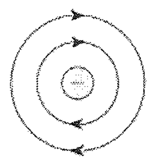
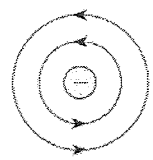
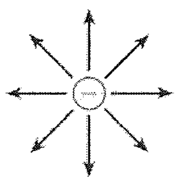
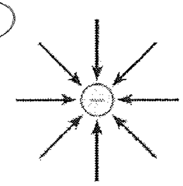
Name: Key

Electrostatics Review Package

1. Which diagram shows the electric field near a negative point charge?

A.  B. 

C.  (D.)  ✓

2. Which pair of values will cause the greatest deflection of an electron beam in a cathode ray tube?

↳ slowest Va smaller
↳ Vs larger

	ACCELERATING VOLTAGE	DEFLECTION (PLATE) VOLTAGE
A.	400 V ✓	20 V
(B.)	400 V ✓	40 V ✓
C.	800 V	20 V
D.	800 V	40 V ✓

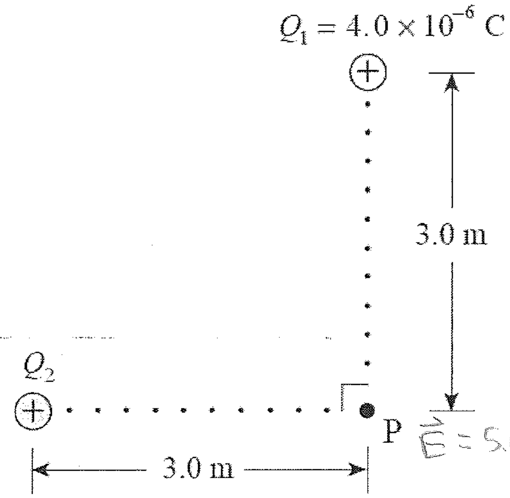
3. The magnitude of the net electric field at P in the diagram below is 5.0×10^3 N/C. (vector)

$E_R^2 = E_1^2 + E_2^2$

$(5.0\times10^3)^2 = \left(\frac{kQ_1}{R^2}\right)^2 + \left(\frac{kQ_2}{R^2}\right)^2$

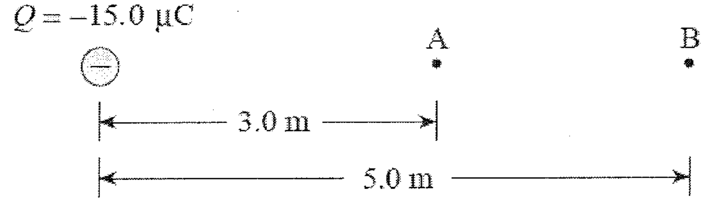
$Q_2 = 3.0\times10^{-6}$ C ✓

Find the magnitude of charge Q_2.



$\vec{E} = 5.0\times10^3$ N/C

4. a) Find the electric potential ~~energy~~ at point A and at point B. (Note: 1.0 μC is 1.0×10^{-6} C)



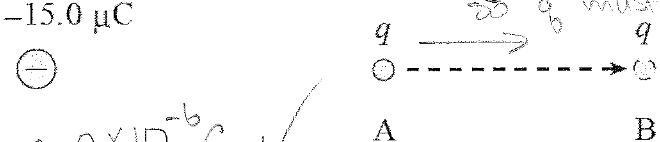
$V_A = \frac{KQ}{R_A} = \frac{(9\times10^9)(-15\times10^{-6})}{3\text{ m}} = -4.5\times10^4$ V ✓

$V_B = \frac{KQ}{R_B} = -2.7\times10^4$ V ✓

b) What is the potential difference between A and B?

$\Delta V = |V_B - V_A| = 1.8\times10^4$ V ✓

c) 0.036 J of work must be done to move a charge *q* from A to B. Find the magnitude and polarity of this charge.

