Final exam notes
IB Physcis
section 11

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TEST ONE

The first question of the exam is worth 30 points.

1) Consider the earth moving around the sun.

a. Determine the orbital angular velocity of the earth.

$$\omega = \frac{2\pi}{T}$$

$$\omega = \frac{(2 \times 3.14)}{365.24 \times 24 \times 60 \times 60}$$

$$\omega = 1.99 \times 10^{-7} rad/sec$$

b. Determine the speed of the earth relative to the sun.

$$V = \omega r$$

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

$$V = (1.99 \times 10^{-7}) * (1.5 \times 10^{11}) = 3.0 \times 10^{4} m/s$$

c. Determine centripetal acceleration of the earth relative to the sun.

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

$$a = \frac{(3 \times 10^4)^2}{1.m, mm, 5 \times 10^{11}} = 6 \times 10^{-3} m/s^2$$

d. Determine the net force on the earth considering this acceleration.

$$Fnet = ma$$

$$Fnet = (5.98 \times 10^{24}) * (6 \times 10^{-3})$$

$$Fnet = 3.6 \times 10^{22} N$$

e. Determine the mass of the sun from the above.

$$M = \frac{Fg * r^2}{mg}$$

$$M = \frac{(3.6 \times 10^{22}) * (1.5 \times 10^{11})^2}{(5.98 \times 10^{24}) * (6.67 \times 10^{-11})}$$

$$M = 2.0 \times 10^{30} kg$$

The second question is worth 30 points.
2) Consider gravitation at the surface of the moon.

a. Determine the acceleration due to gravity on the surface of the moon.

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

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

$$a = \frac{(7.36 \times 10^{22}) * (6.67 \times 10^{-11})}{(1.74 \times 10^6)^2}$$

$$a = 1.62 m/s^2$$

b. Determine the launch velocity for circular orbit.

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

$$1.62 = \frac{V^2}{1.74 \times 10^6}$$

$$V^2 = (1.62) * (1.74 \times 10^6)$$

$$V = 1680 m/s$$

c. Determine the launch velocity for escape from the moon's gravity.

$$E = 0$$

$$KE + PE = 0$$

$$\frac{1}{2} m v^2 - \frac{mMG}{r} = 0$$

$$v = \sqrt{\frac{2MG}{r}}$$

$$v = \sqrt{\frac{(2) * (7.36 \times 10^{22}) * (6.67 \times 10^{-11})}{(1.74 \times 10^6)}}$$

$$v = 2370 m/s$$

d. Determine the result of launching an object at 2000 m/s into the moon's horizon.

- It would not escape the moon, instead, it would orbit the moon in elliptical shape (like an egg)

Question three is worth 40 points.
3) Consider a capacitor. Two very large parallel conducting plates are connected to the leads of a 9 Volt battery.

a. Determine the separation between the plates to generate a 30.0 $\frac{\mathrm{N}}{\mathrm{C}}$ electric field.

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

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

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

$$X = 0.3m$$

b. Determine the force of this electric field on a 0.012 Coulomb charge.

$$F = q * E$$

$$F = 0.012 \times 30$$

$$F = 0.36N$$

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

$$PEq = qV$$

$$PEq = 0.012 \times 9$$

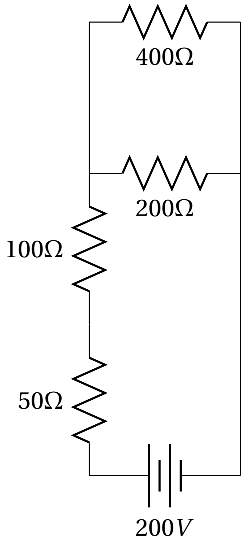
$$PEq = 0.108 Joules$$

d. Draw the parallel plates and the electric field between them.

$$understood$$

TEST TWO

1) Consider the following circuit



a. Determine the equivalent resistance of the circuit.

$$R = 100 + 50 = 150\Omega$$
$$\frac{1}{R} = \frac{1}{400} + \frac{1}{200} = \frac{3}{400}$$
$$R = 150 + \frac{400}{3} = 283.3\Omega$$

b. Determine the current through the 50Ω resistor.

$$I = \frac{V}{R} = \frac{200V}{\frac{850}{3}\Omega} = 0.706A$$

c. Determine the current through the 200Ω resistor.

$$V = IR = 0.706A \times 150\Omega = 105.88V$$
$$V = 200v - 105.88v = 94.12v$$
$$I = \frac{V}{R} = \frac{94.12V}{200\Omega} = 0.471A$$

d. Determine the voltage drop across the 100Ω resistor.

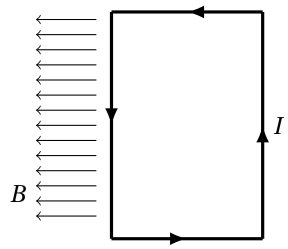
$$V = IR = 0.706A \times 100\Omega = 70.6V$$

e. Determine the power dissipated by the 400Ω resistor.

$$I = \frac{94.12V}{400\Omega} = 0.2353W$$

The second question is worth 30 points.

