

# AQA A-Level Physics

## 2.2 Electromagnetic radiation and quantum phenomena

### Flashcards



Are electromagnetic waves transverse or longitudinal?



Are electromagnetic waves transverse or longitudinal?

Transverse.



What phenomenon can be used to show that light behaves as a particle?



What phenomenon can be used to show that light behaves as a particle?

The photoelectric effect.



Describe the photoelectric effect.



**Describe the photoelectric effect.**

When light above a particular frequency is shone on metal, electrons are released - these released electrons are “photoelectrons”.



# What is the threshold frequency?





# What is the threshold frequency?

The minimum frequency of light required for an electron to be emitted.



What equation is used to determine the energy of a photon?



What equation is used to determine the energy of a photon?

$$E = hf = hc/\lambda$$

Energy = Planck's constant x frequency

Energy =  $(PC \times 3 \times 10^8) / \text{wavelength}$



Why does a photon need to have a minimum frequency in order to liberate an electron?



Why does a photon need to be of a minimum frequency to liberate an electron?

The energy of the photon is determined by its frequency, the photon's energy must be greater than the work function (energy needed to break bonds holding the electron) in order for an electron to be emitted.



If a photon has a frequency higher than the threshold frequency, what would occur?



If a photon has a frequency higher than the threshold frequency, what would occur?

The electron will be liberated and the remaining energy is the kinetic energy of the electron.



If light is incident on a metal and photoelectric emission does NOT occur, what is the effect of increasing light intensity?





If light is incident on a metal and photoelectric emission does NOT occur, what is the effect of increasing light intensity?

- If it is more intense then there would be more photons incident on the metal each second
- However each photon still carries the same amount of energy as before
- Therefore it still does not contain enough energy to liberate an electron
- No effect



# What is the photoelectric equation?



What is the photoelectric equation?

$$hf = \phi + E_{k(\text{max})}$$

*Planck's constant x frequency = work function + maximum kinetic energy of the photoelectrons*



Define the work function.



**Define the work function.**

The energy required by an electron to overcome the metallic bond holding it in the metal.



# What is an electron volt?



## What is an electron volt?

The kinetic energy of an electron that has been accelerated from rest through a potential difference of 1V.

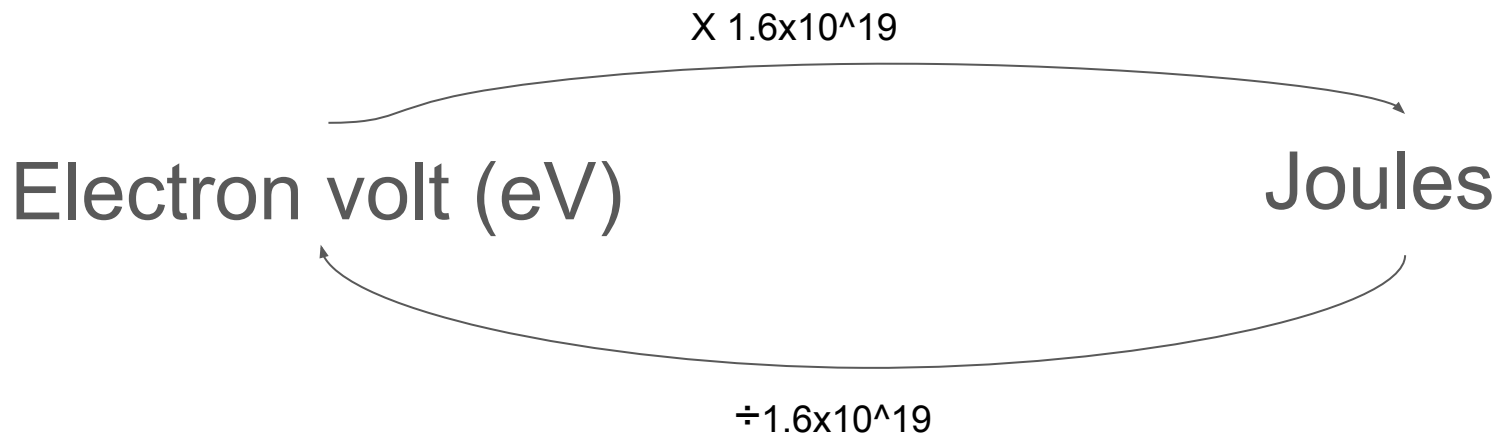


How do you convert between electron volts and joules?





# How do you convert between electron volts and joules?



# How does a fluorescent tube work?



# How does a fluorescent tube work?

- High voltage applied across mercury vapour accelerates fast moving free electrons which collide with the mercury atoms.
- Mercury electrons are excited and then return to the ground state, releasing a UV photon.
- The tube's phosphorus coating absorbs the UV photons and its electrons are excited, they cascade down the energy levels and emit visible light photons.



What can be used as evidence for the discrete energy levels in atoms?



# What can be used as evidence for the discrete energy levels in atoms?

Line emission and absorption spectra as the lines appear at discrete points which show where a light photon of specific frequency and wavelength has been absorbed or emitted, this shows electrons can only absorb an exact amount of energy to be excited to the next discrete energy level.



# What is wave particle duality?



## What is wave particle duality?

All particles have both particle and wave properties, waves can have particle properties e.g. light acts as a particle in the photoelectric effect and as a wave when it is diffracted.



What is the equation for de Broglie wavelength?





What is the equation for de Broglie wavelength?

$$\lambda = h / mv$$

Where  $mv$  is momentum.

