Concordia University CHEM 205

Fall 2009, Dr. C. Rogers, Section 02, W/F

A

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 8 pages; please read over the whole test before starting.
- Potentially useful information and a periodic table (incomplete) are included.
- You may detach the periodic table page for easier reference if you wish.
- Please write clearly and organize your work logically.
- Read the instructions to each section carefully.
- **Duration: 70 minutes. GOOD LUCK!**

Mark breakdown:

Page 2.	/ 10
Page 3.	/ 15
Page 4.	/ 8
Page 5.	/ 8
Page 6.	/ 12
TOTAL:	/ 52 (MAXIMUM MARK = 53)
PERCENT:	%

EARNED towards FINAL GRADE: / 15

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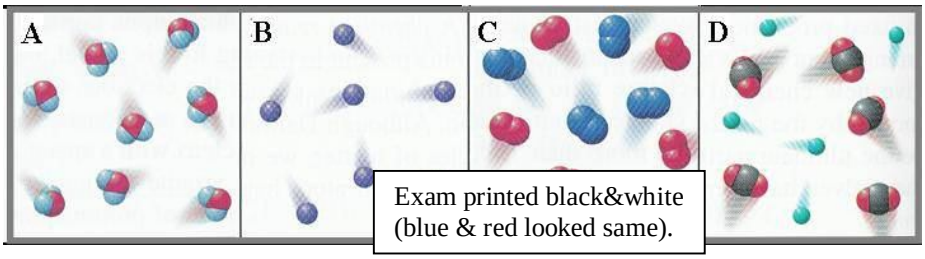
PART A: ONLY YOUR FINAL ANSWER WILL BE MARKED

 # 1. (2 marks) The figures below represent four different samples of gas-phase matter. Which figure represents a mixture?

a) A
b) B
c) C
d) D
e) They all do.



 # 2. (2 marks) Consider the following statement: "The degree of agreement among several measurements of the same quantity reflects the reproducibility of the given type of measurement." What concept does this statement describe?

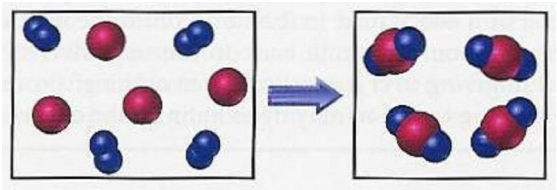
a) significance
b) accuracy
c) precision
d) certainty
e) error

 # 3. (2 marks) The statements below summarize various scientists' contributions to the understanding of atomic structure. Which statement incorrectly describes the scientist's work?

a) J. Dalton proposed his atomic theory, in which he (incorrectly) postulated that all atoms of the same element are identical.
b) The Curies showed that atoms cannot be subdivided, based on their experiments involving radioactivity.
c) J.J. Thomson proposed the plum-pudding model of the atom, based on his cathode-ray tube experiments.
d) R. Millikan determined the charge and mass of the electron, using his "oil-drop" experiments.
e) E. Rutherford proposed the nuclear model of the atom, based on his gold-foil experiments.

 # 4. (2 marks) The reaction between reactant A (larger spheres) and reactant B (smaller spheres) is shown in the diagram below. Based on the diagram, which equation best describes the reaction?

a) $A_2 + B \rightarrow A_2B$
b) $2\,A + B_4 \rightarrow 2\,AB_2$
c) $A_2 + 4\,B \rightarrow 2\,AB_2$
d) $A + B_2 \rightarrow AB_2$
e) $A + B_2 \rightarrow A_2B$



 # 5. (2 marks) What is the concentration of manganese ions in a 2.0 M solution of $Mn_2(SO_4)_3$?

a) 1.0 mol/L
b) 2.0 mol/L
c) 3.0 mol/L
d) 4.0 mol/L
e) 6.0 mol/L

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 # 6. (4 marks) Identify the following statements as true or false. *(Circle T or F.)*

T / F When salt dissolves in water, the result is a heterogeneous mixture.

T / F A change in colour does not always indicate a chemical change.

T / F Most elements on the periodic table are classified as metals.

T / F Elemental sulfur exists as gas-phase diatomic molecules.

