

**PERIODIC TABLE OF THE ELEMENTS**

1A											2A											3A											4A											5A											6A											7A											8A																																																																																																																								
1											2											13											14											15											16											17											18																																																																																																																								
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K											Ca											Sc											Ti											V											Cr											Mn											Fe											Co											Ni											Cu											Zn											Ga											Ge											As											Se											Br											Kr										
39.10											40.08											44.96											47.88											50.94											52.00											54.94											55.85											58.93											58.69											63.55											65.39											69.72											72.59											74.92											78.96											79.90											83.80										
37											38											39											40											41											42											43											44											45											46											47											48											49											50											51											52											53											54										
Rb											Sr											Y											Zr											Nb											Mo											Tc											Ru											Rh											Pd											Ag											Cd											In											Sn											Sb											Te											I											Xe										
85.47											87.62											88.91											91.22											92.91											95.94											(99)											101.1											102.9											106.4											107.9											112.4											114.8											118.7											121.8											127.6											126.9											131.3										
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Cs											Ba											La											Hf											Ta											W											Re											Os											Ir											Pt											Au											Hg											Tl											Pb											Bi											Po											At											Rn										
132.9											137.3											138.9											178.5											180.9											183.9											186.2											190.2											192.2											195.1											197.0											200.6											204.4											207.2											209.0											(209)											(210)											(222)										
87											88											89											104											105											106											107											108											109											110											111											112											113											114											115											116											117											118										
Fr											Ra											Ac											Rf											Db											Sg											Bh											Hs											Mt											Ds											Rg											Cn											Nh											Fl											Mc											Lv											Ts											Og										
(223)											226.0											227.0											(261)											(262)											(266)											(264)											(277)											(268)											(281)											(272)											(285)											(284)											(289)											(288)											(291)											(294)											(294)										

Lanthanides											58											59											60											61											62											63											64											65											66											67											68											69											70											71										
Lanthanides											Ce											Pr											Nd											Pm											Sm											Eu											Gd											Tb											Dy											Ho											Er											Tm											Yb											Lu										
Lanthanides											140.1											140.9											144.2											(145)											150.4											152.0											157.2											158.9											162.5											164.9											167.3											168.9											173.0											175.0										
Actinides											90											91											92											93											94											95											96											97											98											99											100											101											102											103										
Actinides											Th											Pa											U											Np											Pu											Am											Cm											Bk											Cf											Es											Fm											Md											No											Lr										
Actinides											232.0											231.0											238.0											237.0											(244)											(243)											(247)											(247)											(251)											(252)											(257)											(258)											(259)											(260)										

### Fundamental Physical Constants

Avogadro's Number	$N_A = 6.02214 \times 10^{23} / \text{mol}$
Atomic Mass Unit	$\text{amu} = 1.66054 \times 10^{-27} \text{ kg}$
Charge of the Electron	$e = 1.60218 \times 10^{-19} \text{ C}$
Faraday Constant	$F = 9.64853 \times 10^4 \text{ C/mol}$
Mass of the Electron	$m_e = 9.10939 \times 10^{-31} \text{ kg}$
Mass of the Neutron	$m_n = 1.67493 \times 10^{-27} \text{ kg}$
Mass of the Proton	$m_p = 1.67262 \times 10^{-27} \text{ kg}$
Planck's Constant	$h = 6.62607 \times 10^{-34} \text{ J}\cdot\text{s}$
Speed of Light	$c = 2.99792 \times 10^8 \text{ m/s}$
Acceleration of Gravity	$g = 9.80665 \text{ m/s}^2$
Rydberg Constant	$R_H = 1.09677 \times 10^7 \text{ m}^{-1}$
Universal Gas Constant	$R = 8.31447 \text{ J/mol}\cdot\text{K}$ $R = 0.082058 \text{ L}\cdot\text{atm/mol}\cdot\text{K}$

