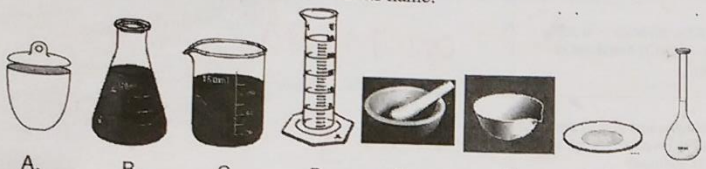
• present: start counting on left w/ 1st nonzero #

• absent: start counting on right w/ 1st nonzero #

Chemistry SOL Review Packet Name KEY

1. Match the following **lab equipment** with its name:



C beaker — F evaporating dish — B Erlenmeyer flask — G watch glass

H volumetric flask — D graduated cylinder — E mortar & pestle — A crucible

2. Put the following values into correct **scientific notation** and indicate the number of **significant figures** in each measurement.

Measurement	# of significant figures	Scientific Notation
0.00005607 m	4	5.607×10^{-5} m
205.00 mL	5	2.0500×10^{2} mL
345000 J	3	3.45×10^{5} J
0.00300 kg	3	3.00×10^{-3} kg
250. g	3	2.50×10^{2} g
.003159L	4	3.159×10^{-3} L
21400xmg	3	2.14×10^{4} mg

3. Perform the calculations & **round** your answer to the **correct number of significant figures**

Problem	Raw Answer	Rounded Answer
1.35 x 2.467		3.33
12.01 + 35.2 + 6		53
55.46 - 28.9		26.6
0.021 x 3.2 x 100.1		6.7

* Add/Sub: Round to value w/ least # decimal places

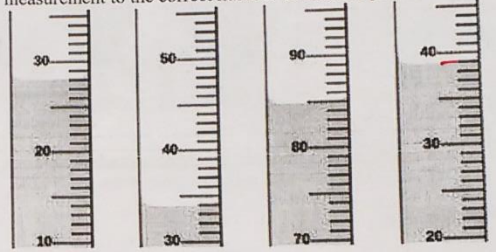
* Mult/Div: Round to value w/ least # sig figs

4. The boiling point of water is 100.0°C. Give an example of data for the boiling point (BP) of water that is ***PRECISE BUT NOT ACCURATE:*** → NOT close to 100

Trial 1:_____ Trial 2:_____ Trial 3:_____ Trial 4:_____

→ 4 answers are close together/consistent

5. What is the measurement in the graduated cylinder? Make sure you estimate each measurement to the correct number of decimal places!



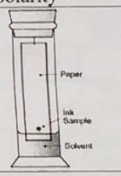
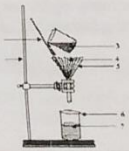
28.0 _____ _____ _____

estimate to tenths place.

6. Complete the table below about **separation techniques** and the physical property the mixtures are separated by.

Separation Techniques: distillation, filtration, chromatography

Physical Properties: size/state of matter, boiling point, polarity

Image of separation technique			
Name of technique	distillation	chromatography	filtration
Separated by this differing physical property	boiling point	polarity	solubility, state of matter

7. What is the difference between an element and a compound? A homogeneous and heterogeneous mixture?

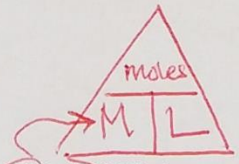
Empirical/Molecular Formula, Molar Mass, Percent Composition

Empirical Formula	Molecular Formula	Molar Mass of MF	% comp	WORK HERE
CH_2	C_2H_4	26.06 g/mol	%C:85.6% %H:14.4%	
N_2O_5	N_2O_5	108.02	%N: 25.94 %O: 74.06	
CH_3	C_2H_6	30.07 g/mol	%C: 79.88 %H: 20.15	
P_2O_3	P_4O_6	220 g/mol	%P: 56.3% %O: 43.7%	

Molar Conversions 1 mole = 6.02×10^{23} molecules

Problem	Work – Circle final answer with correct sig figs and unit
How many *moles* are present in a 100.0 g sample of C_2H_6O?	2.170 moles
What is the *mass* of 9.25×10^{22} molecules of water?	2.77 g
What is the volume of a 3.56g of O_2 at STP?	2.49 L
What is the volume of 3.01×10^{23} atoms of He gas at STP?	11.2 L

1 mole = 22.4 L (@ STP)



