ANSWERS TO MULTIPLE CHOICE QUESTIONS

1. According to Newton's second law, *Force* = *mass* $\times$ *acceleration*. Thus, the units of *Force* must be the product of the units of *mass* (kg) and the units of *acceleration* (m/s^2). This yields, kg m/s^2, which is answer (a).

2. Both answers (d) and (e) could be physically meaningful. Answers (a), (b), and (c) must be meaningless since quantities can be added or subtracted only if they have the same dimensions.

3. Using a calculator to multiply the length by the width gives a raw answer of 6 783 m^2, but this answer must be rounded to contain the same number of significant figures as the least accurate factor in the product. The least accurate factor is the length, which contains either 2 or 3 significant figures, depending on whether the trailing zero is significant or is being used only to locate the decimal point. Assuming the length contains 3 significant figures, answer (c) correctly expresses the area as $6.78 \times 10^3\ m^2$. However, if the length contains only 2 significant figures, answer (d) gives the correct result as $6.8 \times 10^3\ m^2$.

4. The calculator gives an answer of 57.573 for the sum of the 4 given numbers. However, this sum must be rounded to 58 as given in answer (d) so the number of decimal places in the result is the same (zero) as the number of decimal places in the integer 15 (the term in the sum containing the smallest number of decimal places).

5. The required conversion is given by:

$$h = (2.00\ \cancel{m})\left(\frac{1\,000\ \cancel{mm}}{1.00\ \cancel{m}}\right)\left(\frac{1.00\ \text{cubitus}}{445\ \cancel{mm}}\right) = 4.49\ \text{cubiti}$$

This result corresponds to answer (c).

6. The given area (1 420 ft^2) contains 3 significant figures, assuming that the trailing zero is used only to locate the decimal point. The conversion of this value to square meters is given by:

$$A = \left(1.42 \times 10^2\ \text{ft}^2\right)\left(\frac{1.00\ \text{m}}{3.281\ \text{ft}}\right)^2 = 1.32 \times 10^2\ \text{m}^2 = 132\ \text{m}^2$$

Note that the result contains 3 significant figures, the same as the number of significant figures in the least accurate factor used in the calculation. This result matches answer (c).

7. The population of the Earth is approximately 6 billion people, including women and children. If we assume the average person has a mass of about 50 kg (i.e., weighs approximately 110 lbs at Earth's surface), the total mass of all the people living on Earth would be on the order of

$$m \sim (6 \times 10^9 \text{ peoples})(50 \text{ kg/person}) = 3 \times 10^{11} \text{ kg}$$

which agrees with answer (d).

8. The given Cartesian coordinates are $x = -5.00$, and $y = 12.00$, with the least accurate containing 3 significant figures. Note that the specified point is in the second quadrant. The conversion to polar coordinates is then given by:

$$r = \sqrt{x^2 + y^2} = \sqrt{(-5.00)^2 + (12.00)^2} = 13.0$$

$$\tan\theta = \frac{y}{x} = \frac{12.00}{-5.00} = -2.40 \quad \text{and} \quad \theta = \tan^{-1}(-2.40) = -67.3° + 180° = 113°$$

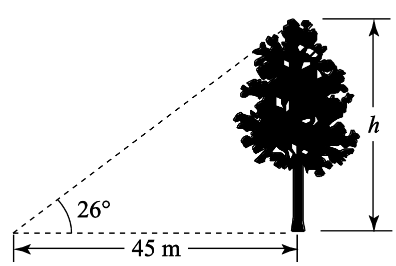
Note that 180° was added in the last step to yield a second quadrant angle. The correct answer is therefore (b).

9. The situation described is shown in the drawing at the right:

From this, observe that $\tan 26° = \dfrac{h}{45 \text{ m}}$, or

$$h = (45 \text{ m})\tan 26° = 22 \text{ m}$$

Thus, the correct answer is (a).



10. An adult at rest has a respiration rate that is on the order of 10 breaths/minute. The approximate number of breaths one would take over a period of 70 years is then

$$n \sim \left(10 \frac{\text{breaths}}{\cancel{\text{min}}}\right)(70 \cancel{\text{yr}})\left(\frac{3.156 \times 10^7 \cancel{\text{s}}}{1 \cancel{\text{yr}}}\right)\left(\frac{1 \cancel{\text{min}}}{60 \cancel{\text{s}}}\right) = 3 \times 10^8 \text{ breaths}$$

The correct answer is then seen to be (c).

11. Doing dimensional analysis on the first 4 given choices yields:

(a) $\dfrac{v}{\left[t^2\right]} = \dfrac{\mathrm{L/T}}{\mathrm{T}^2} = \dfrac{\mathrm{L}}{\mathrm{T}^3}$

(b) $\dfrac{v}{\left[x^2\right]} = \dfrac{\mathrm{L/T}}{\mathrm{L}^2} = \mathrm{L}^{-1}\,\mathrm{T}^{-1}$

(c) $\dfrac{\left[v^2\right]}{t} = \dfrac{\left(\mathrm{L/T}\right)^2}{\mathrm{T}} = \dfrac{\mathrm{L}^2/\mathrm{T}^2}{\mathrm{T}} = \dfrac{\mathrm{L}^2}{\mathrm{T}^3}$

(d) $\dfrac{\left[v^2\right]}{x} = \dfrac{\left(\mathrm{L/T}\right)^2}{\mathrm{L}} = \dfrac{\mathrm{L}^2/\mathrm{T}^2}{\mathrm{L}} = \dfrac{\mathrm{L}}{\mathrm{T}^2}$

Since acceleration has units of length divided by time squared, it is seen that the relation given in answer (d) is consistent with an expression yielding a value for acceleration.