Chemistry 121
Exam 1

Fall 2009
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Instructions: You should have with you several number two pencils, an eraser, your 3" x 5" note card, a calculator, and your University ID Card. If you have notes with you, place them in a sealed backpack and place the backpack OUT OF SIGHT or place the notes directly on the table at the front of the room.

Fill in the front page of the Scantron answer sheet with your test form number (listed above), last name, first name, middle initial, and student identification number. **Leave the class section number and the test form number blank.**

This exam consists of 25 multiple-choice questions. Each question has four points associated with it. Select the best multiple-choice answer by filling in the corresponding circle on the rear page of the answer sheet. If you have any questions before the exam, please ask. If you have any questions during the exam, please ask the proctor. Open and start this exam when instructed. When finished, place your Scantron form and note card in the appropriate stacks. You may keep the exam packet, so please show your work and mark the answers you selected on it.

1 inch = 2.54 cm (exact)	10 dm = 1 m	100 cm = 1 m
1000 mm = 1 m	1000 m = 1 km	10 mm = 1 cm
1 mole (N_A) = 6.022 x 10^{23}	1000 mL = 1 L	

IA		IIIB	IVB	VB	VIB	VIIB	VII			1B	IIB	IIIA	IVA	VA	VIA	VIIA	VIIIA
1 H Hydrogen 1.0079																	2 He Helium 4.0026
3 Li Lithium 6.941	4 Be Beryllium 9.01218											5 B Boron 10.81	6 C Carbon 12.011	7 N Nitrogen 14.0067	8 O Oxygen 15.9994	9 F Fluorine 18.9984	10 Ne Neon 20.179
11 Na Sodium 22.98977	12 Mg Magnesium 24.305											13 Al Aluminum 26.9815	14 Si Silicon 28.0855	15 P Phosphorus 30.97376	16 S Sulfur 32.06	17 Cl Chlorine 35.453	18 Ar Argon 39.948
19 K Potassium 39.0983	20 Ca Calcium 40.08	21 Sc Scandium 44.9559	22 Ti Titanium 47.88	23 V Vanadium 50.9415	24 Cr Chromium 51.996	25 Mn Manganese 54.9380	26 Fe Iron 55.847	27 Co Cobalt 58.9332	28 Ni Nickel 58.70	29 Cu Copper 63.546	30 Zn Zinc 65.38	31 Ga Gallium 69.72	32 Ge Germanium 72.59	33 As Arsenic 74.9216	34 Se Selenium 78.96	35 Br Bromine 79.904	36 Kr Krypton 83.80
37 Rb Rubidium 85.4678	38 Sr Strontium 87.62	39 Y Yttrium 88.9059	40 Zr Zirconium 91.22	41 Nb Niobium 92.9064	42 Mo Molybdenum 95.94	43 Tc Technetium 98.906	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.9055	46 Pd Palladium 106.4	47 Ag Silver 107.868	48 Cd Cadmium 112.41	49 In Indium 114.82	50 Sn Tin 118.69	51 Sb Antimony 121.75	52 Te Tellurium 127.60	53 I Iodine 126.9045	54 Xe Xenon 131.30
55 Cs Cesium 132.9054	56 Ba Barium 137.33	57–71 *Rare earths	72 Hf Hafnium 178.49	73 Ta Tantalum 180.9479	74 W Tungsten 183.85	75 Re Rhenium 186.207	76 Os Osmium 190.2	77 Ir Iridium 192.22	78 Pt Platinum 195.09	79 Au Gold 196.9665	80 Hg Mercury 200.59	81 Tl Thallium 204.37	82 Pb Lead 207.2	83 Bi Bismuth 208.9804	84 Po Polonium (209)	85 At Astatine (210)	86 Rn Radon (222)
87 Fr Francium (223)	88 Ra Radium 226.0254	89–103 †Actinides	104 Rf Rutherfordium (261)	105 Ha Hahnium (262)	106 Sg Seaborgium (263)	107 Ns Neilsbohrium (262)	108 Hs Hassium (265)	109 Mt Meitnerium (266)	110 ‡ (269)	111 ‡			114				

→ Stable region?

