Final Paper

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1 Circular motion

Polar coordinates r, θ

Angular velocity

$$w = \frac{\Delta\theta}{\Delta t}$$

Angular acceleration

$$\alpha = \frac{\Delta w}{\Delta t}$$

Centripetal acceleration

$$a = \frac{v^2}{r}$$

Tangential speed

$$v = w \times r$$

2 Orbits

Force that causes circular motion

Force that causes centripetal acceleration

Centripetal Force

$$F_c = \frac{mv^2}{r}$$

Period of orbit

$$T = \frac{2\pi r}{V}$$

Keplers 3rd Law

$$T^2 = \frac{4\pi^2}{GM}a^3$$

$$T^2 = a^3$$

Launch velocity for escape

Elliptical orbits

Electron + proton hydrogen Atom

3 Force

Gravity

$$\frac{mMG}{r^2} = m\frac{v^2}{r}$$

$$-\frac{mMG}{r} = PE$$

Tension

Spring

Electrostatics

Magnetics

Normal force

4 Electricity

Point charges

$$F_e = \frac{qQK_e}{r^2}$$

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

$$PE = \frac{qQK_e}{r}$$

$$V = \frac{QK_e}{r}$$

General

$$E = \frac{-\Delta V}{\Delta\ X}$$

$$F = q \times E$$

Capacitor

Current I

5 Electric Field lines

Electric dipoles

Equipotential lines

6 Circuits

Resistors

Parallel and in Series

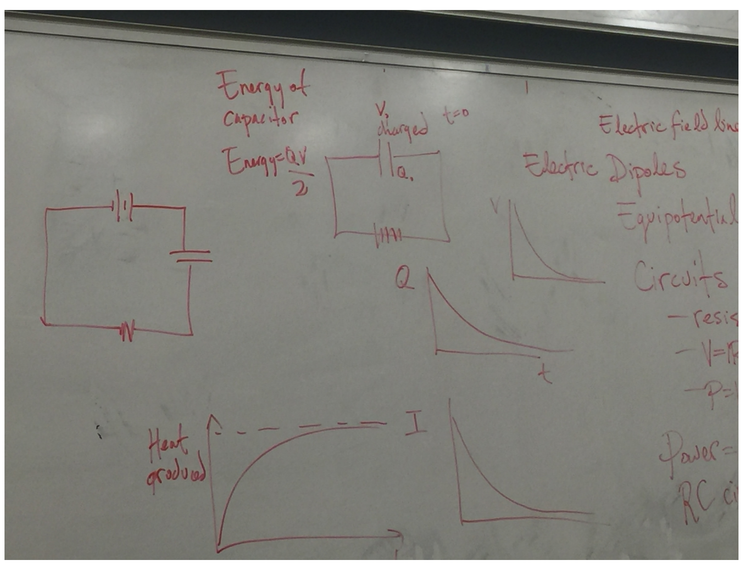
$$V = I \times R$$
$$P = I \times V$$

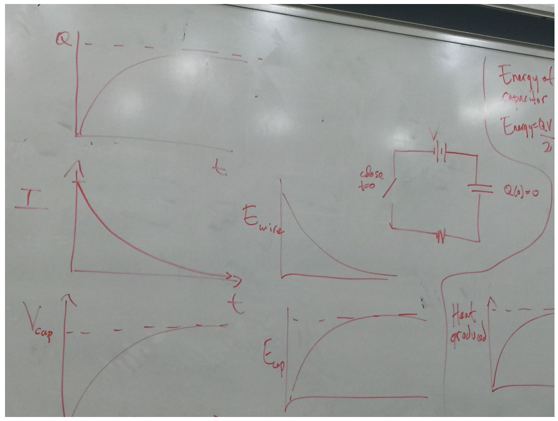
Power=P

RC circuits

Energy of Capacitor

$$Energy = \frac{QV}{2}$$





7 Magnetism

Force equations

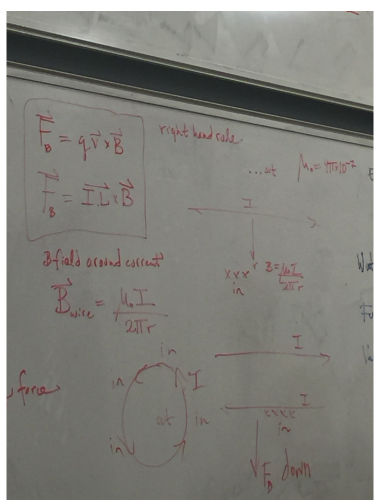
$$F_b = q\overrightarrow{v}\overrightarrow{B}$$

$$F_b = \overrightarrow{IL}\overrightarrow{B}$$

What are the B fields produced by currents? B field around current and B wire

B field around current

$$\overrightarrow{Bwire} = \frac{\mu I}{2\pi r}$$



8 Parallel Currents

They are repulsive.Out on the top.Force will be down

What is the E Field around the circle. Direction is out.The loop will be placed in the same way. If they point in the same direction they attract each other

