CIE A Level Chemistry Solved Past Paper May/June 2020 P11

Monday, November 9, 2020 2:48 PM

Cambridge Assessment International Education

Cambridge International AS & A Level

CHEMISTRY **9701/11**

Paper 1 Multiple Choice **May/June 2020**

1 hour

You must answer on the multiple choice answer sheet.

6841780614

You will need: Multiple choice answer sheet
Soft clean eraser
Soft pencil (type B or HB is recommended)
Data booklet

INSTRUCTIONS

- There are **forty** questions on this paper. Answer **all** questions.
- For each question there are four possible answers **A**, **B**, **C** and **D**. Choose the **one** you consider correct and record your choice in soft pencil on the multiple choice answer sheet.
- Follow the instructions on the multiple choice answer sheet.
- Write in soft pencil.
- Write your name, centre number and candidate number on the multiple choice answer sheet in the spaces provided unless this has been done for you.
- Do **not** use correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.

INFORMATION

- The total mark for this paper is 40.
- Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
- Any rough working should be done on this question paper.

I have used following colour codes:

- Blue colour used for facts or reasoning
- Red colour used for steps part of calculations along with its explanation
- Black colour used for right answer choice

This document has **16** pages. Blank pages are indicated.

Section A

For each question there are four possible answers **A**, **B**, **C** and **D**. Choose the **one** you consider to be correct.

Use of the Data Booklet may be appropriate for some questions.

1 Ethene can be oxidised to form epoxyethane, C_2H_4O.

loss of electrons

gain of oxygen

exothermic

$$C_2H_4(g) + \tfrac{1}{2}O_2(g) \rightleftharpoons C_2H_4O(g) \qquad \Delta H^\circ = -107\,kJ\,mol^{-1}$$

Which set of conditions gives the greatest yield of epoxyethane at equilibrium?

	pressure	temperature /°C
A	high ✓	100 ✓
B	high ✓	200
C	low	100
D	low	200

High pressure will favour formation of C_2H_4O bcz there are fewer moles on the product side

Among 100 & 200°C, you should choose the one which shifts the equilibrium towards the right increasing temperature. Ofcourse for temp. to increase you should first lower temp.

2 Cobalt can form the positive ion $Co(NH_3)_4Cl_2^+$.

x -3 +1 -1

$x + (4\times -3) + (4\times 3\times +1) + (2\times -1) = 0$

$x = +3$

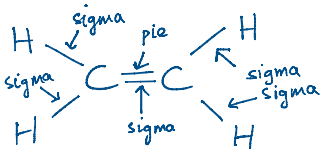
What is the oxidation number of cobalt in this ion?

A +1 **B** +2 **C** +3 **D** +6

3 When considering one molecule of ethene, which row describes both the hybridisation of the atomic orbitals in the carbon atoms and the overall bonding?

	hybridisation	bonding
A	sp^2 ✓	4 σ bonds 1 π bond
B	sp^2 ✓	5 σ bonds 1 π bond ✓
C	sp^3	4 σ bonds 1 π bond
D	sp^3	5 σ bonds 1 π bond

C_2H_4 undergoes sp^2 hybridisation = fact



4 10 cm^3 of ethane is burned in 45 cm^3 of oxygen at a pressure of 101 kPa and a temperature of 200 °C. Complete combustion takes place.

What is the total volume of gas present when the reaction is complete, measured under the same conditions?

$C_2H_6 + \frac{7}{2}O_2 \longrightarrow 2CO_2 + 3H_2O$

A 30 cm^3 **B** 50 cm^3 **C** 55 cm^3 **D** 60 cm^3

$PV = nRT \longrightarrow n = \frac{101\times1000\times 45/(100)^3}{8.314\times(200+273)} = 1.16\times10^{-3}$ moles of O_2

$O_2 : CO_2$

$3.5 : 2$

$1.16\times10^{-3} : 6.6\times10^{-4}$ moles of CO_2

moles = volume / 24

vol = $24\times6.6\times10^{-4}$ = 0.01584×1000 = 15.84 cm^3 of CO_2 formed

Total vol = 15.84 + 45 = 60.84 cm^3 ≈ 60 cm^3

5 Two reactions are shown.

molecule — broken H–H — not atomisation bc2 it forms only ½ mole of H

$$H_2(g) \rightarrow 2H(g)$$

$$CO(g) + \tfrac{1}{2}O_2(g) \rightarrow CO_2(g)$$

If molar amounts are used, how can the two energy changes associated with these reactions be described?

