Big Time Review

1) **Conversions**

a) 55km = ? m
55000m

b) 425 cL=? mL
4250mL

c) 25mg = ?g
0.025g

d) 25,000J = ?kJ
25kJ

2) How many Significant figures?

a) 10.1	b) 0.00556	c) 0.0001	d) 1.0×10^{-3}
3	3	1	2

3) Calculations with Significant Figures

a) 0.0026 x 10. = ____2.6×10^{-2}______

b) 236.1 + 0.00999 = _236.1__

c) 102.3 ÷ .0023 = ___4.4×10^{-4}____

d) 0.01256 - 1.096 = 1.083

4) Scientific Notation and Sig Figs

a) 0.02568 = __2.568×10^{-2}_ b) 0.000589 = __5.89×10^{-4}__ c) $1.5 \times 10^{-3} \bullet 5.00 \times 10^{+5}$ = __7.2×10^{2}_

d) $\frac{1.0 \times 10^{-14}}{1.56 \times 10^{-7}}$ = _6.4×10^{-8}_

5) In the lab you measure the room temperature to be 23.5°C, but the more actual temperature was 23.2°C. What was your percent error?

$$\frac{23.5 - 23.2}{23.2} \times 100 = 1.29\%$$

6) Give several examples of physical properties.

Color, density, Boiling point

7) Give several examples of chemical properties.

Any chemical reaction

8) What is the difference between a compound and an element?

Compound is several elements bonded together

9) Explain how a cathode ray tube explained the existence of the electron. Who was credited with the discovery of the electron?

Thomson – bent a beam of electrons with a magnetic field – electrons came from the metal

10) Explain how the results of Rutherford's gold foil experiment explained the presence of a dense, positive nucleus.

1 in 6000 alpha particles was deflected – nucleus is small
Since they repelled, must be the same charge. Alpha particles are positive charge, so is the nucleus.
Since they were deflected, and alpha particles are massive (dense), so is the nucleus.

11) Describe the following:
Atomic number - # protons

Mass Number - #protons + neutrons

Average Atomic Mass
Mass of a sample with mixed isotopes

12)

	Name	At #	At Mass	p	n	e	charge
${}^{37}_{17}Cl^{-1}$	Chlorine - 37	17	37	17	20	18	-1
${}^{81}_{35}Br^{o}$	Bromine-81	35	81	35	46	35	0
${}^{146}_{60}Nd^{o}$	Neodynium-146	60	146	60	86	60	0
${}^{19}_{8}O^{-2}$	Oxygen-19	8	19	8	11	10	-2
${}^{121}_{51}Sb^{+5}$	Antimony-121	51	121	51	70	46	+5

13) What were Dalton's laws and which ones were not entirely correct? Explain how they were incorrect.
1) Everything is made up of atoms (yes) 2) Atoms are indestructible (no, nuclear reactions)
3) Atoms of the same element are the same, different elements are different (no, isotopes and ions)
4) Atoms join in specific whole number ratios to make compounds (yes)

14) Why do colors appear when hydrogen gas is exposed to electric current? Use the Bohr model to explain.
Electrons are excited to a higher energy level. When they drop back down to lower levels, they release energy of a specific wavelength (since the energy levels are quantized) Those wavelengths = specific colors of light.

15) What are the major differences between the Quantum Mechanical model and the Bohr model of the atom?

Quantum – electrons are in clouds, orbitals where there is a probability of finding them.
Bohr – electrons orbit in rings which are their energy levels.

16) In quantum mechanics, what is the volume of space that the electron in probably in called?

Orbital

Nuclear

17) Explain the differences between make-up and penetrating power for alpha particles, beta particles, and gamma rays.

Alpha – helium nucleus – low penetrating power
Beta – electron – high penetrating power
Gamma – energy (EM wave) – very high penetrating power

18) Explain the differences between fission and fusion regarding the fuels and the way reaction occurs.

Fission – large unstable nucleus is broken into 2 small nuclei (U-235)
Fusion – 2 small nuclei (H) combine to make one larger one
Change in mass = energy $E=mc^2$ for both

19) Balance the following nuclear equation:

$$^{14}_{7}N + ^{4}_{2}He \rightarrow ^{0}_{-1}e \quad + \quad ? \; ^{18}_{10}Ne$$

20) How much energy is in a beam of light with a wavelength of $6.32x10^{-14}$m?

