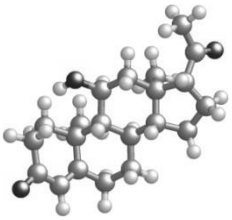


*Chem!stry*

**Name:** …… **(  )**

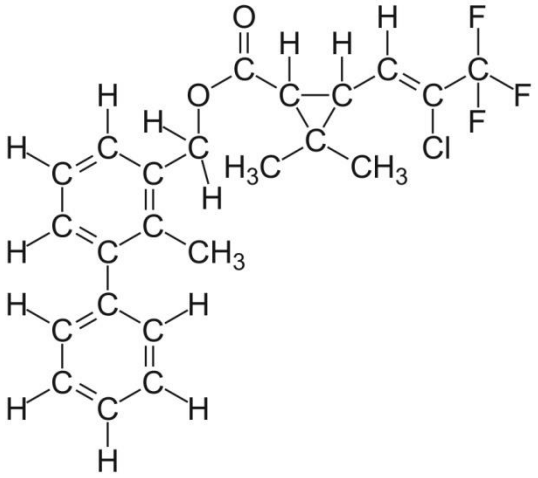
**Class:** ……

**Date:** …… **/** …… **/** ……

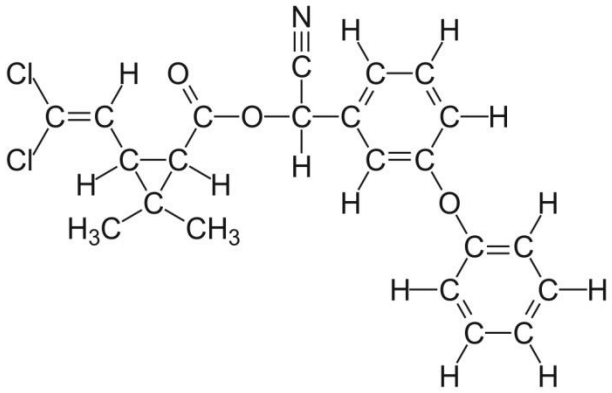
**Mole Calculations Assignment Eight**

**Question 1:**

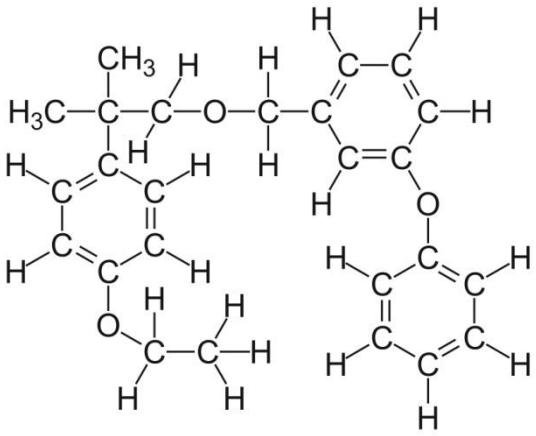
The Structural formulae of three insecticides used to kill the *Aedes* mosquito in the fight against dengue fever are given below:



Bifenthrin



Cypermethrin



Etofenprox

Choose *one* of the insecticides and determine the following information about it:

**a)** Molecular formula. **b)** Relative molecular mass. **c)** Percentage carbon by mass.

**d)** The concentration (mol $dm^{-3}$) of the solution formed if 30.0 g of the insecticide are dissolved in 5000 $cm^3$ of water before *fogging*.

**Question 2:**

The balanced chemical equation for the reaction between hydrochloric acid and aqueous sodium carbonate is given below:

$$2HCl(aq) + Na_2CO_3(aq) \rightarrow 2NaCl(aq) + H_2O(l) + CO_2(g)$$

5.40 $cm^3$ of aqueous sodium carbonate of concentration 0.500 mol $dm^{-3}$ are found to react exactly with 27.0 $cm^3$ of hydrochloric acid.

**a)** Calculate the number of moles of sodium carbonate that were used.

**b)** Refer to your answer to **Question 2 a)** and the balanced chemical equation. Calculate the number of moles of hydrochloric acid that reacted with the aqueous sodium carbonate.

**c)** Refer to your answer to **Question 2 b)**. Calculate the concentration (mol $dm^{-3}$) of the hydrochloric acid.

**Question 3:**

The chemical *borax* has the formula $Na_2B_4O_7 \cdot 10H_2O$.

