

Year 10

Chemistry booklet

Topic 3 – Energy and Analysis

Name: \_\_\_\_\_

## Energy and Analysis

Give a definition for each of these key words:

Exothermic	
Endothermic	
Enthalpy	
Activation energy	
Bond energy	
Pure substance	
Formulation	
Chromatography	
Cation	
Anion	
Halide	
Flame emission spectroscopy	

## Looking at energy changes

### Making and breaking bonds

In a chemical reaction, new substances are produced. In order to do this the \_\_\_\_\_ in the reactants must be broken so that new bonds in the \_\_\_\_\_ can be made.

- Breaking chemical bonds takes lots of energy – energy must be put in so it is an \_\_\_\_\_ process.
- When a new bond is made, energy is given out – it is an \_\_\_\_\_ process.

If more energy is NEEDED to break bonds than is released when new bonds are made, a reaction is ENDOTHERMIC.

If more energy is RELEASED when new bonds are made than is needed to break the old bonds, a reaction is EXOTHERMIC.

## Energy level diagrams

1. Exothermic



2. Endothermic



3. Including the activation energy – exothermic



4. Including activation energy - endothermic



## Bond Enthalpy and Energy Calculations

### BOND ENTHALPY

- This is the average energy required to break the bond in 1 mole of gaseous compounds
- Bond breaking is endothermic,  $\Delta H$  is +ve
- Bond making is exothermic,  $\Delta H$  is -ve

### WORKED EXAMPLE



#### Bonds Broken

$$\begin{aligned} 1 \times \text{C-C} (347) &= 347 \\ 6 \times \text{C-H} (413) &= 2478 \\ 3.5 \times \text{O=O} (498) &= 1743 \end{aligned}$$

$$\text{Total} = +4568$$

#### Bonds Made

$$\begin{aligned} 4 \times \text{C=O} (805) &= 3220 \\ 6 \times \text{O-H} (464) &= 2784 \end{aligned}$$

$$\text{Total} = -6004$$

+ is the sign for bond breaking

- is the sign for bond making

$$\Delta H_c(\text{C}_2\text{H}_6) = (+4658) + (-6004) = -1346 \text{ kJ/mol}$$

This symbol refers to enthalpy change when a substance burns completely in oxygen

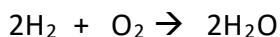
Energy has been released so to show  $\Delta H$  we put a -ve

