



Chemistry 11

Midterm Review Package



- Introduction to Chem. & Safety
- Organic Chemistry
- Measurement
- Matter & Naming
- The Mole
- Chemical Reactions

Name: KEY

Block: _____

Unit 1: Measurement & Communication

- B 32. Standards of measurement are chosen because they
- can be related to everyday objects.
 - are reproducible in another laboratory.
 - cannot be destroyed by any common physical or chemical means.
 - are easily changed.
- C 33. Which of these statements does *not* describe a measurement standard?
- Measurement standards avoid ambiguity.
 - Measurement standards must be unchanging.
 - A standard can be easily changed to suit the experiment.
 - Confusion is eliminated when the correct measurement is applied.
- C 34. Which of these statements about units of measurement is *not* true?
- A unit compares what is being measured with a previously defined quantity.
 - A unit is usually preceded by a number.
 - Measurements can be compared without knowing their units.
 - The choice of unit depends on the quantity being measured.
- C 35. Which of these is *not* an SI base unit?
- kilogram
 - second
 - liter
 - Kelvin
- D 36. The SI base units for length and time are
- centimeter and second.
 - meter and hour.
 - centimeter and hour.
 - meter and second.
- C 37. The metric unit for length that is closest to the diameter of a pencil is the
- micrometer.
 - millimeter.
 - centimeter.
 - decimeter.
- D 38. The symbols for units of length in order from largest to smallest are
- m, cm, mm, km.
 - mm, m, cm, km.
 - km, mm, cm, m.
 - km, m, cm, mm.
- C 39. Which of these metric units is used to measure mass?
- m
 - mm
 - g
 - L
- B 40. The liter is defined as
- 1000 m^3 .
 - 1000 cm^3 .
 - 1000 g^3 .
 - 1000 c^3 .
- D 41. The standard base unit for mass is the
- gram.
 - cubic centimeter.
 - meter.
 - kilogram.
- A 42. Which of these symbols represents a unit of volume?
- mL
 - mg
 - mm
 - cm
- D 43. Which of these is the abbreviation for the SI base unit of time?
- hr
 - h
 - sec
 - s

- C 44. The most appropriate SI unit for measuring the length of an automobile is the
a. millimeter. c. meter.
b. kilometer. d. liter.
- D 45. All of the following are SI units for density *except*
a. kg/m^3 . c. g/cm^3 .
b. kg/L . d. g/m^2 .
- C 46. A change in the force of gravity on an object will affect its
a. mass. c. weight.
b. density. d. kinetic energy.
- D 47. Which of these is a measure of the amount of material?
a. density c. volume
b. weight d. mass
- D 48. Which of these statements about mass is true?
a. Mass is expressed in pounds or newtons.
b. Mass is usually measured with a spring scale.
c. The mass of an object depends on the force of gravity acting on it.
d. The mass of an object is determined by comparing it to an object of known mass.
- C 49. The relationship between the mass m of a material, its volume V , and its density D is
a. $D = mV$. c. $D = m/V$.
b. $D = V/m$. d. $D = m + v$.
- B 50. The density of an object is calculated by
a. multiplying its mass times its volume.
b. dividing its mass by its volume.
c. dividing its volume by its mass.
d. adding its mass to its volume.
- C 51. When density is measured,
a. a graduated cylinder is always used.
b. the units are always kg/m^3 .
c. the temperature should be specified.
d. the material must be a pure substance.
- C 52. Which of these statements about density is true?
a. Larger objects are more dense.
b. Density does not depend on temperature.
c. Density is a physical property.
d. The density of an object depends on the force of gravity.
- B 53. A sample of gold has a mass of 96.5 g and a volume of 5.00 cm^3 . The density of gold is
a. 0.0518 g/cm^3 . c. 101.5 g/cm^3 .
b. 19.3 g/cm^3 . d. 483 g/cm^3 .
- A 54. The density of pure diamond is 3.5 g/cm^3 . What is the volume of a diamond with a mass of 0.25 g?
a. 0.071 cm^3 c. 3.75 cm^3
b. 0.875 cm^3 d. 14 cm^3
- B 55. What is the density of 37.72 g of material whose volume is 6.80 cm^3 ?
a. 0.180 g/cm^3 c. 30.9 g/cm^3
b. 5.55 g/cm^3 d. $256. \text{g/cm}^3$
- D 56. 100 milliliters is equivalent to
a. 1 hectoliter. c. 1 centiliter.
b. 1 microliter. d. 1 deciliter.
- B 57. 0.25 g is equivalent to
a. 250 kg. c. 0.025 mg.
b. 250 mg. d. 0.025 kg.

- D 58. 0.05 cm is the same as
a. 0.000 05 m. c. 0.05 m.
b. 0.005 mm. d. 0.5 mm.
- C 59. How many minutes are in 1 week?
a. 168 min c. 10 080 min
b. 1440 min d. 100 800 min
- D 60. If 1 inch equals 2.54 cm, how many centimeters equal 1 yard?
a. 0.0706 cm c. 30.5 cm
b. 14.2 cm d. 91.4 cm
- B 61. How is the measurement 0.000 065 cm written in scientific notation?
a. 65×10^{-6} cm c. 6.5×10^{-6} cm
b. 6.5×10^{-5} cm d. 6.5×10^{-4} cm
- C 62. The measurement 0.020 L is the same as
a. 2.0×10^{-3} L. c. 2.0×10^{-2} L.
b. 2.0×10^2 L. d. 2.0×10^{-1} L.
- A 63. The speed of light is 300 000 km/s. In scientific notation, this speed is written to one significant figure as
a. 3×10^5 km/s. c. $3. \times 10^6$ km/s.
b. 3.0×10^5 km/s. d. 3.0×10^6 km/s.
- D 64. The average distance between the Earth and the moon is 386 000 km. Expressed in scientific notation, this distance is written as
a. 386×10^3 km. c. 3.9×10^5 km.
b. 39×10^4 km. d. 3.86×10^5 km.
- C 65. When 6.02×10^{23} is multiplied by 9.1×10^{-31} , the product is
a. 4.3×10^{-8} . c. 4.3×10^{-7} .
b. 4.3×10^{54} . d. 4.3×10^{-53} .
- C 66. Two variables are directly proportional if their ____ has a constant value.
a. sum c. quotient
b. difference d. product
- C 67. Two variables are inversely proportional if their ____ has a constant value.
a. sum c. product
b. difference d. quotient
- D 68. The graphs of two variables that are inversely proportional to one another is
a. a straight line. c. a parabola.
b. an ellipse. d. a hyperbola.
- A 69. In the equation $density = mass/volume$, mass divided by volume has a constant value. This means that the
a. equation graphs as a straight line.
b. variables mass and volume are inversely proportional.
c. equation graphs as a hyperbola.
d. product of mass and volume is a constant.

