Concordia University CHEM 205

Fall 2015, Dr. C. Rogers, Section 02, Wed/Fri

LAST NAME:

FIRST NAME:

STUDENT ID:

Chem 205 - GENERAL CHEMISTRY I

MIDTERM EXAMINATION

PLEASE READ THIS BOX WHILE WAITING TO START

INSTRUCTIONS:

- Calculators are permitted; cell phones and other electronic devices are not allowed.
- This test paper includes 9 pages; please read over the whole test before starting.
- A periodic table (incomplete) is included and may be detached (not graded).
- Fill in your name & ID # on scansheet, in pencil (fill circles completely).
- Please write clearly and organize your work logically.
- Read the instructions to each section carefully.
- **Duration: 70 minutes. GOOD LUCK!**

Professor use - Grades:

Pages 2-4:	/ 40
Page 5:	/ 11
TOTAL:	/ 50 (MAX. 51)
PERCENT:	%

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PART A: MULTIPLE-CHOICE QUESTIONS – 2 marks each

Colour in final answer on scansheet, in pencil. Circle answer here too, as a backup.

 # 1. Many classic experiments have given us indirect evidence of the nature of the atom. Which one of the experiments listed below did not give the results described?

a) The Curies' experiments with radioactivity proved that atoms are made up of smaller particles.
b) Rutherford's experiments proved that Thomson's "plum-pudding" model of the atom is correct.
c) Millikan's oil-drop experiment showed that the charge on any particle was a simple multiple of the charge on the electron.
d) The electric discharge tube proved that electrons have a negative charge.

 # 2. How many protons, neutrons, and electrons are in a $^{80}Br^-$ anion?

a) 35 p^+, 45 n^0, 35 e^-
b) 35 p^+, 45 n^0, 36 e^-
c) 45 p^+, 35 n^0, 45 e^-
d) 45 p^+, 35 n^0, 46 e^-

 # 3. The density of gasoline is 0.7025 g/mL at 20°C. When water (1.00 g/mL at 20°C) is added to gasoline, what will happen?

a) The mixture will improve the running of the engine.
b) The water will sink to the bottom of the gasoline.
c) The water will float on top of the gasoline.
d) The water will mix in so you can't see it.

 # 4. An analysis was performed to find the concentration of an HCl solution, with the following results:

Trial	Molarity
1	1.25 ± 0.01
2	1.24 ± 0.01
3	1.26 ± 0.01

If the actual concentration of HCl was 1.00 M, which choice best describes the analysis data?

a) both inaccurate and imprecise
b) both accurate and precise
c) accurate but imprecise
d) precise but inaccurate

 # 5. Which one of the following statements about ionic compounds is incorrect?

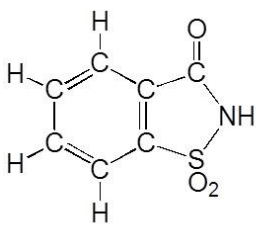
a) Ionic compounds form extended 3-dimensional networks called crystal lattices.
b) Positive and negative ions are attracted to each other by electrostatic forces.
c) As the ion charges increase, the attraction between the ions decreases.
d) Ionic crystals tend to be rigid, and they cleave along planes.

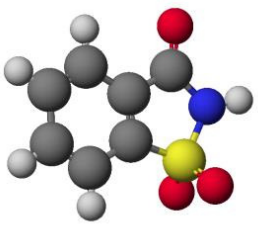
 # 6. What is the concentration of $K_2Cr_2O_7$ (294.18 g/mol) in a 5.00×10^2 mL solution containing 2.335 g of dissolved potassium dichromate?

a) 1.59×10^{-5} M
b) 7.94×10^{-3} M
c) 3.18×10^{-2} M
d) 1.59×10^{-2} M

 # 7. Which one of the following statements about the artificial sweetener saccharin (shown) is incorrect?

a) Saccharin's formula is $C_7H_5NO_2S$.
b) It contains 41% C atoms by mole.
c) It is made of molecules, not ions.
d) A mole of it weighs 183.18 g.





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 # 8. Which choice correctly classifies the following three reactions?

$$2\ K(s) + Br_2(\ell) \rightarrow 2\ KBr(s)$$
$$AgNO_3(aq) + NaCl(aq) \rightarrow AgCl(s) + NaNO_3(aq)$$
$$HCl(aq) + KOH(aq) \rightarrow H_2O(\ell) + KCl(aq)$$

a) precipitation, precipitation and acid-base, respectively
b) redox, precipitation, and acid-base, respectively
c) all precipitation reactions
d) all acid-base reactions
e) all redox reactions

 # 9. Which is the best description of the change is involved when water boils?
a) It is a physical change, because the steam produced is chemically the same as the liquid.
b) It is a chemical change, because heat is needed for the process to occur.
c) It is a physical change, because the substance merely disappears.
d) It is a chemical change, because a gas (steam) is given off.
e) It is a chemical and physical damage.

