

- 9 The variation with distance r of the electric potential V of a charged object is shown in Fig. 9.1.

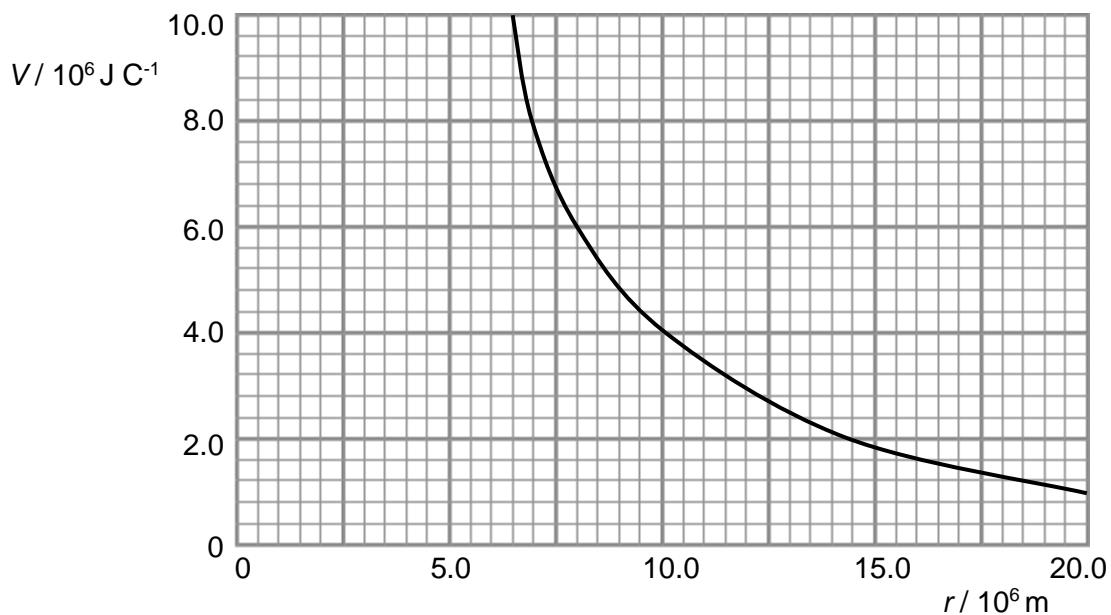


Fig. 9.1

- (a) The charged object is fixed in its position. A proton is initially at rest at $7.5 \times 10^6 \text{ m}$ from the centre of the charged object.

Determine its kinetic energy when it has moved a distance of $7.0 \times 10^6 \text{ m}$ away from the charged object.

kinetic energy = J [3]

- (b) On Fig. 9.2, draw a graph to show the variation with distance r of the electric field strength E for values of r from 7.5×10^6 m to 17.5×10^6 m.

