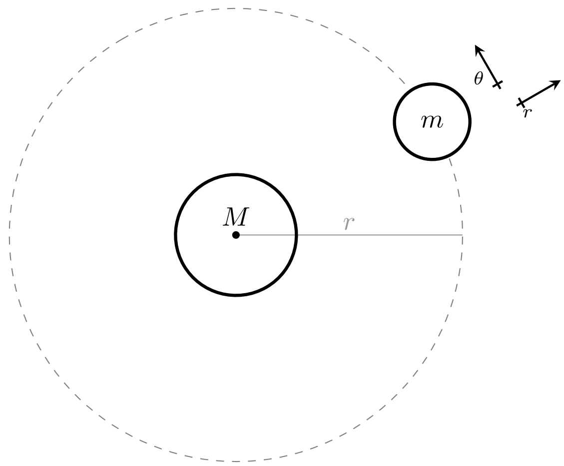
IB Physics **Name :**______________________________

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.

$$V_{earth} = wr$$

$$V_{earth} = 1.99 * 10^{-7} * 1.50 * 10^{11}$$

$$V_{earth} = 29850 \frac{m}{s}$$

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

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

$$a = \frac{(1.7 * 10000)^2}{1.50 * 10^{11}}$$

$$a = 19.5 \frac{m}{s^2}$$

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

$$F = ma$$

$$F = 5.98 * 10^{24} * 19.5 = 1.17 * 10^{26} (N)$$

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

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

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

$$M = \frac{a * r^2}{G}$$

$$M = \frac{19.5 * (1.5 * 10^{11})^2}{6.67 * 10^{-11}}$$

$$M = 6.58 * 10^{33}$$

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.

$$F_{net} = ma$$

$$F_g = \frac{m * M * G}{r^2}$$

$$a = \frac{M * G}{r^2}$$

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

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

b. Determine the launch velocity for circular orbit.

$$F_{net} = ma$$

$$F_g = ma$$

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

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

$$\sqrt{\frac{GM}{r}} = v$$

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

$$v = 1680\frac{m}{s}$$

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

$$TE = 0$$

$$PE + KE = 0$$

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

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

$$\sqrt{\frac{2GM}{r^2}} = v$$

$$v = \sqrt{2} * 1680$$

$$v = 2375\frac{m}{s}$$

$$d.Determinetheresultoflaunchinganobjectat2000m/sintothemoon'shorizon.$$

At 2000m/s, the object will go like an eclipse surround the moon. Because it exceeds the circular orbit's velocity and less than the escape velocity, which is 2375m/s.

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.

$$E = \frac{-\delta V}{\delta x}$$

$$30 = \frac{9}{\delta x}$$

$$\delta x = 0.3(m)$$

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

$$F = E_g = 30 * 0.012 = 0.36$$

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

Initial

$$PE = q * V = 0.012 * 9 = 0.108$$

Final

$$PE = q * V = 0.012 * 0 = 0$$

$$\delta PE = 0.108$$

d. Draw the parallel plates and the electric field between them. 0v— 3m —9v