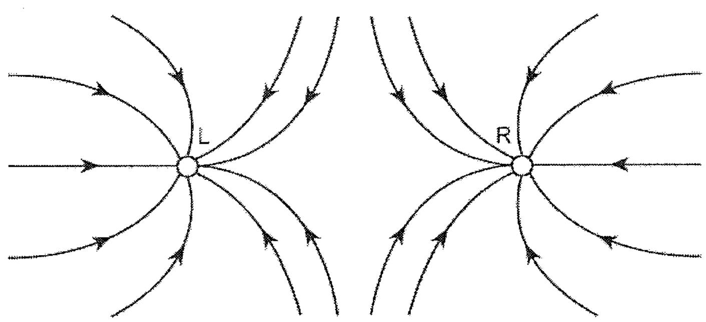


doing work to move away from –Q so q must be positive

$\Delta V = \frac{\Delta E_p}{Q}$

$Q = \frac{\Delta E_p}{\Delta V} = \frac{0.036\text{ J}}{1.8\times10^4\text{ V}} = 2.0\times10^{-6}$ C ✓

5. The diagram shows the electric field lines near two point charges, L and R. identify the polarity of these point charges.



+ test charge moving toward so L and R must both be neg.

	Polarity of L	Polarity of R
(A.) ✓	Negative	Negative
B.	Negative	Positive
C.	Positive	Negative
D.	Positive	Positive

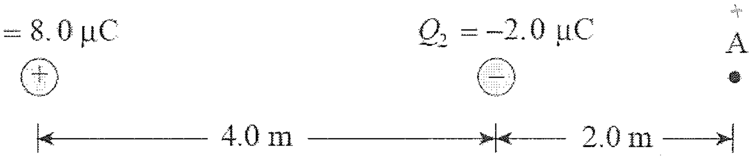
6. An electron orbits the nucleus which carriers a charge of $+9.6\times10^{-19}$ C. If the electron's orbital radius is 2.0×10^{-10} m, what is its potential energy?

scalar – use signs in equation

$E_p = \frac{KQQ}{R} = \frac{(9\times10^9)(-1.6\times10^{-19})(+9.6\times10^{-19})}{2\times10^{-10}}$

$= -6.9\times10^{-18}$ J

7. Two charges are positioned as shown in the diagram below.



$\vec{E}_1 = \frac{KQ_1}{R_1^2} = \frac{(9\times10^9)(8\times10^{-6})}{(6\,m)^2} = 2000\,\frac{N}{C}\,[Rt]$

$\vec{E}_2 = \frac{KQ_2}{R_2^2} = 4500\,\frac{N}{C}\,[Lf]$

a) Find the magnitude and direction of the electric field at A. (Note: 1.0 μC is 1.0x10^{6} C)

vector – no signs in eqn

$\vec{E}_{net} = 2500\,\frac{N}{C}\,[Lf]$ ✓

b) A charge placed at A experiences a force of 4.0x10^{-3} N towards the right. What are the magnitude and polarity of this charge?

$\vec{E} = \frac{\vec{F}}{Q_A}$ $\quad Q_A = \frac{\vec{F}}{\vec{E}} = \frac{4\times10^{-3}\,N\,[rt]}{2500\,\frac{N}{C}\,[rt]} = 1.6\times10^{-6}\,C$

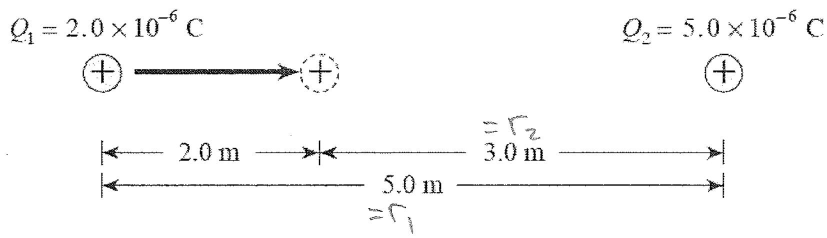
(Since $\vec{E}$ is [Lf], pos test charge has F to left, so if force rt then Q_A must be negative)

$= 1.6\times10^{-6}\,C$ ✓

8. In a cathode ray tube,

A. protons are accelerated from anode (positive) to cathode (negative).
B. protons are accelerated from cathode (negative) to anode (positive).
C. electrons are accelerated from anode (positive) to cathode (negative).
(D.) electrons are accelerated from cathode (negative) to anode (positive).

