Reference Table Review ANSWER KEY

Regents Chemistry

Table A
Standard Temperature and Pressure

Name	Value	Unit
Standard Pressure	101.3 kPa 1 atm	kilopascal atmosphere
Standard Temperature	273 K 0°C	kelvin degree Celsius

Table A Questions:

Convert 2 atm in kPa. **202.6 kPa**

Convert 303.9 kPa in atm. **3 atm**

What is the difference between 1 K and 1°C? **0K = 273^{0}C, Celsius is higher**

What is the 0 K temperature called? **Absolute zero, no kinetic energy**

What does STP stand for? **Standard temperature and pressure**

What are the two units of pressure represented in the table? **kPa & atm**

What are the two units of temperature represented in the table? **Kelvin [K] and Celsius [^{0}C]**

Table B
Physical Constants for Water

Heat of Fusion	334 J/g
Heat of Vaporization	2260 J/g
Specific Heat Capacity of H_2O (ℓ)	4.18 J/g•K

Table B Questions:

What is the definition of the Heat of Fusion? **Amount of energy needed to melt 1 g of ice**

What is the definition of the Heat of Vaporization? **Amount of energy needed to vaporize 1g of water**

What is the definition for the Specific Heat Capacity of $H_2O_{(L)}$.

The amount of energy needed to raise 1g of water 1 K.

Table C Questions

How many grams are in 10 kg? **10,000**

How many meters are in 100 micrometers? **.0001 m**

Convert 45 pm to cm. **(0. 000 000 004 5 cm)**

Convert 1 kg to pg. **(1,000,000,000,000,000pg)**

Table C
Selected Prefixes

Factor	Prefix	Symbol
10^{3}	kilo-	k
10^{-1}	deci-	d
10^{-2}	centi-	c
10^{-3}	milli-	m
10^{-6}	micro-	μ
10^{-9}	nano-	n
10^{-12}	pico-	p

Table D Questions:

What units could be used to calculate the density of a solid? **mass and volume**

What are the units for molarity?
Moles per (divided by) liters

What is one mole equal to?
6.02×10^{23} particles
or
22.4 Liters for gases only
or
the Molar Mass of a compound or element

Table D
Selected Units

Symbol	Name	Quantity
m	meter	length
g	gram	mass
Pa	pascal	pressure
K	kelvin	temperature
mol	mole	amount of substance
J	joule	energy, work, quantity of heat
s	second	time
L	liter	volume
ppm	part per million	concentration
M	molarity	solution concentration

Table E Questions:

What is a polyatomic ion?
An ion made of more than one atom covalently bonded together

What is the charge of carbonate? **-2**

Table E
Selected Polyatomic Ions

H_3O^+	hydronium	CrO_4^{2-}	chromate
Hg_2^{2+}	dimercury (I)	$Cr_2O_7^{2-}$	dichromate
NH_4^+	ammonium	MnO_4^-	permanganate
$C_2H_3O_2^-$ / CH_3COO^-	acetate	NO_2^-	nitrite
		NO_3^-	nitrate
CN^-	cyanide	O_2^{2-}	peroxide
CO_3^{2-}	carbonate	OH^-	hydroxide
HCO_3^-	hydrogen carbonate	PO_4^{3-}	phosphate
		SCN^-	thiocyanate
$C_2O_4^{2-}$	oxalate	SO_3^{2-}	sulfite
ClO^-	hypochlorite	SO_4^{2-}	sulfate
ClO_2^-	chlorite	HSO_4^-	hydrogen sulfate
ClO_3^-	chlorate	$S_2O_3^{2-}$	thiosulfate
ClO_4^-	perchlorate		

Table F
Solubility Guidelines for Aqueous Solutions

Ions That Form *Soluble* Compounds	Exceptions
Group 1 ions (Li^+, Na^+, etc.)	
ammonium (NH_4^+)	
nitrate (NO_3^-)	
acetate ($C_2H_3O_2^-$ or CH_3COO^-)	
hydrogen carbonate (HCO_3^-)	
chlorate (ClO_3^-)	
perchlorate (ClO_4^-)	
halides (Cl^-, Br^-, I^-)	when combined with Ag^+, Pb^{2+}, and Hg_2^{2+}
sulfates (SO_4^{2-})	when combined with Ag^+, Ca^{2+}, Sr^{2+}, Ba^{2+}, and Pb^{2+}

