Oxford Cambridge and RSA

A Level Physics A

H556/01 Modelling physics

Question Set 13

1 (a) Phobos is one of the two moons orbiting Mars. Fig. 17.1 shows Phobos and Mars.

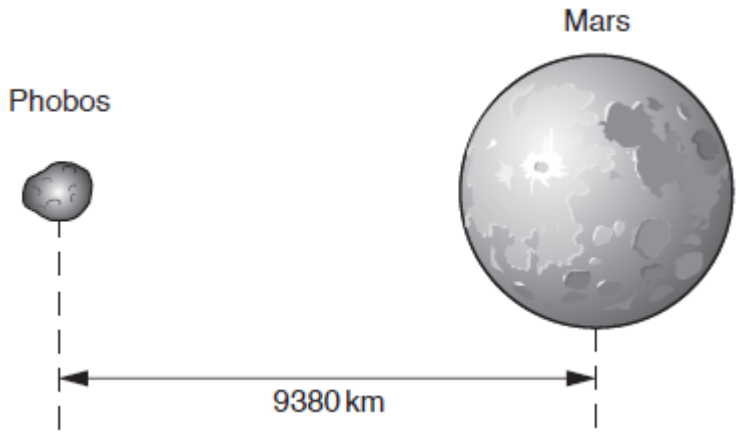

Fig. 17.1

The orbit of Phobos may be assumed to be a circle. The centre of Phobos is at a distance 9380 km from the centre of Mars and it has an orbital speed $2.14 \times 10^3\,\text{m s}^{-1}$.

(i) On Fig. 17.1, draw an arrow to show the direction of the force which keeps Phobos in its orbit. **[1]**

(ii) Calculate the orbital period T of Phobos.

T = ... s **[2]**

(iii) Calculate the mass M of Mars.

M = ... kg **[3]**

(b) The gravitational field strength at a distance r from the centre of Mars is g.

The table below shows some data on Mars.

g / N kg^{-1}	r / km	lg (g / N kg^{-1})	lg (r / km)
1.19	6000	0.076	3.78
0.87	7000		
0.67	8000	−0.174	3.90
0.53	9000	−0.276	3.95
0.43	10000	−0.367	4.00

(i) Complete the table by calculating the missing values. **[1]**

(ii) Fig. 17.2 shows the graph of lg (g/N kg^{-1}) against lg (r/km).

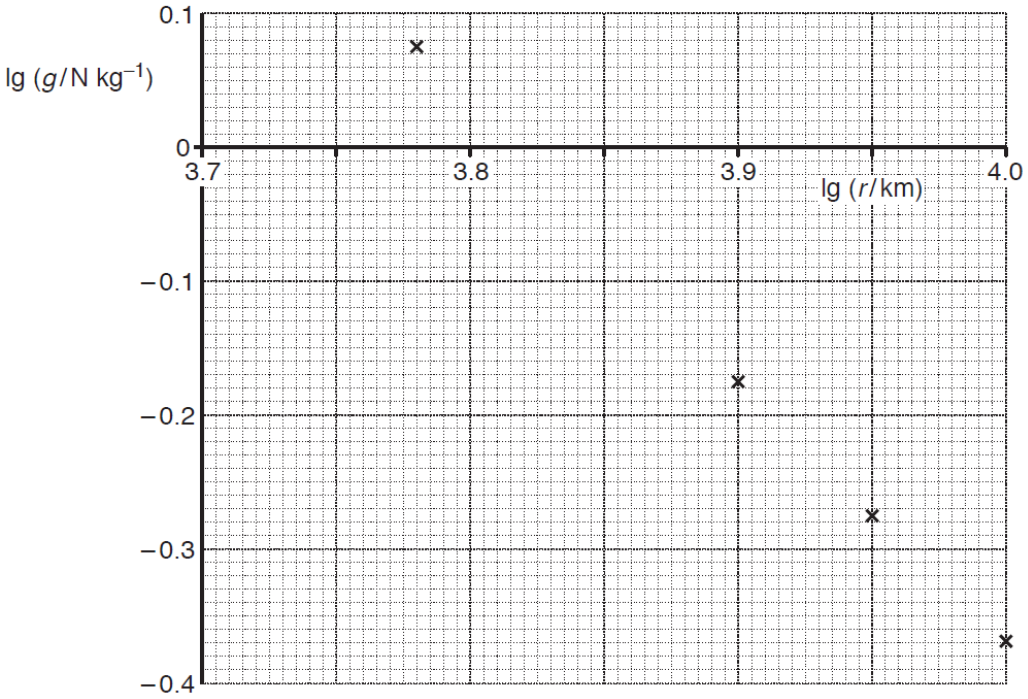

Fig. 17.2

1 Plot the missing data point on the graph and draw the straight line of best fit. **[2]**

2 Use Fig. 17.2 to show that the gradient of the straight line of best fit is −2. **[1]**

3 Explain why the gradient of the straight line of best fit is −2. **[2]**

(c) In July 2018, the closest distance between the centre of Mars and the centre of Earth will be 5.8 × 10^{10} m.
Fig. 17.3 shows the variation of the **resultant** gravitational field strength g between the two planets with distance r from the centre of the **Earth**.

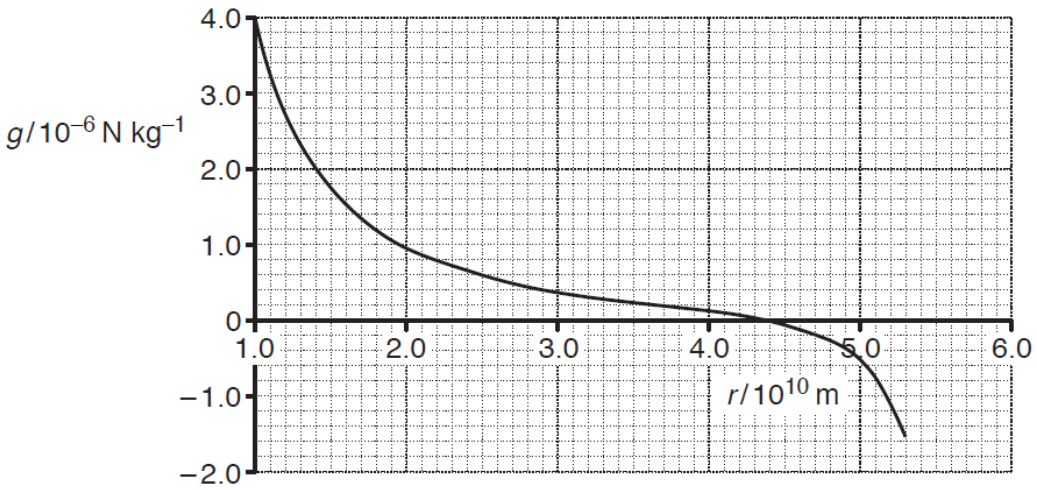

Fig. 17.3

(i) Explain briefly the overall shape of the graph in Fig. 17.3. **[2]**

(ii) Use the value of r when $g = 0$ from Fig. 17.3 to determine the ratio

$\dfrac{\text{mass of Earth}}{\text{mass of Mars}}$.

$\dfrac{\text{mass of Earth}}{\text{mass of Mars}}$ = ... **[2]**

Total Marks for Question Set 13: 16