

Name of the Student: _____

Max. Marks : 22 Marks

Time : 22 Minutes

Q1.

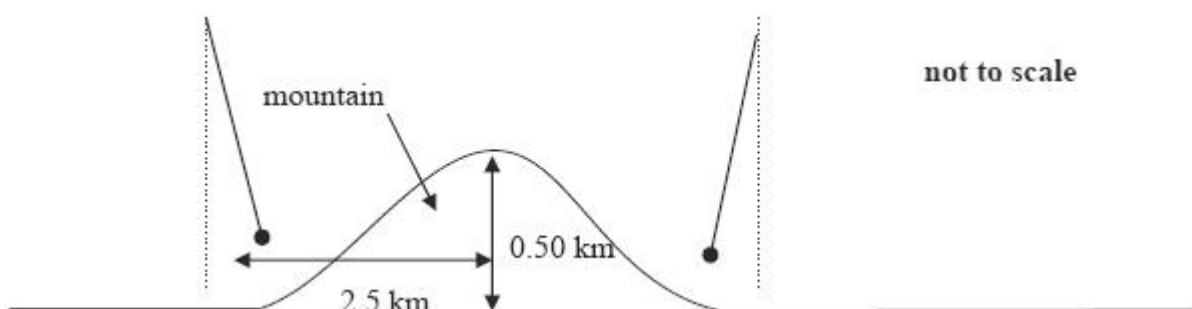
- (a) Give **two** examples of the techniques used by geologists to obtain values of the strength of the local gravitational field of the Earth. In each of your quoted examples, describe the information that the geologists can derive from their measurements.

(4)

In 1774, Nevil Maskelyne carried out an experiment near the mountain of Schiehallion in Scotland to determine the density of the Earth.

Figure 1 shows two positions of a pendulum hung near to, but on opposite sides of, the mountain. The centre of mass of the mountain is at the same height as the pendulum.

Figure 1



- (b) (i) Explain why the pendulums do not point towards the centre of the Earth.

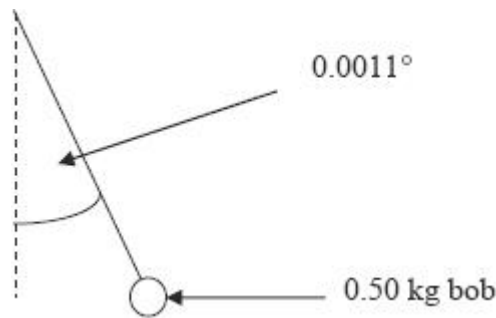
(2)

(ii) Suggest why Maskelyne carried out the experiment on both sides of the mountain.

(1)

(c) **Figure 2** shows measurements made with the left-hand pendulum in **Figure 1**.

Figure 2



(i) The mountain is in the appropriate shape of a cone 0.50 km high and 1.3 km base radius; it rises from a locally flat plain. Show that the mass of the mountain is about 2×10^{12} kg.

$$\text{volume of a cone} = \frac{1}{3} \pi r^2 h$$

$$\text{density of rock} = 2.5 \times 10^3 \text{ kg m}^{-3}$$

(3)

(ii) **Figure 2** shows the left-hand pendulum bob lying on a horizontal line that also passes through the centre of mass of the mountain. The bob is 1.4 km from the centre of the mountain and it hangs at an angle of 0.0011° to the vertical.

Calculate the mass of the Earth.

(3)

- (iii) The answer Maskelyne obtained for the mass of the Earth was lower than today's accepted value even though he had an accurate value for the Earth's radius.

Suggest **one** reason why this should be so.

(1)

(Total 14 marks)

Q2.

- (a) Explain what is meant by the *gravitational potential* at a point in a gravitational field.

(2)

- (b) Use the following data to calculate the gravitational potential at the surface of the Moon.

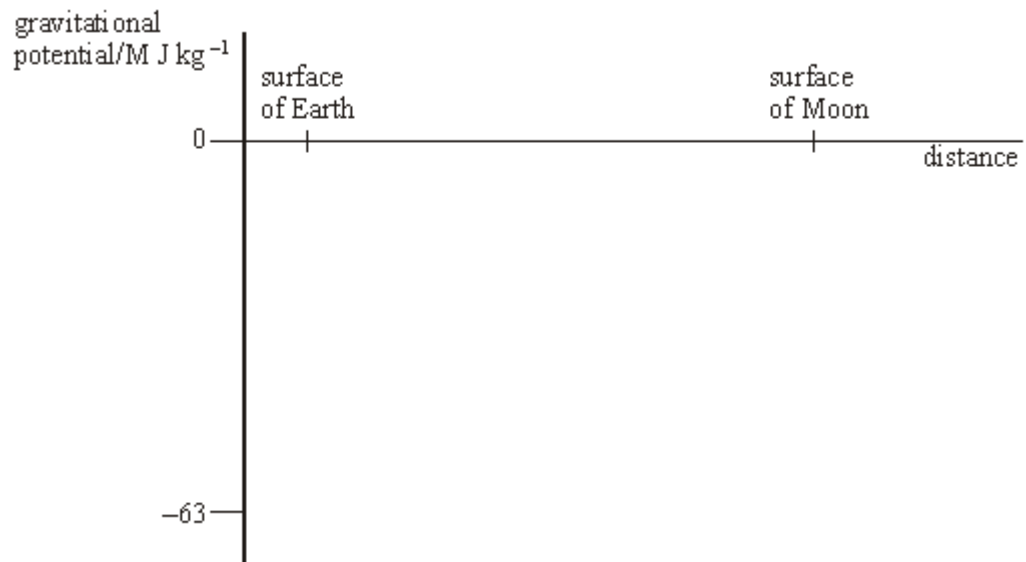
mass of Earth = 81 × mass of Moon

radius of Earth = 3.7 × radius of Moon

gravitational potential at surface of the Earth = -63 MJ kg^{-1}

(3)

- (c) Sketch a graph on the axes below to indicate how the gravitational potential varies with distance along a line outwards from the surface of the Earth to the surface of the Moon.



(3)
(Total 8 marks)