

ERROR ANALYSIS PROBLEMS - ANSWERS

1. :

$$\begin{aligned}\Delta h &= 75\text{cm} \pm 0.5\text{cm} \\ &= 0.75\text{m} \pm 5 \times 10^{-3}\text{m} \\ g &= 9.8\text{m/s}^2 \pm 0.05\text{m/s}^2 \\ m &= 255\text{g} \pm 0.5\text{g} \\ &= 0.255\text{kg} \pm 5 \times 10^{-4}\text{kg}\end{aligned}$$

$$\begin{aligned}E &= mg \Delta h \\ &= (0.255\text{kg})(9.8\text{m/s}^2)(0.75\text{m}) \\ &= 1.87425\text{J} \\ &= 1.9\text{J}\end{aligned}$$

we 5

$$\% \text{ Error } \Delta h = \frac{5 \times 10^{-3}}{0.75\text{m}} \times 100\% = 0.67\% \quad \text{0.67\%}$$

$$\% \text{ Error } g = \frac{0.05\text{m/s}^2}{9.8\text{m/s}^2} \times 100\% = 0.51\%$$

$$\% \text{ Error } m = \frac{5 \times 10^{-4}\text{kg}}{0.255\text{kg}} \times 100\% = 0.22\%$$

$$\begin{aligned}\% \text{ Error } E &= 0.67 + 0.51 + 0.22 \\ &= 1.4\%\end{aligned}$$

$$\therefore E = 1.9\text{J} \pm 1.4\% \quad \text{OR} \quad E = 1.9\text{J} \pm 0.03\text{J}$$

$$2. \Delta d = 153\text{m} \pm 1\text{m}$$

$$\Delta t = 0.95\text{s} \pm 0.05\text{s}$$

But, the echo travels from the source, to the surface and back in 0.95s, $\therefore \Delta d = 2(153\text{m}) = 306\text{m}$

$$v = \frac{\Delta d}{\Delta t}$$

$$= \frac{306\text{m}}{0.95\text{s}}$$

$$= 322\text{ m/s}$$

$$= 320\text{ m/s}$$

$$\% \text{ error } \Delta t = \frac{0.05\text{s}}{0.95\text{s}} \times 100\% = 5.32$$

$$\% \text{ error } \Delta d = \frac{1\text{m}}{153\text{m}} \times 100\% = 0.65\%$$

$$\% \text{ error } v = 5.3 + 0.65 = 5.952 \\ = 6\%$$

$$\therefore v = 320\text{ m/s} \pm 6\% \quad \underline{\text{OR}} \quad v = 320\text{ m/s} \pm 20\text{ m/s}$$

$$3. \text{Exp} = 320\text{ m/s} \\ \text{Acc} = 340\text{ m/s}$$

$$\% \text{ Accuracy} = \frac{\text{Exp} - \text{Acc}}{\text{Acc}} \times 100\% \\ = -5.88\%$$

\therefore the percent accuracy is -5.88%

$$4. \% \text{ Difference} = \frac{\text{Value 1} - \text{Value 2}}{\text{Average}} \times 100\%$$

$$= 0.34490\%$$

5. ① Mean $\frac{25+27+24+22+25+26+25}{7} = 24.8 \text{ beats/10s}$

② Deviations $0.2, 2.2, -0.8, -2.8, 0.2, 1.2, 0.2$

③ Mean Deviation $\frac{0.2+2.2+0.8+2.8+0.2+1.2+0.2}{7}$
 $= 1.08$

④ % Deviation from Mean = $\frac{\text{Mean Deviation}}{\text{Mean}} \times 100\%$

$$= \frac{1.08}{24.8} \times 100\%$$

$$= 4.4\%$$