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A-Level Physics

Key Diagrams · Diagram Bank

A-Level Physics | Diagram Bank | 26 entries

Every diagram and graph you must draw, label or interpret in A-Level Physics - what to draw, what to label, and when it comes up.

Mechanics and materials

Free-body force diagram	**Draw:** the single object reduced to a dot or simple box, with one straight arrow per force acting on it, each starting at the object and pointing in the direction the force pulls or pushes, lengths roughly to scale. **Label:** name every arrow (weight downwards, normal contact force perpendicular to the surface, tension along the string, friction or drag opposing motion) and, where useful, resolve a slope force into components parallel and perpendicular to the incline. **Comes up in:** any resultant-force or equilibrium question - objects on slopes, hanging masses, lifts accelerating, or a body moving at terminal velocity.
Velocity-time graph	**Draw:** velocity in m s^{-1} up the vertical axis against time in s along the horizontal axis, sketching straight or curved sections to match the motion. **Label:** the gradient as acceleration, the area beneath the line as displacement, and the time-axis crossing as the instant the body is momentarily at rest. **Comes up in:** kinematics questions where you read off acceleration and distance, and in terminal-velocity stories where the line curves and levels off.
Displacement-time graph	**Draw:** displacement in m up the vertical axis against time in s along the horizontal axis, with a straight line for constant velocity and a curve for changing velocity. **Label:** the gradient at any point as the instantaneous velocity, a horizontal section as a stationary object, and a tangent drawn to find velocity on a curved line. **Comes up in:** describing motion in words, comparing it with the matching velocity-time graph, and spotting where a body changes direction.
Stress-strain graph	**Draw:** stress in Pa up the vertical axis against strain (no unit) along the horizontal axis, showing a straight initial section that then curves for a ductile metal. **Label:** the limit of proportionality, the elastic limit, the yield point, the ultimate tensile stress and the breaking (fracture) point, with the gradient of the straight part as the Young modulus. **Comes up in:** materials questions comparing brittle, ductile and polymeric behaviour, and finding the Young modulus from the straight region.
Force-extension graph with loading and unloading	**Draw:** force in N up the vertical axis against extension in m along the horizontal axis, with a straight Hooke's-law region and, for a stretched-then-released sample, separate loading and unloading curves. **Label:** the gradient as the spring constant, the area under the line as the elastic strain energy stored, and the gap between loading and unloading curves as energy lost (hysteresis) in rubber. **Comes up in:** spring and wire experiments, elastic potential energy calculations, and questions on permanent (plastic) deformation.
Moments and the principle of moments	**Draw:** a horizontal beam or rod resting on a pivot, with downward force arrows at their points of application and their perpendicular distances from the pivot marked. **Label:** each turning effect as force × perpendicular distance, the clockwise moments and the anticlockwise moments, set equal for a balanced beam. **Comes up in:** equilibrium of rigid bodies - see-saws, loaded shelves, bridges and the reaction forces at supports.

Waves and quantum

Transverse and longitudinal wave	**Draw:** for a transverse wave a sine curve of displacement against distance, and for a longitudinal wave a row of dots showing compressions and rarefactions along the direction of travel. **Label:** one wavelength λ, the amplitude, and the direction of oscillation relative to the direction of energy transfer (perpendicular for transverse, parallel for longitudinal). **Comes up in:** defining wave types, comparing sound with light or water waves, and reading wavelength and amplitude off a snapshot.
Stationary (standing) wave on a string	**Draw:** a string fixed at both ends vibrating in its fundamental and higher harmonics, sketching the looped envelope of the standing wave pattern. **Label:** the nodes where the string never moves and the antinodes of maximum amplitude, with the distance between adjacent nodes equal to half a wavelength. **Comes up in:** the formation of stationary waves by superposition of two waves travelling in opposite directions, and harmonics on strings and in air columns.
Young's double-slit interference	**Draw:** coherent light passing through two narrow slits, with overlapping circular wavefronts spreading out and reaching a screen to give a fringe pattern. **Label:** the path difference to each point, bright fringes where waves arrive in phase (path difference = nλ) and dark fringes where out of phase (path difference = (n + ½)λ), and the fringe spacing w. **Comes up in:** demonstrating that light is a wave, calculating wavelength from fringe spacing, and the conditions of coherence and monochromatic light.
Single-slit and grating diffraction pattern	**Draw:** for single-slit diffraction an intensity-against-position graph with a wide bright central maximum and smaller side maxima, and for a grating a set of sharp, widely spaced bright lines. **Label:** the central maximum being roughly twice the width of the others, the order n of each maximum, and the angle θ to each grating line. **Comes up in:** comparing single-slit with grating patterns, line spectra, and finding wavelength using d sin θ = nλ.
Refraction and total internal reflection	**Draw:** a ray crossing a boundary between two media bending towards or away from the normal, and a second diagram with the ray striking the boundary above the critical angle and reflecting back. **Label:** the normal, the angles of incidence and refraction measured from the normal, the critical angle θ_c, and the bending towards the normal on entering a denser medium. **Comes up in:** Snell's law calculations, optical fibres and the conditions needed for total internal reflection.
Photoelectric effect graph	**Draw:** a graph of maximum kinetic energy of emitted electrons up the vertical axis against frequency of incident light along the horizontal axis, giving a straight line crossing the frequency axis. **Label:** the threshold frequency where the line meets the axis, the gradient equal to the Planck constant, and the negative intercept equal to minus the work function. **Comes up in:** particle nature of light, Einstein's photoelectric equation, and explaining why intensity does not raise electron energy.
Energy levels and line spectra	**Draw:** a set of horizontal lines representing the discrete energy levels of an atom, with arrows showing an electron dropping between levels and emitting a photon. **Label:** the ground state and excited states in eV, downward transitions giving emission lines and upward transitions giving absorption, with photon energy equal to the difference between levels. **Comes up in:** explaining emission and absorption line spectra and calculating the wavelength of an emitted photon.

