



Please write clearly in block capitals.

Centre number

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Candidate number

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Surname

Model Answers

Forename(s)

Candidate signature

AS CHEMISTRY

Paper 2: Organic and Physical Chemistry

Friday 10 June 2016

Afternoon

Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:

- the Periodic Table/Data Sheet, provided as an insert (enclosed)
- a ruler with millimetre measurements
- a calculator, which you are expected to use where appropriate.

Instructions

- Use black ink or black ball-point pen.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- All working must be shown.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- The maximum mark for this paper is 80.
- The Periodic Table/Data Sheet is provided as an insert.

Advice

- You are advised to spend about 65 minutes on **Section A** and 25 minutes on **Section B**.



J U N 1 6 7 4 0 4 2 0 1

IB/M/JUN16/7404/2

7404/2

Section A

Answer all questions in this section.

- 1 Ethene reacts with steam in the presence of an acid catalyst to form ethanol.



- 0 1 . 1 Write an expression for the equilibrium constant K_c for this equilibrium.
Deduce the units of K_c .

[2 marks]

Expression
$$K_c = \frac{[\text{CH}_3\text{CH}_2\text{OH}]}{[\text{CH}_2\text{CH}_2][\text{H}_2\text{O}]}$$

~~mol dm⁻³~~
mol dm⁻³ mol dm⁻³

Units
$$\text{mol}^{-1}\text{dm}^3$$

- 0 1 . 2 An equilibrium mixture was found to contain 0.700 mol of ethene, 1.20 mol of steam and 4.40 mol of ethanol at a temperature T . The volume of the container was 2.00 dm³.

Calculate a value of K_c for this equilibrium at this temperature.

Give your answer to an appropriate number of significant figures.

[2 marks]

Don't forget
to turn moles
into concentration!

$$K_c = \frac{\left(\frac{4.40}{2}\right)}{\left(\frac{0.700}{2}\right) \times \left(\frac{1.20}{2}\right)} = 10.5 \text{ mol}^{-1}\text{dm}^3$$

3 sf.
because the last zero
in each is significant!



Turn over for the next question

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ANSWER IN THE SPACES PROVIDED**



Turn over ►

- 2 Alcohols such as methanol (CH_3OH), ethanol ($\text{CH}_3\text{CH}_2\text{OH}$) and propan-1-ol ($\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$) are good fuels.

0 2 . 1 A student carried out an experiment to determine the enthalpy of combustion of methanol.

Methanol was placed in a spirit burner and the mass of the spirit burner measured. The student placed 100 g of water in a copper calorimeter and clamped it above the spirit burner. The burner was lit and allowed to burn for a few minutes. The flame was then extinguished and the new mass of the spirit burner found.

The measured temperature rise was $38.0\text{ }^\circ\text{C}$. The specific heat capacity of water is $4.18\text{ J K}^{-1}\text{ g}^{-1}$.

Figure 1, a diagram of the apparatus, is shown alongside Table 1 which shows the measurements the student recorded.

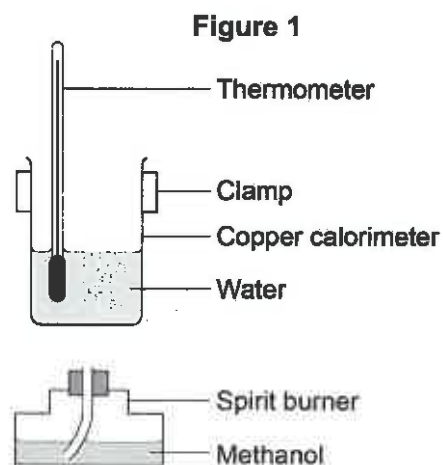


Table 1

Mass of burner containing methanol before experiment	214.02 g
Mass of burner containing methanol after experiment	212.37 g

Use the student's data to calculate an experimental value for the enthalpy of combustion of methanol in kJ mol^{-1} .

[4 marks]

$$q = mc\Delta t \quad (\text{methanol mass} = 214.02 - 212.37 = 1.65\text{ g})$$

$$q = 100 \times 4.18 \times 38 \quad q = 15884\text{ J}$$

$$\frac{1.65\text{ g}}{32} = 0.052 \text{ moles of methanol}$$

$$\frac{15884}{0.052} = 305461.5 \text{ J mol}^{-1}$$

$\swarrow \div 1000$

$$\therefore = -305.5 \text{ kJ mol}^{-1}$$

Remember that final answer must be negative as it is exothermic!



- 0 2 . 2 Suggest one reason, other than incomplete combustion or heat transfer to the atmosphere, why the student's value for the enthalpy of combustion of methanol is different from that in a Data Book.

[1 mark]

Heat energy needed to heat up the calorimeter
not taken into account.

