AP Physics : Final Exam Review

I. Forces/Applying Newton's Laws

Force ⇒ units : Newtons (N) = $\frac{kg\,m}{s^2}$

↳types : Weight ($\vec{W}, \vec{F_g}$); normal ($\vec{F_N}$); friction ($\vec{F_f}, \vec{f}$); applied ($\vec{F_a}$); tension ($\vec{F_T}, \vec{T}$); drag ($\vec{D}$); air resistance ($\vec{F_{air}}$)

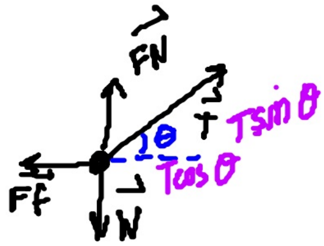
* contact vs. field *

Free Body Diagram (FBD)

vector diagram of all force acting on an object.

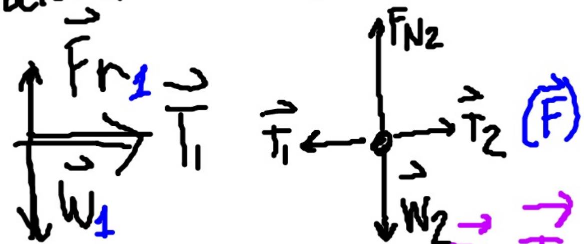
P1

(a)



P2

Block#1 Block#2



$\sum F_x = T\cos\theta - F_F = ma$

$\sum F_y = T\sin\theta + F_N - W = 0$

$\sum F_x = T_1 = m_1 a$

$\sum F_y = F_{N1} - W_1 = 0_N$

$\sum F_x = \vec{F} - \vec{T_1} = m_2 a$

$\sum F_y = \vec{F_{N_2}} - \vec{W_2} = 0N$

$mg - \sin\theta\, T = \vec{F_N}$

$a = \frac{F}{(m_1 + m_2)}$

$\frac{T\cos\theta - (\mu mg)}{m} = a$

$T_1 = m_1 \frac{F}{(m_1 + m_2)}$

Newton's 1st Law

Equilibrium

- $V = 0\frac{m}{s}$ (rest)
- V is constant

} $a = 0\frac{m}{s^2}$

$\sum F = F_{net} = 0\,N$

$\sum F_x$ $\sum F_y$

Newton's 2nd Law

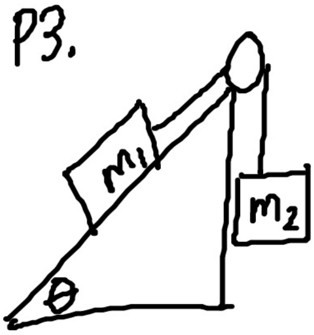
Accelerating objects

$F_{net} = ma$

$\sum F = F_{net} = ma$

Inclined Planes

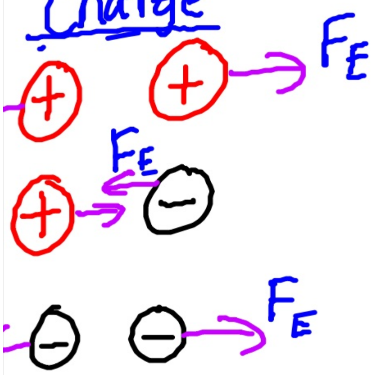
P3.



* frictionless surface

I. Electrostatics

Charge



like "repel"

unlike "attract"

proton

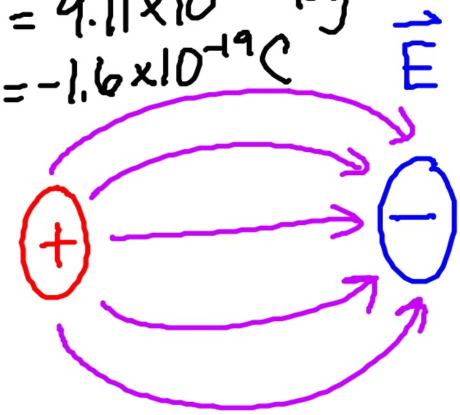
$m_p = 1.67 \times 10^{-27}$ kg

$q_p = 1.6 \times 10^{-19}$ C

electron

$m_e = 9.11 \times 10^{-31}$ kg

$q_e = -1.6 \times 10^{-19}$ C



Coulomb's Law (Electric Force ⇒ F_E)

$$F_E = \frac{K q_1 q_2}{r^2}$$

$+F_E \Rightarrow$ repel

$-F_E \Rightarrow$ attract

$K = 8.99 \times 10^9 \frac{Nm^2}{C^2}$

Coulomb's constant

$q_1, q_2 \Rightarrow$ charges

$r \Rightarrow$ distance between charges

$F_E \uparrow$, q_1 or q_2 $\uparrow$

$F_E \downarrow$, r $\uparrow$

$\left(F_E \propto \frac{1}{r^2}\right)$

(Ex. If r doubles, F_E will decrease by a factor of 4)