### Conversions and Relationships

Length	1 km = $1 \times 10^3 \text{ m} = 0.621 \text{ mile}$
	1 inch = 2.54 cm      1 ft = 12 in
	1 pm = $1 \times 10^{-12} \text{ m} = 0.01 \text{ \AA}$
Mass	1 kg = $1 \times 10^3 \text{ g} = 2.205 \text{ lb}$
	1 metric ton = $1 \times 10^3 \text{ kg}$
Volume	1 dm <sup>3</sup> = $1 \times 10^{-3} \text{ m}^3 = 1 \text{ liter}$
	1 cm <sup>3</sup> = 1 mL      1 m <sup>3</sup> = 35.3 ft <sup>3</sup>
	1 gallon = 3.785 liters
Energy	1 J = $1 \text{ kg}\cdot\text{m}^2/\text{s}^2 = 1 \text{ C}\cdot\text{V}$
	1 calorie = 4.184 J
Temperature	$T(\text{K}) = T(^{\circ}\text{C}) + 273.15$
	$T(^{\circ}\text{C}) = (T(^{\circ}\text{F}) - 32)(5/9)$
	H <sub>2</sub> O: mp = 0°C and bp = 100°C
Pressure	1 Pa = $1 \text{ N/m}^2 = 1 \text{ kg/m}\cdot\text{s}^2$
	1 atm = $1.01325 \times 10^5 \text{ Pa}$
	1 atm = 760 torr = 760 mmHg
Math	$\pi = 3.1416$ $e = 2.7183$

### Equations

$\Delta E = \Delta U = q + w$	$\Delta H = \Delta E + \Delta(PV)$	$q = mc\Delta T$	$w = -P_{\text{ext}}\Delta V$
$\Delta H_{\text{rxn}}^{\circ} = \sum \text{mol} \cdot \Delta H_f^{\circ}(\text{products}) - \sum \text{mol} \cdot \Delta H_f^{\circ}(\text{reactants})$			
$\Delta H_{\text{rxn}}^{\circ} = \sum \text{mol} \cdot BE(\text{bonds broken}) - \sum \text{mol} \cdot BE(\text{bonds formed})$			
$c = \lambda\nu$	$\Delta E = h\nu$	$\Delta E = \frac{hc}{\lambda}$	$\Delta E = -2.18 \times 10^{-18} \text{ J} \left( \frac{1}{n_1^2} - \frac{1}{n_2^2} \right)$
$M = \text{molar mass}$	$d = M\rho/RT$		$M = mRT/PV$
$PV = nRT$	$\frac{P_1V_1}{n_1T_1} = \frac{P_2V_2}{n_2T_2}$		$KE = \frac{3}{2}RT = \frac{1}{2}mv^2$
$F_c = \frac{kQ_1Q_2}{d^2}$	$v_{\text{rms}} = \sqrt{\frac{3RT}{M}}$		$\frac{\text{Rate}_A}{\text{Rate}_B} = \frac{\sqrt{M_B}}{\sqrt{M_A}}$
$P_A = X_A \cdot P_{\text{total}}$	$(P + n^2a/V^2)(V - nb) = nRT$		
$\ln\left(\frac{P_2}{P_1}\right) = \frac{-\Delta H_{\text{vap}}}{R} \left( \frac{1}{T_2} - \frac{1}{T_1} \right)$	$\ln\left(\frac{k_2}{k_1}\right) = \frac{-E_a}{R} \left( \frac{1}{T_2} - \frac{1}{T_1} \right)$		$k = Ae^{-E_a/RT}$
$P_{\text{solvent}} = X_{\text{solvent}}P^{\circ}_{\text{solvent}}$	$\Delta P = (X_{\text{solute}}P^{\circ}_{\text{solvent}})i$		$\Pi = (MRT)i$
$\Delta T_{\text{bp}} = (k_{\text{bp}}\cdot m)i$	$\Delta T_{\text{fp}} = (k_{\text{fp}}\cdot m)i$		$S_{\text{gas}} = k_{\text{H}}\cdot P_{\text{gas}}$
$[A]_t = -kt + [A]_0$	$\ln[A]_t = -kt + \ln[A]_0$		$\frac{1}{[A]_t} = kt + \frac{1}{[A]_0}$
$t_{1/2} = \frac{[A]_0}{2k}$	$t_{1/2} = \frac{\ln 2}{k}$		$t_{1/2} = \frac{1}{k[A]_0}$

