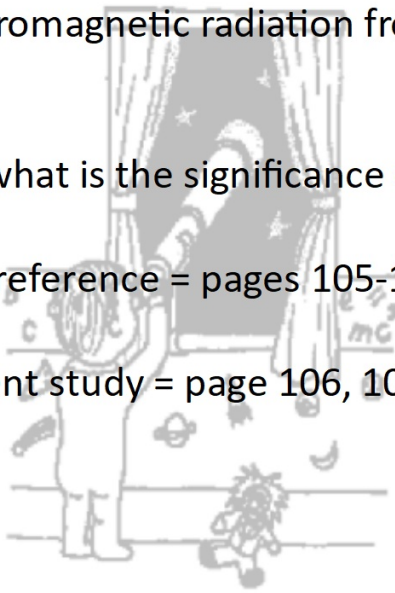
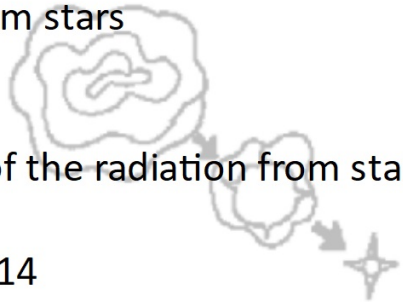
STARLIGHT 1 spectra

OCR A LEVEL PHYSICS H556
Module 5: Newtonian world and astrophysics
5.5 Astrophysics and cosmology
5.5.2 Electromagnetic radiation from stars
a) to k)

twinkle, twinkle, little star,
how I wonder what you are





up above the world so high,
a contracting ball of hot
hydrogen gas ...

Outline = what is the significance of the radiation from stars

Text book reference = pages 105-114

Independent study = page 106, 108, 111 & 114 questions

What is this lesson all about?

- What is the significance of the radiation from stars?
- What can we learn from it?
- Electron orbitals
- Emission spectra
- Absorption spectra
- Analysing spectra using a diffraction grating*
- Wein's law
- Stefan's law

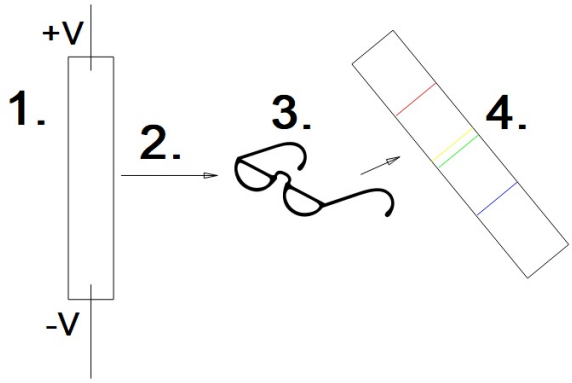
*we'll look at this in more detail later ...

SPECTRA

Observing an emission spectrum

- what?
- how?
- why?

'coloured lines on a dark background'



1

2

3

4

SPECTRA

Electrons, orbitals and transitions [information]

- Electrons exist in orbitals
- Each orbital has its own energy level
- They can transition between these orbitals
- Energy of orbital measured relative to ionisation energy
- Lower orbit, higher energy*, further from ionisation
- Jumping 'higher' needs energy input
- Falling 'back down' releases energy
- Energy in/out only = transtion energies

*and -ve as energy needs to be given to get closer to '0'

Making transitions

- electron recieves energy (pd or photon) = jump up!
- electron gives out energy (photon) = fall back!

Calculating transition energies

$$\Delta E = E2 - E1$$

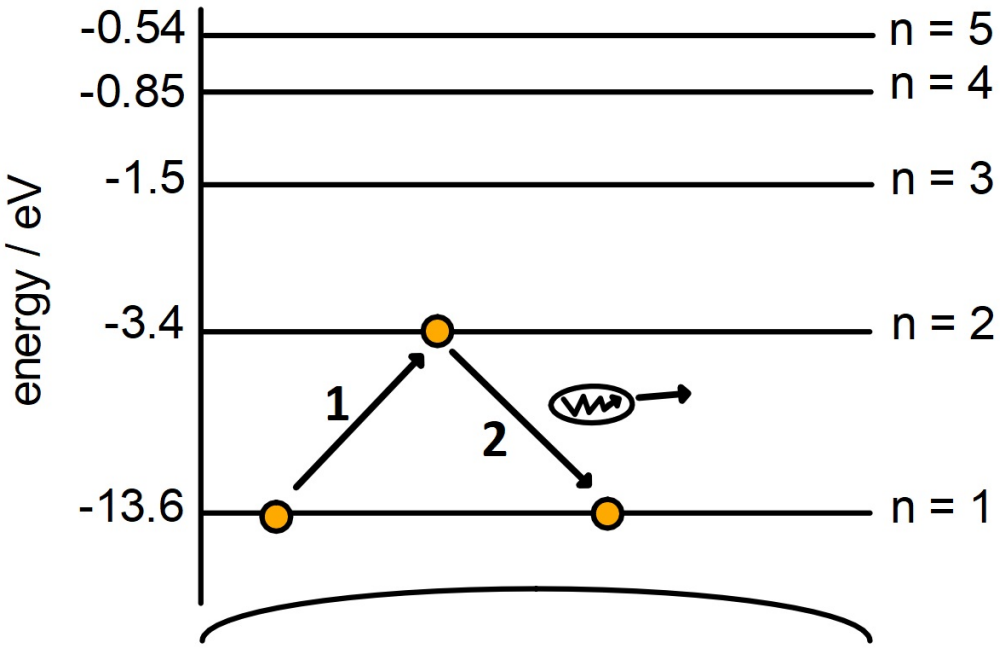
Where:

