Concordia University CHEM 205

Winter 2008, Dr. C. Rogers, Section 03

LAST NAME:

FIRST NAME:

STUDENT ID:

Chem 205: GENERAL CHEMISTRY I
MIDTERM EXAMINATION

PLEASE READ THIS BOX WHILE WAITING TO START

INSTRUCTIONS: This test paper includes 8 pages, including a periodic table; please ensure your paper is complete. You may detach the periodic table if you wish. For Part A, you do not need to show calculations; for Part C, you must show your calculations to receive full marks. Please write clearly and organize your work logically. Non-programmable calculators are permitted; book-style translation dictionaries are allowed, but electronic dictionaries and cell phones are not allowed.

Duration: 70 minutes - spend at least half that time on Parts B & C. **GOOD LUCK!**

Mark breakdown:

Page 2.	/ 8
Page 3.	/ 15
Page 4.	/ 9
Page 5.	/ 5
Page 6.	/ 14
TOTAL:	/ 50 (MAXIMUM MARK = 51)
PERCENT:	%

EARNED towards FINAL GRADE: / 20

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PART A: ONLY YOUR FINAL ANSWER WILL BE MARKED

 # 1. (2 marks) The nuclear model of the atom, as proposed by Ernest Rutherford, was based on observations of the scattering of alpha particles by a thin gold foil. Which of the following statements is <u>not true</u>?

a) Most of the positively charged alpha particles passed directly through the foil without being significantly deflected (scattered) away from their original direction of flight.
b) The majority of the alpha particles bounced straight back from the shiny gold foil.
c) A small fraction of the positively charged alpha particles was deflected through very large angles.
d) The alpha particles were scattered because they are much lighter than gold nuclei.
e) Earlier models of the atom predicted that the majority of the positively charged alpha particles would be deflected, but not by very large angles.

 # 2. (2 marks) When water boils, bubbles can be seen rising to the surface. What do the bubbles contain?

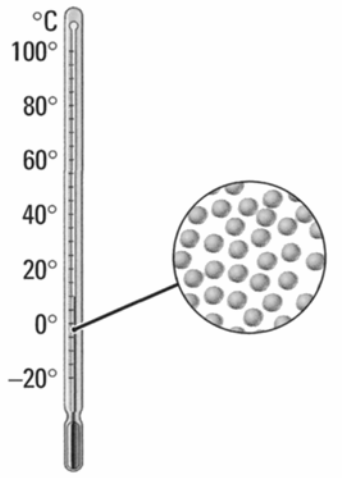
a) A mixture of hydrogen, H_2, and oxygen, O_2, gases
b) Nothing (a vacuum)
c) Air (mostly nitrogen, N_2, and oxygen, O_2)
d) H_2O vapour
e) Ionized water (H^+ and OH^-)

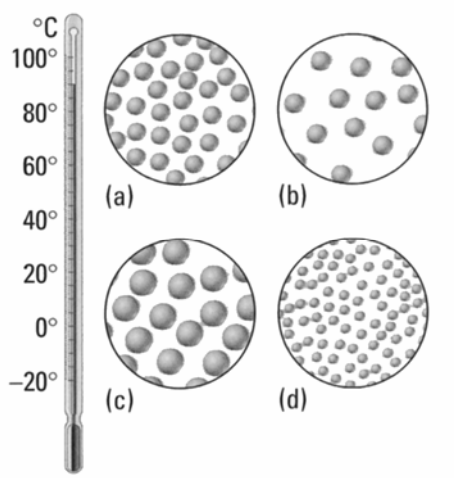
 # 3. (2 marks) What is the pH of 0.0050 M HNO_3?

a) 2.30
b) –2.30
c) 5.30
d) –5.30
e) 7.00

 # 4. (2 marks) The figure on the left shows a "nanoscale" view of the mercury atoms in a thermometer registering 10 °C. Which figure on the right (on the same scale as the figure on the left) best represents the mercury atoms in the thermometer if it is registering 100 °C?

a) a
b) b
c) c
d) d
e) none





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 # 5. (5 marks) Identify the following statements as true or false. *(Circle T or F.)*

T / F A hydrated ionic compound is an ionic compound which is dissolved in water.

T / F All isotopes of the same element contain the same number of neutrons.

T / F In elemental form, oxygen generally acts as an oxidizing agent.

T / F All reactions involving an acid are classified as acid-base reactions.

T / F An aqueous solution is an example of a homogeneous mixture.