 # 10. In a recent accident, some containers of uranium hexafluoride (UF_6) were lost in the English Channel, which is known for its cold water (~17°C). The melting point of UF_6 is 148°F. In what physical state was the UF_6 in these containers at 17°C? (Note: $T_F = T_C \times (9°F / 5°C) + 32°F$)
a) solid
b) liquid
c) gas
d) a mixture of solid and liquid
e) a mixture of solid, liquid and gas

 # 11. Which one of the following formulae does <u>not</u> represent a possible ionic compound?
a) $MgBr_2$
b) Na_2S
c) Al_2O
d) CaI_2
e) LiCl

 # 12. Which one pair of reactants would react to produce a gas-phase product?
a) $HNO_3(aq) + Na_2CO_3(aq)$
b) $NaCl(aq) + CaCO_3(aq)$
c) $HCl(aq) + NaNO_3(aq)$
d) $H_2SO_4(aq) + NH_3(aq)$
e) $NaOH(aq) + HCl(aq)$

 # 13. For the reaction of VO_2^+ and Zn in acidic solution: $VO_2^+ + Zn \rightarrow VO^{2+} + Zn^{2+}$, what is the overall balanced equation?
a) $Zn + VO_2^+ + 2\ H^+ \rightarrow VO^{2+} + H_2O + Zn^{2+}$
b) $Zn + 2\ VO_2^+ + 2\ H^+ \rightarrow 2\ VO^{2+} + H_2O + Zn^{2+}$
c) $2\ Zn + VO_2^+ + 2\ H^+ \rightarrow VO^{2+} + H_2O + 2\ Zn^{2+}$
d) $Zn + 2\ VO_2^+ + 4\ H^+ \rightarrow 2\ VO^{2+} + 2\ H_2O + Zn^{2+}$
e) $Zn + 2\ VO_2^+ \rightarrow 2\ VO^{2+} + O_2 + Zn^{2+}$

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 # 14. Which one of the following compounds is named <u>incorrectly</u>?

a) NH_4ClO_4, ammonium perchlorate
b) $Mg(OH)_2$, magnesium hydroxide
c) $Pb_3(PO_4)_2$, lead(II) phosphate
d) N_2O_4, dinitrogen tetroxide
e) $NaNO_3$, sodium nitrite

 # 15. Which one of the following statements is <u>not</u> true?

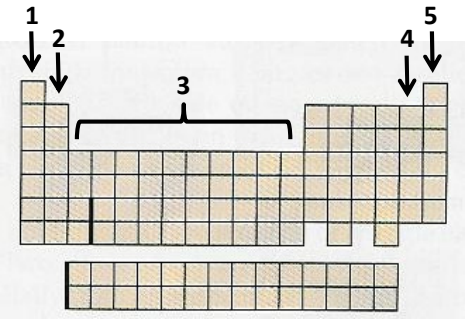
a) When a redox reaction occurs, the oxidizing agent steals electrons from the reducing agent.
b) When two soluble salts are mixed together, an insoluble salt may form and precipitate.
c) When an acid reacts with a base, the acid accepts a proton from the base.
d) When a metal reacts with a nonmetal, an ionic compound is formed.
e) When two nonmetals react, a covalent compound is formed.

 # 16. A piece of indium metal with a mass of 16.6 g is submerged in 46.3 cm^3 of water in a graduated cylinder, and the volume increases to 48.6 cm^3. Based on these data, what is the density of indium?

a) 7.217 g/cm^3
b) 7.2 g/cm^3
c) 0.14 g/cm^3
d) 0.138 g/cm^3
e) more than 0.1 g/cm^3 away from any of these values.

 # 17. Which choice correctly identifies the numbered sets of elements?

a) 1=transition metals, 2=alkali earth metals, 5=halogens
b) 1=alkali metals, 2=alkali earth metals, 5=halogens
c) 1=alkali metals, 3=alkali earth metals, 4=halogens
d) 1=alkali metals, 3=transition metals, 4=halogens
e) 1=transition metals, 3=alkali metals, 5=halogens



 # 18. Which one of the following elements exists in its elemental form as diatomic molecules?

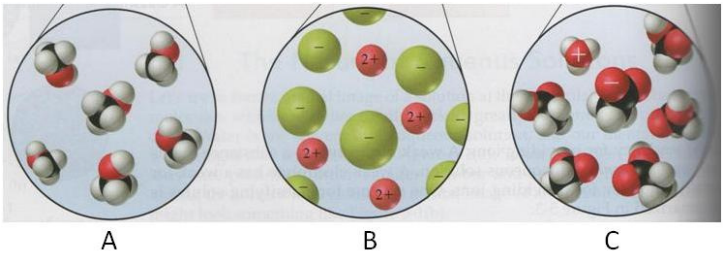
a) magnesium
b) nitrogen
c) sodium
d) carbon
e) neon

