1) List three functions of BLOOD.
   1) distribution  2) regulation  3) protection

2) a) What are the “formed elements” in blood?
   Red Blood Cells (RBCs; erythrocytes), White Blood Cells (WBCs; leukocytes), platelets (thrombocytes)

   b) Describe the composition of the liquid portion of blood, PLASMA. Pale yellow; 92% H2O and 8% dissolved/ suspended materials (sugars, amino acids, electrolytes such as Na+, K+, hormones)

   c) What is the name of RBC (erythrocyte) formation? hematopoiesis Where do blood cells form? Red bone marrow

   d) Erythropoietin is available as a drug (sold by Amgen!). Why would athletes abuse it? To force their bodies to make more RBC’s. As a result, they can carry extra oxygen & go through cellular respiration longer during competitions

3) Across what type of blood vessel are nutrients and gases exchanged between mother and fetus at the placenta? capillaries

4) Approximately how long does a RBC “live?” approximately 120 days Where recycled? Liver and spleen

5) What is the function of blood platelets? Initiate the clotting of blood

6) a) Distinguish between a THROMBUS and an EMBOLUS.
   Thrombus: clot
   Embolus: when a piece of a clot breaks off and moves through the circulatory system

   b) When a blood clot forms in a vessel supplying the heart and heart tissue dies, the result is a heart attack.

   c) When a blood clot forms in a vessel supplying the brain and brain tissue dies, the result is a stroke.

7) What happens when there is a mismatched blood transfusion. Agglutination (clumping of red blood cells because the person receiving the wrong type of blood’s immune system has made antibodies that are “grabbing” onto the RBC’s and forming them into a big clump)

8) a) Which blood type is the “universal recipient”? AB+ Why? can get blood from anyone (has all antigens in their RBC (A, B, and Rh), therefore, no antibodies in their plasma serum)

   b) Which blood type is the “universal donor”? O- Why? no antigens at all in their RBC; can give these cells to anyone since they are “naked” **remember, only the cells are donated, not the plasma/serum
c) How might a technique to remove A and B antigens from red blood cells be used to increase the supply of donated blood?

If antigens could be removed from RBC's then any donated blood could be transformed into O- blood which could then be given to anyone. Currently, if an AB+ person donates blood, their blood can only be given to an AB+ person. B+ blood cells can only be given to other B+ people or AB+ people.

d) Discuss Rh antigens and antibodies. Also, explain how the Rh factor affects moms and babies.

Rh antigens are another antigen/protein that can be found in a person’s RBC membrane. If you have the Rh antigen on your RBC (genotype + + or + -), you will not make anti-Rh antibodies. If you are Rh- (genotype - -), then if you are exposed to Rh+ blood, your immune system will make anti-Rh antibodies. This is especially important when an unborn baby is Rh + and the mother is Rh- because if the mother makes anti-Rh antibodies, these antibodies are small enough to pass through the placenta membranes from mother to baby and the baby’s blood will agglutinate. Today, mothers who are Rh- are given a shot called Rhogam which attaches to any Rh antigen that get into the mother's blood preventing her immune system from responding and making anti-Rh antibodies.

e) Why can a person receive platelets donated by anyone, but must receive a particular type of whole blood?

Platelets do not have antigen on them & since they are fragments of a cell and they also don’t have a nucleus. Your immune system won’t see them as an “invader” to be destroyed.

9) Starting with hemostasis, describe the process for how a blood clot forms. Include the activation of fibrinogen in your explanation.

HEMOSTASIS: First, the blood vessel spasms (vasoconstricts). Then, a platelet plug will form when platelets adhere to the rough surfaces and exposed collagen of the injured area. When platelets adhere to each other, they form a platelet plug. The last step, blood coagulation, occurs when the inactive fibrinogen protein is converted to its active form, fibrin. Fibrin threads form a meshwork that trap RBC’s which forms a blood clot.

10) Describe the following blood conditions:

a) hemophilia: genetic disease where clotting is abnormal or absent (mutation of a gene on the “X” chromosome); symptoms= blood doesn’t clot; treated with shot of missing clotting factors
b) anemia: Any disorder caused by the inability of the blood to carry sufficient oxygen supplies (not enough RBC's due to cancer/radiation/infection or Vitamin B-12 deficiency, not enough iron so can’t make enough hemoglobin for RBC’s, irregular hemoglobin like in sickle cell anemia
c) leukemia: type of cancer which has abnormal WBC production (too many & don't function as supposed to); cells are immature; abnormal; susceptible to infection

11) What is polycythemia and when does it occur naturally? **High red blood cell count; can occur if you live at high altitude (your body adapts to needing extra oxygen at that altitude)**

### Major Arteries and Veins – Study Questions

1) Name the largest artery in the human body: **aorta**  
   largest vein? **Vena cava**

2) What 3 major arteries extend from the arch of the aorta?  
   1) brachiocephalic  
   2) L common carotid  
   3) L subclavian

### STUDY QUESTIONS – Heart

1a) Describe the structure, size, and location of the heart.  
   **Approx. size of fist; 2/3 of mass lies to L of midline; less than 1lb (mostly protected by sternum)**

   b) How is a fetal heart different than a child’s or an adult’s heart?  
   **Fetal heart has a hole (foramen ovale) between the right and left atrium** and an extra connection called the ductus arteriosus from pulmonary trunk to aorta so that oxygenated blood can pass into systemic circulation faster. The hole and the extra duct should seal after the baby is born. Since the baby is not using their lungs to bring in oxygen, they only need to send some blood to the lungs to provide oxygen & nutrients to those tissues. The blood entering the baby’s heart is already oxygenated and can therefore bypass the trip to the lungs & head out to the baby’s body.

