Q1.

What is the IUPAC name of the major product of the reaction between 2-ethylbut-1-ene and hydrogen bromide?

A 1-bromo-2-ethylbutane ⬭

B 2-bromo-2-ethylbutane ⬭

C 2-bromo-2-methylpentane ⬭

D 3-bromo-3-methylpentane ⬭

(Total 1 mark)

Q2.

Which has *E*-*Z* isomers?

A $C_2H_2Br_2$ ⬭

B C_2H_3Br ⬭

C $C_2H_4Br_2$ ⬭

D C_2H_5Br ⬭

(Total 1 mark)

Q3.

Which compound has *E*–*Z* isomers?

A $CH_2=CHBr$ ⬭

B $CH_2=CBr_2$ ⬭

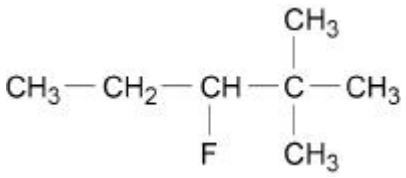
C $CHBr=CHBr$ ⬭

D $CBr_2=CHBr$ ⬭

(Total 1 mark)

Q4.

What is the IUPAC name for this compound?



A 2-dimethyl-3-fluoropentane ⬭

B 2,2-dimethyl-3-fluoropentane ⬭

C 3-fluoro-2,2-dimethylpentane ⬭

D 3-fluoro-2-dimethylpentane ⬭

(Total 1 mark)

Q5.

How many structural isomers, which are esters, have the molecular formula $C_4H_8O_2$?

A 2

B 3

C 4

D 5

(Total 1 mark)

Q6.

Which alkene shows *E*–*Z* isomerism?

A 2,3-dimethylbut-2-ene ⬭

B 4-methylpent-2-ene ⬭

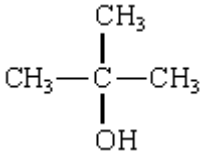
C methylpropene ⬭

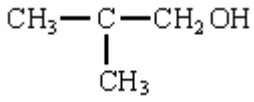
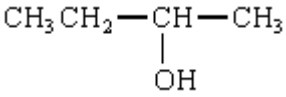
D pent-1-ene ⬭

(Total 1 mark)

Q7.

Four isomers with the formula C_4H_9OH are given below.

Isomer	Name
$CH_3CH_2CH_2CH_2OH$	butan-1-ol
	2-methylpropan-2-ol

(i) Complete the naming of the isomers in the table above.

(ii) Name the type of isomerism shown by these four isomers.

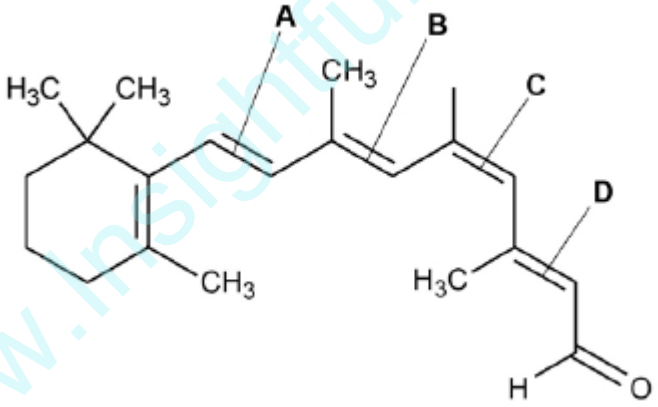
_____

(Total 3 marks)

Q8.

Z-Retinal, shown in the diagram, is a component in vitamin A.

Which of the double bonds, labelled **A**, **B**, **C** or **D**, is responsible for the letter Z in the name?



A ○

B ○

C ○

D ○

(Total 1 mark)

Q9.

Avgas is an aviation fuel used in the internal combustion engines of helicopters.
It consists of a large number of hydrocarbons, including a high proportion of hexane, which can exist as several isomers.

(a) Draw the skeletal formulae of **two** branched isomers of hexane.

(1)

(b) State the type of isomerism shown by these branched isomers.

_____

(1)

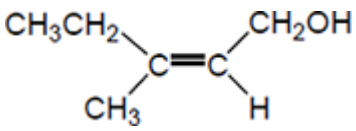
Q10.

Compound **J**, known as leaf alcohol, has the structural formula $CH_3CH_2CH{=}CHCH_2CH_2OH$ and is produced in small quantities by many green plants. The *E* isomer of **J** is responsible for the smell of freshly cut grass.

