Answer all questions
Write your answers in the spaces provided on the question paper.

For Examiner's Use

1 (a) Define a *Brønsted Lowry acid.*

_____

_____ [1]

(b) The pH of 0.01 moldm^{-3} benzoic acid, C_6H_5COOH, is 3.09 at 25 °C.

(i) Write an equation for the dissociation of C_6H_5COOH.

_____

(ii) Calculate the acid dissociation constant of benzoic acid at 25 °C.

[4]

(c) The values of the ionic product of water, K_w at different temperatures are given in **Table 1.1**.

Table 1.1

temperature/°C	K_w/mol^{2}dm^{-6}
0	0.10×10^{-15}
25	1.00×10^{-14}
50	5.47×10^{-14}

(i) Write an expression for K_w.

_____

For Examiner's Use

(ii) State and explain the effect of temperature on K_w.

(iii) Calculate the pH of the water at 50 °C.

[5]
[Total: 10]

2 (a) **Fig. 2.1** shows the Boltzmann distribution curve for reacting gas molecules at temperatures T_1 and T_2.

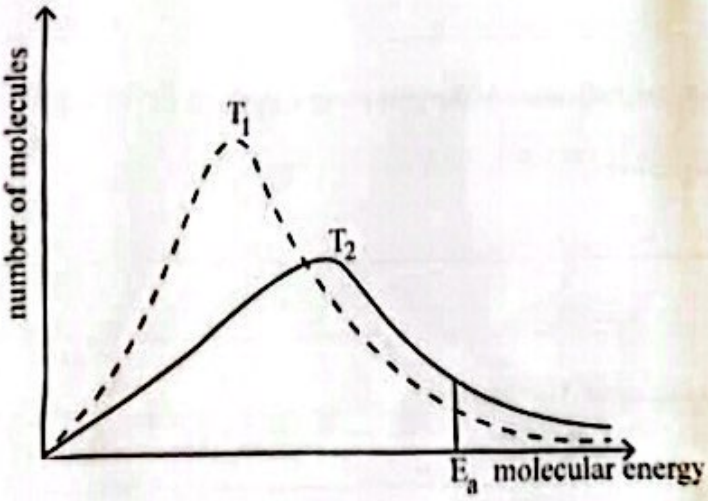

Fig. 2.1

(i) State and explain which of the two temperatures, T_1 and T_2, is higher.

[Turn over

(ii) Mark the position on Fig. 2.1, of the activation energy for the catalysed reaction using letter P. [3]

For Examiner's Use

(b) Sketch an energy profile diagram to show the effect of a catalyst for an endothermic reaction.

[3]

(c) State the *Collision Theory*.

_____

_____

_____

_____ [2]

(d) Explain the significance of the given steps in water purification.

(i) *Aeration*

_____

_____

(ii) *Addition of* $Al_2(SO_4)_3$

_____

_____

[2]

[Total: 10]

For Examiner's Use

3 (a) (i) Write two equations to show the amphoteric nature of aluminium oxide.

1. _____

2. _____

(ii) Explain why aluminium oxide is amphoteric in terms of bonding and structure.

_____

_____

_____

_____

[4]

(b) Explain why

(i) bond energies quoted in the Data Booklet are referred to as *average bond energies*.

_____

_____

(ii) the bond energy of fluorine is lower than that of chlorine.

_____

_____

[3]

(c) (i) Write an equation for the reaction between chlorine and sodium thiosulphate.

_____

(ii) Explain why the reaction between iodine and hydrogen is reversible whereas that between chlorine and hydrogen is not.

_____

_____

_____

[3]
[Total: 10]

For Examiner's Use

4 (a) Fig. 4.1 shows the reaction scheme for the synthesis of a drug, **D**.

