WORKED ANSWERS | STEP-BY-STEP CHECKS

Emission Spectra & Threshold Energy Calculations

Use this answer key after completing the separate question set. Answers are rounded to three significant figures unless the data suggest otherwise.

Worked Answers

1. Use c = lambda f: f = c/lambda = $(3.00 \times 10^{8})/(121.6 \times 10^{-9}) = 2.47 \times 10^{15}\ s^{-1}$.

2. E = hc/lambda = $[(6.63 \times 10^{-34})(3.00 \times 10^{8})]/(102.6 \times 10^{-9}) = 1.94 \times 10^{-18}$ J per photon.

3. E = hc/lambda = 2.18×10^{-18} J per photon. Multiply by 6.02×10^{23} and divide by 1000: 1.31×10^{3} kJ mol^{-1}, or about 1313 kJ mol^{-1}.

4. Because E is inversely proportional to lambda, species A has the larger value. A: 1497 kJ mol^{-1}. B: 998 kJ mol^{-1}.

5. E(molar) = (hc/lambda)N_A = $[(6.63 \times 10^{-34})(3.00 \times 10^{8})/(250.0 \times 10^{-9})](6.02 \times 10^{23}) = 479$ kJ mol^{-1}.

6. lambda = hc/E = $[(6.63 \times 10^{-34})(3.00 \times 10^{8})]/(3.40 \times 10^{-18}) = 5.85 \times 10^{-8}$ m = 58.5 nm.

7. First convert to one atom: E = $(738 \times 10^{3})/(6.02 \times 10^{23}) = 1.23 \times 10^{-18}$ J. Then lambda = hc/E = 162 nm.

8. E = hf = $(6.63 \times 10^{-34})(3.29 \times 10^{15}) = 2.18 \times 10^{-18}$ J. Molar energy = EN_A = 1313 kJ mol^{-1}.

9. (a) E = hc/lambda = 3.98×10^{-18} J. (b) EN_A = 2395 kJ mol^{-1}.

10. Yes. The photon energy is greater than the ionization energy. Excess energy = $4.00 \times 10^{-18} - 2.50 \times 10^{-18} = 1.50 \times 10^{-18}$ J.

11. Energy per atom = $(900 \times 10^3)/(6.02 \times 10^{23}) = 1.50 \times 10^{-18}$ J. Since f = E/h, f = 2.25×10^{15} s^{-1}.

12. Energy per atom = $(1200 \times 10^3)/(6.02 \times 10^{23}) = 1.99 \times 10^{-18}$ J. lambda = hc/E = 99.8 nm.

13. Percentage error = |1305 - 1312|/1312 x 100 = 0.534%.

14. Energy = amount x molar ionization energy = (0.250)(1312) = 328 kJ.

15. At 95.0 nm: 1261 kJ mol^{-1}. At 145.0 nm: 826 kJ mol^{-1}. Difference = 435 kJ mol^{-1}.