2) What ensures:  
   a) that the blood in the right and left side of the heart don’t mix? **Interventricular septum**  
   b) that the blood only flows in one direction between the atria and ventricles? **AV valves (tricuspid & bicuspid)**

3) Explain the relationship between and the significance of the **CHORDAE TENDINEAE** and the **PAPILLARY MUSCLES**.  
   **Chordae tendineae are anchored to papillary muscles; Chordae tendineae keep AV valves from evertting into atrium (“blowing backwards” like a cheap umbrella on a windy day)**

4) Why does the left ventricle have thicker, more muscular walls than the right ventricle? **the left ventricle has to pump blood out to the body (needs lots of pressure to push the blood out to that distance)**
5) Complete the following chart comparing two heart-related medical conditions:

<table>
<thead>
<tr>
<th>Condition</th>
<th>What is it? / Symptoms?</th>
<th>Caused by?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ANGINA PECTORIS</strong></td>
<td>Pain results from low blood supply (and therefore low oxygen) to cardiac muscle</td>
<td>Narrowed and hardened arterial walls → arteriosclerosis/atherosclerosis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>*pain receptors stimulated by lactic acid (low oxygen conditions leads to lactic acid</td>
</tr>
<tr>
<td></td>
<td></td>
<td>fermentation pathway in cells)</td>
</tr>
<tr>
<td><strong>MYOCARDIAL INFARCTION</strong></td>
<td>Prolonged lack of blood leads to lack of O₂ &amp; then cellular death (if reestablished w/in 20 min, no permanent damage)</td>
<td>Blocked artery (atherosclerosis leads to higher risk of this happening)</td>
</tr>
</tbody>
</table>

6) Complete the following chart summarizing the components involved in cardiac conduction.

<table>
<thead>
<tr>
<th>Component</th>
<th>Where is it?</th>
<th>Role in cardiac conduction?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SA node</strong></td>
<td>Top of R atrium</td>
<td>Pacemaker cells; initiates contraction impulse (SA node → AV node causes atrial systole)</td>
</tr>
<tr>
<td><strong>AV node</strong></td>
<td>Top of interventricular septum</td>
<td>Passes impulse to AV bundle</td>
</tr>
<tr>
<td><strong>Purkinje fibers</strong></td>
<td>Throughout apex of heart (around ventricles)</td>
<td>Impulse throughout apex and leads to ventricular systole (contraction)</td>
</tr>
</tbody>
</table>

7) Differentiate between systole and diastole.

- **Systole**: contract (there is atrial systole and then ventricular systole)
- **Diastole**: relax

8) Describe the following heart conditions:

a) arteriosclerosis: hardening of the plaque lining the arteries
b) atherosclerosis: artery wall thickens with plaque build-up
c) Bradycardia: resting heart beat is slow (slower than 60 bpm)
d) Tachycardia: resting heart beat is fast (higher than 100 bpm)
e) aneurysm: abnormal widening or ballooning of a portion of an artery due to weakness in the wall of the blood vessel
f) heart murmur: sounds that are produced as a result of turbulent blood flow (valve is leaking & blood is flowing backwards) that is sufficient to produce audible noise (hissing) with stethoscope
   - How would a doctor diagnose a heart murmur? Listen with a stethoscope & hears a “hissing” noise

g) stroke: blood flow to the brain stops & brain cells die

9) Describe the two causes of varicose veins.

1) weakness in the walls of veins
2) Defective or damaged valves
   - allow blood to “pool” in an area & that distends the walls of the veins so that they bulge out

10) A blood pressure of 120/70 means what? when the ventricles contract, the blood exerts a force/pressure of 120mmHg on arterial walls as the blood moves through the brachial artery; when the heart is in diastole (relaxing), the blood exerts a force/pressure of 70mmHg on the brachial artery wall
11) How is blood pressure regulated by negative feedback? Baroreceptors in the walls of the aorta & carotid arteries sense changes in blood pressure. These changes in pressure cause the baroreceptors to send nerve impulses to medulla oblongata which then sends nerve impulses to S-A node to increase or decrease heart rate. For example, if too high, blood pressure will be decreased as a result of this pathway → negative feedback.

12) How is a bypass different than an angioplasty? In a bypass, surgery is performed & veins from elsewhere in the patient’s body are grafted to the coronary arteries to bypass atherosclerotic narrowings and improve the blood supply to the coronary circulation supplying the myocardium (heart muscle). Angioplasty is a technique of mechanically widening a narrowed or obstructed blood vessel, the latter typically being a result of atherosclerosis (sometimes a stent can be inserted after the balloon).

13) What is defibrillation? Defibrillation is a process in which an electronic device gives an electric shock to the heart. This stops the heart so that the normal rhythm can be re-established by the SA node. This helps reestablish normal contraction rhythms in a heart having dangerous arrhythmia or in cardiac arrest. In recent years small portable defibrillators have become available. These are called automated external defibrillators or AEDs.

**KNOW: The pathway of blood as it flows through a complete systematic and pulmonary cycle. (Include all chambers, valves, and blood vessels associated with the heart & lungs.) DETAIL!! You know this will be on the test!