Chemistry 121 | Fall 2007 | Oregon State University
Exam 1 | October 18, 2007 | Dr. Richard Nafshun

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												IIIA	IVA	VA	VIA	VIIA	VIIIA
1 H Hydrogen 1.0079								VII									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	IIIB	IVB	VB	VIB	VIIB				IB	IIB	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

1. A student measures the length of a green crystal to be 0.091470 m.

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

Zeroes to the left are not sig
Zeroes to the right are sig
(they are reported as measured)

2. A student combines 12.1 g of iron chloride and 16421.03 g of nickel oxalate. The mass of the mixture (with the proper number of significant figures) is:

(A) 16433.13 g
(B) 16433.1 g
(C) 16433. g
(D) 1.643×10^4 g
(E) 1.64×10^4 g

$$\begin{array}{rr} 16421.03 & g \\ + \quad 12.1 & g \\ \hline 16433.1 & g \end{array}$$

3. Which of the following statements is **FALSE?**

(A) Protons and neutrons are located inside the nucleus.
(B) The nucleus occupies about 99.9% of the volume of the atom.
(C) Electrons carry a negative charge; protons carry a positive charge.
(D) A neutral atom has an equal number of protons and electrons.
(E) An electron is roughly 1/2000th the mass of a neutron.

4. Which of these pairs of elements would most likely combine to form a molecule?

(A) He and Li
(B) Ne and F
(C) Mg and Sr
(D) K and Br
(E) S and F

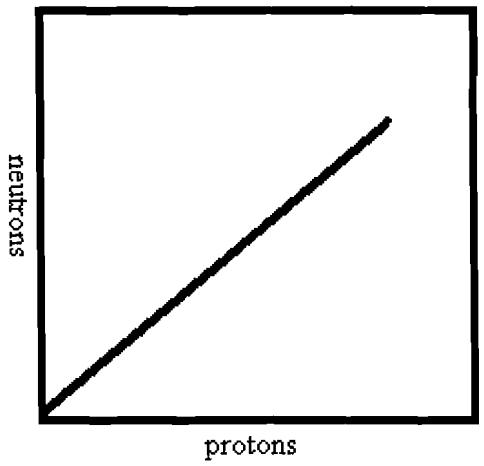
↓
Non-metals - but not inert gases

5. Which of these pairs of elements would be most likely to form an ionic compound?

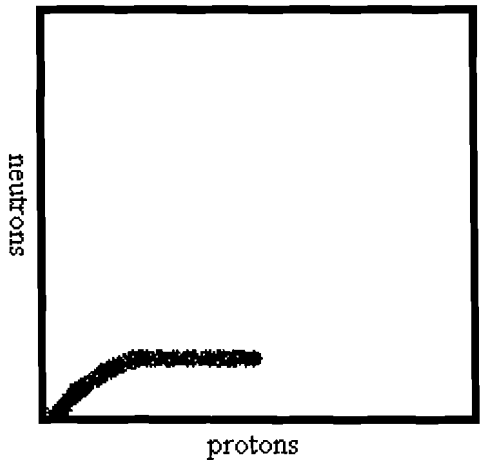
↓ metal & Non-metal

(A) P and Br
(B) Cr and K
(C) C and O
(D) Rb and Al
(E) Li and O

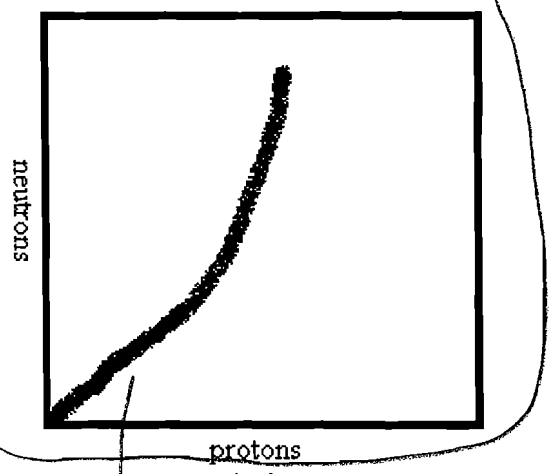
6. Which of the following figures best represents stable isotopes?



