Amount of substance – AS 2022 Chemistry P2

1. June/2022/Paper_7404/2/No.4

0 4 This question is about gas volumes.

0 4 . 1 TNT ($C_7H_5N_3O_6$) is an explosive because it can decompose very quickly and exothermically to form a large volume of gas. An equation for this decomposition is

$$2\,C_7H_5N_3O_6(s) \rightarrow 3\,N_2(g) + 5\,H_2(g) + 12\,CO(g) + 2\,C(s)$$

Calculate the volume of gas, in m^3, measured at 1250 °C and 101 000 Pa, produced by the decomposition of 1.00 kg of TNT (M_r = 227.0).

The gas constant, R = 8.31 J mol^{-1} K^{-1}

[5 marks]

Volume of gas _____ m^3

0 4 . 2 Alkenes have the general formula C_nH_{2n}

When alkenes undergo complete combustion, 1.0 mol of C_nH_{2n} reacts with $\frac{3n}{2}$ mol of oxygen.

Calculate the volume of oxygen needed for the complete combustion of 200 cm^3 of but-1-ene.

The volumes of all gases are measured at the same temperature and pressure.

[1 mark]

Volume of oxygen _____ cm^3

0 4 . 3 Alkanes have the general formula C_nH_{2n+2}

Alkanes undergo complete combustion in a plentiful supply of oxygen.

$$C_nH_{2n+2} + x\,O_2 \rightarrow n\,CO_2 + (n+1)\,H_2O$$

Determine x in terms of n

[1 mark]

x _____

2. June/2022/Paper_7404/2/No.6

0 6 Trichlorofluoromethane (CCl_3F) was developed as a refrigerant. The production and use of CCl_3F is now restricted.

0 6 . 1 The equation for a process used to manufacture CCl_3F is

$$SbF_3Br_2 + CCl_4 \rightarrow CCl_3F + SbF_2Br_2Cl$$

Calculate the percentage atom economy for the production of CCl_3F in this reaction. Give your answer to 3 significant figures.

[2 marks]

Percentage atom economy _____

An alternative synthesis of CCl_3F is the free-radical substitution reaction between fluoromethane (CH_3F) and chlorine.

0 6 . 2 An intermediate in this alternative synthesis is dichlorofluoromethane ($CHCl_2F$)

Give equations to represent the two propagation steps in the conversion of $CHCl_2F$ into CCl_3F

[2 marks]

Propagation step 1

_____

Propagation step 2

_____

0 6 . 3 Analysis of the products of this reaction shows the formation of a compound with the empirical formula CCl_2F

Give an equation to represent a termination step forming this compound.
Show the structural formula of the product in the equation.

[1 mark]