57 La Lanthanium 138.9055	58 Ce Cerium 140.12	59 Pr Praseodymium 140.9077	60 Nd Neodymium 144.24	61 Pm Promethium 145	62 Sm Samarium 150.4	63 Eu Europium 151.96	64 Gd Gadolinium 157.25	65 Tb Terbium 158.9254	66 Dy Dysprosium 162.50	67 Ho Holmium 164.9304	68 Er Erbium 167.26	69 Tm Thulium 168.9342	70 Yb Ytterbium 173.04	71 Lu Lutetium 174.967
89 Ac Actinium 227.0278	90 Th Thorium 232.0381	91 Pa Protactinium 231.0359	92 U Uranium 238.029	93 Np Neptunium 237.0482	94 Pu Plutonium (244)	95 Am Americium (243)	96 Cm Curium (247)	97 Bk Berkelium (247)	98 Cf Californium (251)	99 Es Einsteinium (254)	100 Fm Fermium (257)	101 Md Mendelevium (258)	102 No Nobelium 259	103 Lr Lawrencium 262

zeroes on the left are not (they are placeholders) ↓ ← zeroes on the right are significant

1. A student measures the energy of a reaction to be 0.00850 J. (3)

(A) There are six significant figures in this measured quantity
(B) There are five significant figures in this measured quantity
(C) There are four significant figures in this measured quantity
(D) There are three significant figures in this measured quantity
(E) There are two significant figures in this measured quantity

2. A student adds 72.30 grams of calcium chloride to 2412.0721 grams of sodium fluoride. The total mass of this sample (with the proper number of significant figures) is:

(A) 2484. grams
(B) 2484.4 grams
(C) 2484.37 grams
(D) 2484.372 grams
(E) 2484.3721 grams

```
   72.30   | 9
+ 2412.0721| 9
-----------
  2484.37  | 9
```

2484.37

3. Which of the following is **false**?

(A) Krypton and xenon are expected to behave similarly because they are in the same group. T
(B) Carbon and oxygen can form a molecule. T
(C) Potassium and calcium can form an ionic compound False - both are metals
(D) A student constructs a bike frame of titanium and aluminum. This is an alloy. T
(E) Ammonium nitrate is an ionic compound. T

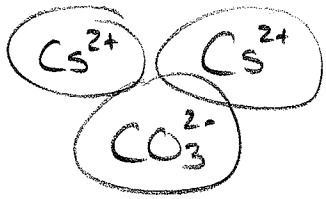
4. Which of the following pairs are isotopes?

(A) ^{16}N and ^{16}O
(B) ^{15}N and ^{15}O
(C). ^{14}N and ^{16}N Same p Different n
(D) $^{20}F^-$ and ^{20}Ne
(E) ^{40}Ar and ^{20}Ne

5. Consider cesium carbonate. Each unit contains:

Cs_2CO_3

(A) Two cesium ions and one carbonate ion.
(B) Two cesium ions and one carbide ion.
(C) One cesium ion and two carbide ions.
(D) One cesium ion and two carbonate ions.
(E) Two cesium ions, one carbide ion, and three oxide ions.



6. Which of the following pairs of elements will form an ionic compound?

↓
Metal & Non-Metal

(A) Carbon and oxygen
(B) Fluorine and neon
(C) Calcium and sulfur
(D) Carbon and nitrogen
(E) Sodium and calcium

7. $^{245}Am^{3+}$ has:

95 p ← 95 Am

245 − 95 = 150 n

95 − 3 = 92 e^-

(A) 245 **protons**, 245 **neutrons**, 92 **electrons**
(B) 245 **protons**, 245 **neutrons**, 98 **electrons**
(C) 95 **protons**, 150 **neutrons**, 98 **electrons**
(D) 95 **protons**, 98 **neutrons**, 92 **electrons**
(E) 95 **protons**, 150 **neutrons**, 92 **electrons**

8. A student obtains a sample of octane, C_8H_{18}. She measures the volume of the sample to be 137.5 in^3. Expressed in cm^3, the volume of the sample is:

$$137.5\ in^3 \left(\frac{2.54\ cm}{1\ in}\right)^3 = 2253\ cm^3$$

(A) 8.391 cm^3
(B) 2253 cm^3
(C) 349.3 cm^3
(D) 54.13 cm^3
(E) 3.14 cm^3

9. A fictitious element, Ed, has two naturally occurring isotopes. ^{294}Ed has a mass of 293.83 g/mol and is 19.4551% abundant. ^{292}Ed has a mass of 291.91 g/mol and is 80.5449% abundant. What is the average atomic mass of Ed?

