PHYS 202 Test #2 Spring 2015 Name: KEY

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

3pts each

B 1. An object is charged by contact using a negatively charged rod. What type is the charge on the charged object?

A 2. An object is charged by induction using a negatively charged rod. What type is the charge on the charged object?

Answers for 1 and 2:

A. Positive B. Negative C. No charge

d 3. There is an electric field at point *P*. A very small charge is placed at this point and it experiences a force. Another very small charge is then placed at this point and it experiences a force that differs in both magnitude and direction from that experienced by the first charge. Which of the following statements is true about these charges?

a. Both are identical charges, equal in magnitude and sign of charge.

b. One is positive and the other is negative but equal magnitude of charge on both.

c. One is negative and the other is positive but equal magnitude of charge on both.

d. Both are different charges in sign and magnitude.

B 4. A plate carries a charge of –3.0 μC, while a rod carries a charge of +2.0 μC. What must be done to make the objects have the same charge?

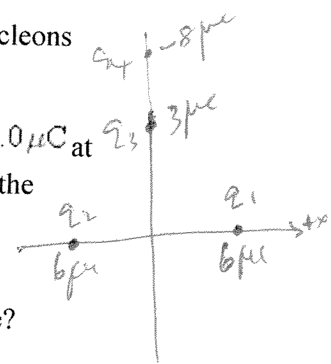
A. –3.0 μC, transferred from plate to rod. B. –2.5 μC, transferred from plate to rod.

C. –2.5 μC, transferred from rod to plate. D. +3.0 μC, transferred from rod to plate.

C 5. Conductors have free: A. Protons B. Neutrons C. Electrons D. Nucleons

a 6. Two charges are located along the *x* axis: $q_1 = +6.0\,\mu C$ at $x_1 = +4.0$ cm, and $q_2 = +6.0\,\mu C$ at $x_2 = -4.0$ cm. Two other charges are located on the *y* axis: $q_3 = +3.0\,\mu C$ at $y_3 = +5.0$ cm, and $q_4 = -8.0\,\mu C$ at $y_4 = +7.0$ cm. The net electric field from which of the following two charges is zero?

a. q_1 and q_2 b. q_1 and q_3 c. q_1 and q_4 d. q_3 and q_2 e. q_4 and q_2



C 7. What is the shape of one of the equipotential surfaces for an isolated point charge?

a. plane b. circle c. sphere d. parabola e. ellipse

B 8. In a common household circuit, devices are connected in

A. Series B. Parallel

9-10) Deals with the electric field lines of two charges as shown:

B 9. The polarities of the charges are,

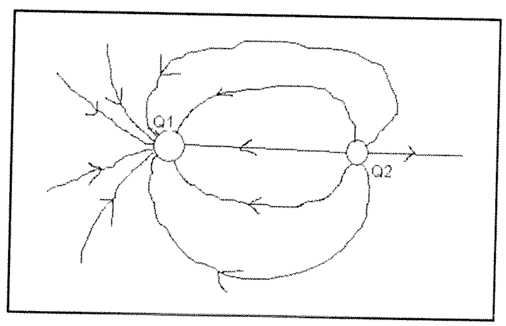
A. Q_1 is positive and Q_2 is negative

B. Q_2 is positive and Q_1 is negative

C. Both are positive D. Both are negative

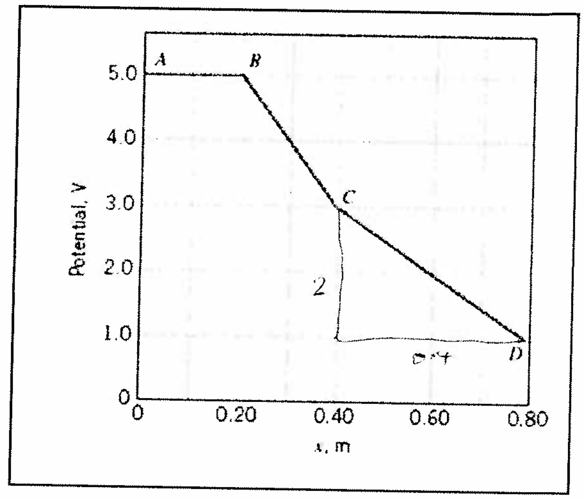
B 10. The ratio Q_1/Q_2 is given by,

A. 1 B. 1.5 C. 2 D. 3 E. 4 F. 5



d 11. The *electron volt* is a unit of

a. Voltage b. Current c. Power
d. Energy e. Force

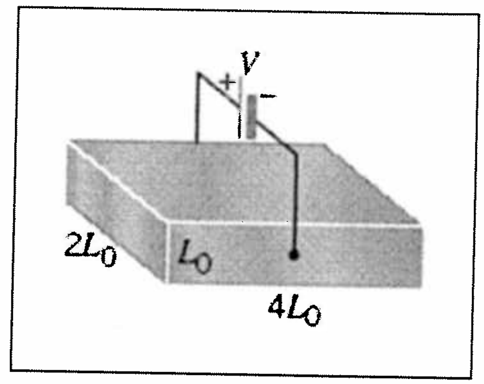


12-14) Refer the figure to the right which shows the electric potential as a function of distance along the *x* axis.

