111-1 semester General Chemistry Midterm Exam (A)-20221102

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

1) The net ionic equation for formation of an aqueous solution of NiI_2 accompanied by evolution of CO_2 gas via mixing solid $NiCO_3$ and aqueous hydriodic acid is _____.
   A) $2NiCO_3\,(s) + HI\,(aq) \rightarrow 2H_2O\,(l) + CO_2\,(g) + 2Ni^{2+}\,(aq)$
   B) $NiCO_3\,(s) + 2HI\,(aq) \rightarrow H_2O\,(l) + CO_2\,(g) + Ni^{2+}\,(aq) + 2I^-\,(aq)$
   C) $NiCO_3\,(s) + 2H^+\,(aq) \rightarrow H_2O\,(l) + CO_2\,(g) + Ni^{2+}\,(aq)$
   D) $NiCO_3\,(s) + 2HI\,(aq) \rightarrow 2H_2O\,(l) + CO_2\,(g) + NiI_2\,(aq)$
   E) $NiCO_3\,(s) + I^-\,(aq) \rightarrow 2H_2O\,(l) + CO_2\,(g) + Ni^{2+}\,(aq) + HI\,(aq)$

   Answer: C

2) Which one of the following is a diprotic acid?
   A) sulfuric acid
   B) phosphoric acid
   C) nitric acid
   D) hydrofluoric acid
   E) chloric acid

   Answer: A

3) Which one of the following is a weak acid?
   A) $HClO_4$ B) HF C) HCl D) HI E) HNO_3

   Answer: B

4) In which reaction does the oxidation number of oxygen increase?
   A) $MgO\,(s) + H_2O\,(l) \rightarrow Mg(OH)_2\,(s)$
   B) $Ba(NO_3)_2\,(aq) + K_2SO_4\,(aq) \rightarrow BaSO_4\,(s) + 2KNO_3\,(aq)$
   C) $2SO_2\,(g) + O_2\,(g) \rightarrow 2SO_3\,(g)$
   D) $HCl\,(aq) + NaOH\,(aq) \rightarrow NaCl\,(aq) + H_2O\,(l)$
   E) $2H_2O\,(l) \rightarrow 2H_2\,(g) + O_2\,(g)$

   Answer: E

5) Which solution has the same number of moles of NaOH as 50.0 mL of 0.100 M solution of NaOH?
   A) 20.0 mL of 0.200 M solution of NaOH
   B) 25.0 mL of 0.175 M solution of NaOH
   C) 50.0 mL of 0.125 M solution of NaOH
   D) 100.0 mL of 0.0500 M solution of NaOH
   E) 30.0 mL of 0.145 M solution of NaOH

   Answer: D

6) One method for removal of metal ions from a solution is to convert the metal to its elemental form so it can be filtered out as a solid. Which metal can be used to remove aluminum ions from solution?
   A) lead
   B) copper
   C) zinc
   D) cobalt
   E) none of these

