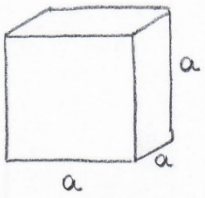
Open Book Quiz – Ch1 Measurements

(Duration: 30 minutes)

1. The side of a cube of metal is measured to be (1.60±0.05) cm and its mass is measured to be (30.1±0.4) g (a) Find the perimeter of one face of the cube with the uncertainty. (b) Find the volume and uncertainty in the volume. (c) Determine the density of the solid in kilograms per cubic meter and the uncertainty in the density.



$a = (1.60 \pm 0.05)\,cm = (1.60 \pm 0.05)\times10^{-2} m$ (3 sig fig)

$m = (30.1 \pm 0.4)\,g = (30.1 \pm 0.4)\times10^{-3} kg$ (3 sig figs)

a) $4a = 4(1.60 \pm 0.05)\times10^{-2} m = (6.40 \pm 0.20)\times10^{-2} m$ //

b) $V = a^3$ Raised to a power $C = A^n$, $\Delta C = C\,|n|\,\frac{\Delta A}{A}$

$C = a^3 \rightsquigarrow \Delta C = a^3\,|3|\,\frac{\Delta a}{a}$

$= (1.60\times10^{-2} m)^3$

$= 4.10\times10^{-6} m^3$

$4.10\times10^{-6}\,|3|\,\frac{0.05}{1.60}$

$0.38\times10^{-6} m^3$

$V = (4.10 \pm 0.38)\times10^{-6} m^3$ //

c) $\rho = \frac{m}{V}$

Multiplation/division $C = \frac{A}{B} \rightsquigarrow \Delta C = |C| \sqrt{\left(\frac{\Delta A}{A}\right)^2 + \left(\frac{\Delta B}{B}\right)^2}$

$\frac{30.1\times10^{-3} kg}{4.10\times10^{-6} m^3}$

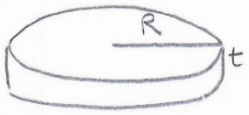
$7341\ kg/m^3$

$\left(\frac{30.1\times10^{-3} kg}{4.10\times10^{-6} m^3}\right) \sqrt{\left(\frac{0.38}{4.10}\right)^2 + \left(\frac{0.4}{30.1}\right)^2}$

$687\ kg/m^3$

$\rho = (7,34 \pm 0,69)\times10^3\ kg/m^3$ (3 sig figs)

2. A circular disk with a radius of (8.50 ±0.02) cm and a thickness of (0.050±0.005) cm. (a) Find the perimeter of the circle with the uncertainty. (b) Find the volume and the uncertainty in the volume.



$R = (8.50 \pm 0.02)\,cm = (8.50 \pm 0.02)\times10^{-2} m$ (3sf)

$t = (0.050 \pm 0.005)\,cm = (0.050 \pm 0.005)\times10^{-2} m$ (2sf)

a) $2\pi R = 2\pi(8.50 \pm 0.02)\times10^{-2}$

$= (53.4 \pm 0.1)\times10^{-2} m$ //

b) $V = (\pi R^2)\,t$

1st step : Raised to a power $C = A^n$, $\Delta C = C\,|n|\,\frac{\Delta A}{A}$

$C = R^2 \rightsquigarrow \Delta C = R^2\,|2|\,\frac{\Delta R}{R} = \left(8.50\times10^{-2}\,m\right)^2 |2|\,\frac{0.02}{8.50}$

$= (8.50\times10^{-2} m)^2$ $= 0.34\times10^{-4} m^2$

$= 7.23\times10^{-3} m^2$.

$\Rightarrow (7.23\times10^{-3} \pm 0.34\times10^{-4})\,m^2$.

2nd step : Multiplation with a scalar $\pi R^2 = 22.7\times10^{-3} \pm 1.07$

$\pi R^2 = (22.7\times10^{-3} \pm 1.07\times10^{-4})\,m^2$.

3rd step : Multiplation/Division

$C = AB \rightsquigarrow \Delta C = |C|\sqrt{\left(\frac{\Delta A}{A}\right)^2 + \left(\frac{\Delta B}{B}\right)^2}$

$= (22.7\times10^{-3} m^2)(0.05\times10^{-2} m)$

$= 1.14\times10^{-5} m^3$

$= |1.14\times10^{-5} m^3|\sqrt{\left(\frac{1.07\times10^{-4}}{22.7\times10^{-3}}\right)^2 + \left(\frac{0.005}{0.05}\right)^2}$

