

Name _____

1) Chlorine (atomic number = 17) has the electronic configuration: _____.

- A) $1s^2 2s^2 2p^6 2d^6 3s^1$
- B) $1s^2 2s^2 2p^6 3s^2 3d^5$
- C) $1s^2 2s^2 2p^6 2d^5 3s^2$
- D) $1s^2 2s^2 2p^6 3s^2 3p^5$
- E) $1s^2 2s^2 2d^{10} 3s^2$

2) The complete electron configuration of argon, element 18, is _____.

- A) $1s^6 2s^6 2p^2 3s^4$
- B) $1s^4 2s^4 2p^{10}$
- C) $1s^2 2s^2 2p^6 3s^2 3p^6$
- D) $1s^2 2s^2 2p^{10} 3s^2 3p^2$
- E) $1s^4 2s^4 2p^6 3s^4$

3) The condensed electron configuration of silicon, element 14, is _____.

- A) $[\text{Ne}]2p^{10}$
- B) $[\text{He}]2s^6 2p^2$
- C) $[\text{He}]2s^4$
- D) $[\text{Ne}]3s^2 3p^2$
- E) $[\text{He}]2s^4 2p^6$

4) Give the ground state electron configuration for Cd.

- A) $[\text{Kr}]5s^2 4d^{10}$
- B) $[\text{Kr}]5s^2 5d^{10}$
- C) $[\text{Kr}]4d^{10} 5s^2$
- D) $[\text{Kr}]5s^2 4d^{10} 5p^2$
- E) $[\text{Kr}]4d^{10}$

5) Give the ground state electron configuration for Pb.

- A) $[\text{Xe}]6s^2 5d^{10} 6p^2$
- B) $[\text{Xe}]4f^{14} 5d^{10} 6p^2 6s^2$
- C) $[\text{Xe}]6s^2 6p^2$
- D) $[\text{Xe}]6s^2 4f^{14} 5d^{10} 6s^2 6p^2$
- E) $[\text{Xe}]6s^2 5f^{14} 6d^{10} 6p^2$

6) Choose the ground state electron configuration for Zn^{2+} .

- A) $[\text{Ar}]4s^2 3d^8$
- B) $[\text{Ar}]$
- C) $[\text{Ar}]4s^2 3d^6$
- D) $[\text{Ar}]3d^{10}$
- E) $[\text{Ar}]3d^8$

7) How many unpaired electrons are present in the ground state Kr atom?

- A) 1
- B) 5
- C) 0
- D) 3
- E) 2

8) How many unpaired electrons are present in the ground state Ge atom?

- A) 3
- B) 1
- C) 2
- D) 0
- E) 4

9) Place the following elements in order of increasing atomic radius.

P Ba Cl

- A) Ba < Cl < P
- B) Cl < P < Ba
- C) P < Cl < Ba
- D) Cl < Ba < P
- E) Ba < P < Cl

10) Place the following in order of decreasing radius.

Te²⁻ F⁻ O²⁻

- A) F⁻ > Te²⁻ > O²⁻
- B) F⁻ > O²⁻ > Te²⁻
- C) Te²⁻ > O²⁻ > F⁻
- D) O²⁻ > F⁻ > Te²⁻
- E) Te²⁻ > F⁻ > O²⁻

11) Which reaction below represents the second electron affinity of S?

- A) S(g) → S⁺(g) + e⁻
- B) S⁻(g) → S(g) + e⁻
- C) S²⁻(g) → S⁻(g) + e⁻
- D) S⁻(g) + e⁻ → S²⁻(g)
- E) S(g) + e⁻ → S⁻(g)

12) Which ionization process requires the most energy?

- A) O(g) → O⁺(g) + e⁻
- B) F⁺(g) → F²⁺(g) + e⁻
- C) F(g) → F⁺(g) + e⁻
- D) O⁺(g) → O²⁺(g) + e⁻

13) Which of the following represent the Lewis structure for S^{2-} ?

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

14) Which of the following reactions is associated with the lattice energy of Li_2O (ΔH°_{latt})?

