A' Level Chemistry
Year 1

Paper 2 Multiple Choice

Summer Examination Revision Pack

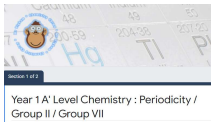
The questions in this pack should be attempted **AFTER** completing all other revision.

Grade Accelerator
Recall Definitions
Drawing Diagrams
Using Equations
Drawing Graphs

Quizlet

Quizlet Classes
Flashcard Based
Games
Tests & Quizzes
Keyword Spell Checker

Condensed Notes
Keywords & Definitions
Key Concepts
Application
Key Skills



Online Forms
Take Time to Answer
Use Paper & Calculator
Work It Out
Review Missed Marks

Use the 3 Wave Process when completing these revision packs.

1. Complete the questions without assistance
(Can't answer a question? Leave it and move on)
2. Use your notes to fill any gaps after step 1
3. Use the mark scheme to fill in any remaining gaps.

1. Having gaps after step 1 is normal, that's why we are doing revision!
2. If your notes don't help during step 2, they are not good enough!
(Change your note taking method and try to understand the problem)
3. If you don't understand why the mark scheme answer is correct, **see Andy.**

If you struggle with the questions in the pack, **STOP!** and complete some more revision.

If you come to a complete dead-end, **STOP!** and speak to **Andy** asap.

Section B

Answer **all** questions in this section.

Only **one** answer per question is allowed.
For each answer completely fill in the circle alongside the appropriate answer.

CORRECT METHOD  WRONG METHODS 

If you want to change your answer you must cross out your original answer as shown. 

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0 9 Which of the following compounds would form an orange-red precipitate when heated with Fehling's solution?

[1 mark]

A CH_3CH_2CN ⬭

B CH_3CH_2COOH ⬭

C CH_3CHO ⬭

D CH_3COCH_3 ⬭

1 0 Pentanenitrile can be made by reaction of 1-bromobutane with potassium cyanide.

Which of these is the correct name for the mechanism of this reaction?

[1 mark]

A Electrophilic addition ⬭

B Electrophilic substitution ⬭

C Nucleophilic addition ⬭

D Nucleophilic substitution ⬭

1 1 Propene can be made by the dehydration of propan-2-ol.

What is the percentage yield when 30 g of propene (M_r = 42.0) are formed from 50 g of propan-2-ol (M_r = 60.0)?.

[1 mark]

A 60% ⬭

B 67% ⬭

C 81% ⬭

D 86% ⬭

1 2 Sulfur dioxide (SO_2) is produced when some fossil fuels are burned.

Which of the following statements is true?

[1 mark]

A Sulfur dioxide can be removed from waste gases in a power station by an acid-base reaction with calcium oxide. ⬭

B Sulfur dioxide is insoluble in water. ⬭

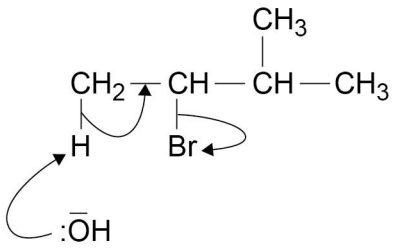
C Sulfur dioxide is a basic oxide. ⬭

D Sulfur dioxide is an ionic compound. ⬭

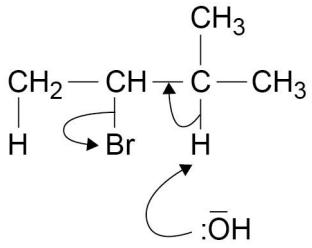
1 3 Which of the following is a correct mechanism for the formation of 2-methylbut-2-ene from 2-bromo-3-methylbutane?

[1 mark]

A



B



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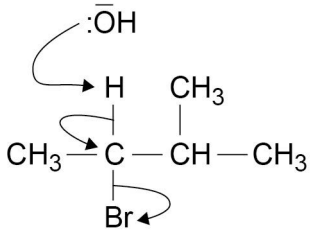
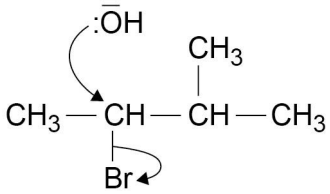


D



1 4 An organic compound is found to contain 40.0% carbon, 6.7% hydrogen and 53.3% oxygen.

Which of the following compounds could this be?

[1 mark]

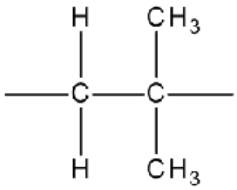
A Ethanol ⬭

B Ethanoic acid ⬭

C Methanol ⬭

D Methanoic acid ⬭

1 5 The repeating unit of a polymer is



Which of the following molecules would form a polymer containing this repeating unit?

[1 mark]

A But-1-ene ⬭

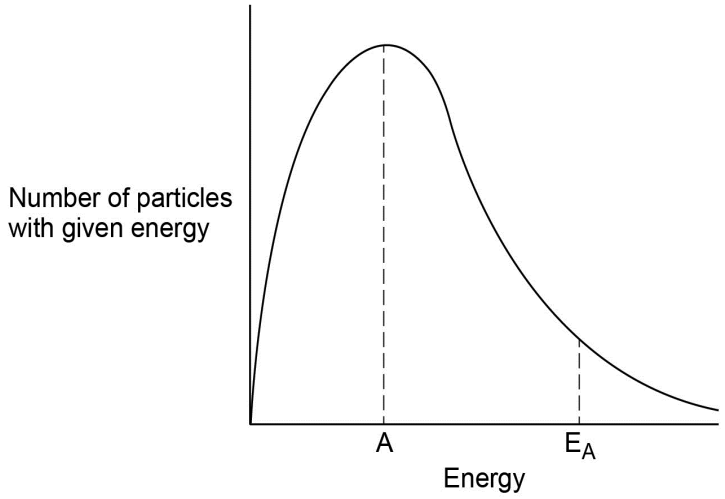
B *E*-but-2-ene ⬭

C *Z*-but-2-ene ⬭

D Methylpropene ⬭

1 6 **Figure 7** shows a typical energy distribution for particles of an ideal gas in a sealed container at a fixed temperature.

Figure 7



Which of the following statements is true?

[1 mark]

A Position A represents the mean energy of a molecule in the container. ⬭

B Addition of a catalyst moves the position of E_A to the right. ⬭

C The area under the curve to the right of E_A represents the number of molecules with enough energy to react. ⬭

D The position of the peak of the curve at a higher temperature is further away from both axes. ⬭

1 7 Tetradecane ($C_{14}H_{30}$) is an alkane found in crude oil. When tetradecane is heated to a high temperature, one molecule of tetradecane decomposes to form one molecule of hexane and three more molecules.

Which of the following could represent this reaction?

[1 mark]

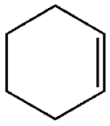
A $C_{14}H_{30} \rightarrow C_6H_{14} + C_4H_8 + 2C_2H_4$ ⬭

B $C_{14}H_{30} \rightarrow C_6H_{14} + C_6H_{12} + C_2H_4$ ⬭

C $C_{14}H_{30} \rightarrow C_5H_{12} + 3C_3H_6$ ⬭

D $C_{14}H_{30} \rightarrow C_6H_{14} + C_2H_6 + 2C_3H_6$ ⬭

1 8 The structure of cyclohexene is shown.



Which of the following is the general formula of cyclic alkenes such as cyclohexene?

[1 mark]

A C_nH_{2n-4} ⬭

B C_nH_{2n-2} ⬭

C C_nH_{2n} ⬭

D C_nH_{2n+2} ⬭

1 9 **A** and **B** react together in this reversible reaction.

$$\mathbf{A} + \mathbf{3B} \rightleftharpoons \mathbf{C} + \mathbf{2D}$$

A mixture of 10 mol of **A** and 10 mol of **B** were left to reach equilibrium. The equilibrium mixture contained 4 mol of **B**.

What is the total amount, in moles, of substances in the equilibrium mixture?

[1 mark]

A 14 ⬭

B 16 ⬭

C 18 ⬭

D 20 ⬭

2 0 The M_r of hydrated copper sulfate ($CuSO_4.5H_2O$) is 249.6.

Which of the following is the mass of hydrated copper sulfate required to make 50.0 cm^3 of a 0.400 mol dm^{-3} solution?