2) Consider a magnetic field interacting with a loop of current. The loop is a 4x6 cm rectangle. The wire contains 10^{18} free moving electrons. The magnetic field is $B = 0.050$ Tesla. The current is $I = 1.6$ Amperes.



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

use the right hand rules

b. Determine the magnitude of force on each section of the loop.

c. Describe the structure of the magnetic field created by the loop.

use the right hand rules (grab)

d. Determine the subsequent motion of the loop if it is free to move.

The left side will go into the paper, and the right side will go out, they will start to rotate.

Question three is worth 30 points.

3) Consider a charged capacitor that holds 60×10^{-3} Coulombs with 12 Volts of potential. The capacitor is connected in series with a 300 Ω resistor. The capacitor begins discharging at $t = 0$.

a. Draw the circuit described above.

Draw the circuit, read the question carefully

b. Draw a graph of the current as a function of time, $I(t)$. Include the value of the initial current.

$$I = \frac{V}{R} = \frac{12V}{300\Omega} = 0.04A$$

The grath is from 0.04 the maximum dramatically decreased when time increases, stop until reaches T=0

c. Explain how the capacitor functions as a battery in this system.

There is electric field in capacitor, and it can push charges to cause current.

The voltage in capacitor will for push on resistor. THat will cause surrent flow.

Displacement current

Question four is worth 10 points.
4) Two long straight wires, separated by 50 cm, run parallel and carry current in opposite directions.

Describe the magnetic force between the wires.

The magnetic force between the wires is attraction.

The magnetic force want these two wire to be together.

Because of the drection of current is opposite. These two wire just like two opposite magnitudes attract each other.

Explain how these wires could be used to define the Ampere.

$$B(wire) = \frac{\mu \times I}{2\pi r}$$

$$F(B) = IL \times \frac{\mu \times I}{2\pi r}$$

both "I" are same, beacause they doesn't need to consider direction, but "I" are opposite.

Therefore directions of F(B) are opposite. Two wires attracting.

1 Circular motion

1.1 Polar coordinates

$$r, \theta$$

1.2 Angular velocity

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

1.3 Angular acceleration

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

1.4 Centripetal acceleration

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

1.5 Tangential speed

$$V = \omega r$$

2 Gravity

$$F = \frac{mMG}{r^2}$$
$$PE = -\frac{mMG}{r}$$

when something is escaping FE=0 , when it stay in orbit gravity=MA

3 Antripetal force

$$F = \frac{mv^2}{r} = \frac{I\omega^2}{2}$$
$$V = \omega r$$
$$\frac{mMG}{r^2} = \frac{m\omega^2 r^2}{r}$$
$$\omega = \frac{2\pi}{T}$$
$$T^2 = \frac{4\pi^2 r^3}{MG}$$

4 Electricity point charge

$$F = qQkr^2$$
$$E = Qkr^2$$
$$PE = \frac{qQk}{r}$$
$$V = \frac{Qk}{r}$$

5 Electric general

$$E = \frac{-V}{X}$$
$$F = qE$$
$$PE = qV$$
$$I = \frac{Q}{t}$$
$$C = QV$$
$$V = IR$$
$$P = IV$$

6 B field

$$F = qvB$$
$$F = ILB$$
$$B = \frac{\mu I}{2\pi r}$$

7 Torque

$$\theta$$
$$\omega$$
$$\alpha$$
$$\tau = I\alpha$$
$$I = \Sigma mr^2$$
$$l = I\omega$$
$$KE = \frac{I\omega}{2}$$
$$\tau = \frac{\Delta l}{\Delta t}$$

8 Internal energy

$$Q = cm\Delta t$$
$$\Delta v = Q - W = Q - P\Delta V$$
$$v = \frac{3NKT}{2}$$

For Single Molecular Like He
A to B

$$\Delta v = \frac{3}{2}P(V2 - V1)$$
$$W = P(V2 - V1)$$

$$Q = \frac{5}{2}P(V2 - V1)$$

HEAT IN

B to C

$$\Delta v = \frac{3}{2}V2(P2 - P1)$$

$$W = 0$$

$$Q = \frac{3}{2}V2(P2 - P1)$$

heat out

C to D

$$\Delta v = \frac{3}{2}P2(V1 - V2)$$

$$W = P2(V1 - V2)$$

$$Q = \frac{5}{2}P2(V1 - V2)$$

heat out

D to A

$$\Delta v = \frac{3}{2}V1(P1 - P2)$$

$$W = 0$$

$$Q = \frac{3}{2}V1(P1 - P2)$$

HEAT IN

TOTAL

$$\Delta v = 0$$

$$W = (V1 - V2)(P1 - P2)$$

this show that we can use heat to do work. even though it is very low efficient.