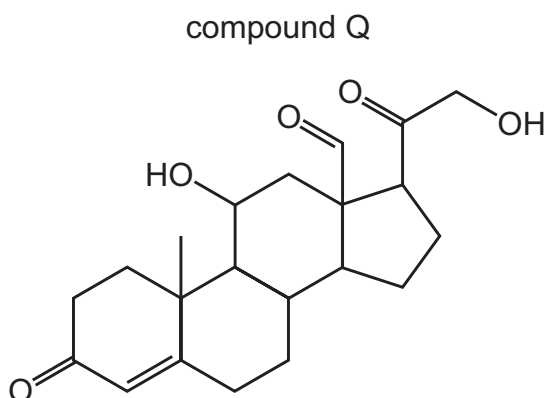


32 Which reaction mixture produces a primary alcohol as the major product?

- A** propanone with NaBH_4
- B** propene with steam in the presence of H_3PO_4
- C** butanoic acid with LiAlH_4
- D** ethene with hot concentrated acidified KMnO_4

35 The structure of a naturally occurring compound, Q, is shown.



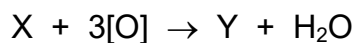
Compound Q is heated under reflux with an excess of acidified KMnO_4 .

Organic product R is formed.

Which row is correct?

	results of tests with compound Q	results of tests with organic product R
A	orange precipitate with 2,4-DNPH and no reaction with alkaline $\text{I}_2(\text{aq})$	yellow precipitate with alkaline $\text{I}_2(\text{aq})$ and no reaction with Fehling's reagent
B	red precipitate with Fehling's reagent and no reaction with alkaline $\text{I}_2(\text{aq})$	orange precipitate with 2,4-DNPH and no reaction with alkaline $\text{I}_2(\text{aq})$
C	yellow precipitate with alkaline $\text{I}_2(\text{aq})$ and orange precipitate with 2,4-DNPH	no reaction with alkaline $\text{I}_2(\text{aq})$ and no reaction with Fehling's reagent
D	yellow precipitate with alkaline $\text{I}_2(\text{aq})$ and red precipitate with Fehling's reagent	yellow precipitate with alkaline $\text{I}_2(\text{aq})$ and orange precipitate with 2,4-DNPH

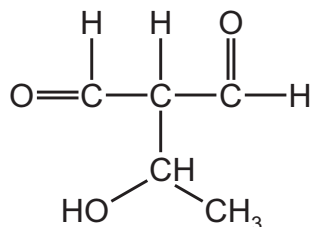
33 The balanced equation for the reaction of X with an excess of acidified $\text{K}_2\text{Cr}_2\text{O}_7$ is shown.



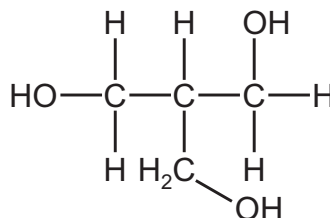
Compound Y is the only organic product of the reaction.

Which compound is X?

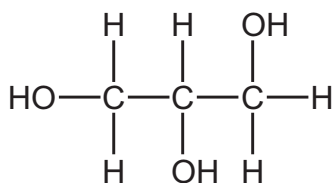
A



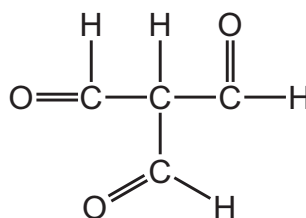
B



C



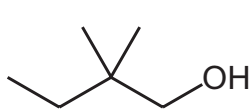
D



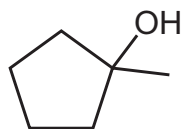
39 Some properties of compound X are listed.

- 1.0 mol X reacts with exactly 8.5 mol oxygen when completely combusted.
- X does **not** react when heated with acidified KMnO_4 .

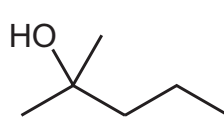
What are the possible identities of X?