[1 mark]

A 3.19 g ⬭

B 3.55 g ⬭

C 3.71 g ⬭

D 4.99 g ⬭

2 1 2 mol of ideal gas **X** are stored in a flask of fixed volume.

Which of the following changes would lead to the greatest increase in pressure inside the flask?

[1 mark]

A Increasing the temperature from 20 °C to 200 °C ⬭

B Adding another 1 mol of gas **X** into the flask at fixed temperature ⬭

C Adding 0.5 mol of argon gas and increasing the temperature from 20 °C to 150 °C ⬭

D Removing 0.5 mol of gas **X** and increasing the temperature from 20 °C to 300 °C ⬭

Questions **22** and **23** refer to the production of hydrogen by the reaction of methane with steam. The reaction mixture reaches a state of dynamic equilibrium.

$$CH_4(g) + H_2O(g) \rightleftharpoons CO(g) + 3H_2(g) \quad \Delta H = +206 \text{ kJ mol}^{-1}$$

2 2 Which of the following shows how the equilibrium yield of hydrogen and the value of the equilibrium constant are affected by the changes shown?

[1 mark]

	Change	Effect on equilibrium yield of $H_2(g)$	Effect on value of K_c	
A	Increase pressure	decrease	decrease	⬭
B	Add a catalyst	increase	no effect	⬭
C	Increase temperature	increase	increase	⬭
D	Remove CO(g) as formed	increase	increase	⬭

2 3 Some enthalpy data is given in **Table 3**.

Table 3

Bond	C−H	O−H	H−H	C≡O
Bond enthalpy / kJ mol^{-1}	413	463	436	To be calculated

Use the information in **Table 3** and the stated enthalpy change to calculate the missing bond enthalpy.

[1 mark]

A 234 ⬭

B 1064 ⬭

C 1476 ⬭

D 1936 ⬭

Turn over for the next question

Question	Marking Guidance	Mark	Comments
09	C	1	
10	D	1	
11	D	1	
12	A	1	
13	B	1	
14	B	1	
15	D	1	
16	C	1	
17	A	1	
18	B	1	
19	C	1	
20	D	1	
21	C	1	
22	C	1	
23	B	1	

Section B

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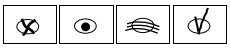
CORRECT METHOD 

WRONG METHODS 

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Do **not** use additional sheets for this working.

1 0 What is the burette reading for this transparent liquid?

[1 mark]

A 24.10 cm^3 ⬭

B 24.30 cm^3 ⬭

C 25.70 cm^3 ⬭

D 25.90 cm^3 ⬭

1 1 A volumetric flask was used to prepare 250 cm^3 of a solution.

The solute was added from a plastic weighing container.

	Mass / g
Weighing container with solute	10.13
Weighing container after solute added to volumetric flask	4.48

Each reading from the balance has an uncertainty of ±0.005 g

What is the percentage uncertainty in the mass of the solute used?

[1 mark]

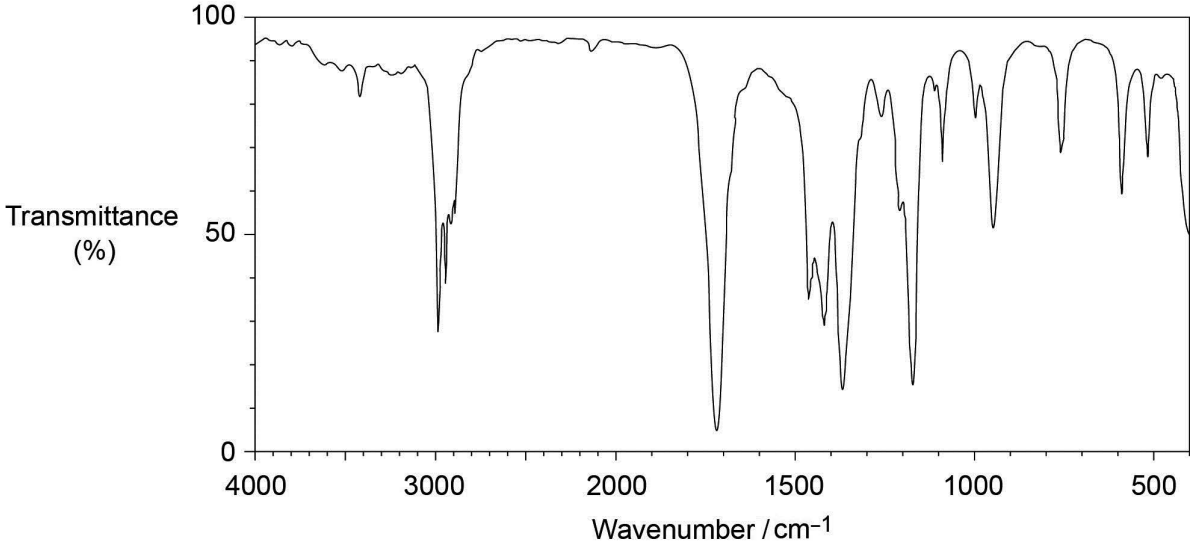
A 0.09% ⬭

B 0.11% ⬭

C 0.18% ⬭

D 0.22% ⬭

1 2 The infrared spectrum of an organic compound is shown.



Which compound produces this spectrum?

[1 mark]

A butanone ⬭

B ethanol ⬭

C pent-2-ene ⬭

D propanoic acid ⬭

1 3 Which is the most likely bond angle around the oxygen atom in ethanol?

[1 mark]

A 104.5º ⬭

B 109.5º ⬭

C 120º ⬭

D 180º ⬭

1 4 Which compound is a structural isomer of *Z*-but-2-ene?

[1 mark]

A butane ⬭

B *E*-but-2-ene ⬭

C cyclobutane ⬭

D methylbut-2-ene ⬭

1 5 Which equation is a propagation step in the conversion of trichloromethane into tetrachloromethane by reaction with chlorine in the presence of ultraviolet light?

[1 mark]

A $CHCl_3 + Cl_2 \longrightarrow CCl_4 + HCl$ ⬭

B $\bullet CCl_3 + \bullet Cl \longrightarrow CCl_4$ ⬭

C $CHCl_3 + \bullet Cl \longrightarrow CCl_4 + \bullet H$ ⬭

D $\bullet CCl_3 + Cl_2 \longrightarrow CCl_4 + \bullet Cl$ ⬭

1 6 Which compound has the fastest rate of reaction with potassium cyanide to form pentanenitrile?

[1 mark]

A 1-bromobutane ⬭

B 1-chlorobutane ⬭

C 1-fluorobutane ⬭

D 1-iodobutane ⬭

1 7 Which alcohol can be oxidised by acidified potassium dichromate(VI) but cannot be dehydrated by heating with concentrated sulfuric acid?

[1 mark]

A 2,3-dimethylbutan-2-ol ⬭

B 2,2-dimethylpropan-1-ol ⬭

C 2-methylpropan-2-ol ⬭

D pentan-3-ol ⬭

1 8 How many structural isomers are there with the molecular formula C_3H_6BrCl?

[1 mark]

A 4 ⬭

B 5 ⬭

C 6 ⬭

D 7 ⬭

1 9 Which sample contains the most molecules?

The Avogadro constant, $L = 6.022 \times 10^{23}$ mol^{-1}

[1 mark]

A 2.10×10^{22} molecules of methane, CH_4 ⬭

B 1.00 g of oxygen, O_2 ⬭

C 65.0 mg of hydrogen, H_2 ⬭

D 0.0300 mol of ethane, C_2H_6 ⬭

2 0 Which compound forms a molecular ion with a different precise molecular mass from the other three?

[1 mark]

A butanone ⬭

B cyclobutanol ⬭

C dimethylpropane ⬭

D methylpropanal ⬭

2 1 Hydrogen can be produced by this reaction.

$$CO(g) + H_2O(g) \rightleftharpoons CO_2(g) + H_2(g)$$

In an experiment 4.20 mol of carbon monoxide were mixed with 2.00 mol of steam. When the reaction reached equilibrium, 1.60 mol of hydrogen had been formed.

What is the value of the equilibrium constant, K_c, for this reaction?

[1 mark]

A 0.30 ⬭

B 0.41 ⬭

C 1.54 ⬭

D 2.46 ⬭

2 2 A sample of 2.0 mol dm^{-3} acid has a volume of 100 cm^3

What volume of water, in cm^3, should be added to this acid to dilute the sample to a concentration of 1.5 mol dm^{-3}?

