KEY

Chemistry 11 – Course Review

Unit 2—Introduction to Chemistry

1. 0.0006 mm = ? μm

$6 \times 10^{-4}\ mm \times \frac{10^{-3}\ m}{1\ mm} \times \frac{1\ \mu m}{10^{-6}\ m}$

Answer 0.6 μm

2. 0.054 mL = ? nL

$5.4 \times 10^{-2}\ mL \times \frac{10^{-3}\ L}{1\ mL} \times \frac{1\ nL}{10^{-9}\ L}$

Answer $5.4 \times 10^{4}\ nL$

3. 3.5 μg/L = ? mg/mL

$\frac{3.5\ \mu g}{L} \times \frac{10^{-6}\ g}{1\ \mu g} \times \frac{1\ mg}{10^{-3}\ g} \times \frac{10^{-3}\ L}{1\ mL}$

Answer $3.5 \times 10^{-6}\ mg/mL$

4. The density of iron is 7860 g/L. Calculate the mass of a 3.2 mL sample of iron.

$0.0032\ L \times \frac{7860\ g}{L}$

Answer 25.2 g

5. Manganese has a density of 7.20 g/mL. Calculate the volume occupied by a 4.0 kg piece of manganese.

$V = \frac{m}{D} = \frac{4000\ g}{7.20\ g/mL} = 555.56$

Answer 556 mL

6. A 0.0460 L piece of copper has a mass of 410.32 g. Calculate the density of copper in g/mL.

$D = \frac{m}{V} = \frac{410.32\ g}{46\ mL} = 8.92\ g/mL$

Answer

7. Give the number of significant digits in each of the following. Assume they are all measurements.

a) 0.0023 ..... 2 d) 3.2×10^{-4} 2

b) 3953 000 ..... 4 e) 50020.000 8

c) 1.0200×10^{5} ..... 5 f) 3450 3

8. Perform the following calculations and round the answers off to the correct number of significant digits as justified by the data. Assume all numbers are measurements.

a) 2.1500×0.31 ..... 0.67 f) $8.90 \times 10^{3} \div 4.400 \times 10^{-6}$ ..... 2.02×10^{9}

b) $0.05 + 394.7322$ ..... 394.78 g) $83.00 \div 1.2300 \times 10^{2}$ 0.6748

c) $4.905 \times 10^{6} \div 4 \times 10^{-2}$ ... 1×10^{8} h) $98.0076 - 2.195$ 95.813

d) $(3.33 \times 9.52) + 13.983$ .. 45.7 i) $0.00000200 \times 245.912$ ..... 4.92×10^{-7} ~~4.95~~

e) $3.813 + 98.98 + 2.669$ .. 105.46 j) $5.802 \div 6.21 + 2.41 \div 9.2565$ ... 1.195

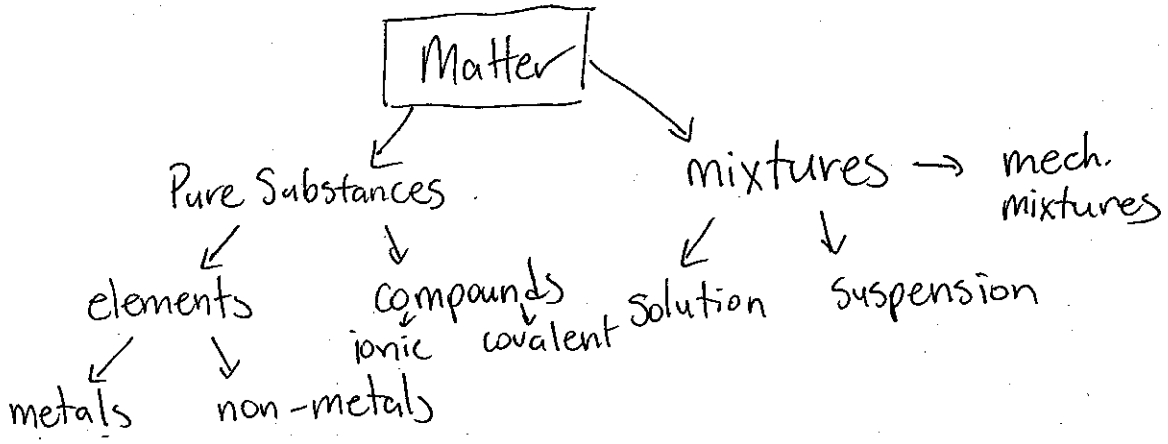
9. Round the following numbers to 2 significant digits. (4 marks)

a) 2 000 000 000 ..... 2.0×10^{9} c) 3.88945×10^{28} ..... 3.9×10^{28}

b) 106 000 ..... 1.1×10^{5} d) 0.000 000 7895 ..... 7.9×10^{-7}

Unit 3—Properties of Matter

1 Draw the diagram from your notes outlining the Classification of Matter. Make sure you can define each classification.



2. Define a physical change – Change where chemical make up does not change

Give some examples of physical changes.

