# 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$^{o}$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. $K\underline{\mathbf{I}}O_4$

b. $Ca_2\underline{\mathbf{S}}_2O_3$

c. $H_2\underline{\mathbf{C}}_2O_4$

d. $H_2\underline{\mathbf{O}}_2$

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

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)* → 2 $NH_4Cl$ *(aq)* + $CaCO_3$ *(s)*

b. $NaC_2H_3O_2$ *(aq)* + HCl *(aq)* → 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. $9.38 \times 10^{-7}$ oz/yd$^3$
3. $C_5H_{12}N_4O_7S_2I$
4. a) 201 g $H_2O$ b) $7.48 \times 10^{23}$ $H_2O$ molecules
5. a) 364 g $H_2O$ b) 89.2% c) 953 g $CO_2$ d) 198 g nitroglycerin unreacted
6. a) $C_{10}H_{21}OH_{(l)} + 15\ O_{2\,(g)} \rightarrow 10\ CO_{2\,(g)} + 11\ H_2O_{(g)}$ 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, $[NO_3\text{-}]$ = 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 g
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) $(NH_4)_2CO_{3\,(aq)} + CaCl_{2\,(aq)} \rightarrow 2\ NH_4Cl_{(aq)} + CaCO_{3\,(s)}$ | |
| Total ionic equation | $2\ NH_4^+{}_{(aq)} + CO_3^{-2}{}_{(aq)} + Ca^{2+}{}_{(aq)} + 2\ Cl^-{}_{(aq)} \rightarrow 2\ NH_4^+{}_{(aq)} + 2\ Cl^-{}_{(aq)} + CaCO_{3\,(s)}$ |
| Net ionic equation | $CO_3^{-2}{}_{(aq)} + Ca^{2+}{}_{(aq)} \rightarrow CaCO_{3\,(s)}$ |
| b) $NaC_2H_3O_{2\,(aq)} + HCl_{(aq)} \rightarrow NaCl_{(aq)} + HC_2H_3O_{2\,(aq)}$ | |
| Total ionic equation | $Na^+{}_{(aq)} + C_2H_3O_2^-{}_{(aq)} + H^+{}_{(aq)} + Cl^-{}_{(aq)} \rightarrow Na^+{}_{(aq)} + Cl^-{}_{(aq)} + HC_2H_3O_{2\,(aq)}$ |
| Net ionic equation | $C_2H_3O_2^-{}_{(aq)} + H^+{}_{(aq)} \rightarrow HC_2H_3O_{2\,(aq)}$ |

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