[1 mark]

A 25 ⬭

B 33.3 ⬭

C 50 ⬭

D 66.7 ⬭

Turn over for the next question

2 3 Two sealed flasks with the same volume are left side by side.

Flask **A** contains 4.0×10^{-3} mol of methane.
Flask **B** contains 340 mg of a different gas.
Both gases are at the same temperature and pressure.

Which gas could be in Flask **B**?

[1 mark]

A CH_2Cl_2 ⬭

B HBr ⬭

C Kr ⬭

D PF_3 ⬭

2 4 Analysis of a sample of a chemical with formula $C_{22}H_{30}N_6O_4S$, showed that it contained 0.0195 mol of carbon.

What mass of nitrogen was present in the sample?

[1 mark]

A 0.041 g ⬭

B 0.057 g ⬭

C 0.074 g ⬭

D 0.420 g ⬭

END OF QUESTIONS

Question	Marking Guidance
10	B
11	C
12	A
13	A
14	C
15	D
16	D
17	B
18	B
19	A
20	C
21	D
22	B
23	A
24	C

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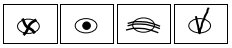
WRONG METHODS 

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0 9 A student has a 10 cm^3 sample of 1.00×10^{-2} mol dm^{-3} methanoic acid solution. The student is asked to dilute the methanoic acid solution to a concentration of 2.00×10^{-4} mol dm^{-3} by adding distilled water.

Which volume of water should be added?

[1 mark]

A 200 cm^3 ⬭

B 490 cm^3 ⬭

C 500 cm^3 ⬭

D 510 cm^3 ⬭

1 0 Which molecule does **not** have a permanent dipole?

[1 mark]

A CH_3Br ⬭

B CH_2Br_2 ⬭

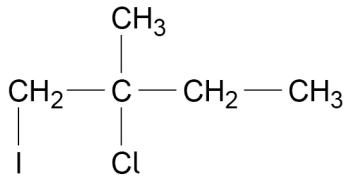
C $CHBr_3$ ⬭

D CBr_4 ⬭

1 1 Which is the major product of the reaction between 2-methylbut-2-ene and iodine monochloride (ICl)?

[1 mark]

A



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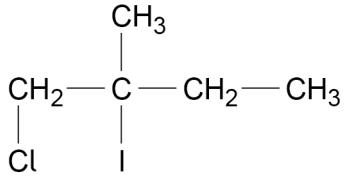

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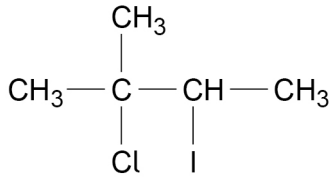
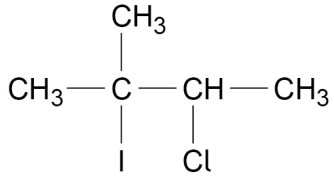


D



1 2 Which statement is **not** correct about the industrial preparation of ethanol by the hydration of ethene at 300 °C?

$$C_2H_4(g) + H_2O(g) \rightleftharpoons C_2H_5OH(g) \qquad \Delta H = -46 \text{ kJ mol}^{-1}$$

[1 mark]

A The reaction is catalysed by an acid.

B The higher the pressure, the higher the equilibrium yield of ethanol.

C The higher the temperature, the higher the equilibrium yield of ethanol.

D A low equilibrium yield of ethanol is acceptable because unreacted ethene is recycled.

1 3 Which compound has the highest boiling point?

[1 mark]

A butanal ⬭

B butan-2-ol ⬭

C but-2-ene ⬭

D 1-fluorobutane ⬭

1 4 Which statement is correct about the fractional distillation of crude oil?

[1 mark]

A A zeolite catalyst is used. ⬭

B Each fraction contains a mixture of hydrocarbons. ⬭

C Gaseous fractions are formed by breaking covalent bonds. ⬭

D The fractionating column is hottest at the top. ⬭

1 5 How many structural isomers with an unbranched carbon chain have the molecular formula $C_4H_8Br_2$?

[1 mark]

A 4 ⬭

B 5 ⬭

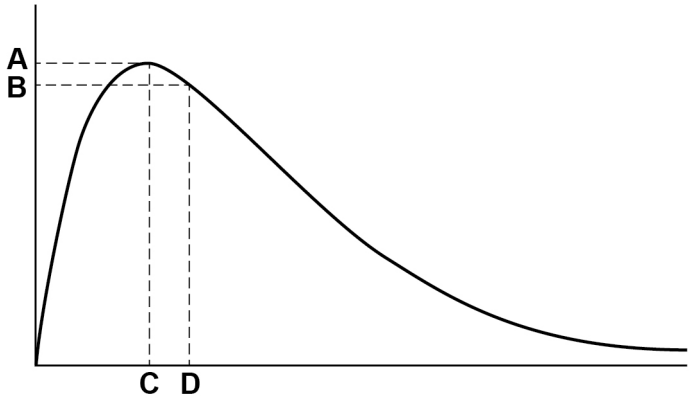
C 6 ⬭

D 7 ⬭

1 6 The Maxwell–Boltzmann distribution of molecular energies in a sample of gas at a fixed temperature is shown.

Which letter represents the mean energy of the molecules?

[1 mark]



A ⬭

B ⬭

C ⬭

D ⬭

1 7 Ethanol can be made from glucose by fermentation.

$$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$$

In an experiment, 268 g of ethanol (M_r = 46.0) were made from 1.44 kg of glucose (M_r = 180.0).

What is the percentage yield?

[1 mark]

A 18.6% ⬭

B 36.4% ⬭

C 51.1% ⬭

D 72.8% ⬭

1 8 Which species could act as a nucleophile?

[1 mark]

A BH_3 ⬭

B NH_4^+ ⬭

C PH_3 ⬭

D SiH_4 ⬭

1 9 Which statement is correct about poly(chloroethene)?

[1 mark]

A It has the empirical formula CHCl ⬭

B It decolourises bromine water. ⬭

C Its brittleness is reduced by plasticisers. ⬭

D Its polymer chain contains alternate single and double bonds. ⬭

2 0 What is the enthalpy of formation of buta-1,3-diene, $C_4H_6(g)$?

Substance	Enthalpy of combustion / kJ mol^{-1}
$C_4H_6(g)$	–2546
C(s)	–394
$H_2(g)$	–286

[1 mark]

A +112 kJ mol^{-1} ⬭

B –112 kJ mol^{-1} ⬭

C +746 kJ mol^{-1} ⬭

D –746 kJ mol^{-1} ⬭

2 1 A gas cylinder contains 5.0 kg of propane.

How many propane molecules are in the cylinder?

The Avogadro constant, $L = 6.022 \times 10^{23}$ mol^{-1}

[1 mark]

A 6.8×10^{22} ⬭

B 7.2×10^{22} ⬭

C 6.8×10^{25} ⬭

D 7.2×10^{25} ⬭

2 2 Which sample of liquid has the greatest volume?

[1 mark]

A 500 mg of pentane (density = 0.63 g cm^{-3}) ⬭

B 650 mg of propan-1-ol (density = 0.80 g cm^{-3}) ⬭

C 1.20 g of dichloromethane (density = 1.33 g cm^{-3}) ⬭

D 1.30 g of trichloromethane (density = 1.48 g cm^{-3}) ⬭

2 3 Which equation represents an initiation step?

[1 mark]

A $CH_3CH_2\dot{C}HBr + Br_2 \longrightarrow CH_3CH_2CHBr_2 + \dot{B}r$ ⬭

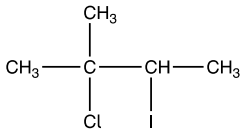
B $O_3 + \dot{C}l \longrightarrow O_2 + \dot{C}lO$ ⬭

C $RCH_2\dot{C}H_2 + H_2C{=}CH_2 \longrightarrow RCH_2CH_2CH_2\dot{C}H_2$ ⬭

D $CH_3CFCl_2 \longrightarrow CH_3\dot{C}FCl + \dot{C}l$ ⬭

15

END OF QUESTIONS

Question	Marking Guidance	Mark	Comments
9	**B**	1	490 cm^3
10	**D**	1	CBr_4
11	**C**	1	
12	**C**	1	The higher the temperature, the higher the equilibrium yield of ethanol
13	**B**	1	butan-2-ol
14	**B**	1	each fraction is a mixture of hydrocarbons
15	**C**	1	6
16	**D**	1	D
17	**B**	1	36.4%
18	**C**	1	PH_3
19	**C**	1	Its brittleness is reduced by plasticisers
20	**A**	1	+112

Question	Marking Guidance	Mark	Comments
21	**C**	1	6.8×10^{25}
22	**C**	1	1.20 g of dichloromethane (density = 1.33 g cm^{-3})
23	**D**	1	$CH_3CFCl_2 \rightarrow CH_3CFCl\bullet + Cl\bullet$

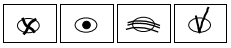
Do not write outside the box

Section B

Answer **all** questions in this section.

