Solutions

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

2.1

- Mass is the amount of matter (kg), the same everywhere; weight is the gravitational force on it (N) and depends on the local field

2.2

$$F_W = mg = (50\text{ kg})(9.8\text{ m s}^{-2}) = \mathbf{490}\text{ N}$$

2.3

- $F_g = \dfrac{Gm_1m_2}{r^2}$, so $F_g \propto \dfrac{1}{r^2}$; tripling r multiplies F_g by $\dfrac{1}{3^2}$: it becomes $\frac{1}{9}$ as large

2.4

- mass = **2.0** kg (mass does not depend on location)

$$F_W = mg_{\text{Moon}} = (2.0\text{ kg})(1.6\text{ m s}^{-2}) = \mathbf{3.2}\text{ N}$$

2.5

- $g = \dfrac{F_g}{m} = \dfrac{36}{4.0} = \mathbf{9.0}\text{ N kg}^{-1}$

3.1 D

- is four times as large.

3.2 C

- both its mass and the local gravitational field.

3.3

(a)

- $g = \dfrac{GM}{R^2}$: doubling M at the same R doubles g, so the field is twice as strong

(b)

- mass = **10** kg (unchanged)

$$F_W = mg_{\text{planet}} = (10\text{ kg})(2 \times 9.8\text{ m s}^{-2}) = \mathbf{196}\text{ N}$$

3.4

(a)

- taking up as positive: $N - mg = ma$ with $a = -1.5\text{ m s}^{-2}$, so $N = m(g - 1.5)$
- $N = 50 \times 8.3 = \mathbf{415}$ N, less than the true weight 490 N

(b)

- at rest, or moving up or down at constant velocity ($a = 0$)

(c)

- the station and the astronauts fall together with the same acceleration; gravity is the only force on them, so there is no normal force and the apparent weight is zero

3.5 A

- inertial mass measures resistance to changes in motion; experiments show it equals gravitational mass