Section B

Answer **one** question from this section in the spaces provided.

7 (a) State *Newton's law of gravitation*. [2]

(b) A satellite of mass *m* is to be placed into orbit round the Earth at a vertical distance of 350 km above the Earth's surface.
(mass of Earth = 6.0 x 10^{24} kg, radius of Earth = 6.4 x 10^6 m)

(i) Calculate the magnitude of the gravitational field strength at a point *P*, 350 km above the Earth's surface and state its direction. [3]

(ii) Calculate, using the answer in (b)(i), the time taken for the satellite to complete one orbit round the Earth. [2]

(c)(i) Define gravitational potential at a point in a gravitational field. [1]

(ii)   Explain why gravitational potential is always negative. [2]

(iii)   Fig. 7 below shows the variation of potential between the surface of the Moon and the surface of Earth along the line joining their centres.
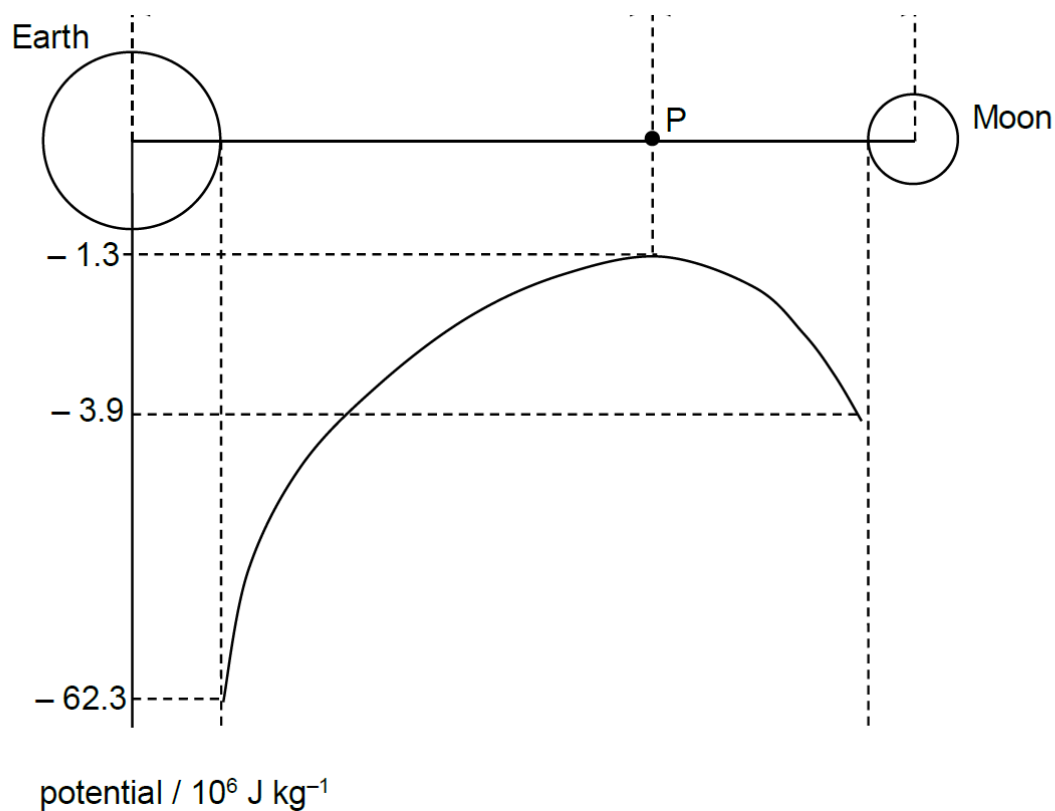

Fig. 7

Explain why the gradient of the potential graph near the surface of the Earth and that near the surface of the Moon have *opposite* signs.   [3]

(iv)   Using the values in Fig. 7, determine the *minimum* speed that a spacecraft of mass m needs to be propelled from the surface of the Moon if it is to reach the surface of the Earth.
                                                                                                                    [3]

(d)(i)   Data for a certain planet are given below:
        Mass of planet   = 1.20 x 10^{24} kg
        Diameter of planet   = 7.50 x 10^6 m

        Calculate the escape velocity of a mass on this planet. Explain your working.   [3]

(ii)   An atmosphere is formed when gases such as nitrogen is allowed to orbit around the planet. Given that the average speed of a molecule of nitrogen at the surface of the planet is 3.9 x 10^4 m s^{-1}, explain whether this planet has an atmosphere.   [1]