Measurement and Communication:

1. Complete the following table of prefixes.

Factor	Prefix	Abbreviation
10^6	mega	M
10^3	kilo	k
10^2	hecto	h
10^1	deka	da
10^{-1}	deci	d
10^{-2}	centi	c
10^{-3}	milli	m
10^{-6}	micro	μ
10^{-9}	nano	n
10^{-12}	pico	p

2. A student weighed a mass 4 times and obtained the following masses:

25.5g, 29.6g, 23.6g, 27.3g

The actual value is known to be 10.20045g

What can be said about the accuracy and precision of the measurements?

- not accurate (correct) or precise (reproducible)

3. Write the following numbers in scientific notation with the same number of significant digits.

- a) 0.000005187 $\underline{5.187 \times 10^{-6}}$
 b) 7,247 $\underline{7.247 \times 10^3}$
 c) 16,140 $\underline{1.614 \times 10^4}$
 d) 0.0921 $\underline{9.21 \times 10^{-2}}$

4. Convert the following numbers from scientific notation into decimal form.

- a) 4.562×10^6 $\underline{4,562,000}$
 b) 8.276×10^{-8} $\underline{0.00000008276}$

5. Complete the following calculations. Include all units and don't forget about sig figs.

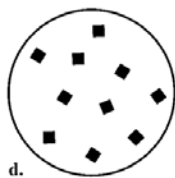
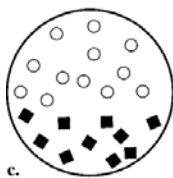
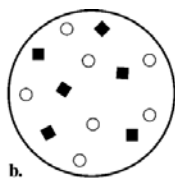
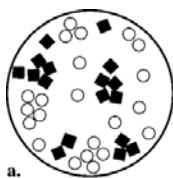
- a) $1.0068\text{g} + 2.15\text{g} + 8.3\text{g} = 11.5\text{g}$
 b) $21.05\text{cm} - 12.1\text{cm} = 9.0\text{cm}$
 c) $\frac{1.50 \times 10^{-2} \text{ mol}}{40.0\text{mL}} = 3.75 \times 10^{-4} \text{ mol/mL}$

d) $\frac{432.8\text{g}}{21.8\text{cm} \times (7.645\text{cm} - 3.58\text{cm})} = \frac{432.8\text{g}}{21.8\text{cm} \times 4.065} = 4.88\text{g/cm}^2$

6. Convert 12 milliamperes into megaamperes.

$$12 \text{ mA} \times \frac{1 \text{ A}}{10^3 \text{ mA}} \times \frac{1 \text{ MA}}{10^6 \text{ A}} = 1.2 \times 10^{-8} \text{ MA}$$

- D 12. Nitrogen monoxide and oxygen, both colorless gases, form a red-brown gas when mixed. Nitrogen monoxide and oxygen are called the
- products.
 - equilibria.
 - synthetics.
 - reactants.
- B 13. A state of matter in which a material has no definite shape but has a definite volume is the ____ state.
- gas
 - liquid
 - plasma
 - solid
- B 14. Under ordinary conditions of temperature and pressure, the particles in a gas are
- closely packed.
 - very far from one another.
 - held in fixed positions.
 - unevenly distributed.
- D 15. The liquid state of matter can be described as
- having definite shape and definite volume.
 - having neither a definite shape nor a definite volume.
 - having lost electrons owing to energy content.
 - having a definite volume but not a definite shape.
- C 16. A solid substance is
- always frozen regardless of its container.
 - always a crystal regardless of its container.
 - always the same shape regardless of its container.
 - always losing particles regardless of its container.
- ~~_____~~ 17. Plasma is the fourth state of matter. In the plasma state
- atoms gain electrons.
 - atoms lose electrons. ← FYI
 - atoms form molecules.
 - atomic nuclei break down.
- C 18. What happens to the energy in a substance when it changes state?
- It is destroyed.
 - It is changed into matter.
 - It changes form, but is neither destroyed nor increased.
 - The energy remains unchanged.
- A 19. Which part of the illustration below shows the particles in a heterogeneous mixture?



a. a
b. b

c. c
d. d

- C 20. A mixture is
- a combination of pure substances bonded chemically.
 - any substance with a uniform composition.
 - a blend of any two or more kinds of matter, as long as each maintains its own unique properties.
 - any group of elements that are chemically bonded to one another.

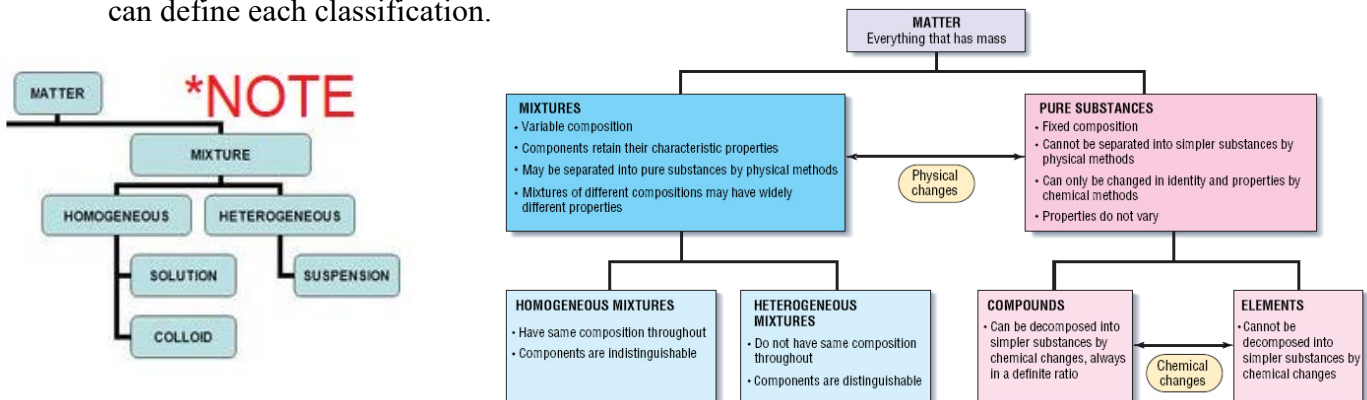
- A 21. If a mixture is uniform in composition, it is said to be
 a. homogeneous. c. heterogeneous.
 b. chemically bonded. d. a compound.
- C 22. A homogeneous mixture is also called
 a. chemically bonded. c. a solution.
 b. a compound. d. a solute.
- B 23. If a mixture is not uniform throughout, it is called
 a. homogeneous. c. chemically bonded.
 b. heterogeneous. d. a solution.
- C 24. Which of the following is an example of a heterogeneous mixture?
 a. a gold ring c. granite
 b. seawater d. sucrose
- A 25. Which of the following is an example of a homogeneous mixture?
 a. air c. raw milk
 b. orange juice d. marble
- B 26. All known chemical elements are organized into groups based on similar chemical properties in the
 a. chemical chart. c. element table.
 b. periodic chart. d. None of the above
- D 27. It is easy to determine whether a substance is a metal if the substance is
 a. easy to break down into its components.
 b. very hard.
 c. very brittle.
 d. a good electrical and heat conductor.

Properties of Matter

1. Define: Qualitative vs Quantitative Data, Physical and Chemical Properties, Malleability, Ductility, Lustre, Viscosity and Diffusion. Review the Phases of Matter.

