Solutions

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

2.1

- the gravitational force between two **point masses** is **proportional to the product of the masses**
- and **inversely proportional to the square of their separation**

2.2

- $G = 6.67 \times 10^{-11}\ \mathrm{N\ m^2\,kg^{-2}}$

2.3

- $F = Gm_1m_2/r^2$

$$F = \frac{(6.67 \times 10^{-11}\ \mathrm{N\ m^2\,kg^{-2}})(1000\ \mathrm{kg})(1000\ \mathrm{kg})}{(2.0\ \mathrm{m})^2} = \mathbf{1.67 \times 10^{-5}}\ \mathrm{N}$$

2.4

- any two: period of **24 h**; orbits **west to east**; stays **above the equator**; appears fixed over one point on Earth

3.1 C

- $F \propto 1/r^2$, so doubling r makes F **one quarter**
- **A** would be $1/r$; **B** is twice as far so half the force; **D** is four times larger

3.2

- $g = GM/R^2$

$$g = \frac{(6.67 \times 10^{-11}\ \mathrm{N\ m^2\,kg^{-2}})(6.0 \times 10^{24}\ \mathrm{kg})}{(6.4 \times 10^{6}\ \mathrm{m})^2} = \mathbf{9.8}\ \mathrm{N\ kg^{-1}}$$

3.3

- gravity provides the centripetal force: $GMm/r^2 = mv^2/r$
- $v = 2\pi r/T$

$$\frac{GM}{r^2} = \frac{4\pi^2 r}{T^2}$$

- $T^2 = 4\pi^2 r^3/(GM)$

3.4

- its orbital plane must contain the **Earth's centre**; only an equatorial orbit keeps it over a **fixed point** as the Earth spins