Store → Transfer → Store

Closed energy system. $E_{in} = E_{out} + E_{waste}$
Waste energy – not always heat (e.g heater)
Heating: conduction, radiation, dissipation
Dissipation: E lost to surroundings

Work done: always use a distance based on the direction the force is working. E.g going up a slope, work against gravity, use height.
Work done against friction means increase in temperature.

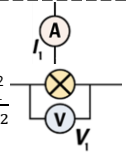
Total GPE before fall = Total KE after fall just before landing – assume no energy dissipation. Reality = dissipation always.

P – rate of energy transfer. 1J/s = 1W

Contact Forces: Air resistance, Friction, Tension, Normal
Non-contact Forces: Gravity, Magnetism, Electrical, Nuclear

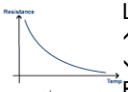
Friction caused by interlocking of microscopic irregularities.
Lubrication stops surfaces touching, so less friction.

Series	Parallel
$I_{TOT} = I_1 = I_2$	$I_{TOT} = I_1 + I_2$
$V_{TOT} = V_1 + V_2$	$V_{TOT} = V_1 = V_2$
$R_T = R_1 + R_2$	$\frac{1}{R_{TOT}} = \frac{1}{R1} + \frac{1}{R2}$



Ammeters in series
Voltmeters in parallel
In parallel: resistance is always smaller than the smallest resistor.

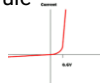
Current: the number of coulombs per second. Rate of charge flow
Voltage: the number of joules per coulomb.
Resistance: -ve electrons collide with +ions, KE transferred, nucleus oscillates more, thermal store increases, temp increases, current decreases.



LDR and Thermistor
↑Temp or Light
↓ Resistance

Lamp
R ↑ as I↑ due to ↑ in voltage

Breaks the normal rule
Ohmic conductor
R is constant, if temperature is



Diode
V-low R in 1 -.
V-high R in other direction

1 Watt is 1 Joule per second.
The power of a circuit depend on the current, which depends on the voltage (p.d.) and the resistance.
Coulombs carry the energy like a bucket carries water. More voltage means more energy per C and more C per second

A.C. changes directions, mains electricity, 50Hz, 230V
D.C. one direction, batteries
Live wires – Brown, 230V. Earth Wires – Green/White, 0V. Neutral wires – Blue, 0V
Earth Wire has low resistance, path to earth for charge in case of bad wiring, reduce chance of shock
Fuses – wired into the live wire, melt when current becomes dangerously high
Circuit breakers – solenoid wired into live wire, high current causes stronger magnetic field, attract a soft iron core to open a circuit.

Like poles attract, unlike poles repel. N←→N N→←S S→←N
Denser magnetic fields – stronger magnetic fields. Fields go N to S.
Earth's core magnetic, compasses are magnetic proof N points N.

Cobalt: high temperature magnets Steel: long-term magnets Iron: looses magnetism very quickly (electromagnets, microphones), Nickel: inexpensive cover for other more expensive magnets.

Induced magnets magnetic in a magnetic field, iron core wrapped in current carrying coil, magnetise by running magnets.
Transformers: ↑or↓ induced voltage and induced current.
Solenoid: coil of wire with current running through it.
Magnetic field around wire with I running through it (+ to -), right hand rule (thumb current, fingers field).
Increase induced potential difference: increase size of magnet, number of coils, speed of movement.
Left Hand Rule: FBI perpendicular fingers show effect of current carrying wire in magnet (thumb, F, first finger B, middle finger I)

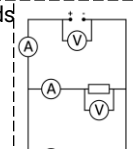
Kinetic theory: more KE = greater internal energy = intermolecular bonds can break / expand because more vibration.
Solid: particles vibrate – cant break bonds, shape, volume fixed
Liquid: particles vibrate with enough KE to change shape.
Gas: particles vibrate with enough KE to change shape and volume

Density: usually solids greater density. Volume increases from S→L→G
$1m^3 = 1{,}000{,}000cm^3$ always check units.

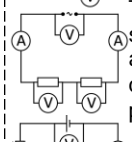
When increasing internal energy changes of state happen. At boiling / melting points all energy is being used to break intermolecular bonds.

Specific latent Heat: Energy needed to change state of 1Kg
Specific Heat Capacity: amount of energy to raise 1Kg by 1^oC.

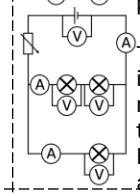
Gas pressure: increases with increased temperature as increased KE.
Absolute Zero: -273^oC, or 0k (identical scale) no internal KE



This circuit has a DC powerpack and 2 fixed resistors in parallel. There are 2 voltmeters connected in parallel over the resistors. There is 1 ammeter in each branch and an ammeter connected in series with the powerpack. To change the voltage and therefore the current change the settings on the powerpack.



This circuit has an AC powerpack and 2 fixed resistors in series. Each resistor has a voltmeter in parallel and 2 ammeters in series with the powerpack and resistors. To change the current and voltage change the settings on the powerpack.



This circuit has a fixed voltage cell and variable resistor. To increase the current, reduce the resistance in the variable resistor. There are 2 filament lamps connected in series, that are connected in parallel with 1 other filament lamp. Each lamp has a voltmeter connected in parallel and an ammeter wired in series.

Usually – physics experiments are about measuring values of terms in equations. Eg. find speed, measure distance and time. For experiments or other questions ALWAYS try to find an equation.

E – what equipment do you need to measure the terms / DV
P – how do you use the equipment
I – how are you measuring the IV / important value
C – how can you keep all other variables the same.
RAVE – Repeat and average / repeat and change it slightly.

CV must be limited so any change is due to IV changing:
Circuit diagrams are used for planning experiments. Label!
If testing resistance, R=V÷I, specify series or parallel
Can change p.d using rheostat / variable resistor.
Find volume using overflow can AND graduated cylinder.
Digital thermometers, easier to read more accurate.
Take volume measurements from eye level
Insulate with lids, polystyrene etc

Test resistance in series / parallel circuits OR resistors and lamps.
E – 2 circuits (drawn), voltmeters in parallel and ammeters in series
P – record I and V in each component over a range of voltages and compare.
I – I using ammeter, V using voltmeter, use R=V÷I
C – identical intervals when increasing V, same temperature. RAVE

Measure the density of an irregular object
E – overflow can, balance, graduated cylinder
P – find mass of object, drop in overflow can, overflow into grad. Cyl.
I – density is important term so d=m÷v
C – find mass dry, overflow can full to brim, push down floaters RAVE

Measure the specific heat capacity of water
E – joulemeter, stopwatch, balance, insulated beaker, thermometer
P – find mass, take temperature, start timer, heat water, stop timer
I – SHC is important term so $c=Q/(m\times\Delta\theta)$
C – insulate beaker, use digital thermometer, RAVE

prefix	Symbol	Multiply by
Giga	G	$X10^9$
Mega	M	$X10^6$
Kilo	k	$X10^3$
Centi	c	$X10^{-2}$
Milli	m	$X10^{-3}$
Micro	μ	$X10^{-6}$
Nano	n	$X10^{-9}$
Pico	p	$X10^{-12}$

Triangles for formulas are not proof you know the formula. Use them, but then write the equation in full.
Terms that are multiplied together form the base of the triangle.
Terms at the top of the top of a division (numerator) are at the top of the triangle.

Meter (m), speed (m/s), velocity (m/s), acceleration (m/s^2), time (s), force (N), energy (J), mass (kg), frequency (Hz), wavelength (m), work done (J), energy transferred (J), power (W)

If asked for significant figures, then mark the first three numbers from the left. Round the third number (x>5 up, x<5 down)