Chemistry 121 | Fall 2008 | Oregon State University
Exam 1 | October 23, 2008 | 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) = 6.022×10^{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

1. A student measures the mass of a sample of aluminum oxide to be 0.02030 mg. (4)

(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 measures the length and width of a rectangular reaction surface to be 21.40 cm and 0.0283 cm. The area of this surface (with the proper number of significant figures) is:

(A) 0.6056200 cm^3
(B) 0.605620 cm^3
(C) 0.60562 cm^3
(D) 0.6056 cm^3
(E) 0.606 cm^3

21.40 cm (4) * 0.0283 cm (3) = 0.6056200

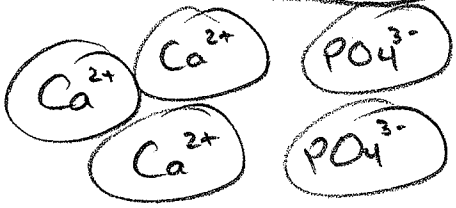
weakest link

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

(A) A student constructs a bike frame of iron, chromium, and manganese. This is an alloy.
(B) Calcium nitride is an ionic compound and helium is an inert gas.
(C) Nitrogen and oxygen can form a molecule.
(D) Carbon monoxide is a polyatomic ion. → CO is a molecule
(E) Fluorine and chlorine are expected to behave similarly because they are in the same group.

4. Consider $Ca_3(PO_4)_2$. Each unit contains:

(A) Three calcium ions, one phosphorus ion, and two oxide ions
(B) One calcium ion, one phosphorus ion, and two oxide ions
(C) Three calcium ions, two phosphorus ions, and four oxide ions
(D) One calcium ion, three phosphorus ions, and two oxide ions
(E) Three calcium ions, two phosphate ions



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

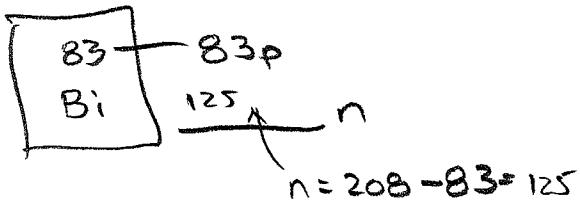
(A) Sodium and calcium
(B) Carbon and oxygen
(C) Carbon and nitrogen
(D) Fluorine and neon
(E) Calcium and sulfur

↓
Metal & Non-metal

CaS

6. $^{208}Bi^{2+}$ has:

(A) 83 **protons**, 83 **neutrons**, 85 **electrons**
(B) 83 **protons**, 125 **neutrons**, 81 **electrons**
(C) 125 **protons**, 83 **neutrons**, 81 **electrons**
(D) 125 **protons**, 83 **neutrons**, 85 **electrons**
(E) 83 **protons**, 81 **neutrons**, 83 **electrons**



81 e⁻
↑
83 - 2 = 81

7. A student obtains a sample of methane, CH_4. She measures the volume of the sample to be 205.85 cm^3. Expressed in in^3, the volume of the sample is:

(A) 12.562 in^3
(B) 31.907 in^3
(C) 81.043 in^3
(D) 522.86 in^3
(E) 3373.3 in^3

$$205.85\ cm^3 \left(\frac{1\ in}{2.54\ cm} \right)^3 = 12.562\ in^3$$

↑

$$\left(\frac{1\ in^3}{16.39\ cm^3} \right)$$

8. A fictitious element, OMG, has two naturally occurring isotopes. ^{285}OMG has a mass of 284.67 g/mol and is 28.7557% abundant. ^{288}OMG has a mass of 287.73 g/mol and is 71.2443% abundant. What is the average atomic mass of OMG?