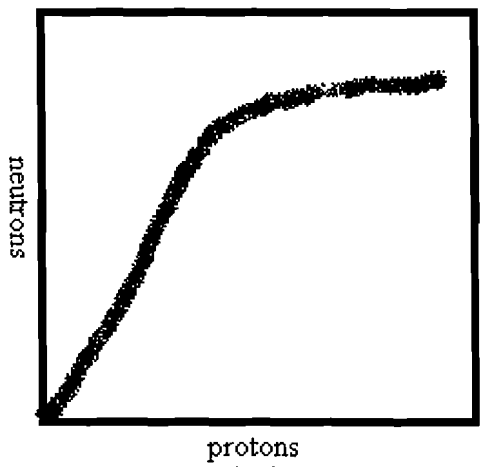
(A)



(B)



(C)



(D)

→ n = p for the smaller atoms and then n > p

7. A student measures the volume of a Potassium Trioxalatoferrate (III) crystal to be 0.05320 inches^3. Expressed in mm^3, this volume is:

(A) 1.351×10^{-3} mm^3
(B) 8.718 mm^3
(C) 1.351×10^{-6} mm^3
(D) 1.351 mm^3
(E) 871.8 mm^3

$0.05320\ in^3 \left(\frac{2.54\ cm}{1\ in}\right)^3 \left(\frac{10\ mm}{1\ cm}\right)^3 =$

$871.8\ mm^3$

8. The two stable isotopes of beaverium are Bv-281 (mass = 281.103 amu and a percent abundance of 23.55%) and Bv-283 (mass = 283.192 amu and a percent abundance of 76.45%). What is the average mass of beaverium?

(A) 282.7 amu
(B) 353.7 amu
(C) 282.2 amu
(D) 282.1 amu
(E) 281.9 amu

$(281.103\ amu)(0.2355) + (283.192\ amu)(0.7645) =$

$282.7\ amu$

9. Consider $(NH_4)_3PO_4$. Each unit contains:

(A) One nitrogen ion, four hydrogen ions, one phosphorous ion, and four oxide ions
(B) Twelve ammonium ions, one phosphorous ion, and four oxide ions
(C) Three sodium ions, one phosphorus ion, and four oxide ions
(D) Three ammonium ions and one phosphate ion
(E) Three ammonium ions and four phosphate ions

3 NH_4^+ ions (ammonium ions)
and
1 PO_4^{3-} ion (phosphate ion)

10. A student places 731.77 grams of an irregularly shaped piece of metal into 56.22 mL of water in a graduated cylinder. The water level rises to 120.75 mL. The metal is:

(A) Al (d = 2.72 g/mL)
(B) Cr (d = 7.25 g/mL)
(C) Pb (d = 11.34 g/mL)
(D) Au (d = 19.28 g/mL)
(E) Pt (d = 21.46 g/mL)

$d = \frac{m}{V} = \frac{731.77\ g}{120.75\ mL - 56.22\ mL} = 11.34\ g/mL$

11. $^{241}Am^{2+}$ has:

(A) 95 **protons**, 241 **neutrons**, 95 **electrons**
(B) 146 **protons**, 146 **neutrons**, 97 **electrons**
(C) 95 **protons**, 146 **neutrons**, 97 **electrons**
(D) 95 **protons**, 146 **neutrons**, 95 **electrons**
(E) 95 **protons**, 146 **neutrons**, 93 **electrons**

Am^{2+}
95 p
241 − 95 = 146 n
95 − 2 = 93 e⁻

12. Which of the following sets of elements are expected to have similar properties?

(A) Sulfur and phosphorous
(B) Sulfur and oxygen
(C) Sulfur and fluorine
(D) Sulfur and chlorine
(E) Sulfur and argon

↓
Same Group

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

(A) $Ba_3(PO_4)_2$
(B) MgO
(C) $Ca(CO_3)_2$
(D) Na_2S
(E) KNO_3

Ba^{2+} PO_4^{3-}
Mg^{2+} O^{2-}
Ca^{2+} CO_3^{2-}
Na^{+} S^{2-}
K^{+} NO_3^{-}

14. The name of $Ca(NO_3)_2$ is:

(A) calcium nitrate
(B) calcium nitride
(C) calcium dinitrate
(D) calcium dinitride
(E) monocalcium dinitride

calcium nitrate

15. Two elements that will form 2+ ions in ionic compounds are:

(A) N and P
(B) O and S
(C) Cl and Br
(D) Ba and Ca
(E) Na and K

↘ Group 2

16. The mass percent compositions of the elements in dimethyl ether, C_2H_6O, are:

(A)	C = 12.011 %	H = 1.0079 %	O = 15.999 %
(B)	C = 24.022 %	H = 6.0474 %	O = 15.999 %
(C)	C = 26.07 %	H = 2.188 %	O = 15.999 %
(D)	C = 52.14 %	H = 13.13 %	O = 34.73 %
(E)	C = 41.39 %	H = 3.473 %	O = 55.14 %

↘ Molar Mass = 46.07 g/mol

C ⇒ $\frac{2 * 12.011\ g/mol}{46.07\ g/mol} = 0.5214$ or 52.14%

H ⇒ $\frac{6 * 1.0079\ g/mol}{46.07\ g/mol} = 0.1313$ or 13.13%

O ⇒ $\frac{1 * 16.00\ g/mol}{46.07\ g/mol} = 0.3473$ or 34.73%

17. Which of the following pairs are isotopes?

(A) ^{12}C and ^{12}C.
(B) ^{14}C and ^{14}N.
(C) ^{12}C and ^{14}N.
(D) ^{14}N and ^{15}N.
(E) ^{14}C and ^{28}Si.

↘ Same element (same number of protons) but different number of neutrons.

18. Provide the coefficients needed to balance the following combustion equation:

$$a\ C_7H_{16}\ (l) + b\ O_2\ (g) \rightarrow c\ CO_2\ (g) + d\ H_2O\ (g)$$

1 11 7 8

(A)	a = 1	b = 11	c = 7	d = 8
(B)	a = 2	b = 11	c = 7	d = 8
(C)	a = 7	b = 22	c = 14	d = 16
(D)	a = 1	b = 22	c = 7	d = 8
(E)	a = 2	b = 11	c = 14	d = 8

19. 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 7.00g. If the reaction actually produces 2.50 g hydrogen gas, what is the percent yield for the reaction?

(A) 0.50 %
(B) 2.80 %
(C) 17.7 %
(D) 50.0 %
(E) 35.7 %

$$\text{Percent Yield} = \left[\frac{\text{actual}}{\text{theoretical}}\right](100\%) = \left[\frac{2.50\ g}{7.00\ g}\right](100\%) =$$

35.71%

20. Consider the following reaction: $4\ P\ (s) + 5\ O_2\ (g) \rightarrow P_4O_{10}\ (s)$

How many moles of P_4O_{10} (s) are produced from 8 moles of P (s) in an excess amount of O_2 (g)?

(A) 1 mol P_4O_{10} (s)
(B) 2 mol P_4O_{10} (s)
(C) 4 mol P_4O_{10} (s)
(D) 8 mol P_4O_{10} (s)
(E) 16 mol P_4O_{10} (s)

$$8\ mol\ P \left(\frac{1\ mol\ P_4O_{10}}{4\ mol\ P}\right) = 2\ mol\ P_4O_{10}$$

21. The mass of a single carbon atom is:

(A) 12.011 grams
(B) 6.022×10^{23} grams
(C) 6.022×10^{-23} grams
(D) 1.995×10^{-23} grams
(E) 5.014×10^{-22} grams

$$12.011\ g/mol \left(\frac{1\ mol}{6.022 \times 10^{23}\ atoms} \right) = 1.995 \times 10^{-23}\ \frac{g}{atom}$$

22. A student places 6.750 grams of sodium chloride into a 5.000 liter volumetric flask and fills to the mark with water. What is the molarity (a unit of concentration) of the solution?

(A) 1.350 M
(B) 0.02310 M
(C) 43.29 M
(D) 0.7407 M
(E) 0.6022 M

$$6.750\ g \left(\frac{1\ mol}{58.45\ g} \right) = 0.1155\ mol$$

$$M = \frac{mol}{L} = \frac{0.1155\ mol}{5.000\ L} = 0.02310\ M$$

23. A student obtains 100.0 grams of H_2O (l). How many water molecules are present?

(A) 3.342 x 10^{24} H_2O molecules
(B) 2.408 x 10^{24} H_2O molecules
(C) 3.601 x 10^{24} H_2O molecules
(D) 6.684 x 10^{23} H_2O molecules
(E) 1.204 x 10^{24} H_2O molecules

$$100.0\ g\ H_2O \left(\frac{1\ mol}{18.02\ g} \right) = 5.549\ mol\ H_2O$$

$$5.549\ mol\ H_2O \left(\frac{6.022 \times 10^{23}\ molecules}{1\ mol} \right) = 3.342 \times 10^{24}\ H_2O\ molecules$$

24. A student combusts 220.48 grams of propane, C_3H_8 (g), in an excess amount of oxygen. How many grams of H_2O (g)are produced?

C_3H_8 (g) + 5 O_2 (g) → 3 CO_2 (g) + 4 H_2O (g)

① $220.48\text{ g } C_3H_8 \left(\frac{1\text{ mol}}{44.096\text{ g}} \right) = 5.000\text{ mol } C_3H_8$

② $5.000\text{ mol} \left(\frac{4\text{ mol } H_2O}{1\text{ mol } C_3H_8} \right) = 20.000\text{ mol } H_2O$

③ $20.000\text{ mol } H_2O \left(\frac{18.02\text{ g}}{1\text{ mol}} \right) = 360.4\text{ mol } H_2O$

(A) 5.0000 grams of H_2O (g) are produced
(B) 20.000 grams of H_2O (g) are produced
(C) 360.32 grams of H_2O (g) are produced
(D) 90.100 grams of H_2O (g) are produced
(E) 22.525 grams of H_2O (g) are produced

25. Because of Chemistry 121...

(A) I get lots of dates by using pick-up lines that include the words charge, centimeters, molecules, charge, neutrons, metalloids, ions, and combustion.
(B) My appreciation for art has increased.
(C) I have laughed more times in the past three weeks than I have in the previous three years.
(D) I have completely forgotten about Lindsay Lohan —at least until 3 seconds ago!
(E) I am able to love again.

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