Electricity and fields

Current-voltage (I-V) characteristics	**Draw:** current in A up the vertical axis against potential difference in V along the horizontal axis, sketching a straight line through the origin for an ohmic resistor, an S-shaped curve for a filament lamp, and a sharp turn-on in forward bias for a diode. **Label:** the constant gradient (constant resistance) of the resistor, the decreasing gradient of the lamp as it heats, and the very high reverse resistance of the diode. **Comes up in:** identifying components from their behaviour and explaining how resistance changes with temperature or polarity.

Series and parallel circuit diagram	**Draw:** a circuit using standard symbols for the cell, resistors, ammeter and voltmeter, with the ammeter in series and the voltmeter in parallel with the component being measured. **Label:** current the same all the way round a series loop, current splitting at parallel junctions, potential differences adding in series and being equal across parallel branches. **Comes up in:** Kirchhoff's laws, combining resistances, and setting up an experiment to measure resistance.
Potential divider circuit	**Draw:** a supply connected across two resistors in series, with the output voltage taken across one of them, and a version using a thermistor or light-dependent resistor as a sensor. **Label:** the share of the supply voltage in proportion to the resistances, the output rising or falling as a sensor's resistance changes. **Comes up in:** producing a variable or sensor-controlled voltage, and explaining temperature- or light-triggered switching.
Radial and uniform field lines	**Draw:** for a radial field a point charge or small mass with arrows pointing straight out (or in) and getting further apart with distance, and for a uniform field a set of evenly spaced parallel arrows between two charged plates. **Label:** the direction of the field (away from positive charge, towards a mass), equipotential lines crossing the field lines at right angles, and the constant strength of a uniform field. **Comes up in:** gravitational and electric field questions, parallel-plate capacitors and the motion of charges between plates.
Inverse-square field and potential graphs	**Draw:** field strength against distance from a point mass or charge as a curve falling off as one over distance squared, and potential against distance as a curve approaching zero at infinity. **Label:** the field following an inverse-square law, the gravitational potential always negative, and the area under the field graph linking to the change in potential. **Comes up in:** orbits, escape questions, and comparing gravitational with electric fields around point sources.
Capacitor charge and discharge curves	**Draw:** charge or voltage up the vertical axis against time along the horizontal axis, with an exponential decay curve for discharge and a rising curve flattening towards the supply voltage for charging. **Label:** the time constant equal to resistance × capacitance, the point where the value has fallen to about 37 percent of its start, and the steeper initial slope. **Comes up in:** exponential decay analysis, finding the time constant experimentally and timing or smoothing applications.
Magnetic field and the motor effect	**Draw:** a current-carrying wire between the poles of a magnet, with field lines running from north to south and the resulting force on the wire shown by an arrow. **Label:** the directions of the field, the current and the force using Fleming's left-hand rule, all mutually perpendicular. **Comes up in:** the force on a conductor, electric motors, and the force on a moving charge in a magnetic field.

Thermal and nuclear

Simple harmonic motion graphs	**Draw:** three stacked graphs against time for an oscillator - displacement as a cosine curve, velocity as the curve shifted a quarter cycle, and acceleration as the inverted displacement curve. **Label:** velocity being zero at maximum displacement and greatest at the centre, acceleration always directed back towards equilibrium and proportional to minus the displacement. **Comes up in:** defining simple harmonic motion, the pendulum and mass-on-spring, and the phase relationships between the three quantities.
Resonance curve	**Draw:** amplitude of a driven oscillator up the vertical axis against driving frequency along the horizontal axis, giving a peak at the natural frequency, with a lower, broader peak for heavier damping. **Label:** the resonant frequency at the peak, the sharp tall peak for light damping and the flatter peak shifted slightly lower for more damping. **Comes up in:** forced oscillations, damping, and real examples such as bridges, instruments and tuning circuits.
Maxwell-Boltzmann distribution	**Draw:** number of molecules up the vertical axis against molecular speed along the horizontal axis, a skewed hump starting at the origin, rising to a peak and tailing off at high speed. **Label:** the most probable speed at the peak, the long high-speed tail, and a second curve for a higher temperature that is flatter and shifted to the right. **Comes up in:** the kinetic theory of gases, linking temperature to mean kinetic energy and the spread of molecular speeds.

Pressure, volume and temperature gas graphs	**Draw:** pressure against volume as a smooth curve (Boyle's law isotherm) at constant temperature, and pressure against absolute temperature as a straight line passing through the origin at constant volume. **Label:** pressure inversely proportional to volume, pressure proportional to temperature in kelvin, and the extrapolation of the line back to absolute zero. **Comes up in:** the gas laws, the ideal gas equation, and finding absolute zero from a pressure-against-temperature graph.
Radioactive decay curve	**Draw:** activity or number of undecayed nuclei up the vertical axis against time along the horizontal axis, as a smooth exponential decay curve approaching but never reaching zero. **Label:** the half-life as the time for the value to halve, the constant ratio after each half-life, and the random, spontaneous nature of decay. **Comes up in:** half-life calculations, carbon dating, and choosing a suitable isotope for a use.
Binding energy per nucleon curve	**Draw:** binding energy per nucleon in MeV up the vertical axis against nucleon (mass) number along the horizontal axis, rising steeply, peaking around iron, then falling slowly for heavy nuclei. **Label:** the peak near nucleon number 56 as the most stable region, the rise on the left as fusion releasing energy, and the gentle fall on the right as fission releasing energy. **Comes up in:** nuclear stability, energy released in fusion and fission, and mass-energy calculations.