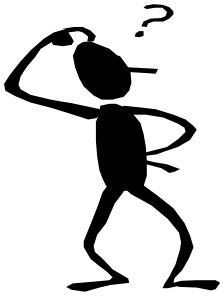
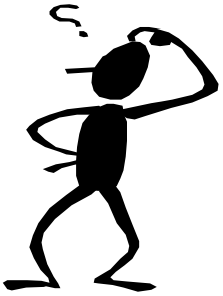


Gravitational Fields

Assessment



Name: _____ Group: _____

Level: Advanced Level Physics

Year: 1st Year

Duration: 1 week

Mark:

Answer all questions. Calculators may be used. All necessary working must be shown.

(1) State Newton's law of gravitation and show that $G = gR_E^2/M$ where M is the mass of the Earth, R_E its radius and g is the acceleration of freefall.

(2,2)

(2) A communications satellite has a circular orbit round the Earth of three times the radius of the Earth. The weight of the satellite on earth is 90N. Given that $g'R^2 = gR_E^2$ show that the weight of the satellite in orbit is 10N.

(3)

(3) A satellite weighs 80N at the Earth's surface. If R_E is the Earth's radius, at what distance from the Earth would the weight of the satellite be 20N?

(3)

(4) A space shuttle is required to place a satellite of mass 1200kg into a geostationary orbit from a place on the equator. (Given: $R_E = 6.4 \times 10^6$m, $M_E = 6 \times 10^{24}$kg).

(a) Assuming that the acceleration of free fall at the earth's surface to be $9.79 ms^{-2}$, use Kepler's third law to calculate the radius of the geostationary orbit. (Given: the orbital period of a satellite close to the surface of earth = 5078s)

(3)

(b) Use the relation given in (2) to calculate the acceleration of free fall in this orbit if the orbital radius is 4.22×10^7m.

(3)

(c) Find the gravitational potential at the Earth's surface. (Given: $G = 6.7 \times 10^{-11} m^3 kg^{-1} s^{-2}$).

(3)

(d) If the satellite possesses a potential of $62.8 MJkg^{-1}$on the surface of Earth, determine the initial energy the satellite must have to escape from the earth's gravitational field.

(3)

(e) Calculate the least initial velocity of the satellite in order to escape from the Earth's gravitational field.

(3)