 # 6. (5 marks) Fill in the blanks:

a) The boiling point of helium (4.2 K) on the Celsius scale is: _____

b) The number of protons in a ^{200}Hg (mercury-200) atom is: _____

c) Two allotropes of carbon are: _____

d) The lab technique to separate insoluble solid from a solution is: _____

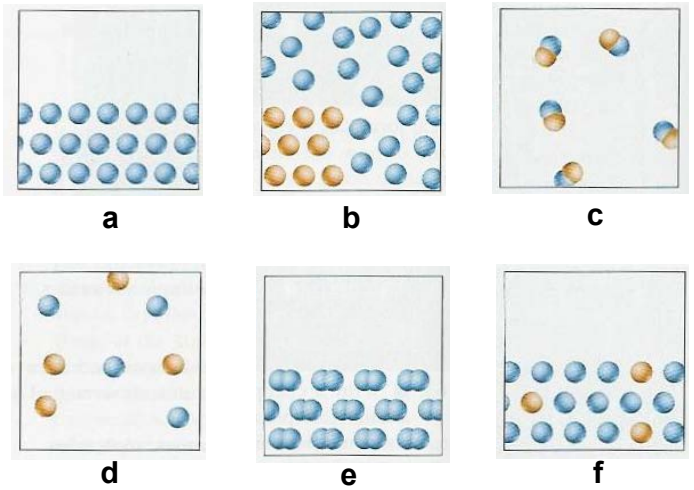
e) The unstable species that forms when CO_2 reacts with H_2O is: _____

 # 7. (3 marks) Write the missing name or formula, and classify each substance by type:

Substance name	Substance formula	Ionic or molecular substance?
potassium carbonate		
phosphorus pentachloride		
	NH_4ClO_4	

 # 8. (2 marks) The diagrams shown here depict various types of matter on the atomic scale. Choose ONE diagram that matches each description in the table (there will be unused diagrams):

Diagram	Description
	A mixture that fits its container
	A solid elemental metal
	A gas-phase compound
	A heterogeneous mixture



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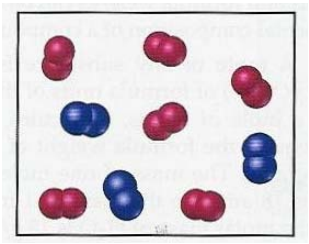
PART B: Short written answers

 # 9. (4 marks) Classify the two reactions below, and briefly justify your choices. Use as many of the following "type" labels as apply to each reaction: **precipitation, acid-base, gas-forming, redox**.

Reaction	Reaction type(s)	How did you decide?
$2\ HCl_{(aq)} + H_2O_{2(aq)} + 2\ FeCl_{2(aq)} \rightarrow 2\ FeCl_{3(\ )} + 2\ H_2O_{(\ )}$		
$Na_2S_{(aq)} + ZnSO_{4(aq)} \rightarrow ZnS_{(\ )} + Na_2S_{(\ )}$		

 # 10. (5 marks) The diagram shown to the right represents the products formed when a sample of an unknown compound decomposed into elements (via an oxidation-reduction reaction with itself; no other reactants were involved).

If the dark spheres represent nitrogen atoms and the light spheres represent oxygen atoms, what was the empirical formula of the original compound? Briefly explain your answer.



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

 # 11. (5 marks) Imagine a man with a serious medical condition that causes him suffer from *hyponatremia* (not enough sodium ion in the blood). He has a blood-plasma sodium ion concentration of 0.118 M and a total blood volume of 4.6 L.

What mass of sodium chloride would need to be added to his blood to bring the sodium ion concentration up to 0.138 M (a healthy level). *[Assume no change in blood volume.]*

Include explanatory comments at each step of your calculation.

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 # 12. (14 marks) Aspirin can be made in the laboratory by reacting acetic anhydride ($C_4H_6O_3$) with salicylic acid ($C_7H_6O_3$) to form aspirin ($C_9H_8O_4$) and acetic acid ($C_2H_4O_2$). The balanced equation is:

$$C_4H_6O_3 + C_7H_6O_3 \rightarrow C_9H_8O_4 + C_2H_4O_2$$

In a laboratory synthesis, a student begins with 3.00 mL of acetic anhydride (density 1.08 g/mL) and 1.25 g of salicyclic acid. Once the reaction is complete, the student collects 1.22 g of aspirin. Determine the limiting reactant, the theoretical yield of aspirin and the percent yield of the reaction.

Include explanatory comments at each step of your calculation.

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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 ONLY – WILL NOT BE MARKED