- 0 2 . 3 The uncertainty in each of the temperature readings from the thermometer in this experiment was $\pm 0.25^\circ\text{C}$. This gave an overall uncertainty in the temperature rise of $\pm 0.5^\circ\text{C}$.

Calculate the percentage uncertainty for the use of the thermometer in this experiment.

[1 mark]

$$\left(\frac{0.5}{38}\right) \times 100 = \underline{\underline{1.32\%}}$$

- 0 2 . 4 The student said correctly that using a thermometer with an overall uncertainty for the rise in temperature of $\pm 0.5^\circ\text{C}$ was adequate for this experiment.

Explain why this thermometer was adequate for this experiment.

[1 mark]

There are more significant errors such as
heat loss to the surroundings.

- 0 2 . 5 The enthalpy of combustion of ethanol is -1371 kJ mol^{-1} . The density of ethanol is 0.789 g cm^{-3} .

Calculate the heat energy released in kJ when 0.500 dm^3 of ethanol is burned. Give your answer to an appropriate number of significant figures.

[3 marks]

$$\text{density} = \frac{\text{mass}}{\text{volume}} \quad \text{density} \times \text{volume} = \text{mass}$$

$$0.789 \times (0.500 \times 1000) = 394.5\text{g of ethanol}$$

$$\frac{394.5}{46} = 8.58\text{ moles of ethanol}$$

$$-1371 \times 8.58\text{ moles} = -11763.18$$

$$\therefore = -11800\text{ kJ} \quad (3\text{sf})$$

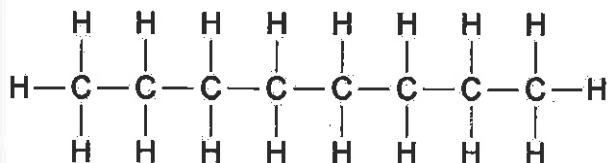
to get an answer
in kJ you need to
divide the mass
from the enthalpy!!!



- 3 Octane and isooctane are structural isomers with the molecular formula C_8H_{18} . The displayed formulas and boiling points of octane and isooctane are shown in Figure 2.

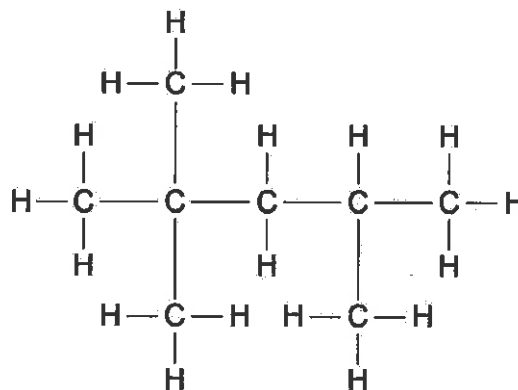
Figure 2

Octane



Boiling point: 125 °C

Isooctane



Boiling point: 99 °C

- 0 3 . 1 Give the IUPAC name for isooctane.

*first find the root (5)
and number your chain.*

[1 mark]

2,2,4-trimethylpentane

- 0 3 . 2 Octane and isooctane can be separated in the laboratory.

Name a laboratory technique that could be used to separate isooctane from a mixture of octane and isooctane.

Outline how this technique separates isooctane from octane.

[3 marks]

Name distillation

Outline Isooctane would have a lower boiling point so will boil first, this can then be condensed off and collected.



- 0 3 . 3 Isooctane is added to petrol to increase its octane rating. Some high-performance engines require fuel with a higher octane rating.

Write an equation for the complete combustion of isooctane. Use the molecular formula (C_8H_{18}) of isooctane in your equation.

[1 mark]



- 0 3 . 4 Explain, in general terms, how a catalyst works.

[2 marks]

If in doubt describe everything.
Speeds up chemical reactions without itself being used up. It does this by providing an alternative pathway which lowers activation energy.

- 0 3 . 5 Carbon monoxide is produced when incomplete combustion takes place in engines. Nitrogen monoxide is another pollutant produced in car engines.

Write an equation to show how these pollutants react together in a catalytic converter.

[1 mark]



- 0 3 . 6 Platinum, palladium and rhodium are metals used inside catalytic converters. A very thin layer of the metals is used on a honeycomb ceramic support.

Explain why a thin layer is used in this way.

[2 marks]

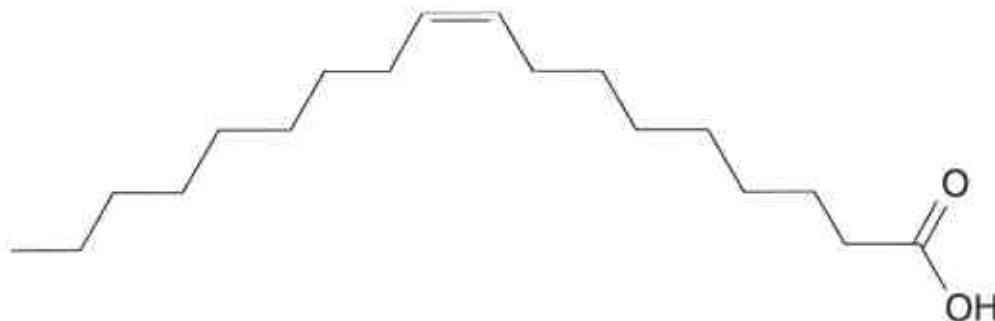
Provides a massive surface area and also reduces cost by limiting the amount of precious metals needed.

