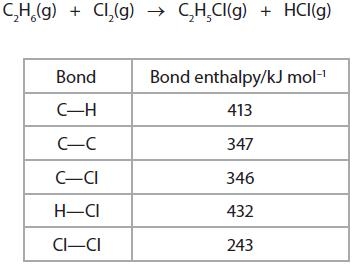
**Q1.**

This question is about the gas ethane, C2H6, and its reactions.

(a)  Write the equation, including state symbols, which represents the reaction taking place when the standard enthalpy change of combustion of ethane is measured.

**(2)**

(b)  Ethane can react with chlorine to form chloroethane and hydrogen chloride.



Rewrite this equation using displayed formulae.  
  
 Use the equation you have written, together with the bond enthalpy data, to calculate the enthalpy change for the reaction.

**(4)**

(c)  This reaction takes place in a number of steps, some of which are shown below.



(i)   State the type of reaction occurring in step 1 and the conditions needed for this step.

**(2)**

Type

.............................................................................................................................................

Conditions

.............................................................................................................................................

(ii)   Complete the equation below for the third step of the reaction, and show the movement of electrons using the appropriate arrows.

**(3)**



(iii)   Write equations for **two** termination steps in this reaction.

**(2)**

(d)  Ethane can be cracked in industry.  Write an equation for the cracking of ethane.

**(1)**

(e)  Suggest **two** reasons why cracking of larger alkane molecules is important in industry.

**(2)**

Reason 1:

.............................................................................................................................................

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Reason 2:

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**(Total for question = 16 marks)**

**Q6.**

Propanone, C3H6O, undergoes complete combustion to form carbon dioxide and water.



(a)  In an experiment to calculate the enthalpy change of combustion for propanone,  
       2.90 g of propanone was burned completely in oxygen.  
  
       The heat energy from this combustion raised the temperature of 200 g of water from  
       20.2 °C to 78.4 °C.  
  
       The specific heat capacity of water is 4.18 J g−1°C−1.

(i)  Calculate the number of moles of propanone present in 2.90 g.

[The molar mass of propanone is 58 g mol−1.]

**(1)**

(ii)  Use the expression



to calculate the heat energy transferred to raise the temperature of 200 g of water  
 from 20.2 °C to 78.4 °C.

**(2)**

(iii)  Use your answers to (a)(i) and (ii) to calculate a value for the enthalpy change  
        of combustion of propanone.  Give your answer to **three** significant figures and  
        include a sign and units.

**(3)**

(b)  In another experiment, the enthalpy change of combustion for butanone, C4H8O, was  
        found to be −1300 kJ mol−1.  
  
        A Data Book value for the standard enthalpy change of combustion for butanone is  
        −2440 kJ mol−1.

(i)  Suggest a reason why the value obtained in the experiment is so different from  
      the Data Book value.

**(1)**

.............................................................................................................................................

(ii)  This Data Book value (−2440 kJ mol−1) refers to the following equation.



How would the value be different if it referred to the formation of water in the  
**gaseous** state?  Justify your answer.

**(2)**

Difference

.............................................................................................................................................

Justification

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(c)  Standard enthalpy changes of combustion can be used to calculate the standard  
        enthalpy change of formation of a compound.

(i)  Define the term **standard enthalpy change of formation**, making clear the  
      meaning of **standard** in this context.

**(3)**

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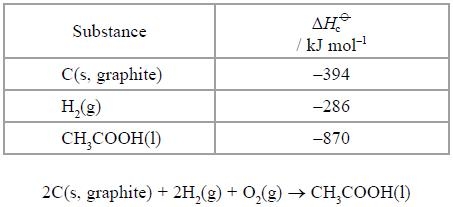
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(ii)  Use the standard enthalpy changes of combustion, Δ*H*c, given in the table  
       below to find the standard enthalpy change of formation for ethanoic acid,  
       CH3COOH, in kJ mol−1.



**(3)**

**(Total for question = 15 marks)**

**Q8.**

(a)  State the general formula of the alkanes, using the letter ***n*** to denote the number of carbon atoms in each molecule.

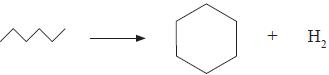
**(1)**

(b)  Alkanes are used as fuels. In the petrochemical industry, useful hydrocarbons are  
       often produced from longer chain molecules.  
  
       Name the type of reaction shown below.

(i)   

**(1)**

Type of reaction ....................................

(ii)   

**(1)**

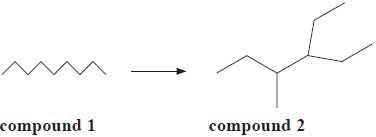
Type of reaction ....................................

