PHYS 121 Quiz #1 (22323234455700335330056686782 34)
Friday, January 31

Last Name: Solns

First Name: _____

Student Number: _____

For each question, circle the best answer.

1) A point charge Q is located a short distance from a point charge $3Q$, and no other charges are present. If the electrical force on Q is F, what is the electrical force on $3Q$?

A) $F/3$
B) $F/\sqrt{3}$
C) F
D) $\sqrt{3}F$
E) $3F$

3rd Law $\vec{F}_{12} = -\vec{F}_{21}$

2) A positive point charge Q is fixed on a very large horizontal frictionless tabletop. A second positive point charge q is released from rest near the stationary charge and is free to move. Which statement best describes the motion of q after it is released?

A) Its speed will be greatest just after it is released.
B) Its acceleration is zero just after it is released.
C) As it moves farther and farther from Q, its acceleration will keep increasing.
D) As it moves farther and farther from Q, its speed will decrease.
E) As it moves farther and farther from Q, its speed will keep increasing.

F is always non-zero.
∴ q is always accelerating.

3) Two identical small conducting spheres are separated by 0.60 m. The spheres carry different amounts of charge and each sphere experiences an attractive electric force of 10.8N. The total charge on the two spheres is -24 μC. The two spheres are now connected by a slender conducting wire, which is then removed. The electric force on each sphere is closest to

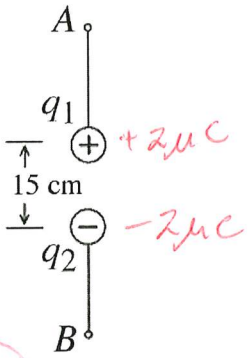
A) zero.
B) 3.6 N, attractive.
C) 5.4 N, attractive.
D) 3.6 N, repulsive.
E) 5.4 N, repulsive.

spheres each charged $-12\,\mu C$ after connected by wire.

like charges.

$$F = \frac{1}{4\pi\varepsilon_0}\frac{q^2}{r^2} = 3.6\,N$$

4) Two small insulating spheres are attached to silk threads and aligned vertically as shown in the figure. These spheres have equal masses of 40 g, and carry charges q_1 and q_2 of equal magnitude 2.0 μC but opposite sign. The spheres are brought into the positions shown in the figure, with a vertical separation of 15 cm between them. Note that you cannot neglect gravity. ($k = 1/4\pi\varepsilon_0 = 8.99 \times 10^9\ N \cdot m^2/C^2$) The tension in the lower thread is closest to



A) 1.2 N.
B) 1.4 N.
C) 1.6 N.
D) 1.8 N.
E) 2.0 N.