$M_1 \times V_1 = M_2 \times V_2$

Molarity & Dilutions

Problem	Work – Circle final answer with correct sig figs and unit
What is the molarity of a 3.89g sample of $CaCl_2$ dissolved in 500.mL?	0.0701 M
How many grams of KCl are required to prepare 500 mL of a 0.125 M solution?	4.66 g
A 35.0 mL 5.0M solution is diluted to 1.67M. What is the volume of the new solution?	105 mL
A 12.3M solution is diluted to a volume of 990.0mL. If the new molarity is 3.0M, what is the initial volume of solution needed?	241 mL

Chemical vs. Physical Changes, Reactions, Balancing Equations, Stoichiometry

1. Balance and identify the type of reaction represented by the chemical equations below (synthesis, decomposition, single replacement, double replacement, combustion, neutralization):

Chemical Equation	Type of Reaction
2 H_2 + 1 O_2 → 2 H_2O	S
2 LiCl + 1 $MgBr_2$ → 2 LiBr + 1 $MgCl_2$	DR
1 $C_6H_{12}O_6$ → 6 C + 3 O_2 + 6 H_2	D
1 C_4H_8 + 6 O_2 → 4 H_2O + 4 CO_2	C
2 Cu + 2 H_3PO_4 → 3 H_2 + 2 $CuPO_4$	SR

2. What is the difference between a chemical and a physical change? Chemical and physical property?

Stoichiometry:

Problem	Work – Circle final answer with correct sig figs and unit
$2H_2 + O_2 \rightarrow 2H_2O$ What is the mass of water produced from 9.67g of hydrogen gas?	86.3 g H_2O
$2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$ If 5.2 moles of ethane (C_2H_6) is burned, how many moles of O_2 are required?	18.2 mol O_2
$Pb(NO_3)_2 + 2KI \rightarrow PbI_2 + 2KNO_3$ If 5.00 grams of potassium iodide reacts according to the equation above, how many grams of lead iodide will be produced?	6.94 g PbI

- **Gas Laws**

1. A 5.67L sample of a gas has a pressure of 1.45atm. What is the new volume of the gas at 2.00atm?

4.11 L

2. A 120.0mL sample of gas has a temperature of 256K and a pressure of 600.torr. What is the new pressure if the volume is decreased to 55.0mL at a temperature of 301K?

1540 torr

3. What is the temperature of a 5.00 mole gas sample with a pressure of 1.57kPa and a volume of 3.56L?

$PV = nRT$

$R = 8.31 \frac{kPa \cdot dm^3}{moles \cdot K}$

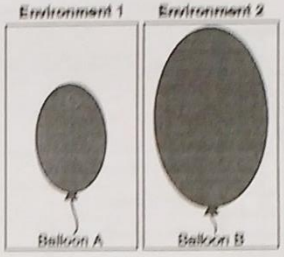
0.185 K

4. What is the partial pressure of oxygen gas if it is mixed with 0.50atm of nitrogen gas? The total pressure of the mixture is 1.30atm?

0.80 atm

$\frac{P_1 \times V_1}{T_1} = \frac{P_2 \times V_2}{T_2}$ $P_{total} = P_1 + P_2 + \cdots$

5.



Each balloon was filled with an identical number of moles of gas. Which of the following best explains why balloon B is larger than balloon A?

A. The gas in balloon A is under less pressure.
B. The gas in balloon A is warmer.
C. The gas in balloon B is under more pressure.
D. The gas in balloon B is warmer.

- **Physical Behavior of Matter, Interpreting Graphs**

6. What is the relationship between strength of intermolecular forces and boiling point?

direct
(↑ IMF, ↑ BP)

These three phase changes are all ENDOTHERMIC:					
Solid → Liquid		Liquid → Gas		Solid → Gas	

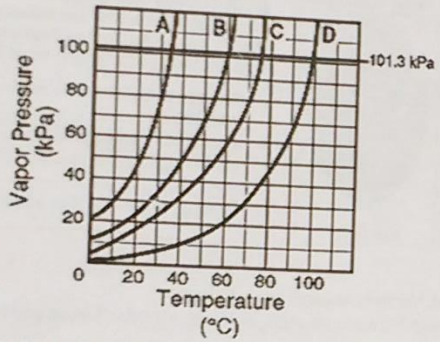
These three phase changes are all EXOTHERMIC:					
Gas → Liquid		Liquid → Solid		Gas → Solid	

Another word for melting is FUSION. Another word for evaporation is VAPORIZATION.