   Answer: E

TABLE 4.5 Activity Series of Metals in Aqueous Solution

Metal	Oxidation Reaction
Lithium	$Li(s) \longrightarrow Li^+(aq) + e^-$
Potassium	$K(s) \longrightarrow K^+(aq) + e^-$
Barium	$Ba(s) \longrightarrow Ba^{2+}(aq) + 2e^-$
Calcium	$Ca(s) \longrightarrow Ca^{2+}(aq) + 2e^-$
Sodium	$Na(s) \longrightarrow Na^+(aq) + e^-$
Magnesium	$Mg(s) \longrightarrow Mg^{2+}(aq) + 2e^-$
Aluminum	$Al(s) \longrightarrow Al^{3+}(aq) + 3e^-$
Manganese	$Mn(s) \longrightarrow Mn^{2+}(aq) + 2e^-$
Zinc	$Zn(s) \longrightarrow Zn^{2+}(aq) + 2e^-$
Chromium	$Cr(s) \longrightarrow Cr^{3+}(aq) + 3e^-$
Iron	$Fe(s) \longrightarrow Fe^{2+}(aq) + 2e^-$
Cobalt	$Co(s) \longrightarrow Co^{2+}(aq) + 2e^-$
Nickel	$Ni(s) \longrightarrow Ni^{2+}(aq) + 2e^-$
Tin	$Sn(s) \longrightarrow Sn^{2+}(aq) + 2e^-$
Lead	$Pb(s) \longrightarrow Pb^{2+}(aq) + 2e^-$
Hydrogen	$\mathbf{H_2(g) \longrightarrow 2\,H^+(aq) + 2e^-}$
Copper	$Cu(s) \longrightarrow Cu^{2+}(aq) + 2e^-$
Silver	$Ag(s) \longrightarrow Ag^+(aq) + e^-$
Mercury	$Hg(l) \longrightarrow Hg^{2+}(aq) + 2e^-$
Platinum	$Pt(s) \longrightarrow Pt^{2+}(aq) + 2e^-$
Gold	$Au(s) \longrightarrow Au^{3+}(aq) + 3e^-$

7) When a system _____, ΔE is <u>always</u> negative.
   A) gives off heat and has work done on it
   B) absorbs heat and does work
   C) gives off heat and does work
   D) absorbs heat and has work done on it
   E) None of the above is <u>always</u> negative.

Answer: C

8) Of the following, which one is a state function?
   A) H
   B) q
   C) w
   D) heat
   E) none of the above

Answer: A

9) Which of the following is a statement of the first law of thermodynamics?
   A) $\Delta E = E_{final} - E_{initial}$
   B) Energy lost by the system must be gained by the surroundings.
   C) A negative ΔH corresponds to an exothermic process.
   D) $E_k = \frac{1}{2}mv^2$
   E) 1 cal = 4.184 J (exactly)

Answer: B

10) Which of the following statements is <u>false</u>?
   A) The enthalpy change for a reaction depends on the state of the reactants and products.
   B) The enthalpy of a reaction is equal to the heat of the reaction.
   C) Enthalpy is an intensive property.
   D) The enthalpy change for a reaction is equal in magnitude, but opposite in sign, to the enthalpy change for the reverse reaction.
   E) Internal energy is a state function.

Answer: C

11) 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: C

12) The value of $\Delta H°$ for the reaction below is -6535 kJ. _____ kJ of heat are released in the combustion of 16.0 g of C_6H_6 (l)?

$$2C_6H_6\,(l) + 15O_2\,(g) \rightarrow 12CO_2\,(g) + 6H_2O\,(l)$$

   A) 1.34×10^3 B) 2.68×10^3 C) 669 D) 5.23×10^4 E) -6535

Answer: C

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

Answer: D

14) According to the Heisenberg Uncertainty Principle, it is impossible to know precisely both the position and the _____ of an electron.
A) mass B) momentum C) charge D) color E) shape

Answer: B

15) Which of the following is <u>not</u> a valid set of four quantum numbers? (n, l, m_l, m_s)
A) 1, 0, 0, +1/2 B) 2, 0, 0, +1/2 C) 1, 1, 0, +1/2 D) 2, 1, 0, -1/2 E) 3, 1, -1, -1/2

Answer: C

16) Which of the subshells below do <u>not</u> exist due to the constraints upon the angular momentum quantum number?
A) 2s
B) 2d
C) 2p
D) all of the above
E) none of the above

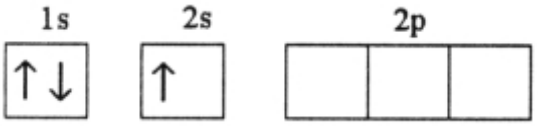
Answer: B

17) The energy of a photon that has a wavelength of 13.2 nm is _____ J.
(Planck constant = 6.626×10^{-34} J·s)
A) 1.62×10^{-17} B) 1.51×10^{-17} C) 9.55×10^{-25} D) 4.42×10^{-23} E) 1.99×10^{-25}

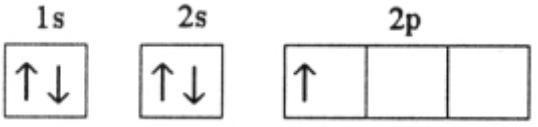
Answer: B

18) Which electron configuration represents a violation of Hund's rule for an atom in its ground state?