$c = \lambda \upsilon$ $3x10^{8}$m/s = $6.32x10^{-14}$m (υ) $\upsilon = 4.75x10^{21}s^{-1}$ E=hυ E = ($6.626x10^{-34}$Js)($4.75x10^{21}s^{-1}$)

E = $3.15x10^{-12}$J

21) Tungsten has five common isotopes present in the following percentages: tungsten-180 at 0.100%, tungsten 182 at 26.3%, tungsten 183 at 14.3%, tungsten-184 at 30.7%, and tungsten-186 at 28.6%. What is the average atomic mass of tungsten?
180 x 0.001 = $1.8x10^{-1}$
182 x .263 = 47.866
183 x 0.143 = 26.169
184 x 0.307 = 56.488
186 x 0.286 = 53.196 add together = 183.90

Periodic Table

22) What is the periodic Law?
With increasing atomic number, the chemical properties of the elements repeat

23) On the periodic table, distinguish between:
Periods - rows
Groups - columns
Metals – left side of staircase (give up electrons)
Non-metals – right side of staircase (gain electrons)
Semi-Metals – one the staircase (both metal and nonmetal properties)

24) On the periodic table identify where to find the:
S-block, D-block, P-Block and F-block s=group 1+2, p = groups 13-18 d=groups 3-12
f = bottom two rows
Alkali Metals - Group 1
Alkali Earth Metals – group 2
Transition Metals – groups 3-12
Halogens – group 17
Noble Gases – group 18

Periodic Trends

25) Describe the trends and give a reason for each:
a) Atomic radius
increases as you go down and increases as you go to the left
– Why does it get smaller across a period, larger down a family/group?
Across a period – more protons in same energy level = smaller atom electrons more attracted to the nucleus
Down a column – more energy levels = larger atom
b) Ionic Size
increases as you go down – more energy levels
decreases when more protons are pulling on the same number of electrons

-Why is an anion larger than a cation from the same period?
-anions gain electrons to fill their outer energy level, cations lose electrons to shed their outer level

c) Electronegativity
Increases as you go up and to the right – noble gases EN = 0
Why is it related to the number of protons in the nucleus and number on energy shells?
More protons- smaller atom = easier to attract electrons
More energy levels = larger atom = harder to attract electrons

Chemical Formulae and Bonding

26) What are the difference between a covalent and ionic bonds?

Covalent = two elements with large electronegativities = can't steal electrons = share
Ionic = one element with a low electronegativity, one with high = electrons are transferred

27) Explain how the octet rule can be used to predict the charge of elements in the S and P blocks. Why is this not true of the D block?

Atoms want to have their s and p sublevels filled which equals 8 electrons, they bond in order to accomplish this
d- block elements have other electrons that can get involved so they have other possibilities of being happy

28) What is a valence electron?
Electrons in the outermost energy level

29)

Names
$Mg(OH)_2$
Magnesium hydroxide
Na_3N
Sodium nitride
PCl_3
Phosphorous trichloride
H_2SO_4
Sulfuric acid
$(NH_4)_2CO_3$
Ammonium carbonate
H_2CO_3
Carbonic acid
$Be(ClO_3)_2$
Beryllium chlorate
$Cu(NO_3)_2$
Copper(II)nitrate

Formulas
Iron (III) Oxide
Fe_2O_3
Potassium bromide
KBr
Uranium (II) nitrate
$U(NO_3)_2$
Arsenic pentaiodide
AsI_5
Cesium chromate
Cs_2CrO_4
Strontium nitrite
$Sr(NO_2)_2$
Titanium (V) oxide
Ti_2O_5
Chromium (I) chromate
Cr_2CrO_4
Aluminum sulfate pentahydrate
$Al_2(SO_4)_3 \cdot 5H_2O$

30) Draw the lewis dot structures for the following molecules and determine if they are polar

Methanol(CH_3OH)	Nitrogen tribromide	Carbon dioxide	Dihydrogen monoxide	CH_4
Polar	Polar	non polar	polar	nonpolar
Asymmetric	Asymmetric	symmetric	asymmetric	symmetric

Chemical Reactions and Equations

31) Why must a chemical equation be balanced?

