Sample Challenge Exam

Try these problems. The answers can be found at the end of the exam.

1. A sample of mercury has a temperature of 215°F. Calculate the equivalent Celsius and Kelvin temperature values.

2. A sample has a density of 0.0365 mg/m^3. Calculate the density in units of oz per yd^3.

3. The percentage composition of a bio-organic compound was reported to be:

13.9% C	2.78% H	12.9% N	25.9% O	14.8% S	29.4% I

    Enter the subscripts: C_H_N_O_S_I_

4. For the reaction : $2 C_{10}H_{22 (s)} + 31 O_{2 (g)} \rightarrow 20 CO_{2 (g)} + 22 H_2O_{(g)}$

   a. How many grams of water result when reaction of decane, $C_{10}H_{22}$, in air yields 446 grams of carbon dioxide, CO_2?

   b. If 0.113 moles of decane are consumed, how many molecules of water, H_2O, are produced?

5. The decomposition of nitroglycerin may be represented by the balanced equation:

   $4 C_3H_5N_3O_{9 (s)} \rightarrow 6 N_{2 (g)} + 12 CO_{2 (g)} + 10 H_2O_{(l)} + O_{2 (g)}$
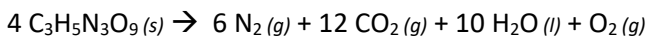
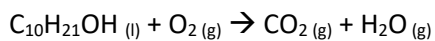   If 325 mL of water are produced by the decomposition of 1.837 kg of nitroglycerin, what is the:

   a. Maximum theoretical yield of water?

   b. Actual percentage yield of water?

   c. Actual yield of CO_2?

   d. Unreacted nitroglycerin?

6. The alcohol in the equation below will burn completely to produce only carbon dioxide and water:

$C_{10}H_{21}OH_{(l)} + O_{2 (g)} \rightarrow CO_{2 (g)} + H_2O_{(g)}$

   a. Balance the equation.

   b. How many grams of carbon dioxide can be produced from 113.0 grams of the alcohol and 255.4 grams of oxygen?

   c. What reactant will be left over?

   d. How many grams of the excess reactant will be left over?

7. A fixed sample of an ideal gas at 266°C and 631 torr pressure occupies a volume of 250 cm^3. At what Celcius temperature will the gas occupy 693 cm^3 at a pressure of 433 torr?

8. 6.96 g of CO_2, 7.62 g of Ne, and 2.51 g of He are confined in a 2.50 liter cylinder at 298K with an unknown quantity of O_2. If the total pressure in the cylinder is 54.9 atm,;
   a. What is the partial pressure of O_2 in atmospheres?

   b. How many grams of O_2 are present?

9. Analysis of a 1.33 gram sample of hydrazine shows that it is 87.5% N and the remainder is hydrogen. If the sample is vaporized at 91°C, it has a density of 0.553 grams/liter and exerts a pressure of 0.498 atm. For the hydrazine find the:

    a. Molar mass

    b. Empirical formula

    c. Molecular formula

10. Calculate the molarity of a solution that is 17.8% $K_2SO_4 \cdot 2H_2O$ and has a density of 1.26 g/mL.

11. A 7.86 mL sample of 0.223 M H_2SO_4 is mixed with 61.2 mL of 0.515 M $AgNO_3$. Calculate the mass of silver sulfate precipitate formed and molarities of the ions remaining in solution.

12. Complete the table by providing a correct answer for each empty box.

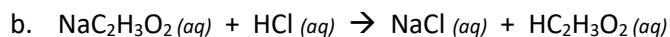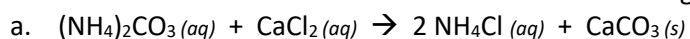| Isotope	Protons	Electrons	Neutrons	Mass Number	Atomic Mass	Atomic Number	Charge
$^{194}Pt^{+2}$							
		54	77	129			
	97		151				+3

13. Determine the oxidation number of the **bold**, underlined atom and write it in the space provided.

   a. $K\underline{I}O_4$

   b. $Ca_2\underline{S}_2O_3$

   c. $H_2\underline{C}_2O_4$

   d. $H_2\underline{O}_2$

   e. $H\underline{P}O_3{}^{2-}$

14. Provide the completely correct name of formula:

IUPAC Name	Formula		Formula	IUPAC Name
Vanadium(II) phosphide			$PbC_2O_4 \cdot 2H_2O$	
Cobalt(III) hypoiodite			$CdSeO_4$	
Dichromic acid			H_2S (aq)	
Acetic acid			SbF_5	
Gold(III) thiosulfate			$(NH_4)_2HAsO_3$	