**a)** Calculate the concentration (mol $dm^{-3}$) of the solution formed when 1.91 g of borax are dissolved in 250 $cm^3$ of distilled water.

**b)** The balanced chemical equation for the reaction between borax and hydrochloric acid is given below:

$$Na_2B_4O_7(aq) + 2HCl(aq) + 5H_2O(l) \rightarrow 4H_3BO_3(aq) + 2NaCl(aq)$$

The solution of borax made in **Question 3 a)** is titrated against a solution of hydrochloric acid of unknown concentration. If 25.0 $cm^3$ of the borax solution reacts exactly with 20.0 $cm^3$ of hydrochloric acid, then calculate the concentration (mol $dm^{-3}$) of the hydrochloric acid.

**Question 4:**

The concentration of hydrogen peroxide ($H_2O_2$) in a contact lens cleaning solution can be determined by titrating a sample of the solution against acidified potassium manganate(VII) ($KMnO_4$). The balanced chemical equation for the reaction between hydrogen peroxide and potassium manganate(VII) in the presence of sulphuric acid is given below:

$$5H_2O_2(aq) + 2KMnO_4(aq) + 3H_2SO_4(aq) \rightarrow 5O_2(g) + 8H_2O(l) + K_2SO_4(aq) + 2MnSO_4(aq)$$

25.0 $cm^3$ of the contact lens cleaning solution were found to react exactly with 18.1 $cm^3$ of potassium manganate(VII) of concentration 0.0200 mol $dm^{-3}$. Calculate the concentration (mol $dm^{-3}$) of the hydrogen peroxide in the contact lens cleaning solution.

**Question 5:**

A geologist finds a rock sample and takes it to the laboratory for analysis. The geologist believes that the rock is composed of a mixture of sand and calcium carbonate and decides to perform an experiment to determine the percentage calcium carbonate present in the rock.

The geologist adds 30.0 $cm^3$ of 1.00 mol $dm^{-3}$ hydrochloric acid to 5.00 g of the rock sample. The balanced chemical equation for the reaction that takes place is given below:

$$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$$

The geologist then performs a titration to determine how much hydrochloric acid is left-over (*i.e.* in excess) after the reaction with the calcium carbonate in the rock sample. The geologist finds that 20.0 $cm^3$ of 0.100 mol $dm^{-3}$ sodium hydroxide is required to neutralise the excess hydrochloric acid:

$$NaOH(aq) + HCl(aq) \rightarrow NaCl(aq) + H_2O(l)$$

**a)** Calculate the number of moles of hydrochloric acid that were added to the rock sample.

**b)** Calculate the number of moles of sodium hydroxide that were required to neutralise the excess hydrochloric acid.

**c)** Use your answer to **Question b 5)** to calculate the number of moles of hydrochloric acid that were in excess.

**d)** Use your answers to **Questions 5 a)** and **c)** to calculate the number of moles of hydrochloric acid that reacted with the calcium carbonate in the rock sample.

**e)** Use your answer to **Question 5 d)** to calculate the number of *moles* and hence the *mass* of calcium carbonate in the rock sample.

**f)** What is the percentage of calcium carbonate in the rock sample?

**Question 6:**

Magnesium burns in air according to the following balanced chemical equation:

$$2Mg(s) + O_2(g) \rightarrow 2MgO(s)$$

**a)** Calculate the mass of magnesium oxide that should, *in theory*, be produced when 9.00 g of magnesium are burned completely in air.

**b)** If the reaction is performed and only 12.0 g of magnesium oxide are produced, calculate the *percentage yield* for the reaction.

**Question 7:**

The balanced chemical equation for the reaction between sulphuric acid and potassium hydroxide is given below:

$$H_2SO_4(aq) + 2KOH(aq) \rightarrow K_2SO_4(aq) + 2H_2O(l)$$

25.0 $cm^3$ of 0.100 mol $dm^{-3}$ sulphuric acid is added to 20.0 $cm^3$ of 0.240 mol $dm^{-3}$ potassium hydroxide. Which of the two chemicals, sulphuric acid or potassium hydroxide, is the *limiting reagent* for the reaction? Explain your answer.

- Scan the QR code below for the answers to this assignment.

http://www.chemist.sg/mole/assignments/mole_eight_ans.pdf