** answers will vary - check all definitions with notes or an online scientific dictionary.*

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



Matter:

1. Define the term "matter".

-anything with mass and volume

2. Differentiate between an atom, ion and molecule (hint, use their definitions).

- atom: smallest particle of an element that still has the chemical properties of the element; neutral \rightarrow protons = electrons
- ion: atom or group of atoms that has gained or lost electrons to form a negative or positive charge
- molecule: neutral group of atoms connected by covalent bonds

Mixtures vs. Pure Substances:

1. Match each separation technique with its appropriate description.

<u>Technique</u>	<u>Description</u>
<u>D</u> centrifugation	A. components of a mixture separate into layers on their own
<u>G</u> chromatography	B. solid component of the mixture becomes trapped in a screen, allowing the liquid component to pass through
<u>F</u> crystallization	C. oil, detergent, or some other chemical is added to a mixture, air is forced through the mixture as a means of stirring, and the desired component is skimmed off the top
<u>E</u> distillation	D. mixture is spun at high speeds creating a force which pulls heavier solid particles towards the bottom of the container
<u>H</u> electrolysis	E. the mixture is heated until a liquid component reaches its boiling point and is evaporated, leaving the other component behind
<u>B</u> filtration	F. the mixture is concentrated and cooled until the solid component slowly forms at the bottom of the container
<u>C</u> floatation	G. the mixture is applied to a solid support and separated into its components by a solvent which carries the various components up the solid support at different rates
<u>A</u> settling	H. a process in which an electric current is applied to a sample, decomposing the sample into its component elements

2. State three things that distinguish a pure substance from a mixture (consider nature, properties)

Pure Substances	Mixture
- only one type of compound	- more than one type of compound present
- cannot be separated physically	- can be separated physically
- unique set of chemical + physical properties	- chemical + physical properties change based on proportions of components

3. Describe what a MECHANICAL MIXTURE is (its nature and properties), provide an example, and state the separation method that should be used to isolate its component parts.

- a heterogeneous mixture (can tell there is more than one component) because there is more than one phase present

- separate using mechanical separation (physically pick apart or use magnets)

4. How is it possible to determine whether a pure substance is an element or a compound?

Provide an example of an element and a compound.

- a compound can be separated by chemical means (electrolysis), elements cannot be separated

- examples will vary

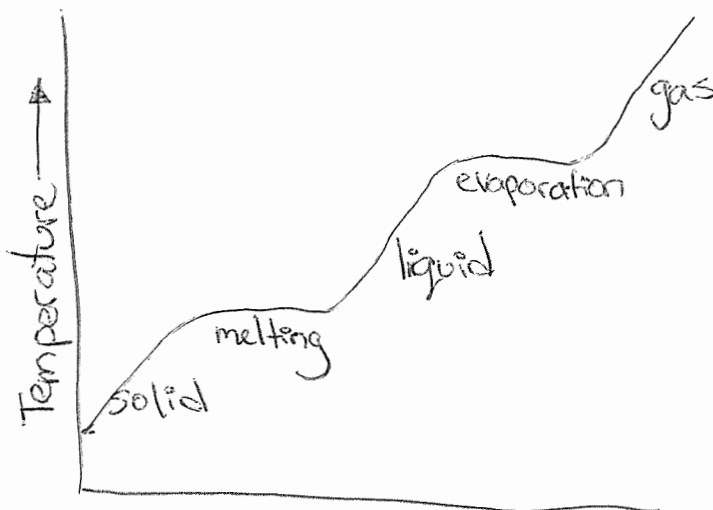
5. How can you determine whether a material is "homogeneous" or "heterogeneous"?

- visual inspection

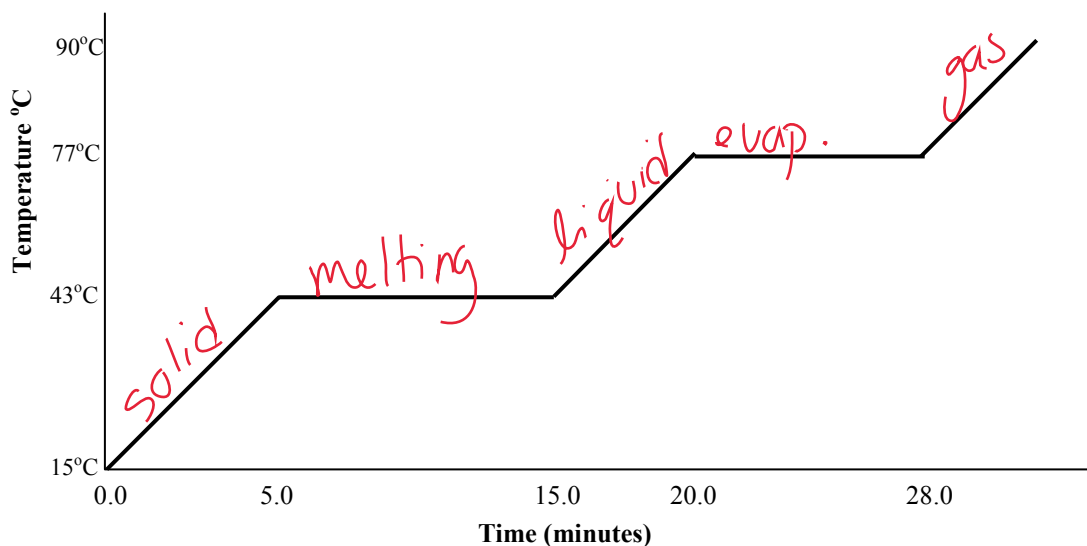
- homogeneous is the same throughout (no visible difference)

- heterogeneous is different in composition (visible difference)

6. Sketch the phase diagram that would be produced when solid nitrogen is heated. Label all states and phase changes.



6. 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 increase the temp. of the solid
- b) During time 5.0 – 15.0 minutes, the added heat energy is being used to melting of the solid
- c) During time 15.0 – 20.0 minutes, the added heat energy is being used to increase temp. of liquid
- d) During time 20.0 – 28.0 minutes, the added heat energy is being used to boiling/evaporation of the 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 M.P. is an intensive property
- h) What phase is substance "X" at 90°C? gas.
- i) Explain WHY the curve levels off between 5.0 min. and 15.0 min.
all added energy is used for melting (ie: breaking bonds + changing state) no "extra" energy is available to raise the temp. of the substance.

