Concordia University CHEM 205

Winter 2018, Dr. C. Rogers, Lec.03

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.
- 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:	/ 10
TOTAL:	/ 50 (MAX. 50)
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. Which one of the following statements involves chemical change(s)?

a) Starch, $(C_6H_{10}O_5)_n$, is converted to glucose, $C_6H_{12}O_6$, by enzymes in your stomach.
b) Naphthalene, $C_{10}H_8$, sublimes when heated then deposits onto a cold surface.
c) Urea, CH_4N_2O, dissolves in water then solidifies when the water evaporates.
d) Iron filings, Fe, stick onto a magnet then are pulled out of a mixture.

 # 2. Which one of the following statements is <u>false</u>?

a) Thomson's experiments involved studying beams of particles generated in a cathode ray tube.
b) Rutherford's experiments involved studying how alpha particles are scattered by gold atoms.
c) Millikan's experiments involved studying the voltage needed to make charged oil drops sink.
d) The Curies' experiments involved studying the radiation emitted from radioactive elements.

 # 3. The accepted value of the melting point of pure aspirin is 135°C. Trying to verify that value, you measure 134, 136, 133 and 138°C in four separate trials. Based on your average value, your accuracy is high, but based on the variation in your measurements, your precision is lower. What is your average absolute deviation (to 1 significant figure)?

a) 0.0°C
b) 0.3°C
c) 1°C
d) 2°C

 # 4. Imagine you put a tray of salted french fries in a hot oven at 450°F. Table salt, NaCl, melts at 1074 K. While in the oven, will the salt on the fries melt? Why? *Note: (x °F – 32°F)(1°C / 1.8°F) = y °C*

a) yes, because 232 < 1347
b) yes, because 752 < 1347
c) no, because 752 < 801
d) no, because 232 < 801

 # 5. The naturally occurring isotopes of uranium are ^{234}U, ^{235}U and ^{238}U, and the atomic mass of uranium is 238.02 g/mol. Which of the following statements must be false?

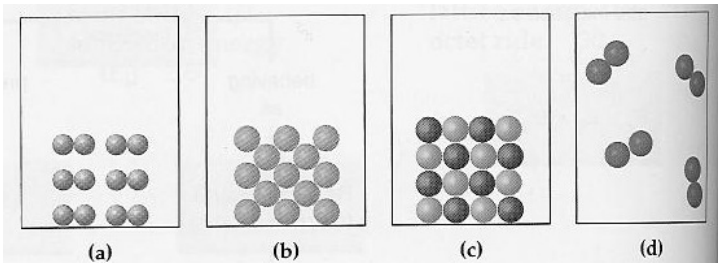
a) The atomic mass of U is the weighted average of its isotopes' masses.
b) ^{234}U nuclei contain 142 n^0 but the other isotopes have fewer neutrons.
c) U's most abundant isotope has 146 neutrons in its nuclei.
d) All three isotopes have 92 p^+ in the nuclei of their atoms.

 # 6. Which species are the particulate-level building blocks of the compound NaClO (same thing as NaOCl)?

a) Na atoms, Cl atoms, O atoms
b) Na^+ ions, Cl^- ions, O^{2-} ions
c) Na^+ ions, ClO^- ions
d) NaClO molecules

 # 7. Each diagram has been labeled as a particular substance at 25°C. Which one is <u>incorrect</u>?

a) Diagram a = magnesium
b) Diagram b = sodium
c) Diagram c = sodium chloride
d) Diagram d = chlorine



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 # 8. You have an irregularly shaped, 65.32 g piece of unknown metal, which you must identify via its density. When the metal is submerged in water, the water level rises from 25.3 to 33.6 mL. Which metal is it?

a) cadmium (density 8.65 g/cm^3)
b) silver (density 10.50 g/cm^3)
c) zinc (density 7.13 g/cm^3)
d) iron (density 7.87 g/cm^3)

 # 9. Which compound is named <u>incorrectly</u>?

a) $NiCl_2 \bullet 6H_2O$, nickel(II) chloride hexahydrate
b) NH_4NO_3, ammonium nitrate
c) P_4O_{10}, phosphorus oxide
d) Na_2SO_3, sodium sulfite

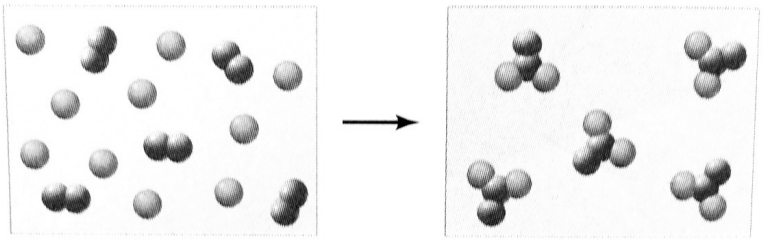
 # 10. Which statement about the trends in reactivity of elements is <u>incorrect</u>?

a) Atoms lose or gain electrons until they have the same number of electrons as a noble gas.
b) In reactions, nonmetals gain electrons, by forming covalent bonds or by forming anions.
c) The nonmetals with strongest pull on electrons are at the top right of the periodic table.
d) The metals with weakest pull on electrons are at the top left of the periodic table.