Only **one** answer per question is allowed.
For each answer completely fill in the circle alongside the appropriate answer.

CORRECT METHOD 

WRONG METHODS 

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If you wish to return to an answer previously crossed out, ring the answer you now wish to select as shown. 

You may do your working in the blank space around each question but this will not be marked. Do **not** use additional sheets for this working.

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 ⬭

Do not write outside the box

1 1 Which statement is correct for the distribution curve of molecular energies in a gas?

[1 mark]

A The curve is symmetrical about the maximum. ⬭

B There are always some molecules with zero energy. ⬭

C The position of the maximum of the curve is not dependent on the temperature. ⬭

D The mean energy of the molecules is greater than the most probable energy of the molecules. ⬭

1 2 When one mole of ammonia is heated to a given temperature, 50 % of it dissociates and the following equilibrium is established.

$$NH_3(g) \rightleftharpoons \tfrac{1}{2}N_2(g) + \tfrac{3}{2}H_2(g)$$

What is the total amount, in moles, of gas in this equilibrium mixture?

[1 mark]

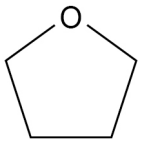
A 1.5 ⬭

B 2.0 ⬭

C 2.5 ⬭

D 3.0 ⬭

1 3 Which compound is **not** an isomer of the following compound?



[1 mark]

A $CH_3CH_2COCH_3$ ⬭

B $CH_3CH{=}CHCH_2OH$ ⬭

C $(CH_3)_2CHCHO$ ⬭

D $CH_2{=}CHCH_2CHO$ ⬭

Do not write outside the box

1 4 How many isomers are there of C_3H_9N?

[1 mark]

A 2 ⬭

B 3 ⬭

C 4 ⬭

D 5 ⬭

1 5 Which equation represents a propagation step?

[1 mark]

A $\bullet CH_2Cl + Cl\bullet \rightarrow CH_2Cl_2$ ⬭

B $\bullet CH_3 + \bullet CH_3 \rightarrow C_2H_6$ ⬭

C $Cl_2 \rightarrow Cl\bullet + Cl\bullet$ ⬭

D $CH_3Cl + Cl\bullet \rightarrow \bullet CH_2Cl + HCl$ ⬭

1 6 Which compound can react with ammonia to produce propylamine?

[1 mark]

A $CH_3CH{=}CH_2$ ⬭

B $CH_3CH_2CH_2OH$ ⬭

C $CH_3CH_2CH_2Br$ ⬭

D $CH_3CH_2CH_3$ ⬭

Do not write outside the box

1 7 Which statement is **not** correct about $CH_2{=}C(CH_3)CH_2Br$?

[1 mark]

A It displays *E*-*Z* isomerism. ⬭

B It forms an addition polymer. ⬭

C It reacts with electrophiles. ⬭

D It decolourises bromine water. ⬭

1 8 Which compound can be oxidised to form $(CH_3)_2CHCOCH_3$?

[1 mark]

A 2-methylpropan-1-ol ⬭

B 2,2-dimethylpropanol ⬭

C 2-methylbutan-2-ol ⬭

D 3-methylbutan-2-ol ⬭

1 9 Which species can act as a nucleophile?

[1 mark]

A NH_4^+ ⬭

B CH_3OH ⬭

C CH_4 ⬭

D H^+ ⬭

Turn over ►

Do not write outside the box

2 0 Which alcohol forms a mixture of alkenes when dehydrated?

[1 mark]

A propan-1-ol ⬭

B propan-2-ol ⬭

C pentan-1-ol ⬭

D pentan-2-ol ⬭

2 1 Which compound has the highest boiling point?

[1 mark]

A $CH_3CH_2CH_2Br$ ⬭

B $CH_3CH_2CH_2F$ ⬭

C CH_3CH_2CHO ⬭

D CH_3CH_2COOH ⬭

2 2 Which compound could **not** be produced by reacting 2-bromo-3-methylbutane with sodium hydroxide?

[1 mark]

A 2-methylbut-1-ene ⬭

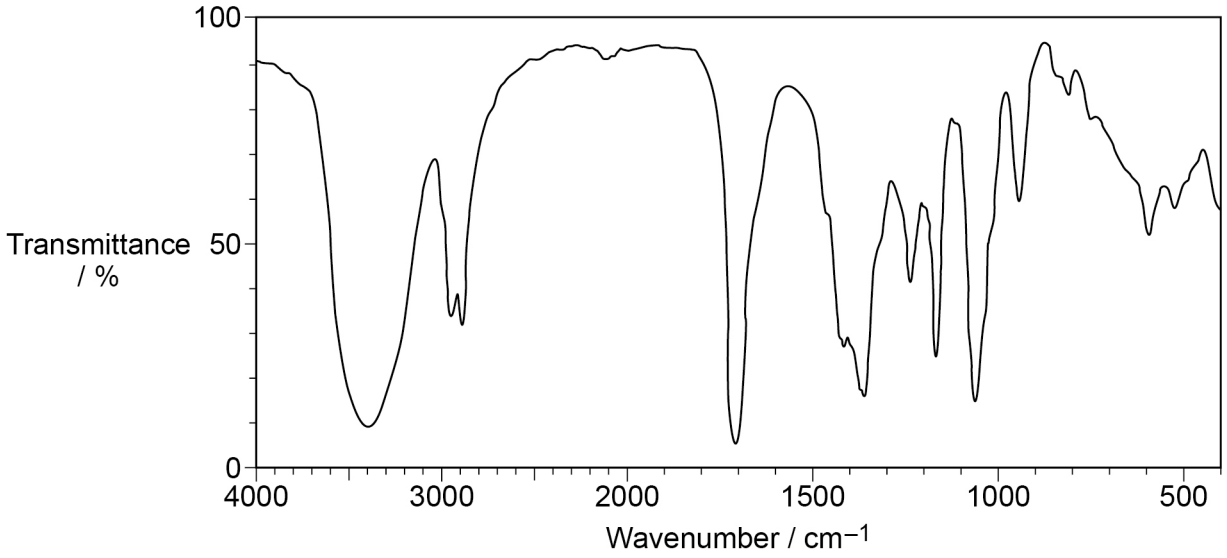
B 3-methylbut-1-ene ⬭

C 2-methylbut-2-ene ⬭

D 3-methylbutan-2-ol ⬭

Do not write outside the box

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 ⬭

Turn over for the next question

Do not write outside the box

2 4 The heat released when 1.00 g of ethanol (M_r = 46.0) undergoes complete combustion is 29.8 kJ

What is the heat released by each molecule, in joules, when ethanol undergoes complete combustion?

(the Avogadro constant $L = 6.022 \times 10^{23}$ mol^{-1})

[1 mark]

A 2.28×10^{-18} J ⬭

B 4.95×10^{-20} J ⬭

C 2.28×10^{-21} J ⬭

D 4.95×10^{-23} J ⬭

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END OF QUESTIONS

Question	Marking Guidance	Mark	Comments
10	**C**	1	0.017
11	**D**	1	The mean energy of the molecules is greater than the most probable energy of the molecules
12	**A**	1	1.5
13	**D**	1	$CH_2{=}CHCH_2CHO$
14	**C**	1	4
15	**D**	1	$CH_3Cl + Cl\bullet \rightarrow \bullet CH_2Cl + HCl$
16	**C**	1	$CH_3CH_2CH_2Br$
17	**A**	1	It displays *E*-*Z* isomerism
18	**D**	1	3-methylbutan-2-ol
19	**B**	1	CH_3OH
20	**D**	1	pentan-2-ol
21	**D**	1	CH_3CH_2COOH
22	**A**	1	2-methylbut-1-ene
23	**B**	1	4-hydroxybutanone
24	**A**	1	2.28×10^{-18} J

Do not write outside the box

Section B

Answer **all** questions in this section.