Rip paper

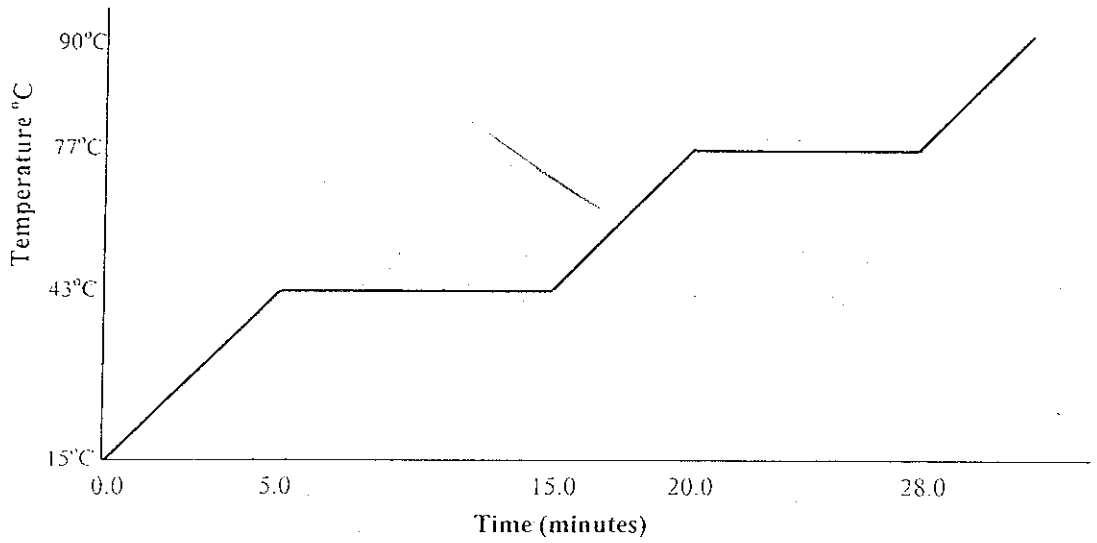
3. Define a chemical change –

new substance is formed

Give some examples of chemical changes.

burning ; cooking ; neutralization

4. Given the following graph of Temperature vs. Time for warming substance "X" which starts out as a solid, answer the questions below:



a) During time 0.0 – 5.0 minutes, the added heat energy is being used to
incr. temp of solid

b) During time 5.0 – 15.0 minutes, the added heat energy is being used to
break bonds holding together solid

c) During time 15.0 – 20.0 minutes, the added heat energy is being used to
increase T of liquid

d) During time 20.0 – 28.0 minutes, the added heat energy is being used to
break bonds of liquid

e) The melting point of substance "X" is 43 °C

f) The boiling point of substance "X" is 77 °C

g) If a greater amount of substance "X" was used, the melting point would be
1. a lower temperature
2. a higher temperature
3. the same temperature Answer 3

h) What phase is substance "X" at 90°C? Gas

Unit 4— Names and Formulas for Compounds

1. Write the correct formula for the following compounds:

a) ammonium chlorate ..... NH_4ClO_3

b) copper (II) sulphite ..... $CuSO_3$

c) zinc carbonate tetrahydrate ..... $ZnCO_3 \cdot 4H_2O$

d) nitric acid ..... HNO_3

e) phosphorus pentaiodide ..... PI_5

f) iron (III) thiocyanate ..... $Fe(SCN)_3$

g) sulphuric acid ..... H_2SO_4

h) dinitrogen tetrafluoride ..... N_2F_4

2. Write the correct names for the following compounds:

a) $Mn(SO_4)_2$ ..... manganese (IV) sulphate

b) $PbCrO_4 \cdot 6H_2O$ ..... lead (II) chromate hexahydrate

c) As_2O_3 ..... diarsenic trioxide

d) CH_3COOH ..... Acetic Acid acid

e) $Ni_2(C_2O_4)_3$ ..... nickel (III) oxalate

f) NF_3 ..... Nitrogen trifluoride

g) $(NH_4)_2HPO_4$ ..... Ammonium monohydrogen phosphate

h) $Ba(OH)_2 \cdot 10H_2O$ ..... Barium hydroxide decahydrate

Unit 5— The Mole Concept

1. Make the following conversions, clearly showing your steps. Include proper units in all of your work and in your answer.

