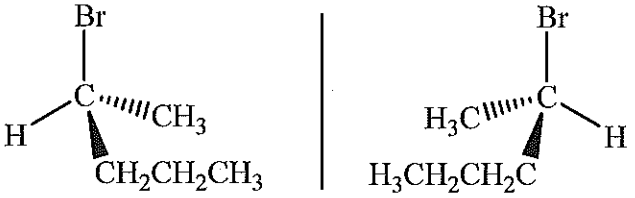
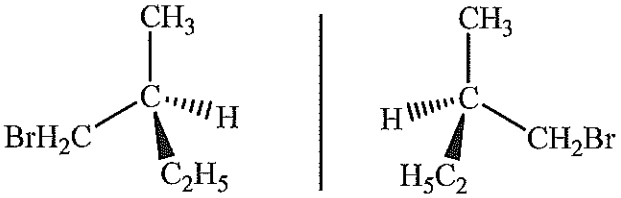
8. (a)

2-bromopentane



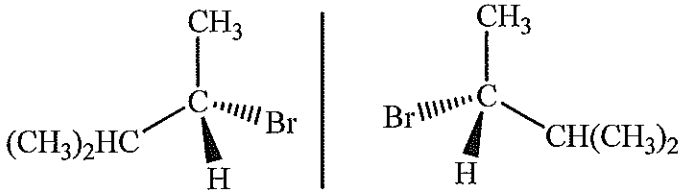
OR

1-bromo-2-methylbutane



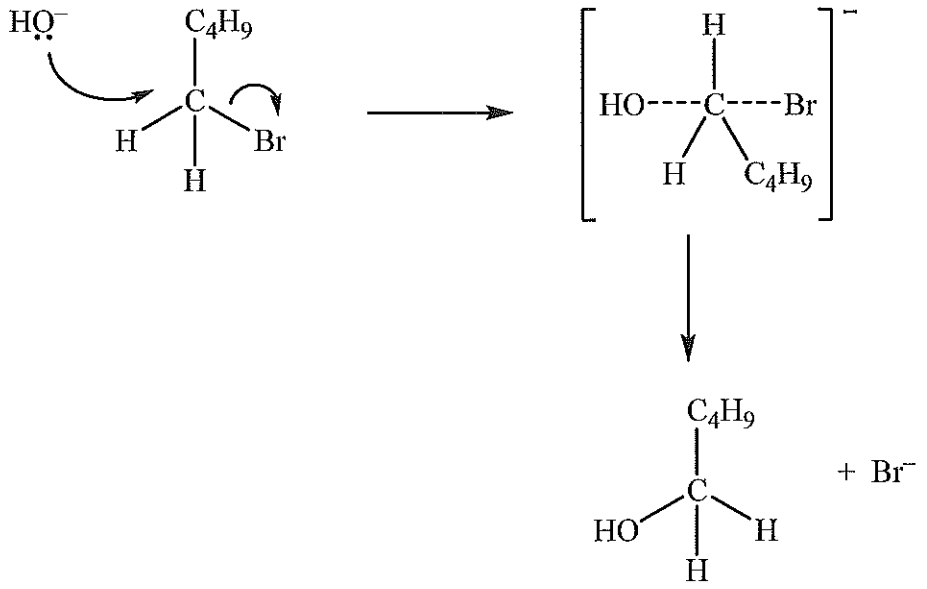
OR

2-bromo-3-methylbutane



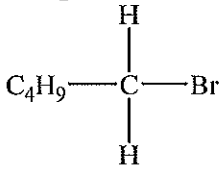
correct isomer 3D structure; ***[3]***
correct name;
correct enantiomer 3D structure;
*If compound incorrectly named award **[2 max]** for two correct 3D enantiomers, and **[1 max]** for a correct structure of an enantiomer not shown in 3D.*
*If non-optically active isomers given (e.g. 2-bromo-2-methyl-butane) award **[1 max]** if name and 3D structure are correct.*
Accept condensed form for alkyl chain throughout.

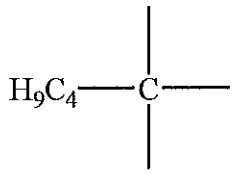
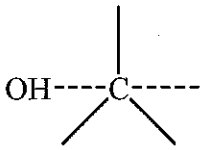
(b) (i)



curly arrow going from lone pair/negative charge on O in HO^- to C bonded to Br;
Do not allow curly arrow originating on H in HO^- (e.g. originating on negative charge on H i.e. lone/pair/negative charge must be on O).

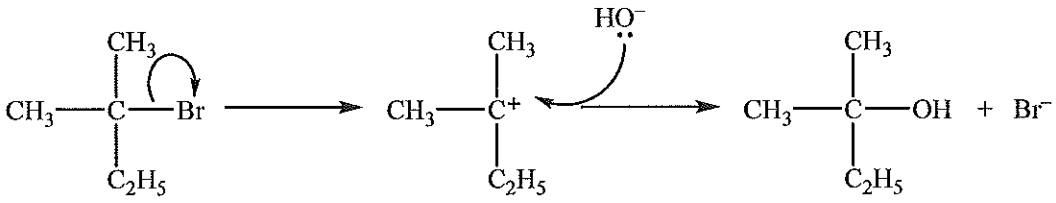
curly arrow from C–Br bond to form Br^- (this can also be shown in transition state);
transition state showing overall negative charge; ***[3]***
Accept condensed formulas as long as curly arrows can still be shown e.g.



