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Problems set # 3 **Physics 131** October 2, 2018

1. At a depth of 10.9 km, the Challenger Deep (in the Marianas Trench of the Pacific Ocean) is the deepest known site in any ocean. Yet, in 1960, Walsh and Piccard reached the Challenger Deep in the bathyscaphe *Trieste*. Assuming that seawater has a uniform density of $1,025$ kg/m^3, calculate the force the water would exert in the ocean floor on Trieste's round observation window of 25 cm diameter.

2. Only a small part of an iceberg protrudes above the water, while the bulk lies below the surface. The density of ice is 917 kg/m^3 and that of seawater is $1,025$ kg/m^3. Find the percentage of the iceberg's volume that lies below the surface.

3. In humans, blood flows from the heart into the aorta, from which it passes into the major arteries. These branch into small arteries (arterioles), which in turn branch into myriads of tiny capilars. The blood returns to the heart via the veins. For an illustration see Fig. 1. The radius of the aorta is about 1.2 cm, and the blood passing through it has a speed of about 40 cm/s. A typical capilar has a radius of about 4×10^{-4} cm, and blood flows through it at speed of about 5×10^{-4} m/s. Estimate the number of capillars that are in the body.

4. Acrobat Sally of mass $m_{\rm S}$ stands on the left end of a seesaw. Acrobat Harry of mass $m_{\rm H}$ jumps from a height $h_{\rm H}$ onto the right end of the seesaw, thus propelling Sally into the air. *(i)* Neglecting inefficiencies (that transform energy into heat), how does the potential energy of Sally at the top of his trajectory compares with the potential energy of Harry just before he jumps? *(ii)* Shows that ideally Sally reaches a height $m_{\rm H}h_{\rm H}/m_{\rm S}$. *(iii)* If Sally's mass is 88 lb, Harry's mass 150 lb, and the height of the initial jump was 4 m, show that Sally rises a vertical distance of 7 m.

5. Harry and Sally are at a ski resort with two ski runs, a beginner's run and an expert's run. Both runs begin at the top of the ski lift and end at finish line at the bottom of the same lift. Let h be the vertical descent for both runs. The beginner's run is longer and less steep than the expert's run. Harry and Sally, who is a much better skier than him, are testing some experimental frictionless skis. To make things interesting, Harry offers a wager that if she takes the expert's run and he takes the beginner's run, her speed at the finish line will not be greater than his speed at the finish line. Forgetting that Harry study physics, Sally accepts the bet. The conditions are that both Harry and Sally start from rest at the top of the lift and they both coast for the entire trip (i.e., there is no external work done on the system). Who wins the bet? (Assume air drag, which may dissipate energy via heat, is negligible).

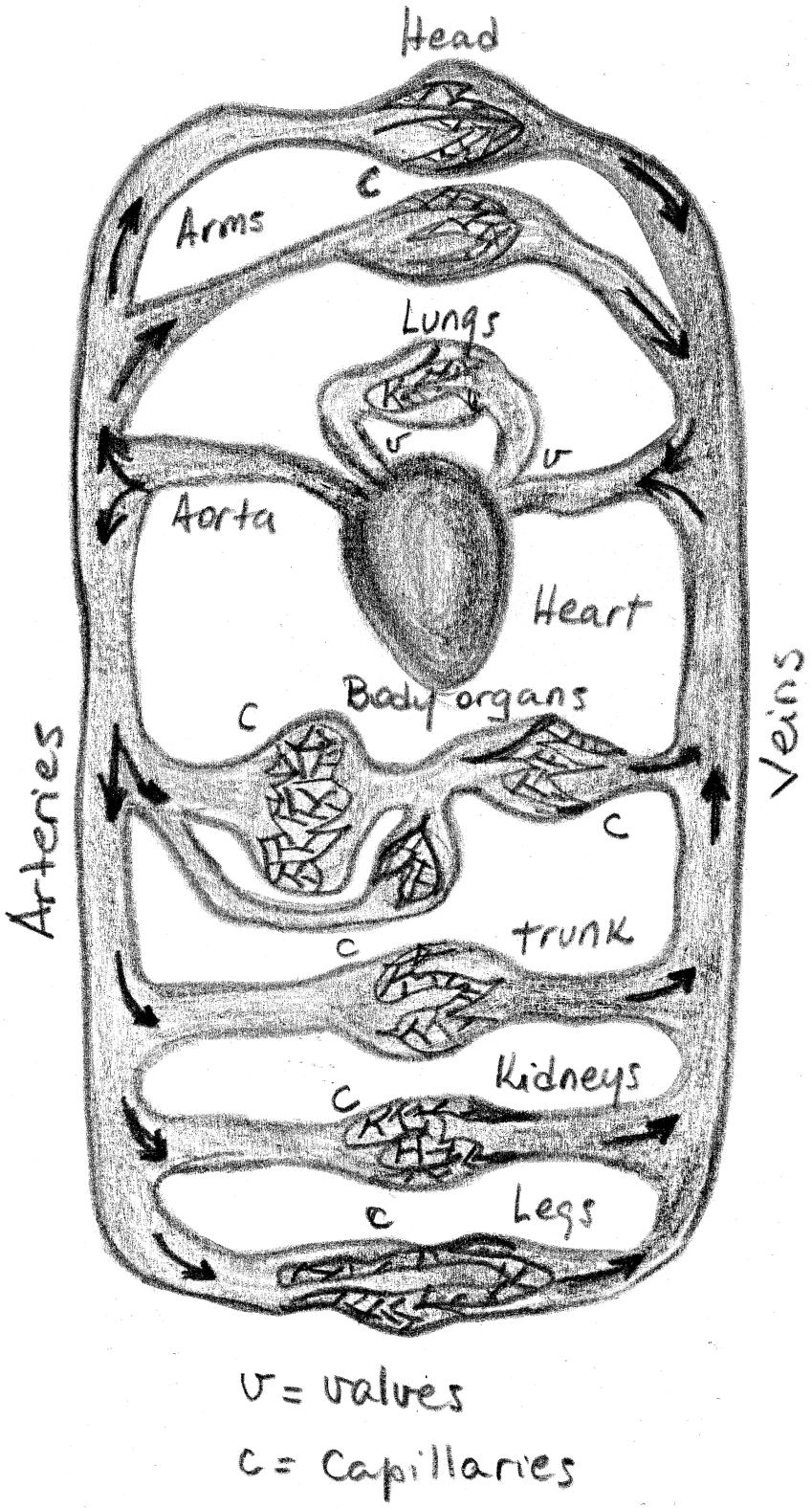

Figure 1: The situation in question 4.