M1. (a) M1 curly arrow from lone pair on oxygen of hydroxide ion to H atom on C-H adjacent to C-Br

1

M2 curly arrow from single bond of adjacent C-H to adjacent single bond C-C

(only credit M2 if M1 is being attempted to correct H atom)

1

M3 curly arrow from C-Br bond to side of Br atom

(credit M3 independently)

1

(b) Ml credit a correct structure for either geometrical E-Z isomer and its designation as either *cis* or *trans.*
OR credit two correct geometrical E-Z isomer structures (ignore the names)
OR credit two correct names for *cis* pent-2-ene and *trans* pent-2-ene (ignore the structures)

1

M2 credit a second mark if all four parts of the required structures and names are correct.

(credit "linear" structures)
(insist on the alkyl groups being attached clearly by C-C bonds)

1

(c) (i) Ml curly arrow from middle of C = C bond to H atom on H-Br

(penalise M1 if partial negative charge or formal positive charge on H)
(penalise Ml if pent-2-ene is used)

1

M2 curly arrow from H-Br bond to side of Br atom

1

M3 correct structure for correct secondary carbocation

1

M4 curly arrow from lone pair on bromide ion to the positive carbon of carbocation, ensuring that bromide ion has a negative charge.

(with the exception of pent-2-ene, if the wrong alkene is used, only penalise the structure M3)
(penalise the use of two dots in addition to a covalent bond, once only)

1

(ii) 1-bromopentane

1

(iii) Ml 2-bromopentane is formed *via* the secondary (or 2°) carbocation

1

OR 1-bromopentane is formed *via* the primary (or 1°) carbocation
M2 a secondary carbocation is more stable than a primary carbocation -
award this mark only if the quality of language justifies the award.

(the argument must involve clear statements about <u>carbocations)</u>

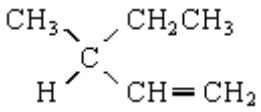
1

[12]

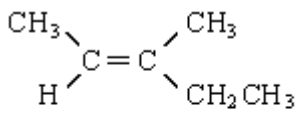
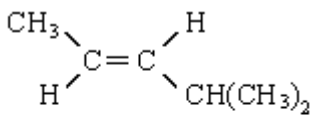
M2.C

[1]

M3. (a) *Structure of* **P**:


(1)

Structures of **Q** and **R**:


and


NOT C_3H_7

(1) **(1)**

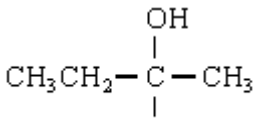
Q and R in any order

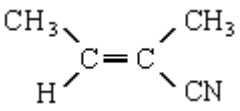
3

(b) (i) *Racemic mixture*: <u>equal</u> mixture of optical isomers / enantiomers
OR in explanation

Explanation: planar (>C=O) **(1)**
attack from either side is equally likely **(1)**

(ii) *Reagent **S***: HCN or (KCN / HCl **or** H_2SO_4) **(1)**

*Compound **T***:  **(1)**

*Compound **U***:  **(1)**

6

[9]

M4. (a) (i) Molecule/compound/consists/composed/made up of hydrogen and carbon only **(1)**

(ii) C_nH_{2n+2} **(1)**

(iii) C_6H_{14} only **(1)**
Do not credit structures alone or in addition.

3

(b) Chemically similar / react in same way / same chemistry
Differ by CH_2
gradation in physical properties OR specified trend e.g. b.p.
same functional group

Any 2, 2 marks 1 + 1

Not same molecular formula

2

(c) (i) Same molecular formula **(1)**

NOT same Mr

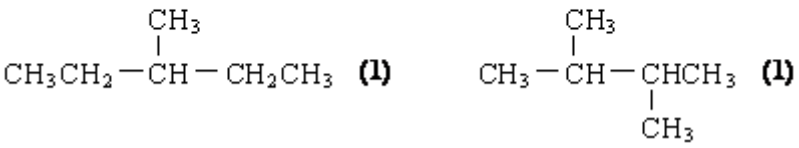
different structural formula / structures **(1)**
(or atoms arranged in different way)

