HCC

HOUSTON COMMUNITY COLLEGE

GENERAL CHEMISTRY I

# CHEM 1411

SYSTEM FINAL EXAM
VERSION A
Spring 2018

Part I: 35 Multiple Choice (2 pts each).
Directions: Select the BEST answer for the following questions and answer on your scantron.

1) Which of the elements listed below would most likely form a *nonpolar covalent bond* when bonded to oxygen?
   A) Rb
   B) Br
   C) C
   D) O
   E) H

2) Of the bonds C-N, C=N, and C≡N, the C-N bond is _____.
   A) weakest/shortest
   B) intermediate in both strength and length
   C) strongest/longest
   D) weakest/longest
   E) strongest/shortest

3) Which of the following is an isoelectronic series?
   A) B^{5-}, Si^{4-}, As^{3-}, Te^{2-}
   B) Si^{2-}, P^{2-}, S^{2-}, Cl^{2-}
   C) S, Cl, Ar, K
   D) F^-, Cl^-, Br^-, I^-
   E) O^{2-}, F^-, Ne, Na^+

4) Of the choices below, which one is <u>not</u> an ionic compound?
   A) $PbCl_2$
   B) $MoCl_6$
   C) RbCl
   D) NaCl
   E) PCl_5

5) What is the frequency of light (s^{-1}) that has a wavelength of 3.12×10^{-3} cm?
   A) 4.10×10^{-17} s^{-1}
   B) 2.44×10^{16} s^{-1}
   C) 9.62×10^{12} s^{-1}
   D) 3.69 s^{-1}
   E) 1.04×10^{-13} s^{-1}

#

6) Arrange the following in order of decreasing atomic radius: Ar, O, S, N, Ca
   A) Ar > O > S > N > Ca
   B) Ca > S > Ar > N > O
   C) O > N > Ar > S > Ca
   D) Ca > S > Ar > O > N
   E) S > Ar > Ca > N > O

7) Of the following elements, which has the smallest ionization energy?
   A) Al
   B) Mg
   C) Ca
   D) Ga
   E) Cs

8) Which of the following CH_4 samples contains the greatest number of moles of CH_4?
   A) 0.356 moles CH_4
   B) 4.65 x 10^{23} CH_4 molecules
   C) 6.78 x 10^1g CH_4
   D) 8.90g CH_4
   E) None of the above

9) A compound with an empirical formula of $C_2H_3Br_2$ has a molar mass of 373.69 g/mol. What is the molecular formula?
   A) $C_2H_3Br_2$
   B) $CHBr$
   C) $C_6H_9Br_6$
   D) $C_4H_6Br_2$
   E) $C_4H_6Br_4$

10) The orbital diagram for a ground-state oxygen atom is

      1s   2s   2p

A. ↑↓ ↑↓ ↑ ↑ ↑

B. ↑↓ ↑↓ ↑↓ ↑↓ __

C. ↑↓ ↑↓ ↑↓ ↑ __

D. ↑↓ ↑↓ ↑↓ ↑ ↑

E. ↑↓ ↑↓ ↑↓ ↑↓ ↑
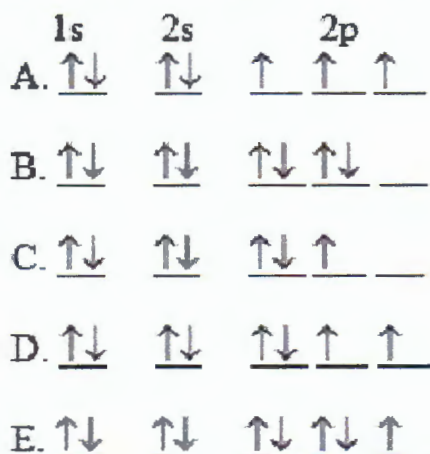
A) A
B) B
C) C
D) D
E) E

11) Which of the following compounds will exhibit hydrogen bonding?
   A) SiH_4
   B) PH_3
   C) H_2S
   D) HF
   E) CH_4

12) Liquid oxygen boils at —182.9°C. Express the boiling point of liquid oxygen in °F.
   A) -384.4
   B) -352.4
   C) -320.4
   D) -297.2
   E) -76.8

13) There are _____ protons, _____ neutrons, and _____ electrons in $^{131}I^-$.
   A) 53, 78, 54
   B) 78, 53, 72
   C) 131, 53, 54
   D) 53, 131, 52
   E) 131, 53, 52

14) Give the correct number of significant figures in the answer to the problem below.