ΔE = change in energy / J (often expressed in eV)
E2 = energy of final obital / J
E1 = energy of initial orbital / J

SPECTRA

Electrons, orbitals and transitions [example]

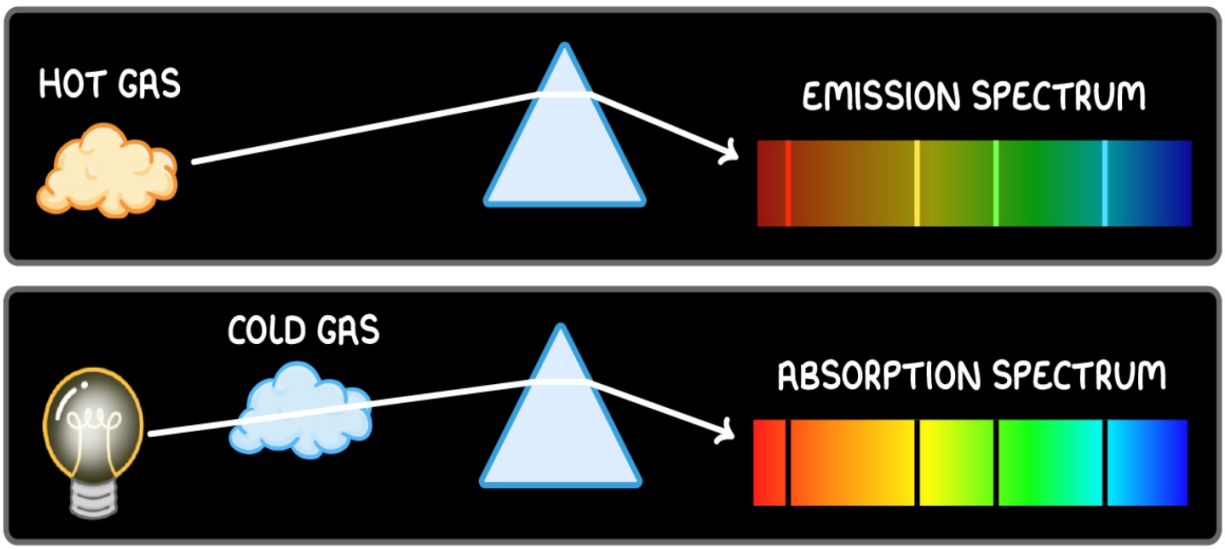
- The diagram represents the lowest five hydrogen orbitals
- An electron in 'ground state' is excited from n=1 to n=2 **1**
- Calculate energy in J required
- The electron falls back from n=2 to n=1 **2**
- Energy is given out as a photon
- Calculate the wavelength of the photon
- From what part of the e-mag spectrum is this photon?
- What other possibilities are there?
- Practice calculating them and their photon energies ...



SPECTRA

Comparing absorption and emission spectra

- An excited gas produces an emission spectrum
- Electrons in the atoms jump to higher orbitals (excited)
- They then fall back and emit photons
- Producing coloured lines on a dark background
- What if a spectrum is passed through an unexcited gas?
- The photons can be absorbed by electrons
- If the photon energies match the transition energies
- So some of the wavelengths passing through are absorbed
- And the spectrum passing though has missing wavelengths
- Producing dark lines on coloured background



SPECTRA

Absorption spectra and stars

- what?
- how?
- why?

'dark lines on a coloured background'

- Stars produce absorption spectra
- All wavelengths produced within the star
- Some wavelengths are absorbed by outer layers
- Absorbed wavelengths correspond to transition energies
- Knowing the wavelengths, can determine the elements
- Primordial star?
- Star born from a supernova?

SPECTRA

Independent study

- Page 106 and 108 questions from your text book

Further thoughts?