(c)  By what **type** of formula are the **organic** molecules in (b) represented?

**(1)**

...........................................................................................................................................................................

(d)  Another reaction carried out in industry can be represented as shown below.



(i)   Give the molecular formula of **compound 2**.

**(1)**

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(ii)   Give the name of **compound 2**.

**(1)**

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(e)  An equation for the reaction between methane and chlorine is:

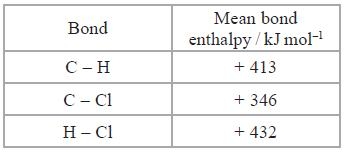


The reaction occurs in the presence of ultraviolet (UV) light via a free-radical chain  
 mechanism.  
  
 The initiation step is Cl2 → 2Cl  
  
 The next step could be



(i)   Use the following data to calculate a value for the enthalpy change for each of  
       the Steps, **A** and **B**.

**(3)**





Answer ....................................... kJ mol−1



Answer ....................................... kJ mol−1

(ii)   Use your answer to (i) to justify which of the Steps, **A** or **B**, is the more likely.

**(1)**

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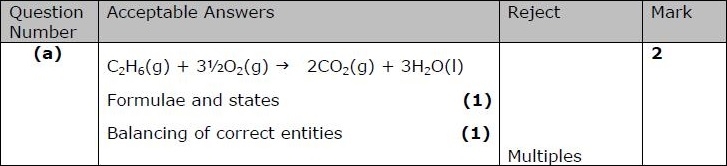
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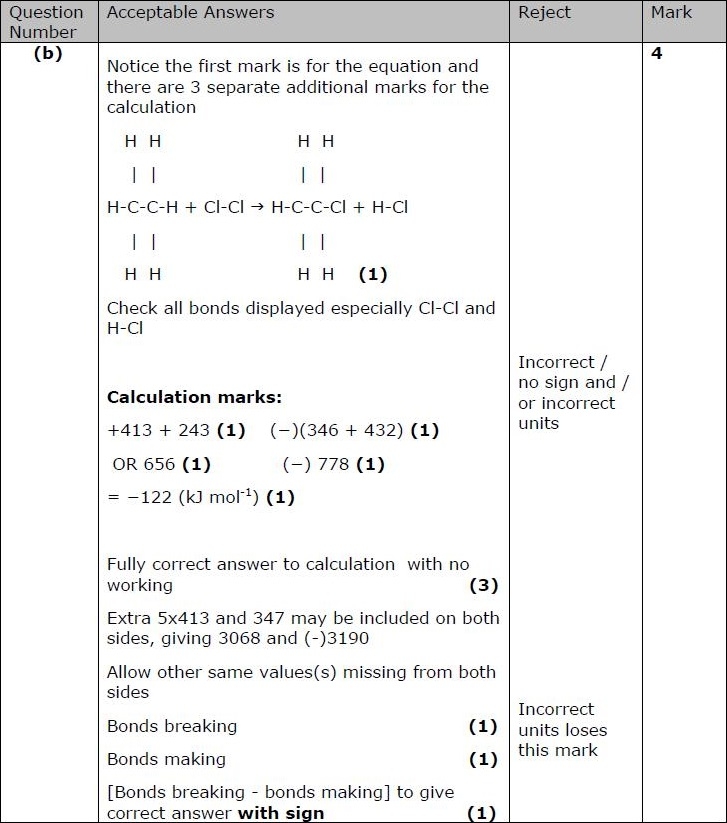
(f)  Another halogenoalkane, bromomethane, CH3Br, is a toxic gas used to protect plants  
       against insects.  
  
       Health and Safety advice states that concentrations above 5 parts per million (ppm)  
       by volume of this gas are harmful.  
  
       A research laboratory contains 2.5 × 105 dm3 of air.  Calculate the maximum volume  
       of bromomethane, in dm3, allowed in the laboratory to comply with the advice given.