~~A~~ enthalpy of atomisation and enthalpy of combustion

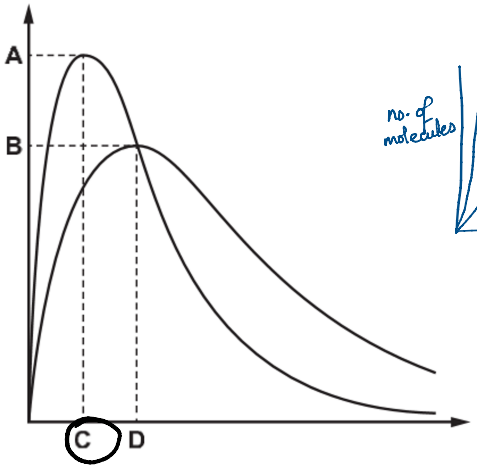
~~B~~ enthalpy of atomisation and enthalpy of formation

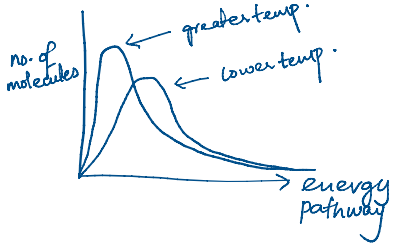
(C) bond energy and enthalpy of combustion

~~D~~ bond energy and enthalpy of formation → formation of 1 mole of a substance from its elements in their standard states

6 The diagram shows the Boltzmann energy distribution curves for molecules of a sample of a gas at two different temperatures.

Which letter on the axes represents the most probable energy for molecules of the same sample of gas at the **lower** temperature?





7 What are the units of K_p for the reaction shown?

$$H_2O(g) + C(s) \rightleftharpoons H_2(g) + CO(g)$$

2 moles ⇌ 2 moles

$$K_p = \frac{[H_2]_p[CO]_p}{[H_2O]_p} = \frac{Pa \times Pa}{Pa} = Pa$$

A Pa^{-1} **(B)** Pa **C** Pa^2 **D** no units

no pressure for solids

$1Cr_2O_7^{2-} + 2V^{2+} + H^+ \rightarrow 2Cr^{3+} + 2VO_3^- + H_2O$

8 In this question you should use changes in oxidation numbers to balance a chemical equation.

Acidified potassium dichromate(VI) solution can oxidise a solution of V^{2+} ions. The equation for this reaction is shown.

$$\overset{+6\ -2}{a Cr_2O_7^{2-}} + b\overset{+2}{V^{2+}} + c\overset{+1}{H^+} \rightarrow d\overset{+3}{Cr^{3+}} + e\overset{+5\ -2}{VO_3^-} + f\overset{+1\ -2}{H_2O}$$

-3×1 $+3\times1$

What is the ratio $a : b$ in the correctly balanced equation?

Label the change in oxidation no.s for each ion/atom. Then multiply both change with some no.s so that the product is equal.
$a=1$ & $b=2$

A 1:1 **B** 1:2 **C** 2:1 **D** 4:1

9 A sample of argon gas has a mass of 0.20 g, at a pressure of 100 000 Pa and a temperature of 12 °C.

Which volume does the gas occupy?

$PV = nRT$ where $n = \frac{mass}{M_r}$

$10^5 \times V = \frac{0.20}{39.95} \times 8.314 \times (12+273)$

$V = 1.186\times10^{-4}\,m^3 \times (100)^3$

$= 118.62\,cm^3$

$\approx 119\,cm^3$

A $1.2 \times 10^{-4}\,cm^3$

B $5.0\,cm^3$

C $59\,cm^3$

D $119\,cm^3$

10 In which pair does each species have the same number of unpaired electrons?

$Al^{13} \rightarrow 1s^2 2s^2 2p^6 3s^2 3p^1$ → ↑ | |

$Cu^{2+} \rightarrow 1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^7$ ↑↓ ↑↓ ↑ ↑ ↑

A Al and Cu^{2+}

B Ca and Cr^{3+}

C Ca and Ni^{2+}

D Fe^{3+} and O^{2-}

11 A sample of solid ammonium chloride decomposes on heating.

solid ammonium chloride → ammonia gas + hydrogen chloride gas

(s) (g) (g)

$NH_4Cl \rightarrow NH_3 + HCl$

A total of 2.4×10^{21} molecules of gas is formed.