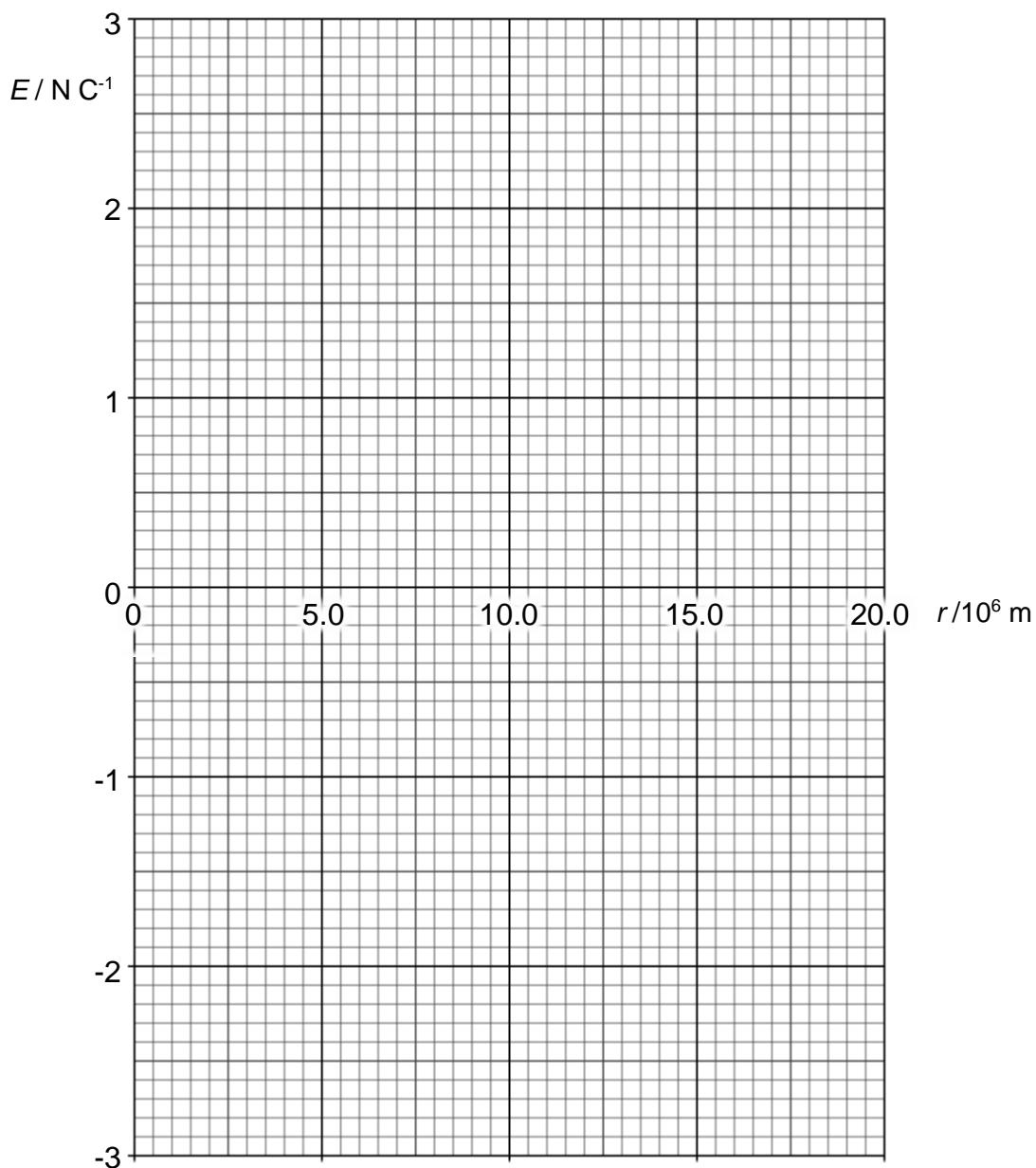


Fig. 9.2

[3]

- (c) A certain planet has a radius of 1150 km. Fig. 9.3 below shows the variation with the distance x from the centre of this planet, of the gravitational potential ϕ near it. The planet may be assumed to be isolated in space.

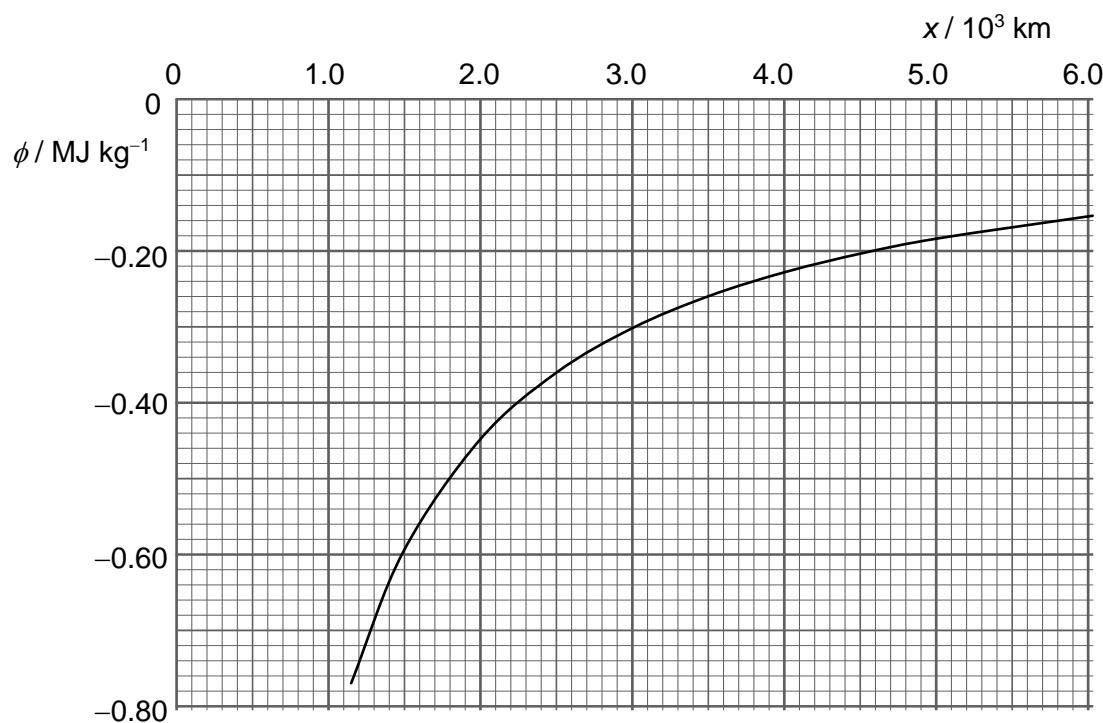


Fig. 9.3

- (i) Explain why gravitational potential has a negative value.

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 [2]

- (ii) Use Fig. 9.3 to determine the mass of the planet.

mass = kg [2]

- (iii) A moon of the planet has a circular orbit of radius 3.0×10^3 km. The period of its orbit is 3.44×10^4 s.

Calculate the centripetal acceleration of the moon.

centripetal acceleration = m s⁻² [2]

- (iv) Explain why the gravitational field strength at the position of the moon has the same magnitude and same direction as the centripetal acceleration of the moon.

[3]

[3]

- (v) The mass of the moon is 1.52×10^{21} kg.

Calculate the total energy of the moon.

total energy = J [3]

- (d) State and explain one similarity and one difference in the variations in the electric potential and gravitational potential shown in Fig. 9.1 and Fig. 9.3 respectively.

similarity:

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difference:

..... [2]

[Total: 20]

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