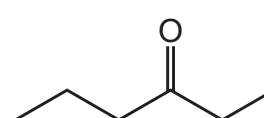
1



2



3



4

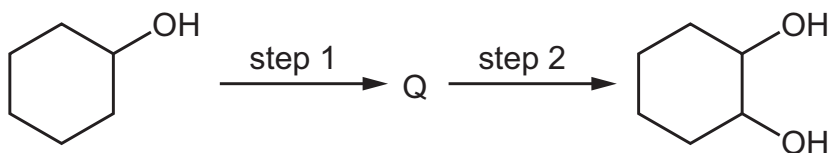
A 1 and 3

B 2 and 4

C 3 only

D 4 only

- 33** Cyclohexanol is converted to cyclohexane-1,2-diol via a two-step synthesis that proceeds via intermediate Q.



Which row identifies the type of reaction in step 1 and in step 2?

	step 1	step 2
A	dehydration	oxidation
B	dehydration	nucleophilic substitution
C	reduction	oxidation
D	reduction	nucleophilic substitution

4 Fig. 4.1 shows a possible synthesis of propene, C_3H_6 .

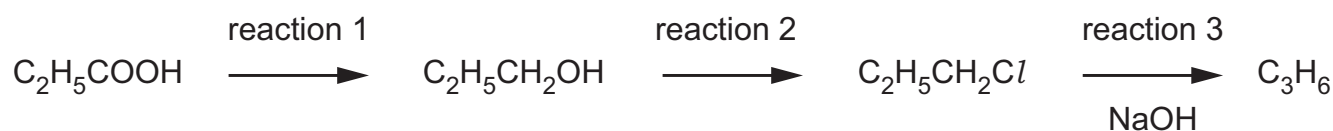


Fig. 4.1

(a) (i) Identify the type of reaction that occurs in reaction 1.

..... [1]

(ii) Suggest a suitable reagent for reaction 2.

..... [1]

(iii) Reaction 3 is an elimination reaction.

Write an equation for this reaction and identify the solvent and conditions used.

equation

solvent and conditions [2]

(iv) $C_2H_5CH_2OH$ can be directly converted to C_3H_6 .

Suggest the reagent and conditions for this conversion.

..... [1]

(b) Under suitable conditions, propene polymerises to form poly(propene).

Poly(propene) exhibits stereoisomerism.

(i) Identify the type of polymerisation that forms poly(propene) from propene.

..... [1]

(ii) Define stereoisomerism.

.....

..... [2]

(iii) Draw a section of poly(propene), showing **two** repeat units.

Use your diagram to identify the type of stereoisomerism shown by poly(propene). Explain your answer.

section of poly(propene)

[3]

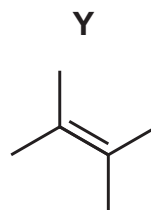
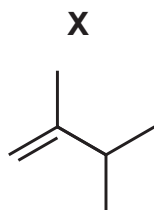
(iv) State **two** difficulties associated with the disposal of poly(propene).

1

2

[2]

(c) Under different conditions, two molecules of propene can combine to form compounds **X** and **Y**.



(i) Name **X**.

..... [1]

(ii) Fig. 4.2 shows the mass spectrum of either compound **X** or compound **Y**.