- A) $2 Li^+(aq) + O^{2-}(aq) \rightarrow Li_2O(s)$
- B) $2 Li^+(g) + O^{2-}(g) \rightarrow Li_2O(s)$
- C) $Li_2O(s) \rightarrow 2 Li^+(aq) + O^{2-}(aq)$
- D) $2 Li(s) + \frac{1}{2} O_2(g) \rightarrow Li_2O(s)$
- E) $Li_2O(s) \rightarrow 2 Li^+(g) + O^{2-}(g)$

15) Identify the compound with the highest magnitude of lattice energy.

- A) NaCl
- B) CsCl
- C) LiCl
- D) KCl

16) A double covalent bond contains _____ of electrons.

- A) 0 pairs
- B) 1 pair
- C) 4 pairs
- D) 2 pairs
- E) 3 pairs

17) Place the following elements in order of **decreasing** electronegativity.

- S Cl Se
- A) $Cl > Se > S$
 - B) $S > Cl > Se$
 - C) $Se > S > Cl$
 - D) $Cl > S > Se$
 - E) $Se > Cl > S$

18) Which molecule or compound below contains a pure covalent bond?

- A) PF_3
- B) Li_2CO_3
- C) NaCl
- D) SCl_6
- E) Cl_2

19) Choose the best Lewis structure for BeF₂.

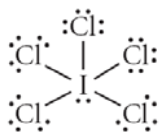
- A) $\text{:}\ddot{\text{F}}\text{---}\ddot{\text{Be}}\text{---}\ddot{\text{F}}\text{:}$
B) $\text{:}\ddot{\text{F}}\text{=Be}=\ddot{\text{F}}\text{:}$
C) $\text{:}\ddot{\text{F}}\text{---Be}=\ddot{\text{F}}\text{:}$
D) $\text{:}\ddot{\text{F}}\text{---}\ddot{\text{Be}}\text{---}\ddot{\text{F}}\text{:}$
E) $\text{:}\ddot{\text{F}}\text{---Be---}\ddot{\text{F}}\text{:}$

20) Choose the best Lewis structure for OCl₂.

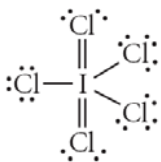
- A) $\text{:}\ddot{\text{Cl}}\text{=O}=\ddot{\text{Cl}}\text{:}$
B) $\text{:}\ddot{\text{Cl}}\text{=}\ddot{\text{O}}\text{---}\ddot{\text{Cl}}\text{:}$
C) $\text{:}\ddot{\text{Cl}}\text{---}\ddot{\text{O}}\text{---}\ddot{\text{Cl}}\text{:}$
D) $\text{:}\ddot{\text{Cl}}\text{---}\ddot{\text{O}}\text{=Cl}\text{:}$
E) $\text{:}\ddot{\text{Cl}}\text{=}\ddot{\text{O}}\text{=Cl}\text{:}$

21) Choose the best Lewis structure for ICl₅.

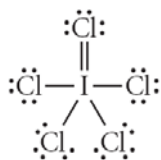
A)



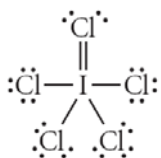
B)



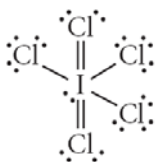
C)



D)



E)



22) Draw the Lewis structure for NO_2^- including any valid resonance structures. Which of the following statements is TRUE?

- A) The nitrite ion contains two $\text{N}=\text{O}$ double bonds.
- B) The nitrite ion contains two $\text{N}-\text{O}$ bonds that are equivalent to $1\frac{1}{2}$ bonds.
- C) The nitrite ion contains one $\text{N}-\text{O}$ single bond and one $\text{N}=\text{O}$ double bond.
- D) The nitrite ion contains two $\text{N}-\text{O}$ single bonds.
- E) None of the above are true.

23) How many of the following elements can form compounds with an expanded octet?

Pb Kr Si B

- A) 1
- B) 3
- C) 4
- D) 0
- E) 2

24) Choose the bond below that is the **strongest**.

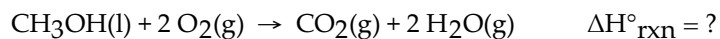
- A) $\text{N}=\text{O}$
- B) $\text{N}-\text{I}$
- C) $\text{N}-\text{S}$
- D) $\text{N}=\text{N}$
- E) $\text{N}-\text{O}$

25) Place the following in order of **decreasing** bond length.

