2021 ASSESSMENT MATERIALS

AS CHEMISTRY

Physical and Organic Chemistry

Total number of marks: 45

0 4 This question is about pentan-2-ol and pent-1-ene.

0 4 . 1 The boiling point of pentan-2-ol is 119 °C
The boiling point of pent-1-ene is 30 °C

Explain why pentan-2-ol has a higher boiling point than pent-1-ene.

[3 marks]

0 4 . 2 Pent-1-ene is formed by the elimination of water from pentan-2-ol.

State the reagent and condition for this reaction.

Outline the mechanism for this reaction.

[5 marks]

Reagent _____

Condition _____

Outline of mechanism

0 1 . 3 1-chloropropane can also be produced by the reaction between propane and chlorine in the presence of ultraviolet light.

State why ultraviolet light is needed for this reaction to occur.

Give an equation for each propagation step in the formation of 1-chloropropane from propane.

[3 marks]

Why ultraviolet light is needed _____

_____

_____

Propagation step 1

_____

Propagation step 2

_____

0 1 . 4 The C–Cl bond in 1-chloropropane is polar because carbon and chlorine have different electronegativities.

Define the term electronegativity.

[1 mark]

0 1 . 5 Ammonia reacts with 1-chloropropane to form propylamine.

Name and outline the mechanism for this reaction.

[5 marks]

Name of mechanism

Outline of mechanism

0 8 Methanol can be manufactured in a reversible reaction as shown by the equation.

$$CO(g) + 2H_2(g) \rightleftharpoons CH_3OH(g)$$

0 8 . 1 State and explain the effect of using a catalyst on the yield of methanol in this equilibrium.

[2 marks]

0 8 . 2 Give an expression for the equilibrium constant (K_c) for this reaction.

[1 mark]

0 8 . 3 A mixture of carbon monoxide and hydrogen was allowed to reach equilibrium in a container of volume 250 cm^3 at temperature *T*.
At equilibrium, the mixture contained 0.340 mol of carbon monoxide, 0.190 mol of hydrogen and 0.0610 mol of methanol.

Calculate the value of the equilibrium constant (K_c) for this reaction at temperature *T*.
[3 marks]

K_c _____ $mol^{-2}\ dm^6$

0 8 . 4 Methanol decomposes on heating in a reaction that is the reverse of that used in its manufacture.

$$CH_3OH(g) \rightleftharpoons CO(g) + 2H_2(g)$$

Use your answer from Question **08.3** to determine the value of K_c for this equilibrium at temperature *T*.
State the units for this value of K_c

(If you were unable to complete the calculation in Question **08.3**, assume a value of $K_c = 0.825\ mol^{-2}\ dm^6$. This is **not** the correct value.)
[2 marks]

Value of K_c _____

Units of K_c _____

0 7 This question is about ethanedioic acid ($H_2C_2O_4$) which is a dicarboxylic acid.

0 7 . 1 Draw the skeletal formula of ethanedioic acid.

[1 mark]

0 7 . 2 Ethanedioic acid is formed by the oxidation of ethane-1,2-diol ($HOCH_2CH_2OH$).

State suitable reagent(s) and a condition for this reaction.

[2 marks]

Reagent(s) _____

_____

Condition _____

_____

0 7 . 3 Ethanedioic acid reacts with an excess of sodium hydroxide to form sodium ethanedioate.

$$H_2C_2O_4\,(aq) + 2\,NaOH\,(aq) \rightarrow Na_2C_2O_4\,(aq) + 2\,H_2O\,(l)$$

A student mixes 10.0 cm^3 of 0.400 mol dm^{-3} ethanedioic acid with 50.0 cm^3 of 0.200 mol dm^{-3} sodium hydroxide.

Show that the sodium hydroxide is in excess.

Calculate the mass, in mg, of sodium ethanedioate that can be formed in this reaction.

[5 marks]

Mass of sodium ethanedioate _____ mg

0 3 Compounds **A**, **B** and **C** all have the molecular formula C_5H_{10}

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

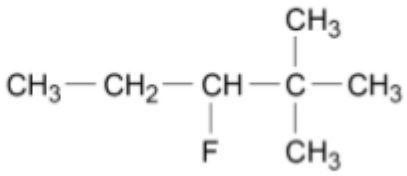
B exists as two stereoisomers but **A** does **not** show stereoisomerism.

