mismatched blood, a transfusion reaction occurs. Define the term transfusion reaction.

Please fill in the table of normal blood values; if appropriate, include units for both males and females.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Normal Value or Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Body Weight</td>
<td></td>
</tr>
<tr>
<td>Blood Volume</td>
<td></td>
</tr>
<tr>
<td>Arterial pH</td>
<td></td>
</tr>
<tr>
<td>Blood Temperature</td>
<td></td>
</tr>
<tr>
<td>RBC Count</td>
<td></td>
</tr>
<tr>
<td>Hematocrit</td>
<td></td>
</tr>
<tr>
<td>Hemoglobin</td>
<td></td>
</tr>
<tr>
<td>WBC Count</td>
<td></td>
</tr>
<tr>
<td>Differential WBC Count</td>
<td></td>
</tr>
<tr>
<td>Neutrophils</td>
<td></td>
</tr>
<tr>
<td>Eosinophils</td>
<td></td>
</tr>
<tr>
<td>Basophils</td>
<td></td>
</tr>
<tr>
<td>Lymphocytes</td>
<td></td>
</tr>
<tr>
<td>Monocytes</td>
<td></td>
</tr>
<tr>
<td>Platelet Count</td>
<td></td>
</tr>
</tbody>
</table>
Clinical Applications – Chapter 17 (Blood)

Please use the following information to answer questions 1-5 below. Mrs. Smutz is pregnant for the first time. Her blood type is Rh negative, her husband Justin is Rh positive. Their first child has been determined to be Rh positive. Ordinarily, the first such pregnancy causes no major problems, but baby Smutz is born blue and cyanotic.

1) What is this condition (a result of Rh incompatibility) called?

2) Why is the baby cyanotic?

3) Because this is Mrs. Smutz’ first pregnancy, how can you account for the baby's problem?

4) Assume that baby Smutz was born pink and healthy. What measures should be taken to prevent the previously described situation from happening in the second pregnancy with an Rh positive baby?

5) Mrs. Smutz’ sister has had two miscarriages before seeking medical help with her third pregnancy. Blood typing shows that she, like her sister, is Rh negative; her husband is Rh positive. What course of treatment will be followed?

6) Please explain how fetal hemoglobin enhances oxygen transfer from the mother to the fetus across the placenta.

7) A bone marrow biopsy of Mr. Bongalonga, a man on a long-term drug therapy, shows an abnormally high percentage of nonhemopoietic connective tissue. What condition does this indicate? If the symptoms are critical, what short-term and long-term treatments may be necessary? Will infusion of whole blood or packed red cells be more likely?
8) Mrs. Francis comes to the clinic complaining of fatigue, shortness of breath, and chills. Blood tests show anemia and a bleeding ulcer is diagnosed. What type of anemia is this?

9) After multiple transfusions, Mr. Cosby experiences a weak transfusion reaction. Is this likely to be caused by the ABO antigens or other antigens? What should be done to avoid this type of reaction?

10) A red marrow biopsy is ordered for two patients—one a child and the other an adult. The specimen is taken from the tibia of the child but from the iliac crest of the adult. Please explain why different sites are used to obtain marrow samples in adults and children.

11) Why is someone more likely to bleed to death when an artery is cleanly severed than when an artery is crushed and torn?

12) Knowing the pathways of hemopoiesis, please explain why leukemia reduces RBC and platelet counts.

13) Please explain the phenomenon called "athlete's anemia."

14) John, a novice to cigarette smoking, is trying to impress his buddies by smoking two packs a day—inhaling every drag. What do you think will happen to his reticulocyte count? Explain your reasoning.