PHYSICS 138 Test 3

Practice test

Question 1

A magnetic field is applied in a direction perpendicular to the flow direction of blood, which carries both positive and negative ions, in an artery. Which of the following statements is FALSE?

A) Positive ions will drift to one side of the artery, negative ions to the other side.

B) The equilibrium potential difference across the artery will be proportional to the flow rate.

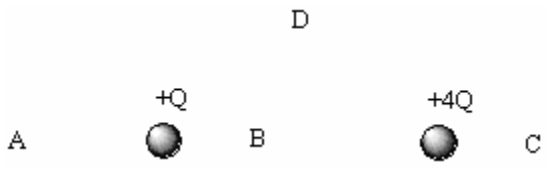
C) All the ions will drift toward the same side.

D) In equilibrium the electric force created by the charges built up on the sides will just balance the magnetic forces on the ions moving with the blood.

E) The equilibrium potential difference across the artery will be proportional to the magnetic field.

Question 2

Fixed charges of +Q and +4Q are placed as shown. In which position is the electric potential zero?



(a) A (b) B (c) C (d) D (e) none of the positions

Question 3

Consider the three circuits made of identical batteries and resistors and choose which one of the statements about the currents below is true :

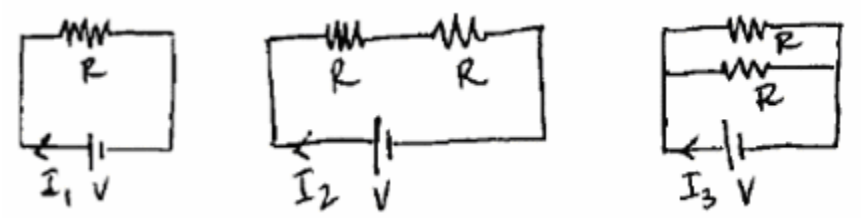
(A) $I_1 = I_2 = I_3$

(B) $I_2 > I_1 > I_3$

(C) $I_1 > I_3 > I_2$

(D) $I_3 > I_2 > I_1$

(E) $I_3 > I_1 > I_2$



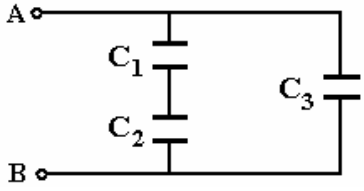
Question 4

Find the equivalent capacitance across terminals A and B, that is find the reading on a capacitance meter placed across terminals A and B of the circuit shown in the figure below.

$C_1 = 3.0\ \mu F$

$C_2 = 3.0\ \mu F$

$C_3 = 10.0\ \mu F$



(A) 16.00 μF (B) 11.50 μF (C) 3.75 μF

(D) 1.30 μF (E) 8.25 μF

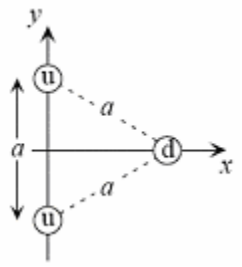
Question 5

Four identical bulbs are connected in parallel to a 12V ideal battery. Two of them burn out. The remaining two:

A. look brighter than before
B. look the same as before
C. look dimmer than before
D. are off

Question 6

According to the quark model, the proton consists of two u (up) quarks each with a charge +2e/3 and one d (down) quark, with a charge –e/3. If the quarks are positioned at the points of an equilateral triangle with edge length a, as in the figure, find the electric force acting on the d quark. Express your answer in unit vectors.

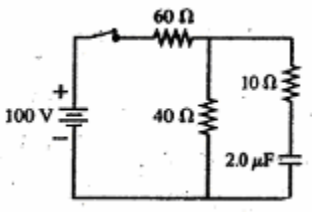


(A) $\vec{F}_d = \frac{2\sqrt{3}ke^2}{9a^2}\hat{x}$ (B) $\vec{F}_d = 0$ (C) $\vec{F}_d = \frac{\sqrt{3}ke^2}{3a^2}\hat{x}$

(D) $\vec{F}_d = -\frac{2\sqrt{3}ke^2}{9a^2}\hat{x}$ (E) $\vec{F}_d = \frac{\sqrt{3}ke^2}{9a^2}\hat{x}$

Question 7

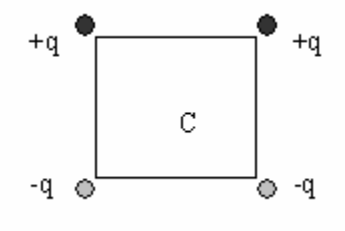
For the following circuit the switch has been closed for a long time. After the switched is opened how long does it take for the charge on the capacitor to decrease to 10% of its initial value?



(A) $2.1\cdot10^{-6}$ s (B) $3.2\cdot10^{-4}$ s (C) $2.3\cdot10^{-4}$ s (D) $4.6\cdot10^{-5}$ s

Question 8

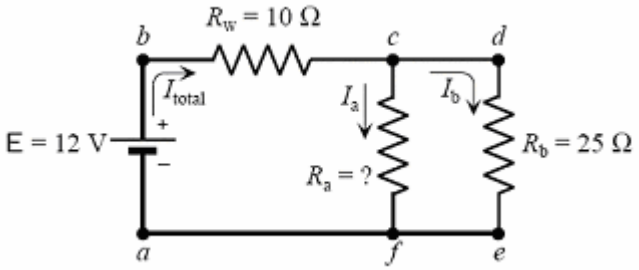
Four electric charges are located at the corners of a square a distance of 10 cm from the centre C. The charges have an equal magnitude of 1 nC but two of the charges are positive and the other two are negative, as shown in the figure. What is the magnitude of the electric potential as well as the direction of the electric field at the centre of the square C?



(A) 90V ↘ (B) 360V ↗ (C) 3600V ↓ (D) 0V ↓ (E) 0V ↑

LONG ANSWER

The circuit to the right shows a battery of EMF $E=12.0\ V$ connected to a small light bulb of resistance $R_b=25.0\Omega$ via a resistance $R_W=10.0\Omega$. Connected in parallel with the light bulb is a resistor R_a. The light bulb is able to dissipate a maximum of $1.0\ W$ of power without burning out.



(a) If the light bulb dissipates $1.0\ W$ of power, what current I_b passes through it?

For the remainder of the problem assume that the current I_b found in part (a) passes through the light bulb.

(b) What is the voltage drop across the light bulb, given the current found in (a)?

(c) Write an equation based on Kirchhoff's loop rule for the closed path *abcdefa* indicated in the circuit and solve for the total current I_{tot} delivered by the battery.

(d) How much current I_a flows through the unknown resistance R_a?

(e) What is the resistance R_a?