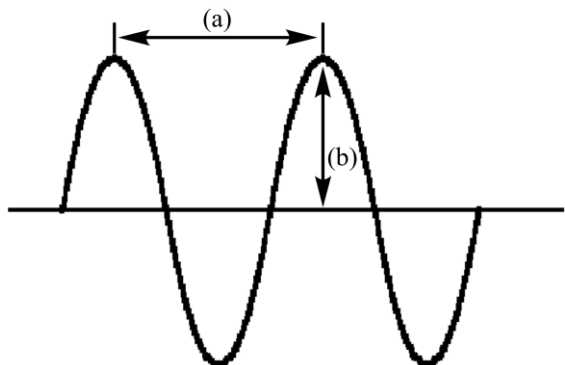


CHEM 1411 – STUDY-GUIDE-for-TEST-3

(CHAPTERS 7, 8)

1. In the following diagram of a wave



- A) (a) is amplitude and (b) is wavelength D) (a) is amplitude and (b) is frequency
B) (a) is frequency and (b) is amplitude E) (a) is wavelength and (b) is amplitude
C) (a) is wavelength and (b) is frequency

Ans: E

2. What is the wavelength of radiation that has a frequency of $5.39 \times 10^{14} \text{ s}^{-1}$? ($c = 2.9979 \times 10^8 \text{ m/s}$)
A) $1.80 \times 10^{-3} \text{ nm}$ B) 556 nm C) 618 nm D) 6180 nm E) $1.61 \times 10^{23} \text{ nm}$

Ans: B

3. In an electron microscope, electrons are accelerated to great velocities. Calculate the wavelength of an electron traveling with a velocity of 7.0×10^3 kilometers per second. The mass of an electron is $9.1 \times 10^{-28} \text{ g}$.
A) $1.0 \times 10^{-13} \text{ m}$ B) $1.0 \times 10^{-10} \text{ m}$ C) $1.0 \times 10^{-7} \text{ m}$ D) 1.0 m

Ans: B

4. When photons with a wavelength of 310. nm strike a magnesium plate, the maximum velocity of the ejected electrons is $3.45 \times 10^5 \text{ m/s}$. Calculate the binding energy of electrons to the magnesium surface.
A) 32.7 kJ/mol D) 386 kJ/mol
B) 321 kJ/mol E) 419 kJ/mol
C) 353 kJ/mol

Ans: C

5. Which one of the following sets of quantum numbers is not possible?

| | n | l | m_l | m_s |
|----|-----|-----|-------|-------|
| A. | 4 | 3 | -2 | +1/2 |
| B. | 3 | 2 | -3 | -1/2 |
| C. | 3 | 0 | 0 | +1/2 |
| D. | 4 | 1 | 1 | -1/2 |
| E. | 2 | 0 | 0 | +1/2 |

A) A B) B C) C D) D E) E

Ans: B

6. List the following sets of quantum numbers in order of increasing energy:

I. $n = 4, l = 1, m_l = 1, m_s = +1/2$

II. $n = 3, l = 2, m_l = -1, m_s = +1/2$

III. $n = 4, l = 0, m_l = 0, m_s = +1/2$

A) I < II < III B) II < III < I C) III < II < I D) I < III < II E) III < I < II

Ans: C

7. What is the maximum number of electrons in an atom that can have the following quantum numbers?

$n = 3, l = 2$

A) 18 B) 10 C) 5 D) 2 E) 1

Ans: B

8. A possible set of quantum numbers to describe an electron in a 3d subshell is

A) $n = 3, l = 0, m_l = 0, m_s = +1/2$

D) $n = 3, l = 3, m_l = 1, m_s = -1/2$

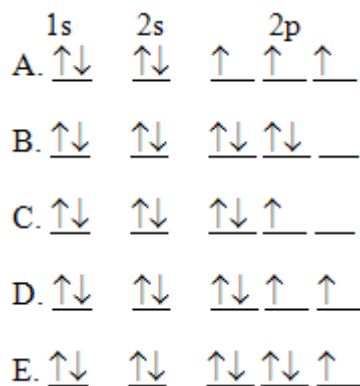
B) $n = 3, l = 1, m_l = 0, m_s = -1/2$

E) $n = 2, l = 0, m_l = 0, m_s = +1/2$

C) $n = 3, l = 2, m_l = 1, m_s = +1/2$

Ans: C

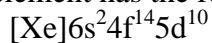
9. The orbital diagram for a ground-state oxygen atom is



A) A B) B C) C D) D E) E

Ans: D

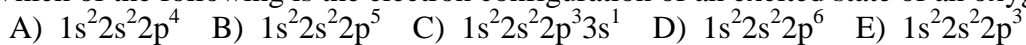
10. Which element has the following ground-state electron configuration?