 # 7. (4 marks) Fill in the blanks:

a) The melting point of lead (600.61 K) on the Celsius scale is: _____

b) An element that tends to lose electrons during reactions is: _____

c) The number of neutrons in an ^{75}As (arsenic-75) atom is: _____

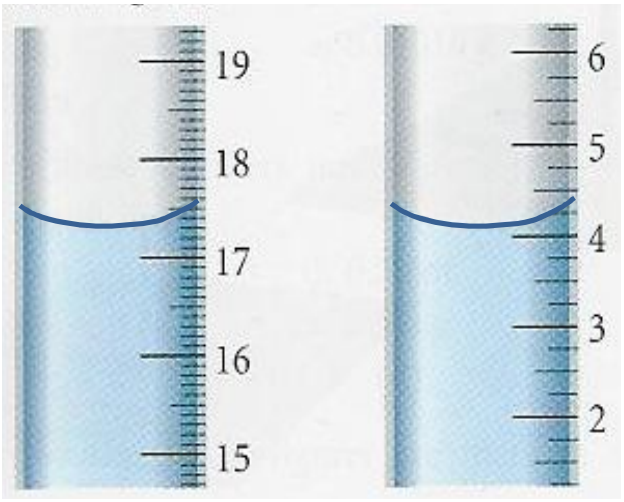
d) The name of the phase change from gas to liquid: _____

 # 8. (4 marks) Write the missing name or formula, and classify each substance by type:

Substance name	**Substance formula**	**Ionic or molecular substance?**
potassium permanganate		
	P_2O_5	
copper (II) sulfate		
	$(NH_4)_3PO_4$	

 # 9. (3 marks) Determine the volume of liquid present in each graduated cylinder, and report your measurements with the correct number of significant figures for the equipment. Next, add the two volumes together, and indicate what determined the number of significant figures in the total volume.

Volume A: **Volume B:** **Total volume & comments (few words only!):**



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PART B: Short written answers

 # 10. (4 marks) Pure acetic acid (CH_3COOH), known as glacial acetic acid, is a liquid with a density of 1.049 g/mL at 25°C. Calculate the molarity of a solution of acetic acid made by dissolving 15.00 mL of glacial acetic acid at 25°C in enough water to make 125.00 mL of solution.

 # 11. (4 marks) When elemental magnesium is ignited in the presence of elemental oxygen, bright light and white smoke (*i.e.,* formation of a white powdery solid) are observed.

a) **(1 mark)** Is the product ionic or molecular in nature? How do you know?

b) **(1 mark)** Write a balanced chemical equation for this reaction.

c) **(2 marks)** Briefly explain the concept of electroneutrality and how it helped you determine the formula of the compound formed in the above reaction.

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PART C: Problems – SHOW COMPLETE WORK TO GET FULL CREDIT

 # 12. (8 marks) An element X forms an iodide XI_3 and a chloride XCl_3. The iodide is quantitatively converted (*i.e.,* with 100 % yield) to the chloride when it is heated in a stream of chlorine gas:

$$2\ XI_3 + 3\ Cl_2 \rightarrow 2\ XCl_3 + 3\ I_2$$

If 0.5000 g of XI_3 is treated, 0.2360 g of XCl_3 is obtained. Calculate the atomic mass of the element X, and identify the element. **Include explanatory comments at each step of your calculation.**

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 # 13. (12 marks) The fizz produced when an Alka-Seltzer® antacid tablet is dissolved in water is due to the reaction between sodium bicarbonate, $NaHCO_3$, and citric acid, $H_3C_6H_5O_7$:

$$3\ NaHCO_3(aq) + H_3C_6H_5O_7(aq) \rightarrow 3\ CO_2(g) + 3\ H_2O(\mathbf{l}) + Na_3C_6H_5O_7(aq)$$

In a certain experiment, imagine you mix 1.00 g of sodium bicarbonate and 1.00 g of citric acid.

a) **(10 marks)** Assuming the reaction proceeds with 100% yield, how many grams of CO_2 form? **Include explanatory comments with your calculations.**

b) **(2 marks)** Calculate how much excess reactant remains after the reaction is complete.

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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}

EXTRA SPACE FOR ROUGH WORK – WILL NOT BE MARKED

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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)

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