H-F H-I H-Br

- A) $\text{H}-\text{I} > \text{H}-\text{Br} > \text{H}-\text{F}$
- B) $\text{H}-\text{F} > \text{H}-\text{I} > \text{H}-\text{Br}$
- C) $\text{H}-\text{I} > \text{H}-\text{F} > \text{H}-\text{Br}$
- D) $\text{H}-\text{Br} > \text{H}-\text{F} > \text{H}-\text{I}$
- E) $\text{H}-\text{F} > \text{H}-\text{Br} > \text{H}-\text{I}$

26) Use the bond energies provided to estimate $\Delta H^\circ_{\text{rxn}}$ for the reaction below.



| <u>Bond</u> | <u>Bond Energy (kJ/mol)</u> |
|-------------|-----------------------------|
| C-H | 414 |
| C-O | 360 |
| C=O | 799 |
| O=O | 498 |
| O-H | 464 |

- A) -91 kJ
- B) +473 kJ
- C) -486 kJ
- D) -392 kJ
- E) +206 kJ

27) Choose the INCORRECT statement.

- A) Pairs of electrons not involved in bonding are called lone pairs.
- B) In a Lewis structure, a covalent bond can be represented by a pair of electrons or a dash.
- C) Three electron pairs involved in a bond produce a triple bond.
- D) Two electrons involved in a bond produce a double bond.
- E) A molecule of two atoms is called a diatomic molecule.

28) Based on the Lewis structures, which of the following molecules would you expect to exhibit resonance?

- A) LiH
- B) HNO₂
- C) CH₄
- D) OF₂
- E) none of these

29) Which of the following molecules is nonpolar?

- A) HCN
- B) HClO₄
- C) CHCl₃
- D) BCl₃
- E) H₂O

30) Which of the following molecules is polar?

- A) CS₂
- B) NH₄⁺
- C) PCl₅
- D) NBr₃
- E) CH₄

31) What is the formal charge on N in NO₃⁻?

- A) 0
- B) +2
- C) +1
- D) -1
- E) -2

32) Which of the following resonance structures for OCN⁻ will contribute most to the correct structure of OCN⁻?

- A) O(1 lone pair)≡C-N(3 lone pairs)
- B) O(2 lone pairs)=C=N (2 lone pairs)
- C) O(1 lone pair)=C(2 lp)=N(1 lone pair)
- D) O(3 lone pairs)-C≡N(with 1 lone pair)
- E) They all contribute equally to the correct structure of OCN⁻.

33) Give the approximate bond angle for a molecule with a trigonal planar shape.

- A) 105°
- B) 109.5°
- C) 90°
- D) 180°
- E) 120°

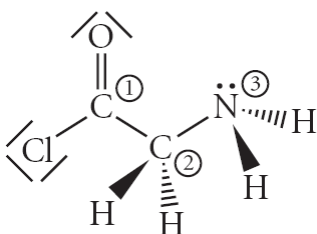
34) Determine the electron geometry (eg) and molecular geometry (mg) of BrF_3 .

- A) eg=trigonal bipyramidal, mg=see-saw
- B) eg=tetrahedral, mg=trigonal pyramidal
- C) eg=trigonal bipyramidal, mg= T-shape
- D) eg=trigonal planar, mg=trigonal planar
- E) eg=trigonal planar, mg=bent

35) Determine the electron geometry (eg) and molecular geometry (mg) of XeF_2 .

- A) eg=trigonal bipyramidal, mg=bent
- B) eg=linear, mg=linear
- C) eg=tetrahedral, mg=linear
- D) eg=tetrahedral, mg=bent
- E) eg=trigonal bipyramidal, mg=linear

36) Consider the molecule below. Determine the molecular geometry at each of the 3 labeled atoms.



- A) 1=tetrahedral, 2=tetrahedral, 3=trigonal planar
- B) 1=trigonal planar, 2=tetrahedral, 3=trigonal pyramidal
- C) 1=tetrahedral, 2=tetrahedral, 3=tetrahedral
- D) 1=trigonal planar, 2=tetrahedral, 3=tetrahedral
- E) 1=trigonal planar, 2=trigonal pyramidal, 3=trigonal pyramidal

37) Determine the electron geometry (eg), molecular geometry (mg), and polarity of SO_2 .