(a) Give the structure of the *E* isomer of **J**.

(1)

(c) Another structural isomer of **J** is shown below.



Explain how the Cahn-Ingold-Prelog (CIP) priority rules can be used to deduce the full IUPAC name of this compound.

_____

_____

_____

_____

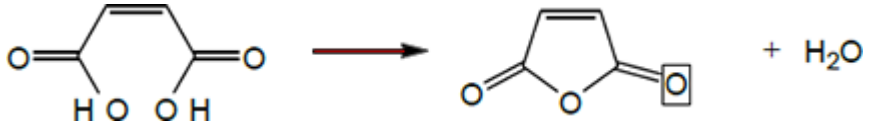
_____

_____

_____

(6)

(d) QUANTITATIVE: The effect of gentle heat on maleic acid is shown below.



A student predicted that the yield of this reaction would be greater than 80%.

In an experiment, 10.0 g of maleic acid were heated and 6.53 g of organic product were obtained.

Is the student correct? Justify your answer with a calculation using these data.

(2)

(Total 10 marks)

Q11.

The alkene 3-methylpent-2-ene ($CH_3CH=C(CH_3)CH_2CH_3$) reacts with hydrogen bromide to form a mixture of 3-bromo-3-methylpentane and 2-bromo-3-methylpentane.

(a) The alkene 3-methylpent-2-ene ($CH_3CH=C(CH_3)CH_2CH_3$) exists as *E* and *Z* stereoisomers.

Draw the structure of *Z*-3-methylpent-2-ene.

(1)

Q12.

(a) Compounds with double bonds between carbon atoms can exhibit geometrical isomerism.

(i) Draw structures for the two geometrical isomers of 1,2-dichloroethene.

Isomer 1 *Isomer 2*

(ii) What feature of the double bond prevents isomer 1 from changing into isomer 2?

_____

(3)

Q13.

Compounds **A**, **B** and **C** all have the molecular formula C_5H_{10}

A and **B** decolourise bromine water but **C** does not.

B exists as two stereoisomers but **A** does **not** show stereoisomerism.

Use this information to deduce a possible structure for each of compounds **A**, **B** and **C** and explain your deductions.

State the meaning of the term stereoisomers and explain how they arise in compound **B**.

_____

_____

_____

_____

_____

_____

_____

_____

(Total 6 marks)

Q1.

D

3-bromo-3-methylpentane

[1]

Q2.

A

[1]

Q3.

C

CHBr=CHBr

[1]

Q4.

C

3-fluoro-2,2-dimethylpentane

[1]

Q5.

C

[1]

Q6.

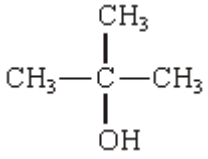
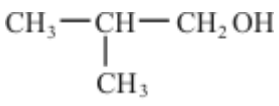
B

4-methylpent-2-ene

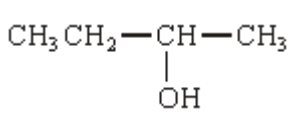
[1]

Q7.

(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 and position(al)

3

[3]

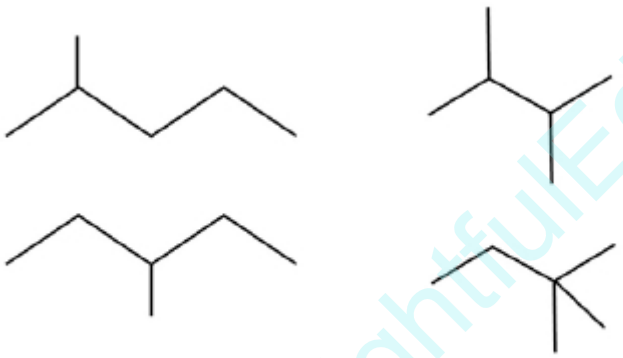
Q8.

C

[1]

Q9.

(a) Any two of these isomers



1

(b) Chain isomerism

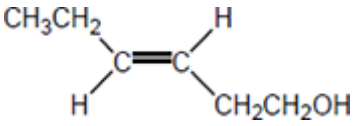
*Mark consequential to part **(a)***

1

[5]

Q10.

