Physics 4B
Fall 2017

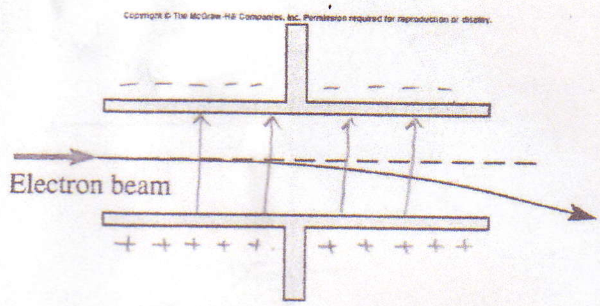
ave. = 7.5
σ = 2.0

Name: Answer Key

Lab (circle one): 8:00 am 11:15 am 2:45 pm

Quiz #4: Electric Potential

Problem 1 (1 point)
A beam of electrons is deflected as it moves between oppositely charged parallel plates. Which plate is at the higher potential?

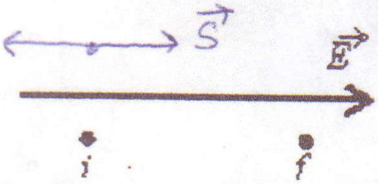


B

a) The upper plate.
(b) The lower plate.
c) They are at the same potential.

Problem 2 (1 point)
An electron moves from point *i* to point *f*, in the direction of a uniform electric field. During this placement:

$\vec{F}$ ←—•—→ $\vec{S}$

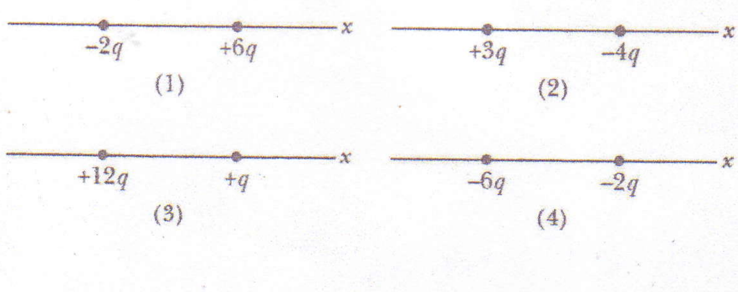


force on electron is to the left so field does negative work + U ~~decreases~~ increases

B

a) the work done by the field is positive and the potential energy of the electron-field system increases
(b) the work done by the field is negative and the potential energy of the electron-field system increases
c) the work done by the field is positive and the potential energy of the electron-field system decreases
d) the work done by the field is negative and the potential energy of the electron-field system decreases
e) the work done by the field is positive and the potential energy of the electron-field system does not change

Problem 3 (3 points)
The figure below shows four pairs of charged particles. For each pair, let V = 0 at infinity and consider V_{net} at points on the x axis. For which pairs is there a point at which $V_{net} = 0$ **(a)** between the particles and **(b)** to the right of the particles? **(c)** Rank the pairs according to their electric potential energy (that is, the energy of the two-particle system), greatest (most positive) first.



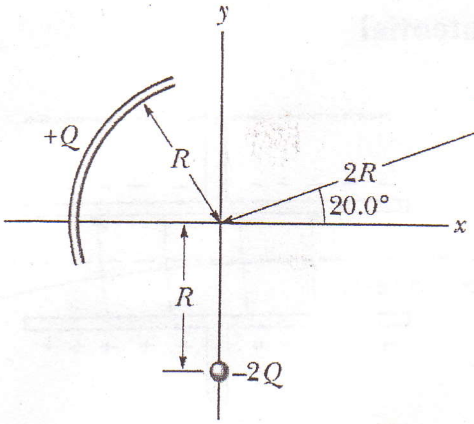
a) 1 + 2

b) none

c) 3 = 4, 1 = 2

$U = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r}$

Problem 4 (5 points)
In the figure below, what is the net electric potential at the origin (assuming V = 0 at infinity) due to the circular arc of charge +Q (whose center of curvature is at the origin) and the two particles of charges +4Q and –2Q? Let Q = 8.0 μC and R = 1.50 m.



for a point charge: $V = \frac{1}{4\pi\varepsilon_0}\frac{q}{r}$

for the circular arc:

$$V = \frac{1}{4\pi\varepsilon_0}\int\frac{dq}{r} = \frac{1}{4\pi\varepsilon_0 R}\int dq$$

$$V = \frac{1}{4\pi\varepsilon_0}\frac{q}{R}$$

$$V_{net} = \frac{1}{4\pi\varepsilon_0}\left[\frac{Q}{R} + \frac{4Q}{2R} - \frac{2Q}{R}\right] = \frac{1}{4\pi\varepsilon_0}\frac{Q}{R}$$

(arc, +4Q charge, −2Q charge)

$$V_{net} = \frac{1}{4\pi\varepsilon_0}\frac{Q}{R} = \frac{(8.99\times10^{9}\,Nm^2/C^2)(8.0\times10^{-6}\,C)}{1.50\,m}$$

$$V_{net} = 4.8\times10^{4}\,V$$