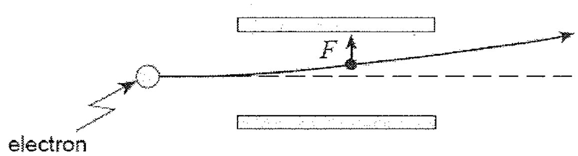
9. Charge Q_1 is located 5.0 m from charge Q_2 as shown



$W = \Delta E_p = KQ_1Q_2\left(\frac{1}{r_2} - \frac{1}{r_1}\right) = 1.2\times10^{-2}\,J$ ✓

How much work must be done to move charge Q_1 2.0 m closer to charge Q_2.

10. An electron passing between parallel plates 0.025 m apart experiences an upward electrostatic force of 5.1x10^{-16} N.



$\vec{E} = \frac{F}{Q} = \frac{5.1\times10^{-16}\,N}{1.6\times10^{-19}\,C}$

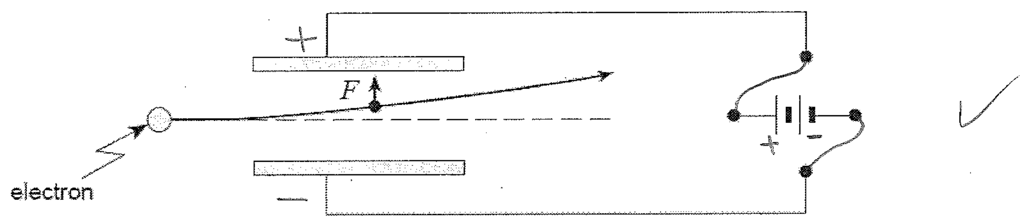
a) What is the magnitude of the electric field between the plates? – uniform → $= 3.2\times10^{3}\,N/C$ ✓

b) What is the potential difference between the plates?

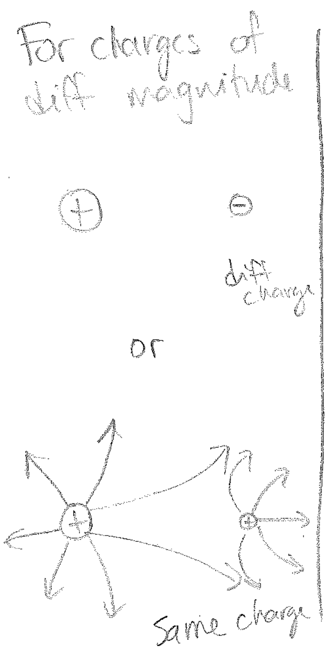
$\Delta V = Ed = (3.1875\times10^{3}\,\frac{N}{C})(0.025\,m)$

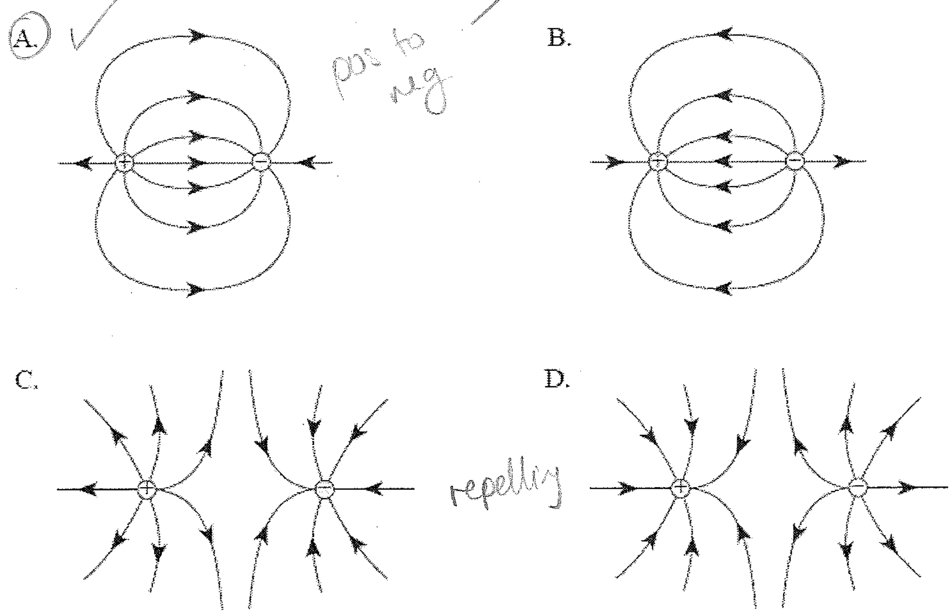
$= 80\,V$ ✓

c) On the diagram below draw in the connections to the power supply necessary for the electron to experience this upward force.



