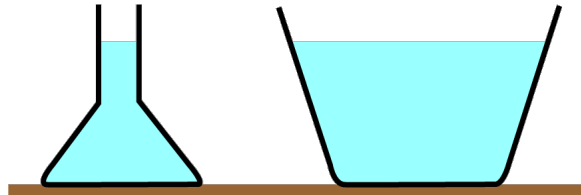

PHYS 1120 Discussion 13. Greatest Hits

We have covered a lot of physics this semester. Let's review some fun topics.

1. Pressure

Two vessels with bases of the same surface area are filled with water to the same height. The empty vessels have the same mass.



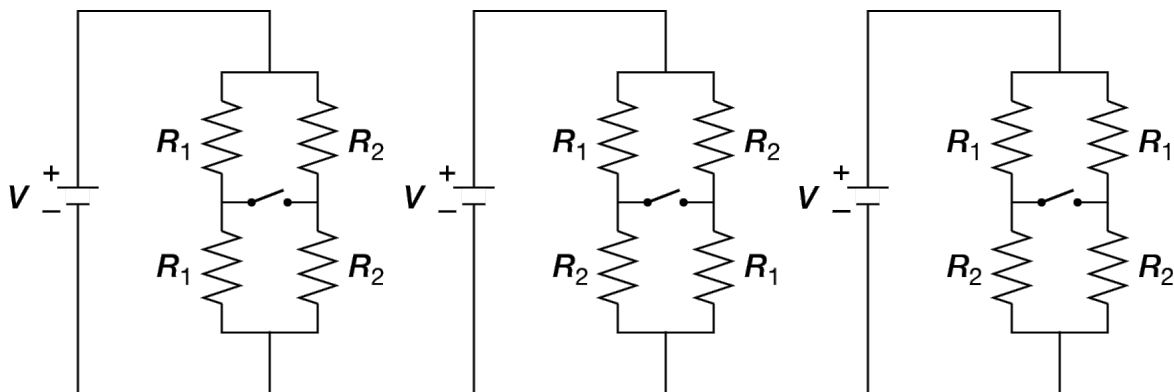
- How do the water pressures at the bottom of the two vessels compare?
- How do the downward forces exerted by the water on the bases of the two vessels compare?
- Which vessel with water weighs more?
- How can this be?

2. Dielectrics

A dielectric material with dielectric constant κ placed in an electric field E_0 will polarize electrically so that the field strength inside the dielectric has magnitude E_0/κ .

- Use this fact to explain why filling the gap between the plates of a parallel-plate capacitor with this dielectric will increase the capacitance of the capacitor by a factor of κ .
- If you have time, use Gauss's law to explain why the capacitance of an air-filled parallel-plate capacitor with area A and gap thickness d is $C = A\epsilon_0/d$.

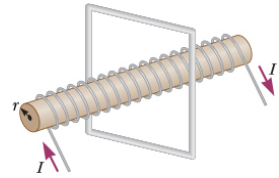
3. DC Circuits



Suppose that in the circuits illustrated, R_1 and R_2 are very different, say, $R_1 = 20 \Omega$, $R_2 = 80 \Omega$, and $V = 4 \text{ V}$. How does closing the switch affect the total current through each circuit?

4. **Faraday's law**

(Problem 20-60.) A long solenoid of radius $r = 2.00$ cm is wound with 3500 turns per meter and carries a current that changes at the rate of 28.5 A/s. What is the magnitude of the emf induced in the conducting loop around the solenoid?

5. **Anti-reflective coating**

An anti-reflective coating of magnesium fluoride, refractive index $n_c = 1.325$, is applied to a crown glass lens, refractive index $n_g = 1.530$.

- A. How thick should the layer of magnesium fluoride be to block reflection of 550-nm light?
- B. (optional) When 450-nm blue light strikes this coating, what is the phase difference between light reflecting from the coating and light reflecting from the lens?

6. **Replacement lens**

A cataract (cloudy lens) is removed from an eye. Without the lens present, the cornea and aqueous humor of the eye produce a real image that falls 5.00 centimeters behind the cornea.

- A. What strength of replacement lens should be implanted just behind the aqueous humor to cause the image to fall on the retina, 2.60 centimeters behind the cornea? Disregard the thickness of the cornea and aqueous humor; our lens equation does not account for lens thickness.
- B. This is a situation with a “virtual object.” Can you figure out how to find the location of the image of a virtual object by ray tracing? (You can't easily use ray tracing to solve the problem here, because the focal length of the corrective lens is unknown. But if you do know the focal length, you can find the image with ray tracing.)