-ve energy change, this is an exothermic reaction

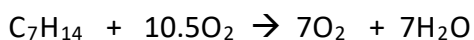
$$\Delta H = -1346 \text{ kJ/mol}$$

### Questions

1. Calculate the enthalpy of combustion of hydrogen

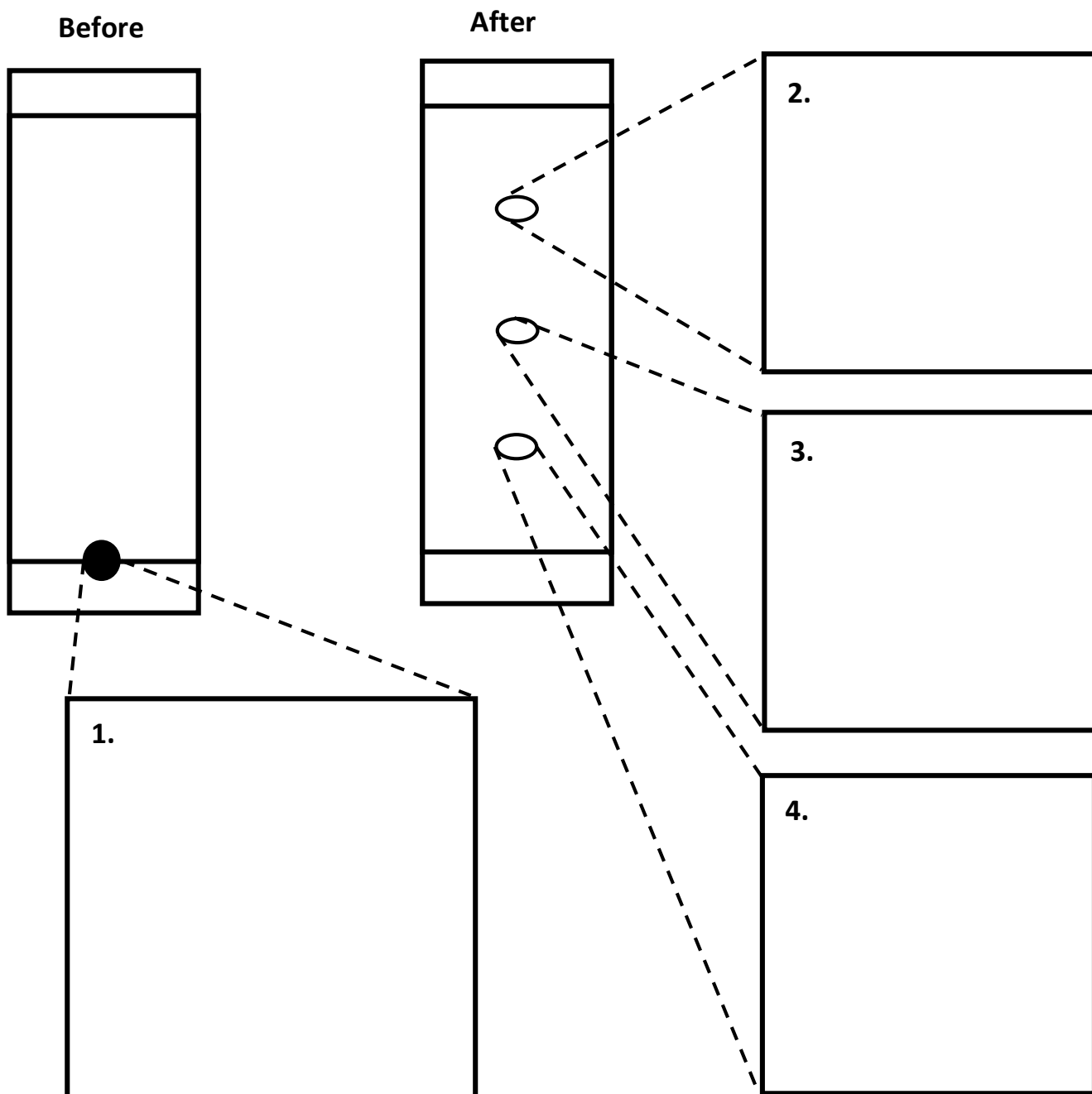


2. Calculate the enthalpy of combustion of hept-1-ene



Bond	Bond Enthalpy kJ/mol
C-C	347
C-H	413
O=O	498
O-H	464
C=O	805
C-O	358
H-H	436
C=C	612

# Chromatography – Draw diagrams of the particles in each of the 4 boxes

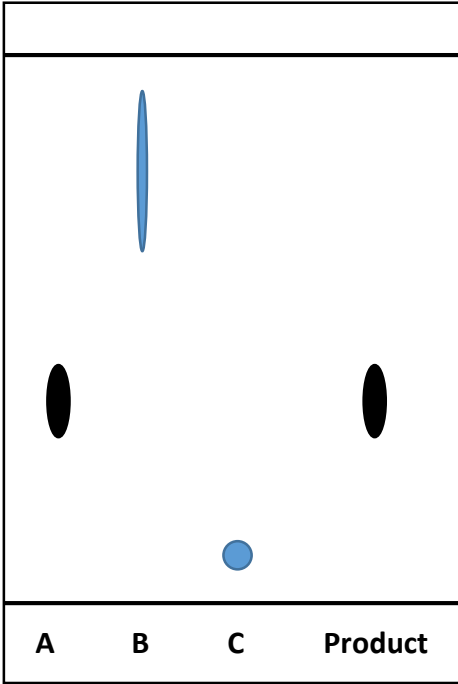


For each box, state whether it is a **mixture** or a **pure substance**:

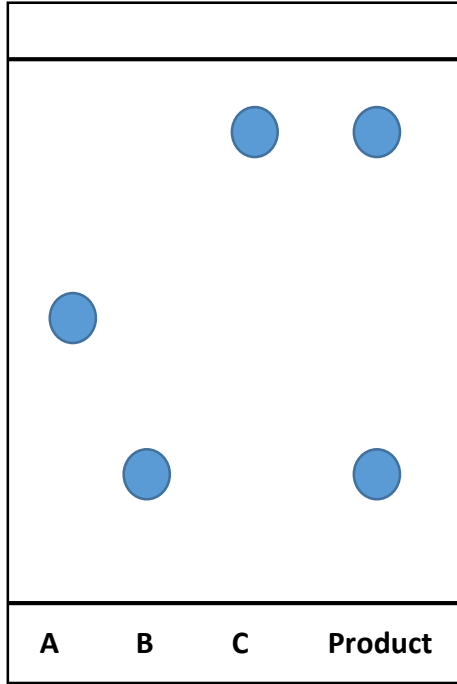
- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_
- 4. \_\_\_\_\_

Which dye was most soluble? Why?