(A) 292.28 g/mol
(B) 292.87 g/mol
(C) 292.71 g/mol
(D) 293.46 g/mol
(E) 293.71 g/mol

$(293.83\ g/mol)(0.194551) + (291.91\ g/mol)(0.805449) =$

$292.28\ g/mol$

10. Which of the following chemical formulae is **incorrect**?

(A) CaO ✓
(B) $MgCO_3$ ✓
(C) Ba_3PO_4
(D) MgF_2 ✓
(E) $(NH_4)_3PO_4$ ✓

Ba^{2+} PO_4^{3-} need $Ba_3(PO_4)_2$

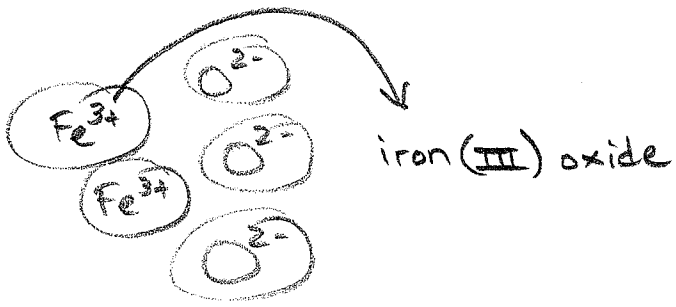
11. Which of the following statements is **false**?

(A) Molybdenum is a transition metal ✓
(B) Lithium is in Group 1 and has an atomic mass of 6.941 g/mol ✓
(C) Aluminum tends to lose three electrons when it forms ionic compounds ✓
(D) Sodium can lose an electron and form an ionic compound with nitrate ion ✓
(E) Helium is a non-metal and tends to gain one electron when it forms ionic compounds

noble gas

12. The name of Fe_2O_3 is:

(A) iron (II) oxide
(B) iron (III) oxide
(C) diiron trioxide
(D) iron trioxide
(E) iron (II) oxide (III)



13. The name of PCl_5 is:

penta ←

phosphorous pentachloride

P Cl_5

(A) phosphorous chloride
(B) phosphorous pentachloride
(C) phosphorous (III) chloride
(D) phosphorous (V) chloride
(E) phosphorous carbonate

14. When the reaction

C_7H_{16} (l) + 11 O_2 (g) → 7 CO_2 (g) + 8 H_2O (g) is correctly balanced,

(A) 7 O_2 are consumed
(B) 11 O_2 are consumed
(C) 14 O_2 are consumed
(D) 15 O_2 are consumed
(E) 16 O_2 are consumed

1 mol → 5 mol

15. Consider the combustion of propane in oxygen: C_3H_8 (g) + 5 O_2 → 3 CO_2 (g) + 4 H_2O (g). How many moles of oxygen are required to react completely with three moles of propane?

(A) 1 mole of O_2
(B) 2 moles of O_2
(C) 3 moles of O_2
(D) 5 moles of O_2
(E) 15 moles of O_2

$$3 \text{ mol } C_3H_8 \left(\frac{5 \text{ mol } O_2}{1 \text{ mol } C_3H_8} \right) = 15 \text{ mol } O_2$$

nitrogen tetroxide (prefixes - molecule)
aluminum oxide (no prefixes - ionic compound)

16. The names of N_2O_4 and Al_2O_3 are:

(A) nitrogen tetroxide and aluminum oxide
(B) dinitrogen tetroxide and dialuminum trioxide
(C) nitrogen oxide and aluminum oxide
(D) nitrogen oxide and tetraaluminum trioxide
(E) dinitrogen tetroxide and aluminum oxide

17. The name of $Al_2(SO_4)_3$ is:

(A) dialuminum trisulfide
(B) aluminum trisulfate
(C) dialuminum trisulfate
(D) aluminum sulfide
(E) aluminum sulfate

Al^{3+} SO_4^{2-}

aluminum sulfate

* I didn't list sulfate on the mini list of polyatomic ions. All students will receive full credit for this question regardless of the selection

18. The mass percent composition of Na_3PO_4 is:

(A) 32.86 % Na 44.27 % P 22.87 % O
(B) 42.07 % Na 44.27 % P 13.66 % O
(C) 37.50 % Na 12.50 % P 50.00 % O
(D) 42.07 % Na 18.89 % P 39.04 % O
(E) 33.00 % Na 33.00 % P 33.00 % O

← Whole

$3 * 22.99\ g/mol$

$1 * 30.97\ g/mol$

$4 * 16.00\ g/mol$

$163.94\ g/mol$

$Na = \frac{3 * 22.99}{163.94} = 42.07\%$

$P = \frac{30.97}{163.94} = 18.89\%$

$O = \frac{4 * 16.00}{163.94} = 39.04\%$

19. A student places 51.88 g of LiF (s) into a 1.000-L volumetric flask and fills to the mark with water. The concentration of the solution is:

