Class Notes: Chapter 1

1) Coulomb's law: use ***absolute values*** of charges, get directions from like/unlike charge repulsion/attraction.

2) charge quantization: all charges in units of $e = 1.6 \times 10^{-19}$ C; protons +e, electrons –e, can only have total of, e.g. 4*e*, –9*e*, etc., not e.g. 4.5*e*, etc.

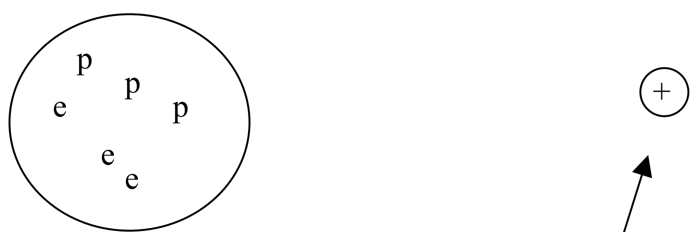
3) "net" charge: algebraic sum of positive and negative charges; e.g. (+3e) + (–2e) + (+5e) = +6e, etc.

4) charge conservation: net charge in closed system is ***constant***.

5) superposition of forces: net electrical force equals vector sum of forces due to each individual charge.

6) "neutral" particles: no charge, no electric force, e.g. neutron

   "neutral" object: no ***net*** charge; no electric force



Net charge is: A) > 0; B) = 0; C) < 0 *[okay]*
Now put charge here and draw all forces on that charge
[this took some prompting and guidance]

Class Notes: Chapter 2

Electric Field

1) Charged particles “alter space,” create “electric field.”
   [“source” charges: charges that produce E]

   E is a vector quantity $\vec{E}$ (little arrows everywhere, every point in space)

   E is ordinarily invisible, has no mass, but ***does have*** energy, can have momentum

2) Can detect presence of E by its effect on charged particles
   charged particles experience a ***force***
   [“test” charge: charge used to detect presence of E]

   magnitude of force: F = q E
   direction of force: ***same*** as E for positive charge; ***opposite*** to E for a negative charge

   “uniform” electric field: same E everywhere: same magnitude, same direction of E

   pp. 15-16, Questions 1-6, Class Quiz: 8, 9
   - #1 and #2: cards slow, somewhat split
   - #3 and # 4: pretty easy
   - #5: somewhat split
   - #6: split
   - #8 and #9: okay

Electric Field (continued)

HW due Thursday September 7:

Chap. 1, HW Exercise #7 (p. 13)
Chap. 2, HW Exercises #1-3 (pp. 25-27)
Chap 2, In-Class Exercises #6-9 (pp. 23-24)

Review Electric Field Worksheet #1-6; then:

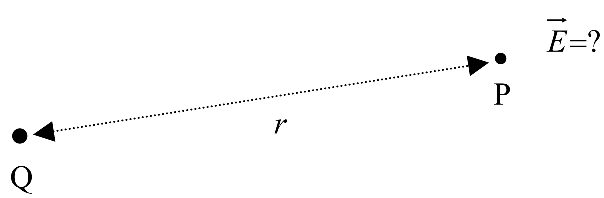
1) Definition of magnitude and direction of electric field at point P:

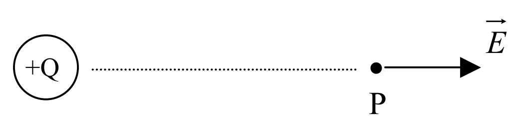
   magnitude = F_{qtest}/q_{test}, where F_{qtest} is force on "test" charge q_{test} located at point P
   direction: same as direction of force on ***positive*** test charge placed at point P

   Example: 2-C charge at point P experiences 6-N force, E = ? E = 6/2 = 3 N/C

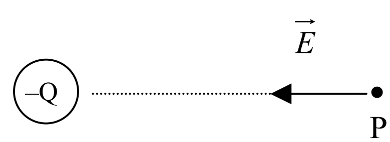
Review Electric Field Worksheet #7-14; then:

