108-2nd Chem Exam (A)

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

1) The photoelectric effect is _____.
   A) the production of current by silicon solar cells when exposed to sunlight
   B) the darkening of photographic film when exposed to an electric field
   C) the total reflection of light by metals giving them their typical luster
   D) a relativistic effect
   E) the ejection of electrons by a metal when struck with light of sufficient energy

   Answer: E

2) In the Bohr model of the atom, _____.
   A) electron energies are quantized
   B) electron paths are controlled by probability
   C) electrons can have any energy
   D) electrons travel in circular paths called orbitals
   E) both A and C

   Answer: A

3) Of the following transitions in the Bohr hydrogen atom, the _____ transition results in the emission of the highest-energy photon.
   A) n = 6 → n = 3
   B) n = 6 → n = 1
   C) n = 1 → n = 4
   D) n = 3 → n = 6
   E) n = 1 → n = 6

   Answer: B

4) The uncertainty principle states that _____.
   A) there can only be one uncertain digit in a reported number
   B) it is impossible to know how many electrons there are in an atom
   C) it is impossible to know anything with certainty
   D) it is impossible to know the exact position and momentum of an electron
   E) matter and energy are really the same thing

   Answer: D

5) Which one of the following is <u>not</u> a valid value for the magnetic quantum number of an electron in a 5d subshell?
   A) 3 B) 0 C) 2 D) 1 E) -1

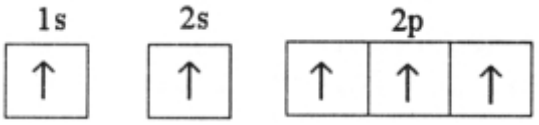
   Answer: A

6) An electron cannot have the quantum numbers n = _____, l = _____, m_l = _____.
   A) 1, 0, 0 B) 6, 1, 0 C) 3, 2, 3 D) 3, 2, -2 E) 3, 2, 1

   Answer: C

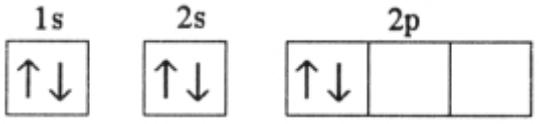
7) Which electron configuration represents a violation of the Pauli exclusion principle?

A)

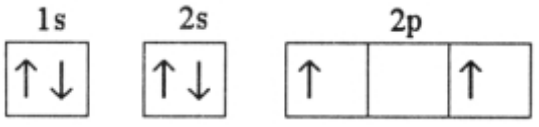


B)

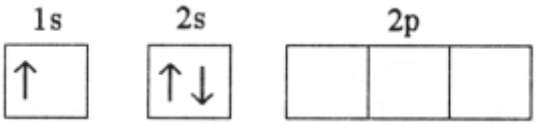
C)



D)



E)



Answer: B

8) The ground state electron configuration of Ga is _____.

A) $[Ar]4s^2 3d^{11}$

B) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^1$

C) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4d^1$

D) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 4d^{10} 4p^1$

E) $1s^2 2s^2 3s^2 3p^6 4s^2 3d^{10} 4p^1$

Answer: B

9) What is the frequency (s^{-1}) of a photon that has an energy of 4.38×10^{-18} J?

Rydberg constant = 1.096776×10^7 m^{-1} ; Planck constant = 6.626×10^{-34} J-s

A) 1.45×10^{-16} B) 1.31×10^{-9} C) 6.61×10^{15} D) 436 E) 2.30×10^7

Answer: C

10) The n = 8 to n = 4 transition in the Bohr hydrogen atom occurs in the _____ region of the electromagnet spectrum.

Rydberg constant = 1.096776×10^7 m^{-1} ; Planck constant = 6.626×10^{-34} J-s

A) microwave B) X-ray C) infrared D) visible E) ultraviolet

Answer: C

11) Which of the following has eight valence electrons?

A) Kr

B) Na^+

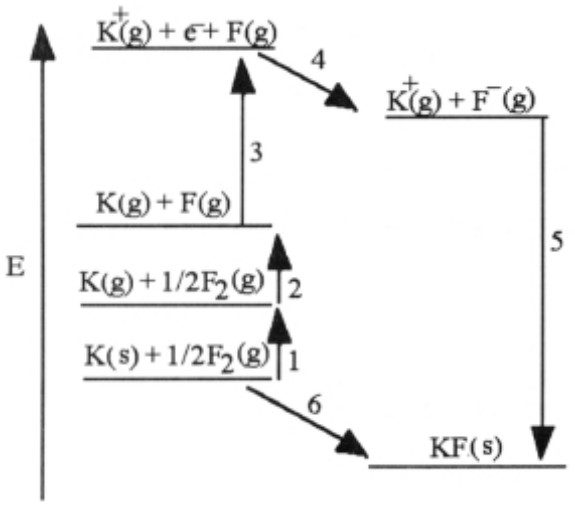
C) Ti^{4+}

D) Cl^-

E) all of the above

Answer: E

The diagram below is the Born-Huber cycle for the formation of crystalline potassium fluoride.