 # 11. Which of the following statements about elements is <u>incorrect</u>?

a) Allotropes are distinct forms of the same element, with different numbers of neutrons per atom.
b) Alkali metals react vigorously with water and O_2, so are not found in elemental form in nature.
c) Air is a mixture of gases whose main components are the elements nitrogen and oxygen.
d) The nonmetal elements in the third period are phosphorus, sulfur, chlorine and argon.

 # 12. The reaction of a sample of element "A" (lighter circles) with a sample of element "B" (darker circles) is shown in the diagram. What is the balanced equation for the chemical reaction?



a) $A_2 + 2\,B \rightarrow A_2B_2$
b) $10\,A + 5\,B_2 \rightarrow 5\,A_2B_2$
c) $2\,A + B_2 \rightarrow A_2B_2$
d) $A_2 + 2\,B \rightarrow 2\,AB$

 # 13. A powdered sample of rock believed to be pure calcium carbonate is analyzed and found to contain 51.3% Ca, 7.7% C and 41.0 % O by mass. Why can't this rock sample be pure $CaCO_3$?

a) The mass percents of all three elements are higher than in pure $CaCO_3$.
b) The mass percent of calcium is higher in the rock than in pure $CaCO_3$.
c) The mass percent of oxygen is higher in the rock than in pure $CaCO_3$.
d) The mass percent of carbon is higher in the rock than in pure $CaCO_3$.

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 # 14. Which one statement concerning the substance H_2S is true?

a) The percentage of S in pure H_2S depends on where the sample is obtained.
b) H_2S has properties similar to elemental hydrogen and elemental sulfur.
c) H_2S is a gas a room temperature that smells like rotten eggs.
d) H_2S is composed of a 2:1 ratio of H^+ cations and S^{2-} anions.

 # 15. Which of these compounds are strong electrolytes in water? $NaNO_3$, $PbCl_2$, HgS, NH_4Br, Al_2O_3

a) $NaNO_3$, HgS, NH_4Br
b) $PbCl_2$, HgS, Al_2O_3
c) $NaNO_3$, NH_4Br
d) $PbCl_2$, Al_2O_3

The next 5 questions relate to the following scenario:

In the lab, you add a 225 mL solution containing 0.25 mol of $K_3PO_4(aq)$ to a 225 mL solution containing 0.25 mol of $CaCl_2(aq)$. When mixed, a white solid precipitates to the bottom of the 450 mL solution.

 # 16. What is the complete ionic equation for the reaction that occurred?

a) $6\ K^+(aq) + 2\ PO_4^{3-}(aq) + 3\ Ca^{2+}(aq) + 6\ Cl^-(aq) \rightarrow\ 6\ KCl(s) + 3\ Ca^{2+}(aq) + 2\ PO_4^{3-}(aq)$
b) $6\ K^+(aq) + 2\ PO_4^{3-}(aq) + 3\ Ca^{2+}(aq) + 6\ Cl^-(aq) \rightarrow\ Ca_3(PO_4)_2(s) + 6\ K^+(aq) + 6\ Cl^-(aq)$
c) $K^+(aq) + PO_4^{3-}(aq) + Ca^{2+}(aq) + Cl^-(aq) \rightarrow\ Ca_3(PO_4)_2(s) + K^+(aq) + Cl^-(aq)$
d) $K^+(aq) + PO_4^{3-}(aq) + Ca^{2+}(aq) + Cl^-(aq) \rightarrow\ KNO_3(s) + Ca^{2+}(aq) + PO_4^{3-}(aq)$

 # 17. What is the net ionic equation for the reaction that occurred?

a) $3\ Ca^{2+}(aq) + 2\ PO_4^{3-}(aq) \rightarrow Ca_3(PO_4)_2(aq)$
b) $3\ Ca^{2+}(aq) + 2\ PO_4^{3-}(aq) \rightarrow Ca_3(PO_4)_2(s)$
c) $K^+(aq) + Cl^-(aq) \rightarrow KCl(aq)$
d) $K^+(aq) + Cl^-(aq) \rightarrow KCl(s)$

 # 18. Which sequence of separation techniques would yield a sample of white solid and a solid sample of the soluble product?

a) filtration, followed by evaporation of the solvent from the filtrate
b) treatment with a magnet, followed by freezing of the solution
c) distillation, followed by chromatography of the distillate
d) sublimation, followed by filtration of the sublimate

 # 19. What is the concentration of potassium ions in the $K_3PO_4(aq)$ solution before mixing the two solutions?

a) 0.056 mol/L
b) 0.17 mol/L
c) 1.1 mol/L
d) 3.3 mol/L

 # 20. What is the concentration of potassium ions in the supernatant solution above the precipitated solid?

a) Zero – they were all precipitated
b) Same as before the reaction
c) 0.56 mol/L
d) 1.7 mol/L

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

 # 21. (10 marks) Imagine you react 1.25 g of germanium, Ge(s), with enough liquid bromine, $Br_2(\ell)$, to consume all the germanium. The reaction makes 6.75 g of a single solid product with formula Ge_xBr_y.

a) **(6 marks)** Based on this data only *(i.e., do NOT use the information given in part (b) yet)*, what is the empirical formula of the product? Show full calculations.

b) **(2 marks)** If a mass spectrometry experiment determines the product's molar mass to be 392 g/mol, what is the molecular formula of the product? Explain in a few words or with a short calculation.

c) **(1 mark)** What is the product's name? Assume the product is molecular in nature.

d) **(1 mark)** What is the balanced chemical equation for the reaction?

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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)