

**Friday Worksheet  
Chromatography**

Name: .....

- 1) A mixture of two compounds, 2-chloro-2-methylpropane and 2-chloro-2-methylbutane were analysed using gas chromatography. The chromatogram of this mixture produced the results below.

Compound	amount	Peak area
2-chloro-2-methylpropane	$1.51 \times 10^{-3}$ mol	450
2-chloro-2-methylbutane	$4.52 \times 10^{-3}$ mol	1300

- a) Which molecule would you expect to have the shortest retention time in the chromatography column? Explain your answer

*2-chloro-2-methylpropane*

*It is a smaller molecule with weaker dispersion forces than 2-chloro-2-methylbutane. It should have a lower boiling point and so be in the gas state more often than 2-chloro-2-methylbutane and so carried by the mobile phase at a faster speed along the column.*

- b) In another experiment,  $0.501 \times 10^{-3}$  mol of 2-chloro-2-methylpropane was analysed in a different mixture under the same conditions.

What would be the expected peak area on the chromatogram associated with this amount of 2-chloro-2-methylpropane?

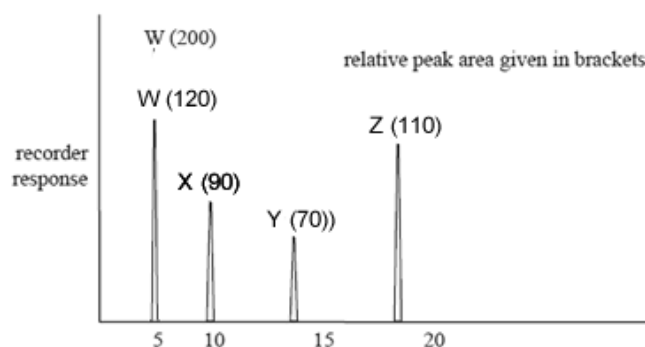
$$1.51 \times 10^{-3} \text{ mol} \Rightarrow 450$$

$$0.501 \times 10^{-3} \text{ mol} \Rightarrow x$$

$$\Rightarrow 450 / 1.51 \times 10^{-3} = x / 0.501 \times 10^{-3}$$

$$\Rightarrow (450 / 1.51 \times 10^{-3}) \times 0.501 \times 10^{-3} = x$$

$$\Rightarrow x = 149$$



- 2) The diagram on the right shows the gas chromatogram of a sample containing four straight chain alkanes. The following statements refer to this chromatogram.

I) The boiling points of the compounds arranged from highest to lowest are  $Z > Y > X > W$ .

II) The retention times will stay the same if the temperature at which the chromatogram is recorded is increased, all other conditions remaining constant.

III) Hydrogen gas could have been used as a carrier gas to obtain this chromatogram.

For each statement, discuss if it is true or false and give a reason.

*Statement I is True.. The lower the boiling point the more likely the compound will be in the gas phase more often than compounds with higher melting points. Since the compound is in the gas phase for a greater proportion of time it is pulled along with the mobile phase and so has a lower retention time.*

*Statement II is false. Higher temperatures increase the speed of the molecules in the column and all should have lower retention times at higher temperatures.*

*Statement III is false. Hydrogen is a reactive gas and only inert gases are used such as He, Ar and Ne.*

- 3) A High-performance liquid chromatography (HPLC) column uses a non-polar stationary phase together with a polar mobile phase. Which of the molecules, 2-chloro-2-methylpropane or 2-chloro-2-methylbutane, will have the greatest retention time on the column? Explain

*2-chloro-2-methylbutane*

*The reason is that 2-chloro-2-methylbutane has a greater non-polar region than 2-chloro-2-methylpropane and hence will have a greater interaction with the stationary phase than the polar mobile phase. It will therefore be frequently and more strongly adsorbed to the stationary phase.*