A) Lu B) Cd C) Hg D) Lr E) Au

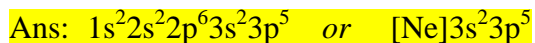
Ans: C

11. Which of the following is the electron configuration of an excited state of an oxygen atom?



Ans: C

12. What is the ground-state electron configuration for chlorine?



13. (TRUE/FALSE) The quantum numbers, $n = 4$, $l = 3$, $m_l = 2$, $m_s = +1/2$, represent an electron in a 4f subshell

Ans: True

14. Which one of the following elements is a Lanthanide?

- A) U B) Ce C) Os D) Bi E) Cs

Ans: B

15. Which of the following is the general electron configuration for the outermost electrons of elements in the alkaline earth group?

- A) ns^1 B) ns^2 C) ns^2np^4 D) ns^2np^5 E) $ns^2np^6(n-1)d^6$

Ans: B

16. The representative elements are those with unfilled energy levels in which the "last electron" was added to

- A) an s orbital. D) a p or d orbital.
B) an s or p orbital. E) an f orbital.
C) a d orbital.

Ans: B

17. Concerning the electron configuration of fluorine, $1s^22s^22p^5$ which of the following represents the core electrons only?

- A) $1s^2$ B) $1s^22s^2$ C) $1s^22s^22p^5$ D) $2s^22p^5$ E) $2p^5$

Ans: A

18. Which one of the following pairs are *isoelectronic*?

- A) Mn^{2+} and Ar D) Cl^- and S
B) Zn^{2+} and Cu^{2+} E) K^+ and Cl^-
C) Na^+ and K^+

Ans: E

19. Which of the following is the electron configuration of a sulfide ion?
 A) $[\text{Ne}]3s^23p^4$ B) $[\text{Ne}]$ C) $[\text{Ne}]3s^23p^1$ D) $[\text{Ar}]$ E) $[\text{Ne}]3s^23p^2$

Ans: D

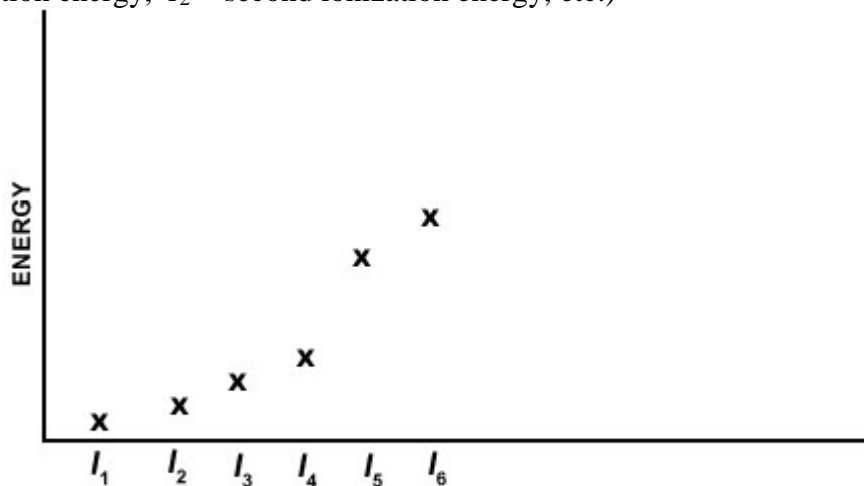
20. Which of the following ground-state ions has unpaired electrons?
 A) P^{3-} B) V^{5+} C) Mg^{2+} D) Sc^{2+} E) S^{2+}

Ans: D

21. For which of the following reactions is the enthalpy change equal to the third ionization energy of vanadium?
 A) $\text{V}^{2+}(\text{g}) \rightarrow \text{V}^{3+}(\text{g}) + \text{e}^-$ D) $\text{V}^{2-}(\text{g}) + \text{e}^- \rightarrow \text{V}^{3-}(\text{g})$
 B) $\text{V}^{3+}(\text{g}) + \text{e}^- \rightarrow \text{V}^{2+}(\text{g})$ E) $\text{V}^{3+}(\text{g}) \rightarrow \text{V}^{4+}(\text{g}) + \text{e}^-$
 C) $\text{V}(\text{g}) \rightarrow \text{V}^{3+}(\text{g}) + 3\text{e}^-$

Ans: A

22. Which of the elements listed below has the following pattern for its first six ionization energies? (I_1 = first ionization energy, I_2 = second ionization energy, etc.)



- A) Ca B) Si C) Al D) Se E) P

Ans: B

23. The electron affinity of fluorine is essentially equal to
- A) the negative of the ionization energy F.
 - B) the ionization energy F^- .
 - C) the negative of the ionization energy F^- .
 - D) the ionization energy Ne.
 - E) the negative of the ionization energy Ne.

Ans: B

24. In a surprisingly large number of their properties, beryllium resembles aluminum and boron resembles silicon. Such a relationship is called
- A) amphoterism.
 - B) an allotropic relationship.
 - C) a diagonal relationship.
 - D) the periodic law.
 - E) an isoelectronic series.

