

Name: _____ Date: _____

1. The radioactive ^{60}Co isotope is used to treat certain types of cancer. Calculate the wavelength (nm) of an emitted gamma particle having the energy 1.29×10^{11} J/mol.
A) 9.28×10^{-4}
B) 1.10×10^{-3}
C) 2.12×10^5
D) 2.4×10^3
E) 3.21×10^{-5}
2. Calculate the frequency (Hz) of the emitted photon when an electron drops from a level of $n = 4$ to $n = 3$ level in a hydrogen atom.
A) 1.60×10^{14}
B) 1.29×10^{15}
C) 4.32×10^{15}
D) 1.0×10^{14}
E) 9.78×10^{13}
3. The correct number of unpaired electrons in each of the following atoms: Cd, I and Se are respectively:
A) 0, 1, 2
B) 2, 1, 0
C) 0, 2, 1
D) 1, 2, 0
E) 1, 0, 3
4. What is the maximum number of electrons in an atom that can have the following set of quantum numbers? $n = 4$; $l = 3$; $m_s = +1/2$
A) 7
B) 1
C) 14
D) 5
E) 10

5. What is the de Broglie wavelength (in cm) associated with a 24.8 g object travelling at 65.0 m/s? ($1\text{J} = 1\text{kg}\cdot\text{m}^2/\text{s}^2$)
- A) 4.11×10^{-32}
 - B) 4.11×10^{-34}
 - C) 2.43×10^{22}
 - D) 2.43×10^{-22}
 - E) 2.43×10^{-34}
6. Arrange the following elements in order of increasing atomic radii: N, P, O, Na
- A) $\text{O} < \text{N} < \text{P} < \text{Na}$
 - B) $\text{Na} < \text{N} < \text{P} < \text{O}$
 - C) $\text{N} < \text{O} < \text{P} < \text{Na}$
 - D) $\text{O} < \text{N} < \text{Na} < \text{P}$
 - E) $\text{P} < \text{N} < \text{Na} < \text{O}$
7. Which one of the following elements has the largest second ionization energy (IE_2)?
- A) Na
 - B) Mg
 - C) Cl
 - D) Si
 - E) Al
8. If a phosphorus atom gained three additional electrons, the resulting species would be,
- A) negatively charged and isoelectronic with argon.
 - B) negatively charged and isoelectronic with neon.
 - C) smaller in size than a neutral sulfur atom
 - D) as big as a neutral phosphorous atom.
 - E) smaller in size than a neutral phosphorus atom.
9. The electron configuration of cobalt (III) ion is
- A) $[\text{Ar}]3\text{d}^6$
 - B) $[\text{Ar}]3\text{d}^5$
 - C) $[\text{Ar}]4\text{s}^13\text{d}^5$
 - D) $[\text{Ar}]4\text{s}^23\text{d}^4$
 - E) $[\text{Ar}]4\text{s}^23\text{d}^9$

10. Which statement is **false**?
- A) There are 10 *d* orbitals when $n = 3$.
 - B) A set of *p* orbitals can accommodate a maximum of 6 electrons.
 - C) None of the *p* orbitals has spherical symmetry.
 - D) The third shell (or major energy level) with $n = 3$ has no *f* orbitals.
 - E) The energy level with $n = 5$ has a set of *f* orbitals.
11. How many electrons with angular momentum quantum number $l = 0$ does an Arsenic (As) atom have?
- A) 8
 - B) 6
 - C) 4
 - D) 2
 - E) 0
12. The bond enthalpies of N_2 and F_2 are 941 and 154 kJ/mol, respectively. The standard enthalpy of formation of $NF_3(g)$ is given by the following reaction:
- $$\frac{1}{2} N_2(g) + \frac{3}{2} F_2(g) \rightarrow NF_3(g) \quad \Delta H^\circ = -103 \text{ kJ/mol}$$
- Calculate the N–F bond energy.
- A) 268 kJ/mol
 - B) 113 kJ/mol
 - C) 317 kJ/mol
 - D) 805 kJ/mol
 - E) 155 kJ/mol
13. When drawing the Lewis structure for ICl_4^- , how many lone pairs of electrons are around the central iodine atom?
- A) 2
 - B) 1
 - C) 0
 - D) 3
 - E) 4

14. Calculate the lattice energy (LE) of magnesium sulfide from the following informations:
- $\text{Mg}(s) \rightarrow \text{Mg}(g) \Delta H^\circ = 148 \text{ kJ/mol}$
 $\text{Mg}(g) \rightarrow \text{Mg}^{2+}(g) + 2e^- \Delta H^\circ = 2186 \text{ kJ/mol}$
 $\text{S}_8(s) \rightarrow 8\text{S}(g) \Delta H^\circ = 2232 \text{ kJ/mol}$
 $\text{S}(g) + 2e^- \rightarrow \text{S}^{2-}(g) \Delta H^\circ = 450 \text{ kJ/mol}$
 $8\text{Mg}(s) + \text{S}_8(s) \rightarrow 8\text{MgS}(s) \Delta H^\circ_f = -2744 \text{ kJ/mol}$
 $\text{Mg}^{2+}(g) + \text{S}^{2-}(g) \rightarrow \text{MgS}(s) \Delta H^\circ_{\text{MgS}} = \text{LE} ?$
- A) -3406 kJ/mol
 B) -2722 kJ/mol
 C) 2272 kJ/mol
 D) 3406 kJ/mol
 E) -686 kJ/mol
15. Arrange the following bonds by the increase of their ionic character.
 K-F, Br-Br, N-O, C-F, Ca-O
- A) Br-Br < N-O < C-F < Ca-O < K-F
 B) K-F < Ca-O < C-F < N-O < Br-Br
 C) C-F < N-O < Br-Br < K-F < Ca-O
 D) Br-Br < Ca-O < K-F < N-O < C-F
 E) K-F < Br-Br < N-O < C-F < Ca-O
16. Which of the following molecule(s) will exhibit resonance structure(s)?
 I. NO_3^- II. Br_3^- III. O_3
- A) I and III
 B) I only
 C) II only
 D) III only
 E) All of them
17. Valence bond theory predicts that carbon will use _____ hybrid orbitals in the carbonate anion, CO_3^{2-} .
- A) sp^2
 B) sp
 C) sp^3
 D) sp^3d
 E) sp^3d^2

18. Identify the nonpolar molecules in the following group:
I. SO_2 II. NH_3 III. XeCl_2 IV. CO_2
- A) III and IV
B) I, III and IV
C) II, III
D) IV only
E) I only
19. What is the molecular shape of the IBr_3 molecule?
- A) T-shaped
B) tetrahedral
C) bent
D) trigonal planar
E) distorted tetrahedral (see-saw)
20. Complete this sentence:
The PCl_5 molecule has
- A) polar bonds, but it is a nonpolar molecule.
B) sp^3d^2 hybridization for the P atom.
C) a distorted tetrahedral (or see-saw) structure.
D) two lone pairs of electrons on each Cl atom.
E) one lone pair of electrons on the central atom (P).

Answer Key

1. A
2. A
3. A
4. A
5. A
6. A
7. A
8. A
9. A
10. A
11. A
12. A
13. A
14. A
15. A
16. A
17. A
18. A
19. A
20. A