# Fractional distillation synoptic questions

This resource accompanies the infographic article **How to teach fractional distillation** in *Education in Chemistry* which can be viewed at: https://rsc.li/3V1766Z/

## Learning objectives

1 To recall prior learning on bonding, structure and the properties of matter and changes of state.

2 To apply this prior learning in the context of fractional distillation.

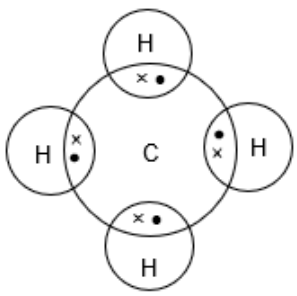
## Introduction

To fully understand fractional distillation, learners need to have a secure understanding of a number of concepts including bonding, structure and the properties of matter and changes of state.

The synoptic worksheets within this resource require learners to retrieve relevant knowledge and understanding from prior learning and apply it in the context of fractional distillation. Higher and foundation versions of the worksheet are provided to offer different levels of challenge depending on the needs of the group of learners.

## Answers

### Foundation worksheet

1. Protons = 6
   Neutrons = 6
   Electrons = 6
2. 2; carbon and hydrogen
3. 14; 4 carbon atoms and 10 hydrogen atoms
4. $C_3H_6$
5. (8 x 12) + (18 x 1) = 114
6. 

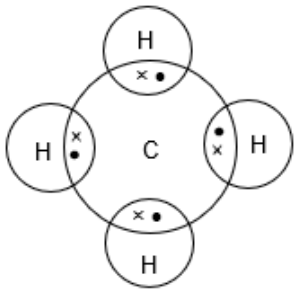
7. It contains only atoms of carbon and hydrogen.

8. (a) Chromatography
   (b) A separating funnel
   (c) Filtration
   (d) Evaporation
9. Intermolecular forces.
10. As the molecules become larger the strength of the intermolecular forces increases meaning more energy is needed to change the hydrocarbon from a liquid to a gas.
11. The larger the hydrocarbon the more viscous the liquid.
12. $C_{28}H_{58}$
13. Gas
14. Propane + Oxygen → Carbon dioxide + Water
15. Exothermic

## Higher worksheet

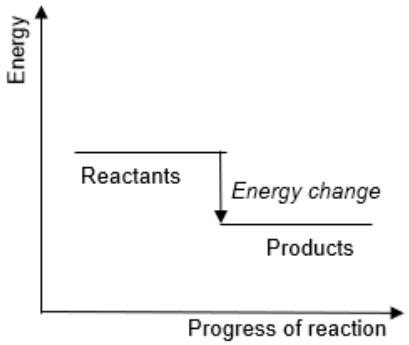
1. Protons = 6
   Neutrons = 6
   Electrons = 6
2. $C_3H_6$
3. $(8 \text{ x } 12) + (18 \text{ x } 1) = 114 \text{ g mol}^{-1}$

$$\text{Amount in moles} = \frac{28.5 \text{ g}}{114 \text{ g mol}^{-1}} = 0.25 \text{ mol}$$

4. 


5. There is a strong electrostatic force of attraction between the shared pair of electrons and the positively charged nuclei of the bonded atoms.
6. $C_{28}H_{58}$
7. Shorter hydrocarbons have a lower boiling point, so they don't condense at the temperatures in the fractional distillation column and remain as gases.
   Shorter hydrocarbons have a lower boiling point because the smaller molecules have weaker intermolecular forces between them meaning less energy is needed to change the hydrocarbon from a liquid to a gas.
8. $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$
9. Gas

**10.**




**11.** Bonds broken;

$$4\,C-H \quad 4 \times 413$$
$$2\,O=O \quad 2 \times 498$$
$$\text{Total energy in} = 2648\ \text{kJ mol}^{-1}$$

Bonds made;

$$2\,C=O \quad 2 \times 805$$
$$4\,O-H \quad 4 \times 464$$
$$\text{Total energy out} = 3466\ \text{kJ mol}^{-1}$$

$$\text{Energy change} = \text{energy in} - \text{energy out}$$
$$= 2648 - 3466$$
$$= -818\ \text{kJ mol}^{-1}$$

**12.** The shorter the hydrocarbon the more flammable (easier to ignite) it is.

**13.** The longer the hydrocarbon, the more viscous a hydrocarbon is.
This is due to the intermolecular forces of attraction between the chains being greater and a higher chance of the chains becoming entangled, meaning that it is more difficult for the molecules to flow past each other.