How many hydrogen atoms are present in the gaseous products?

2.4×10^{21} molecules $\times 2$

$= 4.8\times10^{21}$ atoms of hydrogen

A 1.2×10^{21} **B** 2.4×10^{21} **C** 4.8×10^{21} **D** 9.6×10^{21}

12 A white powder is a mixture of sodium chloride and sodium iodide. It is dissolved in water in a test-tube. An excess of aqueous silver nitrate is added to the test-tube. A precipitate, X, is observed.

An excess of concentrated ammonia is then added to the test-tube containing X. After the test-tube has been shaken, a precipitate, Y, is observed.

Ions	AgNO3	Aq.NH3	Conc.NH3
Cl^-	white ppt.	dissolves	dissolves
Br^-	cream ppt.	insoluble	dissolves
I^-	yellow ppt.	insoluble	insoluble

Which statement about X or Y is correct?

A X is a pure white colour.

B X is pure silver iodide.

C Y is pure silver chloride.

D Y is yellow.

X could be white or yellow ppt.

If X was white ppt., upon addition of conc. NH_3 ppt should have dissolved. Another precipitate forms on addition of conc. NH_3 proves that Y is yellow ppt.

13 6.90 g of an ammonium salt is heated with an excess of aqueous sodium hydroxide. The volume of ammonia produced, measured under room conditions, is 2.51 dm^3.

Which ammonium salt is used?

A ammonium carbonate (M_r = 96.0) $(NH_4)_2CO_3 \longrightarrow 2NH_3$ 6.90 g not giving 2.51 dm^3 of NH_3

B ammonium chloride (M_r = 53.5) $\longrightarrow NH_4Cl \longrightarrow NH_3$ 6.90 g not giving 2.51 dm^3 of NH_3

C ammonium nitrate (M_r = 80.0) $\longrightarrow NH_4NO_3 \longrightarrow NH_3$ 6.90 g not giving 2.51 dm^3 of NH_3

D ammonium sulfate (M_r = 132.1) $\longrightarrow (NH_4)_2SO_4 \longrightarrow 2NH_3$

$6.90/132.1 \longrightarrow 0.1045 \times 24 = 2.51\ dm^3$ of NH_3

14 An excess of MgO is shaken with water. The resulting mixture is filtered into test-tube P.

An excess of BaO is shaken with water. The resulting mixture is filtered into test-tube Q.

Which oxide reacts more readily with water and which filtrate has the **lower** pH?

	oxide reacts more readily with water	test-tube with filtrate of **lower** pH
A	BaO ✓	P ✓
B	BaO ✓	Q
C	MgO	P
D	MgO	Q

$MgO + H_2O \longrightarrow Mg(OH)_2$ less soluble (P)

$BaO + H_2O \longrightarrow Ba(OH)_2$ more soluble (Q)

a less soluble substance has low pH

15 Element Z has a giant structure.

The chloride of Z reacts with water to give a solution with a pH less than 5.

Which pair shows two elements which could be Z?

A aluminium, magnesium

B aluminium, silicon

C phosphorus, magnesium

D phosphorus, silicon

16 Sodium, aluminium and silicon are three elements in Period 3. Each element forms an oxide.

Which row has three correct properties of these oxides?

	sodium oxide	aluminium oxide	silicon dioxide
A	basic	basic	amphoteric
B	giant ionic	giant ionic	simple molecular
C	high melting point	low melting point	high melting point
D	reacts with water	no reaction with water	no reaction with water

17 0.25 g of anhydrous magnesium nitrate is heated strongly until it completely decomposes.

What is the total volume of gas produced, measured under room conditions?

A 40 cm^3 B 81 cm^3 C 101 cm^3 D 202 cm^3

18 Astatine, At, is below iodine in Group 17 of the Periodic Table.

Which statement is most likely to be correct?

