Oww, that Hertz 1.1

1. Use information from page 14 of the data booklet to calculate
(a) The energy in joules of the photons associated with the lilac light produced from a potassium discharge lamp.
(b) The energy in kilojoules per mole of photons associated with a calcium flame
(c) The frequency of the crimson light light produced from a lithium flame
(d) The wavelength of the radiation containing photons of energy 2×10^{-25} J
(e) The energy of the photons that produce the 5335 cm^{-1} line in the Paschen series of the emission spectrum of Hydrogen.

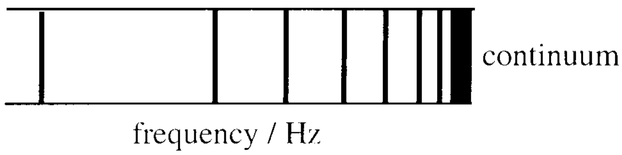
2. **Bromine and pentane react in a photochemical reaction producing bromopentane. The first step in this reaction is the dissociation of bromine molecules into bromine atoms.**

(a) What is meant by the term "photochemical reaction"?
(b) Calculate the energy in joules required to break one bromine molecule into bromine atoms.

(d) To which part of the visible spectrum do these waves belong?

3. Calculate the wavelength of the radiation required to bring about the first ionisation energy of caesium metal.

4. The emission spectrum of an element is seen as a series of bright coloured lines on a dark background.
Within a series , the intervals between the frequencies of each line decrease until the lines are so close together that they converge to form a continuous spectrum or continuum as shown in the diagram.



(a) Which end of the emission spectrum, left or right, is the high energy end? Explain your answer.
(b) Why do the lines converge as they reach the continuum?
(c) The frequency at the continuum is $1{\cdot}26 \times 10^{15}$ Hz.
(i) Calculate the energy in kJ mol^{-1} represented by this frequency.
(ii) What does this energy represent?

5. Helium is named from the greek Helios which means the sun. It was discovered as an unkown element in the sun's atmosphere before it was found on earth.
(a) Explain how we can identify elements in stars.
(b) Use information in the data booklet to calculate the frequency of the continuum in the emission spectrum of helium.

Ex 1.1

1.

(a) wavelength of lilac light = 405 nm
(page 14 databa

Energy of photon from 1 atom $= h\nu = \frac{hc}{\lambda}$

$= \frac{6.63 \times 10^{-34} \times 3 \times 10^{8}}{405 \times 10^{-9}}$

$= 4.91 \times 10^{-19}$ J

(b) wavelength of light from calcium flame = 620 nm

Energy of photons from 1 mole $= Lhc$

$= \frac{6.02 \times 10^{23} \times 6.63 \times 10^{-34} \times 3 \times 10^{8}}{620 \times 10^{-9}}$

$= 193125$ J $= 193.125$ kJ

(c) wavelength of crimson light = 671 nm

frequency $= \frac{c}{\lambda} = \frac{3 \times 10^{8}}{671 \times 10^{-9}}$

$= 4.47 \times 10^{14}$ Hz

1. (d) $E = \frac{hc}{\lambda}$

$$\lambda = \frac{hc}{E} = \frac{6.63 \times 10^{-34} \times 3 \times 10^{8}}{2 \times 10^{-25}}$$

$$= \frac{1.989 \times 10^{-25}}{2 \times 10^{-25}}$$

$$= \underline{0.99} \text{ m}$$

(e) $E = hc\bar{\upsilon}$

$$= 6.63 \times 10^{-34} \times 3 \times 10^{8} \times 5335 \times 10^{2}$$

$$= 1.06 \times 10^{-19} \text{ J}$$

2 (a) A reation that requires light to occur/start.

(b) Energy to break 1 mole Br_2 molecules = bond dissociation enthalpy in data book

$= 194$ kJ

Energy to break one Br molecule

$= \frac{194}{L} = \frac{194}{6.02 \times 10^{23}} = 3.22 \times 10^{-22}$ kJ

$= 3.22 \times 10^{-19}$ J

(c) (i) $E = h\nu$

$\nu = \frac{E}{h} = \frac{3.22 \times 10^{-19}}{6.63 \times 10^{-34}} = 4.86 \times 10^{14}$ Hz

(ii) $E = \frac{hc}{\lambda}$

$\lambda = \frac{hc}{E} = \frac{6.63 \times 10^{-34} \times 3 \times 10^{8}}{3.22 \times 10^{-19}} = 6.17 \times 10^{-7}$ m

$= 617$ nm

(d) orange/red end

382 kJ/mol

382000 J/mol

energy per atom $= \frac{382000}{6.02 \times 10^{23}}$

$= 6.34 \times 10^{-19}$ J

$=$

$E = \frac{hc}{\lambda}$

$\lambda = \frac{hc}{E} = \frac{6.63 \times 10^{-34} \times 3 \times 10^{8}}{6.34 \times 10^{-19}}$

$= 3.13 \times 10^{-7}$ m

$= 313$ nm

4 (a) Right, Lines converge to biggest energy drop of electrons ie from highest (outermost) energy shell to lowest (innermost) energy shell therefore convergence point will due to emission of photons of highest energy

(b) Energy gap between shells decreases as shells get further from nucleus.

(c)

(i) $E = h\nu = 6.63 \times 10^{-34} \times 1.26 \times 10^{15}$ (per photon)

$= 8.3538 \times 10^{-19}$ J

$= 8.3538 \times 10^{-22}$ kJ

E (per mol photons) $= 8.3538 \times 10^{-22} \times 6.02 \times 10^{23}$

$= 5.029 \times 10^{2}$ kJ/mol

(ii) 1st ionisation energy

5.

(a) pass light from star through a spectrometer, measure frequency of absorbtion lines, then compare frequencies to lines of spectra from known elements.

(b) 1st ionisation energy of Helium $= 2380 \text{ kJ mol}^{-1}$

$= 2380 \times 10^{3} \text{ J mol}^{-1}$

$E = Lh\upsilon$
(per mol)

$$\upsilon = \frac{E}{Lh} = \frac{2380 \times 10^{3}}{6.02 \times 10^{23} \times 6.63 \times 10^{-34}}$$

$$= \underline{5.96 \times 10^{15}} \text{ Hz}$$