decay constant $\lambda = \frac{\ln 2}{t_{1/2}}$

Answer **all** the questions in the space provided.

1 **(a)** The Earth spins on its axis with a period of one day.

(i) Show that the angular velocity of a point on the Earth's surface is 7.27×10^{-5} rad s^{-1}.

[1]

(ii) Calculate the centripetal acceleration of a point on the Earth's equator. The radius of the Earth's equator is 6.38×10^{6} m.

centripetal acceleration = …… m s^{-2} [2]

(b) The acceleration of free fall *g* at the equator is not equal to the acceleration of free fall at the poles. Explain

(i) why they are different,

……

……

……

…… [2]

(ii) why the difference is small.

……

……

……

……

…… [2]

(c) (i) State Newton's law of gravitation.

…..……

…….[1]

(ii) The mass *M* of the Earth may be considered to be concentrated at its centre. The radius of the Earth is *R*. Derive, in terms of *M* and *R*, the equation relating the Earth's gravitational field strength *g* to the gravitational constant *G*.

Explain your working.

[2]

(d) **(i)** Calculate how far a satellite needs to be from the centre of the Earth for its angular velocity to be equal to the angular velocity of the Earth.

distance =…….m [3]

(ii) State two circumstances under which a satellite at this distance will be a geostationary satellite.

1. ……

...……

2. …...……

…….. [2]