Electric Field ⇒ E

$$E = \frac{F_E}{q}$$

units: N/C

∴ $F_E = Eq$

$$E = \frac{kq_1q_2}{r^2} \cdot \frac{1}{q_1}$$

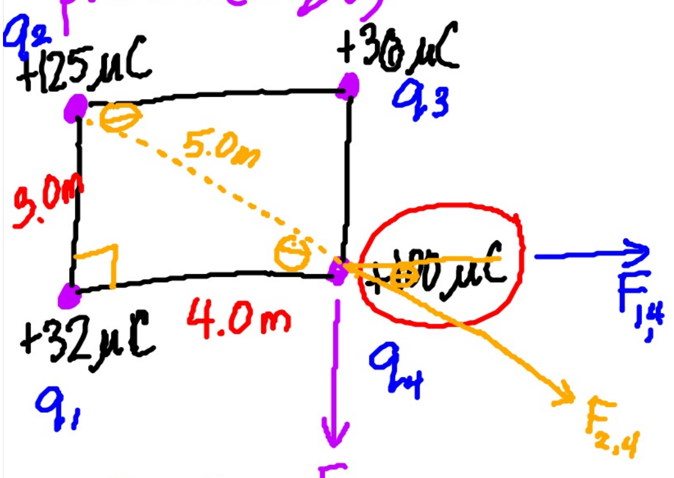
$$E = \frac{kq}{r^2}$$

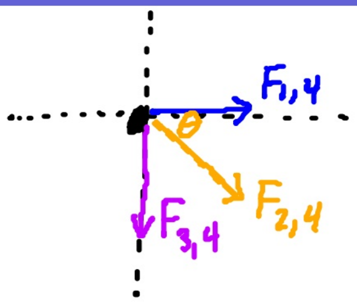
$$E = \sum \frac{kq}{r^2}$$

* $\vec{E}$ is a vector quantity
  - ↳ magnitude
  - **AND**
  - ↳ direction

matter!!!

p. 574 (#23)





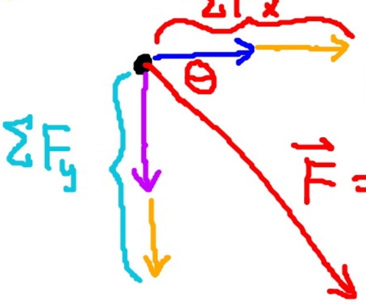
$\theta = \tan^{-1}\left(\frac{opp}{adj}\right)$

$\theta = \tan^{-1}(3/4)$

$\theta = 36.87°$

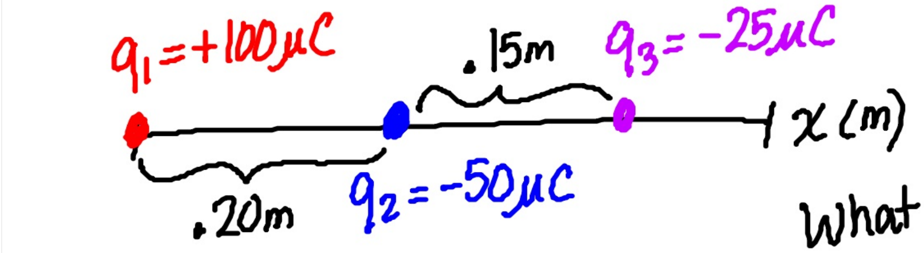
$\sum F_x = F_{1,4} + F_{2,4}\cos\theta$

$\sum F_y = -F_{3,4} - F_{2,4}\sin\theta$

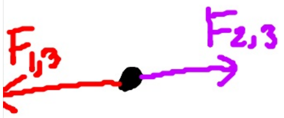


$\theta = \tan^{-1}\left(\frac{F_x}{F_y}\right)$

$\vec{F} = \sqrt{F_x^2 + F_y^2}$



What is the force on q_3?