Generate electromagnetic disturbance

$$Constant - Displacement - current = \frac{\Delta E}{\Delta t}$$

$$Induced - current = \frac{\Delta B}{\Delta t}$$

$$\frac{1}{\sqrt{\mu\epsilon}} = 3 \times 10^8 \frac{m}{s} light$$

9 Torque+Angular Momentum

$$x$$

$$\theta$$

$$v = \frac{\Delta x}{\Delta t}$$

$$w = \frac{\Delta \theta}{\Delta t}$$

$$a = \frac{\Delta v}{\Delta t}$$

$$\alpha = \frac{\Delta w}{\Delta t}$$

$$Fnet = ma$$

$$Tnet = I\alpha$$

$$\overrightarrow{T} = \overrightarrow{r}\overrightarrow{F}$$

$$m$$

$$I = \Sigma m r^2$$

10 Exam 1

The orbital angular velocity of the earth

$$w = \frac{\Delta\theta}{\Delta t} = \frac{2\pi}{365.24Days} = 1.99 \times 10^-7\frac{rad}{sec}$$

Speed of earth relative to the sun

$$Vearth = wr = 1.99 \times 10^-7\frac{rad}{sec} \times 1.50x10^11 = 2.99x10^-11\frac{m}{s}$$

Centripetal acceleration of the earth relative to the sun

$$a = \frac{v^2}{r} = \frac{2.99x10^2}{1.50x10^(11)}\frac{m}{s^2}$$

Net force on the earth considering the acceleration

$$Fnet = ma = 5.98x10^24x5.96x10^-3 = 3.56x10^22N$$

Mass of the sun from the above

$$\frac{mMG}{r^2} = ma$$

The acceleration due to gravity on the surface of the moon

$$\frac{mMG}{r^2} = ma$$

$$\frac{MG}{r^2} = a$$

The launch velocity for circular orbit

$$\frac{mMG}{r^2} = m\frac{v^2}{r}$$

The launch velocity for escape from the moon's gravity

$$PE + KE = 0$$

$$-\frac{mMG}{r} + \frac{mv^2}{2} = 0$$

$$v_{escape} = \sqrt{\frac{2MG}{r}}$$

The result of launching an object at 2000m/s into the moon's horizon. It will still remain on the surface of the moon, flying with elliptical motion.

The separation between the plates to generate a

$$30.0\frac{N}{C}$$

electric field

$$E = \frac{-\Delta V}{\Delta\, X}$$

$$30 = \frac{9}{\Delta X}$$

$$x = 0.3m$$

The force of this electric field on a 0.012 Coulomb charge

$$F_e = qE$$

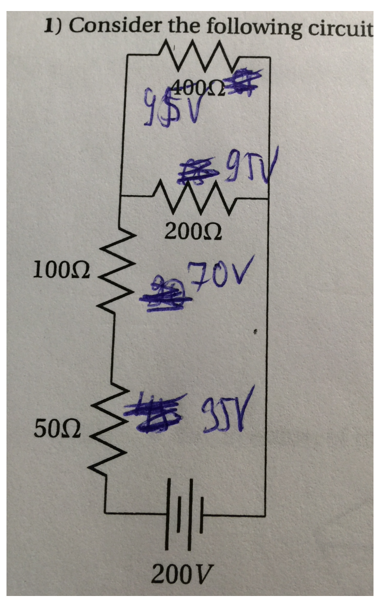
The change in potential energy for the 0.012 C charge moving from the 9V plate to the 0v plate.

