



### The Photoelectric Effect

**Checklist statement** ✓

I can define the threshold frequency.

I can explain the threshold frequency using the photon model.

I can define the work function,  $\phi$ .

I can define stopping potential.

I can apply  $hf = \phi + E_k(\text{max})$ , define all terms and know their standard units.

I can explain that  $E_k(\text{max})$  is the maximum kinetic energy of the photoelectrons.

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### Collisions of Electrons with Atoms

**Checklist statement** ✓

I can explain ionisation and excitation of atoms.

I can describe ionisation and excitation in a fluorescent tube.

I can define the electron volt (eV).

I can convert between electron volts (eV) and joules (J).

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### Energy Levels and Photon Emission

**Checklist statement** ✓

I can explain how line spectra (e.g. hydrogen) provide evidence for transitions between discrete energy levels in atoms.

I can apply  $hf = E_1 - E_2$ , define all terms and know their standard units.

I know that energy levels may be given in joules (J) or electron volts (eV).

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## Wave–Particle Duality

### Checklist statement

✓

I can explain how electron diffraction provides evidence that particles have wave properties.

I can explain how the photoelectric effect provides evidence that electromagnetic waves have a particle nature.

I can apply the de Broglie wavelength equation  $\lambda = \frac{h}{mv}$ , define all terms and know their standard units.

I can explain how and why the amount of diffraction changes when the momentum of a particle changes.

I can describe how scientific understanding of the nature of matter changes over time.

I can explain the role of peer review and the scientific community in validating new ideas.