

Circle your answer or put your answer in the box provided.

1) How are the small pieces of paper attracted to the comb? (5pts)

- a) Only, the comb is charged.
- b) The comb is charged and the pieces of paper are charged.
- c) The comb and the pieces of paper are polarized.
- d) Only, the paper is charged.
- e) The comb is charged and the pieces of paper are polarized.



2) In the Mechanical Universe, you saw the magician use 'magic' with the Electroscope. When a rod was brought close to the top of the post what caused the gold leaves to move away from each other? (5 pts)

- a) The rod was charged and induced the same charge toward the top of the post leaving the gold leaves with the same charge.
- b) The rod is charged and induces the opposite charge toward the top of the post leaving the gold leaves with the same charge.
- c) The rod is charged and induces the opposite charge toward the top of the post leaving the gold leaves with different charges.
- d) The rod and the top are oppositely charged causing charge to flow from the leaves which causes the leaves to move away from each other.



3) Two electrons close to each other are released from rest and are completely free to move. After being released (there may be more than one correct choice), (5pts)

- A. their speeds gradually decrease to zero as they move apart.
- B. their speeds gradually increase as they move apart.
- C. their accelerations gradually increase as they move apart.
- D. their accelerations gradually decrease to zero as they move apart.

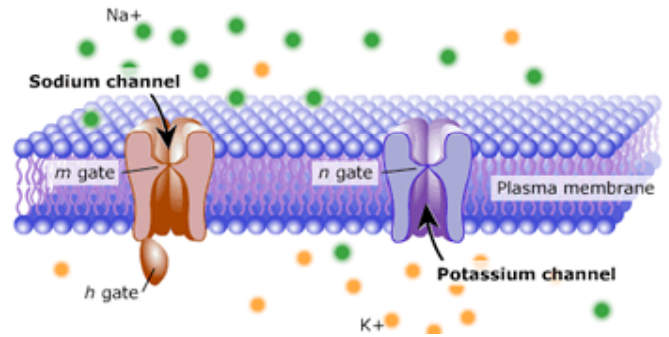
4) In ordinary laboratory circuits, charges in the  $\mu\text{C}$  and  $\text{nC}$  range are common. How many excess electrons must you add to an object to give it a charge of  $3.58 \text{ nC}$ ? (5 pts)

5) The platypus senses prey with its snout. How does it seem to do this? Why is this ability found in water-dwelling creatures? (One or two words will suffice.) (10 pts)

6a) What is the sequence of the Action Potential? (5 pts)

- a) 5,2,3,1,4
- b) 2,5,3,4,1
- c) 3,2,5,4,1
- d) 3,5,2,4,1
- e) 3,5,2,1,4

Channel Gating during an action potential



- 1) Hyperpolarization (potassium flows out of the cell past -70mV but soon returns to -70mV)
- 2) Depolarization (trigger region reacts. . .Sodium flows into the cell -70 mV to +0 mV)
- 3) Resting (all active channels closed)
- 4) Repolarization (Potassium flows out of the cell +30 mV to -70 mV)
- 5) Depolarization (Sodium flow slows into the cell 0 mV to +30 mV)

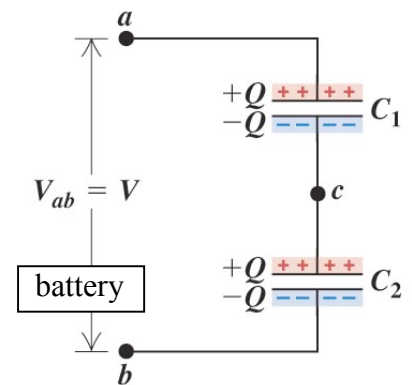
6b) For Na<sup>+</sup> and K<sup>+</sup> ions to move between the cell membrane:

The cell membrane acts as a(n) \_\_\_\_\_ with a(n) \_\_\_\_\_ across it.  
 The movement of ions across the membrane would represent a(n) \_\_\_\_\_. (5 pts)

- a) battery, voltage, current
- b) power source, current, voltage
- c) capacitor, current, voltage
- d) voltage, capacitor, current
- e) capacitor, voltage, current