11. Which of the following diagrams shows the electric field between two equal but opposite charges?



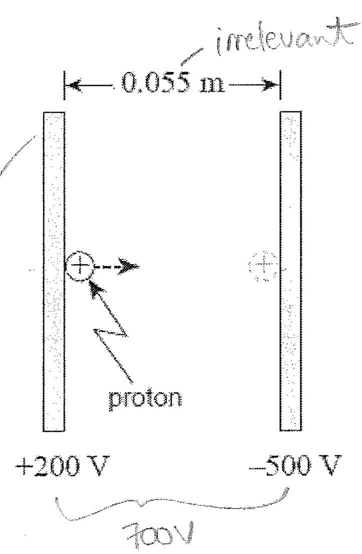


12. A proton initially at rest is accelerated between parallel plates through a potential difference of 700 V.

$\Delta E_p = \Delta V Q = \frac{1}{2}mv^2$

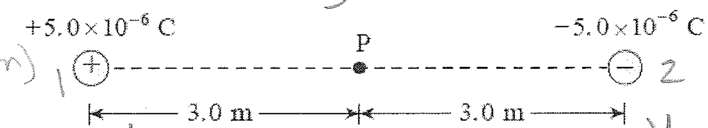
$v = \sqrt{\frac{\Delta V Q \times 2}{m}} = 3.7 \times 10^5 \text{ m/s}$

What is the maximum speed reached by the proton?



13. What are the magnitudes of the electric field and the electric potential at point P midway between the two fixed charges?

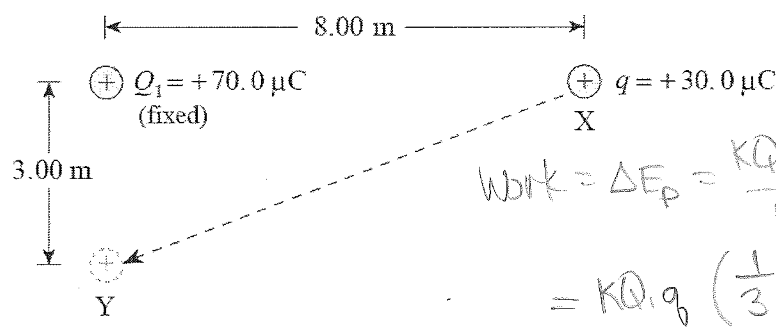
vector $\vec{E}_1 + \vec{E}_2$ (add up) (same direction)



scalar V: opp charge so cancel

	MAGNITUDE OF ELECTRIC FIELD $\vec{E}$	ELECTRIC POTENTIAL V
A.	0 N/C	0 V
B.	0 N/C	30 000 V
C.	10 000 N/C	0 V
D.	10 000 N/C	30 000 V

14. A charge q of 30.0 μC is moved from point X to point Y.

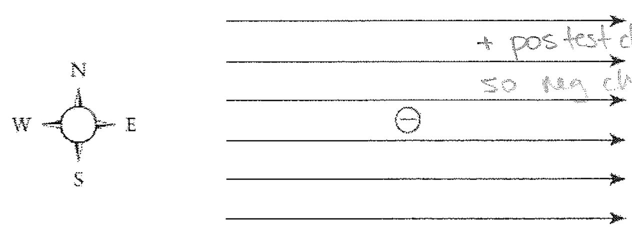


$$\text{Work} = \Delta E_p = \frac{KQ_1q}{R_y} - \frac{KQ_1q}{R_x} = KQ_1q\left(\frac{1}{3} - \frac{1}{8}\right) = 3.94\ \text{J}$$

How much work is done on the 30.0 μC charge? (Note: 1.0 μC is 1.0x10⁶ C)