FBD q_2

$\vec{F}_e = K\frac{q_1 q_2}{r^2}$ ↑

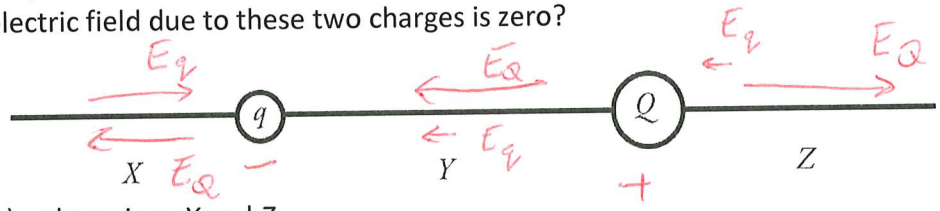
$m\vec{g}$ ↓

$\vec{T}$ ↓

$$\therefore \frac{Kq_1q_2}{r^2} = mg + T$$

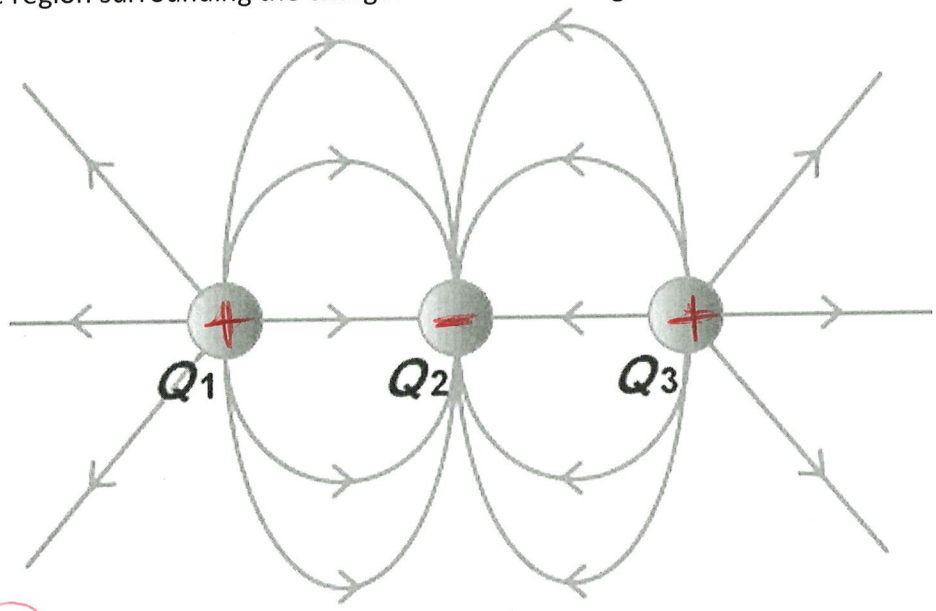
$$T = \frac{Kq_1q_2}{r^2} - mg = 1.21\,N$$

5) The figure shows two unequal point charges, q and Q, of opposite sign. Charge Q has greater magnitude than charge q. In which of the regions X, Y, Z will there be a point at which the net electric field due to these two charges is zero?



A) only regions X and Z
B) only region X
C) only region Y
D) only region Z
E) all three regions

6) The figure shows three electric charges labeled Q_1, Q_2, Q_3, and some electric field lines in the region surrounding the charges. What are the signs of the three charges?



$\vec{E}$ leaves +
$\vec{E}$ converges on −

A) Q_1 is positive, Q_2 is negative, Q_3 is positive.
B) Q_1 is negative, Q_2 is positive, Q_3 is negative.
C) Q_1 is positive, Q_2 is positive, Q_3 is negative.
D) All three charges are negative.
E) All three charges are positive.

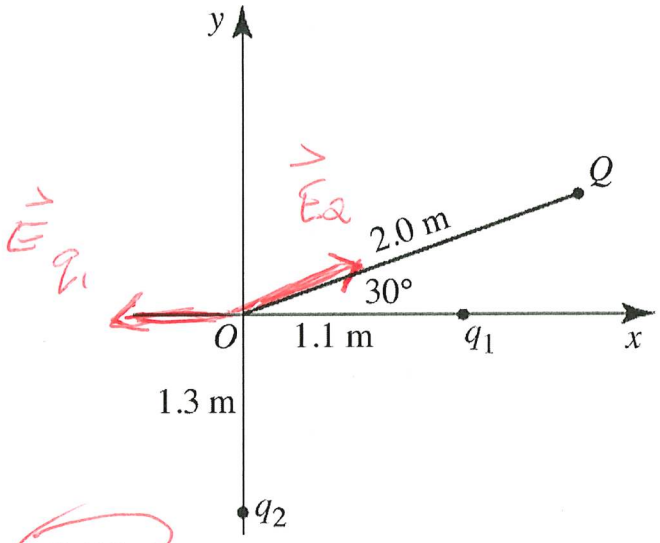
•E ↑ d

7) Two large, flat, horizontally oriented plates are parallel to each other, a distance *d* apart. Half way between the two plates the electric field has magnitude *E*. If the separation of the plates is reduced to *d*/2 what is the magnitude of the electric field half way between the plates?