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**.

[6 marks]

1 1 What is the IUPAC name for this compound?



[1 mark]

A 2-dimethyl-3-fluoropentane ⬭

B 2,2-dimethyl-3-fluoropentane ⬭

C 3-fluoro-2,2-dimethylpentane ⬭

D 3-fluoro-2-dimethylpentane ⬭

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

[1 mark]

A 1-bromo-2-ethylbutane ⬭

B 2-bromo-2-ethylbutane ⬭

C 2-bromo-2-methylpentane ⬭

D 3-bromo-3-methylpentane ⬭

1 3 Which can be used to distinguish between these two compounds?

$(CH_3)_2CHCH_2CHO$ and $(CH_3)_3CCHO$

[1 mark]

A Acidified potassium dichromate(VI) ⬭

B Fingerprint region of infrared spectrum ⬭

C M_r value in high resolution mass spectrometry ⬭

D Tollens' reagent ⬭

1 9 What is the minimum volume of 0.0500 mol dm^{-3} aqueous bromine needed to react completely with 0.0200 g of buta-1,3-diene?

(M_r of buta-1,3-diene = 54.0)

[1 mark]

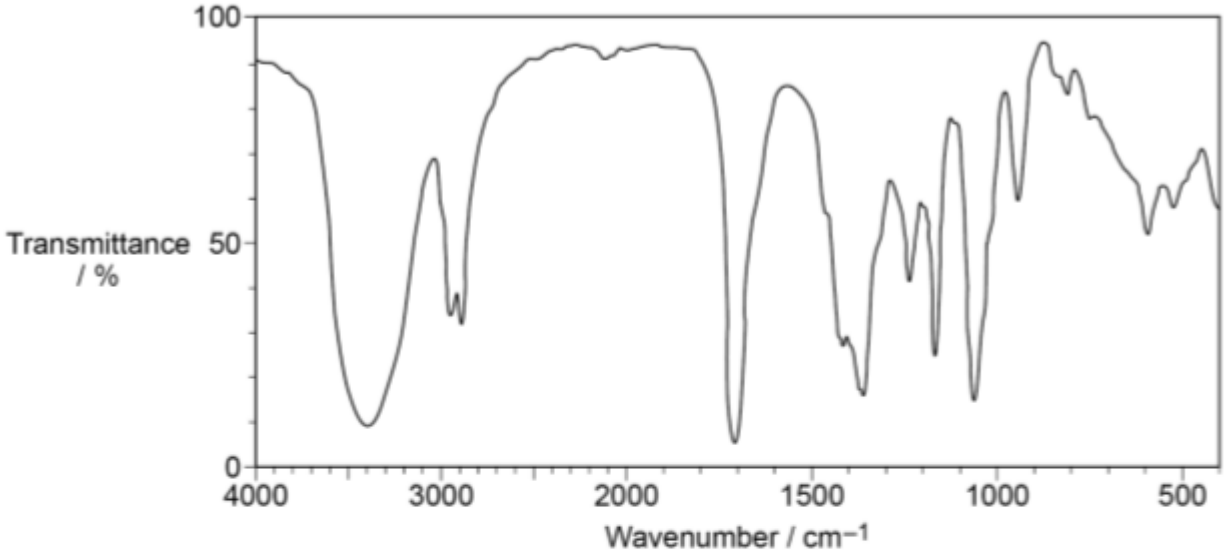
A 7.40 cm^3 ⬭

B 14.8 cm^3 ⬭

C 29.6 cm^3 ⬭

D 67.5 cm^3 ⬭

2 3 The infrared spectrum of an organic compound is shown.



Which compound produces this spectrum?

[1 mark]

A ethanoic acid ⬭

B 4-hydroxybutanone ⬭

C propan-1-ol ⬭

D prop-2-en-1-ol ⬭

1 0 A 'drink-driving' offence is committed if the blood alcohol level of a driver is over 80 mg of ethanol per 100 cm^3 of blood.
What is the concentration, in mol dm^{-3}, of ethanol if there are 80 mg of ethanol (M_r = 46.0) per 100 cm^3 of blood?

[1 mark]

A 0.00017 ⬭

B 0.0017 ⬭

C 0.017 ⬭

D 1.7 ⬭