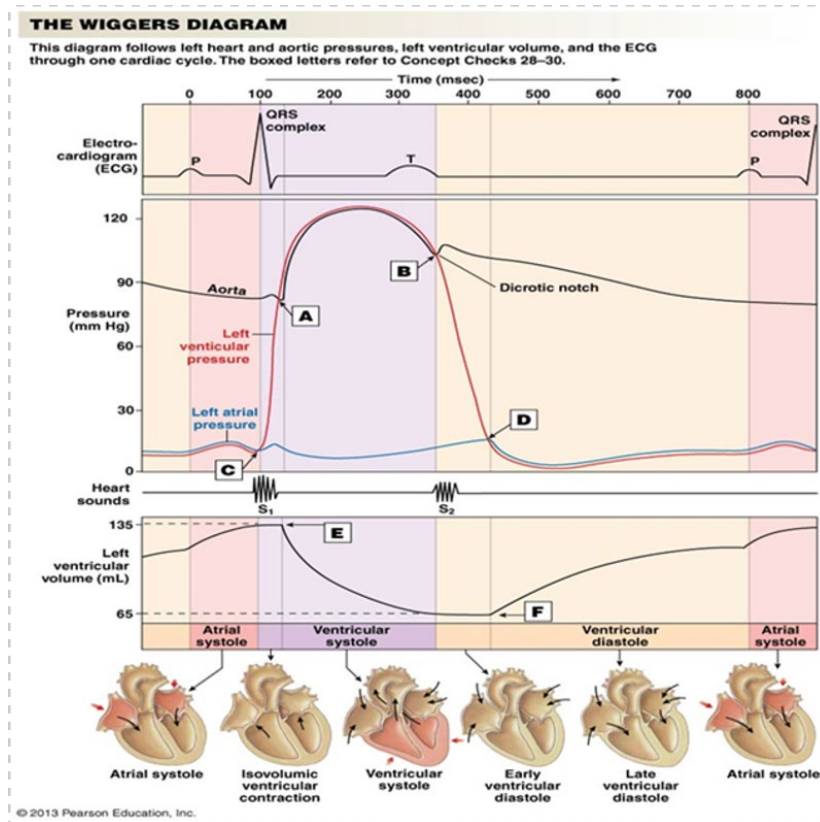**PAL Worksheet**

Week 9 Problem Set 1

Cardiac Cycle

1. Define cardiac output. Which two variables influence cardiac output? Write the formula for cardiac output.

2. Explain how the autonomic nervous system can influence heart rate.

3. Clearly explain which variables regulate stroke volume.

4. On the Wigger's Diagram below, identify the following:

THE WIGGERS DIAGRAM

This diagram follows left heart and aortic pressures, left ventricular volume, and the ECG through one cardiac cycle. The boxed letters refer to Concept Checks 28–30.

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A. The first and second heart sounds. These are caused by..?

B. Isovolumic contraction and relaxation periods (From __ to _____ and from __ to ___). What is the state of the valves during these periods?

C. Opening of the AV valves – at this time the pressure in the atria is higher/lower than the pressure in the ventricles

D. Opening of the semilunar valves – at this time the pressure in the ventricles is higher/lower than the pressure in the arteries

E. Ventricular ejection from __ to ___

5. In the pressure-volume loop below, identify the following:
   a. Atrial pressure is higher than ventricular pressure
   b. Ventricular pressure is higher than aortic pressure
   c. Ventricular filling
   d. Ventricular ejection
   e. Opening of AV valves, opening of semilunar valves
   f. Isovolumic contraction, isovolumic relaxation
   g. End diastolic volume, end systolic volume
   h. 1st and 2nd heart sounds

i.   Indicate how the loop would change if a positive ionotropic drug was added
j.   Indicate how the loop would change if heart rate decreased
k.   Indicate how the loop would change if the aortic semilunar valve was stenotic

LV Pressure-Volume Loop
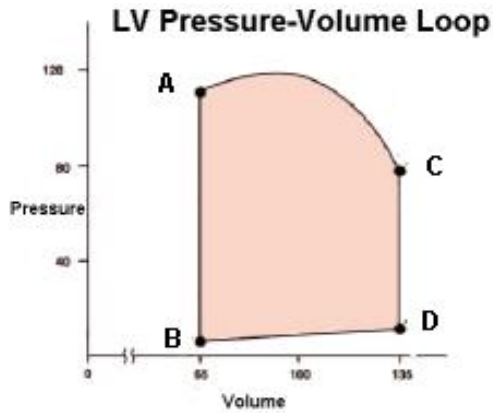
Blood vessels, blood, blood pressure, resistance

4. Make a table clearly listing the major differences between an artery, capillary, and vein.

Poiseuille's law: Flow = $\underline{\Delta P \pi r^4}$ where r is radius of the vessel, L is vessel

                                  8ηL   length, and η is the viscosity of the blood

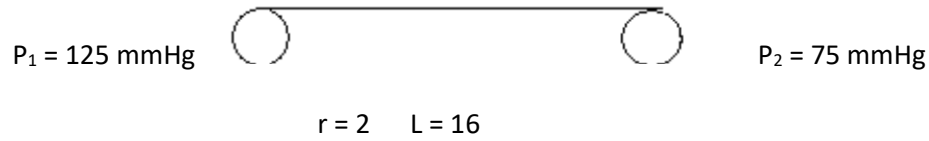 $\Delta P = P_1 - P_2$

This equation can be simplified to read Flow = $\Delta P/R$, where R is resistance. In this case, R = $8\eta L/\pi r^4$, and in most situations, R ~ L/r^4
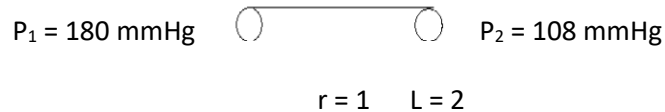
A. If the liver needs more blood, what should happen to the resistance and radius of the hepatic arterioles?

B. Calculate and compare the flow rates between tubes A and B, below.

Tube A

P₁ = 125 mmHg $\bigcirc$ ———————— $\bigcirc$ P₂ = 75 mmHg

r = 2   L = 16

Tube B

P₁ = 180 mmHg $\bigcirc$ ——— $\bigcirc$ P₂ = 108 mmHg

r = 1   L = 2

C. In "blood doping", a person injects extra red blood cells into their bloodstream in an attempt to increase oxygen-carrying capacity. How might this affect flow?

5. A) If the metabolic activity of an organ is decreased, the amount of oxygen in each milliliter of blood leaving the organ in the vein (compared to normal) will:
    A. Increase
    B. Decrease
    C. Remain unchanged   Explain your answer

B) For the following sentences use these terms: increase/decrease/remain the same
If the arterioles leading to a capillary bed vasoconstrict, blood flow into those capillaries will _____. At the same time, blood pressure in the arteries leading into those arterioles will _____.

6. Define blood pressure.