A AgAt(s) reacts with an excess of dilute aqueous ammonia to form a solution of a soluble complex.

B Astatine and KCl(aq) react to form KAt(aq) and chlorine.

C KAt(aq) and dilute sulfuric acid react to form HAt(g).

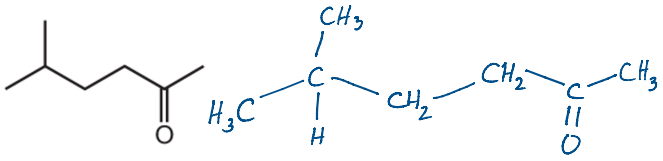
D NaAt(s) and concentrated sulfuric acid react to form astatine.

19 What is the order of increasing melting point of the three chlorides shown?

covalent ionic covalent
CCl_4 $MgCl_2$ PCl_5

	lowest melting point →		highest melting point
A	CCl_4	PCl_5	$MgCl_2$
B	$MgCl_2$	CCl_4	PCl_5
C	$MgCl_2$	PCl_5	CCl_4
D	PCl_5	CCl_4	$MgCl_2$

20 The skeletal formula of compound X is shown.



Which row is correct?

	molecular formula of X	observation on addition of X to Fehling's reagent → test for aldehyde
A	$C_7H_{14}O$	no change
B	$C_7H_{14}O$	red precipitate forms
C	$C_7H_{16}O$	no change
D	$C_7H_{16}O$	red precipitate forms

21 Which statement is correct?

A 2,2-dimethylpropanoic acid is an isomer of propyl methanoate.

B 2-methylbutan-2-ol is an isomer of hexan-3-ol.

C 3-methylbutan-2-one is an isomer of pentanal.

D 3,3-dimethylbutan-2-one is an isomer of pentan-3-one.

22 But-1-ene and but-2-ene are treated separately with cold, dilute acidified manganate(VII) ions.

Four students, W, X, Y and Z, make statements about these alkenes and the diols formed from them.

W One diol contains two primary alcohol groups.

X One diol contains a primary and a secondary alcohol group.

Y One diol contains two secondary alcohol groups.

Z Both alkenes exhibit *cis-trans* isomerism.

Which two students are correct?

A W and Y **B** W and Z **C** X and Y **D** X and Z

23 2-bromo-2-methylpentane is a tertiary halogenoalkane.

Which organic products are formed when 2-bromo-2-methylpentane reacts with a hot concentrated ethanolic solution of sodium hydroxide?

A 2-methylpent-1-ene only

B 2-methylpent-1-ene and 2-methylpent-2-ene

C 2-methylpent-2-ene only

D 2-methylpent-2-ene and 4-methylpent-2-ene

24 Poly(propene) is an addition polymer.

What are the C–C–C bond angles along its polymer chain?

A They are all 109°.

B Half of them are 109° and half are 120°.

C Half of them are 90° and half are 180°.

D They are all 120°.

25 An alcohol has the molecular formula $C_5H_{12}O$. It has several isomers.

Which isomer forms a yellow precipitate with alkaline aqueous iodine?

A 2,2-dimethylpropan-1-ol

B 2-methylbutan-2-ol

C 3-methylbutan-2-ol

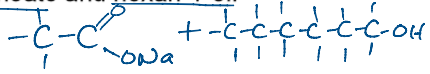
D pentan-3-ol

ester hydrolisis

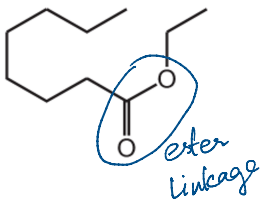
26 When compound X is heated under reflux with aqueous sodium hydroxide solution two products are formed: sodium ethanoate and hexan-1-ol.

Acid = ethanoic acid
Alcohol = hexanol

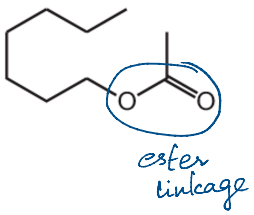
What is compound X?