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CORRECT METHOD  WRONG METHODS 

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0 9 Which statement is correct about thermal cracking?

[1 mark]

A A pressure between 100 and 200 kPa is used. ⬭

B Aromatic hydrocarbons are the major products. ⬭

C C–C bonds are broken. ⬭

D Zeolite catalysts are used. ⬭

1 0 Which statement is **not** correct about ozone?

[1 mark]

A It absorbs harmful ultraviolet radiation in the upper atmosphere. ⬭

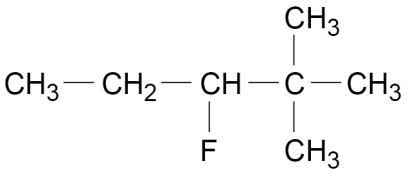
B It decomposes to form oxygen. ⬭

C Its decomposition is catalysed by chlorine molecules. ⬭

D Ozone holes are regions of the upper atmosphere where there is a reduced concentration of ozone. ⬭

Do not write outside the box

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 ⬭

Do not write outside the box

1 4 An excess of methane reacts with chlorine in the presence of ultraviolet radiation.

What are the main products of this reaction?

[1 mark]

A CCl_4 and H_2 ⬭

B CCl_4 and HCl ⬭

C CH_3Cl and H_2 ⬭

D CH_3Cl and HCl ⬭

1 5 In which reaction does the inorganic reagent act initially as an electrophile?

[1 mark]

A bromoethane with ethanolic potassium hydroxide ⬭

B chloroethane with aqueous sodium hydroxide ⬭

C ethane with chlorine ⬭

D ethene with concentrated sulfuric acid ⬭

1 6 What is the empirical formula of a hydrocarbon that contains 90% carbon by mass?

[1 mark]

A C_2H_3 ⬭

B C_3H_2 ⬭

C C_3H_4 ⬭

D C_4H_3 ⬭

Do not write outside the box

1 7 Which compound has the lowest relative molecular mass?

[1 mark]

A ethanoic acid ⬭

B 1-fluoropropane ⬭

C propanenitrile ⬭

D propylamine ⬭

1 8 Which statement is correct about the production and use of ethanol as a biofuel?

[1 mark]

A Biofuel ethanol is produced by the fermentation of glucose in the presence of yeast and air. ⬭

B Biofuel ethanol is purified by fractional distillation. ⬭

C No carbon dioxide is released when biofuel ethanol is burned. ⬭

D Biofuel ethanol burns with a cleaner flame than ethanol made by hydration of ethene. ⬭

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 ⬭

Do not write outside the box

2 0 Which statement about the molecules in a sample of a gas is correct?

[1 mark]

A At a given temperature they all move at the same speed. ⬭

B At a given temperature their average kinetic energy is constant. ⬭

C As temperature increases, there are more molecules with the most probable energy. ⬭

D As temperature decreases, there are fewer molecules with the mean energy. ⬭

2 1 Some enthalpy change data are shown.

$$C(s) + 2\,H_2(g) \rightarrow CH_4(g) \qquad \Delta H = -75 \text{ kJ mol}^{-1}$$
$$H_2(g) \rightarrow 2\,H(g) \qquad \Delta H = +436 \text{ kJ mol}^{-1}$$

What is the enthalpy change, in kJ mol^{-1}, for the following reaction?

$$CH_4(g) \rightarrow C(s) + 4\,H(g)$$

[1 mark]

A –947 ⬭

B –361 ⬭

C +361 ⬭

D +947 ⬭

Turn over for the next question

Do not write outside the box

2 2 The temperature changed from 21.8 °C to 19.2 °C during a calorimetry experiment.

The uncertainty of each reading of the thermometer is ±0.1 °C

What is the percentage uncertainty in the temperature change?

[1 mark]

A 0.5% ⬭

B 1.0% ⬭

C 3.8% ⬭

D 7.7% ⬭

2 3 An experiment is done to determine the enthalpy of combustion of a fuel using a calorimeter containing water.

b = mass of fuel burned / g
w = mass of water heated / g
ΔT = temperature rise of water / K
M_r = relative molecular mass of fuel
c = specific heat capacity of water / J K^{-1} g^{-1}

Which expression gives the enthalpy of combustion (in J mol^{-1}), assuming there is no heat loss?

[1 mark]

A $-\frac{c\,w\,\Delta T\,M_r}{b}$ ⬭

B $-\frac{c\,b\,\Delta T M_r}{w}$ ⬭

C $-\frac{c\,b\,w\,M_r}{\Delta T}$ ⬭

D $-\frac{c\,b\,w\,\Delta T}{M_r}$ ⬭

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END OF QUESTIONS

Question	Marking Guidance	Mark	Comments
9	C	1	C-C bonds are broken
10	C	1	Its decomposition is catalysed by chlorine molecules
11	C	1	3-fluoro-2,2-dimethylpentane
12	D	1	3-bromo-3-methylpentane
13	B	1	Fingerprint region of infrared spectrum
14	D	1	CH_3Cl and HCl
15	D	1	Ethene with concentrated sulfuric acid
16	C	1	C_3H_4
17	C	1	Propanenitrile
18	B	1	Biofuel ethanol is purified by fractional distillation
19	B	1	14.8 cm^3
20	B	1	At a given temperature their average kinetic energy is constant
21	D	1	+947
22	D	1	7.7%
23	A	1	$-\frac{c\ w\ \Delta T\ M_r}{b}$

Do not write outside the box

Section B

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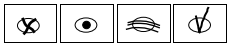
CORRECT METHOD  WRONG METHODS 

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0 9 Which alkene shows *E*–*Z* isomerism?

[1 mark]

A 2,3-dimethylbut-2-ene ⬭

B 4-methylpent-2-ene ⬭

C methylpropene ⬭

D pent-1-ene ⬭

1 0 A compound contains 40.0% carbon, 6.7% hydrogen and 53.3% oxygen by mass.

Which could be the molecular formula of this compound?

[1 mark]

A $C_2H_2O_2$ ⬭

B C_2H_2O ⬭

C $C_2H_4O_2$ ⬭

D C_2HO_2 ⬭

Do not write outside the box

1 1 When driving a car, a legal limit for ethanol (M_r = 46.0) is 80 mg per 100 cm^3 of blood.

What is this concentration in mol dm^{-3}?

[1 mark]

A 1.74×10^{-1} ⬭

B 1.74×10^{-2} ⬭

C 1.74×10^{-3} ⬭

D 1.74×10^{-4} ⬭

1 2 Which is a propagation step in the chlorination of methane?

[1 mark]

A $H\bullet + Cl_2 \rightarrow HCl + Cl\bullet$ ⬭

B $Cl\bullet + CH_4 \rightarrow CH_3Cl + H\bullet$ ⬭

C $\bullet CH_3 + Cl\bullet \rightarrow CH_3Cl$ ⬭

D $\bullet CH_3 + Cl_2 \rightarrow CH_3Cl + Cl\bullet$ ⬭

1 3 Which compound is **not** formed by reacting 3-bromo-3-methylhexane with warm, ethanolic potassium hydroxide?

[1 mark]

A 2-ethylpent-1-ene ⬭

B 3-methylhex-1-ene ⬭

C 3-methylhex-2-ene ⬭

D 3-methylhex-3-ene ⬭

Turn over for the next question

Do not write outside the box

Questions 14 to 16 refer to the reaction of 1-bromopropane with a solution of potassium cyanide in aqueous ethanol.

1 4 What is the organic product of this reaction?

[1 mark]

A propylamine ⬭

B butylamine ⬭

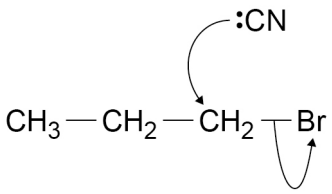
C propanenitrile ⬭

D butanenitrile ⬭

1 5 Which is the correct mechanism for the reaction?