a) 133.44 grams of PCl_5 = ? moles

$$133.44\,g \times \frac{1\,mol}{208.5\,g}$$

Answer 0.64 mol

d) 570.625 g of PCl_3 gas = ? L (STP)

$$570.625\,g \times \frac{1\,mol}{137.5\,g} \times \frac{22.4\,L}{1\,mol} =$$

Answer 92.96 L

e) 1030.4 mL of C_2H_6 gas at STP = ? g

$$1.0304\,L \times \frac{1\,mol}{22.4\,L} \times \frac{30.0\,g}{1\,mol}$$

Answer 1.38

f) 5.00 kg of nitrogen gas = ? L (STP)

$$5000\,g \times \frac{1\,mol}{28.0\,g} \times \frac{22.4\,L}{1\,mol}$$

Answer 4000. L

g) 0.5696 kg of $CH_{4(g)}$ = ? mL

$$0.5696\,kg = 569.6\,g \times \frac{1\,mol}{16.0\,g} \times \frac{22.4\,L}{1\,mol} \times \frac{1\,mL}{10^{-3}\,L}$$

Answer 7.97×10^5 mL

2. The density of liquid ethanol (C_2H_5OH) is 0.790 g/mL. Calculate the number of molecules in a 35.0 mL sample of liquid ethanol. (NOTE: You CAN'T use 22.4 L/mol since this is NOT a gas at STP!)

$$\frac{0.790\,g}{mL} \times 35\,mL = 27.65\,g \times \frac{1\,mol}{46\,g} \times \frac{6.022 \times 10^{23}\,molec}{1\,mol}$$

Answer $= 3.62 \times 10^{23}$ molec.

7. A compound was analyzed and the following results were obtained:
Molar mass: 270.4 g/mol
Mass of sample: 162.24 g
Mass of potassium: 46.92 g
Mass of sulphur: 38.52 g
Mass of oxygen: the remainder of the sample is oxygen

a) Determine the mass of oxygen in the sample.

$162.24\,g - 46.92 - 38.52$ Answer 76.8

b) Determine the empirical formula for this compound.

K $\frac{46.92}{162.24} \times 100\% \times \frac{1\,mol}{39.1\,g} = 1.20 \div 1.2 = 1$

S $\frac{38.52}{162.24} \times 100\% \times \frac{1\,mol}{32.1\,g} = 1.2 \div 1.2 = 1$

O $\frac{76.8}{162.24} \times 100\% \times \frac{1\,mol}{16\,g} = 4.8 \div 1.2 = 4$

Answer: Empirical Formula: KSO_4

c) Determine the molecular formula for this compound.

$\frac{MF}{EF} = \frac{270.4\,g/mol}{135.2\,g/mol} = 2 \times KSO_4$

Answer: Molecular Formula: $K_2S_2O_8$

8. 123.11 g of zinc nitrate, $Zn(NO_3)_2$ are dissolved in enough water to form 650.0 mL of solution. Calculate the $[Zn(NO_3)_2]$) Include proper units in your work and in your answers.

$123.11\,g \times \frac{1\,mol}{189.4\,g} = 0.65\,mol$

$[Zn(NO_3)_2] = \frac{0.65\,mol}{0.65\,L}$ Answer 1.000M

9. Calculate the mass of potassium sulphite (K_2SO_3) needed to make 800.0 mL of a 0.200 M solution of K_2SO_3. Include proper units in your work and in your answers.

$$\frac{0.200\,mol}{L} \times 0.800L = 0.160\,mol \times \frac{158.3g}{1\,mol}$$

Answer 25.328g

10. What volume of 2.50 M Li_2CO_3 would need to be evaporated in order to obtain 47.232 g of solid Li_2CO_3? Include proper units in your work and in your answers.