Ions That Form *Insoluble* Compounds	Exceptions
carbonate (CO_3^{2-})	when combined with Group 1 ions or ammonium (NH_4^+)
chromate (CrO_4^{2-})	when combined with Group 1 ions, Ca^{2+}, Mg^{2+}, or ammonium (NH_4^+)
phosphate (PO_4^{3-})	when combined with Group 1 ions or ammonium (NH_4^+)
sulfide (S^{2-})	when combined with Group 1 ions or ammonium (NH_4^+)
hydroxide (OH^-)	when combined with Group 1 ions, Ca^{2+}, Ba^{2+}, Sr^{2+}, or ammonium (NH_4^+)

Table F Questions

Write the products and balance the reaction for the following double replacement reactions including the phase to describe the solubility of the products.

$MgSO_{4(AQ)} + BaCl_{2(AQ)} \rightarrow MgCl_{2(AQ)} + BaSO_{4(S)}$

$Al_2(SO_4)_{3(AQ)} + 3ZnCl_{2\ (AQ)} \rightarrow 2AlCl_{3(AQ)} + 3ZnSO_{4\ (AQ)}$ NO REACTION (no precipitate in products)

$2AlBr_{3(AQ)} + 3K_2SO_{4(AQ)} \rightarrow 6KBr_{(AQ)} + Al_2(SO_4)_{3(AQ)}$ NO REACTION (no precipitate in the products)

$FeCl_{3(AQ)} + 3NaOH_{(AQ)} \rightarrow 3NaCl_{(AQ)} + Fe(OH)_{3(S)}$

$AgNO_{3(AQ)} + NaCl_{(AQ)} \rightarrow AgCl_{(S)} + NaNO_{3\ (AQ)}$

Table G Solubility Curves

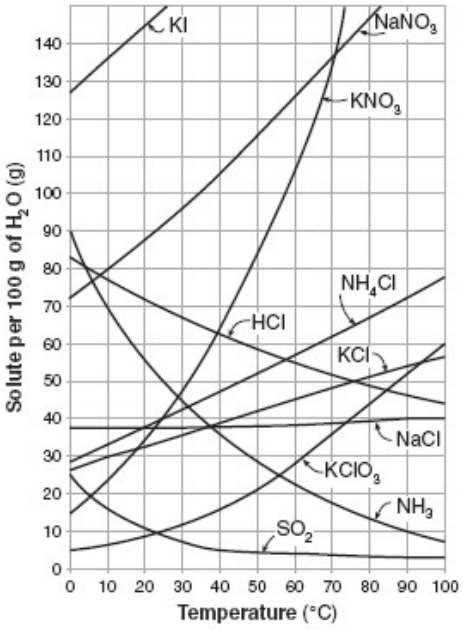


Table G Questions:

What compounds show a decrease in solubility from 0 to 50°C?
SO_2, NH_3, HCl

Which salt is most soluble at 60°C? **KI**

Which salt is least soluble at 70°C? **SO_2**

How many grams of KCl can be dissolved in 500 g of H_2O at 30°C?
5 x (35) = 175 g

At 50°C, how much KNO_3 can be dissolved in 200 g of H_2O?
2 x (85g) = 170g

At 30°C, 90 g of $NaNO_3$ is dissolved in 200 g of H_2O. Is the solution saturated or unsaturated?
Unsaturated; 90g $NaNO_3$ in 200 g of water = 45 g $NaNO_3$ in 100g of water (it's under the curve)

A saturated solution of $KClO_3$ is formed from 50g of water. If the solution is cooled from 90°C to 70°C, how many grams of precipitate are formed? **16-18g in 100g of water = 8 or 9g in 50 g of water**

Table H Questions:

What is the vapor pressure in kPa and atm of propanone at 75°C?
181 kPa, 181/101 x 1atm = 1.79 atm

Liquids boil when the vapor pressure is equal to the pressure on the system. For instance, pure water boils at 100°C at 1 atm, but when the pressure is 2 atm, water boils at 118°C. Consider the four liquids on table H, propanone, ethanol, water, and ethanoic acid. If they were to all boil at 70°C, what pressures would they be under to boil at that temperature?