$$PE = qV$$

$$KE = 0$$

PE=0.108J KE=0J TE=0.108J KE=0.108J

11 Exam 2



The equivalent resistance of the circuit

$$Req = 283.3 = 133.3 + 100 + 50 = 283.3\Omega$$

$$\frac{1}{R} = \frac{1}{R1} + \frac{1}{R2}$$

$Thecurrentthroughthe 50\Omega resistor$

$$V = IR$$

$$I = \frac{200}{283.3} = 0,7A$$

$$V = IR$$

$$I = 0.7Amps$$

The current through the 200Ω resistor

v=95

$$I = \frac{95}{200} = 0.475A$$

$Thevoltagedropacrossthe 100\Omega resistor$

$$V = IR$$

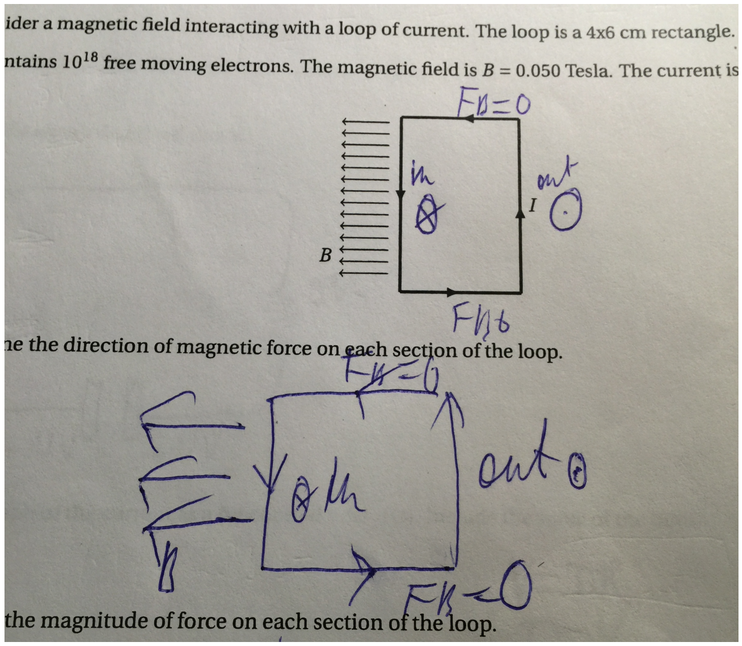
$$0.7x100 = 70v$$

$Thepowerdissipatedbythe 400\Omega resistor$

$$P = IV$$

$$0.2375x95 = 22.5625Watts$$

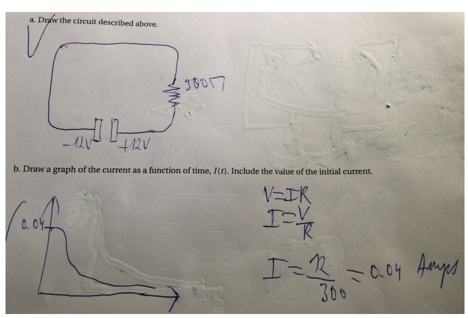
Determine the direction of magnetic force on each section of the loop.



The structure of the magnetic field created by the loop. Magnetic field is created by the loop, which is going out when we look at it from this perspective. It goes out and rotates around the wire.

The subsequent motion of the loop if it is free to move The loop would rotate so that internal and external magnetic fields align with each other since they exert repulsive forces.

draw the circuit described above



Draw a graph of the current as a function of time

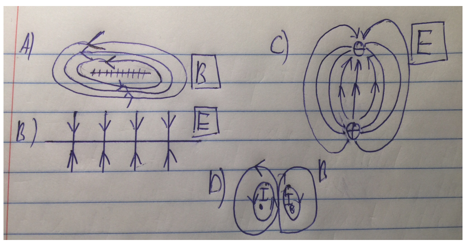
The capacitor provides the voltage that allows the current to move around the circuit and through the resistor.

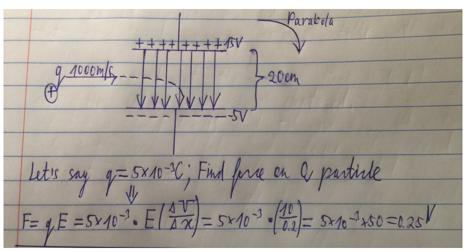
Describe the magnetic forces between the wires Those wires repel one another, the magnetic force on the wires will be in opposite direction

Explain how these wires could be used to define Ampere. The Ampere can be described as the current needed to induce a certain amount of force in a conductive material.

12 Extra tasks

For each of the following describe if the field is electric or magnetic. Explain what would produce the field.





