VANCOUVER COMMUNITY COLLEGE

Atomic Theory Calculations

CONVERSIONS & CONSTANTS

1 Angstrom unit (Å) = 10^{-10} m
Avogadro's number = 6.022×10^{23}
1 electron volt (eV) = 1.60×10^{-19} J
1 nanometer (nm) = 10^{-9} m
Planck's constant (h) = 6.63×10^{-34} J·s
speed of light (c) = 3.00×10^{8} m/s

FORMULAS

Wavelength: $\lambda = c / f$
Photon energy: $E = hf = hc / \lambda$

EXERCISES

A. Perform the following conversions:

1) 1 J to eV
2) 420 nm to m
3) 0.5 Å to m
4) 2.75 eV to J

B. Determine the wavelength of light in nanometers whose frequency is 8.0×10^{15} Hz.

C. Determine the frequency of light whose wavelength is 200.0 nm.

D. One of the green lines in the spectrum of mercury has a wavelength of 546 nm. What is the frequency of this line?

E. Determine the energy of a photon with a frequency of 3×10^{15} Hz.

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F. One wavelength of red light is 6500 Å. Determine the:

1) frequency of the light
2) energy of one such photon in J
3) energy of one such photon in eV
4) energy of 1 mol of these photons in J

G. The lowest wavelength of light you can see is 380 nm (near ultraviolet) and the highest wavelength you can see is 780 nm (near infrared). Compute the energy of the corresponding photons.

H. If a photon has an energy of 2.75 eV, what is its wavelength?

SOLUTIONS

A. (1) 6.25×10^{18} eV (2) 4.20×10^{-7} m (3) 5×10^{-11} m (4) 4.40×10^{-19} J

B. 38 nm C. 1.50×10^{15} Hz D. 5.49×10^{14} Hz E. 2×10^{-18} J

F. (1) 4.6×10^{14} Hz (2) 3.1×10^{-19} J (3) 1.9 eV (4) 1.8×10^{5} J

G. (violet) 5.23×10^{-19} J, (red) 2.55×10^{-19} J H. 452 nm