A Level H2 Physics Tutorial 1: Measurement

Syllabus :
(a) Recall the following base quantities and their SI units mass (kg), length (m), time (s), current (A), temperature (K), amount of substance (mol).

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1. Express the following in terms of their SI units :

(i) 1 Mg
(ii) 2 Gm
(iii) 3 ms
(iv) 4 kA
(v) 5 cmol
(vi) 6 nK

(b) Express derived units as products or quotients of the base units, listed un 'Summaryof Key Quantities, Symbols and Units' as appropriate.

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2. Express the following in terms of their base units.

(i) N
(ii) J
(iii) Pa
(iv) Hz
(v) C
(vi) V

(c) Use SI base units to check the homogeneity of physical equations.

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3. By checking homogeneity of units in the equations below, determine which one(s) are definitely wrong.

(i) $E = ½ mv$, where E = energy, m = mass, v = velocity.
(ii) $P = \rho gh^2$, where P = pressure, r = density, h = depth.
(iii) p = mgv, whre p = power, g = acceleration, v = velocity.

(d) show an understanding of and use the conventions for labelling graph axes and table columns as set out in the ASE publication Signs, symbols and systematics: the ASE companion to 16-19 science (2000)

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4. Given this data relating force F and velocity v of a boat :

F (N)	25	53	96	150	217
v (m/s)	2.0	3.0	4.0	5.0	6.0

make a table and sketch a graph of F against v.

(e) use the following prefixes and their symbols to indicate decimal sub-multiples or multiples of both base and derived units: pico (p), nano (n), micro (μ), milli (m), centi (c), deci (d), kilo (k), mega (M), giga (G), tera (T)

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5. Write the following in more compact form using prefixes with the SI units, so that the numerical value is between 1 and less than 10.

(i) 0.000000007 m
(ii) 3700000000 Hz
(iii) 5200000 Ω
(iv) 0.000006 g

(f) make reasonable estimates of physical quantities included within the syllabus

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6. State the order of magnitude of the following in powers of 10.

(i) thickness of human hair
(ii) height of an adult
(iii) diameter of hydrogen atom
(iv) diameter of a proton

(g) distinguish between scalar and vector quantities, and give examples of each

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7. (a) Give 2 examples of scalar quantities.
(b) Give 2 examples of vector quantities.
(c) What is the difference between a scalar and a vector quantity?

(h) add and subtract coplanar vectors

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8. A cow pulls a cart towards the East with a 400 N force. At the same time, a horse pulls it towards the north with a 300 N force. Find the resultant magnitude and direction of the force.

(i) represent a vector as two perpendicular components

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9. A stone is thrown horizontally with velocity 3 m/s. As it falls, it picks up speed in the vertical direction. After a short while, it has a vertical velocity component of 4 m/s. Find the resultant velocity at this point in time. Neglect air resistance.

(j) show an understanding of the distinction between systematic errors (including zero error) and random errors

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10.

(a) Every time I use my ruler to measure something, the reading is bigger by 0.5 cm. What kind of error is this?

(b) I measured the same bunch of chicken feathers on a weighing three times, and got three slightly different readings. What kind of error is this?

(k) show an understanding of the distinction between precision and accuracy

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11. Tom and Jerry each used a ruler to measure the height of a piece of cake. The actual height is 10 cm. Tom got the readings 10.5, 10.4 and 10.6 cm. Jerry had a harder time holding the rule, but he did his best and got 9.2 cm, 10.4 cm and 10.7 cm. Tom laughed at the big differences in values.

Whose reading is more precise? Whose is more accurate.

(l) assess the uncertainty in a derived quantity by addition of actual, fractional, percentage uncertainties or by numerical substitution (a rigorous statistical treatment is not required).

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12. A box has dimenions 50 cm x 40 cm x 30 cm. The error of each of these numbers is 0.2 mm. Calculate its volume and find the percentage error.

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