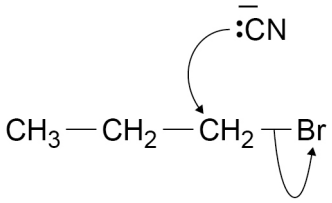
[1 mark]

A



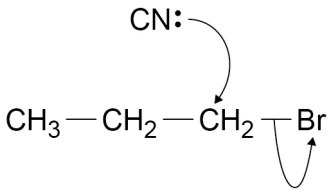
⬭

B



⬭

C



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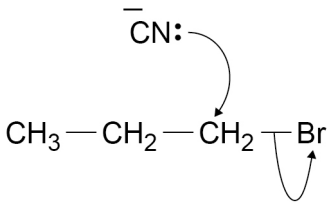
D



⬭

Do not write outside the box

1 6 The reactions of 1-bromopropane and 1-chloropropane with potassium cyanide in aqueous ethanol occur at different rates under the same conditions.

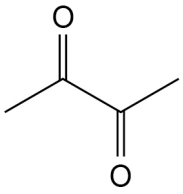
Which row correctly shows the compound that has a faster rate of reaction and the correct reason for this?

[1 mark]

	Compound	Reason	
A	1-bromopropane	C–Br bond weaker than C–Cl bond	⬭
B	1-bromopropane	C–Br bond stronger than C–Cl bond	⬭
C	1-chloropropane	C–Br bond weaker than C–Cl bond	⬭
D	1-chloropropane	C–Br bond stronger than C–Cl bond	⬭

1 7 Which compound has a molecular formula that is different from the others?

[1 mark]

A 

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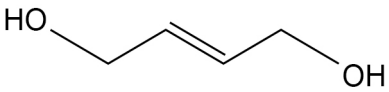
B 

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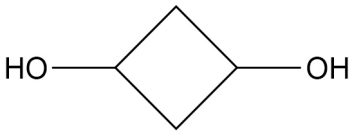
C 

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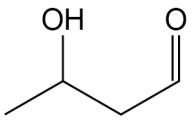
D 

⬭

Turn over for the next question

Do not write outside the box

1 8 Which compound reacts with hydrogen bromide to give 2-bromo-3-methylbutane as the major product?

[1 mark]

A $(CH_3)_2C=CHCH_3$ ⬭

B $(CH_3)_2C=CH_2$ ⬭

C $CH_2=C(CH_3)CH_2CH_3$ ⬭

D $(CH_3)_2CHCH=CH_2$ ⬭

1 9 Which statement is **not** correct about the industrial production of ethanol from ethene at 300 °C?

$$C_2H_4(g) + H_2O(g) \rightleftharpoons C_2H_5OH(g) \qquad \Delta H = -46\ kJ\,mol^{-1}$$

[1 mark]

A The reaction is catalysed by an acid. ⬭

B The reaction has 100% atom economy. ⬭

C An increase in temperature decreases the equilibrium yield of ethanol. ⬭

D An increase in pressure increases the value of K_c ⬭

2 0 Which statement about the use of a catalyst in a reversible reaction is correct?

[1 mark]

A The activation energy for the reverse reaction is increased. ⬭

B The equilibrium constant increases. ⬭

C The rate of the reverse reaction increases. ⬭

D The enthalpy change for the forward reaction decreases. ⬭

Do not write outside the box

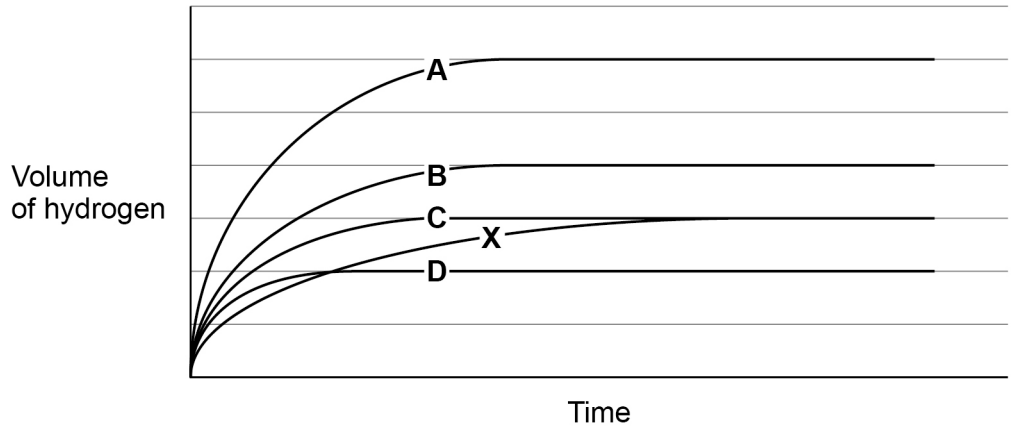
2 1 An excess of magnesium reacts with hydrochloric acid to form hydrogen gas.

Line **X** on the graph shows how the volume of hydrogen produced changes with time as magnesium reacts with 30 cm^3 of 1.0 mol dm^{-3} hydrochloric acid.

The reaction is repeated using 20 cm^3 of 2.0 mol dm^{-3} hydrochloric acid, with all other conditions the same.

Which line shows how the volume of hydrogen produced changes with time?

[1 mark]



A ⬭

B ⬭

C ⬭

D ⬭

Turn over for the next question

Do not write outside the box

2 2 Which statement is **not** correct about the pollutant sulfur dioxide?

[1 mark]

A It can be removed from car exhaust gases by a catalytic converter. ⬭

B It can be removed from power station flue gases by reaction with calcium oxide. ⬭

C It can cause respiratory problems. ⬭

D It can cause acid rain. ⬭

2 3 What is the percentage atom economy for the production of ethanol from glucose?

$$C_6H_{12}O_6 \rightarrow 2\,C_2H_5OH + 2\,CO_2$$

[1 mark]

A 25.6% ⬭

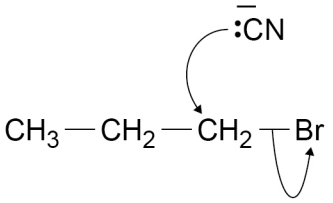
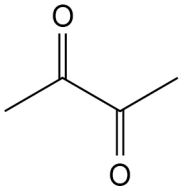
B 27.1% ⬭

C 51.1% ⬭

D 54.2% ⬭

15

END OF QUESTIONS

Question	Marking Guidance	Mark	Comments
9	B	1	4-methylpent-2-ene
10	C	1	$C_2H_4O_2$
11	B	1	1.74×10^{-2}
12	D	1	$^{\bullet}CH_3 + Cl_2 \rightarrow CH_3Cl + Cl^{\bullet}$
13	B	1	3-methylhex-1-ene
14	D	1	butanenitrile
15	B	1	
16	A	1	1-bromopropane, C–Br bond weaker than C–Cl bond
17	A	1	
18	D	1	$(CH_3)_2CHCH=CH_2$

19	D	1	An increase in pressure increases the value of K_c
20	C	1	The rate of the reverse reaction increases.
21	B	1	
22	A	1	It can be removed from car exhaust gases by a catalytic converter.
23	C	1	51.1%

Do not write outside the box

Section B

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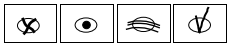
Only **one** answer per question is allowed.
For each answer completely fill in the circle alongside the appropriate answer.

CORRECT METHOD  WRONG METHODS 

If you want to change your answer you must cross out your original answer as shown. 

If you wish to return to an answer previously crossed out, ring the answer you now wish to select as shown. 

You may do your working in the blank space around each question but this will not be marked. Do **not** use additional sheets for this working.

0 9 Which alkene shows *E*–*Z* isomerism?

[1 mark]

A 2,3-dimethylbut-2-ene ⬭

B 4-methylpent-2-ene ⬭

C methylpropene ⬭

D pent-1-ene ⬭

1 0 A compound contains 40.0% carbon, 6.7% hydrogen and 53.3% oxygen by mass.

Which could be the molecular formula of this compound?

[1 mark]

A $C_2H_2O_2$ ⬭

B C_2H_2O ⬭

C $C_2H_4O_2$ ⬭

D C_2HO_2 ⬭

Do not write outside the box

1 1 When driving a car, a legal limit for ethanol (M_r = 46.0) is 80 mg per 100 cm^3 of blood.

What is this concentration in mol dm^{-3}?

[1 mark]

A 1.74×10^{-1} ⬭

B 1.74×10^{-2} ⬭

C 1.74×10^{-3} ⬭

D 1.74×10^{-4} ⬭

1 2 Which is a propagation step in the chlorination of methane?