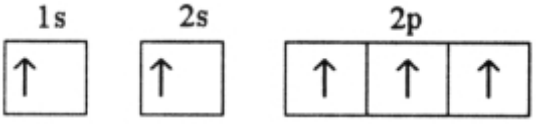
A)



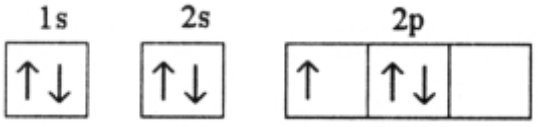
B)



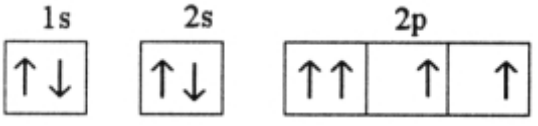
C)



D)



E)



Answer: D

19) The de Broglie wavelength of an electron with a velocity of 6.00×10^{6} m/s is _____ m. The mass of the electron is 9.11×10^{-28} g.

A) 8.25×10^{9} B) 8.25×10^{12} C) 1.21×10^{-16} D) 1.21×10^{-10} E) 1.21×10^{-13}

Answer: D

20) For which of the following can the composition vary?

A) homogeneous mixture
B) pure substance
C) element
D) heterogeneous mixture
E) both homogeneous and heterogeneous mixtures

Answer: E

21) Which one of the following is <u>not</u> an intensive property?

A) mass
B) density
C) boiling point
D) temperature
E) melting point

Answer: A

22) Which of the following are chemical processes?
1. rusting of a nail
2. freezing of water
3. decomposition of water into hydrogen and oxygen gases
4. compression of oxygen gas

A) 1, 3 B) 2, 3, 4 C) 1, 4 D) 1, 3, 4 E) 1, 2

Answer: A

23) Of the objects below, _____ is the most dense.

A) an object with a volume of 3.91×10^{-24} nm^3 and a mass of 7.93×10^{-1} ng

B) an object with a volume of 0.00212 m^3 and a mass of 4.22×10^4 mg

C) an object with a volume of 2.5 L and a mass of 12.5 kg

D) an object with a volume of 13 dm^3 and a mass of 1.29×10^3 g

E) an object with a volume of 139 mL and a mass of 93 g

Answer: A

24) Which of the following is <u>not</u> an exact number?

A) the number of liters in a gallon

B) the number of centimeters in an inch

C) the number of millimeters in a kilometer

D) the number of seconds in a year

E) the number of grams in a kilogram

Answer: A

25) The correct result (indicating the proper number of significant figures) of the following calculation of the molecular mass for H_2SO_4 is _____.

$$4 \times 15.9994 + 32.066 + 2 \times 1.0079$$

A) 98.079 B) 98.838 C) 98.84 D) 98.08 E) 98.074

Answer: A

26) A molecule of water contains hydrogen and oxygen in a 1:8 ratio by mass. This is a statement of _____.

A) the law of multiple proportions

B) the law of constant composition

C) the law of conservation of energy

D) the law of conservation of mass

E) none of the above

Answer: B

27) Consider the following selected postulates of Dalton's atomic theory:

(i) Each element is composed of extremely small particles called atoms.

(ii) Atoms are indivisible.

(iii) Atoms of a given element are identical.

(iv) Atoms of different elements are different and have different properties.

Which of the postulates is(are) no longer considered valid?

