

# Chemistry 151H Sample Exam I

Fall 2009

Chapters 1, 2 & 3\*

Name (PRINTED LEGIBLY) \_\_\_\_\_

Student ID Number \_\_\_\_\_

**Please read and acknowledge the following instructions.**

1. There is a periodic table attached to this exam. You may tear it off the exam, however all exam materials are to be turned in with the exam.
2. You will have 1 hour, 50 minutes to complete the exam.
3. You are responsible for any corrections announced during the first hour of the exam.
4. Anyone arriving more than 15 minutes late will not be allowed to take the exam.
5. You are only allowed a single-line, non-programmable calculator on this exam.
6. **No cell phones, PDAs, or music devices** of any kind are allowed during the exam
7. Use the spaces between questions and the backs of the exam page for scratch paper. No additional scratch paper is allowed.
8. Circle your answers on this exam form and use a number two type pencil to mark carefully the answer (scantron-type) sheet.
9. This exam consists of 9 pages total (cover sheet, test pages, misc. information and periodic table). Be sure you have all 9 pages.
10. During the exam if you have a question please raise your hand and the instructor or proctor will come to you.
11. On the scantron sheet, fill in your name and student ID number and pencil-fill the corresponding circles for the letters and numbers.

Signature \_\_\_\_\_

Date: \_\_\_\_\_

# CHMY 151H Sample Exam I

Fall 2008

Chapters 1 & 2: Gilbert, Kirss & Davies

Name \_\_\_\_\_

There is a periodic table and a section of miscellaneous information at the end of this exam. Show work for all problems requiring dimensional analysis, circle your answer for multiple choice questions on this test form. **NO PROGRAMABLE CALCULATORS.**

1. (4 points) In 1 second, light can travel  $2.998 \times 10^8$  m. How many inches does light travel in 1 femtosecond ( $1 \text{ fs} = 10^{-15} \text{ s}$ )?

3. (4 points) What is the speed of light in furlongs per fortnight?  
Given:  $c = 2.998 \times 10^8 \text{ m/s}$     1 furlong = 201.16800 m    1 fortnight = 14 days

4. (3 points) Which of the following is an intensive property?

- a. density
- b. mass
- c. volume
- d. none of the above

5. (3 points) The stability of a nucleus is proportional to the \_\_\_\_\_ of that nucleus.

- a. binding energy
- b. number of protons
- c. number of bosons
- d. ratio of electrons to protons

6. (3 points) Liquid nitrogen boils at 77 K. What is this temperature in °F?

- a. -196°F
- b. -321°F
- c. -256°F
- d. -77°F

7. (3 points) Which of the following is not an SI base unit?

- a. cm
- b. m
- c. kg
- d. sec

8. (4 points) Jupiter's mass is estimated to be  $1.90 \times 10^{27}$  kg, and it has a diameter of 142,984 km. Assuming that Jupiter is essentially spherical, estimate its density (the volume of a sphere is  $\frac{4}{3}\pi r^3$ ).

2. (4 points) Energy generation results in the addition of an estimated 27 billion metric tons (tonnes) of CO<sub>2</sub> to the atmosphere each year. 1 metric ton = 1000 kg

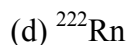
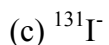
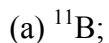
(a) How many moles of CO<sub>2</sub> does 27 gigatonne represent?

(b) How many kilograms of *carbon* are in 27 gigatonne of CO<sub>2</sub>?

10. (3 points) Which of the following represents a physical property of water?
- Water boils at 100°C.
  - An electrical current decomposes water into hydrogen gas and oxygen gas.
  - Water reacts with iron metal to form “rust.”
  - Water reacts with carbon monoxide to form carbon dioxide and hydrogen gas.
11. (5 points) If the concentration of mercury in the water of a bankrupt, and abandoned mine pit lake (e.g. The Berkeley Pit) is 0.33 μg (micrograms) per liter of water, what is the total mass of mercury in the lake, in kilograms, if the lake has a surface area of 10.0 square miles and an average depth of 45 feet?
12. (5 points) Using the following table of abundances and masses of the three naturally occurring argon isotopes, calculate the exact mass of <sup>40</sup>Ar.

Symbol	Exact Mass (amu)	Natural Abundance (%)
<sup>36</sup> Ar	35.96755	0.337
<sup>38</sup> Ar	37.96272	0.063
<sup>40</sup> Ar	?	99.60
<b>Average</b>	39.948	

14. (8 points) How many protons, neutrons, and electrons (respectively) are there in the following atoms or ions?



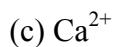
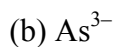
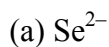
15. (8 points) Fill in the missing information in the following table of ions:

Symbol	$^{137}\text{Ba}^{2+}$			
Number of protons		30		40
Number of neutrons		34	16	
Number of electrons		28	18	36
Mass number		?	32	90

16. (3 points) Which element is most likely to form an anion with a 2- charge?



17. (3 points) Which ion has the same number of electrons as an atom of krypton?



18. (4 points) More than a dozen binary compounds containing sulfur and oxygen have been identified. Write the chemical formulas for the following:

(a) sulfur monoxide

(b) heptasulfur dioxide

(c) disulfur monoxide

(d) hexasulfur monoxide

19. (4 points) Give chemical names of the following ionic compounds:

(a)  $\text{NiCO}_3$

(b)  $\text{NaCN}$

(c)  $\text{LiHCO}_3$

(d)  $\text{Ca}(\text{ClO})_2$

20. (4 points) Give the name or chemical formula of each of the following acids:

(a)  $\text{HBr}$

(b)  $\text{HIO}_4$

(c) selenous acid

(d) hypochlorous acid

21. (10 points) Give examples for each of the following:

a. an Alkali metal \_\_\_\_\_

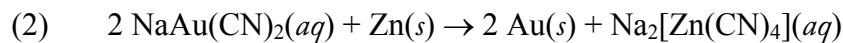
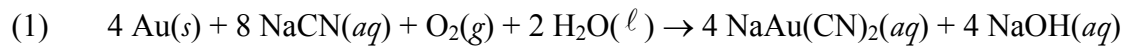
b. a Halogen \_\_\_\_\_

c. a Transition metal \_\_\_\_\_

d. an Ionic compound \_\_\_\_\_

e. a Molecular compound \_\_\_\_\_

(5 points) Mining for Gold Unlike most metals, gold is found in nature as the pure element. Miners in California in 1849 searched for gold nuggets and gold dust in streambeds, where the denser gold could be easily separated from sand and gravel. However, larger deposits of gold are found in veins of rock and can be separated chemically in a two-step process:



If a  $1.0 \times 10^3$  kilogram sample of rock is 0.019% gold by mass, how much Zn is needed to react with the gold extracted from the rock? Assume that reactions (1) and (2) are 100% efficient.

Extra Credit (5 points)

From the mass defect, calculate the binding energy of the potassium-39 nucleus. The exact mass of the  $^{39}\text{K}$  atom is 38.9637074 amu.

a.  $5.192\text{E-}11$  J

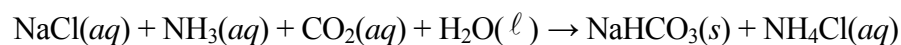
b.  $5.867\text{E-}9$  J

c.  $5.347\text{E-}11$  J

d.  $5.815\text{E-}9$  J

5. (5 points) The combustion of 40.5 mg of a compound containing C, H, and O, and extracted from the bark of the sassafras tree, produces 110.0 mg of CO<sub>2</sub> and 22.5 mg of H<sub>2</sub>O. The molar mass of the compound is 162 g/mol. Determine its empirical and molecular formulas.

6. (5 points) Baking soda (NaHCO<sub>3</sub>) can be made in large quantities by the following reaction:



If 10.0 g of NaCl reacts with excesses of the other reactants and 4.2 g of NaHCO<sub>3</sub> (84.007 g/mol) is isolated, what is the percent yield of the reaction?

### Useful Formulae and Constants

$$T (^{\circ}\text{F}) = ^{\circ}\text{C}(9^{\circ}\text{F} / 5^{\circ}\text{C}) + 32.0 ^{\circ}\text{F}$$

$$\text{Avogadro's Number } 6.0221 \times 10^{23} \text{ mol}^{-1}$$

$$1 \text{ inch} = 2.54 \text{ cm}; \quad 1 \text{ L} = 1.0567 \text{ qt}; \quad 1 \text{ lb} = 453.6 \text{ g}; \quad 1 \text{ pm} = 10^{-12} \text{ m}$$

$$1 \text{ m} = 10^2 \text{ cm}; \quad 12 \text{ in} = 1 \text{ ft}; \quad 1 \text{ mi} = 1.609 \text{ km} = 5280 \text{ ft}; \quad 1 \text{ m}^3 = 10^3 \text{ L} = 35.3 \text{ ft}^3$$

$$\text{volume} = \ell \cdot w \cdot h \quad E = m \cdot c^2 \quad c = 2.998 \text{E}8 \text{ m s}^{-1}$$

$$\text{mass electron} = 5.485799\text{E-}4 \text{ amu} = 9.1093897\text{E-}31 \text{ kg}$$

$$\text{mass neutron} = 1.0086649 \text{ amu} = 1.6749286\text{E-}27 \text{ kg}$$

$$\text{mass proton} = 1.00727649 \text{ amu} = 1.6726231\text{E-}27 \text{ kg}$$

$$1.6605402\text{E-}27 \text{ kg} = 1 \text{ amu}$$