A) 4*E*
B) 2*E*
C) *E*
D) 0
E) *E*/2

$\vec{E}$ due to large plate constant.
Distance d doesn't matter

8) A point charge Q = -500 nC and two unknown point charges, q_1 and q_2, are placed as shown in the figure. The electric field at the origin *O*, due to charges Q, q_1 and q_2, is equal to zero. The charge q_1 is closest to



A) 130 nC.
B) 76 nC.
C) 150 nC.
D) -76 nC.
E) -130 nC.

Require $q_1 > 0$.

$E_Q \cos 30 = E_{q_1}$

$\therefore E_Q \cos 30 = \frac{k q_1}{(1.1)^2}$

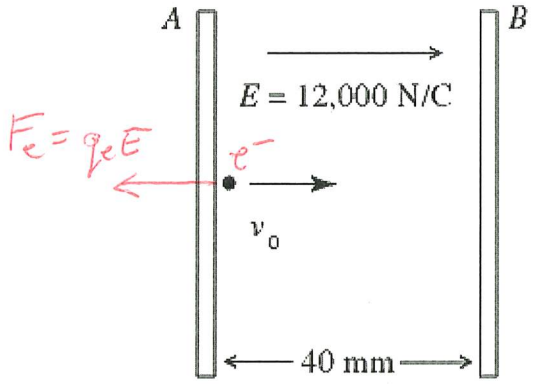
$q_1 = \frac{(1.1\text{m})^2 E_Q \cos 30}{k}$

$= \frac{k Q}{(2.0\text{m})^2} \cos 30 = \frac{k q_1}{(1.1\text{m})^2}$

$\therefore q_1 = \left(\frac{1.1}{2}\right)^2 Q \cos 30$

$= 131\text{ nC}$

9) A pair of charged conducting plates produces a uniform field of 12,000 N/C, directed to the right, between the plates. The separation of the plates is 40 mm. An electron is projected from plate *A*, directly toward plate *B*, with an initial velocity of $v_0 = 1.0 \times 10^7$ m/s, as shown in the figure. ($e = 1.60 \times 10^{-19}$ C, $\varepsilon_0 = 8.85 \times 10^{-12}$ C^2/N · m^2, $m_e = 9.11 \times 10^{-31}$ kg) The distance of closest approach of the electron to plate *B* is nearest to



$F_e = q_e E$

$a = \frac{F_e}{m_e} = \frac{q_e E}{m_e}$ (left)

want $V = 0$.

$V^2 = V_0^2 - 2a\Delta x$ ($V^2 \to 0$)

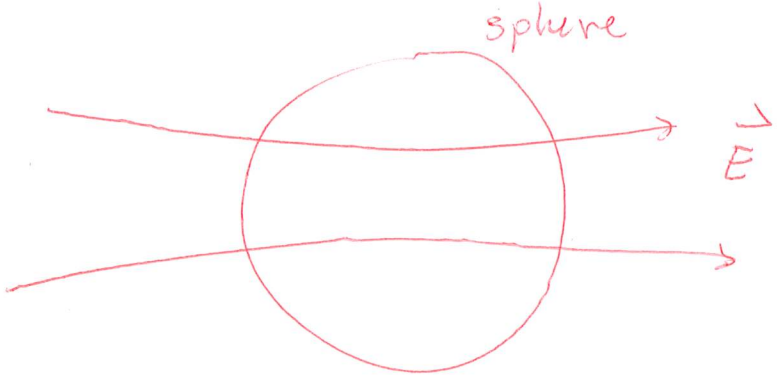
$\therefore \Delta x = \frac{V_0^2}{2a} = \frac{V_0^2}{2}\frac{m_e}{q_e E} = 23.7\text{ mm}$

$40 - 23.7 = 16.3\text{ mm}$

A) 16 mm.
B) 18 mm.
C) 20 mm.
D) 22 mm.
E) 24 mm.

10) If the electric flux through a closed surface is zero, the electric field at points on that surface must be zero.

A) True
B) False



$\vec{E} \neq 0$, but $\Phi_e = 0$