Ans: C

25. Which of the following is a *basic* oxide?
- A) CO_2
 - B) CaO
 - C) SO_2
 - D) H_2O
 - E) NO_2

Ans: B

26. Which of the following elements behaves chemically similarly to potassium?
- A) magnesium
 - B) sodium
 - C) beryllium
 - D) chlorine
 - E) iron

Ans: B

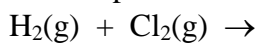
27. Consider the following reaction: $3Li + Z \rightarrow Li_3Z$. What is the formula for the compound if we substitute magnesium for lithium?
- A) MgZ
 - B) Mg_2Z
 - C) MgZ_2
 - D) Mg_3Z
 - E) Mg_3Z_2

Ans: E

28. Which species has the greater radius, an Γ ion or an I atom? Briefly explain your choice of answer.

Ans: Γ ; I and Γ have the same number of protons, but Γ has a greater number of electrons. The additional electron–electron repulsion in Γ causes the radius of the ion to be larger than that of the neutral atom.

29. Write the products of the following reaction:



Ans: $2\text{HCl}(\text{g})$

30. (TRUE/FALSE): *Electron affinity* is always a positive quantity.

Ans: False

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Chapter-9.
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31. Which one of the following is most likely to be an ionic compound?

A) NCl_3 B) BaCl_2 C) CO D) SO_2 E) SF_4

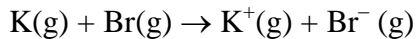
Ans: B

32. The Lewis dot symbol for the calcium ion is

A) $:\text{Ca}:^{2+}$ B) $-\text{Ca}-$ C) $:\overset{\cdot\cdot}{\underset{\cdot\cdot}{\text{Ca}}}:^{2+}$ D) Ca^{2+} E) Ca

Ans: D

33. Calculate the energy change for the reaction



given the following ionization energy (IE) and electron affinity (EA) values

| | IE | EA |
|-----|-------------|------------|
| K: | 419 kJ/mol | 48 kJ/mol |
| Br: | 1140 kJ/mol | 324 kJ/mol |

- A) -1,092 kJ/mol D) 1,092 kJ/mol
B) -95 kJ/mol E) 1,187 kJ/mol
C) 95 kJ/mol

Ans: C

34. Which of the elements listed below would most likely form an *ionic bond* when bonded to oxygen?

- A) Cl B) C C) O D) H E) Ca

Ans: E

35. Arrange the elements C, O, and H in order of increasing electronegativity

- A) C < O < H
B) H < C < O
C) C < H < O
D) O < C < H
E) H < O < C

Ans: B

36. A polar covalent bond would form in which one of the following pairs of atoms?

- A) Cl — Cl B) Si — Si C) Ca — Cl D) Cr — Br E) P — Cl

Ans: E

37. Classify the C — Cl bond in CCl_4 as ionic, polar covalent, or nonpolar covalent.
A) ionic B) polar covalent C) nonpolar covalent

Ans: B

38. The total number of valence electrons in the molecule P_2O_5 is
A) 11 B) 22 C) 23 D) 40 E) 70

Ans: D

39. Which of the following ionic solids would have the largest lattice energy?
A) KF B) KI C) LiF D) LiI E) NaF

Ans: C

40. Which one of the following is most likely to be a covalent compound?
A) Rb_2O B) BaO C) SrO D) SeO_2 E) MnO_2

Ans: D

CHEM 1411 Formulas and Constants

mass of proton = 1.00728 amu

mass of neutron = 1.00866 amu

$c = 3.00 \times 10^8$ m/s

$F = 96500$ C/(mol of e^-) = 96500 J/(V mol of e^-)

$K = ^\circ C + 273.15$

$R = 0.08206$ (L atm)/(mol K) = 8.314 J/(mol K)

1 g = 6.022×10^{23} amu

1 atm = 760 mm Hg

1 mL = 1 cm³

Temperature scales/Conversion:

-
- $T_K = T_C + 273$ (Celsius to Kelvin)
 - $T_C = T_K - 273$ (Kelvin to Celsius)
 - $T_F = (1.8 \times T_C) + 32$ (Celsius to Fahrenheit)
 - $T_C = (T_F - 32) / 1.8$ (Fahrenheit to Celsius)
-

Percent by mass =
$$\frac{\text{mass of solute}}{[\text{mass of solute} + \text{mass of solvent}]} \times 100\%$$

Two-component solution:

Mole fraction of solute A: $X_A = \frac{\text{moles of solute A}}{\text{moles of solute A} + \text{moles of solvent B}}$

Molarity = number of moles of solute in 1 L of solution:

Molarity =
$$\frac{\text{moles of solute}}{\text{Liters of solution}}$$

Molality = number of moles of solute dissolved in 1 kg (1000 g) of solvent:

Molality =
$$\frac{\text{moles of solute}}{\text{Mass of solvent (1 kg)}}$$

Density = Mass / Volume.