Propanone - press = 155 kPa
Ethanol – press = 70 kPa
Water – press = 30kPa
Ethanoic acid – press = 19 kPa

Table H
Vapor Pressure of Four Liquids

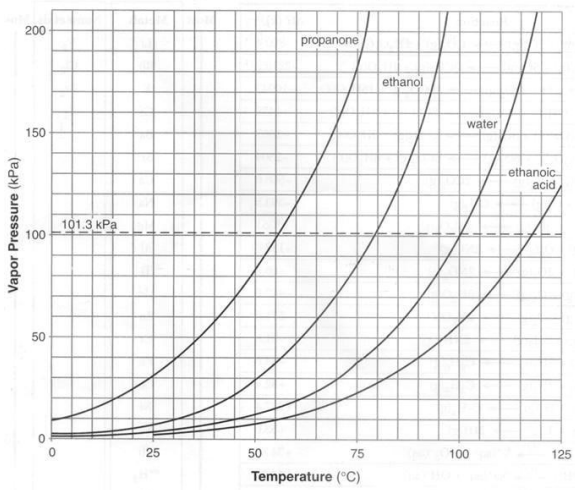


Table I
Heats of Reaction at 101.3 kPa and 298 K

Reaction	ΔH (kJ)*
$CH_4(g) + 2O_2(g) \longrightarrow CO_2(g) + 2H_2O(\ell)$	–890.4
$C_3H_8(g) + 5O_2(g) \longrightarrow 3CO_2(g) + 4H_2O(\ell)$	–2219.2
$2C_8H_{18}(\ell) + 25O_2(g) \longrightarrow 16CO_2(g) + 18H_2O(\ell)$	–10943
$2CH_3OH(\ell) + 3O_2(g) \longrightarrow 2CO_2(g) + 4H_2O(\ell)$	–1452
$C_2H_5OH(\ell) + 3O_2(g) \longrightarrow 2CO_2(g) + 3H_2O(\ell)$	–1367
$C_6H_{12}O_6(s) + 6O_2(g) \longrightarrow 6CO_2(g) + 6H_2O(\ell)$	–2804
$2CO(g) + O_2(g) \longrightarrow 2CO_2(g)$	–566.0
$C(s) + O_2(g) \longrightarrow CO_2(g)$	–393.5
$4Al(s) + 3O_2(g) \longrightarrow 2Al_2O_3(s)$	–3351
$N_2(g) + O_2(g) \longrightarrow 2NO(g)$	+182.6
$N_2(g) + 2O_2(g) \longrightarrow 2NO_2(g)$	+66.4
$2H_2(g) + O_2(g) \longrightarrow 2H_2O(g)$	–483.6
$2H_2(g) + O_2(g) \longrightarrow 2H_2O(\ell)$	–571.6
$N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g)$	–91.8
$2C(s) + 3H_2(g) \longrightarrow C_2H_6(g)$	–84.0
$2C(s) + 2H_2(g) \longrightarrow C_2H_4(g)$	+52.4
$2C(s) + H_2(g) \longrightarrow C_2H_2(g)$	+227.4
$H_2(g) + I_2(g) \longrightarrow 2HI(g)$	+53.0
$KNO_3(s) \xrightarrow{H_2O} K^+(aq) + NO_3^-(aq)$	+34.89
$NaOH(s) \xrightarrow{H_2O} Na^+(aq) + OH^-(aq)$	–44.51
$NH_4Cl(s) \xrightarrow{H_2O} NH_4^+(aq) + Cl^-(aq)$	+14.78
$NH_4NO_3(s) \xrightarrow{H_2O} NH_4^+(aq) + NO_3^-(aq)$	+25.69
$NaCl(s) \xrightarrow{H_2O} Na^+(aq) + Cl^-(aq)$	+3.88
$LiBr(s) \xrightarrow{H_2O} Li^+(aq) + Br^-(aq)$	–48.83
$H^+(aq) + OH^-(aq) \longrightarrow H_2O(\ell)$	–55.8

*Minus sign indicates an exothermic reaction.