Law of conservation of matter

32) Balance the following chemical equations.

$(NH_4)_2CO_3 \rightarrow 2NH_3 + H_2O + CO_2$

$2KClO_3 \rightarrow 2KCl + 3O_2$

33) Calcium phosphate and silicon dioxide are mixed to produce tetraphosphorus decaoxide and calcium silicate ($CaSiO_3$).

$2Ca_3(PO_4)_2 + 6SiO_2 \rightarrow P_4O_{10} + 6\,CaSiO_3$

34) Phosphorus pentachloride and water react to produce phosphoric and hydrochloric acids

$PCl_5 + 4H_2O \rightarrow H_3PO_4 + 5HCl$

35) Give an example of the following types of reactions:

a) Direct combination

$2H_2 + O_2 \rightarrow 2H_2O$

b) Single replacement

$Mg + 2\,HCl \rightarrow MgCl_2 + H_2$

c) Double replacement

$HCl + NaOH \rightarrow NaCl + H_2O$

d) Decomposition

$2NaCl \rightarrow Na + Cl_2$

e) Combustion

$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

36) Write the balanced the equation and determine type of reaction:

a) Copper (III) chloride reacts with sulfur to produce a gas and a salt.

$2\,CuCl_3 + 3S \rightarrow Cu_2S_3 + 3Cl_2$ single replacement

b) Calcium carbonate is heated to produce an oxide and a gas.

Hint: the gas puts out fires.

$CaCO_3 \rightarrow CaO + CO_2$ decomposition

c) Magnesium hydroxide and phosphoric acid neutralize each other.

$3Mg(OH)_2 + 2H_3PO_4 \rightarrow Mg_3(PO_4)_2 + 6H_2O$ double replacement

d) Uranium metal reacts with concentrated sulfuric acid to produce a gas and a uranium (III) salt.

$2U + 3H_2SO_4 \rightarrow U_2(SO_4)_3 + 3H_2$ single replacement

e) Nickel (II) bromide and sodium phosphate yield

$3NiBr_2 + 2Na_3PO_4 \rightarrow Ni_3(PO_4)_2 + 6NaBr$

37) What is the percent composition of calcium in calcium phosphate?

Ca_3PO_4 3(40.08) + 2(30.97) + 8(16) = 310.06

$\frac{120.24}{310.06} \times 100 = 38.78\%Ca$

Stoichiometry

38) In #36a, how many liters of gas at STP would be produced from the reaction of 16.5g of copper(III)chloride with excess sulfur?

$\frac{16.5g\ CuCl_3}{1} \times \frac{1\ mole\ CuCl_3}{169.9g\ CuCl_3} \times \frac{3\ mole\ Cl_2}{2\ mole\ CuCl_3} \times \frac{22.4L\ Cl_2}{1\ mole\ Cl_2} = 3.26L\ Cl_2$

39) In #36a, how many formula units of the salt are created from a reaction with 5.38g of sulfur reacting with excess copper(III)chloride?

$\frac{5.38g\ S}{1} \times \frac{1\ mole\ S}{32.06g\ S} \times \frac{3\ mole\ Cu_2S_3}{3\ mole\ S} \times \frac{6.02x10^{23}\ atoms\ S}{1\ mole\ Cu_2S_3} = 3.37x10^{22}\ FU\ Cu_2S_3$

40) In #36a, how many atoms of sulfur were reacted with excess copper(III)chloride if 83.5g of the gas was created?

$\frac{83.5g\ Cl_2}{1} \times \frac{1\ mole\ Cl_2}{70.9g\ Cl_2} \times \frac{3\ mole\ S}{3\ mole\ Cl_2} \times \frac{6.02x10^{23}\ atoms\ S}{1\ mole\ S} = 7.09x10^{23}\ atoms\ S$

Energy

41) How much would the temperature of water change if 62.5kJ of energy was added to a 3.00kg sample?