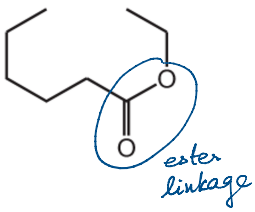
A



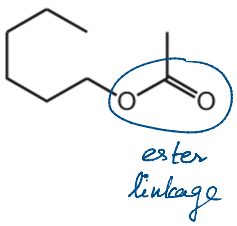
B



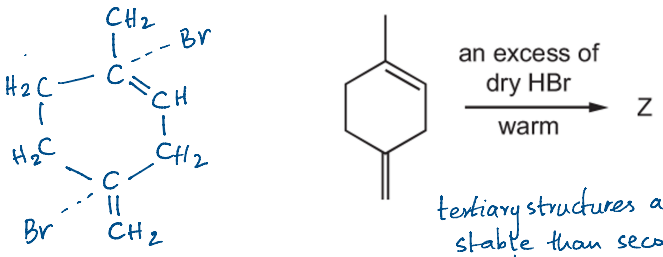
C



D

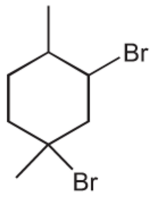


27 What is the major product Z of the following reaction?

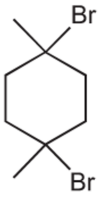


tertiary structures are more stable than secondary structures

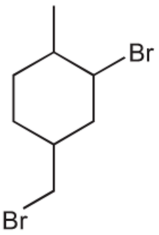
~~A~~



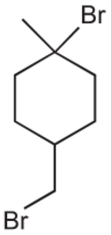
B



~~C~~

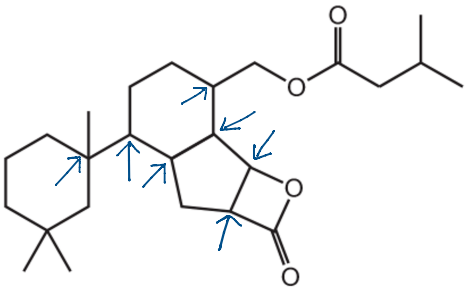


~~D~~



28 The structure of compound Q is shown.

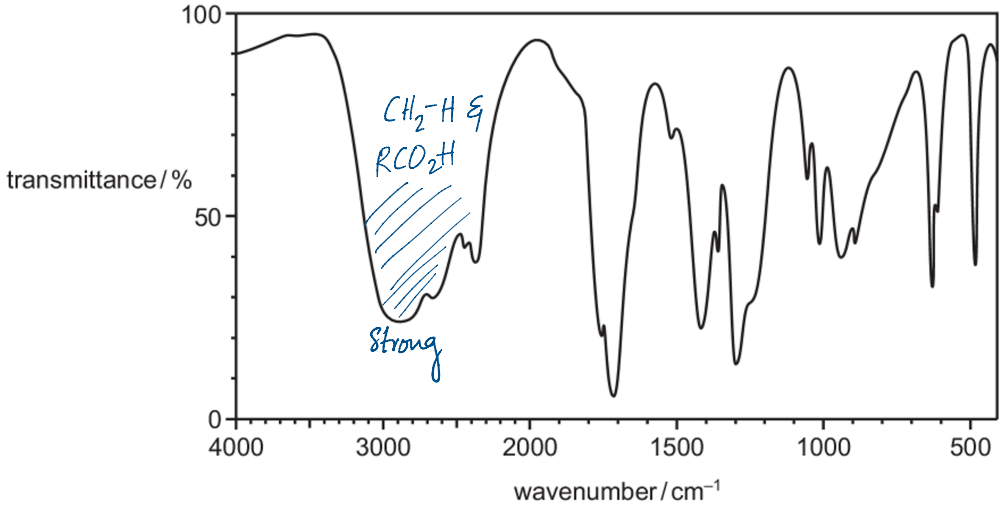
compound Q



How many chiral centres are present in a molecule of Q?

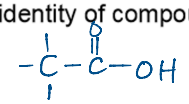
A 4 **B** 5 **C** 6 **D** 7

29 Compound X has the infra-red spectrum shown.



What could be the identity of compound X?