(a)



1

(c) **Stage 1**: consider the groups joined to right hand carbon of the C=C bond

Extended response

Maximum of 5 marks for answers which do not show a sustained line of reasoning which is coherent, relevant, substantiated and logically structured.

Consider the atomic number of the atoms attached

M1 can be scored in stage 1 or stage 2

C has a higher atomic number than H, so CH_2OH takes priority **1**

Stage 2: consider the groups joined to LH carbon of the C=C bond **1**

Both groups contain C atoms, so consider atoms one bond further away

C, (H and H) from ethyl group has higher atomic number than H, (H and H) from methyl group, so ethyl takes priority **1**

Stage 3: conclusion

The highest priority groups, ethyl and CH_2OH are on same side of the C=C bond so the isomer is Z **1**

Allow M5 for correct ECF conclusion using either or both wrong priorities deduced in stages 1 and 2

The rest of the IUPAC name is 3-methylpent-2-en-1-ol **1**

(d) Moles of maleic acid = 10.0 / 116.0 = 8.62×10^{-2}

AND mass of organic product expected = $(8.62 \times 10^{-2}) \times 98.0 = 8.45$ g

Or moles of organic product formed = 6.53 / 98.0 = 6.66×10^{-2} **1**

% yield = 100 × 6.53 / 8.45

OR = $100 \times (6.66 \times 10^{-2}) / (8.62 \times 10^{-2})$

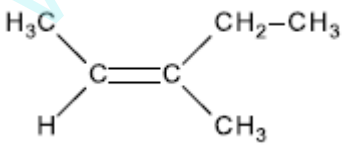
= 77.294 = 77.3%

AND statement that the student was NOT correct **1**

[10]

Q11.

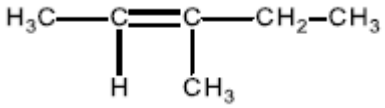
(a)



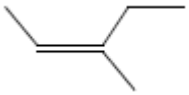
Must show all 4 groups bonded to C=C

Allow CH_3- for methyl group; allow C_2H_5 for ethyl group

Allow correct structure of the style



Allow correct skeletal structure

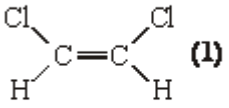


1

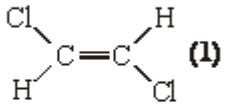
Q12.

(a) (i)

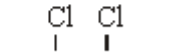
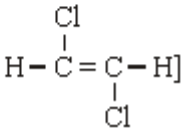
Isomer 1 either order *Isomer 2*



(1)



(1)

[credit  and ]

(ii) restricted rotation OR no rotation OR cannot rotate **(1)**

3

Q13.

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 marks)
All stages are covered, three correct structures are given and each stage is generally correct and virtually complete. Answer communicates reasoning coherently and shows a logical progression through the identification of structures including explaining about stereoisomerism.

Level 2 (3 – 4 marks)
Two stages are covered or parts of three stages (if two stages are covered, they must be complete for 4 marks)

Level 1 (1 – 2 marks)
One stage covered or parts of two stages (if one stage is covered, it must be complete for 2 marks)

Level 0 (0 marks)
No relevant correct chemistry to warrant a mark.

Indicative chemistry content

Stage 1 – deduces which compounds are saturated/unsaturated

1a states that A & B are unsaturated / do contain C=C / alkenes (this can be obtained from the structures)
1b as they decolourise bromine water
1c states that C is saturated / does not contain C=C / is (cyclo)alkane (this can be obtained from the structures)
1d as it does not decolourise bromine water

Stage 2 – deduces the structures

2a suggests suitable name/structure for **A**
- pent-1-ene,
- 2-methylbut-1-ene,
- 3-methylbut-1-ene,
- 2-methylbut-2-ene

2b **B** = pent-2-ene (name / structure)

2c suggests a suitable name / structure of **C** (cyclopentane, methylcyclobutane, any dimethylcyclopropane)

Stage 3 – can explain the stereoisomerism

3a explains what stereoisomerism is in terms of molecules with the same structural formula but a different arrangement of atoms / bonds / groups in space

3b explains how it arises by discussing that C=C cannot rotate,

3c explains how it arises by discussing that each C in C=C has two different groups (ignore reference to Mr in this context) or by drawing the E and Z isomers of **B**

Note
- compounds may be identified by name or structure (but if both given and there is error in one, then award lower mark in whichever level the answer fits, i.e. it penalises the mark within a level, but not the overall level itself).

[6]