Question 3 continues on the next page



0 3 . 7 Oleic acid ($C_{18}H_{34}O_2$) is a straight-chain fatty acid obtained from plant oils. Isooctane can be made from oleic acid. The skeletal formula of oleic acid is shown in Figure 3.

Figure 3



Identify a reagent that could be used in a chemical test to show that oleic acid is unsaturated.

State what would be observed in this test.

[2 marks]

Reagent Bromine water

Observation would decolourise the bromine.

Orange → colourless

even with a complex molecule like this the test remains the same.



Turn over for the next question

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4 The compounds in Table 2 all have a relative molecular mass of 58.0

Table 2

Name	Propanal	Prop-2-en-1-ol	Butane
Structure	$\begin{array}{c} \text{H} & \text{H} & \text{O} \\ & & \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{H} \\ & \\ \text{H} & \text{H} \end{array}$	$\begin{array}{c} \text{H} & \text{H} & \text{H} \\ & & \\ \text{C}=\text{C}-\text{C}-\text{O}-\text{H} \\ & & \\ \text{H} & & \text{H} \end{array}$	$\begin{array}{c} \text{H} & \text{H} & \text{H} & \text{H} \\ & & & \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{C}-\text{H} \\ & & & \\ \text{H} & \text{H} & \text{H} & \text{H} \end{array}$

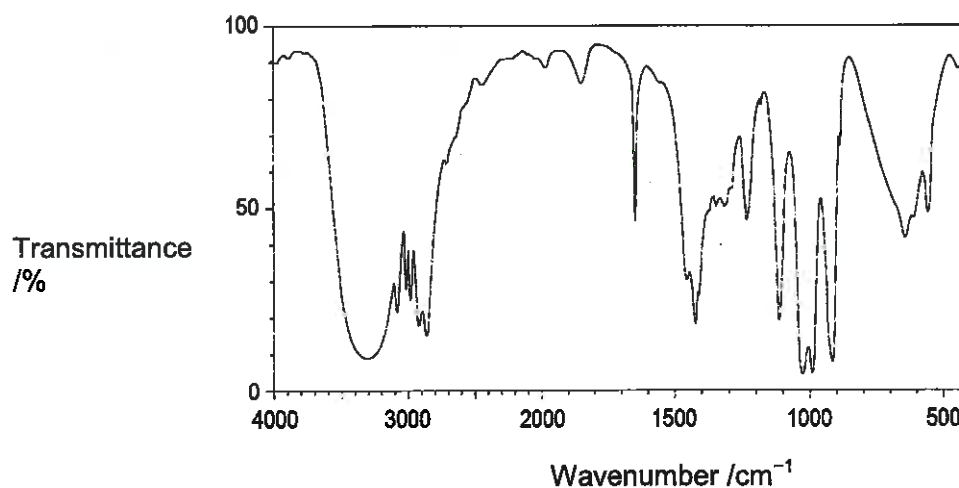
0 4 . 1 Explain why determining the precise relative molecular mass of propanal and prop-2-en-1-ol by mass spectrometry could not be used to distinguish between samples of these two compounds.

[2 marks]

They have the same molecular formula ($\text{C}_3\text{H}_6\text{O}$)
so would therefore have exactly the same Mr.

0 4 . 2 The infrared spectrum of one of these three compounds is shown in Figure 4.

Figure 4



Use the spectrum to identify the compound.

State the bond that you used to identify the compound and give its wavenumber range. You should only consider absorptions with wavenumbers greater than 1500 cm^{-1} .

[2 marks]

Compound Prop-2-en-1-ol

Bond used to identify compound O-H

Wavenumber range of bond used to identify compound 3230-3550 cm^{-1}



0 4 . 3 Predict the relative boiling points of these three compounds from the highest to the lowest boiling points.

Justify this order in terms of intermolecular forces.

[6 marks]

Highest B.P. $\xrightarrow{\hspace{10em}}$ Lowest B.P.
Prop-2-en-ol \rightarrow Propanal \rightarrow Butane

Highest
intermolecular
forces

Prop-2-en-ol has hydrogen bonding

Propanal has dipole-dipole interactions

Butane has VdW only

Prop-2-en-ol has hydrogen bonding as well as van der Waals giving it the highest b.p. Next is propanal which has dipole-dipole between C=O bond as well as van der Waals. Butane has the lowest as only intermolecular force is van der Waals.