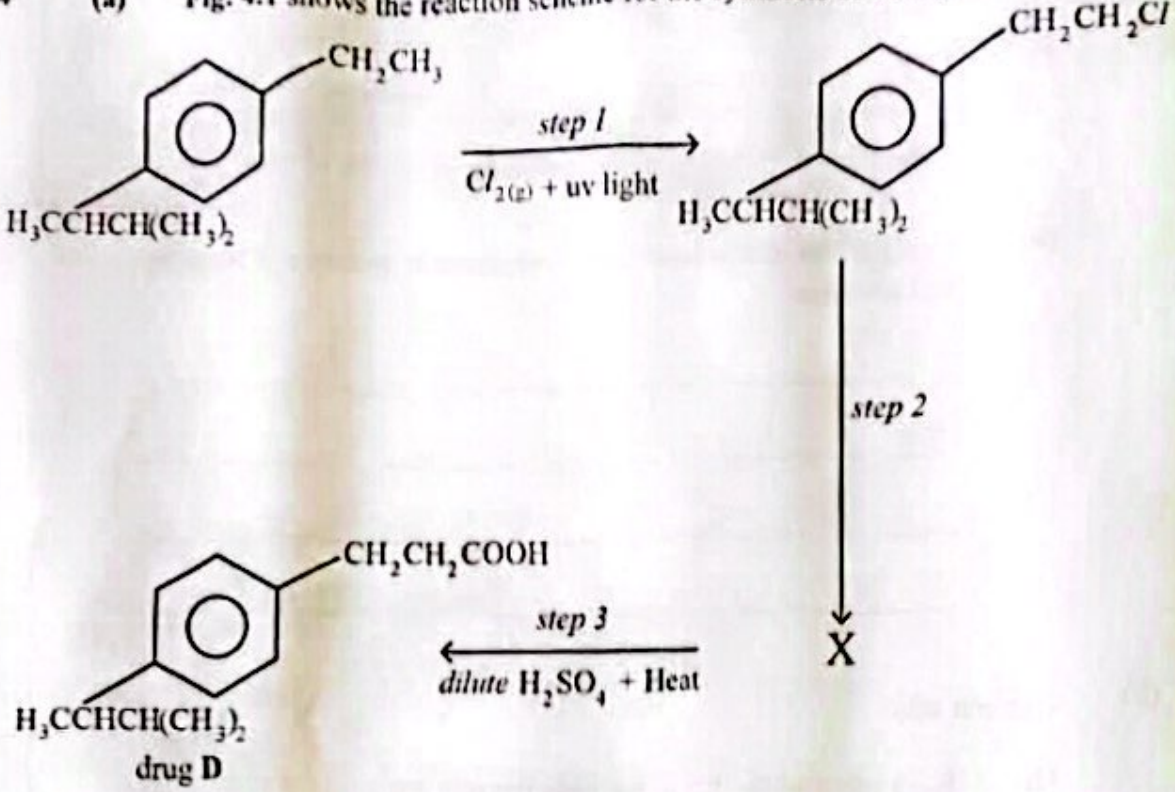

Fig. 4.1

(i) State, with a reason, the type of isomerism exhibited by **D**.

_____

_____

_____

(ii) Write the structural formula of the intermediate **X**.

(iii) Give the reagents and condition(s) for *step 2*.

reagents _____

condition(s) _____

(iv) State the significance of the reaction in *step 2*.

_____

[6]

For Examiner's Use

(b) Drug **D** was boiled in acidified $KMnO_4$.

(i) State the observable change that occurred.

_____

(ii) Name the organic product formed.

_____ [2]

(c) Fig. 4.2 shows the general structural formula of nylon.

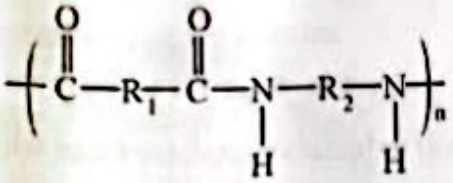

Fig. 4.2

Explain why clothes made of nylon should **not** be washed in boiling water.

_____

_____

_____

_____ [2]

[Total: 10]

For Examiner's Use

5 (a) Fig. 5.1 shows a catalytic converter fitted in the exhaust systems of most modern vehicles.

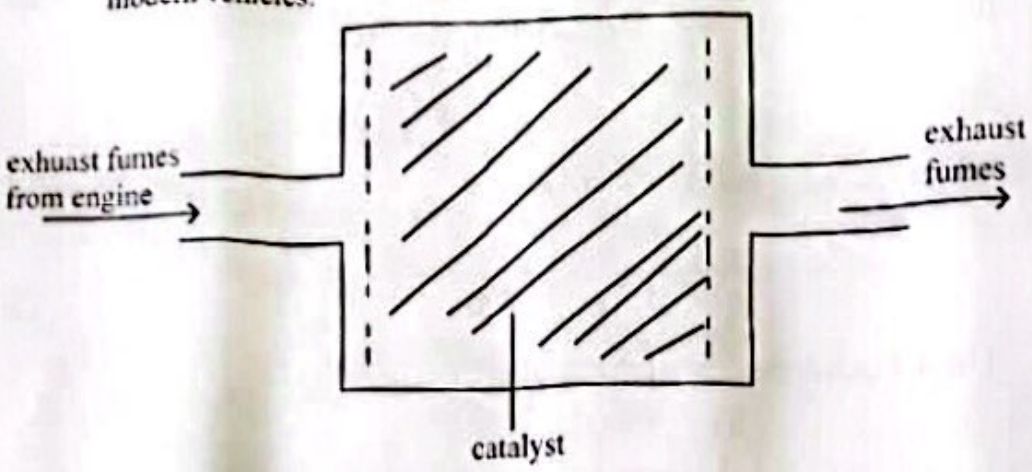

Fig. 5.1

(i) Explain why car exhaust systems are fitted with a catalytic converter.

_____

(ii) Give the names of metals that are used in making the catalyst.

_____

(iii) Name the **three** gases in clean exhaust fumes.

1. _____

2. _____

3. _____

(iv) Unburnt hydrocarbons, are some of the gases in the exhaust fumes from the engine.

Write an equation to show how, an unburnt hydrocarbon of formula C_xH_y reacts in the converter.

_____

[4]

(b) (i) Distinguish between *catalytic cracking* and *steam cracking*.

_____

_____

_____

_____

_____

For Examiner's Use

(ii) Describe the importance of cracking.

[6]
[Total: 10]

6 (a) Explain why transition elements

(i) show variable oxidation states,

(ii) act as catalysts.

[3]

(b) Explain why radioactive waste is

(i) concentrated by incineration before disposal,

(ii) diluted to acceptable levels before being discharged.

[4]