HOUSTON COMMUNITY COLLEGE SYSTEM

DEPARTMENTAL FINAL EXAM

CHEM 1311- SPRING 2019

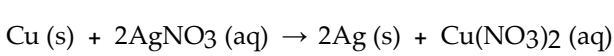
VERSION D

CHEM 1311 FINAL EXAM (SPRING 2019)

Part I

There are 35 questions in this section. Each question carries 2 points. Choose the best answer and mark your answer on the scantron.

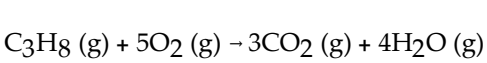
1) Which of the following substance is being reduced in the following reaction.? 1) _____



$$Cu\ (s) + 2AgNO_3\ (aq) \rightarrow 2Ag\ (s) + Cu(NO_3)_2\ (aq)$$

A) Ag B) $AgNO_3$ C) Cu D) $Cu(NO_3)_2$

2) The combustion of propane (C_3H_8) in the presence of excess oxygen yields CO_2 and H_2O: 2) _____

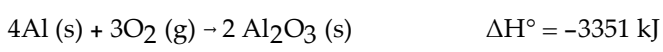


$$C_3H_8\ (g) + 5O_2\ (g) \rightarrow 3CO_2\ (g) + 4H_2O\ (g)$$

When 2.5 mol of O_2 are consumed in their reaction, _____ mol of CO_2 are produced.

A) 1.5 B) 3.0 C) 4.2 D) 7.5 E) 2.5

3) The reaction 3) _____



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

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

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

4) A sample of a gas originally at 29 °C and 1.25 atm pressure in a 3.0 L container is allowed to contract until the volume is 2.2 L and the temperature is 11 °C. The final pressure of the gas is _____ atm. 4) _____

A) 2.1 B) 2.9 C) 2.8 D) 1.6 E) 0.38

5) Which one of the following represents an acceptable set of quantum numbers for an electron in an atom? (arranged as n, l, m_l, and m_s) 5) _____

A) 4, 4, 4, –1/2
B) 4, 5, 7, –1/2
C) 4, 3, –3, –1/2
D) 4, 4, –5, 1/2
E) 4, 3, 0, 0

6) The element X has two naturally occurring isotopes. The masses (amu) and % abundances of the isot 6) _____
are given in the table below. The average atomic mass of the element is _____ amu.

Isotope	Abundance (%)	Mass (amu)
^{31}X	35.16	31.16
^{34}X	64.84	34.30

A) 34.02 B) 30.20 C) 33.20 D) 32.73 E) 35.22

7) The specific heat of liquid bromine is 0.226 J/g–K. How much heat (J) is required to raise the 7) _____
temperature of 10.0 mL of bromine from 25.00 °C to 27.30 °C? The density of liquid bromine: 3.12 g/mL.

A) 32.4 J B) 10.4 J C) 300 J D) 16.2 J E) 5.20 J

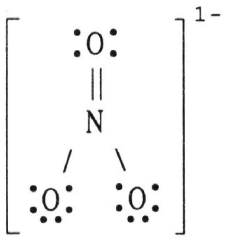
8) Which pair of elements would you expect to exhibit the greatest similarity in their physical and 8) _____
chemical properties?

A) H, Li B) Cs, Ba C) C, O D) Ga, Ge E) Ca, Sr

9) Of the following, which gives the correct order for atomic radius for Mg, Na, P, Si and Ar? 9) _____

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

10) The formal charge on nitrogen in NO_3^- is _____, where the Lewis structure of the ion is: 10) _____



A) 0 B) –1 C) +1 D) –2 E) +2

11) Based on the activity series, which one of the reactions below will occur? 11) _____

A) $3Hg\ (l) + 2Cr(NO_3)_3\ (aq) \rightarrow 3Hg(NO_3)_2 + 2Cr\ (s)$
B) $2AgNO_3\ (aq) + Pb\ (s) \rightarrow 2Ag\ (s) + Pb(NO_3)_2\ (aq)$
C) $3FeBr_2\ (aq) + 2Au\ (s) \rightarrow 3Fe\ (s) + 2AuBr_3\ (aq)$
D) $Zn\ (s) + MnI_2\ (aq) \rightarrow ZnI_2\ (aq) + Mn\ (s)$
E) $SnCl_2\ (aq) + Cu\ (s) \rightarrow Sn\ (s) + CuCl_2\ (aq)$