$6.2 \times 10^{-13} \times 5.68 \times 10^{8} =$

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

15) The correct names for $AlPO_4$, $BaSO_4$, Fe_2S_3 (in the same order) are

A) Aluminum Phosphorus oxide, Barium sulfite, Iron Sulfide
B) Aluminum (II) Phosphate, Barium (II) sulfate, Iron Sulfide
C) Aluminum(III) Phosphate, Barium (II) sulfate, Iron (II) Sulfide
D) Aluminum Phosphate, Barium Sulfate, Iron (III) Sulfide
E) Aluminum (III) Phosphate, Barium (II) sulfate, Iron (III) Sulfide

16) The ground state condensed electron configuration of Ga is _____.

A) $[Ar]4s^2 3d^{10} 4d^1$
B) $[Ar]4s^2 3d^{11}$
C) $\{Kr]4s^2 3d^{10} 4p^1$
D) $[Ar]4s^2 3d^{10} 4p^1$
E) $[Ar]4s^2 4d^{10} 4p^1$

17) The wavelength of a photon that has an energy of 5.25×10^{-19} J is _____ m.

A) 3.79×10^{7}
B) 3.79×10^{-7}
C) 2.64×10^{6}
D) 4.21×10^{-24}
E) 2.38×10^{23}

18) What is the percent mass of Cl in $KClO_3$?

A) 31.90
B) 28.93
C) 13.06
D) 39.17
E) 20.01

19) The elements in groups 1A, 7A, and 8A are called _____, respectively

A) alkaline earth metals, halogens, and chalcogens
B) halogens, transition metals, and alkali metals
C) alkali metals, halogens, and noble gases
D) alkaline earth metals, transition metals, and halogens
E) alkali metals, halogens, and noble gases

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20) What volume (mL) of a concentrated solution of magnesium chloride (9.00M) must be diluted
to 350mL to make a 2.75M solution of magnesium chloride?
   A) 107
   B) 350
   C) 50.0
   D) 2.75
   E) 45.0

21) The oxidation number of iron in Fe_2O_3 is _____.
   A) -2
   B) +1
   C) +2
   D) -3
   E) +3

22) Calculate the volume occupied by 35.2 g of methane gas (CH_4) at 25°C and 1.0 atm.
   A) 0.0186 L
   B) 4.5 L
   C) 11.2 L
   D) 49.2 L
   E) 53.7 L

23) The temperature of a 35.2 g sample of iron increases from 23.7 °C to 29.5 °C. If the specific heat
of iron is 0.450 J/g-K, how many joules of heat are absorbed?
   A) 1100
   B) 4.3
   C) 1.1×10^3
   D) 92
   E) 0.450

24) 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.

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

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

25) The combustion of ammonia in the presence of oxygen yields NO_2 and H_2O:

$$4 NH_3 (g) + 7 O_2 (g) \rightarrow 4 NO_2 (g) + 6 H_2O (g)$$

The complete combustion of 2.58 moles of ammonia consumes ---------moles of O_2.

A) 22.4
B) 2.69
C) 3.76
D) 4.53
E) 9.87

26) Bromine is a red liquid at 25°C. Its density is 3.12 g/cm^3. What is the volume in cm^3 of 28.1 g of liquid bromine?

A) 87.7
B) 9.01
C) 28.1
D) 0.111
E) None of the above

27) Gases behave most ideally under which conditions?

A) High temperature, low pressure
B) Low temperature, low pressure
C) High temperature, high pressure
D) Low temperature, high pressure
E) none of the above

28) The combustion of propane produces heat according to the following reaction:

$$C_3H_8 (g) + 5 O_2(g) \text{-------> } 3 CO_2 (g) + 4 H_2O(l) \qquad \Delta H°_{rxn} = -2220kJ$$
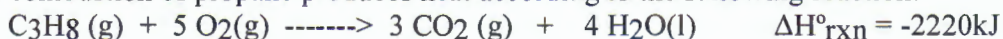
How many moles of propane are required to barbecue a whole chicken knowing that a fully cooked chicken requires 35.8 kJ of heat?

A) 3.22×10^{-2}
B) 22.2
C) 1.61×10^{-2}
D) 22.2
E) 31.0

29) Which of the following solids would have the highest melting point?

