Key

Unit 4 Major Quiz Problem-Based Review

These questions are purely calculation/problem based. This sheet is not sufficient review on its own. Be sure to *also* study the periodic table and relevant history, and check out the Kahoots for more practice.

1. Analyze each isotope and fill in the chart.

Symbol-Mass #	% Abundance	Mass of Atom	# protons	# electrons	# neutrons	Isotopic Notation
K-39	93.26%	38.96 amu	19	19	20	$^{39}_{19}K$
K-40	0.01%	39.96 amu	19	19	21	$^{40}_{19}K$
K-41	6.73%	40.96 amu	19	19	22	$^{41}_{19}K$

2. Calculate the average atomic mass of potassium using the information in the previous chart.

$(.9326)(38.96) + (.0001)(39.96) + (.0673)(40.96)$

$= \boxed{39.09\text{ amu}}$

3. Europium has two stable isotopes, ^{151}Eu (atomic mass 150.9198 u) and ^{153}Eu (atomic mass 152.9212 u). If the average atomic mass of europium is 151.97 u, what are the percent abundances of each isotope?

$150.9198x + 152.9212(1-x) = 151.97$

$150.9198x + 152.9212 - 152.9212x = 151.97$

$-2.0014x + 152.9212 = 151.97$

$-2.0014x = -.9512$ so $x = .4753$

^{151}Eu is 47.53% abundant

^{153}Eu is $100 - 47.53 = 52.47\%$ abundant

4. To eject one electron from the surface of potassium metal, a potassium atom must absorb 2.3 eV in the form of a quantum. $\frac{2.3\text{ eV} \mid 1.602\times10^{-19}\text{ J}}{\mid 1\text{ eV}} = 3.7\times10^{-19}\text{ J}$

a) Calculate the wavelength, in nm, of this quantum.

$E = \frac{hc}{\lambda}$ so $\lambda = \frac{hc}{E} = \frac{(6.626\times10^{-34}\text{ J}\cdot\text{s})(3.00\times10^{8}\text{ m/s})}{3.7\times10^{-19}\text{ J}}$

$\lambda = 5.4\times10^{-7}\text{ m}$; $\frac{5.4\times10^{-7}\text{ m} \mid 10^{9}\text{ nm}}{\mid 1\text{ m}} = \boxed{540\text{ nm}}$

b) Calculate the frequency of this quantum.

$\nu = \frac{E}{h} = \frac{3.7\times10^{-19}\text{ J}}{6.626\times10^{-34}\text{ J}\cdot\text{s}} = \boxed{5.6\times10^{14}\text{ s}^{-1}\text{ or Hz}}$

c) How much energy, in Joules, is required to eject a mole of electrons from the surface of potassium metal?

$\frac{3.7\times10^{-19}\text{ J}}{1\text{ photon}} \times \frac{6.02\times10^{23}\text{ photons}}{1\text{ mole}} = \boxed{2.2\times10^{5}\text{ J/mole}}$

5. A photon of yellow light has a wavelength of about 570 nm.

$\frac{570\ nm}{} \Big| \frac{1\ m}{10^9\ nm} = 5.70 \times 10^{-7} m = \lambda$

a) Calculate the frequency of yellow light?

$\nu = \frac{c}{\lambda} = \frac{3.00 \times 10^8 m/s}{5.70 \times 10^{-7} m} = $ **$5.3 \times 10^{14} s^{-1}$ or Hz**

b) Does yellow light have sufficient energy to excite a hydrogen electron from its ground state of n = 2 to n = 5, which requires the absorption of 4.58×10^{-19} J? → ~~minimum~~ energy needed

$\nu = 5.3 \times 10^{14} s^{-1}$

$E = h\nu = (6.626 \times 10^{-34} J \cdot s)(5.3 \times 10^{14} s^{-1}) = $ **3.5×10^{-19} J supplied (not enough – NO)**

6. Are these sets of quantum numbers allowable?

m_ℓ must be −1 to +1 ; ℓ must be 0 to (n−1)

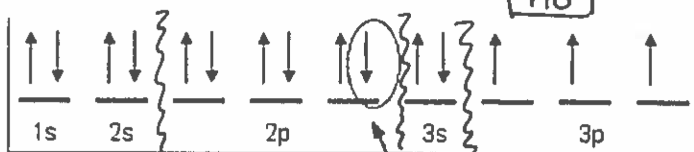
a) 3, 1, (−2) +½ — **no**

b) 4, 2, -2, -½ — **yes**

c) 3, 2, 0, -½ — **yes**

d) 5, (6), -4, +1/2 — **no**

7. Write an allowable set of quantum numbers for the indicated electron.



n = 2
ℓ = 1
m_ℓ = −1 m_s = −½

For the following questions, note that exceptions to the Aufbau order may exist.

8. Write the unabbreviated electron configuration for each element, determine their number of valence electrons, and its valence energy level.

a) F — $1s^2 2s^{②} 2p^{⑤}$ # v.e. = 2+5 = 7 v.e. level = n = 2

b) V — $1s^2 2s^2 2p^6 3s^2 3p^6 4s^{②} 3d^3$ # v.e. = 2 v.e. level = 4

c) Sn — $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^{②} 4d^{10} 5p^{②}$ # v.e. = 4 (2+2) v.e. level = 5

9. Write the noble gas core electron configuration for:

a) Nd — $[Xe] 6s^2 4f^3 5d^1$

b) Cd — $[Kr] 5s^1 4d^{10}$

} both exceptions to Aufbau principle

10. Identify the element:

a) $[Ar] 4s^1 3d^{10}$ — Zn

b) $[Xe] 6s^2 5d^7$ — Ir

11. Are these atoms and/or ions isoelectronic? To prove this, write the configurations first.

a) N^{3-} and Sc^{+3}

$N^{3-}: 1s^2 2s^2 2p^6$
$Sc^{3+}: 1s^2 2s^2 2p^6 3s^2 3p^6$
NO

b) Kr and Se^{2-}

Kr: $[Ar] 4s^2 3d^{10} 4p^6$
Se^{2-}: $[Ar] 4s^2 3d^{10} 4p^6$
YES

12. Draw the noble gas core orbital notation for:

a) Nb — [Kr] ↑↓ (5s) ↑ ↑ ↑ _ _ (4d)

b) As — [Ar] ↑↓ (4s) ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ (3d) ↑ ↑ ↑ (4p)

c) Np — [Rn] ↑↓ (7s) ↑ ↑ ↑ ↑ _ _ _ (4f) ↑ _ _ _ _ (5d)

d) Ag — [Kr] ↑ (5s) ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ (4d)

13. Draw the noble gas core orbital notation - valence orbitals only - for:

a) N — ↑↓ (2s) ↑ ↑ ↑ (2p)

b) Sb — ↑↓ (4s) ↑ ↑ ↑ (4p)