Mark schemes

Q1.

(a)

This question is marked using levels of response. Refer to the Mark Scheme Instructions for Examiners for guidance on how to mark this question.	
Level 3 5-6	**All stages are covered and each stage is generally correct and virtually complete.** (6 v 5) Answer is well structured, with no repetition or irrelevant points, and covers all aspects of the question. Accurate and clear expression of ideas with no errors in use of technical terms.
Level 2 3-4	**All stages are covered but stage(s) may be incomplete or may contain inaccuracies OR** **two stages are covered and are generally correct and virtually complete.** (4 v 3) Answer has some structure and covers most aspects of the question. Ideas are expressed with reasonable clarity with, perhaps, some repetition or some irrelevant points. If any, only minor errors in use of technical terms.
Level 1 1-2	**Two stages are covered but stage(s) may be incomplete or may contain inaccuracies OR** **only one stage is covered but is generally correct and virtually complete.** (2 v 1) Answer includes statements which are presented in a logical order and / or linked.
Level 0 0	Insufficient correct chemistry to gain a mark.

Stage 1 - **What stereoisomers are (1 'covered' or 'virtually complete')**
1a same structure/structural formula
1b different arrangement of atoms/bonds in space

Stage 2 - ***E-Z isomerism occurs (1 'covered ', 2 'virtually complete')***
2a lack of rotation around C=C
2b each C atom of C=C has (two) different groups attached
2c this is *E*

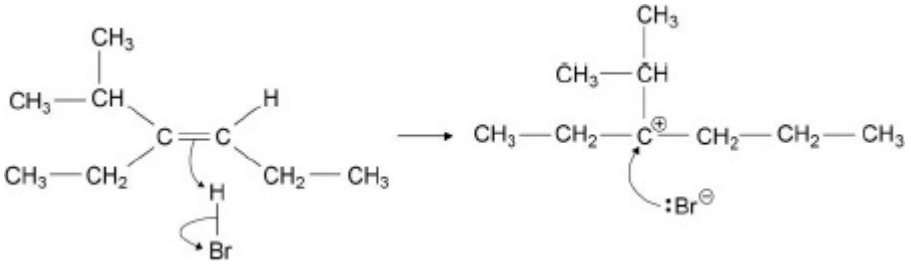
Stage 3 - **Justify *E*/*Z* (2 'covered", 3 'virtually complete')**
3a indicates in some way that CH_3CH_2 is higher priority than H on RHS C
3b as atomic number of C is higher than H or C = 6 v H = 1
3c indicates in some way that $(CH_3)_2CH$ is higher priority than CH_3CH_2 on LHS C

3d as atomic numbers of atoms joined to C (joined to C=C) are higher for $(CH_3)_2CH$ than CH_3CH_2 or 6,6,1 v 6,1,1
3e highest priority groups on opposite sides (of C=C)

6

(b) **M1** Electrophilic addition

M2-5



M2 Arrow from C=C bond towards H of HBr

M3 Breaking of H-Br bond

M4 Correct carbocation

M5 Arrow from lone pair of Br^- to positively charged C of their carbocation

*All arrows are double-headed. Penalise one mark from the total for **2-5** if half headed arrows are used. Do not penalise the "correct" use of "sticks"*

Penalise only once in any part of the mechanism for a line and two dots to show a bond

M2 Ignore partial negative charges on the double bond

M3 Penalise incorrect partial charges on the H-Br bond and penalise formal charges

Penalise M4 if there is a bond drawn to the positive charge

*Max 3 of 4 marks (M2-5) for wrong organic reactant or wrong carbocation (ignore structure of product); for example, correct mechanism for compound **L** would score 3/4 for **M2-5**)*

For M5, credit attack on a partially positively charged carbocation structure, but penalise M4 for the structure of the carbocation

5

(c) **M1** Idea that **K** is formed from/via/has/by the more stable carbocation (intermediate)

M1 and M2 must refer to stability of carbocations (ignore reference to stability of products). M1 and M2 are penalised if answer suggests that the products are carbocation.

M2 Idea that major product from tertiary carbocation rather than secondary carbocation

M2 Allow descriptions in terms of number of alkyl groups attached to positive C atom

M3 Idea of stability from greater (positive) inductive effect (from more alkyl/C groups) or more electron-releasing alkyl/C groups

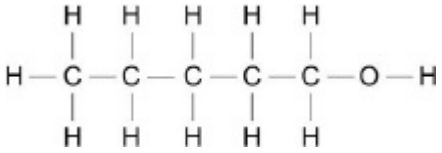
M3 Must be a comparison; could refer to 3 v 2 electron-releasing alkyl/R/C groups (but allow ECF from M2 for number of alkyl groups)

3

[14]

Q2.