Table I Questions:

1. What is the formula for Heat of reaction (ΔH)?
   ΔH = products energy – reactant energy

2. What is the sign of ΔH when the Heat of reactants is more than the Heat of the products?
   Negative

3. What is an exothermic reaction?
   One that has less energy in the products, heat EXITS to the surroundings.

4. What is the sign of ΔH when the Heat of reactants is less than the Heat of the products?
   Positive

5. What is an endothermic reaction?
   More energy in products than reactants, heat must ENTER from surroundings to happen.

6. BONUS: What is heat of solution?
   The ΔH is the heat of reaction, or the heat of solution. On table I there are many chemical reactions and six mixtures, where solids become aqueous, which are NOT chemical reactions. They can't have a "heat of reaction", instead they have "heats of solution".

Table J Questions:

1. Is a more active metal easier to oxidize or reduce? **Oxidize… more active metals lose e^- (LEO)**
2. Is a more active nonmetal easier to oxidize or reduce? **Red… nonmetals gain e^- (GER)**
3. A solution of $CrCl_2$ will react with which of the following metals? **Al Mg Zn**

   Metal higher than Cr+2 on Table J
4. Write the oxidation and reduction half-reactions (if they occur) for

A copper penny placed in a silver nitrate solution. **Cu à Cu^{+2} + $2e^-$ $2Ag^+$ + $2e^-$ à Ag**

A zinc bar is placed in a solution of $NiCl_2$ **Zn à Zn^{+2} $2e^-$ Ni^{+2} + $2e^-$ à Ni**

c. An aluminum nail is placed in a solution of $MgCl_2$ **no reaction**
(Al is not reactive enough—above Mg on table J—to replace the Mg)

Draw a voltaic cell with a copper electrode and a nickel electrode. Include ions in solution. Label the anode and the cathode. Don't forget the salt bridge! Show the direction of current flow. Write equations for the oxidation and reduction half-reactions. **just change Pb for Ni and its all good**

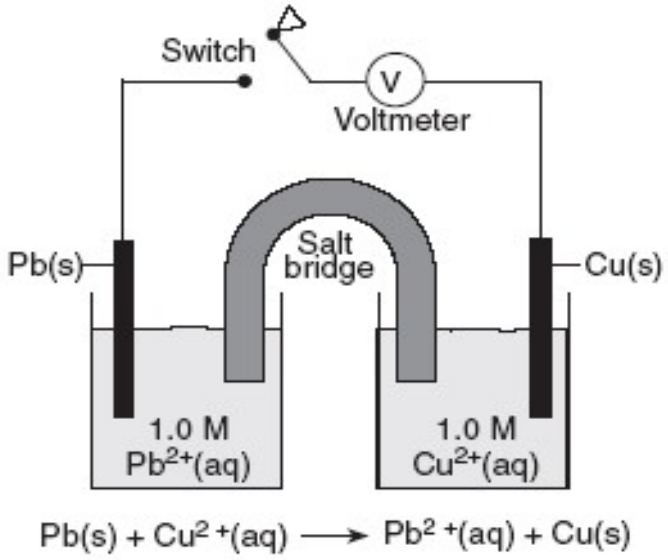
Which one of the following pairs represents a spontaneous reaction?