15. An electron in the electric field has an electric force acting on it in what direction?

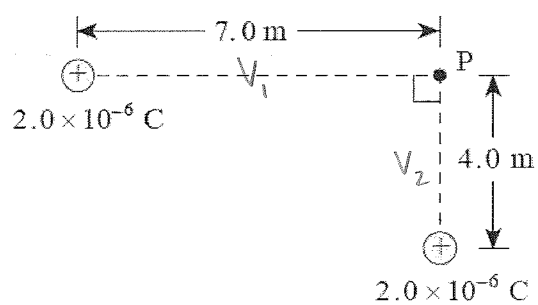
[West]



+ pos test charge [E] so neg charge [W]

16. What is the potential at point P due to the two fixed charges as shown?

(Scalar)

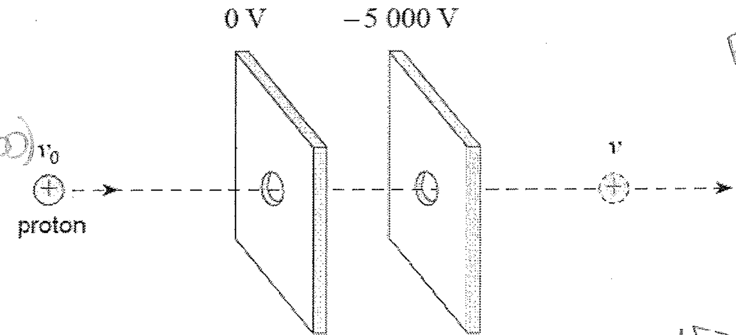


$V_1 = \frac{KQ_1}{R_1} = \frac{(9\times10^9)(2\times10^{-6})}{7} = 2.571\times10^3$ V

$V_2 = \frac{KQ_2}{R_2} = 4500$ V

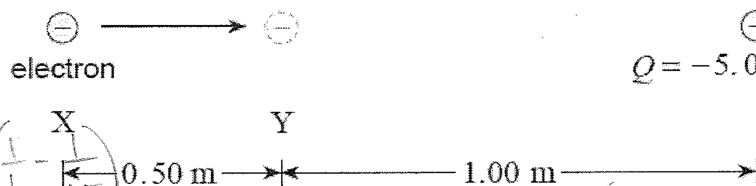
$V_1 + V_2 = 7.1\times10^3$ V

17. A moving proton has 6.4×10^{-16} J of kinetic energy. The proton is accelerated by a potential difference of 5 000 V between parallel plates.



The proton emerges from the parallel plates with what speed?

18. a) How much work is done in moving an electron from point X to point Y?

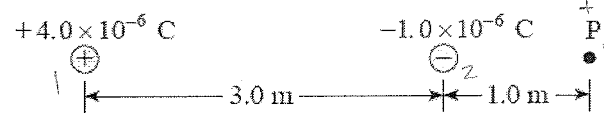


b) What is the potential difference between point X and point Y?

19. The electric field is uniform between

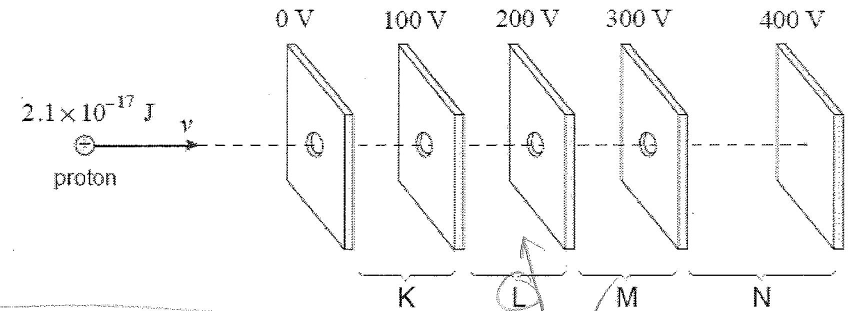
A. two positive point charges.
B. two negative point charges.
C. two opposite point charges.
D. two oppositely charged parallel plates.