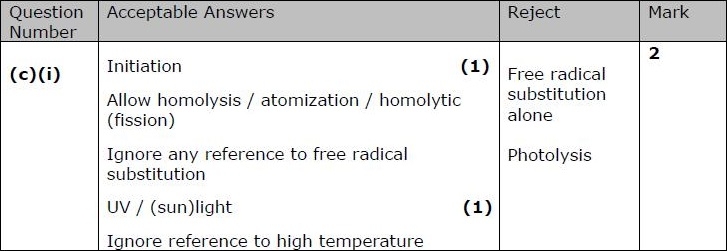
**(1)**

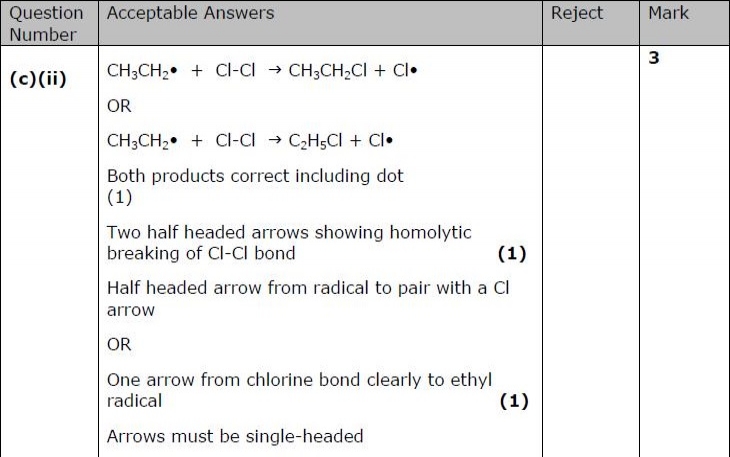
**(Total for question = 11 marks)**

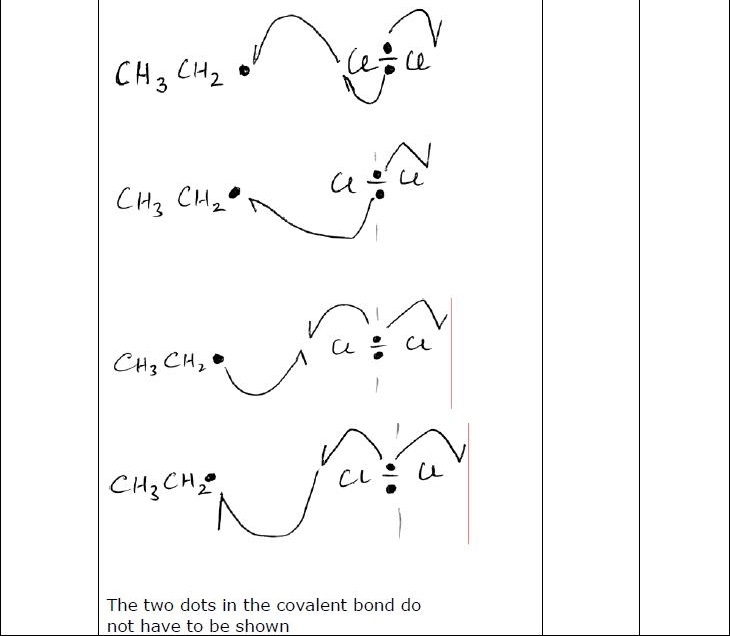
Q1.

