Section A

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

For Examiner's Use

1 A spherical planet has mass M and radius R.
The planet may be assumed to be isolated in space and to have its mass concentrated at its centre.
The planet spins on its axis with angular speed ω, as illustrated in Fig. 1.1.

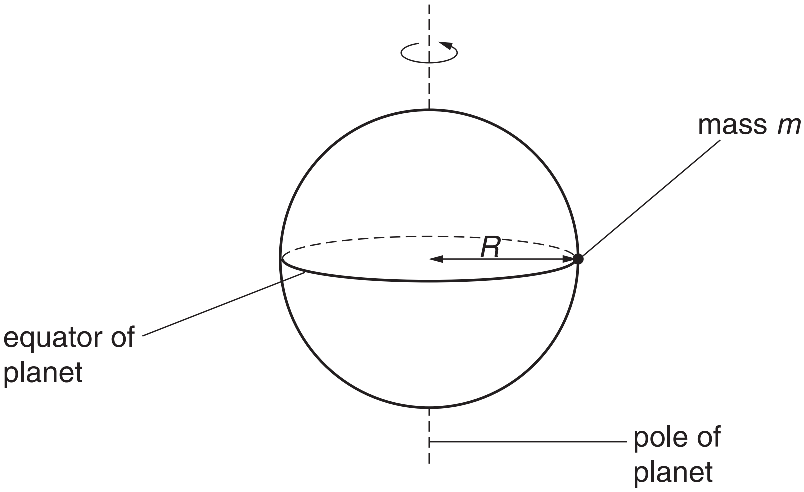

Fig. 1.1

A small object of mass m rests on the equator of the planet. The surface of the planet exerts a normal reaction force on the mass.

(a) State formulae, in terms of M, m, R and ω, for

(i) the gravitational force between the planet and the object,

.... [1]

(ii) the centripetal force required for circular motion of the small mass,

.... [1]

(iii) the normal reaction exerted by the planet on the mass.

.... [1]

(b) (i) Explain why the normal reaction on the mass will have different values at the equator and at the poles.

....

....

.... [2]

For Examiner's Use

(ii) The radius of the planet is 6.4×10^6 m. It completes one revolution in 8.6×10^4 s. Calculate the magnitude of the centripetal acceleration at

1. the equator,

acceleration = ... $m\,s^{-2}$ [2]

2. one of the poles.

acceleration = ... $m\,s^{-2}$ [1]

(c) Suggest two factors that could, in the case of a real planet, cause variations in the acceleration of free fall at its surface.

1. ....

....

2. ....

....

[2]