$$\sum F_x = F_{2,3} - F_{1,3}$$

$$F_{1,3} = \frac{(8.99\times10^9)(100\times10^{-6})(25\times10^{-6})}{(.35)^2}$$

$$F_{2,3} = \frac{(8.99\times10^9)(50\times10^{-6})(25\times10^{-6})}{(.15)^2}$$

Electric Potential $\Rightarrow$ V (volts) $\Rightarrow$ Potential Difference ΔV

$$V = \frac{PE_E}{q} = \frac{W}{q} = \frac{\frac{1}{2}mv^2}{q} = Ed$$

$PE_E \Rightarrow$ electric potential energy (units: J)

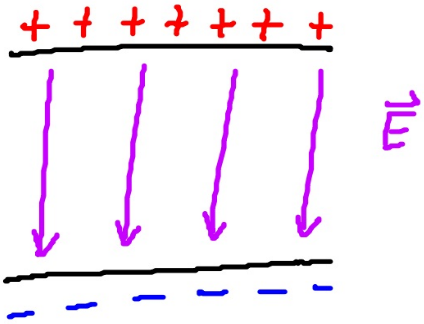
$q \Rightarrow$ charge (units: C)

$W \Rightarrow$ work (units: J)

$KE = \frac{1}{2}mv^2$ (units: J)
(Kinetic energy)

$E \Rightarrow$ electric field (N/C) (V/m)

$d \Rightarrow$ distance between capacitor plates (m)



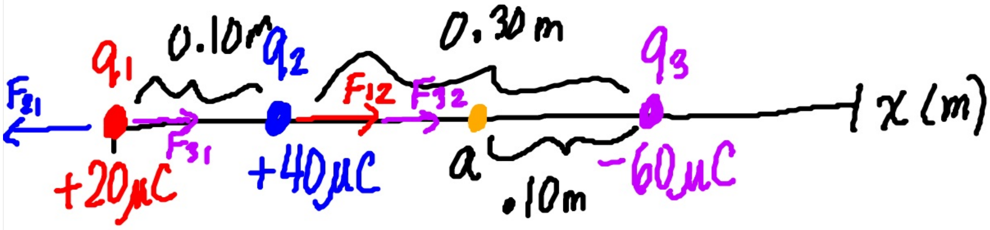
$$V = Ed$$

$$V = \frac{F_E}{q} d$$

$$V = \frac{kqq_1}{r^2}\frac{1}{q} d$$

$$\boxed{V = \frac{kq}{r}} \qquad \boxed{V = \sum \frac{kq}{r}}$$

* potential is a scalar therefor sign comes from charge!!! *



$$V_a = \sum \frac{kq}{r} = \frac{kq_1}{r_1} + \frac{kq_2}{r_2} + \frac{kq_3}{r_3}$$

$$= \frac{k(+20\times10^{-6})}{(.30m)} + \frac{k(+40\times10^{-6})}{(.20m)} + \frac{k(-60\times10^{-6})}{(.10m)}$$

$$E_a = \sum \frac{kq}{r^2} = -\frac{kq_1}{r_1^2} + \frac{kq_2}{r_2^2} + \frac{kq_3}{r_3^2}$$

Capacitance (C) ⇒ units: Farads (F)

$$C = \frac{Q}{V}$$

$$PE_E = \frac{1}{2}QV$$

$$= \frac{1}{2}CV^2$$

$$= \frac{1}{2}Q^2/C$$

$$C = \frac{\varepsilon_0 A}{d}$$

A↑, C↑

d↑, C↓

Circuits ⇒ Parallel | Series

Diagram:

Parallel:

Series:

(V) Potential:
- Parallel: V is constant (same), $V_T = V_i$
- Series: $V_T = V_1 + V_2 + \ldots = \sum_i V_i$

(I) Current:
- Parallel: $I_T = \sum_i I_i = I_1 + I_2 + \ldots$
- Series: I is constant ($I_T = I_i$)

(Q) Charge:
- Parallel: $Q_T = \sum_i Q_i = Q_1 + Q_2 + \ldots$
- Series: Q is constant ($Q_T = Q_i$)

(R) Resistance:
- Parallel: $R_{eq} = \left(\sum_i \frac{1}{R_i}\right)^{-1} = \left(\frac{1}{R_1} + \frac{1}{R_2}\right)^{-1}$
- Series: $R_{eq} = \sum_i R_i = R_1 + R_2 \ldots$

(C) Capacitance:
- Parallel: $C_{eq} = \sum_i C_i = C_1 + C_2 + \ldots$
- Series: $C_{eq} = \left(\frac{1}{C_1} + \frac{1}{C_2}\right)^{-1} = \left(\sum \frac{1}{C_i}\right)^{-1}$