2) Electric field of a "point" charge
   ["point" charge: very small, charged particle]





$$\left|\vec{E}_{at\,P}\right| = \frac{k|Q|}{r^2}$$



3) Electric field due to ***many*** point charges (Q_1, Q_2, . . .): ["superposition" property]

$$\vec{E}_{net} = \vec{E_1} + \vec{E_2} + ...$$

↗ E field due to each source charge by itself (Q_1, Q_2, . . .)

pp. 17, #7 [very split]

pp. 18-19: #10-13, #15-16

#10: 1/3 B, 2/3 D
#11: okay

<u>Wednesday, September 6:</u>

1) If you know E at a point (or, information about E is given) and want to find the force on a test charge ***at that point***, then use F = qE

2) If you know the force on a test charge (or, information about F is given) and you want to find E ***at the location of the test charge***, then use E = F/q

3) If all source charges are ***point*** charges Q_1, Q_2, . . . and you know their locations r_1, r_2, etc., then you can find the ***net*** electric field $\vec{E}_{net} = \vec{E_1} + \vec{E_2} + ...$ where $\vec{E_1}$ is produced by Q_1, $E_1 = \frac{kQ_1}{r_1^2}$, etc.

WARNING: Can ***only*** use $E = kQ/r^2$ if all source charges are ***point*** charges, ***<u>and</u>*** you know where all of them are (i.e., Q_1, r_1; Q_2, r_2, etc.)

page 18, #12 [very split], #13, #14 [class quiz], #15, #16
page 20: #18 [class quiz], #19 [class quiz]
page 21: #1, #2 [about 30% had errors]

Friday, September 8:

Two types of E-field problems:

Source charges "absent": information given about electric field ["external" electric field] but not about source charges; objective is to find what happens to ***test*** charges

Source charges "present": information given about source charges; objective usually to find magnitude and direction of net electric field produced by a set of source charges.

2001:

discuss source charges present and absent problems, review E of point charge, then:

#7: 45 sec, 60% E, 25% A, another 45 s., still need discussion,
do point A, draw arrow, another point B, closer, same radius, arrow shorter, longer, same?
Good response; another point, other radius; another point. Then: again ask; now, Ok.
#8: > 90%
#9: almost 100%
#10: slow and split
#11: almost 100%
page 21, #1: very slow, hard, much confusion.

Class Notes: Chapter 3

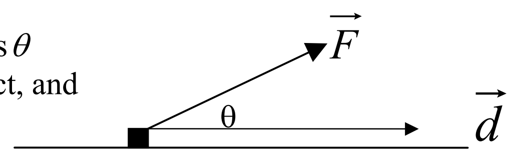
Electric Potential Energy

Review of mechanics concepts:

1. ***Kinetic Energy*** (*KE*) is the energy associated with the ***motion*** of an object;
   $KE = \frac{1}{2}mv^2$

2. ***Work*** (*W*) is a measure of the energy added to an object through the action of a force;
   IF the force is constant, then:

$$W = Fd\cos\theta$$



(d is the magnitude of the displacement of the object, and θ is the angle between the applied force and the displacement)

3. Work-Energy Theorem: Can show from Newton's laws that

   $\Delta KE = W$,

   so for the case when the force is constant,

   $\Delta KE = F\, d\, cos\theta$

   ΔKE = *the* ***change*** *in KE;* $\Delta KE = KE_{final} - KE_{initial}$

4. ***Potential Energy*** (*PE*) is the energy associated with the ***position*** of an object;
   There is no general equation for PE; it depends on the specific force that is involved. For instance, gravitational potential energy is given by *mgh.*

5. ***Total Energy*** (*TE*) of an object is the sum of its kinetic and potential energies;
   $TE = KE + PE$

   When objects are acted upon by certain types of forces ("*conservative*" forces), their total energy does not change. The electrical force is a conservative force, so ***if only the electrical force is acting on an object, the object's total energy does not change.***