$\Delta H = m\ C\ \Delta T$

$62500J = 3000g\ (4.184J/g^oC)\ (\Delta T)$ $\Delta T = 4.98^oC$

42) Calculate the mass of copper placed in 1200.g of water if the specific heat of copper is 0.387J/g°C, the initial temperature of the water was 75.4°C, the final temperature of the water was 95.2°C, and the initial temperature of the copper was 285°C.

$(m\ C\ \Delta T)_{Cu} = -(m\ C\ \Delta T)_{H20}$ $(m)(0.387\ J/g^oC)(95.2 - 285) = -(1200g)(4.184J/g^oC)(95.2 - 75.4^oC)$

$m = 1353g$

43) How much heat will be released when 1.48g of chlorine reacts with excess phosphorus according to the following equation? $2P + 5Cl_2 \rightarrow 2PCl_5 + 886kJ$

$\frac{1.48g\ Cl_2}{1} \times \frac{1\ mole\ Cl_2}{70.9g\ Cl_2} \times \frac{886kJ\ Cl_2}{5mole\ Cl_2} = 3.70kJ$

44) When a 19.2g sample of KCN dissolves in 65.0g of water in a calorimeter, the temperature drops from 28.1°C to 15.4°C. Calculate the ΔH for this process.

$$KCN_{(s)} \rightarrow K^{+}_{(aq)} + CN^{-}_{(aq)} \quad \Delta H = ?$$

$\Delta H = m\,C\,\Delta T$

$= (65g)(4.184 J/g^{o}C)(12.7^{o}C)$

$= 3454J = \Delta H_{H2O}$

$\Delta H_{H2O} = -\Delta H_{KCN} = -3454J$

$$\frac{-3454J}{19.2g\ KCN} \times \frac{65.11g\ KCN}{1\ mole\ KCN} = 11713kJ/mole$$

Gases

45) Why do gases become a liquid under high pressures and low temperatures?

More collisions(because they are closer together), and more attraction (because they are closer together and have less energy to escape each others attraction),

46) Explain how the total pressure of a mixture of gases in a container can be determined if the amount of each gas is known.

Calculate the moles of each gas, and calculate the pressure of each gas using PV=nRT. Add all of the individual pressures up to get the total.

47) Explain why the volume of each gas in the container is the same as the size of the container regardless of how much of each gas is present.

Gas particles are far apart, so they can move in between each other easily and spread out to fill the whole container.

48) If equal parts of 3 gases totaling 4.38 moles of gas were added to a 6.03L container at 305K, then what is the partial pressure of each gas?

$\frac{4.38\ moles}{3} = 1.46$ moles each

PV=nRT P(6.03L) = (1.46mole)(0.0821Latm/moleK)(305K)

P=6.06atm

49) In question #43, if 43L of chlorine gas was consumed in the reaction at 1.04atm of pressure and 289K, then how many grams of PCl_5 would you expect to produce? How much energy in Joules?

PV=nRT (1.04atm)(43L) = (n)(0.0821Latm/moleK)(289K) n = 1.88mole Cl_2

$$\frac{1.88\ mole\ Cl_2}{1} \times \frac{1\ mole\ PCl_5}{5\ mole\ Cl_2} \times \frac{208.22g\ PCl_5}{1\ mole\ PCl_5} = 78.29g\ PCl_5 \qquad \frac{1.88\ mole\ Cl_2}{1} \times \frac{886\ KJ}{5\ mole\ Cl_2} = 3.26x10^{5}J$$

Solutions

50) Can you make 100mL's of a 0.25M solution from 10mL of a 5.0M solution, if so explain how!