B. Cu replaces Ag^+

Table J
Activity Series**

Most	Metals	Nonmetals	Most
	Li	F_2	
	Rb	Cl_2	
	K	Br_2	
	Cs	I_2	
	Ba		
	Sr		
	Ca		
	Na		
	Mg		
	Al		
	Ti		
	Mn		
	Zn		
	Cr		
	Fe		
	Co		
	Ni		
	Sn		
	Pb		
	**H_2		
	Cu		
	Ag		
	Au		
Least			Least

**Activity Series based on hydrogen standard
Note: H_2 is *not* a metal



$Pb(s) + Cu^{2+}(aq) \longrightarrow Pb^{2+}(aq) + Cu(s)$

Table K Questions:

1. What are Arrhenius acids?
   Substances that dissolve in water to form excess H^+ ions (hydronium)

2. What is the alternate theory for BASES and ACIDS?
   Bases accept H+
   Acids donate H^+ ions

3. Given this reaction:
   $H_2SO_{4(aq)} + H_2O_{(l)} \leftrightarrow HSO_4^-{}_{(aq)} + H_3O^+{}_{(aq)}$
   find the acids in the forward and reverse reaction.
   H_2SO_4(aq) – forward; H_3O^+(aq) - reverse

What are the possible pH for acidic solutions?
UNDER 7.0

Table K
Common Acids

Formula	Name
HCl(aq)	hydrochloric acid
HNO_3(aq)	nitric acid
H_2SO_4(aq)	sulfuric acid
H_3PO_4(aq)	phosphoric acid
H_2CO_3(aq) or CO_2(aq)	carbonic acid
CH_3COOH(aq) or $HC_2H_3O_2$(aq)	ethanoic acid (acetic acid)

Table L
Common Bases

Formula	Name
NaOH(aq)	sodium hydroxide
KOH(aq)	potassium hydroxide
$Ca(OH)_2$(aq)	calcium hydroxide
NH_3(aq)	aqueous ammonia

Table L Questions:

1. What are Arrhenius bases? **Produce OH^- when dissolved in water**
2. What is the alternate theory for bases? **bases accept H^+ ions**
3. Given this reaction: $CH_3COO^-(aq) + H_2O(l) \leftrightarrow CH_3COOH(aq) + OH^-(aq)$ find the bases in the forward and reverse reaction. **CH_3COO^-(l) – forward; OH^-- reverse**
4. What are the possible pH for acidic solutions? **OVER 7.0**

Table N Questions:

1. Which radioisotope decays the fastest? **Ca-37 (182 milliseconds)**

2. Which radioisotope decays the slowest? **Th-232 (1.4×10^{10} years, 14 billion years)**

3. A sample of uranium-238 is stored in a safe place, what is the amount remaining after 1.341×10^{10} years and what kind of decay particle is emitted?
   3 half lives; therefore 12.5% of U-238 remains; it emits alpha particles.

4. A sample of an unknown radioisotope has taken 151 years to have 1/32 of the original sample remaining. What is this radioisotope?
   Cesium-137; 1/32 remaining = 5 half-lives, 151yrs/5HL's = 30.2 years

Consider a sample of fossilized wood that originally contained 24g of Carbon-14. It now contains 1.5g of Carbon-14. How old is the sample? **24g to 1.5g = 4 half-lives; 5715 x 4 = 22,860 years old**

Table O
Symbols Used in Nuclear Chemistry

Name	Notation	Symbol
alpha particle	$^{4}_{2}\mathrm{He}$ or $^{4}_{2}\alpha$	α
beta particle (electron)	$^{0}_{-1}\mathrm{e}$ or $^{0}_{-1}\beta$	β^-
gamma radiation	$^{0}_{0}\gamma$	γ
neutron	$^{1}_{0}\mathrm{n}$	n
proton	$^{1}_{1}\mathrm{H}$ or $^{1}_{1}\mathrm{p}$	p
positron	$^{0}_{+1}\mathrm{e}$ or $^{0}_{+1}\beta$	β^+

Table O Questions:

What is the charge and mass of an alpha particle?
Mass = 4 amu charge = +2

What is the difference between a beta particle and a positron? **Beta charge: -1, positron: +1**

What is the charge and mass of gamma radiation? **Zero for both**

What is another way to describe a beta particle? **It's an electron!**

Which particle has the most matter? **Alpha**

What is the symbol for beta particles? **Look in the table above**

Which particles will be deflected towards the positive electrode in an electrical field? **Beta**

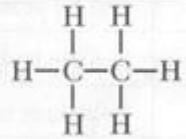
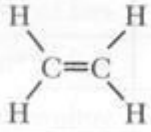
Which particles will be deflected towards the negative electrode in an electrical field?
Alpha, protons and positrons

