Measurement and Mathematics

Estimation: 1 kg = 2.2 lbs 1 apple = 1 N 1 quarter = 5 g = 0.005 kg

Order of magnitude: power of ten (thickness of paper = 10^{-4} m)

Fui	ıdam	enta	l un	its

Quantity	Units	Symbol
Length	meter	m
Mass	kilogram	kg
Time	second	S
Electric current	ampere	А
	e	

experimental - actual

%error

x 100

Fundamental Units: There are only 7 (see table). All other units are derived units.

Factor-Label Conversions: "1 goes with the prefix, exponent goes with the base."

Mean = average Range = highest value – lowest value

Measured Uncertainties: use 1 sig fig and match decimal place of measurement eg.- 2.0 cm ±0.1 cm (exception: extreme variability)

Calculated Uncertainties for multiple trials: use greatest residual of data and match decimal place of measurement

Accuracy: how close a measurement is to the accepted value (a measure of correctness)

Precision: agreement among a number of measurements made in the same way (a measure of exactness)

Systematic Error: all measurements off by same amount – non-zero y-intercept – can be eliminated – measure of accuracy

Random Uncertainty: unpredictable variations in data – the reason for error bars on graph – can be reduced by multiple trials but never eliminated – measure of precision

General Relationships:



	Force (weight, normal force, etc.)	hyp
Anything else!	Momentum Impulse	$\tan \theta = \frac{opp}{adi}$
	Fields (gravitational, electric, magnetic)	

HONORS

Vectors

".

Mechanics



Forces are the same but the effects of the forces are not: mA = Ma



Electricity

Conductors (metals) have free electrons, insulators do not.

Objects become charged by losing or gaining electrons (not protons).

Elementary Charge: proton or electron

1 Coulomb of charge = 6.25×10^{18} elementary charges

Charge of Electron: q = -1e OR $q = -1.60 \times 10^{-19} \text{ C}$ Mass of Electron: $m = 9.11 \times 10^{-31} \text{ kg}$

Charge of Proton: q = +1e OR $q = +1.60 \times 10^{-19} \text{ C}$ Mass of Proton: $m = 1.67 \times 10^{-27} \text{ kg}$

If two or more identical charged spheres touch, the final charge on each is the **average** charge (total charge/# of spheres). The total charge is conserved.

A neutral object will be attracted (never repelled) by any charged object. If two objects attract, they could have opposite charges or one could be neutral. If two objects repel, they must have the same type of charge.

Charging by conduction: direct contact - electroscope gets same charge as rod Charging by induction: no direct contact - electroscope gets charge opposite of rod

Electric potential difference (voltage): work done per unit charge (V = W/q)

Resistance of a wire: $R = \rho L/A$ where $A = \pi r^2$ Least resistance (best conductor): short, fat, cold Most resistance (worst conductor): long, hot, skinny

Voltmeter: connect in parallel, infinite internal resistance

Ammeter: connect in series, zero internal resistance







Control: current

Resistance adds up (greater than greatest)

Adding extra resistor increases total resistance and decreases total current.

Parallel Circuit



Control: voltage

Resistance adds down (less than least)

Adding extra resistor decreases total resistance and increases total current.



Lines go from + to -. Lines never cross. Lines show direction of force on small positive test charge. Field is most intense where field lines are most dense.





Single Positive (Point) Charge





Two Unlike Equal Charges

Two Like Equal Charges

Two Parallel Plates (Capacitor)

Uniform electric field between plates = same E everywhere and same F everywhere

Used to store electric charge









PQV''RP 'TGI GPVU



Heat (Thermal energy)

Photoelectric Effect

Incoming photon (if high enough energy = frequency above threshold frequency) ejects electron – some energy needed to release electron (work function) – remaining energy is kinetic energy

Increasing frequency of light = increasi p =g KE of electrons

Increasing intensity of light = increasing number of electrons mv

Photoelectric effect graphs: Slope = Planck's constant Y- intercept = -work function X-intercept = threshold frequency $(x 10^{18}y)^{-1}$