Accept  *and* 

If wrong formula used for halogenoalkane, e.g. 1-bromobutane award ***[2 max]****.*

(ii)

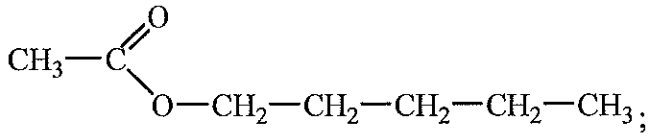


curly arrow from C–Br bond to form Br^-;
correct structure of tertiary carbocation;
curly arrow going from lone pair/negative charge on O in HO^- to C^+; ***[3]***
If non-bonding pair not shown then arrow must originate from negative sign on O or the minus sign.
Only penalize arrow from H once in (b).
If wrong formula is used for 2-bromo-2-methylbutane award ***[2 max].***

(iii) the C bonded to the Br in 1-bromopentane is also bonded to two H atoms so can accommodate five groups around it in the transition state / *OWTTE*;
the C bonded to the Br in 2-bromo-2-methylbutane has three other (bulky) groups bonded to it so cannot accommodate five groups around it in the transition state / *OWTTE*;
2-bromo-2-methylbutane forms a tertiary carbocation which is stabilized by the positive inductive effect of the three alkyl groups / *OWTTE*;
1-bromopentane would form a primary carbocation (if it went by S_N2) which is much less stable as there is only one alkyl group exerting a positive inductive effect / *OWTTE*; ***[3 max]***

(iv) the boiling point of 1-bromopentane is higher than the boiling point of 2-bromo-2-methylbutane;
2-bromo-2-methylbutane is more spherical in shape / less surface area in contact between molecules of 2-bromo-2-methylbutane than between molecules of 1-bromopentane;
hence weaker intermolecular forces of attraction/van der Waals' forces of attraction between molecules of 2-bromo-2-methylbutane / *OWTTE*; ***[3]***

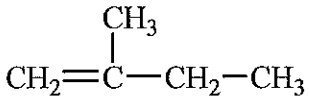
(v) esterification / condensation;
$CH_3–CO–O–(CH_2)_4CH_3$ / $CH_3COO(CH_2)_4CH_3$ /
$CH_3COOCH_2CH_2CH_2CH_2CH_3$ /

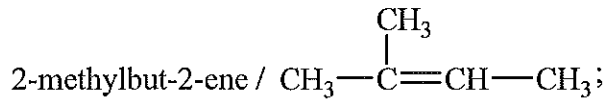


; ***[2]***

Accept $CH_3–CO–O–C_5H_{11}$

(c) elimination;

2-methylbut-1-ene /  ;

2-methylbut-2-ene /  ;

neither can exist as geometrical isomers as they contain the same two groups/atoms on one of the double bonded carbon atoms / *OWTTE*; ***[4]***

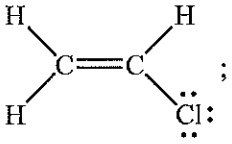
(d) (i) $n\ HO{-}(CH_2)_5{-}OH + n\ HOOC{-}C_6H_4{-}COOH \rightarrow H{-}[O{-}(CH_2)_5{-}O{-}CO{-}C_6H_4{-}CO{-}]_n{-}OH + (2n{-}1)H_2O$ ***[3]***

*Award **[1]** for correct reactants, **[1]** for correct polyester and **[1]** for balanced water.*
*Award **[3]** if correct equation given for one molecule of diol reacting with one molecule of dicarboxylic acid.*
i.e.
$HO{-}(CH_2)_5{-}OH + HOOC{-}C_6H_4{-}COOH \rightarrow HO{-}(CH_2)_5{-}O{-}CO{-}C_6H_4{-}COOH + H_2O$

(ii) formation of polyesters/condensation polymers/synthetic fabrics; ***[1]***

9. (a) (i) colour change from yellow/orange/rust colour/red/brown to colourless; ***[1]***
No mark for change to clear, or for decolourized with no reference to original colour.

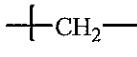
(ii) *Chloroethene:*



;

No mark if the lone pairs missing on Cl.
Accept lines, dots or crosses for e^- pairs.

Poly(chloroethene):

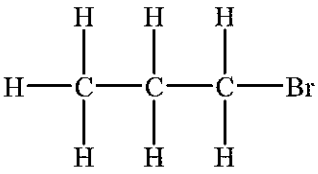


; ***[2]***

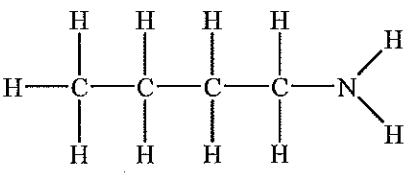
n and square brackets are not required.
Continuation bonds must be shown.