Which particles will not be deflected in an electrical field? **Gamma and neutrons**

Table P
Organic Prefixes

Prefix	Number of Carbon Atoms
meth-	1
eth-	2
prop-	3
but-	4
pent-	5
hex-	6
hept-	7
oct-	8
non-	9
dec-	10

Table Q
Homologous Series of Hydrocarbons

Name	General Formula	Examples	
		Name	Structural Formula
alkanes	C_nH_{2n+2}	ethane	
alkenes	C_nH_{2n}	ethene	
alkynes	C_nH_{2n-2}	ethyne	

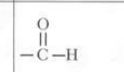
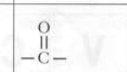
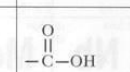
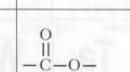
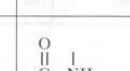
n = number of carbon atoms

Table P and Q Question:

Write the name, molecular formula, and draw the structural formula for 2 alkanes, alkenes, and alkynes using the table P.

Remember that molecular formulas are like "C_3H_8", whereas structural ones are drawings like shown in the right column of Table Q.

Table R
Organic Functional Groups

Class of Compound	Functional Group	General Formula	Example
halide (halocarbon)	−F (fluoro-) −Cl (chloro-) −Br (bromo-) −I (iodo-)	$R{-}X$ (X represents any halogen)	$CH_3CHClCH_3$ 2-chloropropane
alcohol	−OH	$R{-}OH$	$CH_3CH_2CH_2OH$ 1-propanol
ether	−O−	$R{-}O{-}R'$	$CH_3OCH_2CH_3$ methyl ethyl ether
aldehyde			 propanal
ketone			 2-pentanone
organic acid			 propanoic acid
ester			 methyl propanoate
amine			$CH_3CH_2CH_2NH_2$ 1-propanamine
amide			 propanamide

R represents a bonded atom or group of atoms.

Table R Question:

Make up 2 more examples for each class of compounds.
Write their names, and draw their structural formulas.

Show your teacher if you do not know how or are not sure if your are doing this right!

Table T Questions:

Density

What is the density of an object with a mass of 102.0 g and a volume of 10 cm^3?**102/10 = 10.2 g/mL**

An object has a mass of 23 g and a density of 10 g/cm^3 what is its volume? **2.3 mL (2.3 cm^3)**

Mole Calculations

What is the number of mole in a sample of 45g of H_2O? **molar mass = 18, so 45/18 = 2.5 moles**

What is the mass of 2 moles of H_2O_2? **Molar mass = 34, so 34 x 2 = 68 grams**

Percent Error

A Student calculates the density of iron at STP to be 8.956 g/cm^3. What is the Percent Error? **7.874 is accepted value (Table S) so +13.74% (don't forget the sign +/- which tells if you're over or under)**

Percent Composition

1. What is the percent composition by mass of H in H_2O_2? **2/34 x 100 = 5.9%**

Concentration

1. What is the molarity of a solution of KOH if 1000 ml of the solution contains 11.2 grams of KOH? **11.2 g KOH is 0.2 moles of KOH (11.2/molar mass = 11.2/ 56) Molarity = 0.2/1.0 L = 0.2**
2. How many moles of KOH are contained in 250 mL of 2.0 M solution of KOH? **2 M x .250 L = 0.5 moles**
3. What is the concentration in parts per million if a 500 g solution of copper (II) sulfate contains 5 mg of copper (II) sulfate? **10 ppm of $CuSO_4$; (.005g/500g) x 1,000,000**

Combined Gas Law

At STP, a sample of hydrogen gas has a volume of 10 L. If the temperature is double and the pressure is double, what is the new volume of the gas sample? **10 L (double the T causes doubling of V, but doubling pressure causes volume to reduce to ½, so no volume change)**

At STP, a sample of helium gas has a volume of 5 L. If the temperature is quadruple and the pressure is triple, what is the new volume of the gas sample? **4x T causes 4x volume, but 3x P causes 1/3 x volume, so volume changes by 4 x 1/3 or 4/3. So 4/3 x 5 = 20/3 = 6.67 L**