If you see a diagram with a sealed liquid in a jar or flask, you should know that there is an equilibrium happening in there. The rate of evaporation is equal to the rate of condensation.

Vapor pressure is defined as the pressure exerted by the gas above a liquid. Here is an example of some vapor pressure curves:

Vapor pressure is defined as the pressure exerted by the gas above a liquid. Here is an example of some vapor pressure curves:



6. From this graph we can get certain information.

a) The normal boiling point of liquid A is 35°C

b) If the external pressure is reduced to 60 kPa, then Liquid C would boil at 60°C

c) The liquid with the strongest intermolecular forces is most likely D

Liquid	Boiling Point (°C)
ether	35
ethyl alcohol	78
water	100
glycerine	290

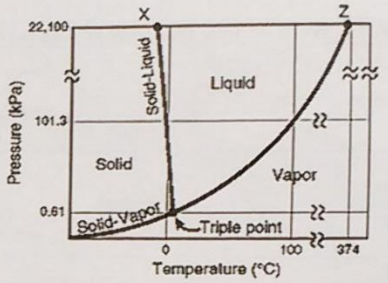
7. Which of the liquids in the table above would have the *highest vapor pressure* at room temperature? Explain

ether

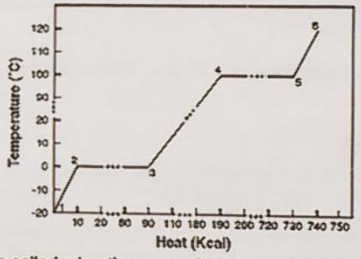
8. If you want to get water to boil BELOW 100°C, you can ↓ the air pressure.

If you want to get water to boil ABOVE 100°C, you can ↑ the air pressure.

9. If you add salt to water, this will ↓ the freezing point and ↑ the boiling point.



10. The diagram above is called a phase diagram. All along the boundary between two phases there is an equilibrium between those phases. What can we say about the triple point?



11. The diagram above is called a heating curve. Match the descriptions of what is happening with the various line segments

C Between 1 and 2	A. ice is melting
A Between 2 and 3	B. liquid water is evaporating
D Between 3 and 4	C. ice is being heated
B Between 4 and 5	D. liquid is being heated
E Between 5 and 6	E. gas is being heated

8. What is the energy needed to heat 5.55g of water to boiling? (ΔH_{vap}=51.5cal/g) $Q=m\times H_{vap}$

286 cal

9. What is the energy needed to heat 30.7g of water from 55°C to 85°C? (Cp=4.186kJ/gC)

3856 kJ

$Q=mC\Delta T$

• Atomic Theory

1. Complete the following table with element symbol, # of protons, neutrons, electrons, valence electrons, electron configuration, and valence electrons

Element Symbol	Mass Number	p^+	e^-	n^o	Long form E.C.	# of valence electrons
$^{52}_{24}Cr^{+3}$	52	24	21	28	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^4$	2
$^{35}_{16}S^{-2}$	35	16	18	19	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$	8
$^{50}_{22}Ti^{+2}$	50	22	20	28	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^2$	2
$^{78}_{33}As$	78	33	33	45	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^3$	5
C-13	13	6	6	7	$1s^2\ 2s^2\ 2p^2$	4
Mg-24	24	12	12	12	$1s^2\ 2s^2\ 2p^6\ 3s^2$	2

S+P

2. What is different between ions of the same element? What is the same? → # E, charge; ↳ # P

3. What is the difference between isotopes of the same element? What is the same? → # N, mass; ↳ # P

4. The natural abundances of all of nitrogen's isotopes are: 70.% N-14, 15% N-15, and 15% N-16? Calculate the average atomic mass of nitrogen.

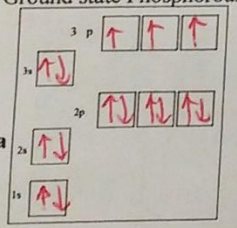
14.5 amu.