$$47.232g \times \frac{1mol}{73.8g} = 0.64\,mol$$

n / m | V

$$V = \frac{0.64mol}{2.50M} =$$

Answer 0.256 L

11. 150.0 mL of water are added to 400.0 mL of 0.45 M HNO_3 . Calculate the final [HNO_3]. Include proper units in your work and in your answers.

$$M_1V_1 = M_2V_2$$

$$M_2 = \frac{(0.45M)(400mL)}{(550mL)} =$$

Answer 0.327 M

12. What volume of water needs to be added to 150.0 mL of 4.00 M H_2SO_4 in order to bring the concentration down to 2.50 M? Include proper units in your work and in your answers.

$$M_1V_1 = M_2V_2$$

$$\frac{(4.00M)(150mL)}{(2.50M)} \rightarrow V_2 = 240mL - 150mL$$

Answer 90mL

Unit 6— Chemical Reactions

1. Balance the following equations

$4\,NH_3 + 5\,O_2 \rightarrow 4\,NO + 6\,H_2O$

$3\,(NH_4)_2C_2O_4 + 2\,AlCl_3 \rightarrow Al_2(C_2O_4)_3 + 6\,NH_4Cl$

$2\,C_{14}H_{30} + 43\,O_2 \rightarrow 28\,CO_2 + 30\,H_2O$

$2\,Fe + 6\,HNO_3 \rightarrow 2\,Fe(NO_3)_3 + 3\,H_2$

$P_4 + 6Cl_2 \rightarrow 4PCl_3$

$Na_2Cr_2O_7 + 14HCl \rightarrow 2NaCl + 2CrCl_3 + 7H_2O + 3Cl_2$

$2H_3PO_4 + 3Ca(OH)_2 \rightarrow Ca_3(PO_4)_2 + 6H_2O$

$Ba(ClO_4)_2 \rightarrow Ba + Cl_2 + 4O_2$

$2C_7H_{15}OH + 21O_2 \rightarrow 14CO_2 + 16H_2O$

$MgSO_4 \cdot 5H_2O \rightarrow MgSO_4 + 5H_2O$

2. Write a balanced chemical equation for each of the following, and classify each as synthesis, decomposition, single replacement, double replacement, neutralization or combustion.

a) potassium sulphate is mixed with cobalt (III) nitrate

$3K_2SO_4 + 2Co(NO_3)_3 \rightarrow Co_2(SO_4)_3 + 6KNO_3$ (DR)

b) liquid propanol (C_3H_7OH) is burned in air

$2C_3H_7OH + 9O_2 \rightarrow 6CO_2 + 8H_2O$ (combustion)

c) ammonium nitrate is decomposed into it's elements

$2NH_4NO_3 \rightarrow 2N_2 + 4H_2 + 3O_2$ (decomposition)

d) a piece of zinc is placed in a test-tube containing a solution of silver nitrate

$Zn + 2AgNO_3 \rightarrow 2Ag + Zn(NO_3)_2$ (S.R.)

e) bromine reacts with sodium iodide

$Br_2 + 2NaI \rightarrow I_2 + 2NaBr$ (S.R.)

f) bromine reacts with aluminum

$3Br_2 + 2Al \rightarrow 2AlBr_3$ (synthesis)

g) rubidium reacts with chlorine gas

$2Rb + Cl_2 \rightarrow 2RbCl_2$ (Synth.)

h) hydrochloric acid reacts with strontium hydroxide

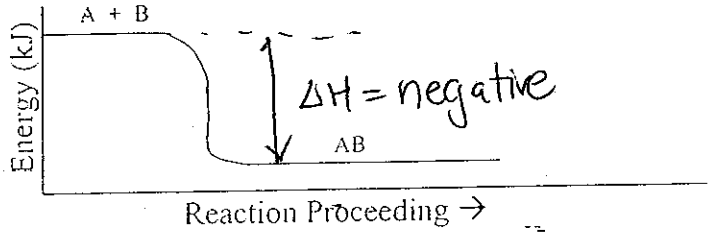
$2HCl + Sr(OH)_2 \rightarrow 2H_2O + SrCl_2$ (neutral

3. State whether each of the following are ***exothermic*** or ***endothermic***.

$HCl + 432\ kJ \rightarrow H + Cl$ Answer endo

$C_{12}H_{22}O_{11} + 12O_2 \rightarrow 12CO_2 + 11H_2O$ $\Delta H = -5638$ kJ Answer exo

$H_2O_{(s)} \rightarrow H_2O_{(l)}$ Answer endo



exo.

