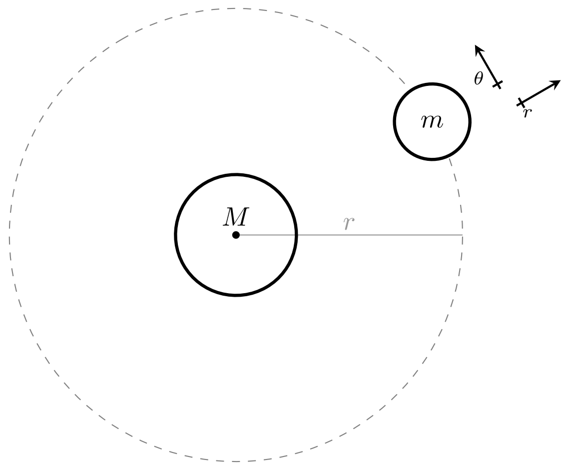
IB Physics **Name :**______________________________

Exam 1



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

Description	Symbol	Quantity
Gravitational Constant	G	$6.67 \times 10^{-11} \mathrm{N \cdot m^2/kg^2}$
Mass of Earth	m_{earth}	5.98×10^{24}kg
Mass of Moon	m_{moon}	7.36×10^{22}kg
Radius of Earth	R_{earth}	6.38×10^{6}m
Radius of Moon	R_{moon}	1.74×10^{6}m
Orbital Radius of Earth	r_{earth}	1.50×10^{11}m
Orbital Radius of Moon	r_{moon}	3.84×10^{8}m
Period of Earth's Orbit	T_{earth}	365.24 days
Period of Moon's Orbit	T_{moon}	27.3 days

Table 1: A list of physical quantities.

The first question of the exam is worth 30 points. The above table is required.

1) Consider the earth moving around the sun.

a. Determine the orbital angular velocity of the earth.

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

$$\omega = \frac{2 * 3.14}{365.24 * 24 * 60 * 60}$$

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

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

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

$$V = \omega r$$

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

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

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

$$a = \frac{(3 \times 10^4)^2}{1.5 \times 10^{11}} = 6 \times 10^{-3} \frac{m}{s^2}$$

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. The table is required.

2) Consider gravitation at the surface of the moon.

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

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

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

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

$$a = 1.62 \frac{m}{s^2}$$

b. Determine the launch velocity for circular orbit.

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

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

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

$$V^2 = 1680 \frac{m}{s}$$

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

$$E = 0$$

$$KE + PE = 0$$

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

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

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

$$v = 2370 \frac{m}{s}$$

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.

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 $\frac{\text{N}}{\text{C}}$ 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.

$$PEq = qV$$

$$PEq = 0.012 \times 9$$

$$PEq = 0.108Joules$$

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

I have it in my notebook.