DRAWING MOLECULES 1

When non-metals combine with other non-metals, the atoms share electrons to form a molecule. The atoms are held together by these shared electrons which are known as covalent bonds.

Molecule = a particle made up of atoms joined by covalent bonds **Covalent bond** = 2 shared electrons

How many covalent bonds?

Atoms	Number of electrons in outer shell	Number of extra electrons needed to fill the outer shell	Number of covalent bonds formed
Group 7 (e.g. F, Cl, Br, I)	7	1	1
Group 6 (e.g. O, S)	6	2	2
Group 5 (e.g. N, P)	5	3	3
Group 4 (e.g. C, Si)	4	4	4
H	1	1	1

Drawing stick diagrams & dot-cross diagrams

Stick diagrams – these show each covalent bond as a stick.

Dot-cross diagrams – these show the outer shell electrons only

1 Draw a stick diagram
2 Re-draw the stick diagram without the sticks
3 Replace the stick with a **X●** which represents the two electrons in the bond (**X** represents electrons from one atom, and ● represents the electron from the other atom).
4 Add in any other outer shell electrons from each atom (electrons are always in pairs)
5 CHECK that there are 8 electrons around each atom (except H where there should be 2 electrons)

Stick diagram	Molecule	Dot-cross diagram
	CH_4	
	NH_3	
	O_2	

	HCl	
	Br_2	
	PH_3	
	CO_2	
	SiH_4	
	H_2O	
	N_2	
	C_2H_4	
	C_2H_2	
	C_6H_6	

Area	Strength	To develop	Area	Strength	To develop
Done with care and thoroughness			Can draw stick diagrams		
Can deduce the number of covalent bonds an atom forms			Can write dot-cross diagrams		

CALCULATIONS MIXTURE 1

1) Sodium reacts with oxygen as shown: $4Na + O_2 \rightarrow 2Na_2O$

Find the M_r of the following substances involved in this reaction.

a) sodium .....

b) oxygen .....

c) sodium oxide .....

2) a) How many moles in the following:

i) 21.3 g of chlorine, Cl_2 .....

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ii) 5.34 kg of aluminium bromide, $AlBr_3$ .....

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b) What is the mass of 0.25 moles of sulfur dioxide, SO_2? .....

3) What mass of bromine reacts with 2.3 g of sodium to form sodium bromide? $2Na + Br_2 \rightarrow 2NaBr$

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4) What mass of oxygen reacts with 280 g of iron to form iron oxide? $2Fe + 3O_2 \rightarrow 2Fe_2O_3$

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5) What is the percentage atom economy to make tungsten (W) from tungsten oxide in this reaction? $WO_3 + 3H_2 \rightarrow W + 3H_2O$

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6) a) What is the maximum mass of calcium hydroxide that can be formed by reaction of 2.8 g of calcium oxide with water? $CaO + H_2O \rightarrow Ca(OH)_2$

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b) In a reaction, 2.6 g of calcium hydroxide was formed from 2.8 g of calcium oxide. Calculate the percentage yield.

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7) 1.95 g of potassium is reacted with 5.08 g of iodine. Work out which is the limiting reagent and then calculate the mass of potassium iodide formed. $2K + I_2 \rightarrow 2KI$

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8) 1.20 g of hydrated tin chloride decompose to form 1.01 g of anhydrous tin chloride on heating. Calculate the value of *x*. $SnCl_2.xH_2O \rightarrow SnCl_2 + xH_2O$

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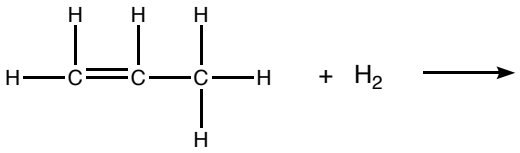
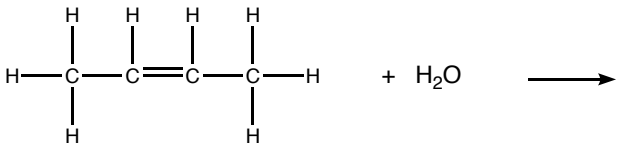
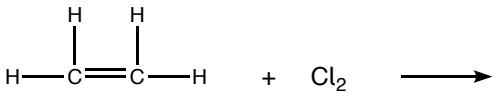
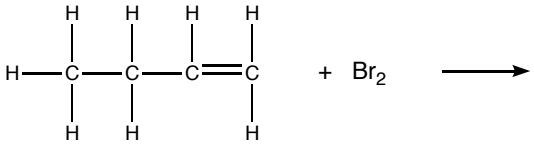
Area	Strength	To develop	Area	Strength	To develop	Area	Strength	To develop
Done with care and thoroughness			Can convert units			Use equation to find reacting moles		
Shows suitable working			Which numbers are part of formula			Can work out % atom economy		
Does not round too much			Can work out M_r			Can work out % yield		
Can use sig figs			Work out moles from mass			Understands limiting reagents		
Gives units			Can work out mass from moles			Water of crystallisation calculations		

1) Complete the equations shown below for some addition reactions of alkenes. You should show the displayed structure of the products.

a)  (2)

b)  (2)

c)  (2)

d)  (2)

2) Hexene and hexane are both colourless liquids containing six carbon atoms.

a) Give the molecular formula of each. *hexene* ..... *hexane* ..... (2)

b) Describe a test that could be used to distinguish these two compounds and give the result for each compound.

test .....

hexene ..... *hexane* ..... (3)

c) Which of these two molecules is saturated? Explain your answer. .....

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..... (2)

3) a) The alkenes propene (C_3H_6) and ethene (C_2H_4) can be formed with one other product when decane ($C_{10}H_{22}$) is cracked. Write an equation for a cracking reaction of decane that forms propene, ethene and one other product.

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b) Describe one way in which cracking is done. .....

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..... (2)

c) Explain why cracking is done. .....

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..... (3)

4) a) Complete the table below about some alkanes. (5)

name	methane	propane	butane
molecular formula			C_4H_{10}
structure			

b) Which of these three alkanes.

i) has the highest boiling point? .....

ii) is the most flammable? .....

iii) is the most volatile? .....

iv) burns with the cleanest flame? .....

5) Crude oil is a mixture of hydrocarbons which are mainly alkanes. These alkanes are separated at an oil refinery by fractional distillation. Describe how this is done and explain how it works.

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Area	Strength	To develop	Area	Strength	To develop	Area	Strength	To develop
Done with care and thoroughness			Understands bromine water test			Knows why cracking is done		
Good SPG			Understands saturated			Can draw alkanes		
Write equations for alkene addition			Can write equations for cracking			Compare properties of alkanes		
Can write molecular formulas			Knows how cracking is done			Fractional distillation of crude oil		