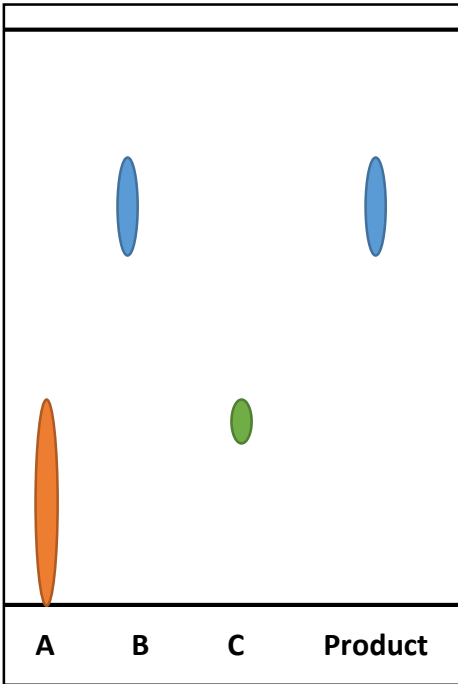
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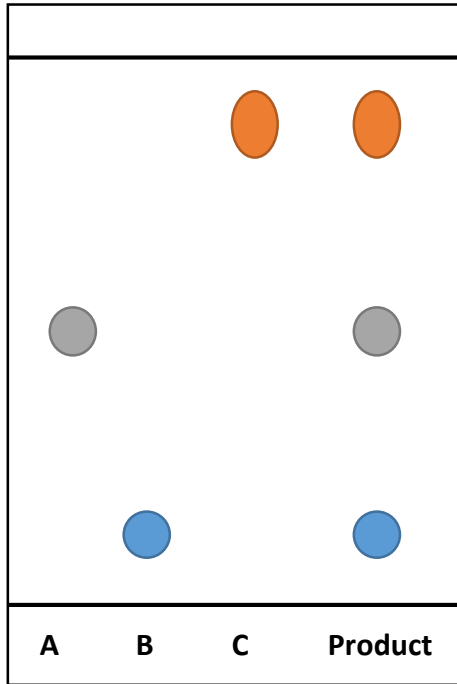
Product is made from.....  
 $R_f =$



Product is made from.....  
 $R_f =$



Product is made from.....  
 $R_f =$



Product is made from.....  
 $R_f =$

### Analysing substances

You need to be able to describe and interpret a range of chemical tests for use in detecting and identifying elements and compounds. You may be asked to interpret results of tests applied to solutions or mixtures of substances in different contexts. This could include forensics, health or the environment.

### Identifying the cation

#### **Test 1 - Flame tests**

These can be used to identify metal ions. You introduce the compound on a needle into a blue flame on the Bunsen burner.

Lithium compounds result in a crimson flame

Sodium compounds result in a yellow flame

Potassium compounds result in a lilac flame

Calcium compounds result in a red flame

Barium compounds result in a green flame

#### **Test 2 - Precipitates with sodium hydroxide**

Metal ion	Colour of precipitate
Calcium	white
Magnesium	white
Copper (II) $\text{Cu}^{2+}$	blue
Iron (II) $\text{Fe}^{2+}$	pale green
Iron (III) $\text{Fe}^{3+}$	brown

### Identifying the anion

#### **Carbonates**

Metal carbonates react with dilute acids to form carbon dioxide. Carbon dioxide produces a white precipitate with limewater. This turns limewater cloudy.

#### **Halide ions**

These are ions of the halogens in group 7 of the periodic table. They form precipitates with silver nitrate in the presence of dilute nitric acid.

Silver chloride is white

Silver bromide is cream

Silver iodide is yellow.

#### **Sulfate ions**

Form a white precipitate with barium chloride solution in the presence of dilute hydrochloric acid.

Use the information on the previous page to work out what the following compounds are:

1. The cation gives no precipitate and bright orange flame  
The anion gives white precipitate with silver nitrate  
I am \_\_\_\_\_
2. The cation gives a lilac flame and no precipitate  
The anion gives a yellow precipitate with silver nitrate  
I am \_\_\_\_\_
3. The flame tests give no colour. The precipitate with sodium hydroxide is orange/brown  
The anion gives a white precipitate when barium chloride is added  
I am \_\_\_\_\_
4. The flame test gives no colour. There is a white precipitate with sodium hydroxide  
The anion gives a cream precipitate with silver nitrate  
I am \_\_\_\_\_

**Challenge:**

Can you plan a sequence of steps as a flow chart that would give you the identity of an unknown salt that is formed from one of the metal cations and anions given on the previous page?



### Testing Gases

Chemical	How do you test for it?	What happens?
Hydrogen		
Carbon Dioxide		
Oxygen		
Chlorine		