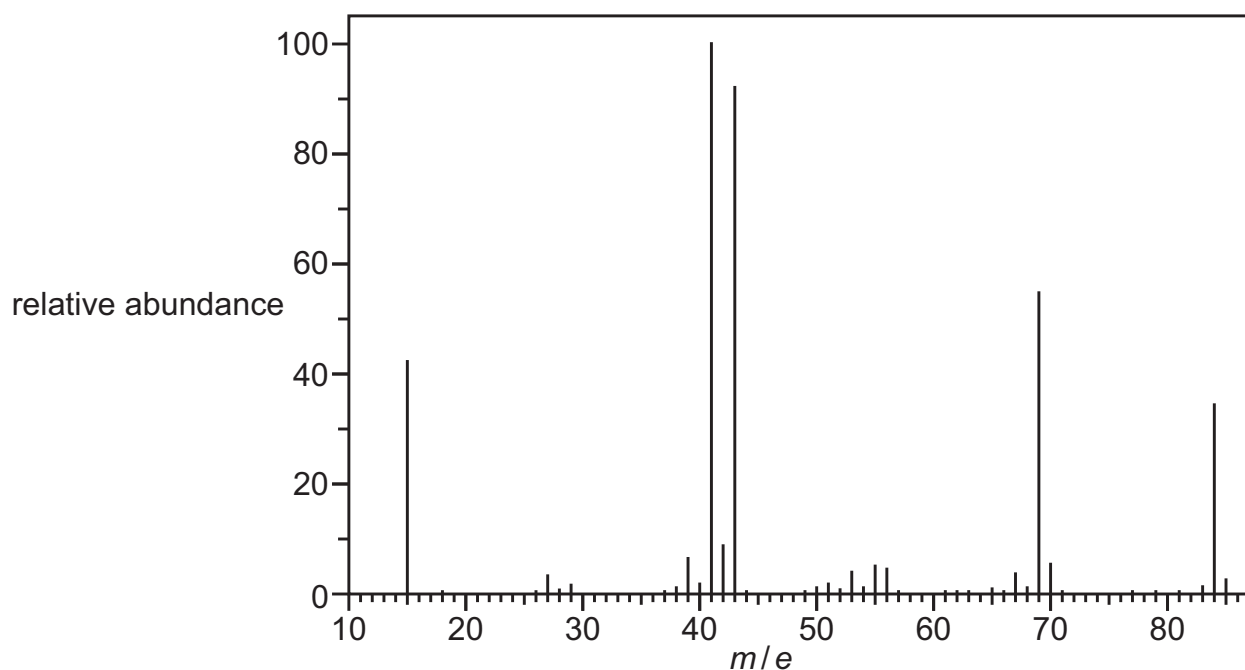


Fig. 4.2

Identify which of **X** and **Y** gives this mass spectrum.

Give **one** reason for your answer, referring to the fragmentation pattern.

.....
.....
..... [1]

(iii) The molecular ion peak in the spectrum in Fig. 4.2 has relative abundance 34.7.

Calculate the relative abundance of the $[M+1]^+$ peak in this spectrum.

relative abundance of $[M+1]^+$ peak = [1]

Important values, constants and standards

molar gas constant	$R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$
Faraday constant	$F = 9.65 \times 10^4 \text{ C mol}^{-1}$
Avogadro constant	$L = 6.02 \times 10^{23} \text{ mol}^{-1}$
electronic charge	$e = -1.60 \times 10^{-19} \text{ C}$
molar volume of gas	$V_m = 22.4 \text{ dm}^3 \text{ mol}^{-1}$ at s.t.p. (101 kPa and 273 K) $V_m = 24.0 \text{ dm}^3 \text{ mol}^{-1}$ at room conditions
ionic product of water	$K_w = 1.00 \times 10^{-14} \text{ mol}^2 \text{ dm}^{-6}$ (at 298 K (25 °C))
specific heat capacity of water	$c = 4.18 \text{ kJ kg}^{-1} \text{ K}^{-1}$ (4.18 J g ⁻¹ K ⁻¹)

The Periodic Table of Elements

Group																			
1	2													13	14	15	16	17	18

2 Aluminium oxide, Al_2O_3 , and phosphorus(V) oxide, P_4O_{10} , are both used as reagents and catalysts.

(a) The melting point of Al_2O_3 is $2072^\circ C$. The melting point of P_4O_{10} is $340^\circ C$.

Explain the difference in the melting points of these two compounds.

.....

 [3]

(b) A 5.00 dm^3 sealed flask contains 0.400 mol of $CO(g)$ and 0.800 mol of $H_2(g)$ and an Al_2O_3 catalyst. The flask is heated to a temperature of $290^\circ C$ and allowed to reach equilibrium. Equation 1 shows the reaction.



The equilibrium constant, K_c , of equation 1 is given.

$$K_c = \frac{[CH_3OH]}{[CO][H_2]^2}$$

(i) State the units of K_c .

..... [1]

(ii) The equilibrium mixture contains 0.280 mol of $CH_3OH(g)$.

Calculate the value of K_c .

Give your answer to **three** significant figures.

value of K_c = [3]

(iii) State and explain the effect, if any, on the value of K_c when the overall pressure in the sealed flask is increased.

.....
 [1]

(c) P_4O_{10} catalyses the reversible reaction of CO with H_2 to form CH_3OH .



P_4O_{10} then acts as a dehydrating agent, causing CH_3OH to form CH_3OCH_3 .

(i) Explain how the presence of a catalyst affects a chemical reaction.

.....
.....
..... [1]

(ii) Construct an equation for the dehydration reaction of CH_3OH to form CH_3OCH_3 .

