Chapter 1 Measurements Notes Answers

Check Your Understanding 1

1. (a) $1 \text{ kmh}^{-1} = \frac{1000}{3600} \text{ m s}^{-1}$

   $2.98\times10^8 \text{ ms}^{-1} = 2.98\times10^8 \times \frac{3600}{1000} = 1.07\times10^9 \text{ km h}^{-1}$

   (b) $31\times10^{-3} = 3.1\times10^2$ A

   (c) 1 nm $=1\times10^{-9} m$

   $1 \text{ m} = 1\times10^9$ nm

   $4.5\times10^7 = 4.5\times10^7\times10^9$ nm $=4.5\times10^{16}$ nm

2. (a) unit of stress = $\frac{\text{units of force}}{\text{units of area}} = \frac{\text{units of mass}\times\text{acc}}{\text{units of area}} = \frac{kgms^{-2}}{m^2} = kgm^{-1}s^{-2}$

   unit of strain = $\frac{\text{unit of }\Delta\text{length}}{\text{length}} = \frac{m}{m}$ (unitless)

   unit of young's modulus = unit of stress = $kgm^{-1}s^{-2}$

   (b) unit of specific heat capacity =

   $\frac{\text{unit of Q (energy)}}{\text{units of mass}\times\text{temp}} = \frac{\text{units of force}\times\text{disp}}{kg\times K} = \frac{kgms^{-2}m}{kgK} = m^2s^{-2}K^{-1}$

3. $V = A + B = 50 + 12 = 62$

   $\Delta V = \Delta A + \Delta B = 1.1 = 1$ (1s.f)

   $V = (62\pm1)$ ml

4. $V = 50 - 25 = 25$

   $\Delta V = 1 + 0.5 = 1.5 = 2$ (1s.f)

   $V = (25\pm2) ml$

5. $1 \text{ g} = 1\times10^{-3}$ kg

   $1 \text{ cm} = 1\times10^{-2} m \rightarrow 1 \text{ cm}^{-3} = (1\times10^{-2})^{-3} = 1\times10^6 \text{ m}^{-3}$

   $13.6 \text{ gcm}^{-3} = 13.6\times10^{-3}\times10^6 = 1.36\times10^4 \text{ kgm}^{-3}$

6. units of Q = units of current $\times$ time = As

   unit of $\varepsilon_0 = \frac{(\text{unit of charge})^2}{\text{unit of force}\times(\text{unit of dist})^2} = \frac{A^2s^2}{kgms^{-2}m^2} = A^2kg^{-1}m^{-3}s^4$

7. $R = \frac{V}{I} = \frac{5.0}{2.0} = 2.5\ \Omega$

   $\frac{\Delta R}{R} = \frac{\Delta V}{V} + \frac{\Delta I}{I} = \frac{0.1}{5.0} + \frac{0.1}{2.0}$

   $\Delta R = 2.5\left(\frac{0.1}{5.0} + \frac{0.1}{2.0}\right) = 0.2$ (1s.f)

   $R = (2.5\pm0.2)\ \Omega$

Check Your Understanding 2

1. mass of 1 marble and 1 golf ball $=\frac{1}{6}(mass_{\text{6 marbles}})+\frac{1}{3}(mass_{\text{3 golf-balls}})=\frac{1}{6}(238)+\frac{1}{3}(179)=99$

   $\Delta m=\frac{1}{6}(5)+\frac{1}{3}(5)=3$ (1s.f.)
   $m=(99\pm 3)$ g

2. taking downwards as positive:
   $\Delta v=v_f-v_i=-8-10=-18$ (upwards)

3. (a) $\frac{1}{98},\frac{1}{858},\frac{1}{503}$

   (b) $\rho=\frac{m}{V}=\frac{m}{\pi r^2 L}=\frac{m}{\pi\left(\frac{d}{2}\right)^2 L}=\frac{4m}{\pi d^2 L}$

   $\frac{\Delta\rho}{\rho}=\frac{\Delta m}{m}+2\frac{\Delta d}{d}+\frac{\Delta L}{L}=0.0236$

   (c) $\Delta\rho=0.0236\rho=2\times 10^2\ \text{kgm}^{-3}$

4. (a) $d=\frac{1}{4}(Y-X)=\frac{1}{4}(5.0-1.0)=1.0$

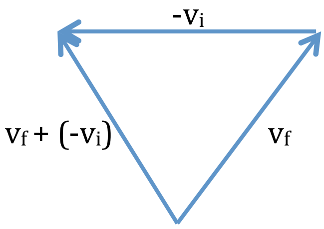
   $\Delta d=\frac{1}{4}(\Delta Y+\Delta X)=\frac{1}{4}(0.2+0.2)=0.1$ (1s.f.)
   $d=(1.0\pm 0.1)$ cm

   (b) $\frac{0.1}{1.0}\times 100\%=10\%$
   using more balls, or use a more precise instrument, e.g. micrometer screw gauge

5. (a) let d be a + b = 6.0
   $\Delta d=\Delta a+\Delta b=0.2$
   $Z=2(6.0)(6.5)=78$
   $\frac{\Delta Z}{Z}=\frac{\Delta d}{d}+\frac{\Delta c}{c}\rightarrow\Delta Z=78\left(\frac{0.2}{6.0}+\frac{0.1}{6.5}\right)=4$ (1s.f.)
   $Z=(78\pm 4)\ \text{cm}^2$

   (b) let d be a + b = 6.0
   $\Delta d=\Delta a+\Delta b=0.2$
   $W=9.39\times 10^{-4}\ \text{kg cm}^{-2}$
   $\frac{\Delta W}{W}=\frac{\Delta m}{m}+2\frac{\Delta d}{d}+\frac{\Delta c}{c}\rightarrow\Delta W=2\times 10^{-4}$ (1s.f.)
   $W=(9\pm 2)\times 10^{-4}\ \text{kg cm}^{-2}$

6. $\Delta v = v_f - v_i = v_f + (-v_i)$



Since the 3 vectors form a equilateral triangle, Δv = 15ms^{-1} at 120^{o} to Ox.