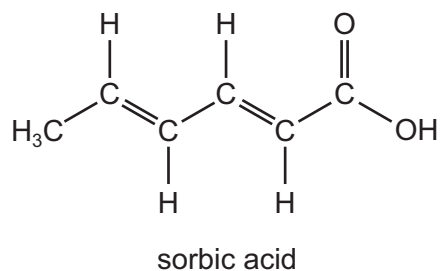


24 Sorbic acid is used as a food preservative because it kills fungi and moulds.



Sorbic acid will react with

- hydrogen in the presence of a nickel catalyst,
- bromine in an organic solvent.

How many moles of hydrogen and of bromine will be incorporated into one mole of sorbic acid by these reactions?

	moles of hydrogen	moles of bromine
<b>A</b>	2	2
<b>B</b>	2	$2\frac{1}{2}$
<b>C</b>	3	2
<b>D</b>	3	$2\frac{1}{2}$

25 Bromine reacts with ethene to form 1,2-dibromoethane.

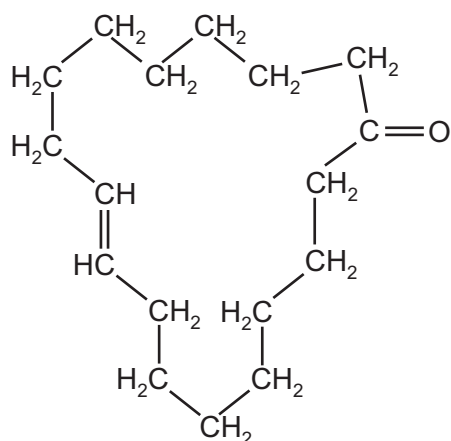
What is the correct description of the organic intermediate in this reaction?

- A** It has a negative charge.
- B** It is a free radical.
- C** It is a nucleophile.
- D** It is an electrophile.

26 Which equation represents a valid propagation step in the free radical reaction between ethane and chlorine?

- A**  $C_2H_6 + Cl^\bullet \rightarrow C_2H_5Cl + H^\bullet$
- B**  $C_2H_5Cl + Cl^\bullet \rightarrow C_2H_4Cl^\bullet + HCl$
- C**  $C_2H_6 + H^\bullet \rightarrow C_2H_5^\bullet + HCl$
- D**  $C_2H_5^\bullet + Cl^\bullet \rightarrow C_2H_5Cl$

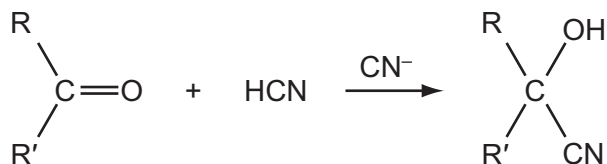
- 27 The naturally-occurring molecule civetone is found in a gland of the African civet cat and has been used in perfumery.



civetone

With which reagent will civetone **not** react?

- A 2,4-dinitrophenylhydrazine reagent  
 B Fehling's reagent  
 C hydrogen bromide  
 D sodium tetrahydridoborate(III) (sodium borohydride)
- 28 Cyanohydrins can be made from carbonyl compounds by generating  $\text{CN}^-$  ions from HCN in the presence of a weak base.

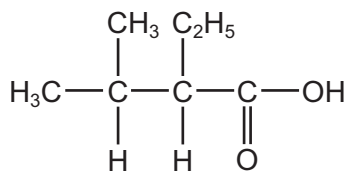


In a similar reaction,  $^-\text{CH}_2\text{CO}_2\text{CH}_3$  ions are generated from  $\text{CH}_3\text{CO}_2\text{CH}_3$  by strong bases.

Which compound can be made from an aldehyde and  $\text{CH}_3\text{CO}_2\text{CH}_3$  in the presence of a strong base?

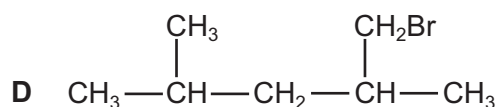
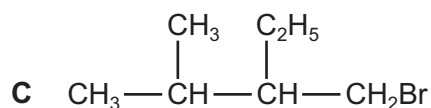
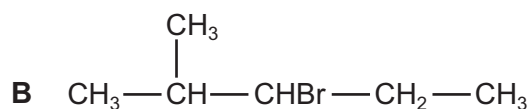
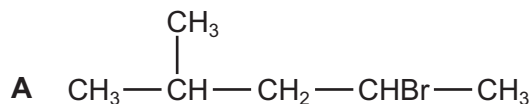
- A  $\text{CH}_3\text{CH}(\text{OH})\text{CO}_2\text{CH}_3$   
 B  $\text{CH}_3\text{CO}_2\text{CH}_2\text{CH}(\text{OH})\text{CH}_3$   
 C  $\text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}_2\text{CO}_2\text{CH}_3$   
 D  $(\text{CH}_3)_2\text{C}(\text{OH})\text{CH}_2\text{CO}_2\text{CH}_3$

- 29 The characteristic odour of rum is attributed to the compound 2-ethyl-3-methylbutanoic acid.

