



HOUSTON COMMUNITY COLLEGE SYSTEM

DEPARTMENTAL FINAL EXAM

CHEM 1311- SPRING 2019

VERSION A

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.

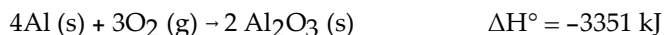
- 1) The molecular weight of a gas that has a density of 7.10 g/L at 25.0 °C and 1.00 atm pressure is _____ 1) _____
_____ g/mol.

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

- 2) Which of the following are combination reactions? 2) _____

1) $\text{CH}_4(\text{g}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{l})$
2) $\text{CaO}(\text{s}) + \text{CO}_2(\text{g}) \rightarrow \text{CaCO}_3(\text{s})$
3) $\text{Mg}(\text{s}) + \text{O}_2(\text{g}) \rightarrow \text{MgO}(\text{s})$
4) $\text{PbCO}_3(\text{s}) \rightarrow \text{PbO}(\text{s}) + \text{CO}_2(\text{g})$
A) 2 and 3
B) 1, 2, and 3
C) 2, 3, and 4
D) 4 only
E) 1, 2, 3, and 4

- 3) The reaction 3) _____



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

- 4) There are _____ σ bonds and _____ π bonds in $\text{H}_3\text{C}-\text{CH}_2-\text{CH}=\text{CH}-\text{CH}_2-\text{C}\equiv\text{CH}$. 4) _____

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

- 5) The specific heat of liquid bromine is 0.226 J/g-K. How much heat (J) is required to raise the temperature of 10.0 mL of bromine from 25.00 °C to 27.30 °C? The density of liquid bromine: 3.12 g/mL. 5) _____

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

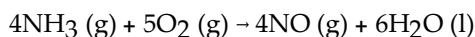
6) Of the following, _____ is the largest mass.

6) _____

- A) 25 kg
- B) 2.5×10^9 fg
- C) 2.5×10^{10} ng
- D) 2.5×10^{-2} mg
- E) 2.5×10^{15} pg

7) Given the data in the table below, $\Delta H^\circ_{\text{rxn}}$ for the reaction

7) _____



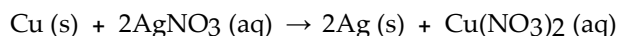
is _____ kJ.

Substance	ΔH°_f (kJ/mol)
H ₂ O (l)	-286
NO (g)	90
NO ₂ (g)	34
HNO ₃ (aq)	-207
NH ₃ (g)	-46

- A) -1172
- B) -150
- C) -1892
- D) -1540
- E) The ΔH°_f of O₂ (g) is needed for the calculation.

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

8) _____



- A) AgNO₃ B) Cu C) Ag D) Cu(NO₃)₂

9) How many molecules of CH₄ are in 48.2 g of this compound?

9) _____

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

10) 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)

10) _____

- A) 3, 2, -2, -1/2
- B) 3, 3, -4, 1/2
- C) 3, 2, 0, 0
- D) 3, 3, 3, -1/2
- E) 3, 4, 6, -1/2

11) Which of the following does not have eight valence electrons?

11) _____

- A) Xe
- B) Br⁻
- C) Ca⁺
- D) Rb⁺
- E) All of the above have eight valence electrons.

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

12) _____

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

13) Which species has London dispersion forces as the only intermolecular force?

13) _____

- A) CH₃OH
- B) HI
- C) CH₃CH₃
- D) KBr
- E) CH₃F

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

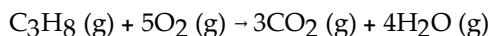
14) _____



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

15) The combustion of propane (C₃H₈) in the presence of excess oxygen yields CO₂ and H₂O:

15) _____

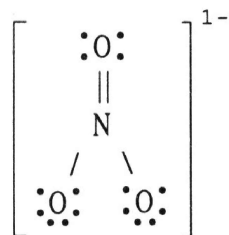


When 2.5 mol of O₂ are consumed in their reaction, _____ mol of CO₂ are produced.

