

1. A U-tube filled with water is closed on one end. The tube is about one meter tall. When water is removed from the open end, the water level in the closed end does not change.

- a. What is the pressure at point *F* before any water is removed?

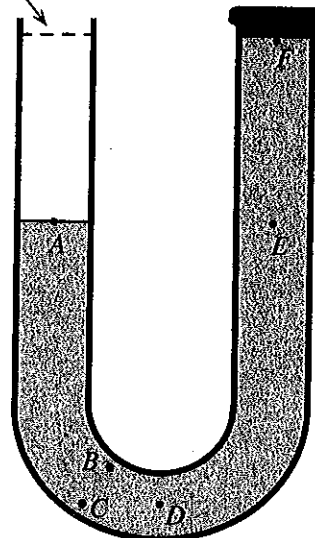
On the basis of your answer, is there a force exerted by the stopper on the top surface of the water?

- b. The water level on the left is lowered until it reaches point *A*.

Does the pressure at point *A* *increase, decrease, or remain the same*? Explain.

On the basis of your answer, does the pressure at point *D* *increase, decrease, or remain the same*? Explain. If the pressure changes, how does the change in pressure at point *A* compare to the change in pressure at point *D*?

Original
water
level



Do the pressures at points *E* and *F* *increase, decrease, or remain the same*? How do the changes in pressure at these points compare to the change in pressure at point *A*?

Does the force exerted by the stopper on the top surface of the water *increase, decrease, or remain the same*? Explain.

- c. Suppose that point *F* is 0.5 m above point *E*. Determine the pressure at point *F*. (*Hint*: What is the pressure at point *E*?) The density of water is $\rho = 1000 \text{ kg/m}^3$, $g \approx 10 \text{ m/s}^2$, and atmospheric pressure $P_o = 1.01 \times 10^5 \text{ N/m}^2$.
- d. Suppose instead that the tube is much taller than 1.0 m. Calculate the distance above point *E* at which the pressure in the water would be zero (*i.e.*, find the height of water above point *E*).
- e. Use your answers above and the definition of pressure to explain why the water level on the right remains at point *F* for a U-tube that is 1.0 m tall.

2. A W-shaped piece of glassware is partially filled with water as shown. Point X is at the same height as the water level in the center of the tube.

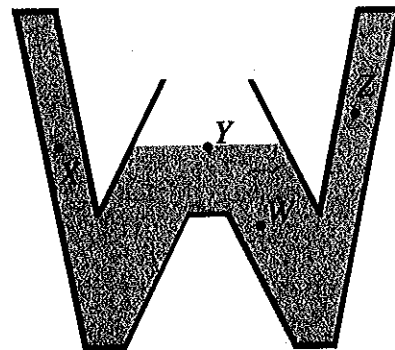
For each of the following points, state whether the pressure is *greater than*, *less than*, or *equal to* atmospheric pressure. Explain your reasoning.

- point W

- point X

- point Y

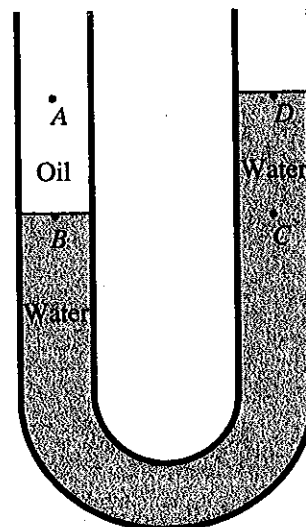
- point Z



3. A U-tube is partly filled with water. Oil is then poured on top of the water on one side. The final water levels on both sides are as shown. The surface of the oil is not shown.

Points A and D are at the same level; points B and C are at the same level.

- a. Is the pressure at point B *greater than*, *less than*, or *equal to* the pressure at point C? Explain.
- b. Will the pressure at the top surface of the oil be *greater than*, *less than*, or *equal to* the pressure at point D? (*Hint*: What is the pressure at point D?)



- c. Based on your answers to parts a and b, will the top surface of the oil be *above*, *below* or *at the same height as* the top surface of the water? Explain how your answer is consistent with $P = P_o + \rho gh$.