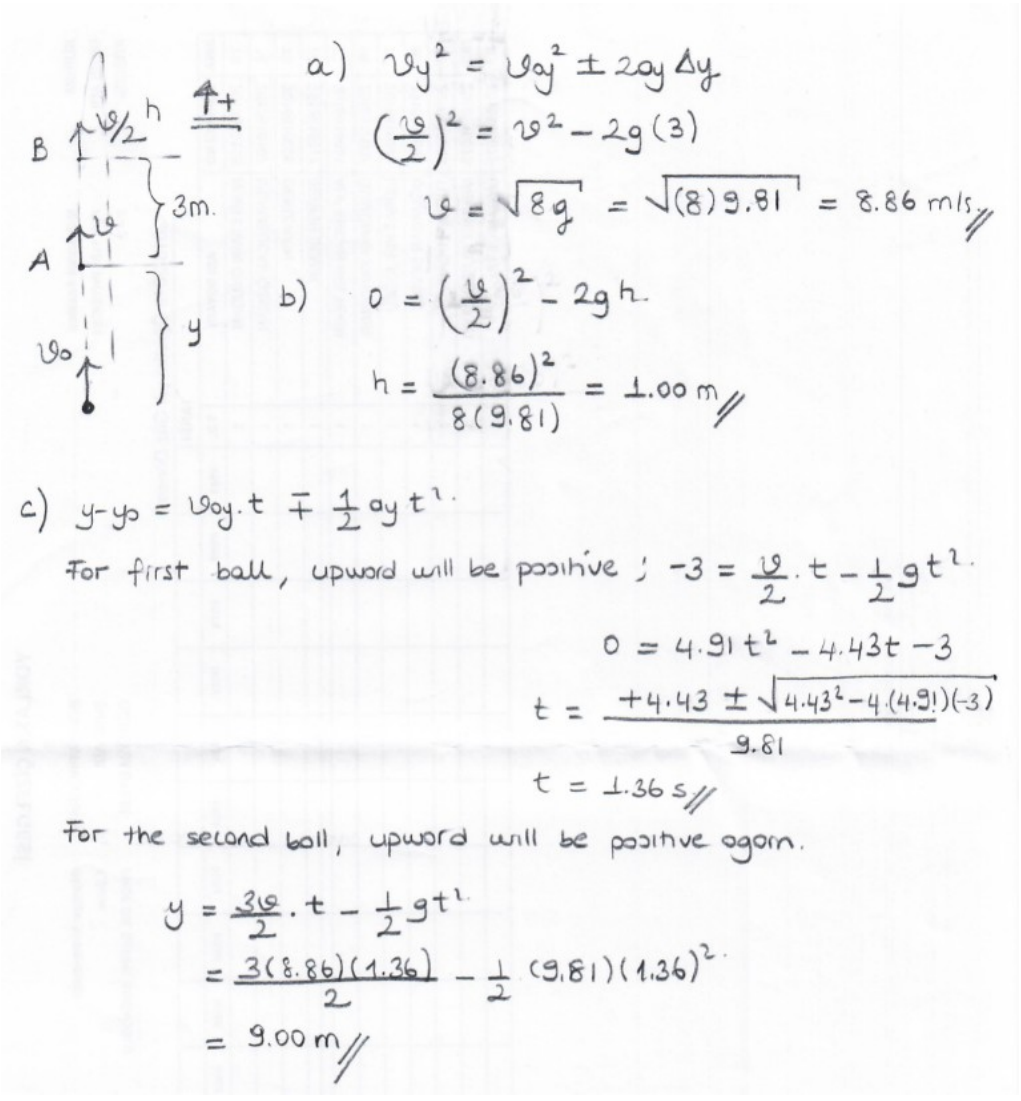
$= 1.14\times10^{-6} m^3$

$\boxed{V = (1.1 \pm 0.1)\times10^{-5} m^3}$ (2 sig figs)

Open Book Quiz – Ch2 Motion Along a Straight Line

(Duration: 30 minutes)

1. A stone is thrown vertically upward. On its way up it passes point A with speed v, and point B, 3.00 m higher than A, with speed $\frac{1}{2}v$. Calculate (a) the speed v, (b) the maximum height reached by the stone above point B. At the instant when the first ball is at point B, second ball is thrown upward with two-thirds the initial velocity from the ground. (c) How long after the second ball is thrown does it take if the two balls are to meet at the point A. (d) What is the height of the point A above the ground if the two balls are to meet at the point A.



a) $v_y^2 = v_{oy}^2 \pm 2a_y \Delta y$

$\left(\frac{v}{2}\right)^2 = v^2 - 2g(3)$

$v = \sqrt{8g} = \sqrt{(8)9.81} = 8.86 \text{ m/s}$ //

b) $0 = \left(\frac{v}{2}\right)^2 - 2gh$

$h = \frac{(8.86)^2}{8(9.81)} = 1.00 \text{ m}$ //

c) $y - y_0 = v_{oy} \cdot t \mp \frac{1}{2} a_y t^2$

For first ball, upward will be positive ; $-3 = \frac{v}{2} \cdot t - \frac{1}{2} g t^2$

$0 = 4.91 t^2 - 4.43t - 3$

$t = \frac{+4.43 \pm \sqrt{4.43^2 - 4(4.91)(-3)}}{9.81}$

$t = 1.36 \text{ s}$ //

For the second ball, upward will be positive again.

$y = \frac{3v}{2} \cdot t - \frac{1}{2} g t^2$

$= \frac{3(8.86)(1.36)}{2} - \frac{1}{2}(9.81)(1.36)^2$

$= 9.00 \text{ m}$ //

2. A juggler performs in a room whose ceiling is 3.00 m above the level of his hands. He throws a ball upward so that it just reaches the ceiling. (a) What is the initial velocity of the ball? (b)What is the time required for the ball to reach the ceiling? At the instant when the first ball is at ceiling, the juggler throws a second ball upward with two-thirds the initial velocity. (c) How long after the second ball is thrown did the two balls pass each other? (d) At what distance above the juggler's hand do they pass each other?