15. Write the Total Ionic and Net Ionic reactions for the following completed Conventional reactions.

   a. $(NH_4)_2CO_{3\ (aq)} + CaCl_{2\ (aq)} \rightarrow 2\ NH_4Cl_{\ (aq)} + CaCO_{3\ (s)}$

   b. $NaC_2H_3O_{2\ (aq)} + HCl_{\ (aq)} \rightarrow NaCl_{\ (aq)} + HC_2H_3O_{2\ (aq)}$

16. What is the appropriate treatment for a chemical injury caused by spilling concentrated sulfuric acid on skin?

17. To what precision can an object be weighed on the usual electronic laboratory balance?

18. To what precision in milliliters can a standard 50 mL buret be read and recorded?

19. Determine the density with units of a solid object from the student data listed below:

Mass of empty container	134.865 g
Mass of container + object	256.104 g
Initial graduated cylinder volume reading	45.3 mL
Graduated cylinder + solid volume reading	96.3 mL

Answers to Sample Challenge Exam

1. 102°C and 375K
2. 9.38 x 10^{-7} oz/yd^3
3. $C_5H_{12}N_4O_7S_2I$
4. a) 201 g H_2O b) 7.48 x 10^{23} H_2O molecules
5. a) 364 g H_2O b) 89.2% c) 953 g CO_2 d) 198 g nitroglycerin unreacted
6. a) $C_{10}H_{21}OH$ (l) + 15 O_2 (g) → 10 CO_2 (g) + 11 H_2O (g) b) 234 g CO_2 c) $C_{10}H_{21}OH$ d) 28.9 g
7. 752°C
8. a) 43.5 atm O_2 b) 142 g O_2
9. a) molar mass = 33 g/mol b) NH_2 c) N_2H_4
10. 1.07 M
11. Total volume 69.1 mL, [H+] = 0.0508 M, [NO_3-] = 0.456 M, [Ag+] = 0.405 M, [SO_4^{2-}] = 0 M, [H_2O] = 55 M, mass of precipitate of Ag_2SO_4 (s)= 547 mg
12.

Isotope	Protons	Electrons	Neutrons	Mass Number	Atomic Mass	Atomic Number	Charge
$^{194}Pt^{+2}$	78	76	116	194	195.1	78	+2
$^{129}Te^{-2}$	52	54	77	129	127.6	52	-2
$^{248}Bk^{+3}$	97	94	151	248	247	97	+3

13. a) +7 b) +1 c) +3 d) -1 e) +3
14.

IUPAC Name	Formula		Formula	IUPAC Name
Vanadium(II) phosphide	V_3P_2		$PbC_2O_4 \cdot 2H_2O$	Lead(II) oxalate dihydrate
Cobalt(III) hypoiodite	$Co(HIO)_3$		$CdSeO_4$	Cadmium selenate
Dichromic acid	$H_2Cr_2O_7$		H_2S (aq)	Hydrosulfuric acid
Acetic acid	$HC_2H_3O_2$ (aq)		SbF_5	Antimony pentafluoride or antimony(V) fluoride
Gold(III) thiosulfate	$Au_2(S_2O_3)_3$		$(NH_4)_2HAsO_3$	Ammonium hydrogen arsenite

15.

a) $(NH_4)_2CO_3$ (aq) + $CaCl_2$ (aq) → 2 NH_4Cl (aq) + $CaCO_3$ (s)	
Total ionic equation	2 NH_4^+ (aq) + CO_3^{-2} (aq) + Ca^{2+} (aq) + 2 Cl$^-$ (aq) → 2 NH_4^+ (aq) + 2 Cl$^-$ (aq) + $CaCO_3$ (s)
Net ionic equation	CO_3^{-2} (aq) + Ca^{2+} (aq) → $CaCO_3$ (s)
b) $NaC_2H_3O_2$ (aq) + HCl (aq) → NaCl (aq) + $HC_2H_3O_2$ (aq)	
Total ionic equation	Na^+ (aq) + $C_2H_3O_2^-$ (aq) + H^+ (aq) + Cl$^-$ (aq) → Na^+ (aq) + Cl$^-$ (aq) + $HC_2H_3O_2$ (aq)
Net ionic equation	$C_2H_3O_2^-$ (aq) + H^+ (aq) → $HC_2H_3O_2$ (aq)

16. Wash with tap water, then with sodium bicarbonate solution and again rinse with water.
17. 0.001 gram or 0.0001 depending on the balance.
18. 0.01 mL
19. 2.38 g/mL