3 Modern gravity meters can measure *g*, the acceleration of free fall, to a high degree of accuracy. The principle on which they work is of measuring *t* the time of fall of an object through a known distance *h* in a vacuum.

(a) Assuming that the object starts from rest, deduce and expression for *g* in terms of *t* and *h*.

[1]

(b) State Newton's law of gravitation relating the force *F* between two point objects of masses *m* and *M*, their separation *r* and the gravitational constant *G*.

.....

..... [1]

(c) Fig. 3.1 shows a standard kilogram mass at the surface of the Earth and a spherical region S of radius 2000 m with its centre 4000 m from the surface of the Earth.

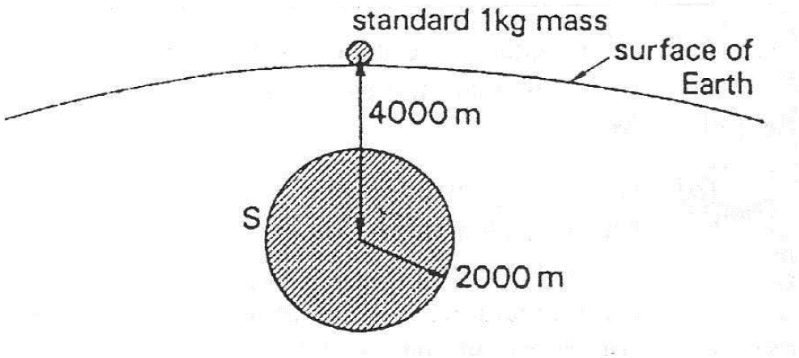

Fig. 3.1 (Not to scale)

Region S is made up of rocks with density 2800 kg m^{-3}. Calculate the force the matter in region S exerts on the standard mass.

force = ... N [2]

(d) Calculate the difference in the force on the standard mass, if region S consists of oil with density 900 kg m^{-3} instead of rock.

difference in force = ... N [2]

(e) In oil prospecting, the gravity meter is used to predict where deposits of oil are under the surface of Earth. Use your answers in **(d)** to suggest one necessary condition in using the gravity meter.

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[1]

[

Total: 7]