..... [1]

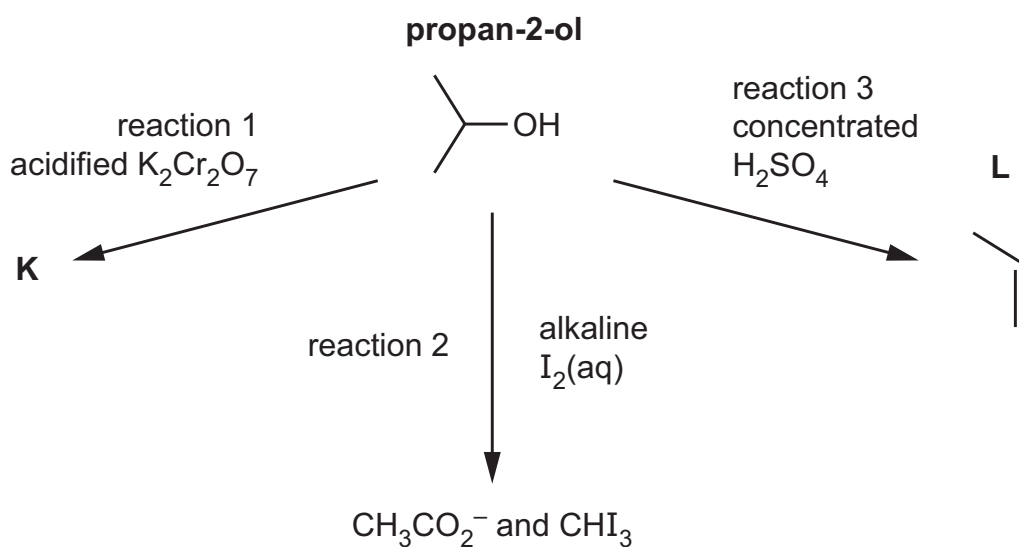
(iii) Write an equation to show the reaction of P_4O_{10} with an excess of water.

..... [1]

[Total: 11]

- 3 Propan-2-ol, $(\text{CH}_3)_2\text{CHOH}$, is sometimes added to fuel to help it burn.

Fig. 3.1 shows some reactions of propan-2-ol.



- (a) (i) Draw the structure of organic compound **K**.

[1]

- (ii) State an observation you would make in reaction 2.

..... [1]

- (iii) State the type of reaction that is shown in reaction 3.

..... [1]

- (iv) Complete Fig. 3.2 to show the pi (π) bond in **L** that is formed from orbital overlap.

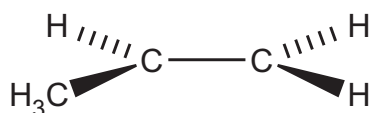


Fig. 3.2

[1]

- (b) Propan-2-ol reacts with sodium to produce $(\text{CH}_3)_2\text{CH-O}^-$ anions.

These anions react with 2-bromopropane to form compound **N**, as shown in Fig. 3.3.

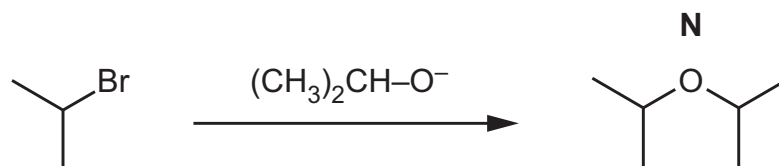


Fig. 3.3

- (i) Write an equation for the reaction of propan-2-ol with sodium.

..... [1]

- (ii) The reaction of 2-bromopropane with $(\text{CH}_3)_2\text{CH-O}^-$ anions follows an $\text{S}_{\text{N}}1$ mechanism.

Complete Fig. 3.4 to show this mechanism. Include charges, dipoles, lone pairs of electrons and curly arrows, as appropriate.



Fig. 3.4

[3]

- (iii) Suggest how the rate of the $\text{S}_{\text{N}}1$ reaction would change, if at all, if 2-chloropropane were used instead of 2-bromopropane.

Explain your answer.

.....
.....
..... [2]

- (iv) **N** is also added to petrol to make it burn more smoothly.

Construct an equation for the complete combustion of **N**, $\text{C}_6\text{H}_{14}\text{O}$.

$\text{C}_6\text{H}_{14}\text{O}$ [1]

[Total: 11]