[1 mark]

A $H\bullet + Cl_2 \rightarrow HCl + Cl\bullet$ ⬭

B $Cl\bullet + CH_4 \rightarrow CH_3Cl + H\bullet$ ⬭

C $\bullet CH_3 + Cl\bullet \rightarrow CH_3Cl$ ⬭

D $\bullet CH_3 + Cl_2 \rightarrow CH_3Cl + Cl\bullet$ ⬭

1 3 Which compound is **not** formed by reacting 3-bromo-3-methylhexane with warm, ethanolic potassium hydroxide?

[1 mark]

A 2-ethylpent-1-ene ⬭

B 3-methylhex-1-ene ⬭

C 3-methylhex-2-ene ⬭

D 3-methylhex-3-ene ⬭

Turn over for the next question

Do not write outside the box

Questions 14 to 16 refer to the reaction of 1-bromopropane with a solution of potassium cyanide in aqueous ethanol.

1 4 What is the organic product of this reaction?

[1 mark]

A propylamine ⬭

B butylamine ⬭

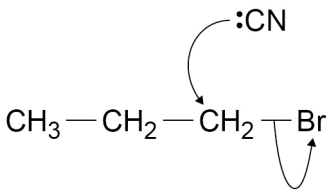
C propanenitrile ⬭

D butanenitrile ⬭

1 5 Which is the correct mechanism for the reaction?

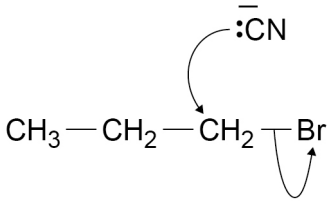
[1 mark]

A



⬭

B



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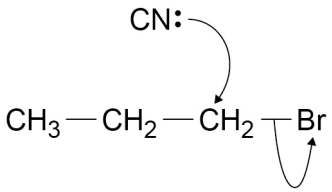
C



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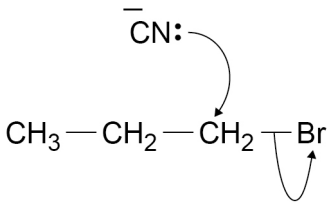
D



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Do not write outside the box

1 6 The reactions of 1-bromopropane and 1-chloropropane with potassium cyanide in aqueous ethanol occur at different rates under the same conditions.

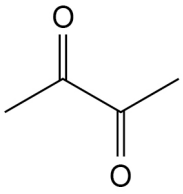
Which row correctly shows the compound that has a faster rate of reaction and the correct reason for this?

[1 mark]

	Compound	Reason	
A	1-bromopropane	C–Br bond weaker than C–Cl bond	⬭
B	1-bromopropane	C–Br bond stronger than C–Cl bond	⬭
C	1-chloropropane	C–Br bond weaker than C–Cl bond	⬭
D	1-chloropropane	C–Br bond stronger than C–Cl bond	⬭

1 7 Which compound has a molecular formula that is different from the others?

[1 mark]

A 

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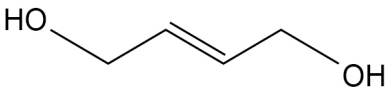
B 

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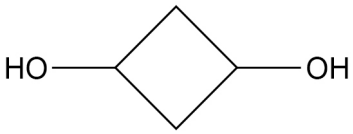
C 

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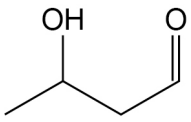
D 

⬭

Turn over for the next question

Do not write outside the box

1 8 Which compound reacts with hydrogen bromide to give 2-bromo-3-methylbutane as the major product?

[1 mark]

A $(CH_3)_2C=CHCH_3$ ⬭

B $(CH_3)_2C=CH_2$ ⬭

C $CH_2=C(CH_3)CH_2CH_3$ ⬭

D $(CH_3)_2CHCH=CH_2$ ⬭

1 9 Which statement is **not** correct about the industrial production of ethanol from ethene at 300 °C?

$$C_2H_4(g) + H_2O(g) \rightleftharpoons C_2H_5OH(g) \qquad \Delta H = -46\ kJ\,mol^{-1}$$

[1 mark]

A The reaction is catalysed by an acid. ⬭

B The reaction has 100% atom economy. ⬭

C An increase in temperature decreases the equilibrium yield of ethanol. ⬭

D An increase in pressure increases the value of K_c ⬭

2 0 Which statement about the use of a catalyst in a reversible reaction is correct?

[1 mark]

A The activation energy for the reverse reaction is increased. ⬭

B The equilibrium constant increases. ⬭

C The rate of the reverse reaction increases. ⬭

D The enthalpy change for the forward reaction decreases. ⬭

Do not write outside the box

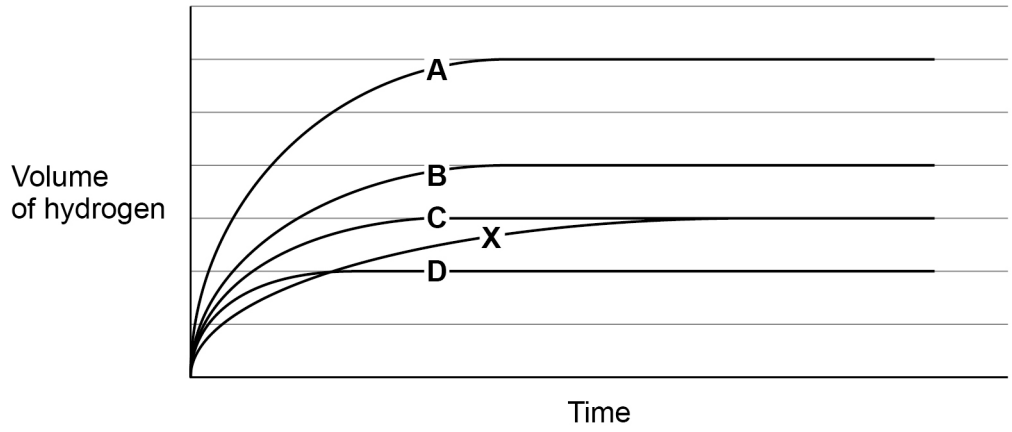
2 1 An excess of magnesium reacts with hydrochloric acid to form hydrogen gas.

Line **X** on the graph shows how the volume of hydrogen produced changes with time as magnesium reacts with 30 cm^3 of 1.0 mol dm^{-3} hydrochloric acid.

The reaction is repeated using 20 cm^3 of 2.0 mol dm^{-3} hydrochloric acid, with all other conditions the same.

Which line shows how the volume of hydrogen produced changes with time?

[1 mark]



A ⬭

B ⬭

C ⬭

D ⬭

Turn over for the next question

Do not write outside the box

2 2 Which statement is **not** correct about the pollutant sulfur dioxide?

[1 mark]

A It can be removed from car exhaust gases by a catalytic converter. ⬭

B It can be removed from power station flue gases by reaction with calcium oxide. ⬭

C It can cause respiratory problems. ⬭

D It can cause acid rain. ⬭

2 3 What is the percentage atom economy for the production of ethanol from glucose?

$$C_6H_{12}O_6 \rightarrow 2\,C_2H_5OH + 2\,CO_2$$

[1 mark]

A 25.6% ⬭

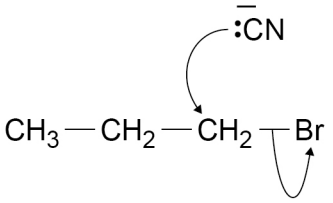
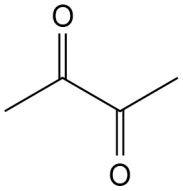
B 27.1% ⬭

C 51.1% ⬭

D 54.2% ⬭

15

END OF QUESTIONS

Question	Marking Guidance	Mark	Comments
9	B	1	4-methylpent-2-ene
10	C	1	$C_2H_4O_2$
11	B	1	1.74×10^{-2}
12	D	1	$^{\bullet}CH_3 + Cl_2 \rightarrow CH_3Cl + Cl^{\bullet}$
13	B	1	3-methylhex-1-ene
14	D	1	butanenitrile
15	B	1	
16	A	1	1-bromopropane, C–Br bond weaker than C–Cl bond
17	A	1	
18	D	1	$(CH_3)_2CHCH=CH_2$

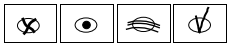
19	D	1	An increase in pressure increases the value of K_c
20	C	1	The rate of the reverse reaction increases.
21	B	1	
22	A	1	It can be removed from car exhaust gases by a catalytic converter.
23	C	1	51.1%

Do not write outside the box

Section B

Answer **all** questions in this section.