(iii) (hydration of ethene for the manufacture of) ethanol/ $C_2H_4 + H_2O \rightarrow C_2H_5OH$;
(synthesis of) CH_3COOH /ethanoic/acetic acid;
(synthesis of) ethylene glycol/1,2-ethanediol/ethane-1,2-diol;
(synthesis of) drugs/pesticides;
(hydrogenation of unsaturated oils in the manufacture of) margarine; ***[2 max]***
Accept other commercial applications.

(b) (i)



and



; ***[1]***

Accept $CH_3CH_2CH_2Br$. *Accept $CH_3CH_2CH_2CH_2NH_2$.*
Penalise missing H atoms once only.

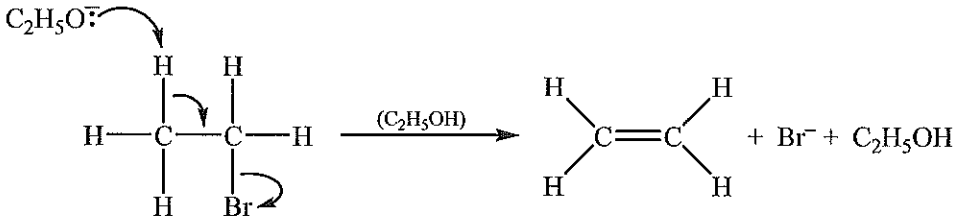
(ii) $CH_3CH_2CH_2Br + KCN \rightarrow CH_3CH_2CH_2CN + KBr$;
Accept ionic equation.

$CH_3CH_2CH_2CN + 2H_2 \rightarrow CH_3CH_2CH_2CH_2NH_2$;
Equation must be balanced for mark.
Accept $LiAlH_4$ in place of reaction with hydrogen.

For the second equation:
Ni (as catalyst);
heat/150 °C; ***[4]***

(c) (i) hot;
alcoholic OH^-/NaOH/KOH;
$C_2H_5Br + C_2H_5ONa \rightarrow C_2H_4 + NaBr + C_2H_5OH$ /
$C_2H_5Br + NaOH \rightarrow C_2H_4 + NaBr + H_2O$; ***[3]***
Accept ionic equation with $C_2H_5O^-$ or OH^-.

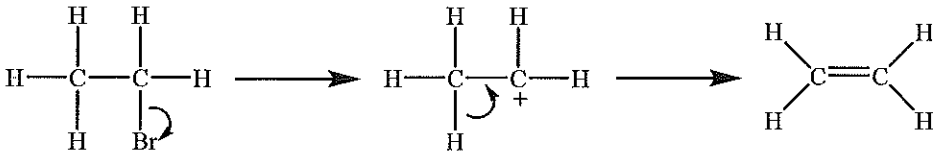
(ii) OH^- reacts with ethanol to form ethoxide ion/ $C_2H_5OH + OH^- \rightarrow C_2H_5O^- + H_2O$;



curly arrow going from lone pair on O in $C_2H_5O^-$/$CH_3CH_2O^-$ to H on β–C;
Accept arrow origin from OH^- but do not allow curly arrow originating on H in OH^-.
Accept OH^- in place of $C_2H_5O^-$ (to form H_2O).

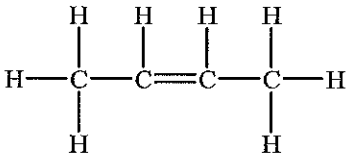
curly arrow going from CH bond to form C=C bond;
curly arrow showing Br leaving;
structural formula of organic product $CH_2=CH_2$;

*Award **[4 max]** for E1 mechanism (unstable primary carbocation)*

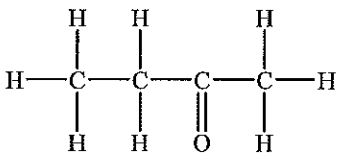


curly arrow showing Br leaving;
representation of primary carbocation;
curly arrow going from lone pair on O in H_2O to H on C adjacent to C^+ **and** curly arrow going from CH bond to form C=C bond;
structural formula of organic product $CH_2=CH_2$; ***[5]***

(d) (i)



/ $CH_3CH=CHCH_3$;



/ $CH_3CH_2COCH_3$;

[2]

Penalize missing H atoms once only.

(ii) $CH_3CH{=}CHCH_3 + H_2O \rightarrow CH_3CH(OH)CH_2CH_3$;
concentrated sulphuric acid/H_2SO_4/ phosphoric acid/H_3PO_4 (catalyst) **and** heat/steam;
$3CH_3CH(OH)CH_2CH_3 + Cr_2O_7^{2-} + 8H^+ \rightarrow 3CH_3COCH_2CH_3 + 2Cr^{3+} + 7H_2O$;
Accept $CH_3CH(OH)CH_2CH_3 + [O] \rightarrow CH_3COCH_2CH_3 + H_2O$.
Accept C_2H_5 as CH_2CH_3.

dichromate(VI) (ion)/$Cr_2O_7^{2-}$ **and** acidic/H^+;
Accept MnO_4^- in place of $Cr_2O_7^{2-}$ for M3 and M4.

heat/reflux; ***[5]***