1. C The specific gravity of a substance is the ratio of its density to the density of water. The density of our sample:

$$\rho = \frac{m}{V} = \frac{330\text{ g}}{30\text{ cm}^3} = 11\frac{\text{g}}{\text{cm}^3}$$

The density of water:

$$\rho_{H2O} = 1\ \frac{\text{g}}{\text{cm}^3}$$

So the specific gravity of lead according to these measurements is 11.

2. C The lead bar would displace the volume 30 cm^3 of water, or 30 g of water. The bouyant force equals the weight of fluid displaced; 30 g weighs .3 N

$$\left(30\text{ g} \times \frac{1\text{ kg}}{1000\text{ g}} \times 10\ \frac{\text{m}}{\text{s}^2} = .3\text{ N}\right)$$

3. C The barge displaces water of volume 200 m^3. This much water has mass equal to this volume times the density of water:

$$200\text{ m}^3 \times \frac{1000\text{ kg}}{\text{m}^3} = 2 \times 10^5\text{ kg}$$

multiplying by the acceleration due to gravity gives the weight: $2 \times 10^6\text{ N}$

4. B The balloon expands because the less dense air exerts less pressure. The proportionate decrease in pressure is equal to the proportionate decrease in air density, so the expanded balloon displaces a larger volume of less dense air. The weight displaced is the same.

5. A The net pressure on the bottom of the tank is the pressure exerted by the water (It's true that the atmosphere exerts pressure from the top transmitted by the water, but it also exerts pressure from below, so we can disregard the atmospheric pressure in computing the *net* force on the tower bottom):

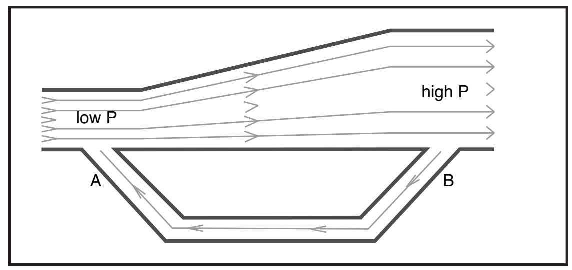
$$P = \rho g h = \frac{1000\text{ kg}}{\text{m}^3} \times 10\ \frac{\text{m}}{\text{s}^2} \times 10\text{ m} = 1 \times 10^5\text{ Pa}$$

The area of the bottom (πr^2) = 314 m^2, so the net force is the product of the pressure and this area.

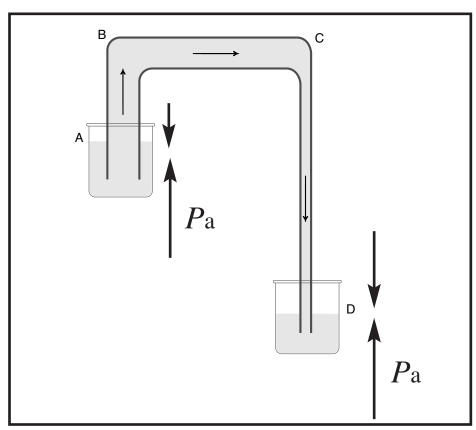
6. D A,B, and C are characteristics of turbulent flow.

7. B Looking at the major flow, we know, from the equation of continuity, that flow in the narrow segment of the large pipe will be quicker than in the expanded segment. Examine Bernoulli's theorem:

Do you see how within a streamline that does not alter in its elevation, the pressure will decrease as flow speed increases? So pressure will be lower in at the A junction than in B junction, and, because fluid flows from high to low pressure, the secondary flow will be from right to left.



8. B The fluid flows between the arms of the siphon because of the weight of fluid at the base of the long arm is greater than at the base of the short arm. It is atmospheric pressure that pushes the fluid through, but the magnitude of the pressure gradient depends completely on the difference in the length of the arms of the siphon:



9. B The cross-sectional area of the narrow tube, CD, is 1/9 that of the wide tube, so the flow speed, by the equation of continuity, will be 9 times greater.

10. B The maximum height of segment AB will be reached when the pressure exerted by the weight of the water column is greater than the atmospheric pressure. The atmosphere will then be unable to hold the water in the siphon. The atmospheric pressure is about 100,000 Pa. Using $\rho g h$ gives an answer of about 10 meters for the height of a water column that will exert this much pressure.

11. C Look to the explanation of question #8 and you will see that C is correct.

12. C By $P=\rho g h$, we know that a more dense fluid will have a lower maximum height for the short segment AB (see question #10). As to whether I or II are correct, neither are. The flow rate will be the same. The pressure gradient will be larger across the siphon, but it will be acting on a more dense medium. The flow rate is the same. An analogy can be seen in the fact that a large stone and a small stone are both subjected to an equal acceleration due to gravity. (For a more definitive explanation, think about Bernoulli's theorem. Density is a coefficient of both the potential and kinetic energy terms.)