

A. Select the correct answer for the following multiple choice questions and write your answer in the line next to the question number.

- A 1. Electric current is the,
 a. Charge flow per unit time b. Charge flow per unit volume
 c. Energy flow per unit time d. Charge flow per unit area

- a 2. Conventional electric current is defined using the flow of
 a. positive charges b. negative charges c. neutral charges

A 3. In the technique of impedance plethysmography, what property of the calf is observed as a function of time?

B 4. In the technique of electrocardiography, what is observed as a function of time?

Answers for 3 & 4

- A. Resistance B. Potential difference C. Electric current
 D. Electric charge E. Capacitance

B 5. In a common household circuit, devices are connected in

A 6. In a regular flashlight, batteries are connected in

Answers for 5 & 6: A. Series B. Parallel

A 7. An appliance with a power rating of 24-W is connected to a 120-volt outlet. What is the current through the appliance?

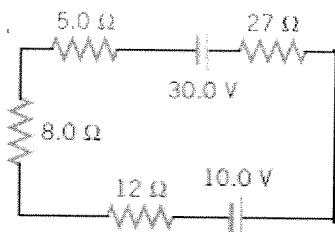
- A. 0.2 A B. 0.1 A C. 24 A D. 12 A E. 5 A

b 8. Kirchhoff's junction rule deals with,
 a. potential b. current c. voltage d. resistance e. capacitance

a 9. What is the direction of current for the circuit shown below?

- a. Clockwise b. Counter clockwise

e 10. Determine the magnitude of the current in the circuit shown below.



- | | | |
|-----------|-----------|-----------|
| a. 0.58 A | b. 0.77 A | c. 0.19 A |
| d. 1.1 A | e. 0.38 A | |

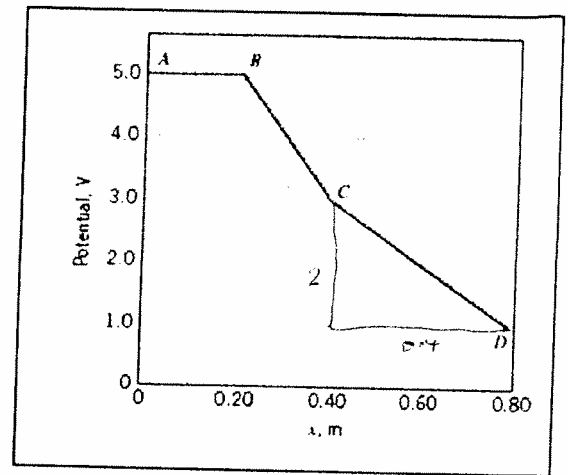
- d 11. The *electron volt* is a unit of
 a. Voltage b. Current c. Power
 d. Energy e. Force

12-14) Refer the figure to the right which shows the electric potential as a function of distance along the x axis.

- d 12. What is the potential in V at 0.30 m?
 a. 1 b. 2 c. 3 d. 4 e. 5

- f 13. Determine the magnitude of the electric field in V/m in the region A to B?
 a. 10 b. 2 c. 3 d. 4 e. 5 f. 0

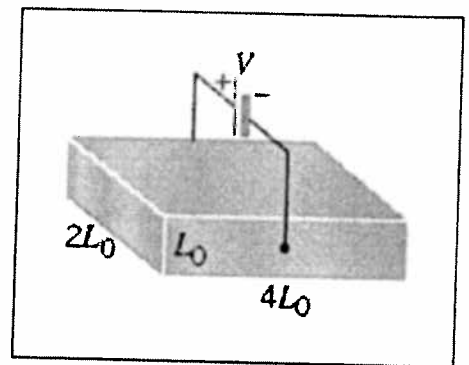
- e 14. Determine the magnitude of the electric field in V/m in the region C to D?
 a. 10 b. 2 c. 3 d. 4 e. 5 f. 0



15-16) Refer the figure to the right of a material. The resistance depends on the path that the current takes. The drawing shows a situation in which the battery is connected as shown.