### Solubility Rules

- All common compounds of Group 1A ions and NH<sub>4</sub><sup>+</sup> are soluble
- All common nitrates, acetates, and most perchlorates are soluble
- All common chlorides, bromides, and iodides are soluble, except those of Ag<sup>+</sup>, Pb<sup>2+</sup>, Cu<sup>+</sup>, and Hg<sub>2</sub><sup>2+</sup>. All common fluorides are soluble, except those of Pb<sup>2+</sup> and Group 2A
- All common sulfates are soluble, except those of Ca<sup>2+</sup>, Sr<sup>2+</sup>, Ba<sup>2+</sup>, Ag<sup>+</sup>, and Pb<sup>2+</sup>
- All common metal hydroxides are insoluble, except those of Group 1A and the larger members of Group 2A (starting with Ca<sup>2+</sup>)
- All common carbonates and phosphates are insoluble, except those of Group 1A and NH<sub>4</sub><sup>+</sup>
- All common sulfides are insoluble, except those of Groups 1A, 2A, and NH<sub>4</sub><sup>+</sup>

## Exam 1 – CHM 2045 – Fall 2020 – Study Review, Questions Only

### Question 1

5 pts

How many grams are in 1  $\mu\text{g}$  ?

- 0.1
- 1
- 0.001
- $1 \times 10^{-9}$
- $1 \times 10^{-6}$
- 0.01
- $1 \times 10^{-5}$
- $1 \times 10^{-4}$

### Question 2

5 pts

You prepare a 2840. mL of tea and transfer it to a 1.000 gallon pitcher for storage. Which of the following statements is true?

- The pitcher will be completely filled and most of the tea will overflow.
- The pitcher will be filled to 100% of its capacity with no tea spilled.
- The pitcher will be filled to about 75% of its capacity.
- The pitcher will be filled to about 50% of its capacity.
- The pitcher will be completely filled and a small amount of tea will overflow.

**Question 3****4 pts**

How many significant figures will the following calculation contain? Enter a number e.g. 0, 1, 2, 3 ....

What is the answer to the calculation to the correct significant figures? Enter a number e.g. 10, 20, 25,50, 60, ....

$$\frac{178.30 - 9.0 + 8.20e2}{100.1}$$

**Question 4****3 pts**

Select the incorrect statement(s) from the list. Select all that apply.

- The flammability of silk is a chemical property
- The fact that copper conducts electricity is a chemical change
- The fact that sulphur is a yellow powder is a physical property
- The boiling point point of ethanol is a physical property
- The burning of propane in a barbecue grill is a physical change
- The condensation of steam on a mirror is an example of a chemical change

**Question 5****5 pts**

Determine the empirical formula of a compound that has a percent composition of 25.9% N and 74.1% O.

N  O  Enter a whole number e.g. 0, 1, 2, 3, ...

**Question 6****3 pts**

One of the following does not describe gases. Which one is it?

- rigid shape
- relatively low densities
- expands infinitely
- particles are far apart
- easily compressed

### Question 7

10 pts

Fill in the blank spaces with the correct number to describe each ion and atom. Enter a number such as 0, 1, 2, 3, ...

Name or Symbol	# of protons	# of neutrons	# of electrons
$^{131}_{51}\text{I}^-$	<input type="text"/>	<input type="text"/>	<input type="text"/>
Arsenic	<input type="text"/>	40	<input type="text"/>

### Question 8

10 pts

Give the name for  $\text{CaH}_2$  and the formula for bromic acid

calcium hydroxide  
 hydrocalcium  
 calcium dihydride  
 calcium dihydrate  
 calcium hydride  
 calcium dihydroxide

respectively.

Note: Formula choices are written without subscripts, for example, water is H2O

### Question 9

10 pts

A newly discovered imaginary element (Floridium - Fo ) has two naturally occurring isotopes, one isotope has an isotopic mass of 82.71 amu, the second isotope has an isotopic mass of 96.22 amu and an abundance = 44.3%. What is the atomic mass of Floridium in amu?