(A) 1.000 M
(B) 2.000 M
(C) 3.000 M
(D) 4.000 M
(E) 8.000 M

→ $6.941\ g/mol + 19.00\ g/mol = 25.94\ g/mol$

$51.88\ g\ LiF \left(\frac{1\ mol}{25.94\ g}\right) = 2.000\ mol$

$M = \frac{mol}{L} = \frac{2.000\ mol}{1.000\ L} = 2.000\ \frac{mol}{L}$ or M

20. Consider the following reaction: $2\ Na\ (s) + 2\ H_2O\ (l) \rightarrow 2\ NaOH\ (aq) + H_2\ (g)$

In a given experiment, the theoretical yield of H_2 (g) for the above reaction is 17.0g. If the reaction actually produces 11.2 g hydrogen gas, what is the percent yield for the reaction?

(A) 5.8 %
(B) 34.1 %
(C) 65.9 %
(D) 1.52 %
(E) 152 %

$$\text{Percent Yield} = \frac{\text{actual}}{\text{theoretical}} * 100\% = \frac{11.2\text{g}}{17.0\text{g}} \cdot 100\% = 65.9\%$$

21. A student () obtains 2.000 moles of iron. What is the mass of this sample?

(A) 2.000 grams
(B) 6.022×10^{23} grams
(C) 111.7 grams
(D) 27.92 grams
(E) 1.000 grams

$$2.000\ \text{mol Fe}\left(\frac{55.85\ \text{g}}{1\ \text{mol}}\right) = 111.7\ \text{g Fe}$$

22. A student  obtains 393.93 grams of gold. How many gold atoms are present?

$$393.93\text{g}\left(\frac{1\ \text{mol}}{196.97\ \text{g}}\right) = 2.000\ \text{mol Au}$$

$$2.000\ \text{mol Au}\left(\frac{6.022\times10^{23}\ \text{Au atoms}}{1\ \text{mol Au}}\right) = 1.204\times10^{24}\ \text{Au atoms}$$

(A) 6.022×10^{23} gold atoms
(B) 2.050×10^{26} gold atoms
(C) 1.204×10^{24} gold atoms
(D) 1.04×10^{24} gold atoms
(E) 6.544×10^{-22} gold atoms

23. The mass of a single methane molecule, CH_4, is:

$1 * 12.01$
$4 * 1.01$
$16.059\ g/mol$

(A) 2.664 x 10^{-23} grams
(B) 9.661 x 10^{24} grams
(C) 4.816 x 10^{-23} grams
(D) 1.604 x 10^{-23} grams
(E) 16.04 grams

$16.05\ \frac{g}{mol}\left(\frac{1\ mol}{6.022 \times 10^{23}\ atoms}\right) = 2.664 \times 10^{-23}\ \frac{g}{atom}$

24. In an excess amount of oxygen, how many grams of H_2O (g) are theoretically produced from the combustion of 576.4 g of citric acid [$C_6H_8O_7$ (s), molar mass of 192.12 g/mol]?

$C_6H_8O_7$ (s) + 9/2 O_2 (g) → 6 CO_2 (g) + 4 H_2O (g)

576.4 g ↓ ①

3.000 mol ——②——→ 12.000 mol

216.2 g ↑ ③

① $576.4\ g\ C_6H_8O_7\left(\frac{1\ mol}{192.12\ g}\right) = 3.000\ mol\ C_6H_8O_7$

② $3.000\ mol\ C_6H_8O_7\left(\frac{4\ mol\ H_2O}{1\ mol\ C_6H_8O_7}\right) = 12.000\ mol\ H_2O$

③ $12.000\ mol\ H_2O\left(\frac{18.02\ g}{1\ mol}\right) = 216.2\ g\ H_2O$

(A) 3.000 g H_2O (g) are produced
(B) 1.107 x 10^5 g H_2O (g) are produced
(C) 216.2 g H_2O (g) are produced
(D) 54.06 g H_2O (g) are produced
(E) 3.846 x 10^{23} g H_2O (g) are produced

25. Because of Chemistry 121...

(A) I contracted swine flu
(B) I am now motivated to build a homemade flying saucer
(C) I am going to have the word "Mole" tattooed on my butt
(D) I'm switching my major to chemistry
(E) I'm switching my major from chemistry to art

[Any response will receive full credit; even no response.]