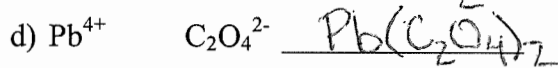
Ionic Compounds:

1) Compare the following properties of both IONIC and MOLECULAR compounds:

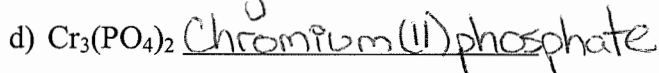
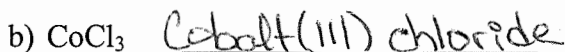
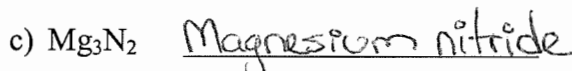
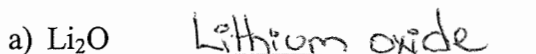
- Component elements (metal vs nonmetal)
- Type of chemical bonding (ionic vs covalent)
- Most likely states at room temperature (solid, liquid, gas)
- General trend in melting point temperatures
- General trend in electrical conductivity

Ionic	Molecular (Covalent)
- metal - non-metal	- non-metal - non-metal
- ionic	- covalent
- usually solid (due to strong bonding)	- gases or liquids usually
- \rightarrow high melting point	- melting points usually low
- conduct electricity in water / in molten form	- don't conduct electricity

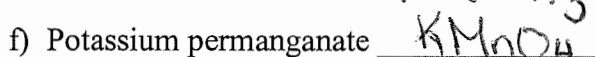
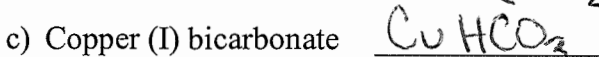
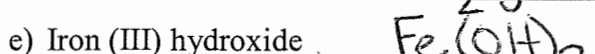
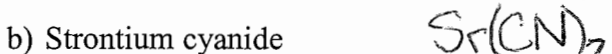
2) Write the chemical formulae resulting from the combination of the following ions.



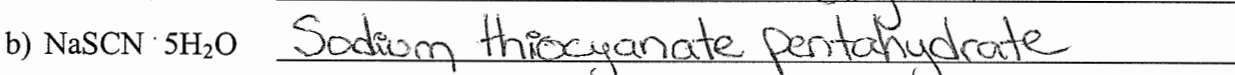
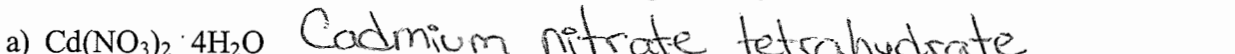
3) Write the correct name for each of the following ionic compounds.



4) Write the correct formula for each of the following ionic compounds.



5) Write the correct name for each of the following ionic hydrates.



Acids and Bases:

1. State three properties of acids and three properties of bases. (you might need your textbook)

Acids	Bases
- dissolve in water to form "H ⁺ " ions	- form "OH ⁻ " ions
- sour/tart taste	- bitter taste
- sting on skin	- feel slippery on skin
- react with most metals	- don't react with most metals
- conduct electricity	- conducts electricity

2. Write the correct names for the following bases.

a. $\text{Ca}(\text{OH})_2$ Calcium hydroxide b. LiOH Lithium hydroxide

3. Provide the missing formula or name for the following simple (binary) acids.

a. Hydrofluoric acid HF c. $\text{H}_2\text{S}_{(\text{aq})}$ Hydrosulphuric acid
b. Hydrobromic acid HBr d. $\text{HI}_{(\text{aq})}$ Hydroiodic acid

4. Provide the missing formula or name for the following complex acids.

a. Chromic acid H_2CrO_4 d. $\text{H}_2\text{CO}_{3(\text{aq})}$ Carbonic acid
b. Sulphurous acid H_2SO_3 e. $\text{H}_3\text{PO}_{4(\text{aq})}$ Phosphoric acid
c. Hypochlorous acid HClO f. $\text{HNO}_{2(\text{aq})}$ Nitrous acid

Molecular Compounds:

1. Write the correct name for each of the following molecular compounds.

a. NF_3 Nitrogen trifluoride d. N_2O_4 Dinitrogen tetroxide
b. CO_2 Carbon dioxide e. SCl_6 Sulphur hexachloride
c. P_2O_5 Diphosphorus pentoxide f. N_2O Dinitrogen monoxide

2. Write the correct formula for each of the following molecular compounds.

a. Silicon disulphide SiS_2 d. Triarsenic pentabromide As_3Br_5
b. Carbon tetrachloride CCl_4 e. Dicarbon hexahydride C_2H_6
c. Oxygen gas O_2 f. Iodine heptachloride ICl_7

Mixed Naming:

- 1) Provide the correct name for each of the following compounds.

a) CsBr Cesium bromide c) H_2SO_4 Sulphuric acid
b) ICl iodine monochloride d) $\text{Cu}(\text{NO}_3)_2$ Copper(II) nitrate

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 $\text{ZnCO}_3 \cdot 4\text{H}_2\text{O}$
- d) nitric acid HNO_3
- e) phosphorus pentaiodide PI_5
- f) iron (III) thiocyanate..... $\text{Fe}(\text{SCN})_3$
- g) sulphuric acid H_2SO_4
- h) dinitrogen tetrafluoride N_2F_4

2. Write the correct names for the following compounds:

- a) $\text{Mn}(\text{SO}_4)_2$ manganese (IV) sulphate
- b) $\text{PbCrO}_4 \cdot 6\text{H}_2\text{O}$ lead (II) chromate hexahydrate
- c) As_2O_3 diarsenic trioxide
- d) CH_3COOH acetic acid
- e) $\text{Ni}_2(\text{C}_2\text{O}_4)_3$ nickel (III) oxalate
- f) NF_3 nitrogen trifluoride
- g) $(\text{NH}_4)_2\text{HPO}_4$ ammonium monohydrogen phosphate
- h) $\text{Ba}(\text{OH})_2 \cdot 10\text{H}_2\text{O}$ barium hydroxide decahydrate

The Mole:

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 $\text{MM } \text{PCl}_5 = 208.5 \text{ g/mol}$

$$? \text{ moles } \text{PCl}_5 = 133.44 \text{ g } \text{PCl}_5 \times \frac{1 \text{ mol}}{208.5 \text{ g}} = 0.6400 \text{ moles}$$

Answer 0.6400 moles

b) 0.00256 moles of $\text{Li}_2\text{Cr}_2\text{O}_7$ = ? grams $\text{MM } \text{Li}_2\text{Cr}_2\text{O}_7 = 229.8 \text{ g/mol}$

$$? \text{ g } \text{Li}_2\text{Cr}_2\text{O}_7 = 0.00256 \text{ moles} \times \frac{229.8 \text{ g}}{1 \text{ mol}} = 0.588 \text{ g}$$

Answer 0.588 g

c) 170.24 L of NO_2 at STP = ? moles $1 \text{ mol} = 22.4 \text{ L}$

$$? \text{ moles } \text{NO}_2 = 170.24 \text{ L} \times \frac{1 \text{ mol}}{22.4 \text{ L}} = 7.60 \text{ mol } \text{NO}_2$$

Answer 7.60 mol NO_2

d) 570.625 g of PCl_3 gas = ? L (STP) $\text{MM} = 137.5 \text{ g/mol}$

$$? \text{ L} = 570.625 \text{ g } \text{PCl}_3 \times \frac{1 \text{ mol}}{137.5 \text{ g}} \times \frac{22.4 \text{ L}}{1 \text{ mol}} = 92.96 \text{ L} = 93.0 \text{ L}$$