(a) Displayed formula of pentan-1-ol

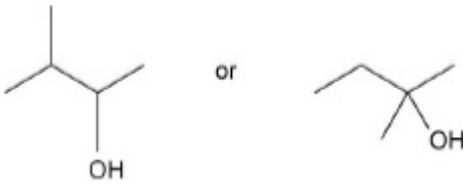


NOT *pentan-3-ol*

NOT *-OH*

1

(b) Skeletal formula of 3-methylbutan-2-ol or 2-methylbutan-2-ol



IGNORE *numbers on C atoms*

IGNORE *'dots' at junctions*

IGNORE *other non-skeletal structures*

IGNORE *skeletal structure of pentan-2-ol*

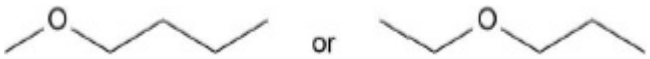
NOT *other incorrect skeletal structures*

NOT *O-H*

NOT *if bond clearly to H of OH*

1

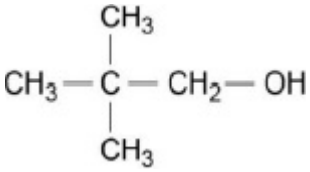
(c) one of these compounds



Any structural representation of correct compound

1

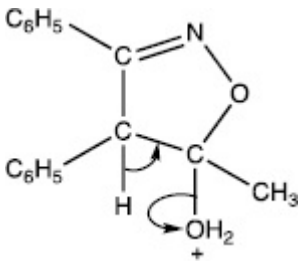
(d)



Any structural representation of correct compound

1

(e)



M1 loss of H_2O: arrow from C-O bond to O

M2 loss of H^+: arrow from correct C-H bond to correct C-C bond

M3 elimination

M1/M2 *list principle for additional arrows on any structure*

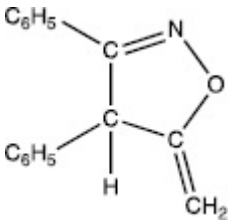
M1 NOT *if arrow to +*

M3 IGNORE *acid-catalysed / dehydration*

NOT *nucleophilic / addition / electrophilic*

3

(f)



Any structural representation of correct compound

If skeletal CH_2 not needed

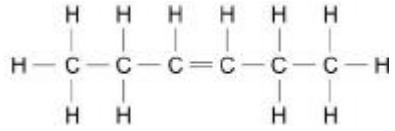
Allow rings in place of C_6H_5

1

[8]

Q3.

(a)

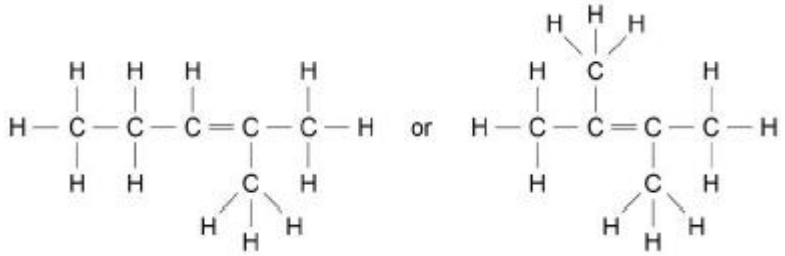


Displayed *structure of hex-3-ene (E or Z isomer)*

Award 1 mark if correct molecules given in (a) and (b) but they are not displayed structures

1

(b)



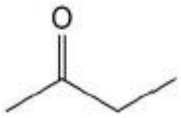
Displayed *formula of 2-methylpent-2-ene or 3,4-dimethylbut-2-ene*

Allow molecules that are both chain and position isomers, eg 2-methylpent-1-ene, 3-methylpent-1-ene, 4-methylpent-1-ene, 3,3-dimethylbut-1-ene, 2,3-dimethylbut-1-ene, 2-ethylbut-1-ene

Award 1 mark if correct compounds given in part (a) and (b) but they are not displayed formulas

1

(c)

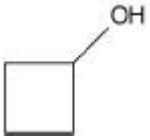


Skeletal *formula*

Award 1 mark if correct compounds given in part (c) and (d) but they are not skeletal formulas

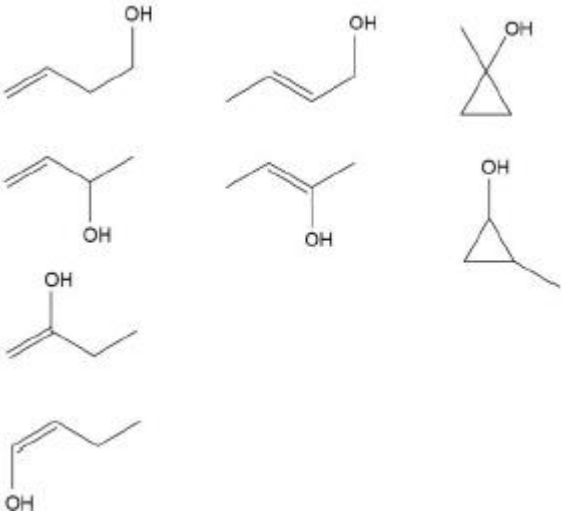
1

(d)



Skeletal *formula*

Alternative answers:



Award 1 mark if correct compounds given in part (c) and (d) but they are not skeletal formulas

1

(e) **M1** divide %s by relative atomic masses:

$$C\ \frac{17.8}{12.0} = 1.48 \qquad H\ \frac{3.0}{1.0} = 3.00 \qquad Br\ \frac{79.2}{79.9} = 0.99$$

*Allow ECF from **M1** to **M2** for a correct empirical formula for their working in **M1***

1

M2 (1.48 : 3.00 : 0.99 = 3 : 6 : 2) empirical formula = $C_3H_6Br_2$

*Allow ECF from **M2** to **M3/4** for compounds that are saturated halogenoalkanes*

1

M3,4 any 2 of:

1,1-dibromopropane
1,2-dibromopropane
1,3-dibromopropane
2,2-dibromopropane

2

[8]