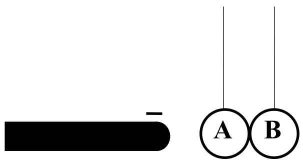
Part 1.

Please c*ircle the correct answer, to the nearest number for the quantitative questions*. *Each Question worth's 1 point.

1. Two uncharged conducting spheres, **A** and **B**, are suspended from insulating threads so that they touch each other. While a negatively charged rod is held *near, but not touching* sphere **A**, someone moves ball B away from A. How will the spheres be charged, *if at all*?

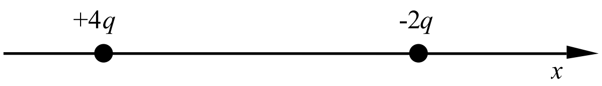


(A) 0 +
(B) – +
(C) 0 0
(D) – 0
(E) + –

2. One mole of a substance contains **6.02×10^{23} protons** and an equal number of electrons. If the protons could somehow be separated from the electrons and placed in very small, individual containers separated by **1.00×10^3 m**, what would be the magnitude of the electrostatic force exerted by one box on the other?

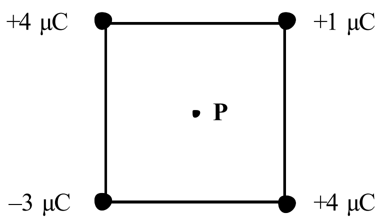
(A) deficiency, 6×10^{13}
(B) excess, 2×10^{13}
(C) deficiency, 1×10^{12}
(D) excess, 3×10^{13}
(E) deficiency, 3×10^{12}

3. At which point (or points) is the electric field (**N/C**) zero for the two point charges shown on the ***x* axis**?



(A) The electric field is never zero in the vicinity of these charges.
(B) The electric field is zero somewhere on the *x* axis to the left of the +4*q* charge.
(C) The electric field is zero somewhere on the *x* axis to the right of the –2*q* charge.
(D) The electric field is zero somewhere on the *x* axis between the two charges, but this point is nearer to the –2*q* charge.
(E) The electric field is zero at two points along the *x* axis; one such point is to the right of the –2*q* charge and the other is to the left of the +4*q* charge.

4. Four point charges are placed at the corners of a square as shown in the figure. Each side of the square has length **2.0 m**. Determine the magnitude of the electric field at the point **P**, the center of the square.



(A) 2.0×10^{-6} N/C
(B) 1.8×10^4 N/C
(D) 3.0×10^{-6} N/C
(C) 2.7×10^4 N/C
(E) 9.0×10^3 N/C

5. What is the electric flux passing through a Gaussian surface that surrounds a **+0.075 C** point charge?

(A) 8.5×10^9 N·m²/C
(B) 1.3×10^7 N·m²/C
(C) 7.2×10^5 N·m²/C
(D) 6.8×10^8 N·m²/C
(E) 4.9×10^6 N·m²/C

6. Which one of the following statements best explains why it is possible to define an *electrostatic potential* in a region of space that contains an *electrostatic field*?

(a) Work must be done to bring two positive charges closer together.
(b) Like charges repel one another and unlike charges attract one another.
(c) A positive charge will gain kinetic energy as it approaches a negative charge.
(d) The work required to bring two charges together is independent of the path taken.
(e) A negative charge will gain kinetic energy as it moves away from another negative charge.

7. Two positive point charges are separated by a distance ***R***. If the distance between the charges is reduced to ***R*/2**, what happens to the total electric potential energy of the system?

(A) It is doubled.
(B) It is reduced to one-half of its original value.
(C) It remains the same.
(D) It is reduced to one-fourth of its original value.
(E) It increases by a factor of 4.

8. A charge $\boldsymbol{q = -4.0\ \mu C}$ is moved **0.25 m** horizontally to point **P** in a region where an electric field is **150 V/m** and directed vertically as shown. What is the change in the electric potential energy of the charge?

(A) -2.4×10^{-3} J
(B) $+1.5 \times 10^{-4}$ J
(C) -1.5×10^{-4} J
(D) $+2.4 \times 10^{-3}$ J
(E) zero joules

9. Which one of the following changes will necessarily increase the capacitance of a capacitor?

(A) decreasing the charge on the plates
(B) increasing the charge on the plates
(C) placing a dielectric between the plates
(D) increasing the potential difference between the plates
(E) decreasing the potential difference between the plates

10. A **10-A** current is maintained in a simple circuit with a total resistance of **200 Ω**. What net charge passes through any point in the circuit during a **1-minute** interval?

(A) 200 C (B) 500 C (C) 1200 C (D) 400 C (E) 600 C

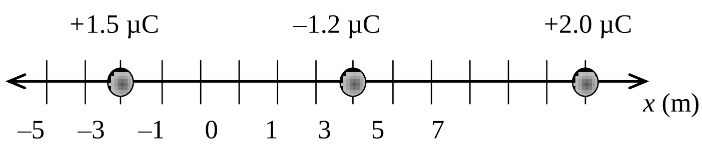
11. Determine the length of a copper wire that has a resistance of **0.172 Ω** and cross-sectional area of $\mathbf{1 \times 10^{-4}\ m^2}$. The resistivity of copper is $\mathbf{1.72 \times 10^{-8}\ \Omega \cdot m}$.

(A) 0.1 m (B) 100 m (C) 10 000 m (D) 10 m (E) 1000 m.

End of part 1.

Part 2 . Please show your work in the space provided.

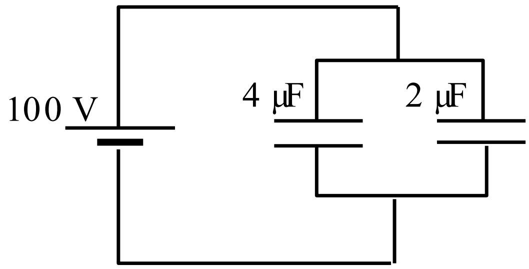
1. Three charges are located along the x axis as shown in the drawing. The mass of the **–1.2 μC** is $\mathbf{4.0 \times 10^{-9}}$ **kg**. Determine the magnitude and direction of the acceleration of the **–1.2 μC** charge when it is allowed to move if the other two charges remain fixed.
(2 points)



(b) 1×10^5 m/s^2, to the left

Answer (with units):___________

2. How much energy is stored in the combination of capacitors shown? ***(2 points)***

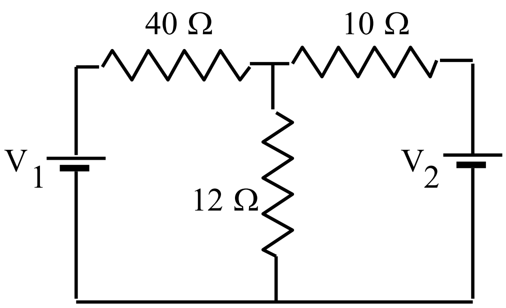


(c) 0.03 J

Answer (with units):___________

3. Three resistors and two **10.0-V** batteries are arranged as shown in the circuit diagram. What is the power delivered to the 12 Ω resistor?

(2 points)



Answer (with units):___________

<u>End of part 2.</u>

<u>Some useful constants:</u> $e^{-} = 1.60 \times 10^{-19}$ **C.,** $\varepsilon_0 = 8.85 \times 10^{-12}\ C^2/(N.m^2)$,
$k = (1/4\pi\varepsilon_o) = 8.99 \times 10^9\ N.m^2/C^2$, $m_e = 9.11 \times 10^{-31}$ **kg,** $m_p = 1.67 \times 10^{-27}$ **kg.**

Good Luck