I approached this question by first trying to write down the intermolecular forces.



- 5 Refrigerants are substances used to cool refrigerators and freezers. Until recently, many of the compounds used as refrigerants were chlorofluorocarbons (CFCs), but these are now known to form chlorine radicals. CFCs have been phased out in many countries by international agreement.

0 5 . 1 Write **two** equations to show how chlorine radicals react with ozone molecules in the upper atmosphere.

[2 marks]

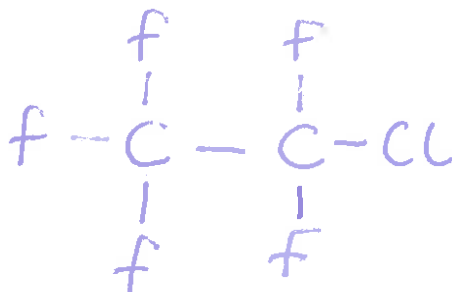
*These are
propagation steps
as a new radical is being
made.*



0 5 . 2 Chloropentafluoroethane is a CFC that has been used as a refrigerant.

Draw its displayed formula.

[1 mark]



0 5 . 3 1,1,1-trifluoroethane (CF_3CH_3) is one of the molecules that has been used as a refrigerant in place of CFCs.

Explain why 1,1,1-trifluoroethane does not lead to the depletion of the ozone in the upper atmosphere.

[1 mark]

*It is this bond
which is broken
by UV light.*

It does not contain Cl so therefore no C-Cl bond.



- 0 5 . 4 One of the steps in the synthesis of 1,1,1-trifluoroethane (CF_3CH_3) is the reaction of 1,1-difluoroethane (CHF_2CH_3) with fluorine in a free-radical substitution reaction.

Write two equations to represent the propagation steps in this conversion of CHF_2CH_3 into CF_3CH_3

[2 marks]

Propagation step 1



Propagation step 2



- 0 5 . 5 A refrigerator contains 1.41 kg of 1,1,1-trifluoroethane (CF_3CH_3).

Calculate the number of molecules of 1,1,1-trifluoroethane in the refrigerator. Give your answer to an appropriate number of significant figures. (The Avogadro constant $L = 6.022 \times 10^{23} \text{ mol}^{-1}$)

[2 marks]

$$1.41 \times 1000 = 1410 \text{ g} \quad \frac{1410}{84} = 16.8 \text{ moles}$$

$84 \leftarrow \text{Mr of } \text{CF}_3\text{CH}_3$

$$16.8 \times 6.022 \times 10^{23} = 1.01 \times 10^{25} \text{ molecules}$$

- 0 5 . 6 There are growing concerns about the use of 1,1,1-trifluoroethane as a refrigerant as it is a greenhouse gas that absorbs some of Earth's infrared radiation.

Give one reason why bonds in molecules such as carbon dioxide and 1,1,1-trifluoroethane absorb infrared radiation.

[1 mark]

The bonds vibrate, bend or stretch.



6 Propane-1,2-diol has the structure $\text{CH}_2(\text{OH})\text{CH}(\text{OH})\text{CH}_3$. It is used to make polyesters and is one of the main substances in electronic cigarettes (E-cigarettes).

A sample of propane-1,2-diol was refluxed with a large excess of potassium dichromate(VI) and sulfuric acid.

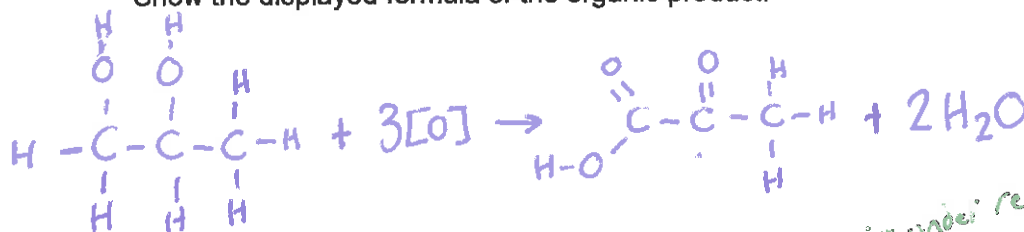
0 6 . 1 Draw the skeletal formula of propane-1,2-diol.



[1 mark]

0 6 . 2 Write an equation for this oxidation reaction of propane-1,2-diol under reflux, using [O] to represent the oxidizing agent.

Show the displayed formula of the organic product.