12) Which energy change corresponds to the electron affinity of fluorine?
A) 1 B) 6 C) 5 D) 2 E) 4

Answer: E

13) Of the molecules below, the bond in _____ is the most polar.
A) HBr B) H_2 C) HF D) HI E) HCl

Answer: C

14) The bond length in an HI molecule is 1.61 Å and the measured dipole moment is 0.44 D. What is the magnitude (in units of *e*) of the negative charge on I in HI?
(1 debye = 3.34×10^{-30} coulomb-meters; e=1.6×10^{-19} coulombs)
A) 0.057 B) 0.22 C) 1 D) 9.1 E) 1.6×10^{-19}

Answer: A

15) Resonance structures differ by _____.
A) number of electrons only
B) number of atoms only
C) number and placement of electrons
D) placement of electrons only
E) placement of atoms only

Answer: D

16) Given that the average bond energies for C-H and C-Br bonds are 413 and 276 kJ/mol, respectively, the heat of atomization of bromoform ($CHBr_3$) is _____ kJ/mol.
A) 1241 B) -1378 C) -689 D) 1378 E) 689

Answer: A

17) In the Lewis structure of HCO_3^-, the formal charge on H is _____ and the formal charge on C is _____.
A) 0, 0 B) 0, -1 C) +1, -1 D) -1, -1 E) -1, +1

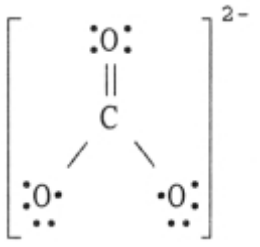
Answer: A

18) How many equivalent resonance forms can be drawn for SO_2 without expanding octet on the sulfur atom (sulfur is the central atom)?
A) 1 B) 3 C) 2 D) 4 E) 0

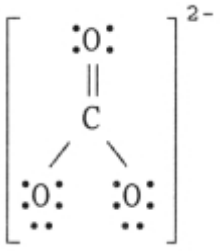
Answer: C

19) The Lewis structure of the CO_3^{2-} ion is _____.

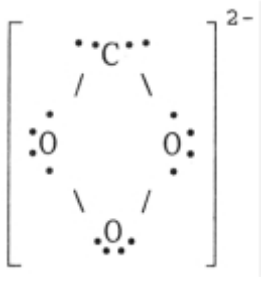
A)



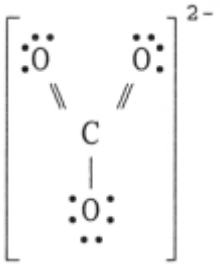
B)



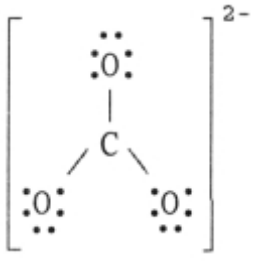
C)



D)



E)



Answer: B

20) Using the table of average bond energies below, the ΔH for the reaction is _____ kJ.

$$H\text{-}C{\equiv}C\text{-}H\ (g) + H\text{-}I\ (g) \rightarrow H_2C{=}CHI\ (g)$$

Bond:	C≡C	C=C	H-I	C-I	C-H
D (kJ/mol):	839	614	299	240	413

A) -931 B) +506 C) -506 D) +129 E) -129

Answer: E

21) At what velocity (m/s) must a 20.0 g object be moving in order to possess a kinetic energy of 1.00 J?

A) 100×10^2 B) 50.0 C) 1.00×10^3 D) 10.0 E) 1.00

Answer: D

22) The internal energy of a system _____.

A) refers only to the energies of the nuclei of the atoms of the component molecules
B) is the sum of the potential and kinetic energies of the components
C) is the sum of the kinetic energy of all of its components
D) is the sum of the rotational, vibrational, and translational energies of all of its components
E) none of the above

Answer: B

23) Which one of the following is an exothermic process?

A) ice melting
B) water evaporating
C) boiling soup
D) condensation of water vapor
E) Ammonium thiocyanate and barium hydroxide are mixed at 25 °C: the temperature drops.

Answer: D

24) Of the following, which one is a state function?

A) heat
B) q
C) H
D) w
E) none of the above

Answer: C

25) A sample of calcium carbonate [$CaCO_3$ (s)] absorbs 45.5 J of heat, upon which the temperature of the sample increases from 21.1 °C to 28.5 °C. If the specific heat of calcium carbonate is 0.82 J/g-K, what is the mass (in grams) of the sample?

A) 5.0×10^3 B) 7.5 C) 410 D) 3.7 E) 5.0

Answer: B

26) The reaction

$$4Al\,(s) + 3O_2\,(g) \rightarrow 2Al_2O_3\,(s) \qquad \Delta H° = -3351\ kJ$$

is _____, and therefore heat is _____ by the reaction.

