(e) As shown in the prediction, answer (a), the theoretical yield of C_2H_2 = 0.106 mol

$$\text{percentage yield} = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100\%$$

$$= \frac{1.30\ \text{g}}{2.76\ \text{g}} \times 100\%$$

$$\text{percentage yield} = 47.2\%$$

Therefore, the CaC_2 is 47.2% pure.

Evaluation

(f) We assume that the reactants are pure, that $H_2O_{(l)}$ is in excess, and that we obtained a 100% yield.

INVESTIGATION 1.5.1 COMPARISON OF THREE ISOMERS OF BUTANOL

(Page 84)

Prediction

(a) All three alcohols will produce alkyl halides, because they can all undergo substitution reactions where the OH group is substituted by a halogen atom.

The primary alcohol will oxidize to an aldehyde; the secondary alcohol will oxidize to a ketone; and the tertiary alcohol will not readily undergo oxidization.

Evidence

(b)

Alcohol	Reaction with $HCl_{(aq)}$	Reaction with $KMnO_{4(aq)}$
1-butanol	cloudy layer formed after more than 1 min	colour change
2-butanol	cloudy layer formed in about a minute	colour change
2-methyl-2-propanol	cloudy layer formed immediately	no reaction

Analysis

(c) Each alcohol undergoes halogenation. Only the primary and secondary alcohols undergo controlled oxidation.

Evaluation

(d) The theory is correct (although the cloudy layer may be difficult to see in the primary alcohol).

Synthesis

(e) All three alcohols form chlorides. The primary and secondary alcohols undergo controlled oxidation; the tertiary alcohol does not. The chlorides do not contain groups capable of hydrogen bonding and thus are not as soluble as the alcohols in water.

(f) $CH_3CH_2CH_2CH_2OH + HCl \rightarrow CH_3CH_2CH_2CH_2Cl + H_2O$

$$\begin{array}{l}CH_3CH_2\underset{\displaystyle\overset{|}{OH}}{C}HCH_3 + HCl \rightarrow CH_3CH_2\underset{\displaystyle\overset{|}{Cl}}{C}HCH_3 + H_2O\end{array}$$

$$CH_3\overset{\displaystyle CH_3\atop |}{\underset{\displaystyle | \atop OH}{C}}CH_3 + HCl \rightarrow CH_3\overset{\displaystyle CH_3\atop |}{\underset{\displaystyle | \atop Cl}{C}}CH_3 + H_2O$$

(g) $CH_3CH_2CH_2CH_2OH + (O) \rightarrow CH_3CH_2CH_2CHO + H_2O$

$$CH_3CH_2\underset{\substack{|\\ OH}}{C}HCH_3 + (O) \rightarrow CH_3CH_2\underset{\substack{\|\\ O}}{C}CH_3 + H_2O$$

$$CH_3\underset{\substack{|\\ OH}}{\overset{\substack{CH_3\\ |}}{C}}CH_3 + (O) \rightarrow \text{ no reaction}$$

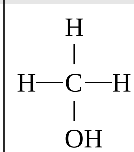
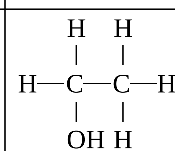
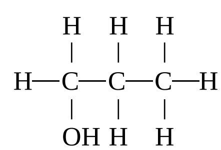
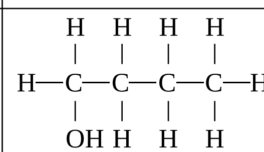
(h) 1°, 2°, and 3° alcohols all undergo halogenation reactions, the OH group being substituted with the halogen atom. 1° and 2° alcohols undergo controlled oxidation to aldehydes and ketones respectively, but 3° alcohols do not.

INVESTIGATION 1.5.2 TRENDS IN PROPERTIES OF ALCOHOLS

(Page 86)

Question

(a)–(c)

Name	Structural Formula	b.p. (°C)	m.p. (°C)	Solubility	Diagram
methanol	CH_3OH	65	–94	w, al, eth, ace, bz, chl	 methanol
ethanol	C_2H_5OH	78	–117	w, al, eth, ace, bz	 ethanol
1-propanol	C_3H_7OH	97	–126	w, al, eth, ace, bz	 1-propanol
1-butanol	C_4H_9OH	117	–89	w, al, eth, ace, bz	 1-butanol

KEY:
w: soluble in water;
al: soluble in ethanol;
eth: soluble in diethyl ether;
ace: soluble in acetone;
bz: soluble in benzene;
chl: soluble in chloroform