

PROBLEM #2 – 25 points USE UNITS of CENTIMETERS SECONDS and GRAMS

Two identical clean glass beakers hold the same volume of fluid.

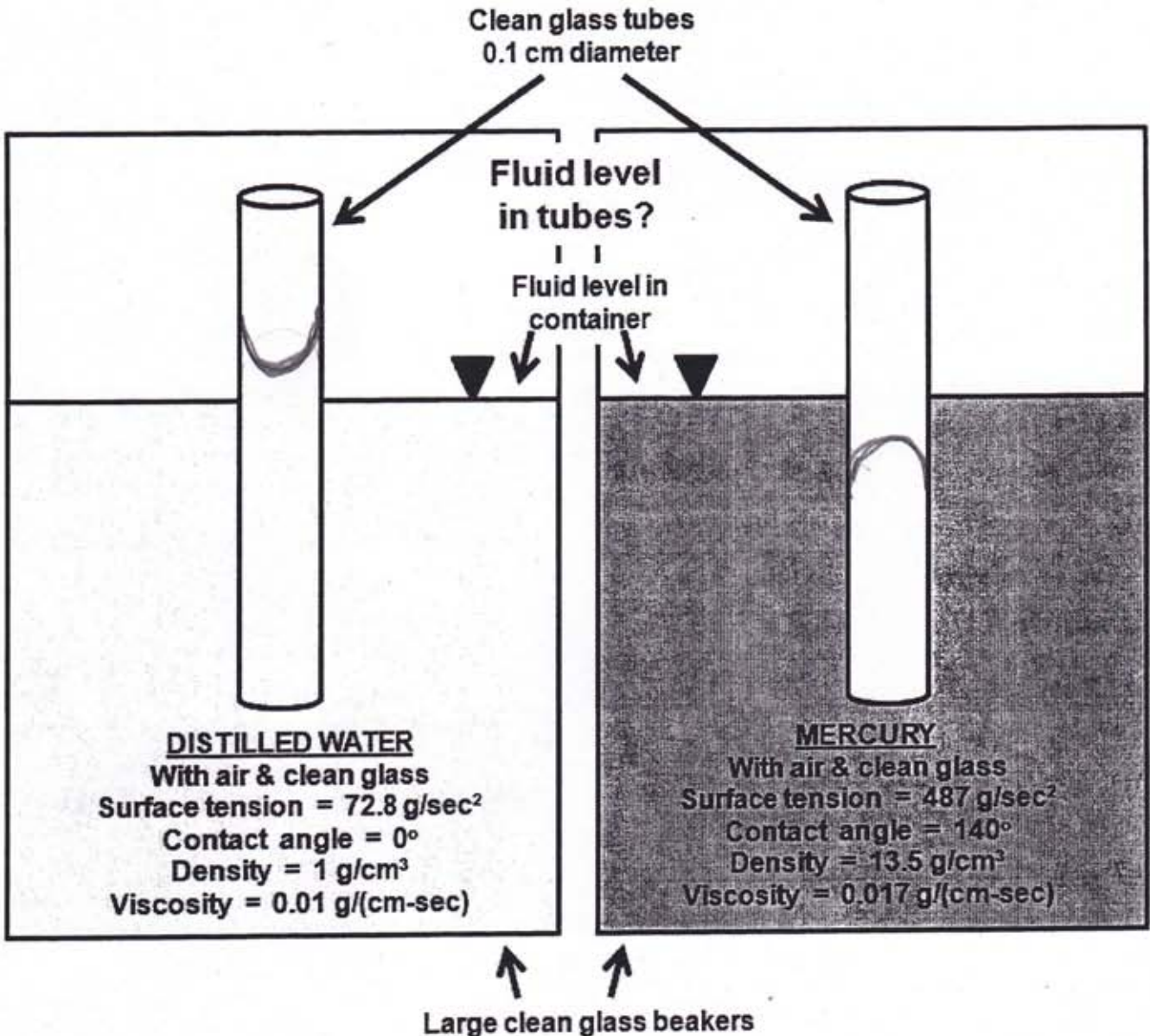
One contains distilled water and the other mercury.

A 0.1cm diameter glass tube is placed vertically in each beaker with the bottom of the tube suspended 10cm above the bottom of the beaker.

The properties of the fluids are indicated in the illustration below

ANSWER THE QUESTIONS ON THE FOLLOWING PAGE, SHOW YOUR WORK

NOT DRAWN TO SCALE



PROVIDE CALCULATIONS AND ANSWERS TO PROBLEM 2 HERE

USE UNITS of CENTIMETERS SECONDS and GRAMS

2a) On the diagrams of the previous page, draw a schematic of the fluid within each tube.

See previous page

2b) What is the capillary rise of each fluid in the 0.1 cm diameter tubes?

$$h_{c \text{ water}} = \frac{2\sigma \cos\lambda}{\gamma_r} = \frac{2 \left(\frac{72.8 \text{ g}}{\text{cm}^2 \text{ s}^2} \right) (\cos 0)}{\frac{981 \text{ g}}{\text{cm}^3 \text{ s}^2} \cdot 0.05 \text{ cm}} = 2.97 \text{ cm}$$

OR 0.0297 m

$$h_{c \text{ mercury}} = \frac{2 \left(487 \frac{\text{g}}{\text{cm}^2 \text{ s}^2} \right) \cos 140^\circ}{13.5 \times \frac{981}{\text{cm}^3 \text{ s}^2} \cdot 0.05 \text{ cm}} = -1.13 \text{ cm}$$

OR -0.0113 m

2c) If the hydraulic conductivity for water in a porous medium is $3 \times 10^{-2} \text{ cm/sec}$. What would the fluid conductivity be for mercury?

$$k = \frac{K\mu}{\rho g} = 3.058 \times 10^{-7} \text{ cm}^2$$

$$K = \frac{k\rho g}{\mu} \quad k \text{ \& } g \text{ are constant}$$

$$\text{water } \frac{\rho}{\mu} = \frac{1 \text{ g}}{\text{cm}^3} = 100 \quad \text{mercury } \frac{\rho}{\mu} = \frac{13.5 \text{ g}}{\text{cm}^3} = 794$$

$$\frac{0.01 \text{ g}}{\text{cm} \cdot \text{s}} \quad \frac{0.017 \text{ g}}{\text{cm} \cdot \text{sec}}$$

K_{mercury} is $7.94 \times K_{\text{water}}$ of $0.03 \frac{\text{cm}}{\text{sec}}$

$$K_m = 2.38 \times 10^{-1} \frac{\text{cm}}{\text{sec}}$$