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

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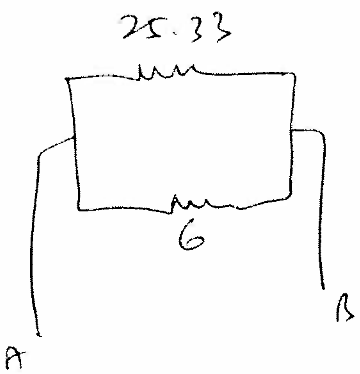
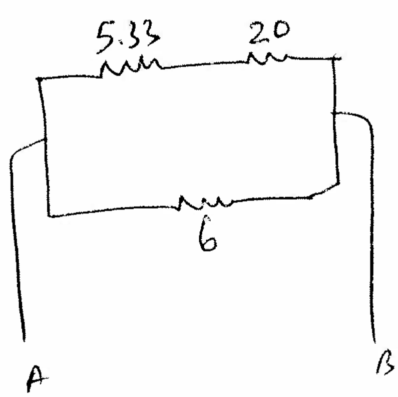
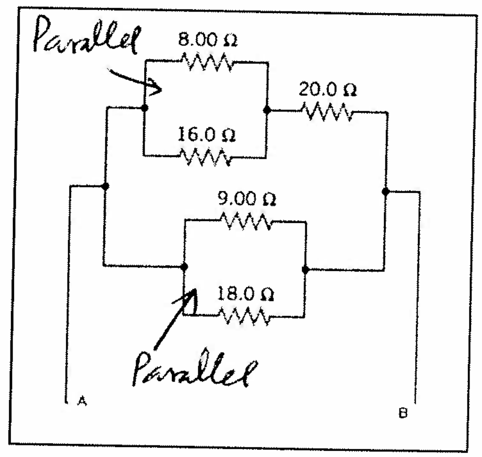
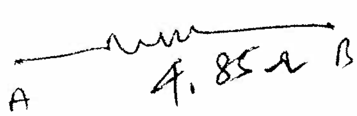
B. Find the equivalent resistance between points *A* and *B* for the resistor network shown below.









C. Equations of kinematics (equations 1-4) & Newton's 2nd law are given below:

1.	2.	3.	4.	Newton's 2nd Law:
$v = v_0 + at$	$x = \frac{1}{2}(v + v_0)t$	$x = v_0 t + \frac{1}{2}at^2$	$v^2 = v_0^2 + 2ax$	$\vec{F} = m\vec{a}$

[6] 1. Define electric field, identify it as a vector or scalar, and state its SI unit.

$\vec{E} = \frac{\text{Electric force}}{\text{test charge}}$ SI unit: N/C It is a vector.

$\vec{E} = \vec{F}/q_0$

[15] 2. The right drawing shows an electron entering the lower left side of a parallel plate capacitor and exiting at the upper right side. The initial speed of the electron is 5.00×10^6 m/s. The capacitor is 2.00 cm long, and its plates are separated y 0.150 cm.

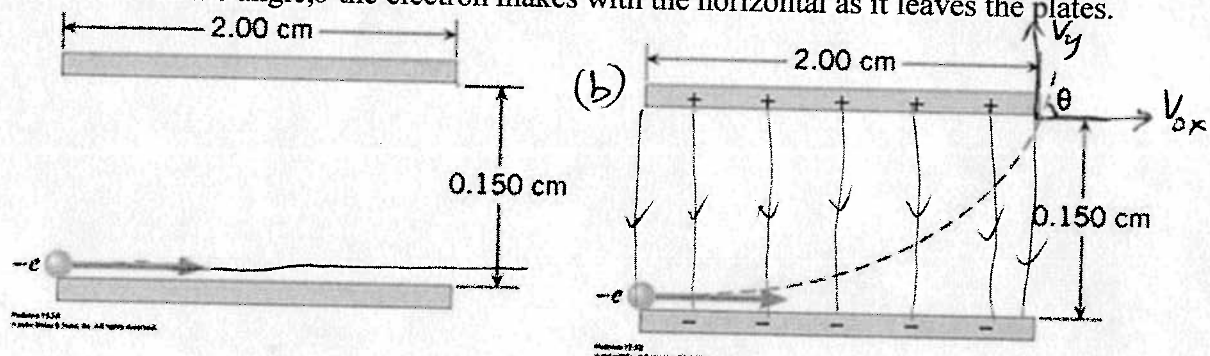
a. When the capacitor plates are not charged, as in the left drawing, draw the subsequent motion of the electron, and determine how long the electron takes to cross the plates.

b. Show the electric field in the right drawing, assuming that the electric field between the plates is uniform everywhere.

c. Determine the vertical acceleration of the electron assuming that the electron escapes the plates as shown in the right drawing.

