Phys 20.01 Practice exercise 1

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Blood flow in the heart. The human circulatory system is closed—that is, the blood pumped out of the left ventricle of the heart into the arteries is constrained to a series of continuous, branching vessels as it passes through the capillaries and then into the veins as it returns to the heart. The blood in each of the heart's four chambers comes briefly to rest before it is ejected by contraction of the heart muscle.

1. If the contraction of the left ventricle lasts 250 ms and the speed of blood flow in the aorta (the large artery leaving the heart) is 0.80 m/s at the end of the contraction, what is the average acceleration of a red blood cell as it leaves the heart?

   a. 310 m/s^2
   b. 31 m/s^2
   c. 3.2 m/s^2
   d. 0.32 m/s^2.

2. If the aorta (diameter d_a) branches into two equal-sized arteries with a combined area equal to that of the aorta, what is the diameter of one of the branches?

   a. $\sqrt{d_a}$
   b. $\sqrt{d_a}/\sqrt{2}$
   c. $2d_a$
   d. $d_a/2$.

3. The velocity of blood in the aorta can be measured directly with ultrasound techniques. A typical graph of blood velocity versus time during a single heartbeat is shown in the figure. Which statement is the best interpretation of this graph?

   a. The blood flow changes direction at about 0.25 s
   b. the speed of the blood flow begins to decrease at about 0.10 s
   c. the acceleration of the blood is greatest in magnitude at about 0.25 s
   d. the acceleration of the blood is greatest in magnitude at about 0.10 s.