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

16) The formal charge on nitrogen in NO₃⁻ is _____, where the Lewis structure of the ion is:

16) _____



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

- 17) Of the following, _____ is a valid statement of Charles' law. 17) _____
- A) $V = \text{constant} \times P$
 B) $\frac{P}{T} = \text{constant}$
 C) $V = \text{constant} \times n$
 D) $\frac{V}{T} = \text{constant}$
 E) $PV = \text{constant}$
- 18) The formula weight of calcium nitrate ($\text{Ca}(\text{NO}_3)_2$), rounded to one decimal place, is _____ amu. 18) _____
- A) 102.1 B) 116.1 C) 150.1 D) 204.2 E) 164.0
- 19) The Lewis structure of PF_3 shows that the central phosphorus atom has _____ nonbonding and _____ bonding electron pair(s). 19) _____
- A) 1, 2 B) 1, 3 C) 3, 1 D) 2, 2 E) 3, 3
- 20) Which pair of elements would you expect to exhibit the greatest similarity in their physical and chemical properties? 20) _____
- A) Ga, Ge B) H, Li C) Ca, Sr D) C, O E) Cs, Ba
- 21) The number 0.0101 has _____ significant figures. 21) _____
- A) 5 B) 6 C) 2 D) 4 E) 3
- 22) In ionic bond formation, the lattice energy of ions _____ as the magnitude of the ion charges _____ and the radii _____. 22) _____
- A) increases, increase, increase
 B) increases, decrease, increase
 C) increases, decrease, decrease
 D) decreases, increase, increase
 E) increases, increase, decrease
- 23) 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. 23) _____
- A) 2.8 B) 2.1 C) 0.38 D) 1.6 E) 2.9
- 24) Which equation correctly represents the first ionization of calcium? 24) _____
- A) $\text{Ca}^- (\text{g}) \rightarrow \text{Ca} (\text{g}) + \text{e}^-$
 B) $\text{Ca}^+ (\text{g}) + \text{e}^- \rightarrow \text{Ca} (\text{g})$
 C) $\text{Ca} (\text{g}) \rightarrow \text{Ca}^- (\text{g}) + \text{e}^-$
 D) $\text{Ca} (\text{g}) + \text{e}^- \rightarrow \text{Ca}^- (\text{g})$
 E) $\text{Ca} (\text{g}) \rightarrow \text{Ca}^+ (\text{g}) + \text{e}^-$

- 25) Which formula/name pair is incorrect? 25) _____
- A) FeSO_3 iron(II) sulfite
 B) $\text{Fe}_2(\text{SO}_4)_3$ iron(III) sulfide
 C) $\text{Fe}_2(\text{SO}_3)_3$ iron(III) sulfite
 D) FeSO_4 iron(II) sulfate
 E) FeS iron(II) sulfide
- 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) 0.45 B) 2.7×10^{-2} C) 0.16 D) 18 E) 27
- 27) The element X has two naturally occurring isotopes. The masses (amu) and % abundances of the isotopes are given in the table below. The average atomic mass of the element is _____ amu. 27) _____
- | Isotope | Abundance (%) | Mass (amu) |
|-----------------|---------------|------------|
| ^{31}X | 35.16 | 31.16 |
| ^{34}X | 64.84 | 34.30 |
- A) 30.20 B) 33.20 C) 32.73 D) 35.22 E) 34.02
- 28) 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? 28) _____
- A) 0.965
 B) 493
 C) 2.03×10^{-3}
 D) 2.03×10^3
 E) 1.04
- 29) Of the following, which gives the correct order for atomic radius for Mg, Na, P, Si and Ar? 29) _____
- A) $\text{Ar} > \text{P} > \text{Si} > \text{Mg} > \text{Na}$
 B) $\text{Si} > \text{P} > \text{Ar} > \text{Na} > \text{Mg}$
 C) $\text{Mg} > \text{Na} > \text{P} > \text{Si} > \text{Ar}$
 D) $\text{Na} > \text{Mg} > \text{Si} > \text{P} > \text{Ar}$
 E) $\text{Ar} > \text{Si} > \text{P} > \text{Na} > \text{Mg}$
- 30) In which set of elements would all members be expected to have very similar chemical properties? 30) _____
- A) Si, As, Te
 B) Br, I, At
 C) Cl, Br, Na
 D) Ne, Na, Mg
 E) P, Se, I