Let's say

$$q = 5x10^-3$$

; Find forsce on Q particle

$$F = QE = 5x10^-3 \times \frac{\Delta v}{\Delta x} = 5x10^-3 \times \frac{10}{0.2} = 0,25N$$

$$Voltage = \frac{kgm^2}{cs^2}$$

What direction do we put a magnetic field in order to make particle move in a straight line? magnetic force is up Bfield must be in.

$$qE = qVB$$

$$B = \frac{E}{V} = \frac{50}{100} = 0.05 Tesla$$

Bfield trajectory of charge particle. Draw the trajectory of moving charged particle in proximity B field. It will spiral around

Centripetal forces What is a centripetal force? A force that causes centripetal acceleration and therefore moves object in a circle.

Tension. Mass attached to a rope moving in a circle

Gravity. Moon orbiting the earth

Normal force. Banked curve, vertical loop.

Friction force. A car which goes in a circle on a flat road.

Magnetic force. Mass spectroscopy. Particle moving perpendicular to Bfield.

Electric force. Hydrogen Atom

Why centripetal forces never do work?

$$W = \overrightarrow{F} \Delta \overrightarrow{X}$$

Displacement is always perpendicular to the Force. W=F(parallel component x)

13 Extra Extra Tasks

New formula!!

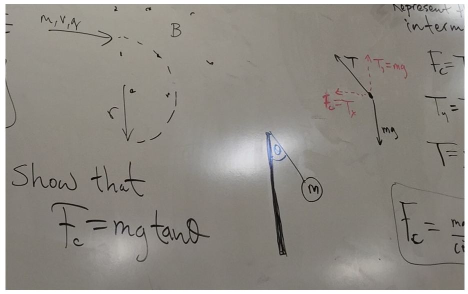
$$F = ma$$

$$qvB = m\frac{v^2}{r}$$

$$\frac{m}{q} = \frac{rB}{v}$$

$$FcisacomponentofthetensionRepresenttheFcintermsof\theta, m, a$$

$$Fc = Tsin\theta$$



$$Ty = Tcos\alpha = mg$$

$$T = \frac{mg}{cos\alpha}$$

$$Fc = \frac{mg}{cos\alpha}sin\alpha = mgtan\alpha$$

Have a system where the centripetal force is electrostatics.

$$ma = Fe$$

$$\frac{mv^2}{r} = \frac{mv^2}{r}\frac{r^2}{Ke} = q^2$$

$$a = \frac{v^2}{r}$$

$$Fe = \frac{q1q2Ke}{r^2}$$

$$Ke = 9x10^9$$

Last tasks Given numbers:

$$1x10^-9$$

$$1x10^-9$$

$$4x10^-12$$

Calculate the moment of inertia for the above molecule rotating around center.

Count R, divide D by 2

$$= mr^2 + mr^2$$

$$I = 8x10^-33\frac{kg}{m^2}$$

State the lowest possible angular momentum of the molecule

$$h = 1,05x10^-34\frac{kgm^2}{s}$$

Find the lowest possible angular speed. L=Iw

$$\frac{Llow}{I} = Wlow = \frac{1.05x10^-34}{8x10^-33}$$

$$Wlow = 1,3x10^-2\frac{w}{sec}$$

Find lowest KErot

$$Ke = \frac{Iw^2}{2} = \frac{8x10^-33x1.3x10^-2}{2}$$

14 Torque+Angular+Momentum of Inertia

$$T = I\alpha$$

$$T = torque, I = momentofinertia, \alpha = angularacceleration$$

$$Tnet = \overrightarrow{r}\overrightarrow{F}$$

$$\overrightarrow{L} = \overrightarrow{r}\overrightarrow{p}$$

$$I = \Sigma mr^2$$

$$p = mv$$

$$KE = \frac{1}{2}mv^2$$

$$\overrightarrow{Fnet} = \frac{\Delta\overrightarrow{p}}{\Delta t}$$

$$\overrightarrow{Tnet} = \frac{\Delta\overrightarrow{L}}{\Delta t}$$

Angular momentum is considered for no external torques

Static

$$Fnet = ma = 0$$

$$Tnet = I\alpha = 0$$

$$I = I + MD^2$$

I center of mass

$$L = Iw$$

$$KErot = \frac{1}{2}Iw^2$$

$$I1w1 = I2w2$$

$$L = L$$

$$Ke = \frac{1}{2}I2w^2$$