d. Determine the magnitude of the electric field between the plates in the right drawing.

e. Determine the angle, θ the electron makes with the horizontal as it leaves the plates.



a. $x = vt$

$t = \frac{x}{v} = \frac{2 \times 10^{-2}}{5 \times 10^6} = 4 \times 10^{-9}$ s

$t = 4$ ns

c. ↑ $V_{oy} = 0$, $y = 0.150$ cm $= 0.15 \times 10^{-2}$ m, $t = 4 \times 10^{-9}$ s

$0.15 \times 10^{-2} = \frac{1}{2} \times a \times (4 \times 10^{-9})^2$

$a = \frac{2 \times 0.15 \times 10^{-2}}{(4 \times 10^{-9})^2} = 1.875 \times 10^{14}$ m/s²

d. $\vec{E} = \frac{\vec{F}}{q} = \frac{m\vec{a}}{q} = \frac{9.11 \times 10^{-31} \times 1.875 \times 10^{14}}{1.6 \times 10^{-19}} = 1068$ N/C

e. $V_y = V_{oy} + at = 1.875 \times 10^{14} \times 4 \times 10^{-9} = 7.5 \times 10^5$ m/s

$\tan\theta = \frac{V_y}{V_{ox}} = \frac{7.5 \times 10^5}{5 \times 10^6} = 0.15$

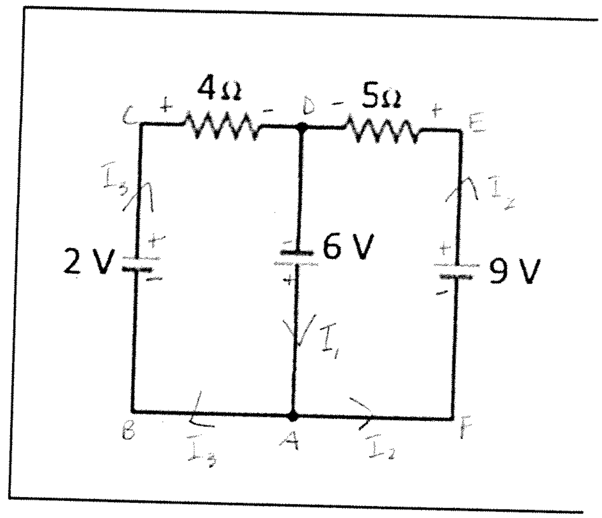
$\theta = \tan^{-1}(0.15) = 8.5°$

($\theta = 8.5°$)

D. Problem with Kirchhoff's rules

a. Arbitrarily assign 3 currents for the 3 independent branches shown in the circuit.

b. Using the direction of the assigned currents, identify the low (-) and high (+) potentials for the two resistors in the diagram.



c. Apply Kirchhoff's junction rule.

$I_1 = I_2 + I_3$

rise = drop

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

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

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

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

f. Solve the equations and find the three currents.

$15 = 5I_2 \rightarrow I_2 = 3\,A$

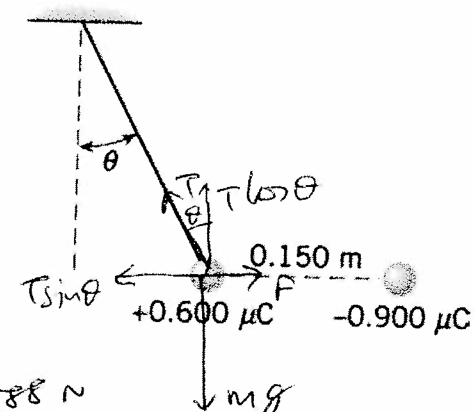
$8 = 4I_3 \rightarrow I_3 = 2A$

$I_1 = 3 + 2 \rightarrow I_1 = 5A$

11 E. Coulomb's law: $F = k\frac{|Q_1||Q_2|}{r^2}$.

1. In the above equation k is Coulomb's constant, which has the SI value of 9×10^9. Express its SI units. $N \cdot m^2/C^2$

2. A small spherical insulator of mass 60 gram and charge +0.600 μC is hung by a thin wire of negligible mass. A charge of - 0.900 μC is held 0.150 m away from the sphere and directly to the right of it, so the wire makes an angle θ with the vertical (see the drawing). Find (a) the angle θ and (b) the tension in the wire.



$$T\sin\theta = F = \frac{kq_1q_2}{r^2}$$

$$T\sin\theta = \frac{9\times10^{9}\times0.6\times10^{-6}\times0.9\times10^{-6}}{0.15^2}$$

$$T\sin\theta = 0.216\ N$$

$$T\cos\theta = mg = 0.060\times9.8 = 0.588\ N$$

$$T\sin\theta = 0.216$$

$$T\cos\theta = 0.588$$

$$\tan\theta = \frac{0.216}{0.588} \longrightarrow \theta = 20^\circ$$

$$T = \frac{mg}{\cos\theta} = \frac{0.588}{\cos 20} = 0.63\ N$$