7a) If the voltage is 12V and C<sub>1</sub> = 20nF and C<sub>2</sub> = 40nF, what is the charge and voltage on each capacitor? (10 pts)

V<sub>1</sub> \_\_\_\_\_ V<sub>2</sub> \_\_\_\_\_ and Q<sub>1</sub> \_\_\_\_\_ Q<sub>2</sub> \_\_\_\_\_



7b) When the voltage was first applied where did the Charge on the top plate of C<sub>1</sub> come from? (5pts)

- a) the battery
- b) the bottom plate of C<sub>1</sub>
- c) the top plate of C<sub>2</sub>
- d) the bottom plate of C<sub>2</sub>

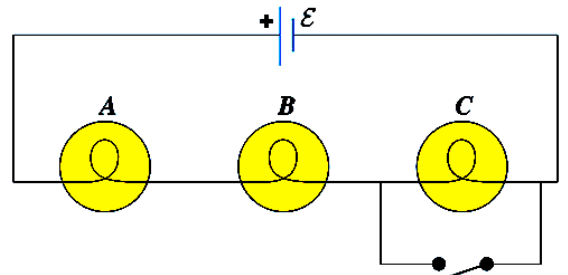
7c) At the moment the switch is closed what happens? (5 pts)

- a) The current in the circuit is at minimum and the the charge on the plates is at a minimum.
- b) The current in the circuit is at maximum and the the charge on the plates is at a minimum.
- c) The current in the circuit is at minimum and the the charge on the plates is at a maximum.
- d) The current in the circuit is zero and the the charge on the plates is at a zero.

8) Two very large charged parallel metal plates are 10.0 cm apart and produce a uniform electric field of  $2.80 \times 10^6$  N/C between them. A proton is fired perpendicular to these plates with an initial speed of 5.20 km/s, starting at the middle of the negative plate and going toward the positive plate. How much work has the electric field done on this proton by the time it reaches the positive plate? (10 pts)

9a) Bulbs A, B, and C are identical. Closing the switch in the figure causes which of the following changes in the potential differences? More than one answer is possible. (5 pts)

- a) The pot. Diff across A and B are unchanged.
- b) The pot. Diff across C drops by 50%
- c) The pot. Diff across A and B each increase by 50%.
- d) The pot. Diff across C drops to zero.



9b) Which lights are lit up after the switch is closed? (5pts)

- a) A, B and C
- b) A and C
- c) A and B
- d) B and C

10) Resistors are dependent upon temperature. The resistance of a substance \_\_\_\_\_ with increasing temperature. What is  $R_0$ ? What is  $\alpha$ ? (5 pts)

Fill in the blank

$R_0$  \_\_\_\_\_

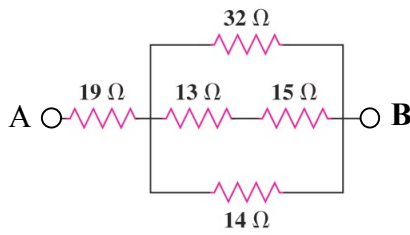
$\alpha$  \_\_\_\_\_

11) A heart defibrillator is used to enable the heart to start beating if it has stopped. This is done by passing a large current of 12 A through the body at 28.5 V for a very short time, usually about 3.08 ms. What power does the defibrillator deliver to the body? How much energy is transferred? (10 pts)

Power

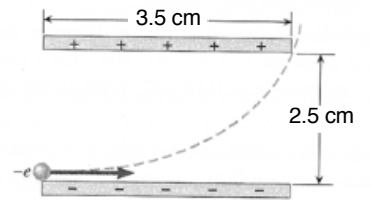
Energy

12) What is the Total Resistance in the circuit? What is the current thru the 13 ohm resistor? (15 pts)





13) An electron is set thru the capacitor as shown. It just passes the upper edge on the way out of the capacitor. The initial speed of the electron is  $2.75 \times 10^6$  m/s. Find the *magnitude and direction* of the Electric Field between the plates. (15 pts)



magnitude

direction