12) Which combination will produce a precipitate? 12) _____

A) $Pb(NO_3)_2$ (aq) and HCl (aq)

B) $Cu(NO_3)_2$ (aq) and $KC_2H_3O_2$ (aq)

C) NaOH (aq) and $Sr(NO_3)_2$ (aq)

D) KOH (aq) and HNO_3 (aq)

E) $AgC_2H_3O_2$ (aq) and $HC_2H_3O_2$ (aq)

13) Which formula/name pair is <u>incorrect</u>? 13) _____

A) FeS iron(II) sulfide

B) $FeSO_3$ iron(II) sulfite

C) $Fe_2(SO_4)_3$ iron(III) sulfide

D) $FeSO_4$ iron(II) sulfate

E) $Fe_2(SO_3)_3$ iron(III) sulfite

14) In ionic bond formation, the lattice energy of ions _____ as the magnitude of the ion charges _____ and the radii _____. 14) _____

A) increases, decrease, increase

B) increases, increase, increase

C) increases, decrease, decrease

D) decreases, increase, increase

E) increases, increase, decrease

15) Which equation correctly represents the <u>first</u> ionization of calcium? 15) _____

A) $Ca\ (g) + e^- \rightarrow Ca^-\ (g)$

B) $Ca^+\ (g) + e^- \rightarrow Ca\ (g)$

C) $Ca\ (g) \rightarrow Ca^+\ (g) + e^-$

D) $Ca^-\ (g) \rightarrow Ca\ (g) + e^-$

E) $Ca\ (g) \rightarrow Ca^-\ (g) + e^-$

16) Which species has London dispersion forces as the <u>only</u> intermolecular force? 16) _____

A) CH_3F B) HI C) KBr D) CH_3OH E) CH_3CH_3

17) Which of the following are combination reactions? 17) _____

1) $CH_4\ (g) + O_2\ (g) \rightarrow CO_2\ (g) + H_2O\ (l)$

2) $CaO\ (s) + CO_2\ (g) \rightarrow CaCO_3\ (s)$

3) $Mg\ (s) + O_2(g) \rightarrow MgO\ (s)$

4) $PbCO_3\ (s) \rightarrow PbO\ (s) + CO_2\ (g)$

A) 4 only

B) 1, 2, 3, and 4

C) 1, 2, and 3

D) 2 and 3

E) 2, 3, and 4

18) Based on the following information, which compound has the strongest intermolecular forces? 18) _____

Substance	ΔH_{vap} (kJ/mol)
Argon (Ar)	6.3
Benzene (C_6H_6)	31.0
Ethanol (C_2H_5OH)	39.3
Water (H_2O)	40.8
Methane (CH_4)	9.2

A) Benzene B) Water C) Methane D) Argon E) Ethanol

19) When the following equation is balanced, the coefficient of Al is _____. 19) _____

$$Al\ (s) + H_2O\ (l) \rightarrow Al(OH)_3\ (s) + H_2\ (g)$$

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

20) Given the data in the table below, $\Delta H°_{rxn}$ for the reaction 20) _____

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

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

21) The molecular weight of a gas that has a density of 7.10 g/L at 25.0 °C and 1.00 atm pressure is _____ g/mol. 21) _____

A) 6.85×10^{-2}
B) 174
C) 28.0
D) 14.6
E) 5.75×10^{-3}

22) The Lewis structure of PF_3 shows that the central phosphorus atom has _____ nonbonding and _____ bonding electron pair(s). 22) _____

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

23) Osmium has a density of 22.6 g/cm^3. What volume (in cm^3) would be occupied by a 21.8 g sample of osmium? 23) _____

A) 1.04
B) 2.03×10^3
C) 0.965
D) 2.03×10^{-3}
E) 493

24) In which set of elements would all members be expected to have very similar chemical properties? 24) _____

A) Ne, Na, Mg
B) P, Se, I
C) Br, I, At
D) Cl, Br, Na
E) Si, As, Te

25) A compound contains 40.0% C, 6.71% H, and 53.29% O by mass. The molecular weight of the compound is 60.05 amu. The molecular formula of this compound is _____. 25) _____

