

# Physics 106 Midterm Exam

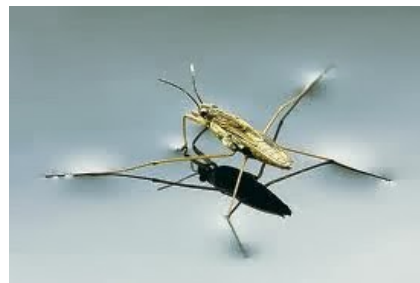
Name: \_\_\_\_\_ UMich unqname: \_\_\_\_\_

- **open book:** prelabs, worksheets, homeworks, non-programmable calculator are allowed.
- **questions** are of equal value; “choose all” questions are graded like set of yes/no questions.
- **time:** 80 minutes

1. You measure how long it takes for a penny to drop by 3 meters. You repeat the experiment three times and end up with the following measurements: 0.83 s, 0.81 s, 0.86 s. Specify:

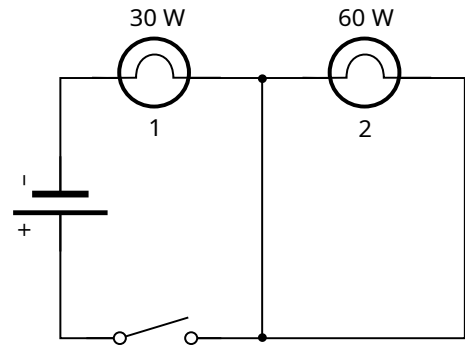
- (a) Physical quantity: \_\_\_\_\_
- (b) Unit: \_\_\_\_\_
- (c) Value: \_\_\_\_\_
- (d) Error estimate: \_\_\_\_\_

2. You find a dead water strider (see picture on the right). If you set it down on the water with its feet pointing down, it floats, however, when you place it on the water belly-up, it sinks. Explain why the strider sinks and why it floats!



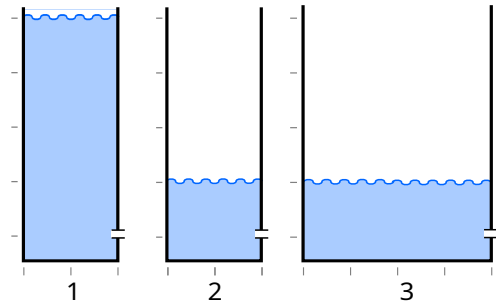
3. Look at the circuit diagram on the right. Once the switch is closed, what will happen? (**choose one**)

- (a) Both light bulbs will light about equally bright.
- (b) Light bulb 2 will be much brighter than light bulb 1.
- (c) Light bulb 1 will light, light bulb 2 will not
- (d) Light bulb 2 will light, light bulb 1 will not
- (e) No light bulb will light, and the battery will start getting hot.



4. You have three cylindrical water tanks of different sizes and different filling levels (see picture on the right). You punch a hole of the same size at the same height in each of them and wait a couple of seconds. Assume that the tanks are so large that the water level did not change by much in that time. Which of the following statements are correct (**choose all that apply**):

- (a) Tanks 1 and 2 lost about the same amount of water.
- (b) Tank 1 lost about twice as much water as tank 2.
- (c) Tanks 2 and 3 lost about the some amount of water.
- (d) Tank 3 lost about twice as much water as tank 2.
- (e) Tanks 1 and 3 lost about the same amount of water.

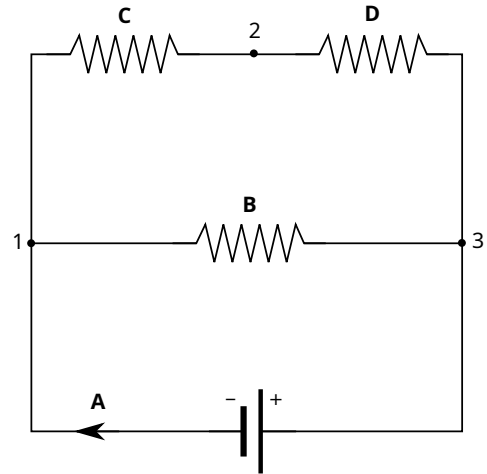


5. You want to build a chain of three christmas lights connected to a battery. However, you want to make sure that the other lights are still working when you remove one light (or it burns out). Draw a circuit diagram for a circuit that accomplishes that.

6. You attach a hanging weight with mass  $m$  to an ideal spring with spring constant  $k$ . The elongation (the difference between the length of a spring with and without the mass attached) is  $x$ . Which of the following actions **doubles** the elongation? (**choose all that apply**)
- (a) use a spring with double the spring constant
  - (b) use a second identical spring in series with the first
  - (c) use a second identical spring in parallel with the first
  - (d) attach a second weight with the same mass as the first
  - (e) attach the weight to the middle of the spring rather than the end
7. You take a look inside a used lead–zinc battery, which is made of a lead (Pb) electrode and a zinc (Zn) electrode immersed in dilute solution of nitric acid ( $\text{HNO}_3$ ). You see that one of the electrodes is completely corroded (it looks like something “ate” part of the electrode), while the other one looks like new.
- (a) Which material is the corroded electrode made from? \_\_\_\_\_
  - (b) Where did the missing material go?
8. Which of these things are **physically impossible**? (**choose all that apply**)
- (a) A machine that melts ice and uses the resulting energy to push a rock up a hill.
  - (b) A machine that condenses water vapor to liquid water and uses the resulting energy to push a rock up a hill.
  - (c) A person sleighing down a hill and using the speed at the bottom to go up a subsequent hill that is greater in height than the one he went down from.
  - (d) A liquid in a tank which has higher pressure close to the surface than at the bottom. (The liquid is not moving)
  - (e) A machine that first uses the charge in a battery to heat up a resistor, then converts the heat from the resistor to electricity, which then charges a capacitor, and finally, once charged, uses the charge from the capacitor to light a light bulb.

9. Look at the circuit diagram on the right. Assume all resistors are identical. Which of the following statements are true? (**choose all that apply**)

- (a) The current through point A is the same as the current through resistor B.
- (b) The current through resistor C is equal to the current through resistor D.
- (c) The voltage between points 1 and 3 is zero.
- (d) The current through resistor B plus the current through resistor C is equal to the current through point A.
- (e) The voltage between points 1 and 2 plus the voltage between points 2 and 3 is equal to the voltage between points 1 and 3.



10. A colleague shows you their designs for a capacitor. Assume that the cross sections you see here are the same throughout the capacitor. You tell them one of their designs **does not work** because it will have a much lower capacitance than all the others. Which one? (**choose one**)

(a)

(b)

	metal
	paper
	air

(c)

(d)

(e)

*Viel Erfolg!*