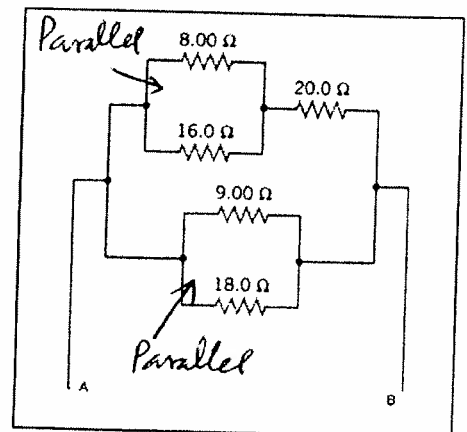
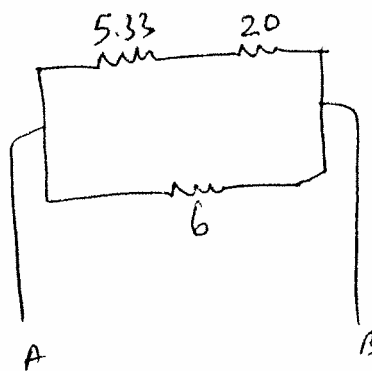
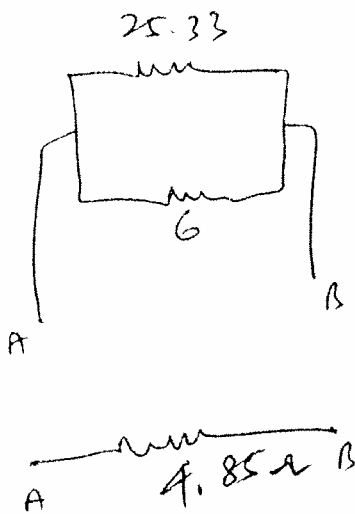
- b 15. To calculate the resistance what length should be used?
 a. L_0 b. $2L_0$ c. $3L_0$ d. $4L_0$

- c 16. To calculate the resistance what cross sectional area should be used?
 a. L_0^2 b. $2L_0^2$ c. $4L_0^2$ d. $8L_0^2$



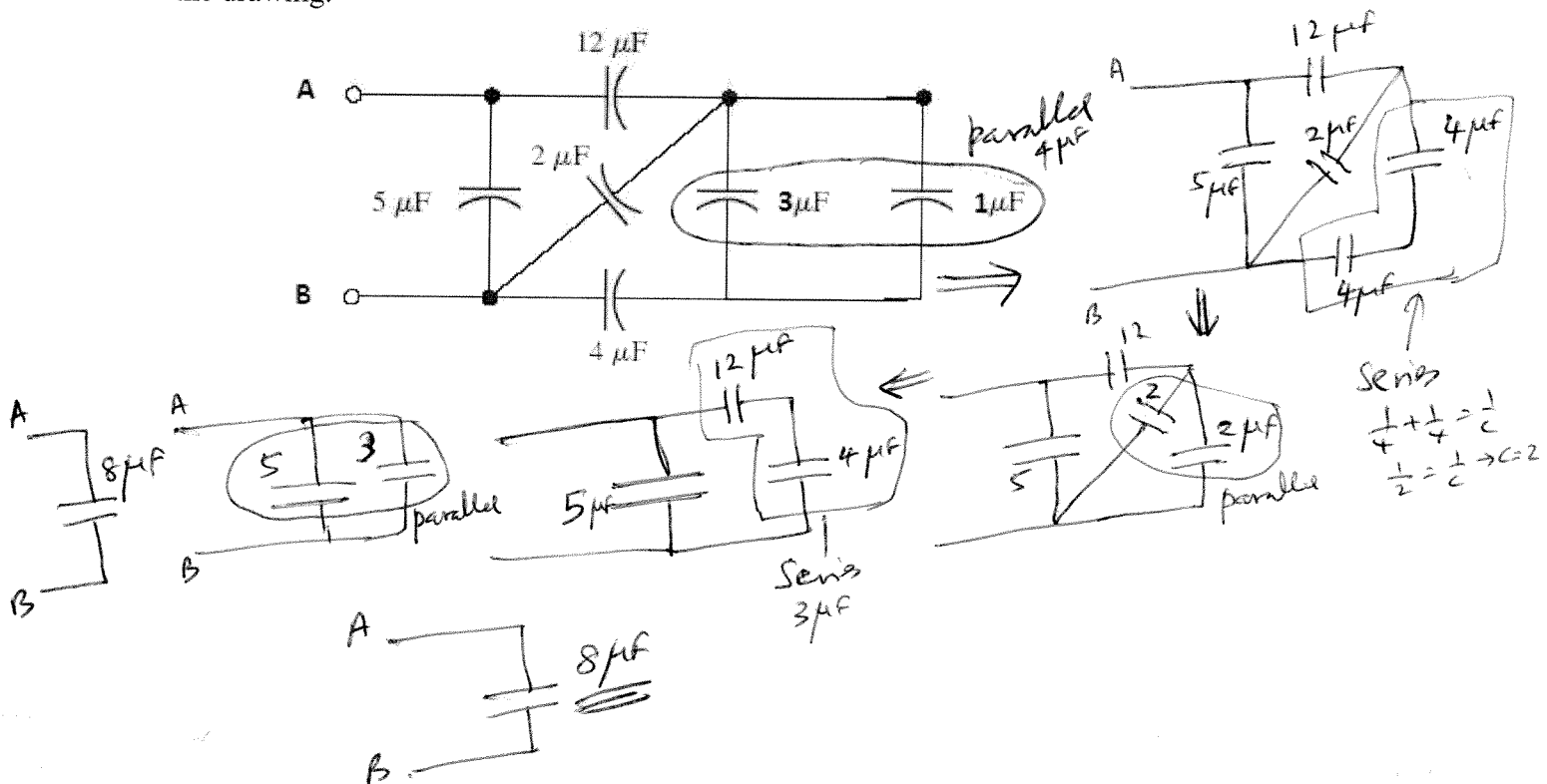
end of MC questions

- 9 B. Find the equivalent resistance between points A and B for the resistor network shown below.