Answer 93.0 L

e) 1030.4 mL of C_2H_6 gas at STP = ? g $\text{MM} = 30.0 \text{ g/mol}$

$$? \text{ g } \text{C}_2\text{H}_6 = 1030.4 \text{ mL} \times \frac{1 \text{ L}}{1000 \text{ mL}} \times \frac{1 \text{ mol}}{22.4 \text{ L}} \times \frac{30.0 \text{ g}}{1 \text{ mol}} = 1.38 \text{ g}$$

Answer 1.38 g

f) 5.00 kg of nitrogen gas = ? L (STP) $\text{N}_2 = 28.0 \text{ g/mol}$

$$? \text{ L } \text{N}_2 = 5.00 \text{ kg} \times \frac{1000 \text{ g}}{1 \text{ kg}} \times \frac{1 \text{ mol}}{28.0 \text{ g}} \times \frac{22.4 \text{ L}}{1 \text{ mol}}$$

Answer $4.00 \times 10^3 \text{ g}$

g) $0.5696 \text{ kg of CH}_4(\text{g}) = ? \text{ mL}$ $MM = 16.0 \text{ g/mol}$

$$P_{\text{mL CH}_4} = 0.5696 \text{ kg} \times \frac{1000 \text{ g}}{1 \text{ kg}} \times \frac{1 \text{ mol}}{16.0 \text{ g}} \times \frac{22.4 \text{ L}}{1 \text{ mol}} \times \frac{1000 \text{ mL}}{1 \text{ L}} =$$

Answer $797 \times 10^3 \text{ mL}$

2. The density of liquid ethanol ($\text{C}_2\text{H}_5\text{OH}$) 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!)

$MM = 46.0 \text{ g/mol}$

$$P_{\text{molecules C}_2\text{H}_5\text{OH}} = 35.0 \text{ mL} \times 0.790 \frac{\text{g}}{\text{mL}} \times \frac{1 \text{ mol}}{46.0 \text{ g}} \times \frac{6.02 \times 10^{23} \text{ molec}}{1 \text{ mol}} = 3.62 \times 10^{23} \text{ molec}$$

Answer $3.62 \times 10^{23} \text{ molec}$

3. A 100.0 mL sample of liquid mercury contains 6.78 moles . Calculate the density of liquid mercury from this data.

$MM = 200.59 \text{ g/mol}$

$$P_{\text{mols Hg}} = 6.78 \text{ moles} \times \frac{200.59 \text{ g}}{1 \text{ mol}} = 1360.0 \text{ g}$$

$$D = \frac{\text{g}}{\text{L}} = \frac{1360.0 \text{ g}}{0.1000 \text{ L}} = 1.36 \times 10^4 \text{ g/L}$$

Answer $1.36 \times 10^4 \text{ g/L}$

4. Calculate the density of $\text{PCl}_3(\text{g})$ at STP.

$MM = 137.5 \text{ g/mol}$

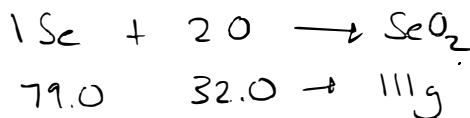
$$P_{\text{Density}} = \frac{137.5 \text{ g}}{\text{mol}} \times \frac{1 \text{ mol}}{22.4 \text{ L}} = 6.14 \text{ g/L}$$

Answer 6.14 g/L

5. a) The density of a gas at STP is 4.955 g/L . Calculate the molar mass of this gas.

$$P_{MM} = 4.955 \frac{\text{g}}{\text{L}} \times \frac{22.4 \text{ L}}{1 \text{ mol}} = 111 \text{ g/mol}$$

b) The gas is an oxide of selenium. Determine the molecular formula.



Answer SeO_2

6. Find the percent composition (% by mass of each element) in the following compound: $\text{Sr}_3(\text{PO}_4)_2$. Show your work.

(working out on next page)

Answer $58.04\% \text{ Sr}, 13.69\% \text{ P}, 28.27\% \text{ O}$

6. Find the percent composition (% by mass of each element) in the following compound: $\text{Sr}_3(\text{PO}_4)_2$. Show your work.

$$\text{MM} = 452.8 \text{ g/mol}$$

$$\% \text{ Sr} = \frac{262.8 \text{ g/mol}}{452.8 \text{ g/mol}} \times 100\% = 58.0\%$$

$$\% \text{ P} = \frac{62.0 \text{ g/mol}}{452.8 \text{ g/mol}} = 13.7\%$$

$$\% \text{ O} = \frac{128.0 \text{ g/mol}}{452.8 \text{ g/mol}} = 28.3\%$$

Answer 58.0% Sr, 13.7% P, 28.3% O

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

KSO

- a) Determine the mass of oxygen in the sample.

Answer 76.8 g

- b) Determine the empirical formula for this compound.

$$P_{\text{mol O}} = 76.8 \text{ g} \times \frac{1 \text{ mol}}{16.0 \text{ g}} = 4.8 \text{ mol} ; 4$$

$$P_{\text{mol K}} = 46.92 \text{ g} \times \frac{1 \text{ mol}}{39.1} = 1.2 \text{ mol} ; 1$$

$$P_{\text{mol S}} = 38.52 \text{ g} \times \frac{1 \text{ mol}}{32.1} = 1.2 \text{ mol} ; 1$$

Answer: Empirical Formula: KSO_4

$$\text{MM} = 135.2 \text{ g/mol}$$

- c) Determine the molecular formula for this compound.

$$\frac{\text{molecular mass}}{\text{empirical mass}} = \frac{270.4 \text{ g/mol}}{135.2 \text{ g/mol}} = 2$$

Answer: Molecular Formula: $\text{K}_2\text{S}_2\text{O}_8$

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.

$$MM = 165.39 \text{ g/mol}$$

$$? \text{ mols } Zn(NO_3)_2 = 123.11 \text{ g} \times \frac{1 \text{ mol}}{165.4 \text{ g}} = 0.7444 \text{ mols}$$

$$C = \frac{n}{V} = \frac{0.7444 \text{ mols}}{0.6500 \text{ L}} = 1.145 \text{ M}$$

Answer 1.145 M

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.

$$MM = 158.3 \text{ g/mol}$$

$$? \text{ g } K_2SO_3 = 0.8000 \text{ L} \times \frac{0.200 \text{ mol}}{\text{L}} \times \frac{158.3 \text{ g}}{\text{mol}} = 25.3 \text{ g}$$

Answer 25.3 g

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.

$$MM = 73.8 \text{ g/mol}$$

$$? \text{ L } Li_2CO_3 = 47.232 \text{ g} \times \frac{1 \text{ mol}}{73.8 \text{ g}} \times \frac{1 \text{ L}}{2.50 \text{ mols}} = 0.256 \text{ L}$$

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.

$$C_1 = 0.45 \text{ M}$$

$$V_1 = 400.0 \text{ mL}$$

$$V_2 = 550.0 \text{ mL}$$

$$C_2 = ?$$

$$C_2 = C_1 \cdot \frac{V_1}{V_2}$$

$$= 0.45 \text{ M} \cdot \frac{400.0 \text{ mL}}{550.0 \text{ mL}} = 0.36 \text{ M}$$

Answer 0.36 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.