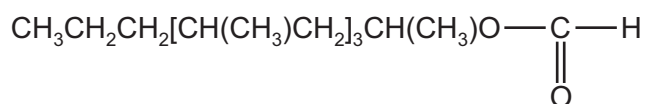


2-ethyl-3-methylbutanoic acid

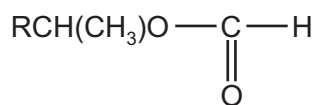
Which compound will produce 2-ethyl-3-methylbutanoic acid by heating under reflux with alcoholic sodium cyanide and subsequent acid hydrolysis of the reaction product?



- 30 The acarid mite releases *lardolure* to attract other mites to a host. This chemical can be destroyed by hydrolysis with acid.



A simplified formula for *lardolure* may be written as follows.



What are the products of its hydrolysis?

- A  $\text{RCH}(\text{CH}_3)\text{CO}_2\text{H} + \text{CH}_3\text{OH}$   
 B  $\text{RCH}(\text{CH}_3)\text{CO}_2\text{H} + \text{HCO}_2\text{H}$   
 C  $\text{RCH}(\text{CH}_3)\text{OH} + \text{CO}_2$   
 D  $\text{RCH}(\text{CH}_3)\text{OH} + \text{HCO}_2\text{H}$

## Section B

For each of the questions in this section, one or more of the three numbered statements 1 to 3 may be correct.

Decide whether each of the statements is or is not correct (you may find it helpful to put a tick against the statements that you consider to be correct).

The responses **A** to **D** should be selected on the basis of

<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

No other combination of statements is used as a correct response.

- 31** A monomer undergoes addition polymerisation. A 1 mol sample of the monomer is completely polymerised.

How many moles of polymer might, theoretically, be formed?

- 1 1
- 2  $10^{-6}$
- 3  $\frac{1}{6.02 \times 10^{23}}$

- 32** Which physical properties are due to hydrogen bonding between water molecules?

- 1 Water has a higher boiling point than  $\text{H}_2\text{S}$ .
- 2 Ice floats on water.
- 3 The H–O–H bond angle in water is approximately  $104^\circ$ .

- 33** Which equilibria, in which all species are gaseous, would have equilibrium constants,  $K_p$ , with no units?

- 1 sulfur dioxide and oxygen in equilibrium with sulfur trioxide
- 2 hydrogen and iodine in equilibrium with hydrogen iodide
- 3 carbon monoxide and steam in equilibrium with carbon dioxide and hydrogen

- 34 Why does a mixture of hydrogen gas and bromine gas react together faster at a temperature of 500 K than it does at a temperature of 400 K?
- 1 A higher proportion of effective collisions occurs at 500 K.
  - 2 Hydrogen molecules and bromine molecules collide more frequently at 500 K.
  - 3 The activation energy of the reaction is lower at 500 K.

- 35 A farmer added lime to damp soil, followed by the nitrogenous fertiliser ammonium sulfate. A chemical reaction occurred in the soil.

Which substances were formed in this reaction?

- 1 sulfuric acid
  - 2 calcium sulfate
  - 3 ammonia
- 36 Which statements about the reaction of solid sodium bromide with concentrated sulfuric acid are correct?
- 1 Hydrogen bromide is a product of the reaction.
  - 2 Sulfuric acid is oxidised to sulfur dioxide.
  - 3 Bromide ions are reduced to bromine.
- 37 Which statements are true for an  $S_N2$  reaction?
- 1 One bond is broken as another bond is formed.
  - 2 The formation of a transition state involves the collision of two molecules or ions.
  - 3 A carbon atom in the transition state is bonded, either fully or partially, to five other atoms.
- 38 The chlorine free radical takes part in the destruction of the ozone layer.

Which statements about this free radical are correct?

- 1 It is formed by the heterolytic fission of the covalent bond in a chlorine-containing molecule.
- 2 It has a single unpaired electron.
- 3 It has the same electron arrangement as a chlorine atom.

