

1 (a) Define gravitational potential at a point.

.....

 [2]

(b) Mars is a planet that may be considered to be an isolated uniform sphere of radius $3.4 \times 10^6 \text{ m}$.

A satellite of mass 122 kg is in orbit around Mars at a constant height of $1.7 \times 10^6 \text{ m}$ above the surface of the planet.

The height of the orbit is increased to $6.8 \times 10^6 \text{ m}$ above the surface. This increases the gravitational potential energy of the satellite by $5.1 \times 10^8 \text{ J}$.

(i) Show that the mass of Mars is $6.4 \times 10^{23} \text{ kg}$.

[3]

(ii) Calculate the gravitational potential ϕ at the surface of Mars. Give a unit with your answer.

$\phi = \dots\dots\dots$ unit $\dots\dots\dots$ [2]

(c) The satellite in (b) is moved to an orbit in which the satellite remains at the same point above the surface of Mars.

(i) The orbit has a period of 25 hours.

State what can be deduced from this about the rotation of Mars on its axis.

.....
 [1]

(ii) State **one** other feature of this orbit.

.....
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- 2 (a) The magnitude of the gravitational potential on the surface of a planet of radius R is ϕ . The planet can be considered to be an isolated sphere.

On Fig. 2.1, sketch the variation of the gravitational potential with distance x from the centre of the planet for values of x between R and $4R$.

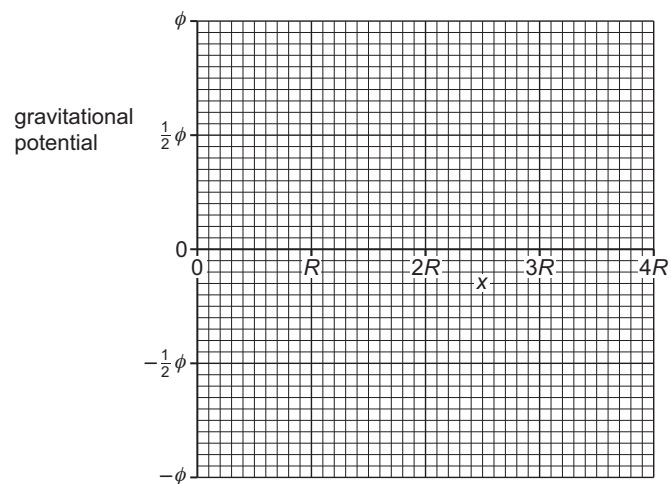


Fig. 2.1

[3]

- (b) A satellite is in a geostationary orbit above the Earth. At time $t = 0$, the magnitude of the gravitational potential due to the Earth at the location of the satellite is ϕ .

On Fig. 2.2, sketch the variation of the gravitational potential due to the Earth at the location of the satellite for values of t between $t = 0$ and $t = 24$ hours.

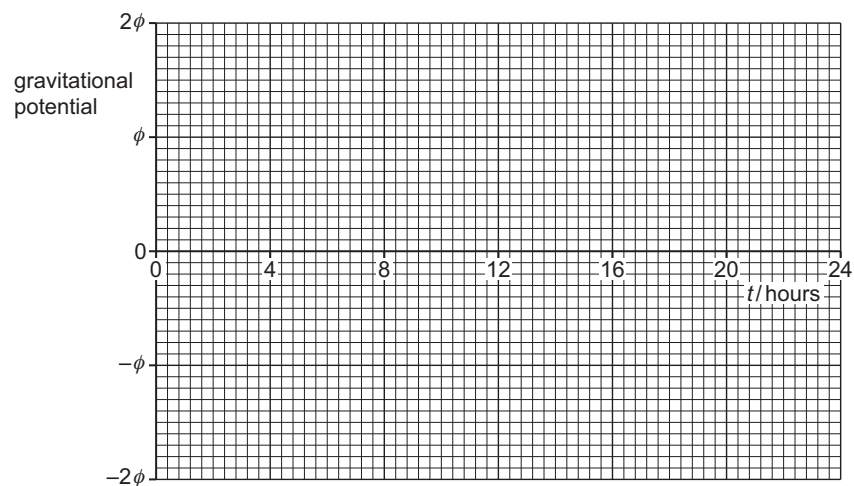


Fig. 2.2

[2]

- (c) The electric potential difference (p.d.) between two parallel plates is V , as shown in Fig. 2.3.

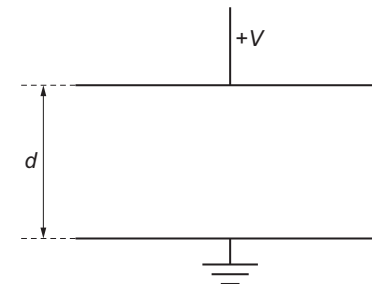


Fig. 2.3

The distance between the plates is d . The region between the plates is a vacuum.

On Fig. 2.4, sketch the variation of the electric potential with distance from the positive plate.

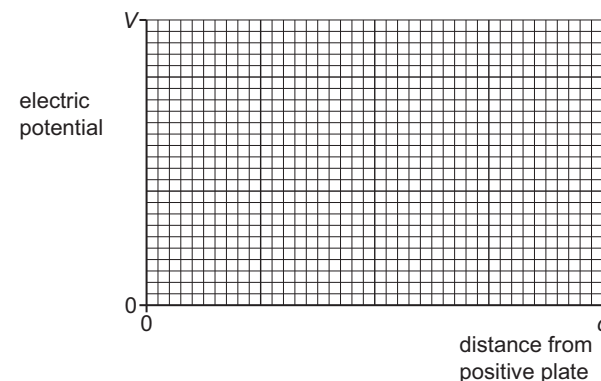


Fig. 2.4

[2]

[Total: 7]