 # 19. Which one statement best describes what happens when white sugar ($C_{12}H_{24}O_{12}$) dissolves in water?

a) Attractions between $C_{12}H_{24}O_{12}$ molecules are broken and replaced by attractions to H_2O.
b) Ionic bonds within $C_{12}H_{24}O_{12}$ molecules are broken and replaced by attractions to H_2O.
c) Covalent bonds within $C_{12}H_{24}O_{12}$ molecules are broken because of reaction with H_2O.
d) Some $C_{12}H_{24}O_{12}$ molecules dissociate and form ionic bonds to H_2O molecules.
e) The $C_{12}H_{24}O_{12}$ molecules are converted into CO_2 and H_2O.

 # 20. Which one of the three diagrams below represents an aqueous solution of a weak electrolyte?

a) A
b) B
c) C



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PART B: SHOW COMPLETE WORK TO GET FULL CREDIT (answer on exam)

 # 21. Imagine you add an exact stoichiometric amount of yellow K_2CrO_4 solution to a colourless solution of $AgNO_3$, and a yellow solid forms. Once the solid precipitates, the supernatant is clear and colourless.

a) **(1.5 marks)** Write the balanced molecular equation for the reaction.

b) **(1.5 marks)** Write the net ionic equation for the reaction; be sure to include phase indicators (states).

c) **(3 marks)** What could you do in the lab to separate the two products from each other, to obtain a solid sample of each one? Explain briefly (point-form is acceptable).

 # 22. (5 marks) The food flavour enhancer *monosodium glutamate* (MSG) has the percent mass composition of 13.6% sodium, 35.5% carbon, 4.8% hydrogen, 8.3% nitrogen and 37.8% oxygen. What is the empirical formula of MSG? Show full calculations and explanatory key words for each step.

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EXTRA SPACE / ROUGH WORK

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POTENTIALLY USEFUL INFORMATION

Atomic mass unit: 1 amu = 1.66054×10^{-27} kg Avogadro's number: N = 6.022×10^{23} mol^{-1}

PERIODIC TABLE OF THE ELEMENTS – missing 1st 20 elements

(this will not be graded)

1.008																	4.00
6.941	9.012											10.81	12.01	14.007	15.999	18.998	20.18
22.99	24.31											26.98	28.09	30.97	32.07	35.45	39.95
39.10	40.08	21 **Sc** 44.96	22 **Ti** 47.87	23 **V** 50.94	24 **Cr** 52.00	25 **Mn** 54.94	26 **Fe** 55.85	27 **Co** 58.93	28 **Ni** 58.69	29 **Cu** 63.55	30 **Zn** 65.39	31 **Ga** 69.72	32 **Ge** 72.61	33 **As** 74.92	34 **Se** 78.96	35 **Br** 79.90	36 **Kr** 83.80
37 **Rb** 85.47	38 **Sr** 87.62	39 **Y** 88.91	40 **Zr** 91.22	41 **Nb** 92.91	42 **Mo** 95.94	43 **Tc** (97.91)	44 **Ru** 101.07	45 **Rh** 102.91	46 **Pd** 106.42	47 **Ag** 107.87	48 **Cd** 112.41	49 **In** 114.82	50 **Sn** 118.71	51 **Sb** 121.76	52 **Te** 127.60	53 **I** 126.90	54 **Xe** 131.29
55 **Cs** 132.91	56 **Ba** 137.33	**La-Lu**	72 **Hf** 178.49	73 **Ta** 180.95	74 **W** 183.84	75 **Re** 186.21	76 **Os** 190.2	77 **Ir** 192.22	78 **Pt** 195.08	79 **Au** 196.97	80 **Hg** 200.59	81 **Tl** 204.38	82 **Pb** 207.2	83 **Bi** 208.98	84 **Po** 208.98	85 **At** 209.99	86 **Rn** 222.02
87 **Fr** 223	88 **Ra** 226.03	**Ac-Lr**	104 **Rf** (261)	105 **Db** (262)	106 **Sg** (263)	107 **Bh** (262)	108 **Hs** (265)	109 **Mt** (266)									

57 **La** 138.91	58 **Ce** 140.12	59 **Pr** 140.91	60 **Nd** 144.24	61 **Pm** (145)	62 **Sm** 150.35	63 **Eu** 151.97	64 **Gd** 157.25	65 **Tb** 158.93	66 **Dy** 162.50	67 **Ho** 164.93	68 **Er** 167.26	69 **Tm** 168.93	70 **Yb** 173.04	71 **Lu** 174.97
89 **Ac** 227.03	90 **Th** 232.04	91 **Pa** 231.04	92 **U** 238.03	93 **Np** (237)	94 **Pu** (245)	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)