Answer

$CD \rightarrow C + D \quad \Delta H = 65.7\ kJ$ Answer endo

$E + F + 437\ kJ \rightarrow G + H$ Answer endo

4. Given the equation: $C_{12}H_{22}O_{11} + 12O_2 \rightarrow 12CO_2 + 11H_2O + 5638\ kJ$

a. How much heat is released during the formation of 880.0 g of CO_2?

$880.0 \times \frac{1\ mol\ CO_2}{44\ g\ CO_2} \times \frac{5638\ kJ}{12\ mol}$ Answer 9396.67 kJ

b. How much heat is released during the formation of 5.6 moles of H_2O?

$5.6\ mol\ H_2O \times \frac{5638\ kJ}{11\ mol\ H_2O}$ Answer 2870.25 kJ ~~3758.67 kJ~~

c. If 179.2 L of O_2 (STP) are consumed, how much heat is released?

~~XXXXXXXX~~

$179.2L \times \frac{1\ mol\ O_2}{22.4L} \times \frac{5638\ kJ}{12\ mol\ O_2}$ Answer 3758.67 kJ

5. Calculate the amount of heat (in Joules) required to warm 200.0 g of water from 8.0°C to 45.0°C. (Heat Capacity (C) for H_2O is 4180 J/kg °C)

$E = mc\Delta T$

$= (0.200kg)(4180)(37°C)$

$=$

Answer 30932 J

6. 13.376 kJ of heat are added to a 400.0 gram sample of water initially at 4.0°C. Calculate the final temperature of the water sample. Be careful with units! (Heat Capacity (C) for H_2O is 4180 J/kg °C)

$E = mc\Delta T$

$13376J = (0.4kg)(4180)\Delta T$

$\Delta T = 8°C$

Answer 12°C

$Final = 4°C + 8°C$

Unit 7— Stoichiometry

1. Given the following balanced equation, answer the questions following it:

$$2NF_{3(g)} + 3H_{2(g)} \rightarrow N_{2(g)} + 6HF_{(g)}$$

a) If 5.5 moles of H_2 are reacted, how many moles of NF_3 will be consumed?

$5.5 \text{ mols } H_2 \times \frac{2}{3} =$

Answer 3.67 mol

b) In order to produce 0.47 moles of HF, how many moles of NF_3 would be consumed?

$0.47 \text{ mol} \times \frac{2}{6} =$

Answer 0.157 mol

c) If you needed to produce 180.6 g of N_2, how many moles of H_2 would you need to start with?

$180.6 \text{g} \times \frac{1 \text{mol}}{28 \text{g}} \times \frac{3}{1} =$

Answer 19.35 mol

d) If you completely react 17.04 g of NF_3, what mass of HF will be produced?

$17.04 \text{g} \times \frac{1 \text{mol}}{71 \text{g}} \times \frac{6}{2} \times \frac{20.0 \text{g}}{1 \text{mol}} =$ Answer 14.4 g

2. Given the following balanced equation, answer the questions following it:

$$HBrO_3 + 5\,HBr \rightarrow 3\,H_2O_{(l)} + 3\,Br_{2(g)}$$

a) If 3.56 moles of HBr are reacted, how many Litres of Br_2 will be formed at STP?

$3.56 \text{ mol} \times \frac{3}{5} \times \frac{22.4 \text{L}}{1 \text{mol}} =$ Answer 47.85L

b) In order to produce 3.311×10^{24} molecules of Br_2, what mass of HBr is needed?

$3.311 \times 10^{24} \text{ molec} \times \frac{1 \text{mol}}{6.022 \times 10^{23}} \times \frac{5}{3} \times \frac{80.9 \text{g}}{1 \text{mol}} =$

Answer 741.6g

4. Given the following balanced equation, answer the questions below it.

$$Ba(OH)_{2(aq)} + 2\,HNO_{3(aq)} \rightarrow 2\,H_2O_{(l)} + Ba(NO_3)_2$$

a) In a titration, 18.20 mL of 0.300 M $Ba(OH)_2$ is required to react completely with a 25.0 mL sample of a solution of HNO_3. Find the $[HNO_3]$.