A) exothermic, absorbed
B) endothermic, released
C) exothermic, released
D) endothermic, absorbed
E) thermoneutral, neither released nor absorbed

Answer: C

27) Consider the following two reactions:

$$A \rightarrow 2B \qquad \Delta H°_{rxn} = 456.7\ kJ/mol$$
$$A \rightarrow C \qquad \Delta H°_{rxn} = -22.1 kJ/mol$$

Determine the enthalpy change for the process:

$$2B \rightarrow C$$

A) 434.6 kJ/mol
B) -478.8 kJ/mol
C) 478.8 kJ/mol
D) -434.6 kJ/mol
E) More information is needed to solve the problem.

Answer: B

28) For the species in the reaction below, $\Delta H_f°$ is zero for _____.

$$2Co\,(s) + H_2\,(g) + 8PF_3\,(g) \rightarrow 2HCo(PF_3)_4\,(l)$$

A) H_2 (g)
B) Co (s)
C) $HCo(PF_3)_4$ (l)
D) PF_3 (g)
E) both Co(s) and H_2 (g)

Answer: E

29) Given the data in the table below, $\Delta H°_{rxn}$ for the reaction

$$4NH_3\,(g) + 5O_2\,(g) \rightarrow 4NO\,(g) + 6H_2O\,(l)$$

is _____ kJ.

Substance	$\Delta H_f°$ (kJ/mol)
H_2O (l)	-286
NO (g)	90
NO_2 (g)	34
HNO_3 (aq)	-207
NH_3 (g)	-46

A) -1172
B) -1892
C) -1540
D) -150
E) The $\Delta H_f°$ of O_2 (g) is needed for the calculation.

Answer: A

30) A slice of apple pie contains 14.0 grams of fat, 2.00 grams of protein, and 52.0 grams of carbohydrate. The respective fuel values for protein, fat, and carbohydrate are 17, 38, and 17 kJ/g, respectively. If cycling typically burns 1000.0 kJ/hour, _____ minutes of cycling are required to completely burn off the slice of pie.

A) 8.25
B) 87.0
C) less than one minute
D) 4.66
E) 1.45

Answer: B

31) The atomic radius of main-group elements generally increases down a group because _____.

A) effective nuclear charge decreases down a group
B) effective nuclear charge increases down a group
C) the principal quantum number of the valence orbitals increases
D) effective nuclear charge zigzags down a group
E) both effective nuclear charge increases down a group and the principal quantum number of the valence orbitals increases

Answer: C

32) Of the following, which gives the correct order for atomic radius for Mg, Na, P, Si and Ar?

A) Na > Mg > Si > P > Ar
B) Si > P > Ar > Na > Mg
C) Ar > P > Si > Mg > Na
D) Mg > Na > P > Si > Ar
E) Ar > Si > P > Na > Mg

Answer: A

33) Which of the following is an isoelectronic series?

A) F^-, Cl^-, Br^-, I^-
B) S, Cl, Ar, K
C) O^{2-}, F^-, Ne, Na^+
D) Si^{2-}, P^{2-}, S^{2-}, Cl^{2-}
E) B^{5-}, Si^{4-}, As^{3-}, Te^{2-}

Answer: C

34) Which of the following correctly represents the <u>third</u> ionization of aluminum?

A) $Al^{-2}(g) + e^- \rightarrow Al^{3-}(g)$
B) $Al^{+2}(g) + e^- \rightarrow Al^{3+}(g)$
C) $Al(g) \rightarrow Al^+(g) + e^-$
D) $Al^{+2}(g) + e^- \rightarrow Al^{+1}(g)$
E) $Al^{+2}(g) \rightarrow Al^{3+}(g) + e^-$

Answer: E

35) Of the following elements, _____ has the most negative electron affinity.

A) Al B) B C) P D) Si E) Cl

Answer: E

36) Of the elements below, _____ is the most metallic.

A) Mg B) Al C) Ar D) K E) Na

Answer: D

37) Consider the general valence electron configuration of ns^2np^5 and the following statements:

(i) Elements with this electron configuration are expected to form -1 anions.
(ii) Elements with this electron configuration are expected to have large positive electron affinities.
(iii) Elements with this electron configuration are nonmetals.
(iv) Elements with this electron configuration form acidic oxides.

Which statements are true?

A) (i) and (ii)
B) (i), (iii,) and (iv)
C) (ii) and (iii)
D) (i), (ii), and (iii)
E) All statements are true.

Answer: B

38) _____ is credited with developing the concept of atomic numbers.

A) Henry Moseley
B) Dmitri Mendeleev
C) Ernest Rutherford
D) Michael Faraday
E) Lothar Meyer

Answer: A

39) Consider the following properties of an element:

(i) It is solid at room temperature.
(ii) It easily forms an oxide when exposed to air.
(iii) When it reacts with water, hydrogen gas evolves.
(iv) It must be stored submerged in oil.

Which element fits the above description the best?

A) sulfur B) sodium C) copper D) magnesium E) mercury

Answer: B

40) All of the following are ionic compounds except _____.

A) Li_3N B) K_2O C) SiO_2 D) NaCl E) Na_2SO_4

Answer: C