A ethanoic acid



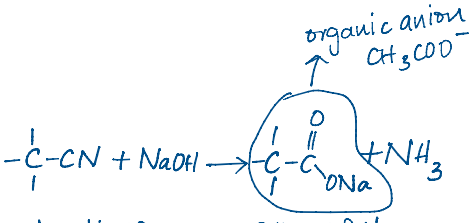
B ethanol

C ethylethanoate

D propanone

30 Which reaction produces an organic anion with a good yield?

A heating ethanenitrile under reflux with dilute sodium hydroxide



B heating ethanenitrile under reflux with dilute sulfuric acid $CH_3CN + H_2SO_4 \longrightarrow CH_3COOH$

C heating ethane with sodium metal

D heating ethanol under reflux with dilute sodium hydroxide

Section B

For each of the questions in this section, one or more of the three numbered statements **1** to **3** may be correct.

Decide whether each of the statements is or is not correct (you may find it helpful to put a tick against the statements that you consider to be correct).

The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, **2** and **3** are correct	**1** and **2** only are correct	**2** and **3** only are correct	**1** only is correct

No other combination of statements is used as a correct response.

Use of the *Data Booklet* may be appropriate for some questions.

31 The definitions of many chemical terms can be illustrated by chemical equations.

Which terms can be illustrated by an equation that includes the formation of a positive ion? B

1 ✓ first ionisation energy $X(g) \longrightarrow X^+(g) + e^-$

2 ✓ heterolytic fission of a covalent bond $X\text{-}Cl \longrightarrow X^+ + Cl^-$

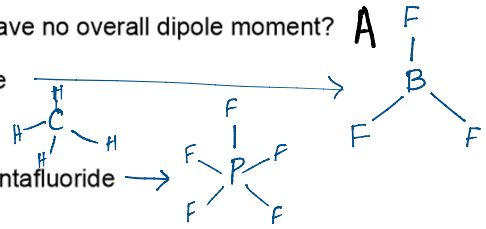
3 ✗ enthalpy change of atomisation $\frac{1}{2}X_2(s) \longrightarrow X(g)$

32 Which molecules have no overall dipole moment? A

1 boron trifluoride

2 methane

3 phosphorus pentafluoride



33 Carbon exists in several different forms. Two of these forms are buckminsterfullerene and graphene. Buckminsterfullerene is a fullerene allotrope of carbon.

Which statements about buckminsterfullerene and graphene are correct? D

1 ✓ Both have delocalised electrons.

2 ✗ Buckminsterfullerene has a giant molecular structure.

3 ✗ The carbon atoms in graphene form a tetrahedral lattice.

Properties of carbon allotropes is part of theory

The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, **2** and **3** are correct	**1** and **2** only are correct	**2** and **3** only are correct	**1** only is correct

No other combination of statements is used as a correct response.

34 Carbon monoxide burns readily in oxygen to form carbon dioxide. $2\overset{+2\ -2}{CO} + \overset{0}{O_2} \longrightarrow 2\overset{+4\ -2}{CO_2}$

What does this information suggest? A

1 The +4 oxidation state of carbon is more stable than the +2 state. Bc2 CO is result of incomplete combustion

2 The standard enthalpy change of formation of carbon dioxide is more negative than the standard enthalpy change of formation of carbon monoxide.

3 The value of the equilibrium constant for the reaction, $2CO(g) + O_2(g) \rightleftharpoons 2CO_2(g)$, is likely to be high.

35 The catalytic converters fitted to cars remove pollutants from the exhaust gases. Some of the reactions that occur involve oxygen, which comes from the air.

Which pollutants in the exhaust gases will react with oxygen on the surface of the catalytic converter? C

1 NO_2

2 unburnt fuel

3 CO ← example of heterogeneous catalysis

36 Chlorine reacts with sodium hydroxide in two different ways depending upon the temperature.

reaction 1 $\overset{0}{Cl_2} + 2OH^- \rightarrow \overset{-1}{Cl^-} + \overset{+1\ -2}{ClO^-} + H_2O$ cold NaOH

reaction 2 $3\overset{0}{Cl_2} + 6OH^- \rightarrow 5\overset{-1}{Cl^-} + \overset{+5\ -2}{ClO_3^-} + 3\overset{+1\ -2}{H_2O}$ hot NaOH

Which statements about these reactions are correct? B

1 Reaction 2 requires a higher temperature than reaction 1.

2 The products of reaction 1 show chlorine in two different oxidation states.

3 The products of reaction 2 show oxygen in two different oxidation states.

gained oxygen atoms

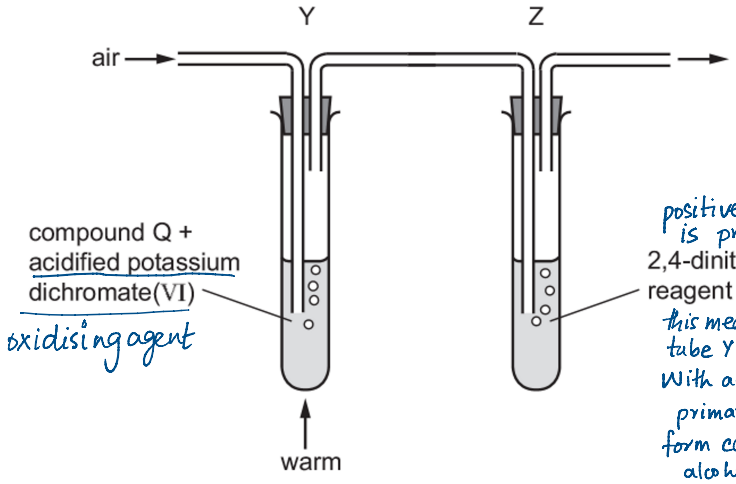
37 In which of the reactions is the organic compound oxidised by the given reagent? C

1 CH_3CHO + HCN reagent ⟶ $CH_3(CN)CH(OH)$

2 $CH_3CH_2CH_2CHO$ + Tollens' reagent

3 CH_3CH_2CHO + Fehling's reagent

38 When the apparatus is set up as shown, an orange precipitate forms in test-tube Z.



oxidising agent

positive result only if aldehyde or ketone is present

this means whatever escapes from tube Y is a carbonyl compound. With acidified $K_2Cr_2O_7$, only primary & secondary alcohols form carbonyl compounds. Tertiary alcohol does not react

What could compound Q be? B

1 $CH_3CH_2CH_2OH$

2 $CH_3CH(OH)CH_3$

3 $(CH_3)_3COH$

39 Chlorofluoroalkanes that diffuse into the stratosphere are broken down by ultraviolet radiation.

Radicals are generated that cause depletion of ozone.

What are these radicals? D

This is part of theory

1 chlorine radicals

2 fluorine radicals

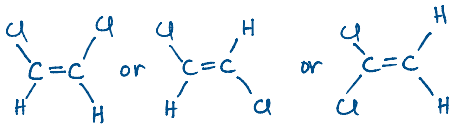
3 alkyl radicals

UV light from Sun breaks C-Cl bonds in CFC molecules. This releases highly reactive chlorine atoms called chlorine free radicals which react with ozone molecules

The responses **A** to **D** should be selected on the basis of

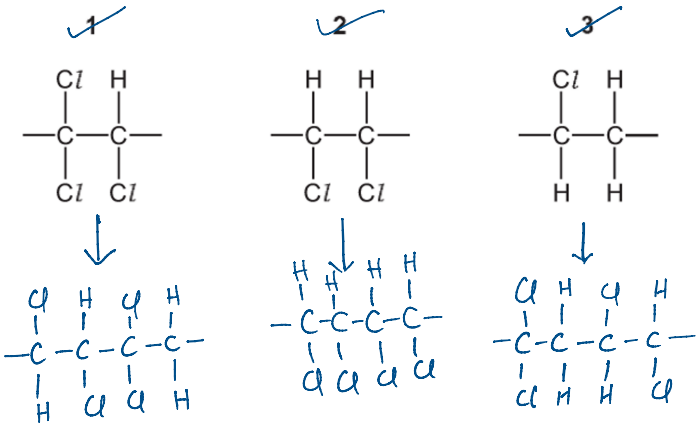
A	B	C	D
1, **2** and **3** are correct	**1** and **2** only are correct	**2** and **3** only are correct	**1** only is correct

No other combination of statements is used as a correct response.



40 A mixture of the three isomers of $C_2H_2Cl_2$ is polymerised.

Which sequences will be seen within the polymer chains? A



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