A) (iii) only B) (iii) and (iv) C) (i) and (ii) D) (ii) and (iii) E) (ii) only

Answer: D

28) Which statement below correctly describes the responses of alpha, beta, and gamma radiation to an electric field?

A) Only alpha is deflected, while beta and gamma show no response.
B) Both alpha and gamma are deflected in the same direction, while beta shows no response.
C) Both beta and gamma are deflected in the same direction, while alpha shows no response.
D) Alpha and beta are deflected in opposite directions, while gamma shows no response.
E) Both alpha and beta are deflected in the same direction, while gamma shows no response.

Answer: D

29) The atomic mass unit is presently based on assigning an exact integral mass (in amu) to an isotope of _____.

A) oxygen B) hydrogen C) helium D) carbon E) sodium

Answer: D

30) Which one of the following molecular formulas is also an empirical formula?

A) C_2H_6SO B) $H_2P_4O_6$ C) C_6H_6 D) H_2O_2 E) $C_6H_6O_2$

Answer: A

31) The charge on the manganese in the salt MnF_3 is _____.

A) 1+ B) 2- C) 1- D) 3+ E) 2+

Answer: D

32) The correct name for HClO is _____.

A) hydrochloric acid
B) chlorous acid
C) chloric acid
D) perchloric acid
E) hypochlorous acid

Answer: E

33) A certain mass of carbon reacts with 128 g of oxygen to form carbon monoxide. _____ grams of oxygen would react with that same mass of carbon to form carbon dioxide, according to the law of multiple proportions.

A) 256 B) 25.6 C) 128 D) 1280 E) 64.0

Answer: A

34) When the following equation is balanced, the coefficients are _____.

$$C_8H_{18} + O_2 \rightarrow CO_2 + H_2O$$

A) 4, 4, 32, 36 B) 2, 25, 16, 18 C) 1, 4, 8, 9 D) 2, 3, 4, 4 E) 2, 12, 8, 9

Answer: B

35) Of the reactions below, which one is a decomposition reaction?

A) $2CH_4 + 4O_2 \rightarrow 2CO_2 + 4H_2O$
B) $2N_2 + 3H_2 \rightarrow 2NH_3$
C) $2Mg + O_2 \rightarrow 2MgO$
D) $Cd(NO_3)_2 + Na_2S \rightarrow CdS + 2NaNO_3$
E) $NH_4Cl \rightarrow NH_3 + HCl$

Answer: E

36) The formula of nitrobenzene is $C_6H_5NO_2$. The molecular weight of this compound is _____ amu.

A) 3.06 B) 107.11 C) 123.11 D) 109.10 E) 43.03

Answer: C

37) The mass % of C in methane (CH_4) is _____.

A) 74.87 B) 133.6 C) 25.13 D) 7.743 E) 92.26

Answer: A

38) Gaseous argon has a density of 1.40 g/L at standard conditions. How many argon atoms are in 1.00 L of argon gas at standard conditions?

A) 3.43×10^{25} B) 2.11×10^{22} C) 4.76×10^{22} D) 6.02×10^{23} E) 1.59×10^{25}

Answer: B

39) Combustion of a 0.9827-g sample of a compound containing only carbon, hydrogen, and oxygen produced 1.900 g of CO_2 and 1.070 g of H_2O. What is the empirical formula of the compound?

A) $C_4H_{11}O_2$ B) $C_4H_{10}O$ C) C_2H_5O D) $C_2H_5O_2$ E) $C_4H_{10}O_2$

Answer: A

40) GeF_3H is formed from GeH_4 and GeF_4 in the combination reaction:

$$GeH_4 + 3GeF_4 \rightarrow 4GeF_3H$$

If the reaction yield is 92.6%, how many moles of GeF_4 are needed to produce 8.00 mol of GeF_3H?

A) 2.16 B) 3.24 C) 2.78 D) 5.56 E) 6.48

Answer: E