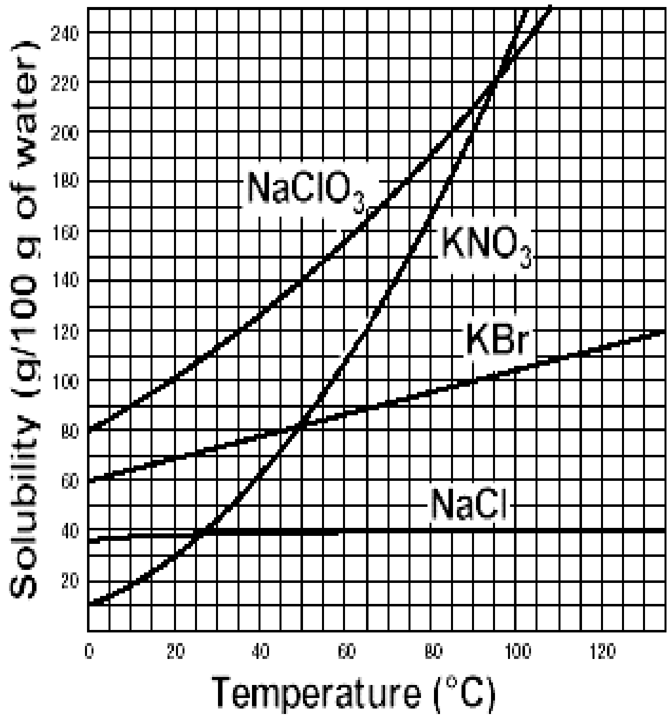
MV = MV (0.25M)(100mL) = (5.0M)(x) x = 5mL of 5.0m solution since you need 5mL and have 10mL, you can do it!!

51) Explain how you can make 250mL's of a 0.68M NaOH solution from solid NaOH.

$$\frac{0.68moles\ NaOH}{1\ L} \times \frac{0.25L}{1} \times \frac{40g\ NaOH}{1mole\ naOH} = 6.8g$$ Add 6.8g and dissolve in a container filled to 250mL

52) What is the only thing that you can do to a solution to change the amount of solute that can be dissolved if you cannot change the amount of solvent?

Change the temperature



53) How much $NaClO_3$ can be dissolved in 100g of water at 65°C?
165g

54) How much KBr can be dissolved in 45g water at 80°C?
At 80⁰C , 95g of KBr can be dissolved in 100g H_2O $\frac{95\text{gKBr}}{100\text{g } H_2O} = \frac{x \text{ g KBr}}{45\text{g } H_2O} = 42.75\text{gKBr in } 45\text{g } H_2O$

55) How much KNO_3 will precipitate if 80g was dissolved in 100g of water and the temperature of the water was lowered to 20°C?

At 20°C you can dissolve 30g in 100g water therefore 50g will precipitate

Acids and Bases

56) What is the pH of a solution if the concentration of NaOH is $2.3\text{x}10^{-5}$M?
$pOH = -\log[OH^-] = -\log(2.3\text{x}10^{-5}M) = 4.64$ pH + pOH = 14 so…. pH = 9.36

57) Define an acid and a base using the Arrhenius and the Bronsted-Lowry definitions.

Arrhenius = acids give off H^+ , bases give off OH^-
Bronsted-Lowry = Acids are proton donors, and bases are proton acceptors

58) Explain how adding base to acid produces a neutral solution.
$H^+ + OH^- = H_2O$ add more base to acid and you get water which is neutral

59) What is the $[H^+]$ in a solution that has a pH of 3.8? What would the pOH be? $[OH^-]$?

$10^{-pH} = [H_3O^+]$ (or H^+) so $10^{-3.8} = 1.58\text{x}10^{-4}$M $[H_3O^+][OH^-] = 1\text{x}10^{-14}$ so…. $[OH^-] = 6.33\text{x}10^{-11}$M
pH +pOH = 14 so… pOH = 10.2

Equilibrium

60) In the following reaction, explain two things that can be done to shift the equilibrium to produce more products:

$$C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O + \text{Heat}$$

Remove energy, add more reactants, remove some products

61) Write the k_{eq} expression for the previous reaction and explain how the k_{eq} value can tell you whether you will find more products or more reactants when the equilibrium is reached

$k_{eq} = \frac{[CO_2]^2[H_2O]^2}{[C_2H_4][O_2]^3}$ small keq = favors reactants large keq = favors products keq = 1 means equal amounts

Misc. Calculations

Use the following equation for 62-65

$$\mathbf{Mg_{(s)} + 2HCl_{(aq)} \rightarrow MgCl_{2\,(aq)} + H_{2\,(g)}}$$

62) If the hydrogen gas was collected in a 0.25L container under 125Kpa of pressure at 28°C, then how many grams of Magnesium were reacted?