$$V_1 = 150.0 \text{ mL}$$

$$C_1 = 4.00 \text{ M}$$

$$C_2 = 2.50 \text{ M}$$

$$V_2 = ?$$

$$V_2 = V_1 \cdot \frac{C_1}{C_2}$$

$$V_2 = 150.0 \text{ mL} \cdot \frac{4.00 \text{ M}}{2.50 \text{ M}} = 240 \text{ mL}$$

added 90 mL

Answer 90.0 mL

13. Give directions on how to make 5.00 L of 0.020 M $\text{Ca}(\text{ClO})_2$ using solid $\text{Ca}(\text{ClO})_2$ and water. Include proper units in your work and in your answers.

$$\text{MM} = 143.08 \text{ g/mol}$$

$$\text{g } \text{Ca}(\text{ClO})_2 = 5.00 \text{ L} \times \frac{0.020 \text{ mol}}{1 \text{ L}} \times \frac{143.08 \text{ g}}{1 \text{ mol}} = 14.3 \text{ g}$$

$$= 14.3 \text{ g}$$

① weigh out 14.3 g

② add 14.3 g to a graduated cylinder

③ fill cylinder to 5.00 L

Molarity Calculations:

1. If a 4.50g sample of solid NaOH is dissolved to make 0.500L of solution, what is the molarity of the solution? $\rightarrow 40.0\text{g/mol}$

$$\frac{4.50\text{g}}{0.500\text{L}} \times \frac{1\text{mol}}{40.0\text{g}} = 0.225\text{M}$$

2. How many grams of Na_2CO_3 would be required to produce 400.0mL of 0.600M Na_2CO_3 ? $\rightarrow 106.0\text{g}$

$$400.0\text{mL} \times \frac{1\text{L}}{10^3\text{mL}} \times \frac{0.600\text{mol}}{1\text{L}} \times \frac{106.0\text{g}}{1\text{mol}} = 25.4\text{g Na}_2\text{CO}_3$$

3. If 75.7g of Magnesium chloride are mixed with sufficient water to make a 0.885M solution, what is the volume of the solution? $\text{MgCl}_2 = 95.3\text{g/mol}$

$$75.7\text{g} \times \frac{1\text{mol}}{95.3\text{g}} \times \frac{1\text{L}}{0.885\text{mol}} = 0.898\text{L}$$

4. How many mL of 16.4 M H_2SO_4 are needed to prepare 755mL of 0.25M H_2SO_4 ?

$$\begin{aligned} m_1 &= 16.4\text{M} & m_1V_1 &= m_2V_2 & V_1 &= \frac{0.25\text{M} \times 755\text{mL}}{16.4\text{M}} \\ V_1 &= ? & V_1 &= \frac{m_2V_2}{m_1} & V_1 &= 12\text{mL} \\ m_2 &= 0.25\text{M} \\ V_2 &= 755\text{mL} \end{aligned}$$

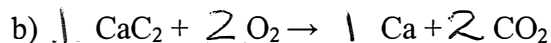
Unit 4: Chemical Reactions and Equations:

1. Balance and classify the following chemical reactions.

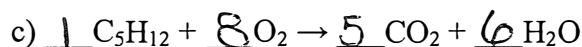


Type of Reaction

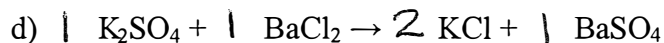
Decomposition



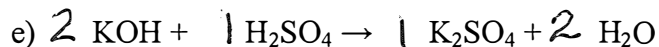
Single Replacement



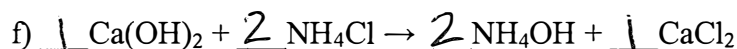
Combustion



Double Replacement



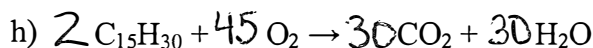
Neutralization



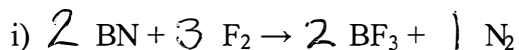
Double Replacement



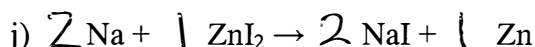
Combustion



Combustion

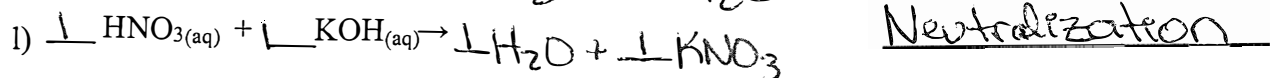
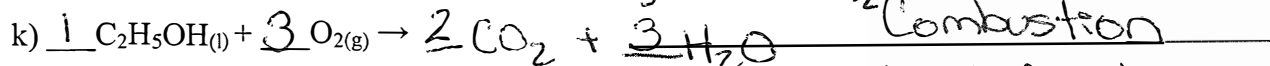
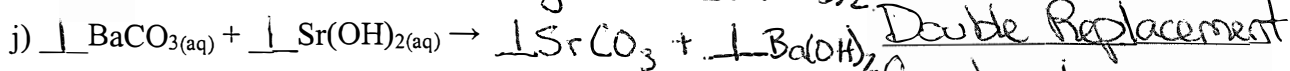
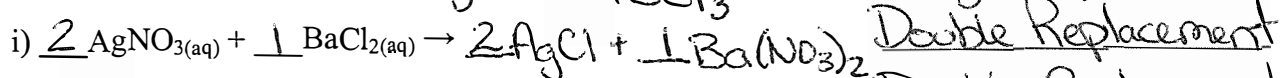
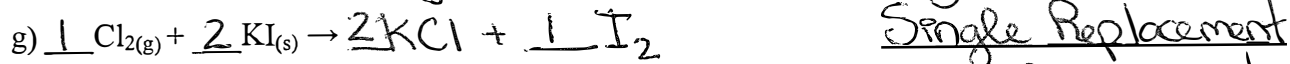
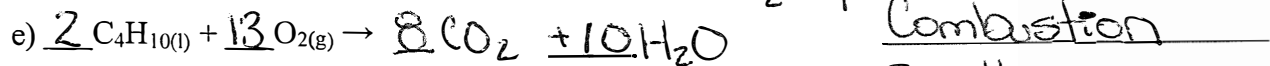
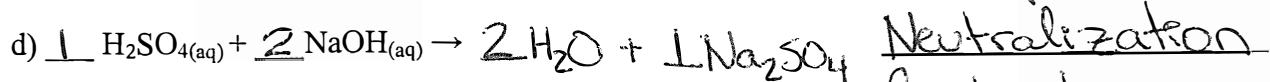


Single Replacement



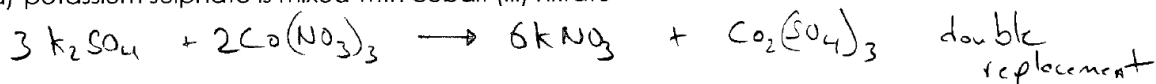
Single Replacement

2. Classify, complete AND balance the following chemical equations. Type of Reaction

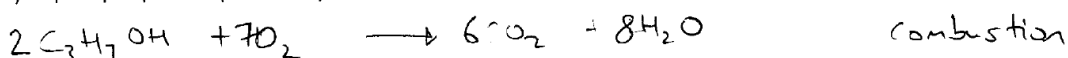


3. Write a balanced chemical equation for each of the following, and classify each as synthesis, decomposition, single replacement, double replacement, neutralization or combustion.