- A) eg=tetrahedral, mg=tetrahedral, nonpolar
- B) eg=trigonal planar, mg=bent, polar
- C) eg=tetrahedral, mg=bent, polar
- D) eg=linear, mg=linear, nonpolar
- E) eg=trigonal pyramidal, mg=trigonal pyramidal, polar

38) Describe a pi bond.

- A) p orbital overlapping with a d orbital
- B) side by side overlap of p orbitals
- C) overlap of two s orbitals
- D) end to end overlap of p orbitals
- E) s orbital overlapping with the end of a p orbital

39) Identify the number of electron groups around a molecule with sp hybridization.

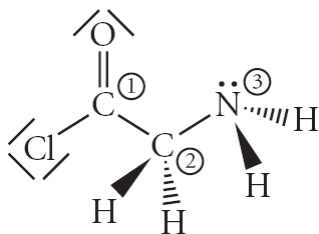
- A) 5
- B) 1
- C) 3
- D) 2
- E) 4

40) A molecule containing a central atom with sp^3d hybridization has a(n) _____ electron geometry.
 A) octahedral
 B) tetrahedral
 C) trigonal planar
 D) trigonal bipyramidal
 E) linear

41) Draw the Lewis structure for SO_3 . What is the hybridization on the S atom?
 A) sp^3d^2
 B) sp^3d
 C) sp^3
 D) sp^2
 E) sp

42) Draw the Lewis structure for BrF_5 . What is the hybridization on the Br atom?
 A) sp^2
 B) sp^3d^2
 C) sp^3d
 D) sp^3
 E) sp

43) Consider the molecule below. Determine the hybridization at each of the 3 labeled atoms.



- A) 1= sp , 2= sp^2 , 3= sp^2
 B) 1= sp^2 , 2= sp^3 , 3= sp^3
 C) 1= sp^2 , 2= sp^3 , 3= sp^2
 D) 1= sp^3 , 2= sp^3 , 3= sp^2
 E) 1= sp^3 , 2= sp^3 , 3= sp^3

44) Draw the Lewis structure for the molecule CH_2CHCH_3 . How many sigma and pi bonds does it contain?
 A) 9 sigma, 0 pi
 B) 8 sigma, 2 pi
 C) 9 sigma, 1 pi
 D) 7 sigma, 2 pi
 E) 8 sigma, 1 pi

- 45) What volume of a 0.716 M KBr solution is needed to provide 30.5 g of KBr?
- A) 21.8 mL
 - B) 42.7 mL
 - C) 357 mL
 - D) 184 mL
- 46) A solution is prepared by dissolving 16.2 g of benzene (C_6H_6) in 282 g of carbon tetrachloride (CCl_4). The concentration of benzene in this solution is _____ molal. The molar masses of C_6H_6 and CCl_4 are 78.1 g/mol and 154 g/mol, respectively.
- A) 0.736
 - B) 0.0543
 - C) 0.102
 - D) 7.36×10^{-4}
 - E) 5.43
- 47) How much water must be added to 40.0 g of $CaCl_2$ to produce a solution that is 35.0 wt% $CaCl_2$?
- A) 87.5 g
 - B) 54.0 g
 - C) 114 g
 - D) 74.2 g
- 48) At 20°C, a 0.376 M aqueous solution of ammonium chloride has a density of 1.0045 g/mL. What is the mass % of ammonium chloride in the solution? The formula weight of NH_4Cl is 53.50 g/mol.
- A) 0.381
 - B) 2.00
 - C) 0.374
 - D) 2.68
 - E) 0.705
- 49) Identify the colligative property.
- A) boiling point elevation
 - B) osmotic pressure
 - C) freezing point depression
 - D) vapor pressure lowering
 - E) all of the above
- 50) Calculate the molality of a solution formed by dissolving 27.8 g of LiI in 500.0 mL of water.
- A) 0.241 *m*
 - B) 0.394 *m*
 - C) 0.254 *m*
 - D) 0.415 *m*
 - E) 0.556 *m*
- 51) Determine the vapor pressure of a solution at 55°C that contains 34.2 g NaCl in 375 mL of water. The vapor pressure of pure water at 55°C is 118.1 torr.
- A) 87.1 torr
 - B) 112 torr
 - C) 108 torr
 - D) 115 torr
 - E) 92.8 torr

52) Determine the freezing point of a solution that contains 78.8 g of naphthalene ($C_{10}H_8$, molar mass = 128.16 g/mol) dissolved in 722 mL of benzene ($d = 0.877$ g/mL). Pure benzene has a melting point of $5.50^\circ C$ and a freezing point depression constant of $4.90^\circ C/m$.