Enter to 2 decimal places, and without units. Do not round until the end.

**Question 10**

10 pts

How many moles of C can be produced if 2 mol of A react with 8 mol of B?

The balanced equation is  $2 A + 3 B \rightarrow 6 C$

Enter a number to 1 decimal places, and without units.

**Question 11**

10 pts

A 30.72 mL sample of an unknown  $H_3PO_4$  solution is titrated with a 0.112 M NaOH solution. The equivalence point is reached when 24.41 mL of NaOH solution is added.

What is the concentration in M of the unknown  $H_3PO_4$  solution?

Enter a number to 4 decimal places, and without units.

**Question 12**

5 pts

Which salt is formed in the neutralization reaction between nitric acid and calcium hydroxide?

$Ca(NO_3)_2$

$Ca_3N_2$

CaO

$CaH_2$

$Ca(NO_2)_2$

**Question 13****10 pts**

What is the percent yield of a reaction in which 211.8 g of phosphorus trichloride reacts with excess water to form 142.2 g of HCl and aqueous phosphorous acid ( $\text{H}_3\text{PO}_3$ )?

Enter a number to 2 decimal places.

**Question 14****10 pts**

44.5 g of Aluminum nitrite and 67.3 g of ammonium chloride react to form aluminum chloride, nitrogen gas, and water. How many grams of the excess reagent remain after the reaction? Enter your answer to 1 decimal place, and without units.

**Question 15****10 pts**

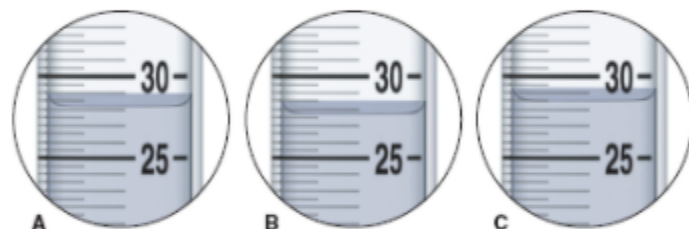
When a 8.80 g of a compound (composed of carbon, hydrogen, and oxygen) was burned in a combustion apparatus, 13.20 g of carbon dioxide and 18.0 g of water formed. What is the compounds's empirical formula?

Enter a number for each blank e.g. 1, 2, 3, etc

C  H  O

**Question 16****5 pts**

A 25.0 g sample of each of three unknown metals is added to 25.0 ml of water in graduated cylinders A, B, and C, and the final volumes are depicted in the circles below. Given their densities, identify the metal in cylinder C: zinc (7.14 g/ml), iron (7.87 g/ml), or nickel (8.91 g/ml).



zinc

nickel

iron



**Question 17****10 pts**

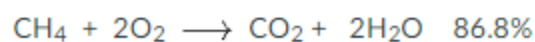
Suppose you have a 100-gram sample of each of the following compounds. Which sample contains the smallest number of moles of compound?

- propane
- lithium chlorate
- potassium chloride
- chromium(III) chloride
- nitrogen trioxide

**Question 18****10 pts**

When 267.9 g of potassium chlorate are decomposed and the yield of oxygen gas is only 61.5%, how much carbon dioxide (in g) can be made if the yield of carbon dioxide in the second reaction is 86.8%. Methane (CH<sub>4</sub>) is in excess.

Enter a number in g to 1 decimal place.

**Question 19****10 pts**

What is the molarity of sodium ions in a solution prepared by mixing 204.3 ml of 0.534 M sodium phosphate with 414.1 ml of 1.12 M sodium sulfide. Enter to 2 decimal places.

**Question 20****5 pts**

Predict whether a reaction occurs, and if so, input the sum of the coefficients for the net ionic equation. If no reaction occurs enter the number 0.