A) NaI
B) NaF
C) MgO
D) $MgCl_2$
E) KF

30) A mixture of O_2 gas and an unknown gas are placed in a container with a pinhole in its side. If the oxygen gas is found to leak at a rate 2.14 times faster than the unknown gas, which of these could be the unknown gas?
   A) Cl_2
   B) SF_6
   C) Kr
   D) UF_6
   E) Xe

31) Which combination will produce a precipitate?
   A) NaOH (aq) and HCl (aq)
   B) NaCl (aq) and $HC_2H_3O_2$ (aq)
   C) NaOH (aq) and $Fe(NO_3)_2$ (aq)
   D) NH_4NO_3 (aq) and $CaCl_2$ (aq)
   E) None of the above

32) What is the coefficient for H_2O when the following combustion reaction of a fatty acid is properly balanced?
   __ $C_{18}H_{36}O_2$ + __ O_2 → __ CO_2 + __ H_2O
   A) 1
   B) 18
   C) 9
   D) 26
   E) 27

33) All of the following are properties of Tungsten, which one is a *chemical* property?
   A) Tungsten can be hammered into a thin sheet.
   B) At 60°C a sheet of tungsten crumbles to a gray powder.
   C) Tungsten boils at 5555°C.
   D) When a bar of tungsten is bent, it emits an audible "cry".
   E) Tungsten erodes when added to hydrochloric acid, and a clear gas forms.

34) How many grams of NaOH are required to make 350mL of 0.400 M NaOH ?
   A) 45.7
   B) 5.60
   C) 35.0
   D) 44.2
   E) 1.75

35) Based on the activity series, which one of the reactions below will occur?
   A) Pb (s) + NiI_2 (aq) → PbI_2 (aq) + Ni (s)
   B) $SnBr_2$ (aq) + Cu (s) → $CuBr_2$ (aq) + Sn (s)
   C) Fe (s) + $ZnCl_2$ (aq) → $FeCl_2$ (aq) + Zn (s)
   D) Mn (s) + $NiCl_2$ (aq) → $MnCl_2$ (aq) + Ni (s)
   E) None of the reactions will occur.

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NAME: _____

Answer the the following six questions by showing all of your calculations in the space provided.   PARTIAL CREDIT WILL BE GIVEN. IF NO WORK IS SHOWN YOU WILL GET NO CREDIT.

    1) A flask contains a mixture of He and Ne at a total pressure of 2.6 atm. There are 2.0 mol of He and 5.0 mol of Ne in the flask. Calculate the partial pressure of He in atm.

    2) Consider the ion ICl_2^-
      a) Draw the Lewis structure of this ion.
      b) what is its electron domain geometry?
      c) what is its molecular geometry ?
      d) what is the hybridization of the central atom in this ion?

3) Write the molecular, ionic and net ionic equations for the reaction of K_2CO_3 (aq) and HNO_3(aq). Indicate the spectator ions if any.

4) An electron in a hydrogen atom undergoes a transition from the n=5 state to the n=3 state.
a) Is a photon emitted or absorbed?
b) Calculate the wavelength of the photon (in nanometers) emitted or absorbed during this transition using the Bohr model of the hydrogen atom .

5)   Calculate the standard enthalpy change for the reaction
        $2C_8H_{18}(l) + 21O_2(g) \rightarrow 8CO(g) + 8CO_2(g) + 18H_2O(l)$.
        Given:
        $2C_8H_{18}(l) + 25O_2(g) \rightarrow 16CO_2(g) + 18H_2O(l)$ $\Delta H° = -11{,}020$ kJ/mol
        $2CO(g) + O_2(g) \rightarrow 2CO_2(g)$ $\Delta H° = -566.0$ kJ/mol
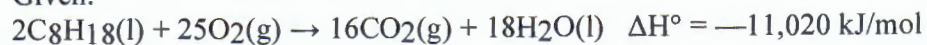
6)
   Under appropriate conditions, nitrogen and hydrogen undergo a combination reaction to yield
   ammonia:
        $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$
   A 7.1-g sample of N_2 and 2.0g sample of H_2 are allowed to react.
   a) Which is the limiting reactant ?
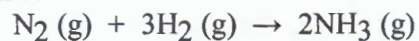
   b) How many grams of NH_3 should be formed ?

   c) If 7.5 g NH_3 are collected after the reaction, what is the percent yield?

Soluble Compounds

1) All compounds of the alkali metals (Group IA) are soluble.

2) All salts containing NH_4^+, NO_3^-, ClO_4^-, ClO_3^-, and $C_2H_3O_2^-$ are soluble.

3) All salts containing Cl^-, Br^-, or I^- are soluble *except* when combined with Ag^+, Pb^{2+}, and Hg_2^{2+}.

4) All sulfates are soluble *except* those of Pb^{2+}, Ca^{2+}, Sr^{2+}, Hg_2^{2+}, and Ba^{2+}.

