

Solutions

Each answer shows the steps, then the **result**.

2.1

- Gravity

2.2

- It increases (lower orbits are faster)

2.3

- gravity supplies the centripetal force, $\frac{GMm}{r^2} = \frac{mv^2}{r}$, so $v = \sqrt{GM/r}$:

$$v = \sqrt{\frac{GM}{r}} = \sqrt{4.0 \times 10^7 \text{ m}^2 \text{ s}^{-2}}$$

- $v = \mathbf{6300 \text{ m s}^{-1}}$

2.4

- The same (mass cancels)

3.1 B

- the central mass and the orbital radius

3.2 B

- a larger orbit has a longer period

3.3

(a)

- B is slower (larger r gives smaller v)

(b)

- Kepler's third law, $T^2 \propto r^3$, with $r_B = 2r_A$:

$$\frac{T_B}{T_A} = \left(\frac{r_B}{r_A}\right)^{3/2} = 2^{3/2}$$

- $T_B \approx \mathbf{2.8 T_A}$

3.4

(a)

- gravity supplies the centripetal force, so $v = \sqrt{GM/r}$:

$$v = \sqrt{\frac{GM}{r}} = \sqrt{2.5 \times 10^7 \text{ m}^2 \text{ s}^{-2}}$$

- $v = \mathbf{5000 \text{ m s}^{-1}}$

(b)

- No – mass cancels, so the speed is unchanged