"threshold frequency" $E = h\nu$

minimum E to eject the e^-

cannot be explained as a wave

beam of light = stream of "particles" → photon

each photon $E = h\nu$

whole #

multiple # of photons   single photon $E = h\nu$

$c = 3.00 \times 10^8$ m/s   94.1 MHz $\lambda = ?$

$c = \nu\lambda$ ν 94.1×10^6 Hz

94.1×10^6 /s

$$\lambda = \frac{c}{\nu} = \frac{3.00 \times 10^8 \, m/\cancel{s}}{94.1 \times 10^6 /\cancel{s}} \rightarrow 3.19 m$$

$c = 3.00 \times 10^{17}$ nm/s $h = 6.63 \times 10^{-34}$ J·s $E = h\nu$

a) orange light $\lambda = 600$ nm (1 s.f.) $\nu = ?$

$$c = \lambda\nu \qquad \nu = \frac{c}{\lambda} = \left(\frac{3.00 \times 10^{17} \, nm/s}{600 \, nm}\right) = 5 \times 10^{14} /s$$

b) E in J of one photon of this light?

$$E = h\nu = (6.63 \times 10^{-34} \, J \cdot s)(5 \times 10^{14} /s) = 3 \times 10^{-19} J$$

c) E of 1 mole of these photons?

$$\frac{3 \times 10^{-19} J}{\cancel{photon}} \times \frac{6.02 \times 10^{23} \, photons}{1 \, mole} = 2 \times 10^5 J/mole$$

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gaseous elements $\longrightarrow$ line spectrum
"emission" spectrum

"fingerprint"

1913 Bohr $\Rightarrow$ planetary orbit model

$\longrightarrow$ e^-'s orbit nucleus @ fixed distances

$E = h\nu$ only specific ν's
$\longrightarrow$ only specific E's available

E is quantized

$E \propto$ distance away

specific distances away from nucleus

e^- closer to nucleus = lower E

level

$$E_n = -R_H\left(\frac{1}{n^2}\right)$$

Rydberg constant
2.18×10^{-18} J

free e^-
$\rightarrow \infty$ distance from nucleus
$\hookrightarrow E_\infty = 0$

as e^- gets closer to the nucleus
$n \longrightarrow 1$, $\frac{1}{n^2} \Uparrow$
$\therefore E_n \longrightarrow -R_H$

closer to nucleus = "lower" E value
bigger (−) #

lower E = greater stability

H $\Rightarrow$ only 1 e^-

$n=1$ "ground state"

lowest E state

atom absorbs E

→ e^- moves to higher E level

"excited state"

→ e^- returns to ground state

E released as photon of light

$E = h\nu$