NOT different spatial arrangements
Only credit M2 if M1 correct

(ii) 2-methylpentane **(1)**
2,2-dimethylbutane **(1)**

(iii)

Isomer 3 either order *Isomer 4*



(1) **(1)**

OR correct condensed / structural formula

Penalise "sticks" once
Penalise absence of vertical bonds once
penalise badly drawn bonds once (vertical between H atoms)

6

(d) (i) M1 % by mass of H = 7.7(0)% **(1)**
M2 mol H = 7.70 / 1 = 7.70
mol C = 92.3 / 12 = 7.69 **(1)**

M3 (ratio 1:1 ∴) CH

Credit variations for M2 e.g. 78 × $\frac{77}{100}$ *= 6*

and $\frac{78}{12} \times \frac{92.3}{100}$ *= 6*

Correct answer = 3 marks

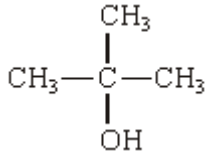
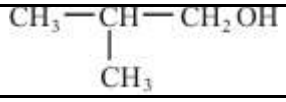
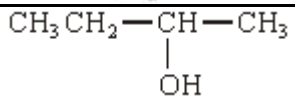
(ii) (CH has empirical mass of 13 and $\frac{78}{13}$ = 6 ∴) C_6H_6 **(1)**

Correct answer 1 mark

4

[15]

M5. (i)

Isomer	Name	
$CH_3CH_2CH_2CH_2OH$	butan-1-ol	
	2-methylpropan-2-ol	
	*(2-)methyl propan-1-ol* **(1)**	NOT prop-1-ol
	*butan-2-ol* **(1)** *OR 2-butanol*	NOT but-2-ol NOT hydroxy No RE

Allow e in the names

2

(ii) Structural **(1)**
OR chain <u>and</u> position(al)

3

[3]

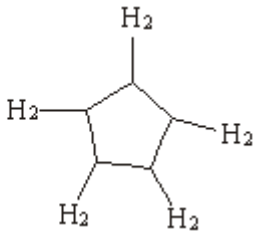
M6. (a) **A** any C_5 alkene

1

B

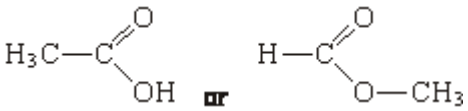
etc

penalise



1

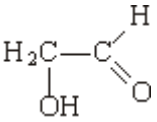
(b) **C**



or CH_3COOH or $HCOOCH_3$

1

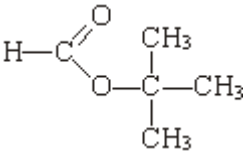
D



or $HOCH_2CHO$

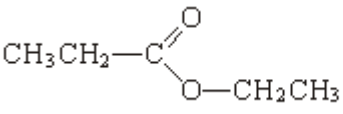
1

(c) **E**



1

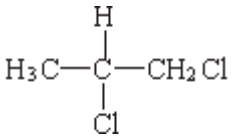
F



(allow C_2H_5)

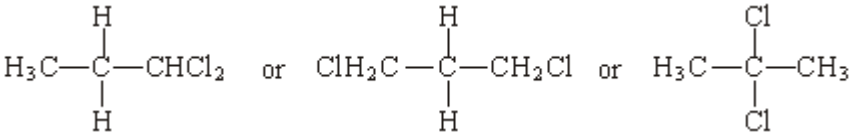
1

(d) **G**



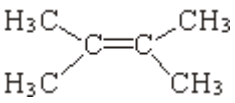
1

H



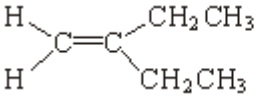
1

(e) **I**



1

J


(allow C_2H_5) **NOT** hex-3-ene

1

[10]