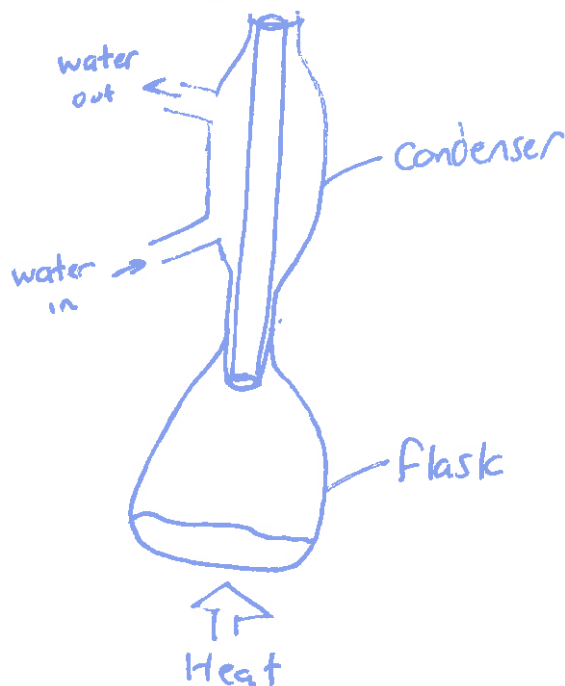


[2 marks]

the clue here is under reflux which means it is complete oxidation. 1^o alcohol group becomes a COOH and 2^o alcohol group becomes C=O.



- 0 6 . 3 Draw a labelled diagram to show how you would set up apparatus for refluxing.



[2 marks]

ensure condenser has
openings top + bottom
but outer condenser
is sealed. Also No
gaps and condenser
+ flask labelled.

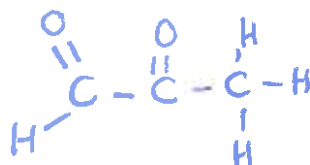
- 0 6 . 4 Anti-bumping granules are placed in the flask when refluxing. Suggest why these granules prevent bumping.

[1 mark]

Prevent large bubbles from forming so reduced uncontrolled bubbling.

- 0 6 . 5 Draw the structure of a different organic product formed when the acidified potassium dichromate(VI) is not in excess.

[1 mark]



there are a few
answers for this -
just make it is not
a carboxylic acid
any more.

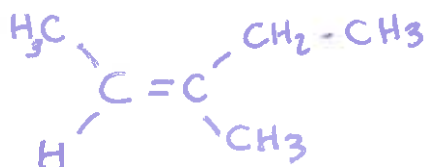


- 7 The alkene 3-methylpent-2-ene ($\text{CH}_3\text{CH}=\text{C}(\text{CH}_3)\text{CH}_2\text{CH}_3$) reacts with hydrogen bromide to form a mixture of 3-bromo-3-methylpentane and 2-bromo-3-methylpentane.

- 0 7 . 1 The alkene 3-methylpent-2-ene ($\text{CH}_3\text{CH}=\text{C}(\text{CH}_3)\text{CH}_2\text{CH}_3$) exists as *E* and *Z* stereoisomers.

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

[1 mark]



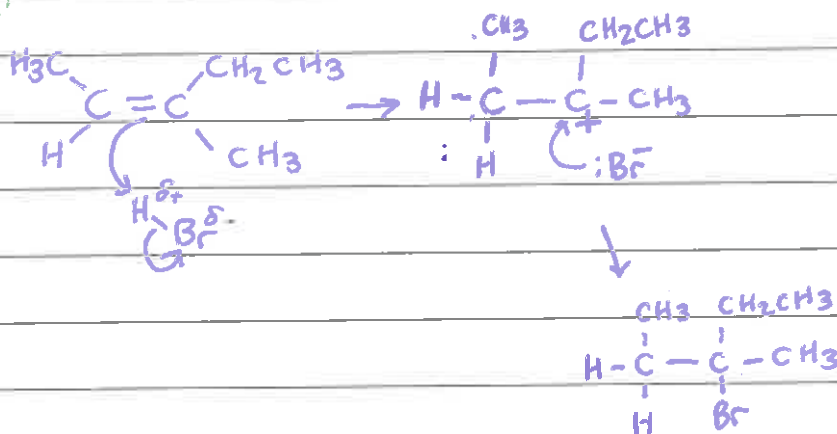
- 0 7 . 2 Name and outline the mechanism for the formation of 3-bromo-3-methylpentane from this reaction of 3-methylpent-2-ene with hydrogen bromide.

Explain why more 3-bromo-3-methylpentane is formed in this reaction than 2-bromo-3-methylpentane.

[7 marks]

Electrophilic Addition

The mechanism is reasonable to explain the relative stability of the carbocations.



More 3-bromo-3-methylpentane is formed as in this product the carbocation formed is a tertiary carbocation which is more stable than the secondary which would have been formed for 2-bromo-3-methylpentane.



Turn over for the next question

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ANSWER IN THE SPACES PROVIDED**



Turn over ►

- 8 When an aqueous solution of ethanoic acid reacts with magnesium, the progress of reaction can be followed using the equipment shown in **Figure 5** to measure the volume of hydrogen produced.

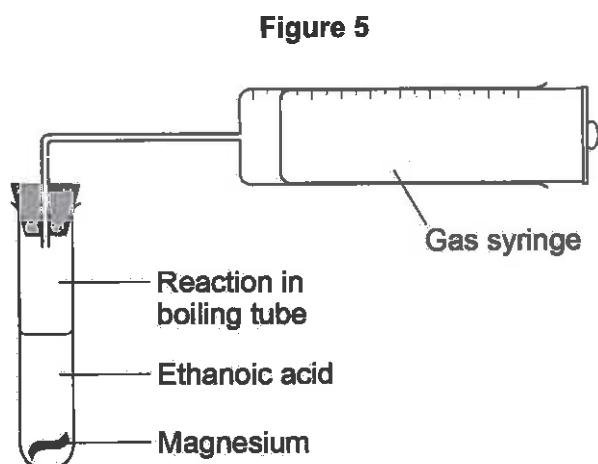
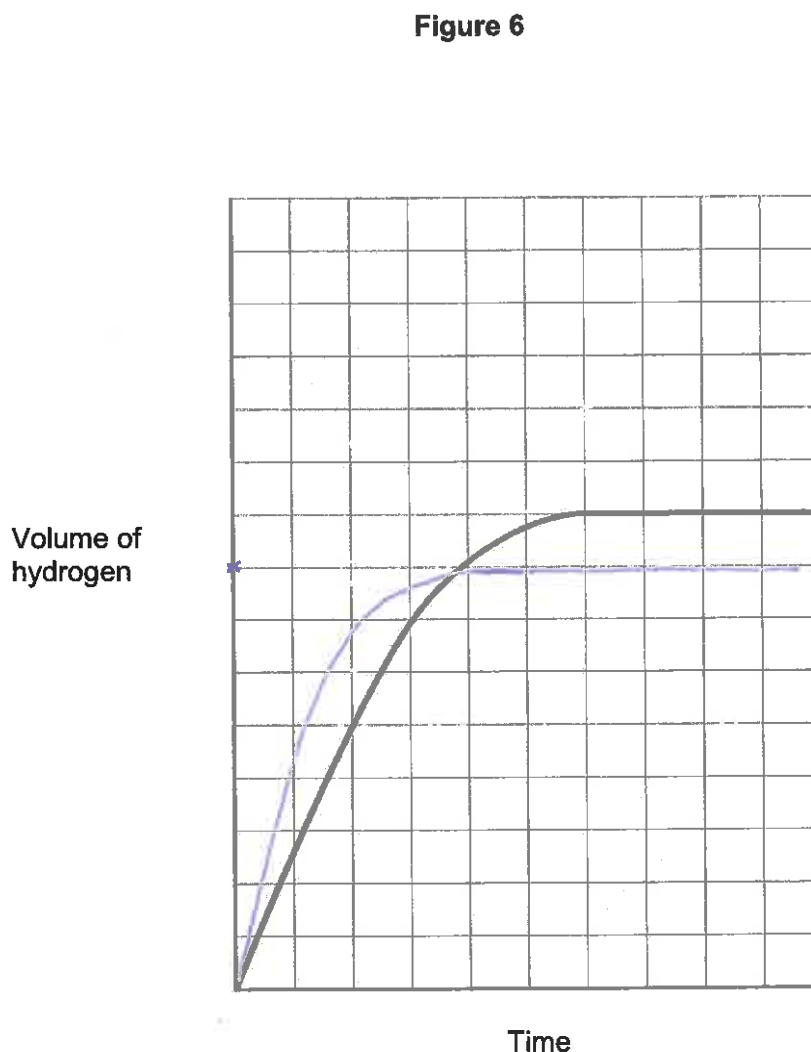


Figure 6 shows how the volume of hydrogen produced varies with time when 396 mg of magnesium are added to 30.0 cm³ of 0.600 mol dm⁻³ ethanoic acid.



0 8 . 1 The equation for the reaction between ethanoic acid and magnesium is shown.



With the aid of calculations, show that the magnesium is in excess in this reaction.

[3 marks]

$$\text{moles} = \frac{\text{mass}}{\text{Mr}} \quad 396\text{mg} = 0.396\text{g} \quad \frac{0.396}{24.3} = 0.0163\text{moles}$$

$$\text{conc} = \frac{\text{moles}}{\text{vol.}} \quad 0.600 \times \left(\frac{30.0}{1000}\right) = 0.018\text{moles}$$

Equation tells us that it is 2:1 \therefore for 0.018 moles of ethanoic only 0.009 moles needed therefore Mg in excess.

0 8 . 2 The reaction was repeated using 20 cm^3 of 0.800 mol dm^{-3} of ethanoic acid solution with all other conditions the same. The magnesium was still in excess.

Sketch a line on Figure 6 to show how the volume of hydrogen produced varies with time in this second experiment.

[2 marks]

Space for working.

$$c = \frac{m}{v} \quad 0.800 \times \left(\frac{20}{1000}\right) = 0.016\text{moles of acid}$$

Explanation
0.018 originally - 9 squares on y axis
 \therefore 0.016 new - 8 squares on y axis.

Higher concentration so graph must be steeper.

Turn over for the next question

Turn over ►



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. 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 out in the blank spaces around the questions but this will not be marked. Do not use additional sheets for this working.

0 9

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

[1 mark]

A $\text{CH}_3\text{CH}_2\text{CN}$ *cyanide x*B $\text{CH}_3\text{CH}_2\text{COOH}$ *ethanoic x*C CH_3CHO *aldehyde ✓*D CH_3COCH_3 *ketone x*

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%



$$\frac{50}{60} = 0.833 \text{ moles theoretical}$$

$$\frac{30}{42} = 0.714 \text{ moles actual}$$

$$\therefore \frac{0.714}{0.833} \times 100 = 86\%$$

1 2

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

Which of the following statements is true?

[1 mark]

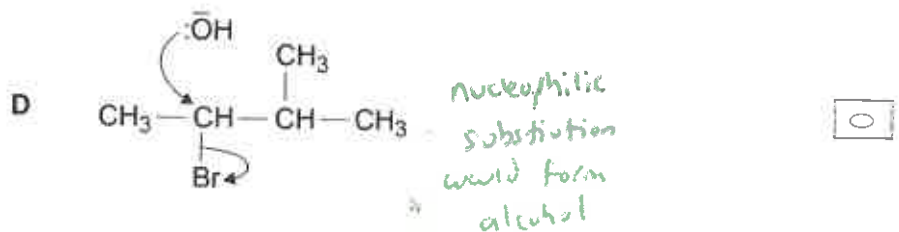
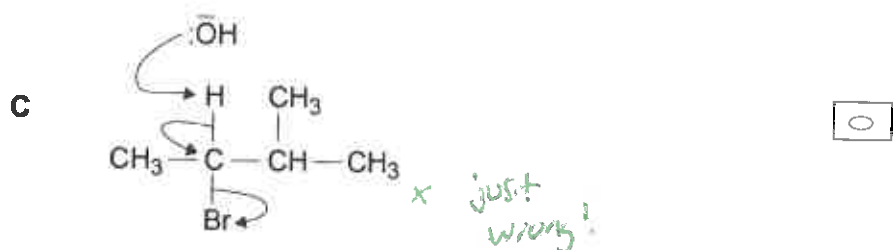
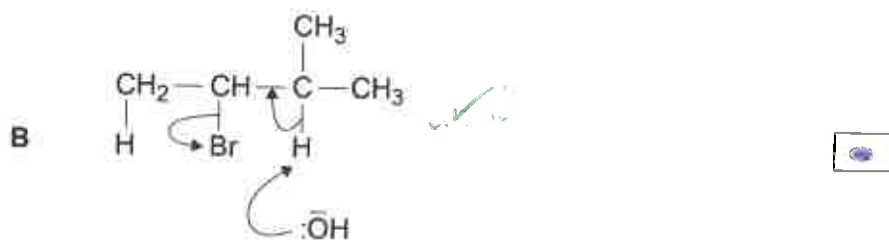
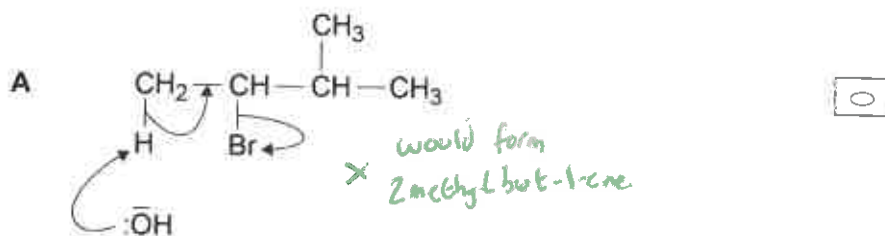
- A Sulfur dioxide can be removed from waste gases in a power station by an acid-base reaction with calcium oxide. ✓
- B Sulfur dioxide is insoluble in water. ✗ Soluble
- C Sulfur dioxide is a basic oxide. ✗ acidic
- D Sulfur dioxide is an ionic compound. ✗ covalent



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]



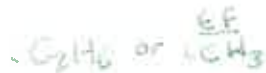
1 4

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



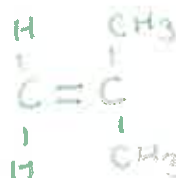
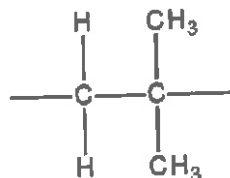
Empirical formula

C	H	O
40	6.7	53.3
12	1	16
3.3	6.7	3.3



1 5

The repeating unit of a polymer is



methylpropene

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

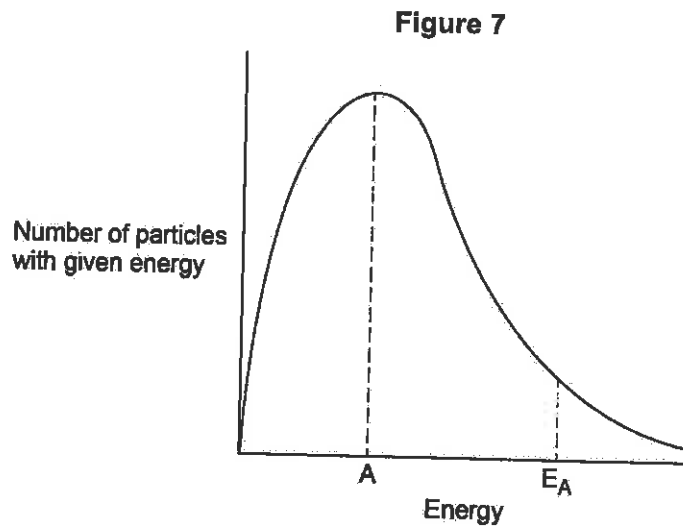
D Methylpropene

Turn over ►



1 | 6

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



Which of the following statements is true?

- A** Position A represents the mean energy of a molecule in the container. [1 mark]
- B** Addition of a catalyst moves the position of E_A to the right.
x left
- 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?

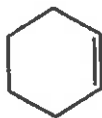
- A** $C_{14}H_{30} \rightarrow C_6H_{14} + C_4H_8 + 2C_2H_4$ [1 mark]
- B** $C_{14}H_{30} \rightarrow C_6H_{14} + C_6H_{12} + C_2H_4$
- C** $C_{14}H_{30} \rightarrow C_5H_{12} + 3C_3H_8$ ✗
- D** $C_{14}H_{30} \rightarrow C_6H_{14} + C_2H_6 + 2C_3H_6$

- C_6H_{14} is hexane - not B
- 3 more molecules - not B
- 32 hydrogens - not D.



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}

when you close the ring you lose 2 hydrogens.
so normal alkene general formula C_nH_{2n} but also -2.

1 9

A and B react together in this reversible reaction.



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

	A	+ 3B	⇌	C	+ 2D
I	10	10		0	0
Eq	$\frac{6}{3} = 2$ $10 - 2 = 8$	<u>4</u>		$\frac{6}{3} = 2$	$\frac{6}{3} \times 2 = 4$

= 18

Turn over ►



2 0

The M_r of hydrated copper sulfate ($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$) is 249.6.

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

A 3.19 g

B 3.55 g

C 3.71 g

D 4.99 g

[1 mark]

$$\text{Conc.} = \frac{\text{moles}}{\text{vol.}}$$

$$0.400 \times \left(\frac{50}{1000} \right) = 0.02 \text{ moles}$$

$$\text{moles} = \frac{\text{mass}}{M_r}$$

$$0.02 \times 249.6 = \underline{\underline{4.99 \text{ g}}}$$



Questions 21 and 22 refer to the production of hydrogen by the reaction of methane with steam. The reaction mixture reaches a state of dynamic equilibrium.



2 1

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 <input type="radio"/>
B Add a catalyst	increase	no effect <input type="radio"/>
C Increase temperature	increase	increase <input checked="" type="radio"/>
D Remove CO(g) as formed	increase	increase <input type="radio"/>

- forward is endo so temp increase shifts eq. right.
- only factor affects K_c is temp. and it would increase.

2 2

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

$$\begin{matrix} \text{H} \\ | \\ \text{H}-\text{C}-\text{H} \\ | \\ \text{H} \end{matrix} + \text{H}_2\text{O} \rightarrow \text{C}\equiv\text{O} + 3\text{H}_2$$

$$413 \times 4 = 1652$$

$$463 \times 2 = 926$$

$$3 \times 436 = 1308$$

$$= 2578$$

$$\therefore 2578 - (? + 1308) = +206$$

Turn over for the next question

$$0 = 2578 - (? + 1308) - 206$$

$$? = 2372 - 1308$$

$$? = 1064$$

Turn over ►



2 3

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

END OF QUESTIONS

*V = anything - I
chose 1m³!*

$$PV = nRT$$

$$P = \frac{nRT}{V}$$

$$a) P = \frac{2 \times 8.31 \times 273}{1} = 7861.26 \times$$

$$b) P = \frac{3 \times 8.31 \times 293}{1} = 7304.49 \times$$

$$c) P = \frac{2.5 \times 8.31 \times 423}{1} = 8787.83 \checkmark$$

$$d) P = \frac{1.5 \times 8.31 \times 573}{1} = 7142.45 \times$$

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