mols $Ba(OH)_2$ = $\frac{0.300\ mols}{L} \times 0.0182\ L = 0.00546$

mols HNO_3 = $0.00546\ mol \times \frac{2}{1} = 0.01092$

$[HNO_3] = \frac{0.01092\ mol}{0.0250\ L} =$ Answer 0.437 M

b) In a titration, 11.06 mL of 0.200 M HNO_3 is required to react completely with a sample of 0.250M $Ba(OH)_2$. Find the volume of the $Ba(OH)_2$ sample.

mols HNO_3 = $\frac{0.200\ mols}{L} \times 0.01106\ L = 0.002212\ mol$

mols $Ba(OH)_2 = 0.002212 \times \frac{1}{2} = 0.001106$ mols

$V = \frac{0.001106\ mols}{0.250\ M} =$ Answer 0.004424 L

5. Given the following balanced equation, answer the questions below it.

$$3\,Cu_{(s)} + 8HNO_{3(l)} \rightarrow 3\,Cu(NO_3)_{2(aq)} + 2NO_{(g)} + 4\,H_2O_{(l)}$$

a) If 317.5 grams of Cu are placed into 756.0 grams of HNO_3, determine which reactant is in excess.

Cu $317.5\ g \times \frac{1\ mol}{63.5\ g} = 5.0\ mol\ Cu \times \frac{2}{3} \times \frac{30\ g}{1\ mol} = 99.99$

$HNO_3 = 756.0\ g \times \frac{1\ mol}{63\ g} = 12.0\ mol \times \frac{2}{8} \times \frac{30\ g}{1\ mol} = 90$ Answer Cu in excess

b) If the reaction in (a) is carried out, what mass of NO will be formed?

HNO_3 is limiting reagent:

Answer 90.0 g

Unit 8— Atoms, Periodic Table and Bonding

1. Give the number of protons, neutrons and electrons in the following:

Isotope	*Protons*	*Neutrons*	*Electrons*
$^{194}Ir^{3+}$	77	117	74
$^{202}Hg^{2+}$	80	122	78
$^{125}Te^{2-}$	52	73	54
^{263}Sg	106	157	106
$^{2}H^{+}$	1	1	0

2. Give the nuclear notation of the following:

Isotope	*Protons*	*Neutrons*	*Electrons*
$^{262}Db^{+2}$	105	157	103
$^{123}Sb^{+3}$	51	72	48
$^{75}As^{-3}$	33	42	36
^{133}Xe	54	79	54
$^{244}Pu^{+3}$	94	150	91

3. Write the ground state electron configurations (eg. $1s^2 2s^2 2p^6$) for the following atoms or ions. You may use the core notation.

a) P $[Ne]\ 3s^2 3p^3$

b) Mo $[Kr]\ 5s^2 4d^4$

c) Se $[Ar]\ 4s^2 3d^{10} 4p^4$

d) Rb $[Kr]\ 5s^1$

e) Cl^- $[Ne]\ 3s^2 3p^6$

f) Al^{3+} $[He]\ 2s^2 2p^6$

g) K^+ $[Ne]\ 3s^2 3p^6$

h) S^{2-} $[Ne]\ 3s^2 3p^6$

4. In order to become stable,

an atom of Sr will lose 2 electrons and become the ion Sr^{+2}

an atom of As will gain 3 electrons and become the ion As^{-3}

atom of Al will lose 3 electrons and become the ion Al^{+3}

an atom of Se will gain 2 electrons and become the ion Se^{-2}

an atom of N will gain 3 electrons and become the ion N^{-3}

an atom of I will gain 1 electrons and become the ion I^-

an atom of Cs will lose 1 electrons and become the ion Cs^+

an atom of Te will gain 2 electrons and become the ion Te^{-2}

Circle the metalloid: Be Rb Os (Ge) Pb Al

Circle the most reactive element in the following: (Na) Mg Si Al Ar

Circle the most reactive element in the following: Na K Rb (Cs) Li

Circle the most reactive element in the following: (Cl) Br I At Ne

Circle the element with the largest atomic radius of these: (Na) Mg Si Al Ar

Circle the element with the largest atomic radius of these: N P As Sb (Bi)