(A) 285.96 g/mol
(B) 287.96 g/mol
(C) 286.96 g/mol
(D) 286.85 g/mol
(E) 286.20 g/mol

$= (0.287557)(284.67 \frac{g}{mol}) + (0.712443)(287.73 \frac{g}{mol})$

$= 286.8501 \frac{g}{mol}$

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

(A) $BaCO_3$
(B) $CaSO_4$
(C) NaOH
(D) MgF
(E) Li_2O

Should be MgF_2

10. A student places 3702.8 grams of an irregularly shaped piece of metal into 84.0 mL of water in a graduated cylinder. The water level rises to 256.5 mL. The metal is:

$d = \frac{g}{mL} = \frac{3702.8\ g}{256.5\ mL - 84.0\ mL} = 21.465 \frac{g}{mL}$

(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)

11. Which of the following elements is a metal?

(A) Calcium
(B) Carbon
(C) Iodine
(D) Radon
(E) Sulfur

12. Consider the reaction: $4\ P + 5\ O_2 \rightarrow P_4O_{10}$. How many moles of phosphorus, P, are required to produce 2.00 moles of P_4O_{10}?

(A) 0.500 moles P
(B) 2.00 moles P
(C) 4.00 moles P
(D) 8.00 moles P
(E) 16.0 moles P

$$2.00\,\text{mol}\,P_4O_{10}\left(\frac{4\ \text{mol}\,P}{1\ \text{mol}\,P_4O_{10}}\right) = 8.00\ \text{mol}\,P$$

13. When combined with sulfur, a Group 2 element will tend to:

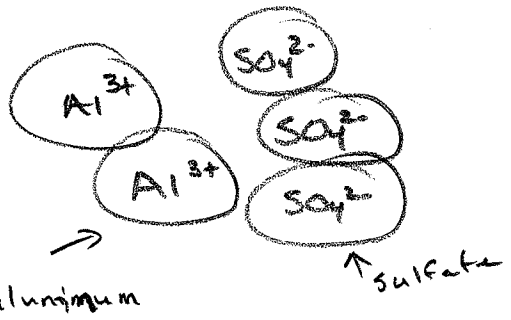
(A) Gain one electron
(B) Gain two electrons
(C) Lose one electron
(D) Lose two electrons
(E) Donate a proton

Such as Ca^{2+} ↑ lose 2e⁻

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

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

aluminum sulfate
(no prefixes – ionic compound)



15. 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
(D) ^{20}F and ^{20}Ne
(E) ^{40}Ar and ^{20}Ne

↑ Same element but different number of neutrons

7p

^{14}N has $14-7=7n$

^{16}N has $16-7=9n$

16. The mass percent composition of $CaSO_4$ is:

(A) 16.7% Ca, 16.7% S, 66.7% O
(B) 20.0% Ca, 20.0% S, 60.0% O
(C) 25.1% Ca, 20.5% S, 54.4% O
(D) 29.4% Ca, 23.6% S, 47.0% O
(E) 33.3% Ca, 33.3% S, 33.3% O

"part" / whole → $CaSO_4$

$40.08\ g/mol$
$32.06\ g/mol$
$4 * 16.00\ g/mol$

$136.14\ g/mol$

Ca → $\frac{40.08\ g/mol}{136.14\ g/mol} \cdot 100\% = 29.44\%$

S → $\frac{32.06\ g/mol}{136.14\ g/mol} \cdot 100\% = 23.55\%$

O = $\frac{4 \cdot 16.00\ g/mol}{136.14\ g/mol} \cdot 100\% = 47.01\%$

17. A student places 23.38 g of NaCl (s) into a 1.000-L volumetric flask and fills to the mark with water. The concentration of the solution is:

22.99 g/mol
+ 35.45 g/mol
58.44 g/mol

(A) 0.1000 M.
(B) 0.2000 M.
(C) 0.3000 M.
(D) 0.4000 M.
(E) 0.6000 M.

$$M = \frac{\text{mol}}{L} = \frac{0.400 \text{ mol}}{1.000 \text{ L}} = 0.400 \text{ M}$$

$$23.38 \text{ g} \left(\frac{1 \text{ mol}}{58.44 \text{ g}} \right) = 0.400 \text{ mol}$$

18. When the reaction

C_9H_{20} (l) + 14 O_2 (g) → 9 CO_2 (g) + 10 H_2O (g) is correctly balanced,

18 + 10 = 28 oxygens

(A) 9 O_2 are consumed.
(B) 14 O_2 are consumed.
(C) 6 O_2 are consumed.
(D) 18 O_2 are consumed.
(E) 10 O_2 are consumed.

