

Cheat Sheet

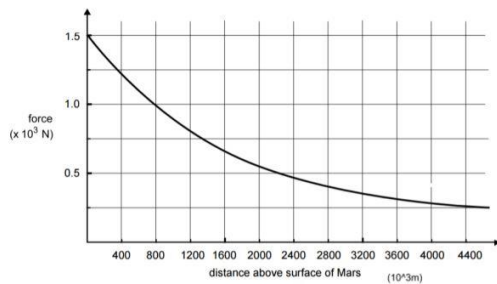
$$\frac{1}{2}mv\left(\frac{m}{s}\right)_f^2 - \frac{1}{2}mv\left(\frac{m}{s}\right)_i^2 = q\Delta V(V)$$

$$r(m) = \frac{m(kg)v\left(\frac{m}{s}\right)}{q(C)B(T)}$$

$$T(s) = 2\pi \sqrt{\frac{r(m)^3}{GM(kg) \text{ orbiting object}}}$$

$$v\left(\frac{m}{s}\right) = \sqrt{\frac{GM(kg)}{r(m)}}$$

Below is a graph of the force of gravitational attraction between the 400 kg spacecraft Odyssey and the planet Mars versus distance above the surface of Mars.



Before its orbit around Mars, Odyssey was originally launched from Earth and took 200 days to reach Mars. At a distance of 3 200 km away from the surface of Mars it was travelling at approximately 24 000 m s⁻¹. At this point it was speeding up due to the gravitational attraction of Mars.

Question 12.

(4 marks)

Calculate, the speed of Odyssey at a distance of 1200 km above the surface of Mars.

Between 3200 and 1200 on x axis there are approx 9 squares.

Each square has an area of $400 \times 10^3 \times 0.25 \times 10^3 = 1 \times 10^8$

Work done = $1 \times 10^8 \times 9 = 9 \times 10^8 J$

$W = \Delta E_k$

$E_{kf} = E_{ki} + W$

$E_{kf} = \frac{1}{2} \times 400 \times 24000^2 + 9 \times 10^8$

$\frac{1}{2} \times 400 v^2 = 1.04 \times 10^{17}$

$v = \sqrt{\frac{2 \times 1.04 \times 10^{17}}{400}}$

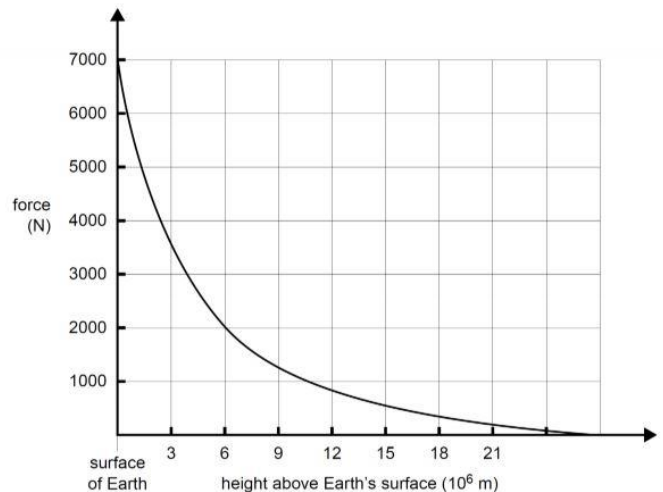
$v = 2.28 \times 10^7 m/s$

Define the function of the split ring commutator and explain how it enabled the coil to rotate continuously in the same direction.

1. Allows the coils to spin (without tangling wires) - OPTIONAL STATEMENT INCLUDED IN 4.
 2. Alternates the direction of the current through the coil every half period
 3. This changes the direction of the Forces every half period
 4. This allows the coil to spin continuously in the same direction or allows the Torque to be continuously applied
- For full marks must have 2,3,4

$$T^2 = 4\pi^2 r^3 / G M$$

10. A 700 kg asteroid is plunging towards the Earth. At 6,000 km altitude the asteroid is moving at 50 km/s. Using the graph below find the kinetic energy of the asteroid at the impact with our planet.



$E_{k \text{ Final}} = \Delta E_{pG} + E_{k \text{ Initial}}$

1 mark

$\Delta E_{pG} = \text{Area} = 8.7 \text{ squares} \times 1000 \times 3 \times 10^6 J = 2.61 \times 10^{10} J$

1 mark

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$E_{k \text{ Initial}} = \frac{700 \times 50000^2}{2} = 8.75 \times 10^{11} J$