9 **(a)** Distinguish between *gravitational field strength* and *acceleration of free fall*.

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…… [2]

(b) Assuming Earth to be a sphere, explain with the help of free body diagrams, the difference in the weight of a person measured on an electronic balance at the poles and at the equator.

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[5]

(c) Assuming Earth to be a sphere of radius 6.4×10^6 m, calculate the mass of Earth.

mass of Earth = …… kg [2]

(d) Calculate the radius of the orbit of a geostationary satellite.

radius = …… m [3]

(e) **(i)** A space mission is to launch a space shuttle from Earth. The space shuttle comprise of a land rover to be delivered to the moon.

Using the answer in part **(c)**, calculate the distance from the centre of Earth where the resultant gravitational field strength due to the Earth and the Moon is zero.

The mass of the Moon is 7.4×10^{22} kg and distance between centres of the Earth and the Moon is 3.8×10^{8} m.

distance from centre of Earth = ... m [3]

(ii) On Fig. 9.1, sketch the variation of gravitational potential ϕ between the surface of Earth and the surface of the moon.

Include the value obtained in **(e)(i)**.

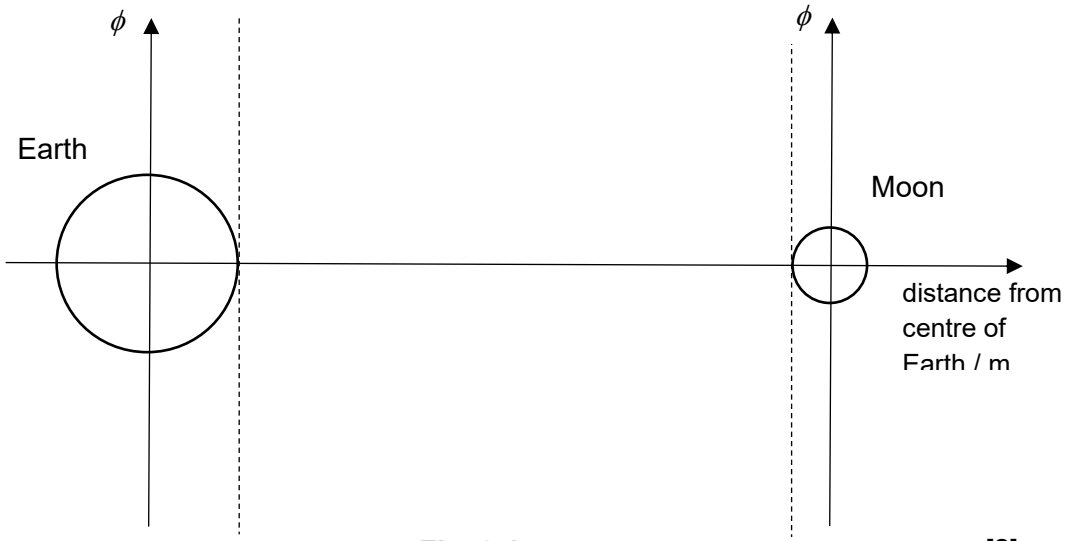

Fig. 9.1

[2]

(iii) Calculate the minimum launch speed of the space shuttle from Earth such that the space shuttle will be able to reach the surface of the moon.

minimum launch speed = ……..…… m s^{-1} [3]

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