Phys101 Assignment Cover Sheet

First Name:_____ Last Name:_____ Mark: _____

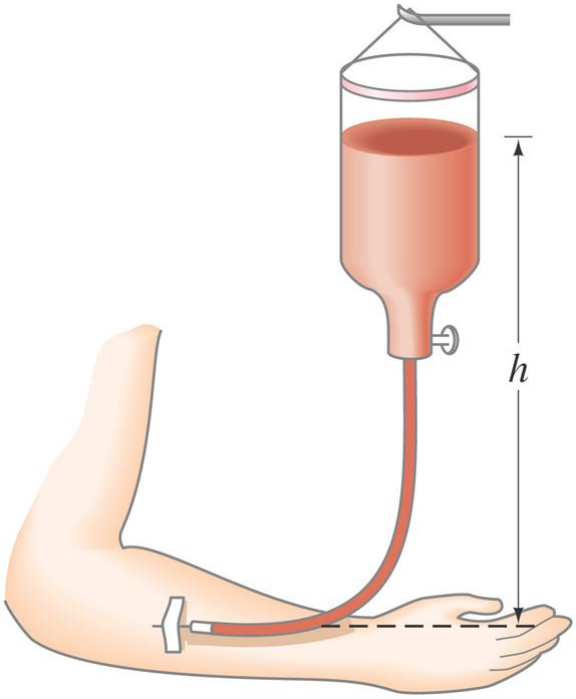
Student ID:_____ Date: _____

Phys101 Written Assignment #6

Due Wed/Thur. March 23/24, 2011, at the end of tutorial

Textbook (Giancoli, 6th edition) page 284 problem #58.

58. A patient is to be given a blood transfusion. The blood is to flow through a tube from a raised bottle to a needle inserted in the vein (Fig. 10–55). The inside diameter of the 4.0-cm-long needle is 0.40 mm, and the required flow rate is 4.0 cm^3 of blood per minute. How high h should the bottle be placed above the needle? Obtain ρ and η from the Tables. Assume the blood pressure is 18 torr above atmospheric pressure.



P101 WRITTEN ASSIGNMENT # 6

58) a patient is to be given a blood transfusion. The blood is to flow through a tube from a raised bottle to a needle inserted in the vein. The inside diameter of the 4.0 cm long needle is 0.40 mm and the required flow rate is $4.0\ cm^3$ of blood per minute. How high should the bottle be placed above the needle?

Blood pressure = 18 TORR above atmospheric pressure $= 18(133.3)\ Pa + 1\ ATM$
$= 2399\ Pa + 1\ ATM$

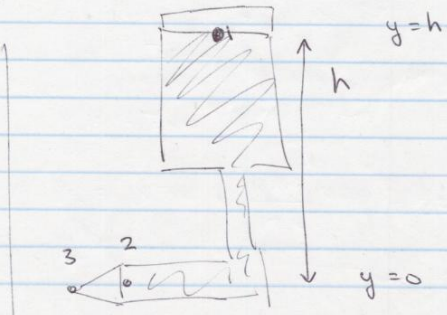
$\rho_{BLOOD} = 1.05 \times 10^3\ kg/m^3$

$\eta_{BLOOD} = 4.0 \times 10^{-3}\ Pa \cdot s$

$R = \frac{0.4}{1000}\left(\frac{1}{2}\right) = 0.0002\ m$

$l = \frac{4}{100} = 0.04\ m$

$Q = \frac{4\ cm^3}{min} \times \frac{1\ min}{60\ s} \times \frac{1\ m^3}{(100)^3\ cm^3} = 6.7 \times 10^{-8}\ m^3/s$



$$Q = \frac{\pi R^4 (P_2 - P_3)}{8 \eta l}$$

$$6.7 \times 10^{-8} = \frac{\pi (0.0002)^4 (P_2 - P_3)}{8 (4.0 \times 10^{-3})(0.04)}$$

$$(P_2 - P_3) = 17070$$

$$P_2 = 17070 + 2399 + 1ATM$$

$$P_1 + \rho g h_1 = P_2$$

$$1ATM + \rho g h_1 = 17070 + 2399 + 1ATM + 0$$

$$(1.05 \times 10^3)(9.8) h_1 = 19469$$

$$h_1 = 1.9m$$