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.

$$E = 0$$

$$KE + PE = 0$$

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

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

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

$$v = 2370 m/s$$

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 $\frac{N}{C}$ 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.

$$understood$$

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

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

$$V = \omega r$$

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

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

$$T^2 = \frac{4\pi^2 r^3}{MG}$$

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

$$Q = cm\Delta t$$

$$\Delta\nu = Q - W = Q - P\Delta V$$

$$\nu = \frac{3NKT}{2}$$

For Single Molecular Like He

A to B

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

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

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

HEAT IN

B to C

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

$$W = 0$$

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

heat out

C to D

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

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

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

heat out

D to A

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

$$W = 0$$

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

HEAT IN

TOTAL

$$\Delta\nu = 0$$

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

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