1.2 - Errors

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- (2000) What is an error? Mention two causes of systematic and two causes of random errors.
- (2000) The pressure P is calculated from the relation $P = F/(\pi R^2)$ where F is the force and R the radius. If the percentage possible errors are $+2\%$ for F and $+1\%$ for R . Calculate the possible percentage error for P .
- (2007) What is systematic error?
- (2007) The smallest divisions for the voltmeter and ammeter are 0.1 V and 0.01 A respectively. If $V = IR$, find the relative error in the resistance R , when $V = 2$ V and $I = 0.1$ A.
- (2010) Define an error.
- (2010) In an experiment to determine the acceleration due to gravity g , a small ball bearing is timed while falling freely from rest through a measured vertical height. The following data were obtained: vertical height $h = (600 \pm 1)$ mm, time taken $t = (350 \pm 1)$ ms. Calculate the numerical value of g from the experimental data, clearly specify the errors.
- (2013) What is the difference between degree of accuracy and precision.
- (2013) In an experiment to determine Young's modulus of a wooden material the following measurements were recorded:
  - length $l = 80.0 \pm 0.05$ cm
  - breadth $b = 28.65 \pm 0.03$ mm
  - thickness $t = 6.40 \pm 0.03$ mm and
  - slope $G = 0.035 \pm 0.001$ cm/gm
  - Given that the Youngs modulus Y is given by:
  - $Y = (4/Gb)(l/t)^3$
  - Calculate the maximum percentage error in the value of Y .
- (2014) Distinguish random error from systematic error.
  - Give a practical example of random error and systematic error and briefly explain how they can be reduced or eliminated.
- (2014) Define the terms error and mistake.

- (2014) An experiment was done to find the acceleration due to gravity by using the formula: $T = 2\pi\sqrt{l/g}$, where all symbols carry their usual meaning. If the clock losses 3 seconds in 5 minutes, determine the error in measuring g given that, $T = 2.22$ sec, $l = 121.6$ cm, $\Delta T_1 = 0.1$ sec, and $\Delta l = \pm 0.05$.
- (2014) The following measurements were taken by a student fort he length of a piece of rod: 21.02 , 20.99 , 20.92 , 21.11 and 20.69 . Basing on error analysis find the true value at the length of a piece of rod and its associated error.
- (2015) What is meant by random errors?
  - Briefly explain two causes of random errors in measurements.
- (2015) The period T of oscillation of a body is said to be 1.5 ± 0.002 s while its amplitude A is 0.3 ± 0.005 m and the radius of gyration k is $0.28 + 0.004$ m. If the acceleration due
  - to gravity g was found to be related to T , A and k by the equation $(gA)/(4\pi^2) = (A^2 + k^2)/T^2$, find the:
  - Numerical value of g in four decimal places
  - Percentage error in g .
- (2016) The period of oscillation of a simple pendulum is given by $T = 2\pi\sqrt{l/g}$ where by 100 vibrations were taken to measure 200 seconds. If the least count for the time and length of a pendulum of 1 m are 0.1 sec and 1 mm respectively, calculate the maximum percentage error in the measurement of g .
- (2017) Give the meaning of the following terms as used in error analysis:
  - Absolute error.
  - Relative error.
- (2017) The force F acting on an object of mass m , travelling at velocity v in a circle of radius r is given by: $F = \frac{mv^2}{r}$ If the measurements are recorded as: $m = (3.5 \pm 0.1)$ kg, $V = (20 \pm 1)$ m/s, $r = (12.5 \pm 0.5)m$; find the maximum possible
  - Fractional error.
  - Percentage error in the measurement of force.
  - Show how you will record the reading of force, F in the question above.
- (2018) How can random and Systematic errors be minimized during an experiment?
- (2018) Estimate the precision to which the Youngs modulus, γ of the wire can be determined from the formula $\gamma = (4Fl)/(\pi d^2 e)$, given that the applied tension, $F = 500$ N, the length of the loaded wire, $l = 3$ m, the diameter of the wire, $d = 1$ mm, the extension of the wire, $e = 5$ mm and the errors associated with these quantities are 0.5 N, 2 mm, 0.01 mm and 0.1 mm respectively.
- (2019) What causes systematic errors in an experiment? Give four points.
- (2019) Estimate the numerical value of drag force $D = 1/2C\rho AV^2$ with its associated error given that the measurements of the quantities C , A , ρ and v were recorded as (10 ± 0.00) unit less (5 ± 0.2) cm^2 , (15 ± 0.15) g/cm^3 and (3 ± 0.5) cm/sec^2 respectively.