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



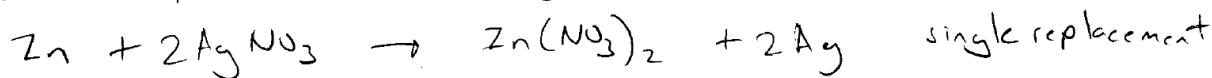
b) liquid propanol ($\text{C}_3\text{H}_7\text{OH}$) is burned in air



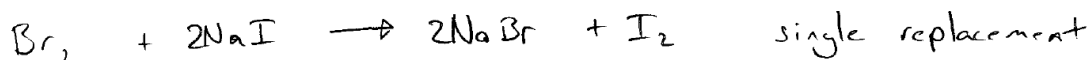
c) ammonium nitrate is decomposed into it's elements



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



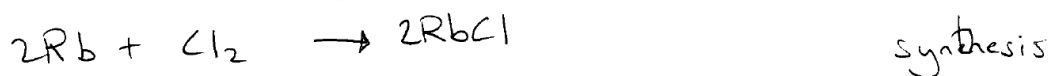
e) bromine reacts with sodium iodide



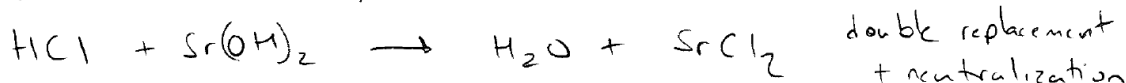
f) bromine reacts with aluminum



g) rubidium reacts with chlorine gas

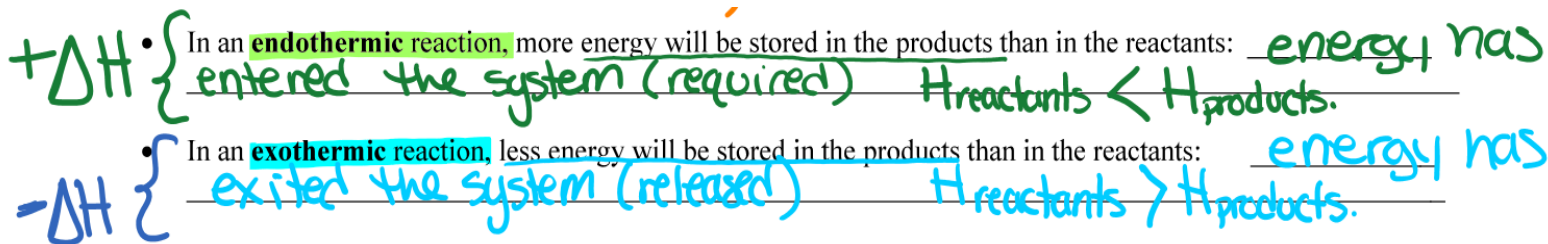


h) hydrochloric acid reacts with strontium hydroxide



Energy of Reactions:

1. Define ENDOTHERMIC and EXOTHERMIC reactions.



2. Classify the following reactions as either endothermic or exothermic.



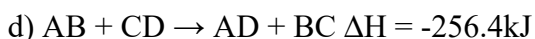
exothermic (energy is a product)



endothermic (energy is a reactant)



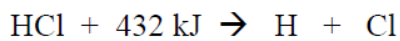
exothermic



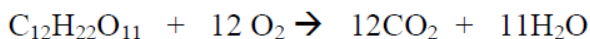
exothermic



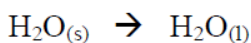
3. State whether each of the following are *exothermic* or *endothermic*.



Answer endothermic

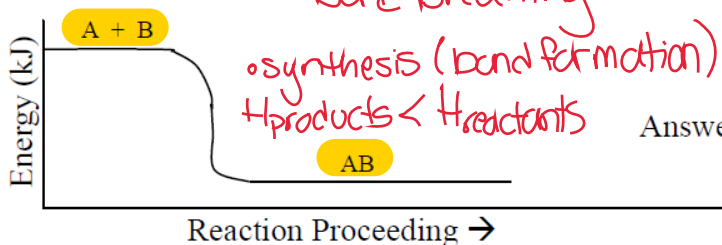


$\Delta H = -5638\text{kJ}$ Answer exothermic

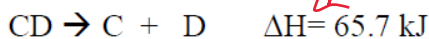


(s) \rightarrow (l)
bond breaking

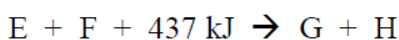
Answer endothermic



Answer exothermic



Answer endothermic



Answer endothermic

energy is a reactant

1 Exothermic and endothermic reactions

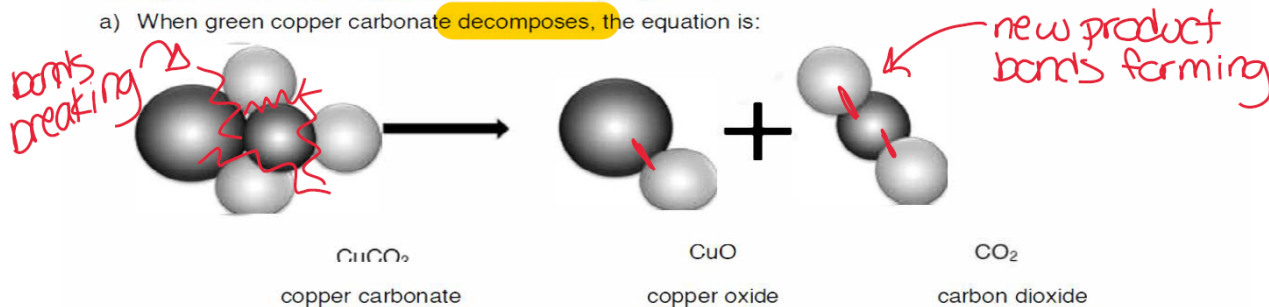
Decide whether each of these reactions is **exothermic** or **endothermic**:

- When two chemicals mix their temperature rises: exothermic
- A solid burns brightly and releases heat, light and sound: exothermic
- When two chemicals are mixed their temperature drops: endothermic
- Two chemicals will only react if you heat them continually: endothermic (require heat) input
- Plants take in light energy for photosynthesis: endothermic (require energy)

2 Making and breaking bonds

During chemical reactions the bonds between atoms break and new bonds form. Energy must be absorbed to break a bond, so breaking bonds is endothermic. Making new bonds is exothermic because energy is released.

- When green copper carbonate **decomposes**, the equation is:



Is the reaction exothermic or endothermic? Use ideas about bonds to explain why.

The reaction is endothermic. Decomposition reactions always require a large energy input to break bonds.