In the field provided you only need to input the sum of the coefficients of the net ionic equation, so enter a whole number, e.g. 0, 1, 2, 3, etc:

barium chloride (aq) + lead(II) acetate (aq)  $\longrightarrow$

**Question 21****5 pts**

You want to clean a 500-ml flask that has been used to store a 0.9M solution. Each time the flask is emptied, 1.00 ml of solution adheres to the walls, and thus remains in the flask. For each rinse cycle, you pour 9.00 ml of solvent into the flask (to make 10.00 ml total), swirl to mix uniformly, and then empty it. What is the minimum number of such rinses necessary to reduce the residual concentration of 0.00001 M or below?

5

7

2

6

1

4

3

## Question 22

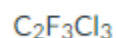
3 pts

A metal has a melting point of 304°C. What is its melting point in Kelvin? Enter to 0 decimal places.

## Question 23

5 pts

How many kilograms of chlorine are in 405.7 kg of the following chlorofluorocarbon (CFC)?



Express your answer numerically in terms of kilograms to 1 decimal place.

## Question 24

10 pts

Identify the oxidizing agent and the reducing agent in the following reaction.



[ Select ]  $\begin{matrix} \text{N}_2 \\ \text{NO}_2 \end{matrix}$   oxidizing agent

[ Select ]  $\begin{matrix} \text{H}_2\text{O} \\ \text{NH}_3 \end{matrix}$   reducing agent

[ Select ]  $\begin{matrix} \text{H}_2\text{O} \\ \text{NO}_2 \end{matrix}$   oxidation state for N in  $\text{NO}_2$

[ Select ]  $\begin{matrix} \text{H}_2\text{O} \\ \text{NH}_3 \end{matrix}$   oxidation state for N in  $\text{NH}_3$

**Question 25****5 pts**

Convert  $896 \text{ lb/in}^2$  to  $\text{kg/cm}^2$ .

Enter a number to 1 decimal place.

**Question 26****5 pts**

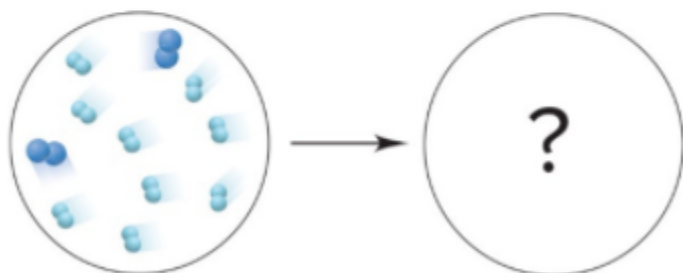
The following scene shows a mixture of oxygen (bigger molecule) and hydrogen (smaller molecule) before they react to produce water.

[ Select ] oxygen  
hydrogen

What is the limiting reactant?

[ Select ] 1, 2, 3, 4, 5, 6, 9, 18

How many water molecules will the mixture produce?



**Question 27****5 pts**

To precipitate  $\text{Zn}^{2+}$  from  $\text{Zn}(\text{NO}_3)_2$  (aq), you should add

- $\text{K}_2\text{CO}_3$
- $\text{MgBr}_2$
- $(\text{NH}_4)_2\text{SO}_4$
- $\text{NH}_4\text{Cl}$
- $\text{KI}$

**Question 28****5 pts**

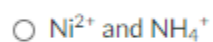
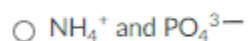
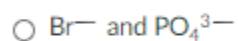
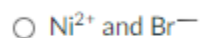
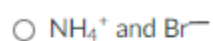
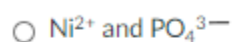
Classify the following statement as true or false.

Compared with a 0.010 M solution of  $\text{NaNO}_3$ , a 0.010 M solution of  $\text{Mg}(\text{NO}_3)_2$  is a better conductor of electricity.

- True
- False

**Question 29****5 pts**

What are the spectator ions in the reaction between nickel(II) bromide and ammonium phosphate?

**Question 30****2 pts**

**Scratch paper:** I am in the process of making very small pieces out of my scratch paper (aka confetti) and showing that process to the camera.

On my honor, I have neither given nor received unauthorized aid in doing this assignment.

True

False