5. Fill in the blanks about the history of the atom:
   a. The Bohr model says the electrons orbit the nucleus
   b. The modern model says the electrons can be found in clouds around the nucleus
   c. Thomson discovered the electron during the cathode ray tube experiment.
   d. The gold foil experiment, performed by Rutherford, which allowed him to conclude the atom was mostly empty space with a dense, positive central core

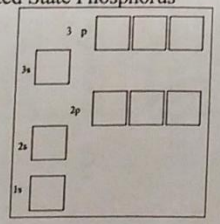
6. What is the ion formed for Magnesium? ↳ +2 Oxygen? ↳ −2

7. Complete the following orbital diagrams and electron configurations:

Ground state Phosphorous



Excited State Phosphorous



• **Periodic Table a**

1. Complete the table below.

Group #	Group/Family Name	Valence Configuration	# of Valence Electrons
1	Alkali Metals	ns^1	1
2	Alkaline Earth Metals	ns^2	2
3-12	Transition Metals	It varies	It varies
13	The Boron Family	ns^2np^1	3
14	The Carbon Family		4
15	The Nitrogen Family		5
16	The Oxygen Family		6
17	Halogens		7
18	Noble Gases	ns^2np^6	8

2. Complete the following sentences with the words ***increase*** **or** ***decrease***.

A. As you move from ***left to right*** across a period on the periodic table, the number of protons will ↑
B. As you move from ***left to right*** across a period on the periodic table, the ***atomic radius*** will ↓
C. As you move from ***left to right*** across a period on the periodic table, the ***1st ionization energy*** will ↑
D. As you move from ***left to right*** across a period on the periodic table, the ***electronegativity*** will ↑
E. As you move from ***top to bottom*** down a group on the periodic table, the ***atomic radius*** will ↑
F. As you move from ***top to bottom*** down a group on the periodic table, the ***1st ionization energy*** will ↓
G. As you move from ***top to bottom*** down a group on the periodic table, the ***electronegativity*** will ↓

3. In Group 1, the most reactive element would be Cs (techn. Fr). This can be explained because metals need to lose electrons when they undergo chemical reactions, and so the larger ____ the atom, the more reactive it will be.

4. In Group 17, the most reactive element would be Fluorine. This can be explained because nonmetals need to gain electrons when they undergo chemical reactions, and so the smaller ____ the atom, the more reactive it will be.

- **Bonding and Nomenclature**

1. Complete the table below by finding the term that fills in the blank correctly

Ionic	Covalent	Metallic
• transfers electrons • Composed of M and NM • To name ionic compounds that have transition metals, use Roman numerals to indicate the charge	• shares electrons • Composed of only NM • To name covalent molecules, use prefixes to indicate the number of atoms for each element.	• mobile electrons • Composed of only M • To name metallic compounds, it is the name of the metal.

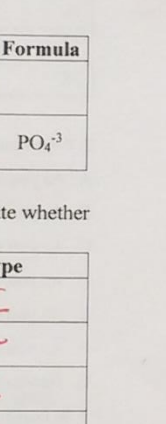
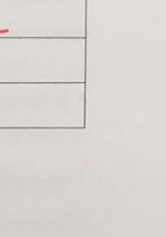
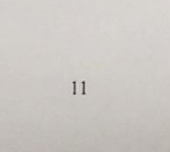
2. Write the name or formula for the following polyatomic ions.

Name	Formula	Name	Formula	Name	Formula
Ammonium		Carbonate		Nitrate	
	OH^{1-}		SO_4^{2-}		PO_4^{-3}

3. Complete the table below. Correctly write the name or formula for each and indicate whether it is ionic (I) or covalent (C).

Name	Formula	Type
magnesium chloride	$MgCl_2$	I
sulfur trioxide	SO_3	C
iron (III) iodide	FeI_3	I
calcium bromide	$CaBr_2$	I
dinitrogen trioxide	N_2O_3	C
chromium (II) sulfate	$CrSO_4$	I

Complete the following table:

	Essential Information:	Structure:	Essential Questions:	Additional Information:
CCl_4	Total valence electrons: 32 Electrons in Bonds: 8 Electrons in Lone Pairs: 24		VSEPR Formula AX_4 Shape: tetrahedral Hybridization sp^3	Polar or Nonpolar Molecule: Major intermolecular force: LDF Oxidation Number: N: H:
H_2O	Total valence electrons: 8 Electrons in Bonds: 4 Electrons in Lone Pairs: 4		VSEPR Formula AX_2E_2 Shape: bent Hybridization sp^3	Polar or Nonpolar Molecule: Major intermolecular force: H-B. Oxidation Number: C: O:
CO_2	Total valence electrons: 16 Electrons in Bonds: 8 Electrons in Lone Pairs: 8		VSEPR Formula AX_2 Shape: linear Hybridization sp	Polar or Nonpolar Molecule: Major intermolecular force: LDF Oxidation Number: C: F: