

Name: _____
School: _____
Date: _____

Harrington High School Chem Lab Test

Score ____ / 84

- 1) Nitrogen is a diatomic element. What is its chemical formula? (1)

N_2

- a) Draw its Lewis structure. Include lone pairs. (1)



- b) What is its molecular mass? (1)

28.014g/mol

- c) Nitrogen is a gas at standard conditions (also at STP, but that's not what this is about). Calculate the density of N₂ gas at 77 F and 3.4atm in g/L. ($F = \frac{9}{5}C + 32$) (3)

3.9g/L

- d) The radius of the sun is 696,000 km. Let's now make a HUGE leap and assume that the sun is actually a sphere of N₂ gas at 77 F and 3.4atm (it really, REALLY isn't; see literally all of Astro). What is the mass of the sun? ← this is not a serious question. (2)

$5.5 \cdot 10^{30}g$

Name: _____

School: _____

Date: _____

2) This going to be one of those ridiculously long dimensional analysis questions. Brace yourself.

- a) Let's say, for the sake of example, that Science Olympiad is totally rigged. Nationals placings are entirely based on trading in medals from invitationals, regionals, and states. You can trade in 2 not-first medals at nationals for one 1st place medal. You can get 5 not-first medals for 9 states medals. You can get 3 states medals for 7 regionals medals. You can get regionals medals for MIT medals at a rate of 7 regionals medals for 15 MIT medals. We can get 36 MIT medals for 94 Stoga medals. How many Stoga medals do we need to get 1st place at Nats in chem lab? (3)

47 stoga medals

3) Let's do some more density questions:

- a) The density of iridium is 22.65g/cm^3 . If someone wanted to get a cube of iridium with side length 4.31cm, how much would it weigh? (2)

1810g

- b) What if someone decided to make it a sphere with diameter 0.0711m? (2)

4260g

- c) There are 31.105g in every Troy Oz (used for metals). The cost of Iridium is \$970/troy oz. Troy High School can melt down their first place SciOly trophies to produce \$15,000 of molten gold, which they can then sell. How many of their trophies do they need to melt to buy the iridium sphere? (4)

9 (trophies are treated as discrete; calculated answers should be 8.9)

Name: _____

School: _____

Date: _____

- 4) Tom has a hunk of unknown metal that weighs 10.0g and wants to find its density. He fills a graduated cylinder to 30.0mL of water, then drops the metal in. The volume rises to 36.5mL. What is the identity of the medal? Why is this experiment infeasible? (2)

It's rubidium with a density of 1.53g/cm^3 ; -1pts for calcium. It's infeasible because that would blow up the graduated cylinder (or something similar).

- 5) If a 1.0000g sample of an unknown organic compound (meaning it's made of C, H, and O) is determined to have 0.1304g of hydrogen and 0.5217g of carbon, what is the mol % of oxygen in the compound? (3)

11.18%

- a) Find its empirical formula. If the empirical formula is the same as the molecular formula, what is the compound's name? (3)

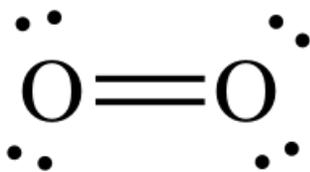
$\text{C}_2\text{H}_6\text{O}$ (C₂H₅OH, CH₃OCH₃)
the second one)

Ethanol or Dimethyl Ether (congrats if you said

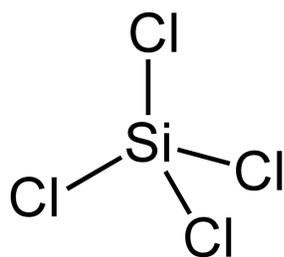
Name: _____

School: _____

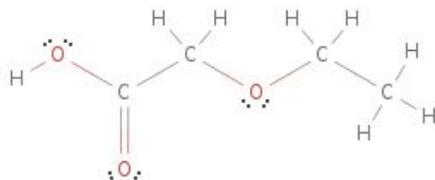
Date: _____



iv) SiCl₄ (1)



v) C₂H₅OCH₂COOH (2)

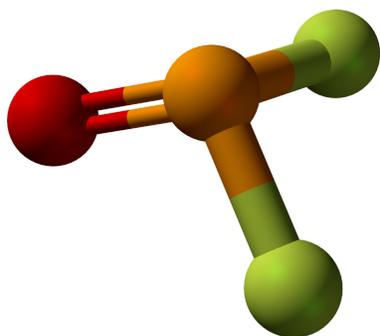


vi) SeOF₂ (1)

Name: _____

School: _____

Date: _____

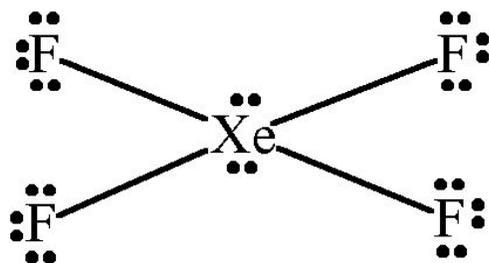


(with yellow being fluorine, orange selenium, red oxygen)

vii) HCN (1)



viii) XeF₄ (1)



7) If I mix 45mL of sulfurous acid at .2M with 20mL of some nice lead (II) acetate at .5M, what mass of lead-based product will I collect? (4)

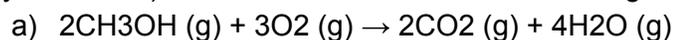
Name: _____

School: _____

Date: _____

3g (sigfigs from 2.59g)

8) What is the change in volume when 0.5g of methanol (CH₃OH) at 73 F (temperature stays constant) and 1 atm is burned via the following reaction? (5)



0.2L

9) An alloy of Cu and Li has an empirical density of 4.52g/cm³.

a) What is the mass % of Cu? Li? (3)

47.5% Cu; 52.5% Li

b) What is the mol % of Cu? Li? (2)

91.0% Li; 9.0% Cu

c) Why can an a solid solution of Cu and Li not really exist? (2)

So many reasons but one of them is their rather different radii

Name: _____

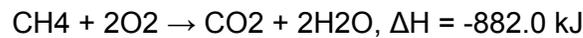
School: _____

Date: _____

10) 50mL of water at 90. C is mixed with 50mL of water at 20. C in a basic calorimeter made of 2 styrofoam cups from starbucks. The final temperature was found to be 44 C. Calculate the calorimeter constant C_{cal} in $J/^{\circ}C$. (3)

190J/ $^{\circ}C$

11) A bunsen burner is able to burn 0.090g of CH_4 / second according to the reaction



- a) Assuming that 20% of this heat makes it to a beaker filled with 32.0mL of water initially at 30.5C, how long will it take until all the water is boiled off? (assume no heat leaves the water to anything else and that heat goes directly from combustion to the water). $c_{H_2O} = 4.184 \text{ J/gC}$; $\Delta H_{vap} H_2O = 2257 \text{ J/g}$ (8)

82s

12) Give a 6 state functions. (3)

0.5pt / state function

13) I decided to dissolve 5.00g of LiCl in 300.mL of water. This depresses the freezing point from 0C to something else. What is the new freezing value of the solution? ($1.853=K_f$) (4)

Name: _____

School: _____

Date: _____

-1.46°C

a) What about if I did the same thing, but the LiCl was actually $(\text{PO}_4)_4\text{Zr}_3$? (2)

-0.331°C

14) 25g of isobutane ($\text{C}(\text{CH}_3)_3\text{H}$) is in a bomb calorimeter initially at 300.235 K. This bomb calorimeter is very low quality, and has a calorimeter constant of 45.3kJ/C. After the isobutane is burn, the calorimeter is at 354.833 K. Calculate the heat of combustion of isobutane. (4)

-2900kJ/mol (look at the reaction if you got double this)

15) At what temperature will the reaction $\text{O}_2 \rightarrow 2\text{O}$ be in equilibrium? ($\Delta S = 117 \text{ J/K-mol}$; $\Delta H = 498.4\text{kJ/mol}$) (3)

4260K; this actually implies that the oxygen in the sun is not bonded together (considered making this a question but that'd be too evil lol)

Name: _____

School: _____

Date: _____

16) H_2SO_4 is great. Let's dissolve some of it in water. The $\Delta H_{\text{solution}}$ is -96.2kJ/mol . If I dissolve 160g of it in 400g water at 80 F (not sure if this is actually possible but still), what will the final temperature be? (assume the solution has the same specific heat value as water) (3)

94°C