Practical 1: INTRODUCTORY EXPERIMENT

Measurements and Experimental Data

Aims and Objectives of the Introductory Experiment;

i. To know how to present measurement
ii. To know how to analyze data
iii. To be able to evaluate error inherent in your data
iv. To be able to state the limitations or uncertainties in your result

EXERCISES

1. A student of physics measured the dimensions of a metal bar as 12.2cm× 2.3cm× 0.94cm. The student calculated the volume of the bar and recorded it as 26.36cm^3. Is this correct value for the measured volume? State the correct value.
2. What effect will an increase in temperature from 25 $^{\circ}$C to 32 $^{\circ}$C of the metal meter stick have on the measurement of the dimension of a rectangular block? Why are corrections not usually necessary for this effect?
3. The number of significant figures in a measurement given as 1.38×10^8 are_____ (a)2 (b)3 (c)8 (d)10
4. The number of significant figures in a measurement given as 0.0036m is (a)2 (b)3 (c)4 (d)5
5. The four side of a trapezium are measured to be 15.0m, 10.36m, 20.2m and 121.34m. Find the best value for the perimeter of the trapezium form this measurement.
6. A cylinder has a measurement radius of 10.1cm and height of 13.02cm if $\pi = 3.1416$. Find the best value for the volume of the cylinder.
7. Express as power of ten the following (a)0.00032 (b)255000000
8. Express as decimal; 2.24×10^4
9. Find the sum and difference; (a)$2.0\times 10^3+3.21\times 10^4$ (b)$4.9\times10^3-2.1\times10^2$
10. In an experiment the tension of a vibrating string was kept constant while its length was varied so as to tune the string to a series of the vibrating turning forks. A student obtained the following result.

Frequency, f (Hz)	Length, L (cm)
256	78.1
288	69.8
320	62.5
384	52.1
512	39.2

a) Draw a graph for the set of the observation and fit the "best" straight line to them.
b) Find the slope and the intercept of the graph.
c) Find the relationship between the frequency (f) of the vibration and the length (L) of the stretched string.
d) What is the frequency of an unmarked fork which was in tune with 14.8cm of string?

11. An object was projected vertically upward and its height to the ground was measured and recorded at various times as shown in the table below.

Times (sec)	0	1	2	3	4	5	6
Height (m)	0.0	35.1	60.0	75.3	75.2	60.1	35.0

a) Plot a graph of height against time and draw a smooth curve through the points plotted
b) What is the maximum height and the time taken to reach this height?

ANSWERS

1. **Note;** volume = $l \times b \times h = 12.2cm \times 2.3cm \times 0.94cm = 26.376cm^3$
The answer given to be $26.36cm^2$ is not correct because , the rule for significant digits (multiplication and division) states that the product or quotient of two numbers have the same number of significant digits as the number with the least significant digits.
The correct value should be **$26cm^3$**.

2. (i) Increase in the temperature of the metal metre stick will alter the dimension of the rectangular block which will happen as a result of linear expansion of the metre stick. (ii) Corrections are not usually made because as the metal metre stick cools down and the temperature gets back to normal, the dimension also returns to normal.

3. Considering 1.38×10^8, the significant figure is **3.**

4. Considering 0.0036, the significant figure is **2**.

5. Perimeter = 15.0m + 10.36m + 20.2m + 121.34m = 166.9m

NB: *The rule for significant digits (Addition and Subtraction) state that the sum or difference of two numbers carries the same number of significant digits to the right of the decimal point as the number with the least significant digits to the right of the decimal point.*

Hence, the best value for the perimeter of the trapezium is **167m**

6. Recall; volume of a cylinder = $\pi r^2 h$

   $V = 3.142 \times 10.1^2 \times 13.02$

   $V = 4172.5795 cm^3$

The best value for the measurement is $4.17 \times \mathbf{10^3\ cm^3}$ (3 s. f)

7. Power of ten means standard form

a. $0.00032 = \mathbf{3.2 \times 10^{-4}}$

b. $255{,}000{,}000 = \mathbf{2.55 \times 10^8}$

8. $2.24x10^4$ to decimal is **22400.0**

9. (a) $2.0x10^3 + 3.21x10^4$

   $= 34100 = \mathbf{3.4x10^4}$

   (b) $4.9x10^3 - 2.1x10^2$

   $= 4690 = \mathbf{4.7x10^3}$

10. (a) The graph is plotted as **frequency (f) against length (l)**

(b) Should be determined from the graph

(c) $f \propto \frac{1}{l}$

(d) Using ; $f = \frac{1}{2\pi}\sqrt{\frac{g}{l}} = \frac{1}{2\pi}\sqrt{\frac{9.8}{14.8x10^{-2}}}$

$=1.296$

$\approx$ **1. 3Hz**

11. I strongly believe that you can **plot a graph of height against time** and do the rest, they are very simple.

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