A) CHO_2 B) $C_2H_3O_4$ C) $C_2H_4O_2$ D) $C_2H_2O_4$ E) CH_2O

26) What is the concentration (M) of a NaCl solution prepared by dissolving 9.3 g of NaCl in sufficient water to give 350 mL of solution? 26) _____

A) 27 B) 0.16 C) 0.45 D) 18 E) 2.7×10^{-2}

27) The formula weight of calcium nitrate ($Ca(NO_3)_2$), rounded to one decimal place, is _____ amu. 27) _____

A) 204.2 B) 116.1 C) 150.1 D) 102.1 E) 164.0

28) Which combination of protons, neutrons, and electrons is correct for the isotope of copper, $^{63}_{29}Cu$? 28) _____

A) 29 p^+, 34 n°, 29 e^-
B) 34 p^+, 34 n°, 29 e^-
C) 63 p^+, 29 n°, 63 e^-
D) 34 p^+, 29 n°, 34 e^-
E) 29 p^+, 29 n°, 63 e^-

29) How many molecules of CH_4 are in 48.2 g of this compound? 29) _____

A) 1.81×10^{24}
B) 5.00×10^{-24}
C) 4.00
D) 2.00×10^{23}
E) 4.64×10^{26}

30) There are _____ σ bonds and _____ π bonds in $H_3C–CH_2–CH=CH–CH_2–C\equiv CH$. 30) _____

A) 14, 2 B) 12, 2 C) 10, 3 D) 13, 2 E) 16, 3

31) Of the following, _____ is a valid statement of Charles' law. 31) _____

A) V = constant × n

B) $\frac{P}{T}$ = constant

C) $\frac{V}{T}$ = constant

D) V = constant × P

E) PV = constant

32) The number 0.0001000 has _____ significant figures. 32) _____

A) 4 B) 5 C) 2 D) 6 E) 3

33) Of the following, _____ is the largest mass. 33) _____

A) 25 kg

B) 2.5×10^{-2} mg

C) 2.5×10^{15} pg

D) 2.5×10^{9} fg

E) 2.5×10^{10} ng

34) Which of the following does <u>not</u> have eight valence electrons? 34) _____

A) Rb^{+}

B) Ca^{+}

C) Xe

D) Br^{-}

E) All of the above have eight valence electrons.

35) What is the electron configuration for the Co^{2+} ion? 35) _____

A) $[Ar]3d^{7}$

B) $[Ar]4s^{2}3d^{9}$

C) $[Ne]3s^{2}3p^{10}$

D) $[Ar]3d^{5}$

E) $[Ar]4s^{1}3d^{6}$

Part II

Name: _____

- **5 points for each question**
- **Show your work / calculations in the space provided**
- **Box your answer wherever possible**
- **Partial credit will be given for these questions.**

1. How many grams of HCl are formed from the reaction of 3.56 g of H_2 with 8.94 g of Cl_2 according to the following reaction:

   H_2 (g) + Cl_2 (g) ----------> 2HCl (g)

2. Write the balanced molecular, ionic, and net ionic equations for any reactions that would occur between the following pair of compounds.

   $Pb(NO_3)_2$ (aq) + HCl (aq) ---------->

3. Calculate the energy change that would accompany an electronic transition in a hydrogen atom from n = 4 to n = 2 shell. Determine whether radiation is absorbed or emitted during this transition. ($R_H = 2.18 \times 10^{-18}$ J)

4. Given the following reactions

Fe_2O_3 (s) + 3CO (s) → 2Fe (s) + $3CO_2$ (g) ΔH = -28.0 kJ

3Fe (s) + $4CO_2$ (s) → 4CO (g) + Fe_3O_4 (s) ΔH = +12.5 kJ

Calculate the enthalpy of the reaction of Fe_2O_3 with CO

$3Fe_2O_3$ (s) + CO (g) → CO_2 (g) + 2 Fe_3O_4 (s)

5. Determine the following for I_3^- ion:
    a. Lewis Structure
    b. Hybridization of the central atom
    c. Molecular Geometry
    d. Polarity (Polar/Nonpolar)

6. SO_2 (5.00 g) and CO_2 (5.00 g) were placed in a 750.0 mL container at 50.0 °C.
    a. Find the partial pressure of each component
    b. Find the total pressure of the gas mixture.