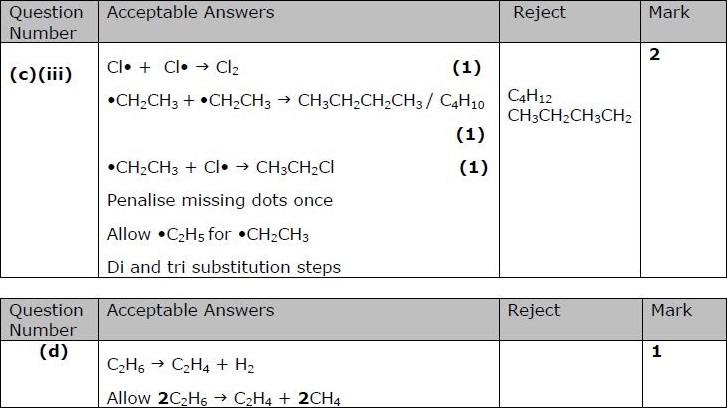


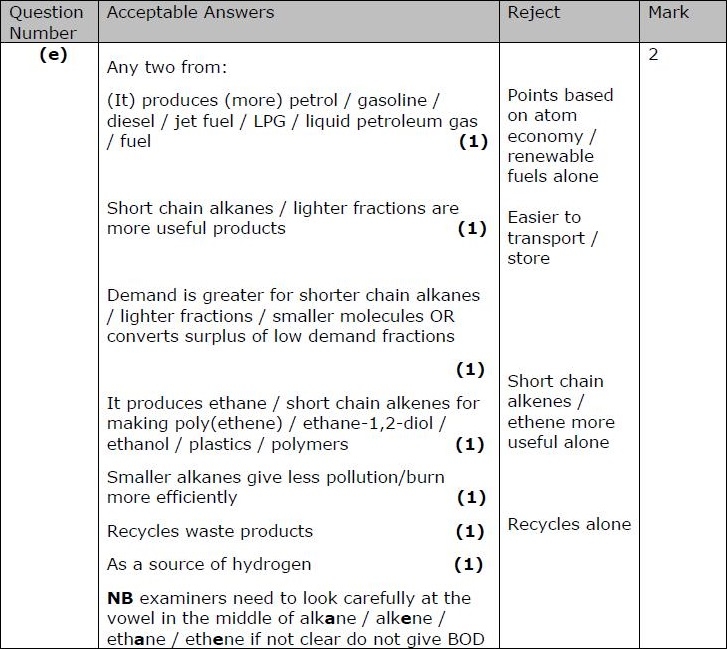




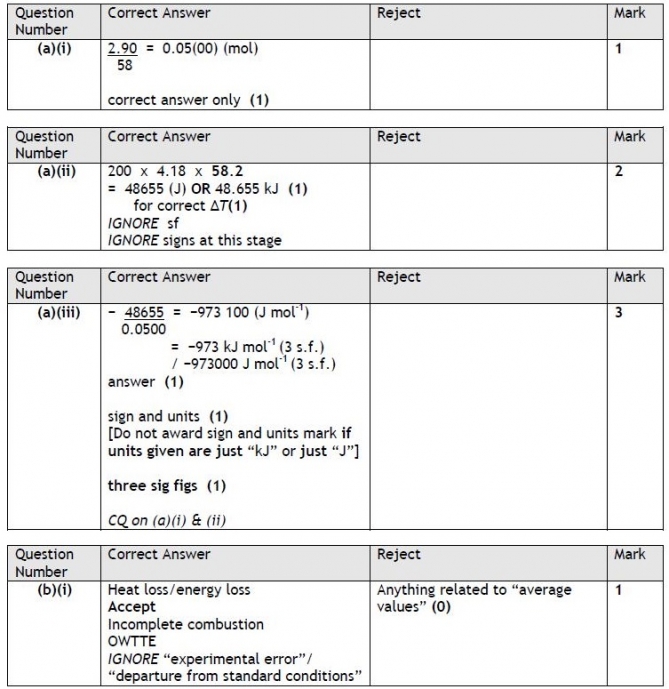


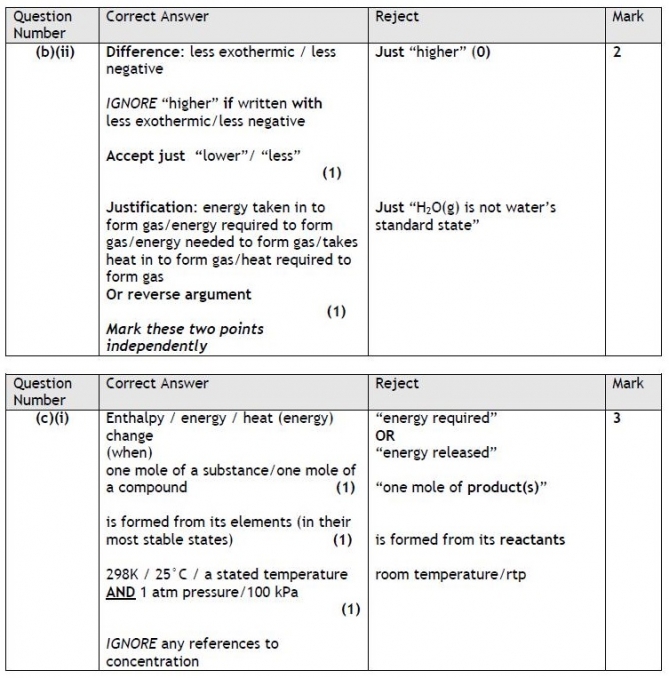


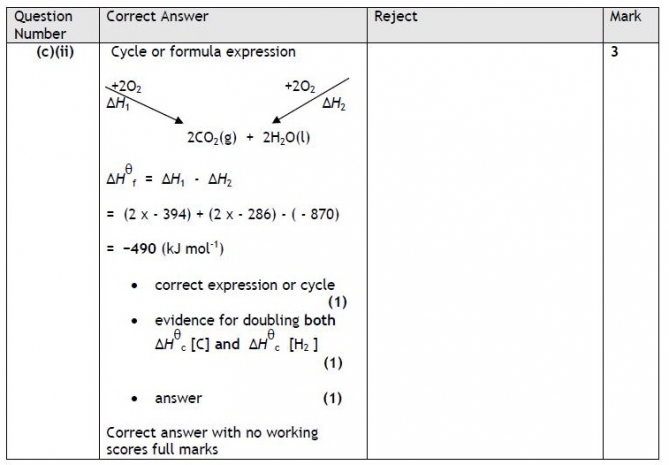




**Q6.**







**Q8.**