Titration

1. How many milliliters of 0.50 M NaOH are required to exactly neutralize 20.0 milliliters of 0.20 M HCl? **(0.20 M)(20 mL) = (0.50 M) Vb Vb = 8 mL**
2. If 100. milliliters of a 3.0 M solution of HCl is exactly neutralized by 80. milliliters of NaOH, what is the molarity of the NaOH solution? **3.75 M NaOH**

What is the molarity of an HNO_3 solution if 10.0 milliliters of 0.40 M LiOH is required to exactly neutralize 200 milliliters of the HNO_3 solution? **0.020 M**

Heat

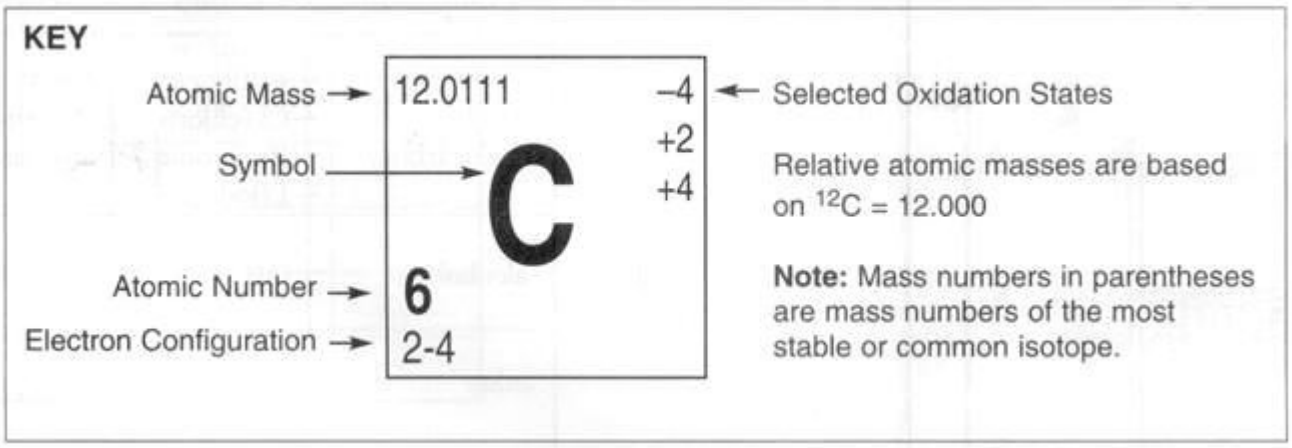
How many Joules are required to melt 1000 g of water? **q = mHf = 1000 g x 334 J/g = 334,000 J or 334 kJ**

How many Joules are needed to vaporize 10 g of water? **q = mHv = 10g x 2260 J/g = 22,600 J = 22.6 kJ**

Temperature

Convert the followings: 0°C to K, **273 K**

373 K to °C, **100°C** 35oC to K **308 K**



Periodic Table Questions:

List the symbol of the 7 metalloids: **B, Si, Ge, As, Sb Te, Po**

What is the number of e-, p, and n in a neutral atom of nitrogen? **7 p^+ n^0 & 7e^-**

What is the Atomic Number of barium? **56**

What is the electron configuration of iodine? **2-8-18-18-7**

What are the Selected Oxidation States of chlorine?**-1, +1, +3, +5, +7**

Name the 6 Noble Gases? **Helium, neon, argon, krypton, xenon, radon**

What is the difference between helium and the other Noble Gases? **He has only 2 valence e^-'s, others have 8**

What does the period number indicate in the electron configuration of an atom? **Number of energy levels of electrons that element uses**

What does the group number indicate in the electron configuration of an atom? **Number of valence e^-'s that element has**

What is the name of group 17? **halogens**

What is the name of group 18? **noble gases**

What does the Selected Oxidation States numbers represent? **possible charges that element is known to take on in its various compounds with other elements**

How many valence electrons are in an atom of cesium? **one**

What element has an electron configuration of 2-8-10-2? **Ti**