31) Based on the following information, which compound has the strongest intermolecular forces? 31) _____

Substance	ΔH_{vap} (kJ/mol)
Argon (Ar)	6.3
Benzene (C ₆ H ₆)	31.0
Ethanol (C ₂ H ₅ OH)	39.3
Water (H ₂ O)	40.8
Methane (CH ₄)	9.2

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

32) Which combination will produce a precipitate? 32) _____

- A) AgC₂H₃O₂ (aq) and HC₂H₃O₂ (aq)
- B) KOH (aq) and HNO₃ (aq)
- C) NaOH (aq) and Sr(NO₃)₂ (aq)
- D) Pb(NO₃)₂ (aq) and HCl (aq)
- E) Cu(NO₃)₂ (aq) and KC₂H₃O₂ (aq)

33) What is the electron configuration for the Co²⁺ ion? 33) _____

- A) [Ar]3d⁷
- B) [Ar]4s¹3d⁶
- C) [Ar]3d⁵
- D) [Ar]4s²3d⁹
- E) [Ne]3s²3p¹⁰

34) 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 _____. 34) _____

- A) C₂H₄O₂ B) CH₂O C) CHO₂ D) C₂H₃O₄ E) C₂H₂O₄

35) Based on the activity series, which one of the reactions below will occur? 35) _____

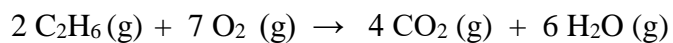
- A) 2AgNO₃ (aq) + Pb (s) → 2Ag (s) + Pb(NO₃)₂ (aq)
- B) SnCl₂ (aq) + Cu (s) → Sn (s) + CuCl₂ (aq)
- C) 3FeBr₂ (aq) + 2Au (s) → 3Fe (s) + 2AuBr₃ (aq)
- D) Zn (s) + MnI₂ (aq) → ZnI₂ (aq) + Mn (s)
- E) 3Hg (l) + 2Cr(NO₃)₃ (aq) → 3Hg(NO₃)₂ + 2Cr (s)

Part II

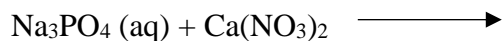
Name _____

- Show all your work / calculations in the space provided.
- Partial credit is provided for each answer.
- Box your answer wherever possible.
- Each question is allotted 5 points.

1. According to the reaction below, how many grams of carbon dioxide can be formed when 123 g of ethane gas is reacted with 212 g of oxygen gas?



2. Write the balanced molecular, total, and net ionic equations when aqueous solutions of sodium phosphate, Na_3PO_4 and calcium nitrate, $\text{Ca}(\text{NO}_3)_2$ are mixed with together.

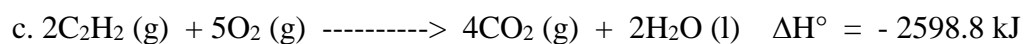
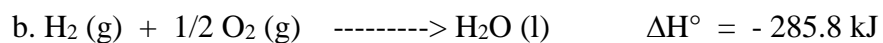
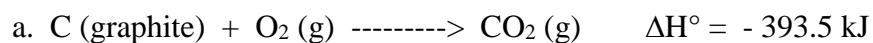


3. a) Calculate the energy during the electronic transition from $n = 5$ state to $n = 2$ state in a hydrogen atom.

b) Is energy absorbed or emitted during this transition?

4. Calculate the standard enthalpy of formation for acetylene (C_2H_2) from the elements:
 $2\text{C (graphite)} + \text{H}_2 (\text{g}) \text{ -----} > \text{C}_2\text{H}_2 (\text{g})$

The equations for each step and the corresponding enthalpy changes are:



5. Consider the species, $(\text{AlH}_4)^{-1}$

Predict the following for the above species:

- a) Lewis dot structure
- b) Molecular shape (or molecular geometry)
- c) Hybridization about the central atom
- d) Polarity

6. A tank contains a mixture of 52.5g of oxygen gas and 65.1g of carbon dioxide gas at 27°C . The total volume of the tank is 23.5 L. Calculate the a) partial pressure of each gas in the tank b) the total pressure in the container.