Insoluble Compounds

5) All metal hydroxides and oxides are insoluble *except* those of Group IA and of Ca^{2+}, Sr^{2+}, and Ba^{2+}. When metal oxides do dissolve, they react with water to form hydroxides. The oxide ion, O^{2-}, does not exist in water.

6) All salts that contain PO_4^{3-}, CO_3^{2-}, SO_3^{2-}, and S^{2-} are insoluble, *except* those of Group IA and NH_4^+.

Activity Series	Electro-negativity
Li	H 2.1
K	Li 1.0
Ba	Na 0.9
Ca	B 2.0
Na	C 2.5
Mg	N 3.0
Al	O 3.5
Zn	F 4.0
Cr	Cl 3.0
Fe	
Cd	Br 2.8
Co	I 2.5
Ni	
Sn	S 2.5
Pb	Se 2.4
H₂	
Cu	
Ag	
Hg	
Pt	
Au	

Constants/ Relationships

d = mass/volume

Avogardo's number= 6.022×10^{23} things/mol

$\Delta E = q + w$

q = mass x specific heat x Δt

1 cal = 4.184 J

$K = {}^\circ C + 273$

${}^\circ F = (9/5)({}^\circ C) + 32$

Planck's constant = $h = 6.63 \times 10^{-34}$ J•s

Speed of light = $c = 3.00 \times 10^8$ m/s

$c = \lambda \nu$

$1\,J = 1\ kg \cdot m^2 \cdot s^{-2}$

$R_H = 2.18 \times 10^{-18}$ J

$\Delta E = h\nu$

$\Delta E = R_H \left(\dfrac{1}{n_i^2} - \dfrac{1}{n_f^2} \right)$

Gas constant = $R = 0.0821$ L•atm mol^{-1}•K^{-1}

$PV = nRT$

$d = (PM)/(RT)$

Molar volume of a gas = 22.4 L at STP

STP = 1 atm and 0°C

1 atm = 760 mm Hg = 760 torr

Periodic Table of the Elements

1A	2A	3B	4B	5B	6B	7B	8B	8B	8B	1B	2B	3A	4A	5A	6A	7A	8A
1 H 1.00794																	2 He 4.0026
3 Li 6.941	4 Be 9.0122											5 B 10.811	6 C 12.0107	7 N 14.0067	8 O 15.9994	9 F 18.9984	10 Ne 20.1797
11 Na 22.9898	12 Mg 24.305											13 Al 26.98154	14 Si 28.0855	15 P 30.97376	16 S 32.065	17 Cl 35.453	18 Ar 39.948
19 K 39.0983	20 Ca 40.078	21 Sc 44.956	22 Ti 47.867	23 V 50.9415	24 Cr 51.996	25 Mn 54.938	26 Fe 55.845	27 Co 58.9332	28 Ni 58.6934	29 Cu 63.546	30 Zn 65.39	31 Ga 69.723	32 Ge 72.64	33 As 74.9216	34 Se 78.96	35 Br 79.904	36 Kr 83.80
37 Rb 85.4678	38 Sr 87.62	39 Y 88.906	40 Zr 91.224	41 Nb 92.9064	42 Mo 95.94	43 Tc 97.9072	44 Ru 101.07	45 Rh 102.9055	46 Pd 106.42	47 Ag 107.8682	48 Cd 112.411	49 In 114.82	50 Sn 118.71	51 Sb 121.75	52 Te 127.60	53 I 126.9045	54 Xe 131.293
55 Cs 132.905	56 Ba 137.327	57 La 138.91	72 Hf 178.49	73 Ta 180.95	74 W 183.84	75 Re 186.207	76 Os 190.2	77 Ir 192.22	78 Pt 195.078	79 Au 196.9665	80 Hg 200.59	81 Tl 204.383	82 Pb 207.2	83 Bi 208.9804	84 Po [209]	85 At [210]	86 Rn [222]
87 Fr [223]	88 Ra [226]	89 Ac [227]	104 Rf [261]	105 Db [262]	106 Sg [263]	107 Bh [262]	108 Hs [265]	109 Mt [266]	110 Uun [271]	111 Uuu [272]	112 Uub [277]		114 Uuq [285]		116 Uuh [289]		

58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm [145]	62 Sm 150.36	63 Eu 151.96	64 Gd 157.25	65 Tb 158.92	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 174.97	71 Lu 174.97
90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np [237]	94 Pu [244]	95 Am [243]	96 Cm [247]	97 Bk [247]	98 Cf [251]	99 Es [252]	100 Fm [257]	101 Md [258]	102 No [259]	103 Lr [260]