PV=nRT (1.23atm)(0.25L) = (n)(0.0821Latm/moleK)(301K) $n = 1.24\text{x}10^{-2}$ moles H_2

$\frac{1.24\text{x}10^{-2} \text{ moles } H_2}{1} \text{ x } \frac{1 \text{ mole Mg}}{1 \text{ mole } H_2} \text{ x } \frac{24.31\text{g Mg}}{1 \text{ mole Mg}} = 3.02\text{g Mg}$

63) If 58mL of a 0.15M HCl solution was used to react excess magnesium, then how many formula units of Magnesium Chloride were produced?

$\frac{0.058\text{L solution}}{1} \text{ x } \frac{0.15\text{mole HCl}}{1 \text{ L HCl soln}} \text{ x } \frac{1 \text{ mole } MgCl_2}{2 \text{ mole HCl}} \text{ x } \frac{6.02\text{x}10^{23} \text{ F.U. } MgCl_2}{1 \text{ mole } MgCl_2} = 2.62\text{x}10^{21} \text{ F.U. } MgCl_2$

64) If the pH of the starting solution was 3.8 and 50mL was used, then how many hydrogen atoms were produced?

$10^{-3.8} = [H_3O] = 1.58\text{x}10^{-4}\text{M}$ $[HCl]=[H_3O^+]$

$\frac{0.05\text{L solution}}{1} \text{ x } \frac{1.58\text{x}10^{-4} \text{ mole HCl}}{1 \text{ L HCl soln}} \text{ x } \frac{1 \text{ mole } H_2}{2 \text{ mole HCl}} \text{ x } \frac{6.02\text{x}10^{23} \text{ molecules } H_2}{1 \text{ mole } H_2} \text{ x } \frac{2 \text{ atoms H}}{1 \text{ molecule } H_2} = 2.62\text{x}10^{21} \text{ F.U. } MgCl_2$

65) What is the percent yield if only 43.2mL of hydrogen gas was collected at 752.5mmHg and 22.3°C, and 0.52g of magnesium was reacted with excess hydrochloric acid?

$\frac{0.52\text{g Mg}}{1} \text{ x } \frac{1 \text{ mole Mg}}{24.31\text{g Mg}} \text{ x } \frac{1 \text{ mole } H_2}{1 \text{ mole Mg}} = 2.14\text{x}10^{-2} \text{ mole } H_2$

PV=nRT $(0.99\text{atm})(V) = (2.14\text{x}10^{-2} \text{ mole})(0.0821\text{Latm/moleK})(295.3\text{K})$

V = 0.524 or 524mL

$\% \text{ yield} = \frac{\text{Experimental}}{\text{Actual}} \text{ x } 100 = \frac{43.2}{524} \text{ x } 100 = 8.24\%$

66) What was the pH of the original HCl solution if 25mL of acid was titrated with 0.2M NaOH and the phenolphthalein changed color after 45mL of base was added.

$NaOH + HCl \rightarrow NaCl + H_2O$

$$\frac{0.045\text{L NaOH solution}}{1} \times \frac{0.2\text{mole NaOH}}{1\text{ L NaOH soln}} \times \frac{1\text{ mole HCl}}{1\text{ mole NaOH}} = 9\text{x}10^{-4}\text{ mole HCl} \times \frac{1}{0.025\text{L}} = 3.6\text{x}10^{-2}\text{M HCl}$$

Since HCl only gives 1 H^+ ion, then $[H_3O^+] = 3.6\text{x}10^{-2}$M also

$pH = -\log[H_3O^+] = -\log[3.6\text{x}10^{-2}\text{M}] = 1.44$

67) If the half-life of a radioisotope is 5.62 days. How many grams of a 58 gram sample will be left after 33.72 days.

Amount (g)	# Half Lives	Time (days)
58	0	0
29	1	5.62
14.5	2	11.24
7.25	3	16.86
3.625	4	22.48
1.813	5	28.10
0.9065	6	33.72

68) If 85 mL's of a gas at STP is compressed into a 0.02L container at 25°C, then what was the final pressure in Kpa?

$$\frac{PV}{T} = \frac{PV}{T} \qquad \frac{(101.3\text{kPa})(85\text{mL})}{273\text{K}} = \frac{(P)(20\text{mL})}{298\text{K}} \qquad P = 470\text{kPa}$$