20. What is the magnitude and direction of the electric field at point P due to the two fixed charges?

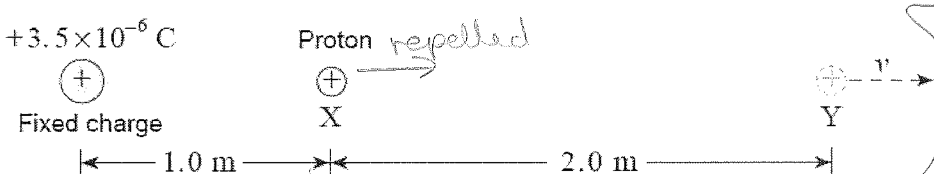


	Electric Field at Point P	
	Magnitude	Direction
A.	6 800 N/C	Right
B.	6 800 N/C	Left
C.	11 000 N/C	Right
D.	11 000 N/C	Left

21. A proton with kinetic energy of 2.1×10^{-17} J is moving into a region of charged parallel plates. The proton will be stopped momentarily in what region?



22. A proton, initially at rest at point X, will have what speed at point Y?



23. Which of the following best describes how electric potential varies with distance in the region around a point charge?

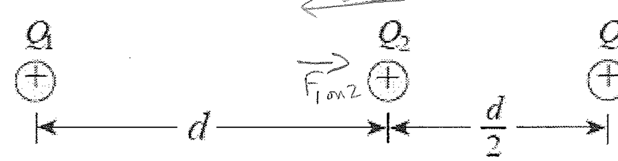
A. $V \propto r$

B. $V \propto \frac{1}{r}$

C. $V \propto r^2$

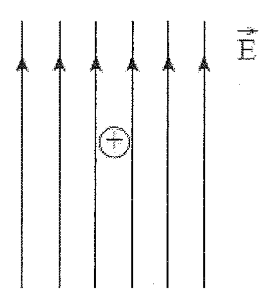
D. $V \propto \frac{1}{r^2}$

24. Three **identical** positive electric charges are fixed as shown in the diagram below.



What is the direction of the net electric force on Q_2 due to Q_1 and Q_3?

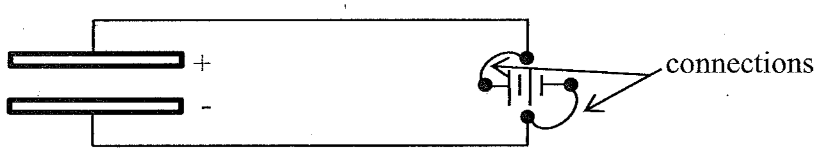
25. In an experiment, a positively charge oil droplet weight 6.5×10^{-15} N is held stationary by a vertical electric field as shown in a diagram.



If the electric field strength is 5.3×10^3 N/C, what is the charge on the oil droplet?

Electrostatics Answers

1. D (Aug ’99, 18)
2. B (Aug ’99, 19)
3. $3.0x10^{-6}$ (Aug ’99, 20)
4. a) $V_A = -4.5x10^4V$ $V_B = -2.7x10^4V$ (Aug ’99, 5LA)
   b) $1.8x10^4V$
   c) $+2.0x10^{-6}C$
5. A (Jan. ’99, 18)
6. $-6.9x10^{-19}J$ (Jan ’99, 19)
7. a) $E = 2.5x10^3N/C$ to the left (Jan ’99, 5LA)
   b) $-1.6x10^{-6}C$
8. D (June ’99, 19)
9. $1.2x10^{-2}$ (June ’99, 20)
10. a) $3.2x10^3N/C$ (June ’99, 5LA)
    b) 80V
    c)



11. A (Jan. ’00, 19)
12. $3.7x10^5m/s$ (Jan. ’00, 20)
13. C (Jan ’00, 21)
14. $W = \Delta E \rightarrow E_{Py} - E_{Px} \rightarrow 3.9J$ (3.94J) (Jan ’00, 5LA)
15. West (June ’00, 18)
16. $7.1x10^3V$ (June ’00, 19)
17. $1.3x10^6m/s$ (June ’00, 20)
18. a) $2.4x10^{-15}J$ (June ’00, 5LA)
    b) $1.5x10^4V$
19. D (Aug ’00, 18)
20. B (Aug ’00, 19)
21. L (Aug ’00, 20)
22. $2.0x10^6m/s$ (Aug. ’00, 5LA)
23. B (Jan’01, 20)
24. to the left (Jan ’01, 20)
25. $1.2x10^{-18}C$ (Jan. ’01, 22)