- A) $0.74^\circ C$
- B) $1.33^\circ C$
- C) $4.17^\circ C$
- D) $1.68^\circ C$
- E) $4.76^\circ C$

53) Place the following solutions in order of **increasing** osmotic pressure.

I. 0.15 M $C_2H_6O_2$

II. 0.15 M $MgCl_2$

III. 0.15 M $NaCl$

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

54) Identify the solute with the highest van't Hoff factor.

- A) $MgCl_2$
- B) $MgSO_4$
- C) $NaCl$
- D) nonelectrolyte
- E) $FeCl_3$

55) Choose the aqueous solution that has the highest boiling point. These are all solutions of nonvolatile solutes and you should assume ideal van't Hoff factors where applicable.

- A) 0.100 *m* $NaCl$
- B) 0.100 *m* $C_6H_{12}O_6$
- C) 0.100 *m* $AlCl_3$
- D) 0.100 *m* $MgCl_2$
- E) They all have the same boiling point.

Answer Key

Testname: 1AEX3RPF11

- 1) D
Page Ref:
Reference: Section 8-11
- 2) C
Page Ref: 8.4
Reference:
- 3) D
Page Ref: 8.4
Reference:
- 4) C
Page Ref: 8.4
Reference:
- 5) B
Page Ref: 8.4
Reference:
- 6) D
Page Ref: 8.7
Reference:
- 7) C
Page Ref: 8.4
Reference:
- 8) C
Page Ref: 8.4
Reference:
- 9) B
Page Ref: 8.6
Reference:
- 10) C
Page Ref: 8.7
Reference:
- 11) D
Page Ref: 8.8
Reference:
- 12) B
Page Ref: 8.7
Reference:
- 13) C
Page Ref: 9.4
Reference:
- 14) B
Page Ref: 9.4
Reference:
- 15) C
Page Ref: 9.4
Reference:
- 16) D
Page Ref: 9.5
Reference:

Answer Key

Testname: 1AEX3RPF11

- 17) D
Page Ref: 9.6
Reference:
- 18) E
Page Ref: 9.6
Reference:
- 19) E
Page Ref: 9.7
Reference:
- 20) C
Page Ref: 9.7
Reference:
- 21) A
Page Ref: 9.7
Reference:
- 22) B
Page Ref: 9.8
Reference:
- 23) B
Page Ref: 9.9
Reference:
- 24) A
Page Ref: 9.10
Reference:
- 25) A
Page Ref: 9.10
Reference:
- 26) D
Page Ref: 9.10
Reference:
- 27) D
Page Ref:
Reference: Section 10-2
- 28) B
Page Ref:
Reference: Section 10-5
- 29) D
Page Ref:
Reference: Section 10-7
- 30) D
Page Ref:
Reference: Section 10-7
- 31) C
Page Ref:
Reference: Section 10-4
- 32) D
Page Ref: 9.8
Reference:

Answer Key

Testname: 1AEX3RPF11

33) E

Page Ref: 10.2

Reference:

34) C

Page Ref: 10.4

Reference:

35) E

Page Ref: 10.4

Reference:

36) B

Page Ref: 10.4

Reference:

37) B

Page Ref: 10.5

Reference:

38) B

Page Ref: 10.7

Reference:

39) D

Page Ref: 10.7

Reference:

40) D

Page Ref: 10.7

Reference:

41) D

Page Ref: 10.7

Reference:

42) B

Page Ref: 10.7

Reference:

43) B

Page Ref: 10.7

Reference:

44) E

Page Ref: 10.7

Reference:

45) C

Page Ref: 12.5

Reference:

46) A

Page Ref: 12.5

Reference:

47) D

Page Ref: 12.5

Reference:

48) B

Page Ref: 12.5

Reference:

Answer Key

Testname: 1AEX3RPF11

49) E

Page Ref: 12.5

Reference:

50) D

Page Ref: 12.5

Reference:

51) D

Page Ref: 12.6

Reference:

52) A

Page Ref: 12.6

Reference:

53) D

Page Ref: 12.6

Reference:

54) E

Page Ref: 12.6

Reference:

55) C

Page Ref: 12.7

Reference: