Concordia University CHEM 205

Fall 2011, 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).
- Answer the multiple-choice questions on the scan sheet, in pencil.
- Please write clearly and organize your work logically.
- Read the instructions to each section carefully.
- **Duration: 70 minutes. GOOD LUCK!**

Professor use - Grades:

Page 2.	/ 10
Page 3.	/ 10
Page 4.	/ 12
Page 5.	/ 11
Page 6.	/ 8
Page 7.	/ 10
TOTAL:	/ 60 (MAX. 61)
PERCENT:	%

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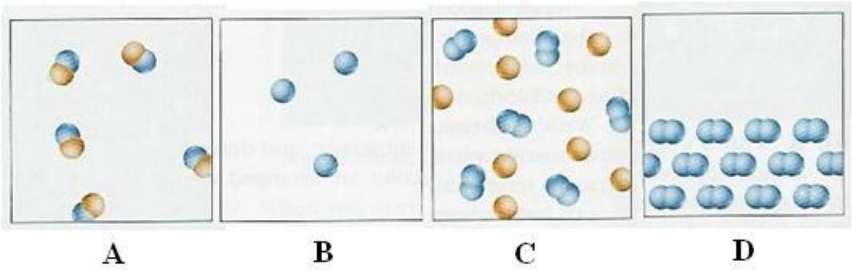
PART A: MULTIPLE-CHOICE QUESTIONS (answer on scan sheet, in pencil)

 # 1. (2 marks) Which of the following figures represents a compound?

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



 # 2. (2 marks) What type of statement is this? "*The total mass of materials is not affected by a chemical change in those materials*"….

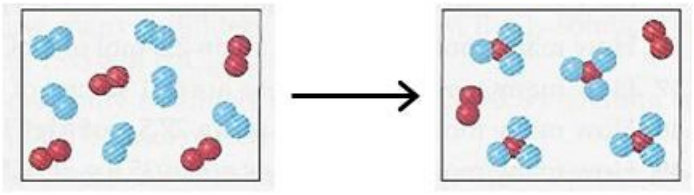
a) a measurement
b) an observation
c) an experiment
d) a natural law
e) a theory

 # 3. (2 marks) The statements below summarize various scientists' contributions to the understanding of atomic structure. Which statement <u>incorrectly</u> 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 some types of atoms can spontaneously disintegrate, based on their experiments involving radioactivity.
c) J.J. Thomson proposed the law of conservation of mass, 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 (darker spheres) and reactant B (lighter spheres) is shown in the diagram below. Based on the diagram, which balanced equation best describes the reaction?

a) $3\ A + B \rightarrow A_3B$
b) $A + 3\ B \rightarrow AB_3$
c) $A_2 + 3\ B_2 \rightarrow 2\ AB_3$
d) $8\ A + 12\ B \rightarrow 4\ AB_3 + 2\ A_2$
e) $4\ A_2 + 6\ B_2 \rightarrow 4\ AB_3 + 2\ A_2$



 # 5. (2 marks) Which of the following statements (1-3) concerning the kinetic-molecular theory of matter is/are CORRECT?

a) 1 only
b) 2 only
c) 3 only
d) 1 and 2
e) 1, 2 and 3

1. Particles in a gas move faster as the temperature increases.
2. Particles in a liquid are packed closely together, but are not confined to specific positions.
3. Particles in a gas vibrate back and forth about an average position.

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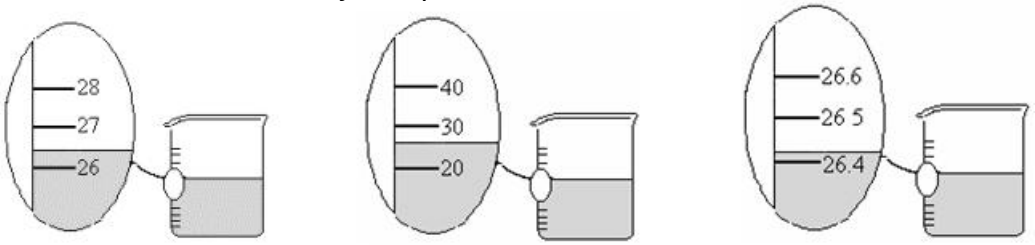
 # 6. (2 marks) Suppose you pour the water from the three beakers shown below into one container. Based on the precision of the three beakers, how should you report the new total volume to the correct number of significant figures?

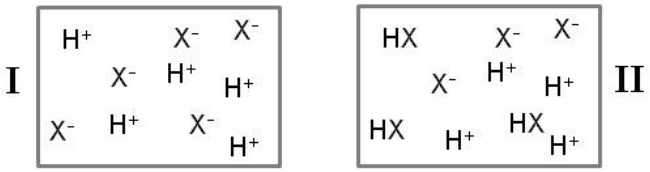
a) 78.817 mL
b) 78.82 mL
c) 78.8 mL
d) 80 mL
e) 79 mL



 # 7. (2 marks) Which one of the following statements is <u>not</u> a comparison of physical properties?

a) The reaction of potassium with water is faster than the reaction of calcium with water.
b) The solubility of NaCl in hot water is greater than the solubility in cold water.
c) The conductivity of aluminum is greater than the conductivity of copper.
d) The boiling point of water is greater than the boiling point of ethanol.
e) The density of copper is less than the density of lead.

 # 8. (2 marks) When an acid HX is mixed with water, one of two possible solutions forms (shown in diagrams I & II; water molecules omitted for simplicity). Which of the statements below is true?



a) In case I, HX is behaving like a strong acid, and in case II, HX is a behaving like a weak acid.
b) In case I, HX is behaving like a weak acid, and in case II, HX is behaving like a strong acid.
c) In both cases, HX is behaving like a strong acid.
d) In both cases, HX is behaving like a weak acid.
e) In both cases, HX is behaving like a base.

 # 9. (2 marks) When solutions of phosphoric acid and iron(III) nitrate react, which of the following terms will be present in the <u>balanced</u> molecular equation?

a) $HNO_3(aq)$
b) $3\ HNO_3(aq)$
c) $2\ FePO_4(s)$
d) $3\ FePO_4(s)$
e) $2\ HNO_3(aq)$

 # 10. (2 marks) When aqueous acetic acid and solid copper(II) hydroxide react, which of the following species are spectator ions?

a) hydroxide ion
b) hydrogen ion
c) copper(II) ion
d) acetate ion
e) none of these

 # 11. (2 marks) What is the boiling point of methane (112 K) on the Celsius scale?

a) -186 °C
b) -161 °C
c) -112 °C
d) 112 °C
e) 434 °C

 # 12. (2 marks) Which one of the following properties is <u>not</u> characteristic of nonmetals?

a) tend to form negative ions in chemical reactions with metals
b) appear in the upper right-hand corner of the periodic table
c) often bond to each other by forming covalent bonds
d) typically have a shiny (lustrous) appearance
e) are poor conductors of electricity

 # 13. (2 marks) How many electrons are in a neutral atom of ^{37}Cl (chlorine-37)?

a) 0
b) 7
c) 17
d) 20
e) 37

 # 14. (2 marks) Which one of the following statements about atomic structure is <u>false</u>?

a) The number of protons and neutrons is always the same in the neutral atom.
b) Almost all of the mass of the atom is concentrated in the nucleus.
c) The protons and neutrons in the nucleus are very tightly packed.
d) Protons and neutrons have approximately the same mass.
e) An atom is mostly empty space.

 # 15. (2 marks) What is the correct description and formula of ammonium carbonate?

a) molecular, $(NH_4)_2CO_3$
b) molecular, NH_4CO_3
c) ionic, $NH_4(CO_3)_2$
d) ionic, $(NH_4)_2CO_3$
e) ionic, NH_4CO_3

 # 16. (2 marks) What is the correct description and name of N_2O_4?

a) molecular, dinitrogen tetroxide
b) molecular, nitrogen oxide
c) ionic, dinitrogen tetroxide
d) ionic, nitrogen (IV) oxide
e) ionic, nitrogen oxide

 # 17. (2 marks) Elemental oxygen (O_2) is abundant in our atmosphere because it is not very reactive.

a) True
b) False

 # 18. (2 marks) When sugar ($C_{12}H_{24}O_{12}$) is melted, covalent bonds within the molecules are broken.

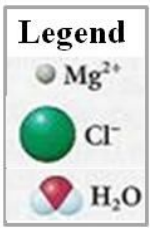
a) True
b) False

 # 19. (2 marks) H_3PO_4, HF and NH_3 are all examples of weak electrolytes.

a) True
b) False

PART B: DRAWINGS & SHORT WRITTEN ANSWERS (answer on exam)

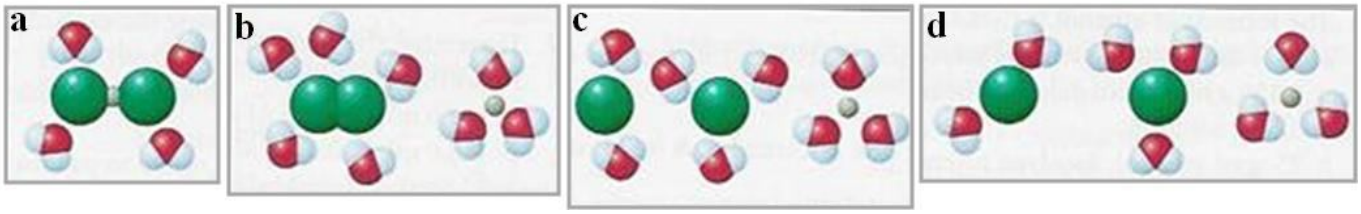
 # 20. Think about magnesium chloride ($MgCl_2$) dissolving in water.



a) **(1 mark)** Which substance is the solute and which substance is the solvent?

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

c) **(3 marks)** Which diagram (a-d) best represents aqueous magnesium chloride? **Explain**.



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

 # 21. (8 marks) Cortisol (MM 362.47 g/mol) is an important steroid hormone that is used as a medicine to treat inflammatory diseases such as rheumatoid arthritis. Cortisol is 69.6% carbon, 8.34% hydrogen and 22.1% oxygen by mass. What is its molecular formula?

Include explanatory comments at each step of your calculation.

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 # 22. (10 marks) Sodium azide, NaN_3, is used in automobile air bags because of its predictable explosive properties. When heated strongly, sodium azide decomposes suddenly via the following reaction:

NOT BALANCED: ___ **$NaN_3(s)$** → ___ **$Na(s)$** + ___ **$N_2(g)$**

a) **(1 mark)** Fill in the missing stoichiometric coefficients needed to balance the reaction equation.

b) **(3 marks)** What type of reaction is this? **Circle all that apply, and explain your choice(s).**

acid-base gas-forming oxidation-reduction precipitation

c) **(4 marks)** Using this reaction, about 90 g of NaN_3 is sufficient to inflate a standard car air bag. The filled air bag contains approximately 45.5 L of N_2 gas, which has a density of 1.61×10^{-3} g/L at 22°C. How many molecules of nitrogen is this? **Show your work.**

d) **(2 marks)** NaN_3 contains the azide ion, a polyatomic ion made of three nitrogen atoms covalently bonded together to make a short chain. Based on your knowledge of ionic compounds, what must be the charge on the azide ion? **Explain in a few key words.**

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EXTRA SPACE FOR 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)