Combination	Capacitors
Series	$\frac{1}{C_S} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \dots$
Parralel	$C_P = C_1 + C_2 + C_3 + \dots$

C. Determine the equivalent capacitance between A and B for the group of capacitors in the drawing.



D. Problem with Kirchhoff's rules

- Arbitrarily assign 3 currents for the 3 independent branches shown in the circuit.
- Using the direction of the assigned currents, identify the low (-) and high (+) potentials for the two resistors in the diagram.
- Apply Kirchhoff's junction rule.

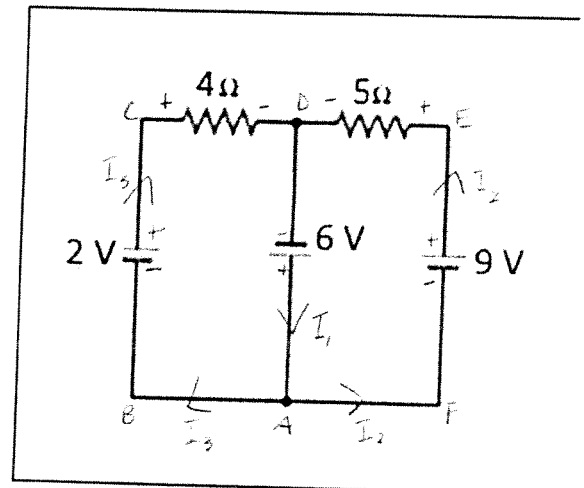
$$I_1 = I_2 + I_3$$

- Apply Kirchhoff's loop rule for the left loop.

ABCA: $2V + 6V = 4I_3$

- Apply Kirchhoff's loop rule for the right loop.

AFEDA: $9V + 6V = 5I_2$



E. Electric potential due to a point charge at a distance r : $V = k \frac{Q}{r}$. ($k = 9 \times 10^9 \text{ sI}$)

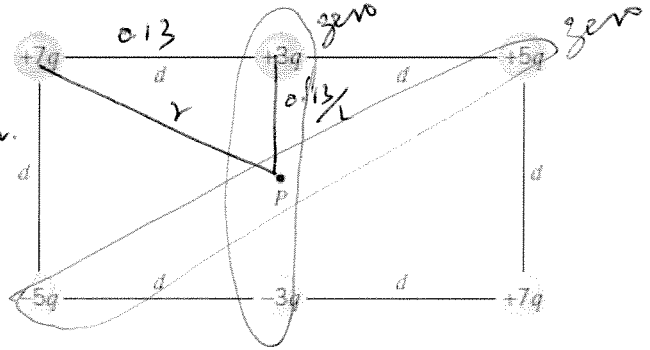
The drawing shows six point charges arranged in a rectangle. The value of q is $9.0 \mu\text{C}$, and the distance d is 0.13 m . Find the total electric potential at location P , which is at the center of the rectangle.

Need to calculate V due to $+7q$'s only. others cancel each other.

$$r = \sqrt{0.13^2 + \left(\frac{0.13}{2}\right)^2} = 0.1453 \text{ m}$$

$$V = \left(\frac{9 \times 10^9 \times 7 \times 9 \times 10^{-6}}{0.1453} \right) \times 2$$

$$V = 7.8 \times 10^6 \text{ volt}$$



F1. Define capacitance.

$$C = \frac{q}{V} = \frac{\text{Charge}}{\text{Voltage}}$$

F2. The capacitance of a parallel plate capacitor with area A and separation d is given by: ($\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2/\text{N}\cdot\text{m}^2$)

$$C = k\epsilon_0 \frac{A}{d}$$

The membrane that surrounds a certain type of living cell has a surface area of $5.0 \times 10^{-9} \text{ m}^2$ and a thickness of $1.0 \times 10^{-8} \text{ m}$. Assume that the membrane behaves like a parallel plate capacitor with a dielectric constant of 5.0 . The potential on the outer surface of the membrane is $+0.06 \text{ volt}$ greater than that on the inside surface. How much charge resides on the outer surface?

$$C = k\epsilon_0 \frac{A}{d} = \frac{5 \times 8.85 \times 10^{-12} \times 5 \times 10^{-9}}{1 \times 10^{-8}} = 2.21 \times 10^{-11} \text{ F}$$

$$q = CV = 2.21 \times 10^{-11} \times 0.06 = \underline{\underline{1.33 \times 10^{-12} \text{ C}}}$$