- Draw diagrams to show what happens when hydrogen reacts with oxygen. Mark the bonds broken in blue and the new bonds formed in red. The equation is:



Energy Changes in Chemical reactions

- In an exothermic reaction does the temperature go up or down?

an exothermic reaction releases energy, so the temperature would go up

- In an endothermic reaction does the temperature go up or down?

an endothermic reaction requires energy input, so the temperature would decrease

- Name two examples of exothermic reactions

combustion reactions, many acid base reactions, acid-metal (single replacement reactions)

- Name two examples of endothermic reactions

decomposition reactions, photosynthesis

- Circle the correct answers.

The bonds between the atoms of the **reactants** / products need to be broken first, this is an **endothermic** / exothermic process. Then bonds are made between the atoms of the reactants / **products**, this is an endothermic / **exothermic** process.

6. Use the table to answer this question

Reaction	Starting temperature °C	Final temperature °C
A	20	31
B	22	18
C	21	25

a. Decide whether each reaction is endothermic or exothermic, explain how you could tell.

..... A) temperature increase--> exothermic.....

..... B) temperature decrease -->endothermic.....

..... C) temperature increase -->exothermic.....

b. Which reaction has the largest energy change?

..... reaction A) increases in temperature the most, so it likely has teh largest energy change

7. In an exothermic reaction, is enthalpy change positive or negative?

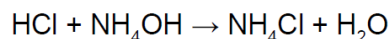
..... Enthalpy (ΔH) is negative for an exothermic reaction ($E_{\text{products}} - E_{\text{reactants}} = \text{negative}$)

8. In an endothermic reaction, is enthalpy change positive or negative?

..... Enthalpy (ΔH) is positive for an exothermic reaction ($E_{\text{products}} - E_{\text{reactants}} = \text{positive}$)

9. When hydrochloric acid reacts with ammonium hydroxide in a beaker, the

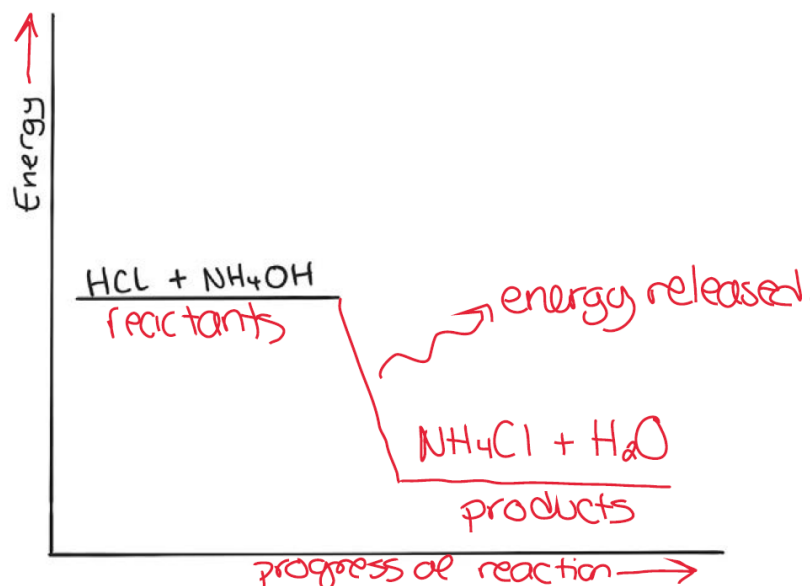
temperature goes up. (energy is released)



$$\Delta H = -53.4 \text{ kJ/mol}$$

$\ominus \Delta H = \text{exothermic reaction } (E_{\text{products}} < E_{\text{reactants}})$

Complete the energy profile diagram and state whether the reaction is endothermic or exothermic, explain your answer.

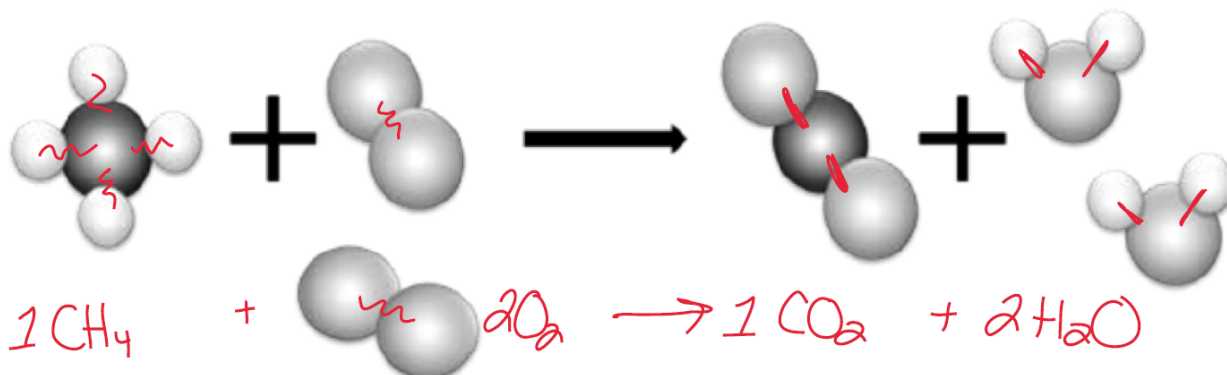


10. What are the units for enthalpy change, ΔH

kJ/mol

3 'Make or break'

- a) Most reactions involve bond breaking and bond making. This equation shows what happens when methane (CH_4) burns in oxygen (O_2). Mark the bonds broken in blue and the bonds formed in red.



- b) Complete the table to show the number of bonds broken and formed:

Bonds broken	Number	Bonds formed	Number
between carbon and hydrogen	4	between carbon and oxygen	2
between oxygen atoms	2	between hydrogen and oxygen	4

- c) Is the reaction exothermic or endothermic overall?

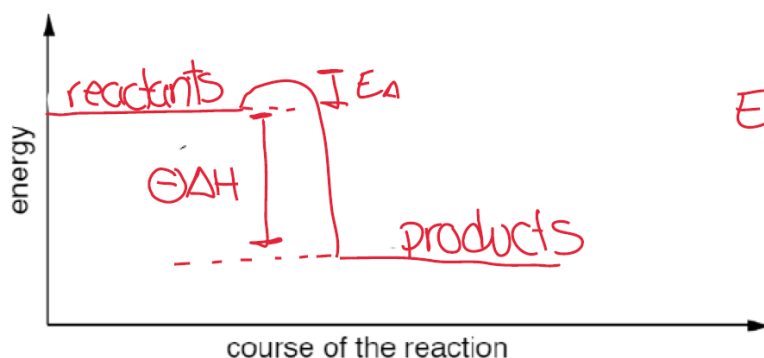
The reaction is exothermic because combustion reactions release energy in the form of heat.

- d) The overall energy change is decided by the strength of the bonds that are broken or formed during the reaction. The stronger the bond the larger the energy change.

Which bonds must be stronger in this reaction – the bonds broken or the new bonds formed?

The reactant bonds must be stronger because more energy is required in the reactants. The formation of product bonds requires less energy, that is why the excess is released.

- e) An energy level diagram shows the energy taken in and released during the reaction. Add the reactants, products and their separated atoms to the correct places on the diagram.



$$E_{\text{reactants}} > E_{\text{products}}$$

$$\ominus \Delta H \text{ (Enthalpy)}$$

Exothermic Reaction.