11 Circle the element with the largest ionization energy of these: K Ca Ga As (Kr)

12 Circle the element with the largest ionization energy of these: (C) Si Ge Sn Pb

13 What is meant by ionization energy? E to remove outer e⁻

14 Circle the element with the largest density of these: C Si Ge Sn (Pb)

15 Circle the element with the largest density of these: Na K Rb (Cs) Li

16 Circle the element with the highest electronegativity of these: (Mg) Sr Ba Ra

17 Circle the element with the highest electronegativity of these: Mg Si S (Cl)

18 Circle the element with the highest electronegativity of these: (F) Cl Br I

19 What is meant by electronegativity? attraction of an atom for e⁻ of another atom

20 Circle the most metallic element of these: Be Mg Ca Sr (Ba)

21 Circle the most metallic element of these: B Al Ga In (Tl)

22 Circle the most metallic element of these: (Ga) Ge Se Br Kr

23 Write a balanced equation for the reaction of potassium with water.

$2K + 2H_2O \rightarrow H_2 + 2KOH$

24 Write a balanced equation for the reaction of aluminum with bromine.

$2Al + 3Br_2 \rightarrow 2AlBr_3$

25 In an ionic bond, electrons are
- a. shared equally by two atoms
- b. shared unequally by two atoms
- (c.) transferred from a metal to a non-metal
- d. transferred from a non-metal to a metal
- e. closer to one end of a molecule, forming a temporary dipole

Answer _____

26 In a covalent bond, electrons are
- (f.) shared equally by two atoms
- g. shared unequally by two atoms
- h. transferred from a metal to a non-metal
- i. transferred from a non-metal to a metal
- j. closer to one end of a molecule, forming a temporary dipole

Answer _____

27 In London forces, electrons are
- p. shared equally by two atoms
- q. shared unequally by two atoms
- r. transferred from a metal to a non-metal
- s. transferred from a non-metal to a metal
- (t.) closer to one end of a molecule, forming a temporary dipole

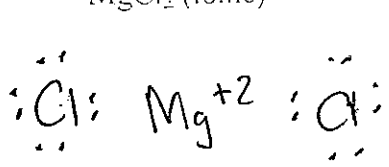
Answer _____

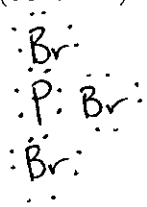
28. What physical evidence to we have that ionic bonds are very strong?

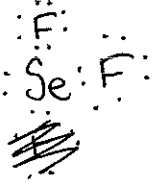
Ionic cmpds have high melting points

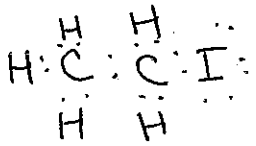
29. Write electron-dot diagrams for:

$MgCl_2$ (ionic) PBr_3(covalent) SeF_2(covalent) CH_3CH_2I(covalent)









46 - 32

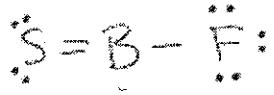
N - H

2

Yet More Lewis Structures – Answers

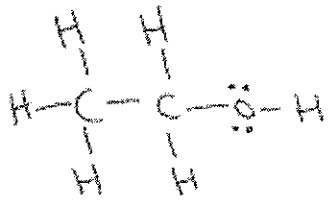
For those of you that enjoy such things, some more Lewis structures to draw:

1) BSF

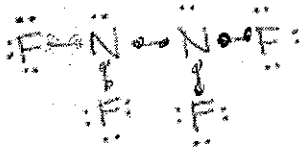


2) HBr

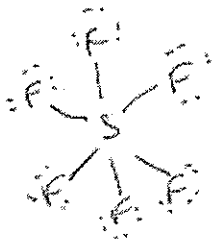
3) C_2H_5OH (ethanol)



4) N_2F_4



5) SF_6



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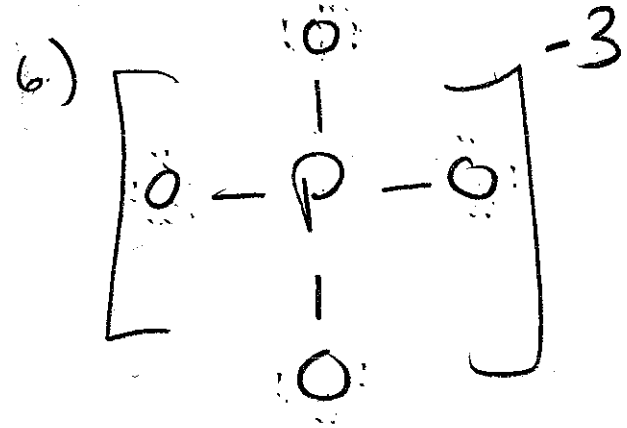

7)