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 1.24 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 %

$$\%\ Yield = \frac{actual}{theoretical} \cdot 100\% = \frac{1.24\ g}{7.00\ g} \cdot 100\% = 17.7\ \%$$

20. A student () obtains 340.72 grams of gold. This is:

(A) 1.73 gold atoms
(B) 2.05×10^{26} gold atoms
(C) 4.04×10^{28} gold atoms
(D) 1.04×10^{24} gold atoms
(E) 2.87×10^{-24} gold atoms

$$340.72\ g \left(\frac{1\ mol}{196.97\ g} \right) = 1.7298\ mol$$

$$1.7298\ mol \left(\frac{6.022 \times 10^{23}\ atoms}{1\ mol} \right) = 1.04 \times 10^{24}\ atoms$$

21. The mass of a single gold atom is:

(A) 196.97 grams
(B) 3.271×10^{-22} grams
(C) 6.022×10^{-23} grams
(D) 3.057×10^{21} grams
(E) 6.022×10^{23} grams

$$196.97\ \frac{g}{mol} \left(\frac{1\ mol}{6.022 \times 10^{23}\ atoms} \right) = 3.271 \times 10^{-22}\ \frac{g}{atom}$$

22. The molar mass of ethane, C_2H_6, is:

(A) ~~13.02 g/mol~~
(B) 30.08 g/mol
(C) 4.818×10^{24} g/mol
(D) 4.818 g/mol
(E) 114.26 g/mol

$2 \cdot 12.01\ g/mol$
$+\ 6 \cdot 1.01\ g/mol$
$30.08\ g/mol$

23. A student obtains 100.0 grams of methane, CH_4 (g). How many methane molecules are present?

(A) 3.754×10^{24} molecules
(B) 2.664×10^{24} molecules
(C) 2.664×10^{-24} molecules
(D) 1.661×10^{23} molecules
(E) 1.604×10^{24} molecules

$12.01\ g/mol$
$+\ 4 \cdot 1.01\ g/mol$
$16.05\ g/mol$

$$100.0\ g\ CH_4 \left(\frac{1\ mol}{16.05\ g}\right) = 6.231\ mol\ CH_4$$

$$6.231\ mol\ CH_4 \left(\frac{6.022 \times 10^{23}\ molecules}{1\ mol}\right) = 3.75 \times 10^{24}\ molecules$$

(Please turn over for the last page of the exam)

24. In an excess amount of oxygen, how many grams of CO_2 (g) are theoretically produced from the combustion of 901.0 g of glucose [$C_6H_{12}O_6$ (s), molar mass of 180.2 g/mol]?

180.2 g/mol

$C_6H_{12}O_6$ (s) + 6 O_2 (g) → 6 CO_2 (g) + 6 H_2O (g)

901.0 g ↓ ① 5.000 mol ② 30.00 mol ③ ↑ 1320. g

① $901.0\ g\ C_6H_{12}O_6 \left(\frac{1\ mol}{180.2\ g} \right) = 5.000\ mol\ C_6H_{12}O_6$

② $5.000\ mol\ C_6H_{12}O_6 \left(\frac{6\ mol\ CO_2}{1\ mol\ C_6H_{12}O_6} \right) = 30.00\ mol\ CO_2$

12.01 g/mol + 2 · 16.00 g/mol = 44.01 g/mol

③ $30.00\ mol\ CO_2 \left(\frac{44.01\ g}{1\ mol} \right) = 1320\ g\ CO_2$

(A) 108.1 g CO_2 (g) are produced
(B) 220.1 g CO_2 (g) are produced
(C) 264.1 g CO_2 (g) are produced
(D) 1320 g CO_2 (g) are produced
(E) 4860 g CO_2 (g) are produced

25. Because of Chemistry 121...

(A) I now understand *chemistry* is responsible for the current state of my life.
(B) I have a blister the size of a Frisbee on my brain.
(C) I have learned to be charming and get dates.
(D) The thought of that forthcoming root canal no longer seems agonizing.
(E) OSU Football defeated USC 27-21.

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