Only **one** answer per question is allowed.
For each answer completely fill in the circle alongside the appropriate answer.

CORRECT METHOD  WRONG METHODS 

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0 8 When hexadecane ($C_{16}H_{34}$) is heated to a high temperature, one molecule of hexadecane decomposes to form an alkane containing eight carbon atoms and two different unsaturated compounds.

Which equation could represent this reaction?

[1 mark]

A $C_{16}H_{34} \rightarrow C_8H_{16} + C_5H_{12} + C_3H_6$ ⬭

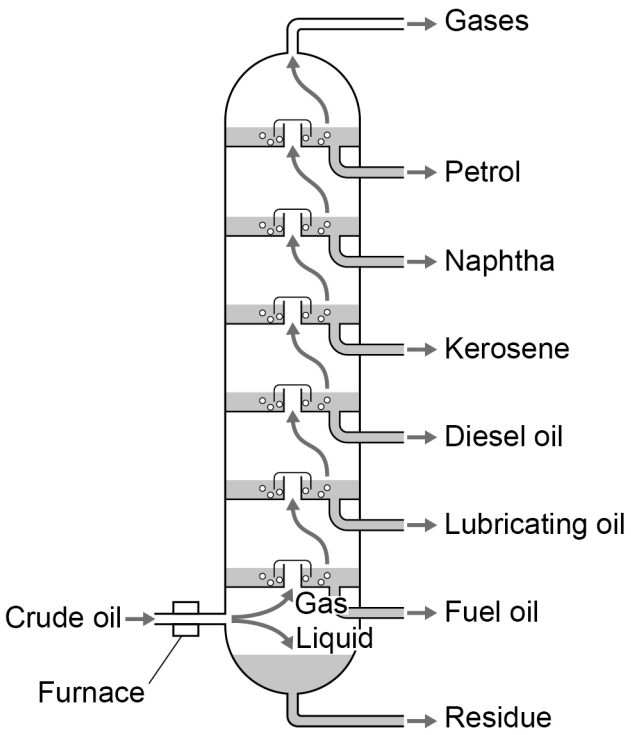
B $C_{16}H_{34} \rightarrow C_8H_{18} + C_6H_{10} + C_2H_6$ ⬭

C $C_{16}H_{34} \rightarrow C_8H_{18} + 2\,C_2H_4 + C_4H_8$ ⬭

D $C_{16}H_{34} \rightarrow C_8H_{18} + C_6H_{14} + C_2H_2$ ⬭

Do not write outside the box

0 9 The diagram shows a fractionating column used in the industrial fractional distillation of crude oil.



Which statement is correct?

[1 mark]

A The most viscous product is fuel oil. ⬭

B The boiling point of naphtha is higher than diesel oil. ⬭

C Molecules in diesel oil are held together by hydrogen bonds. ⬭

D Kerosene is a mixture of compounds. ⬭

1 0 Which statement about poly(ethene) is correct?

[1 mark]

A It has a lower relative molecular mass than ethene. ⬭

B It has a lower density than ethene at standard temperature and pressure. ⬭

C It has a higher melting point than ethene. ⬭

D It decolourises bromine water. ⬭

Turn over ►

Do not write outside the box

1 1 A polymer is formed from the monomer $CH_2=CHCN$

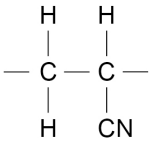
Which statement is **not** correct?

[1 mark]

A The monomer is propanenitrile. ⬭

B The monomer is unsaturated. ⬭

C The polymer is an addition polymer. ⬭

D The polymer has the repeating unit  ⬭

1 2 Which alcohol when dehydrated forms a mixture of alkenes?

[1 mark]

A propan-1-ol ⬭

B propan-2-ol ⬭

C pentan-1-ol ⬭

D pentan-2-ol ⬭

1 3 Which compound has the highest boiling point?

[1 mark]

A $CH_3COCH_2CH_3$ ⬭

B $CH_3CH_2CH_2CH_2OH$ ⬭

C $CH_3CH_2CH_2CHO$ ⬭

D $CH_3CH_2CH_2CH_2CH_3$ ⬭

Do not write outside the box

1 4 Which statement about molecules in a gas is correct?

[1 mark]

A At a fixed temperature they all move at the same speed. ⬭

B At a fixed temperature their average kinetic energy is constant. ⬭

C As temperature increases, there are more molecules with the most probable energy. ⬭

D As temperature decreases, there are fewer molecules with the mean energy. ⬭

1 5 Which compound produces $(CH_3)_2CHCOCH_3$ when oxidised?

[1 mark]

A 2-methylpropan-1-ol ⬭

B 2,2-dimethylpropanol ⬭

C 2-methylbutan-2-ol ⬭

D 3-methylbutan-2-ol ⬭

1 6 Which reaction does **not** result in a change in the shape around a carbon atom?

[1 mark]

A chloromethane with aqueous sodium hydroxide ⬭

B ethene with bromine ⬭

C propane with excess oxygen ⬭

D propan-1-ol with acidified potassium dichromate(VI) ⬭

Do not write outside the box

1 7 Which compound has the same empirical formula and molecular formula?

[1 mark]

A butane ⬭

B but-1-ene ⬭

C propane ⬭

D propene ⬭

Questions **18**, **19** and **20**

Methanol is made in this equilibrium reaction, using a catalyst.

$$CO(g) + 2H_2(g) \rightleftharpoons CH_3OH(g) \qquad \Delta H = -91 \text{ kJ mol}^{-1}$$

1 8 The reaction reaches equilibrium in a container of fixed volume.

Which is the expression for K_c for this equilibrium?

[1 mark]

A $K_c = \dfrac{[CH_3OH]}{[CO] + [H_2]^2}$ ⬭

B $K_c = \dfrac{[CH_3OH]}{[CO]\,[H_2]^2}$ ⬭

C $K_c = \dfrac{[CO] + [H_2]^2}{[CH_3OH]}$ ⬭

D $K_c = \dfrac{[CO]\,[H_2]^2}{[CH_3OH]}$ ⬭

Do not write outside the box

1 9 2.0 mol of carbon monoxide is mixed with 3.0 mol of hydrogen and allowed to reach equilibrium.

The equilibrium mixture contains 0.6 mol of methanol.

What is the total amount, in mol, of gas at equilibrium?

[1 mark]

A 3.2 ⬭

B 3.8 ⬭

C 4.4 ⬭

D 5.0 ⬭

2 0 Which change in condition will decrease the equilibrium yield of methanol?

[1 mark]

A Increase the amount of CO in the equilibrium mixture. ⬭

B Increase the pressure. ⬭

C Increase the surface area of the catalyst. ⬭

D Increase the temperature. ⬭

Turn over for the next question

Do not write outside the box

Questions **21** and **22**

When 2-bromobutane is warmed with potassium hydroxide solution, substitution and elimination reactions both occur.

2 1 Which of these compounds is **not** produced?

[1 mark]

A butan-1-ol ⬭

B butan-2-ol ⬭

C but-1-ene ⬭

D *E*-but-2-ene ⬭

2 2 What is the role of the hydroxide ions in the elimination reaction?

[1 mark]

A base ⬭

B catalyst ⬭

C electrophile ⬭

D nucleophile ⬭

15

END OF QUESTIONS

Question	Marking Guidance	AO	Mark	Comments
8	C	AO2	1	$C_{16}H_{34} \rightarrow C_8H_{18} + 2C_2H_4 + C_4H_8$
9	D	AO1	1	Kerosene is a mixture of compounds
10	C	AO1	1	It has a higher melting point than ethene
11	A	AO3	1	The monomer is propanenitrile
12	D	AO3	1	pentan-2-ol
13	B	AO2	1	$CH_3CH_2CH_2CH_2OH$
14	B	AO1	1	At a fixed temperature their average kinetic energy is constant
15	D	AO1	1	3-methylbutan-2-ol
16	A	AO2	1	chloromethane with aqueous sodium hydroxide
17	C	AO1	1	propane
18	B	AO2	1	$K_c = \frac{[CH_3OH]}{[CO]\,[H_2]^2}$
19	B	AO2	1	3.8
20	D	AO3	1	Increase the temperature
21	A	AO2	1	butan-1-ol
22	A	AO1	1	base