Concordia University CHEM 205

Fall 2009, Dr. C. Rogers, Section 01 T/J

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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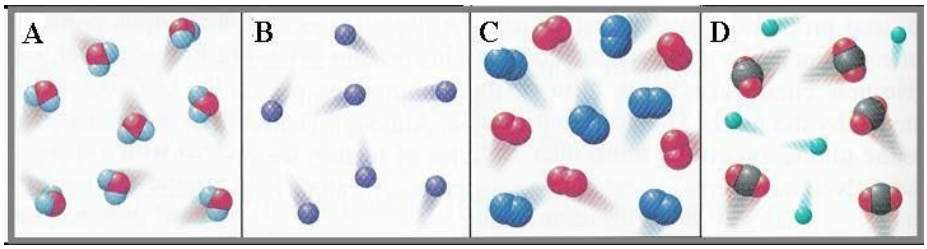
PART A: ONLY YOUR FINAL ANSWER WILL BE MARKED

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

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



 # 2. (2 marks) Consider the following statement: "The total mass of materials is not affected by a chemical change of those materials." What kind of statement is this?

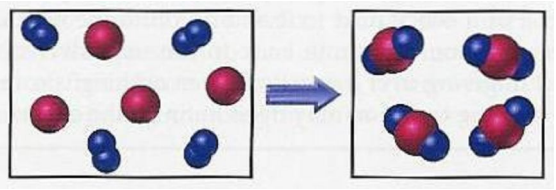
a) a measurement
b) an observation
c) an experiment
d) a natural law
e) a theory

 # 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 are made of smaller particles, based on their observations of radioactive decay.
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 proton, 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 (smaller spheres) and reactant B (larger spheres) is shown in the diagram. Based on the diagram, which equation best describes the reaction?

a) $2\,A + B_4 \rightarrow 2\,AB_2$
b) $A_2 + B \rightarrow A_2B$
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 sulfate 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 A temperature change will be greater if expressed in Kelvins compared to Celsius.

T / F A hydrated compound is an ionic compound with water molecules in its crystal.

T / F The release or absorption of heat always indicates a chemical change.

T / F Manganese (Mn) is classified as a transition metal.

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

a) An example of a lab technique used to separate mixtures is: _____

b) The melting point of lead (327.46°C) on the Kelvin scale is: _____

c) The number of neutrons in a ^{31}P (phosphorus-31) atom is: _____

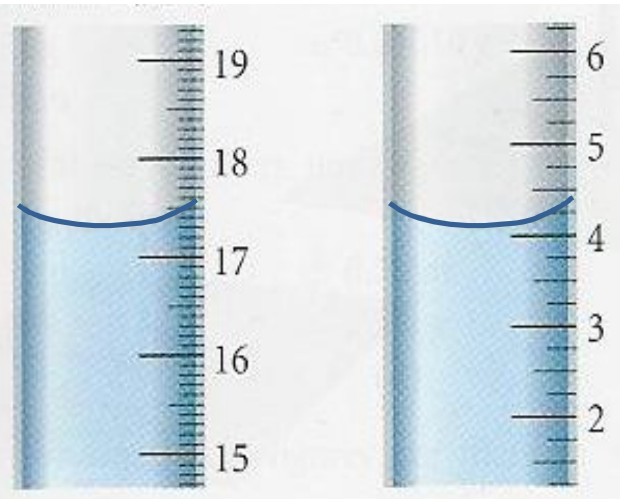
d) An element that tends to gain electrons in reactions is: _____

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

Substance name	**Substance formula**	**Ionic or molecular substance?**
	$Co(NO_3)_3$	
ammonium hydrogen phosphate		
	N_2O_4	
potassium sulfide		

 # 9. (3 marks) Determine the volume (mL) 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 (a few words!):**



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PART B: Short written answers

 # 10. (4 marks) Glycerol, $C_3H_8O_3$, is a substance used extensively in the manufacture of cosmetics, foodstuffs, antifreeze and plastics. Glycerol is a water-soluble liquid with a density of 1.2656 g/mL at 15°C. Calculate the molarity of a solution of glycerol made by dissolving 40.00 mL of glycerol at 15°C in enough water to make 250.00 mL of solution.

 # 11. (4 marks) When elemental aluminum reacts with elemental oxygen, a white solid is formed.

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) The minerals calcite ($CaCO_3$), magnesite ($MgCO_3$) and dolomite (1:1 $CaCO_3$:$MgCO_3$) decompose when strongly heated to form the corresponding metal oxide(s) and carbon dioxide gas.

A 1.000 g sample known to be one of these minerals was strongly heated and 0.477 g of CO_2 was obtained. Which of the three minerals was it?

Include balanced chemical equations, and explanatory comments at each step of your calculation.

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 # 13. (12 marks) One of the steps in the commercial process for converting ammonia to nitric acid involves the conversion of ammonia to nitrogen monoxide:

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

In a certain experiment, imagine you mix 2.50 g of NH_3 with 2.85 g of O_2, and obtain 100% yield.

a) **(10 marks)** How many grams of NO form? **Show all work & include explanatory comments.**

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 page will not be marked)

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)