## Cambridge IGCSE ${ }^{\text {TM }}$

## CHEMISTRY

0620/22
Paper 2 Multiple Choice (Extended)
February/March 2021
45 minutes
You must answer on the multiple choice answer sheet.

## You will need: Multiple choice answer sheet <br> Soft clean eraser <br> Soft pencil (type B or HB is recommended)

## 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.
- Any rough working should be done on this question paper.
- The Periodic Table is printed in the question paper.

1 Which row about a change of state is correct?

|  | change of state | energy change | process |
| :---: | :---: | :---: | :---: |
| A | solid $\rightarrow$ liquid | heat given out | melting |
| B | gas $\rightarrow$ liquid | heat taken in | evaporation |
| C | solid $\rightarrow$ gas | heat taken in | sublimation |
| D | liquid $\rightarrow$ solid | heat given out | condensing |

2 Gases are separated from liquid air by fractional distillation.
The boiling points of four gases are shown.
Which gas is both monoatomic and a liquid at $-200^{\circ} \mathrm{C}$ ?

|  | gas | boiling <br> point $/{ }^{\circ} \mathrm{C}$ |
| :---: | :---: | :---: |
| A | argon | -186 |
| B | helium | -269 |
| C | neon | -246 |
| D | nitrogen | -196 |

3 Two different food colourings, X and Y , are tested using chromatography.
Three pure dyes, 1, 2 and 3, are also tested.
The chromatogram is shown.


Which statements are correct?
$1 X$ and $Y$ both contain two or more dyes.
2 Dyes 2 and 3 are present in both $X$ and $Y$.
3 The $R_{\mathrm{f}}$ of dye 1 is 0.625 .
A 1 and 2 only
B 1 and 3 only
C 1, 2 and 3
D 2 and 3 only

4 Which statement about the atoms of all the isotopes of carbon is correct?
A They are all radioactive.
B They have the same mass.
C They have the same number of neutrons.
D They have the same number of electrons in the outer shell.

5 Which diagram represents the structure of silicon(IV) oxide?
A


B


D


6 Lithium and fluorine react to form lithium fluoride.
A student writes three statements about the reaction.
1 Lithium atoms lose an electron when they react.
2 Each fluoride ion has one more electron than a fluorine atom.
3 Lithium fluoride is a mixture of elements.
Which statements are correct?
A 1 and 2 only
B 1 and 3 only
C 2 and 3 only
D 1, 2 and 3

7 How many electrons are used to form covalent bonds in a molecule of methanol, $\mathrm{CH}_{3} \mathrm{OH}$ ?
A 5
B 6
C 8
D 10

8 Magnesium oxide has a high melting point.
Carbon dioxide has a low melting point.
Which row identifies the attractive forces that are broken when these compounds are melted?

|  | magnesium oxide | carbon dioxide |
| :---: | :---: | :---: |
| A | strong attractions between molecules | weak attractions between atoms |
| B | strong attractions between molecules | weak attractions between molecules |
| C | strong attractions between ions | weak attractions between atoms |
| D | strong attractions between ions | weak attractions between molecules |

9 The ionic half-equation for the formation of oxygen during the electrolysis of aluminium oxide is shown.

$$
x \mathrm{O}^{2-} \rightarrow \mathrm{O}_{2}+y \mathrm{e}^{-}
$$

What are the values of $x$ and $y$ ?

|  | $x$ | $y$ |
| :---: | :---: | :---: |
| A | 1 | 2 |
| B | 1 | 4 |
| C | 2 | 2 |
| D | 2 | 4 |

10 A compound has the formula $\mathrm{XF}_{2}$ and has a relative mass of 70 .
What is element $X$ ?
A gallium
B germanium
C sulfur
D ytterbium

11 The diagram shows a section of an overhead power cable.


Which statement explains why a particular substance is used?
A Aluminium has a low density and is a good conductor of electricity.
B Ceramic is a good conductor of electricity.
C Steel can rust in damp air.
D Steel is more dense than aluminium.

12 During the electrolysis of dilute sulfuric acid, hydrogen is collected at the cathode.
What is the ionic half-equation for this reaction?
A $\mathrm{H}^{+}+\mathrm{e}^{-} \rightarrow \mathrm{H}$
B $\mathrm{H}^{+} \rightarrow \mathrm{H}+\mathrm{e}^{-}$
C $2 \mathrm{H}^{+}+2 \mathrm{e}^{-} \rightarrow \mathrm{H}_{2}$
D $2 \mathrm{H}^{+} \rightarrow \mathrm{H}_{2}+2 \mathrm{e}^{-}$

13 Which row describes an endothermic reaction?

|  | energy level diagram | energy transfer |
| :---: | :---: | :---: |
| A |  | energy is transferred from the surroundings to the reaction |
| B |  | energy is transferred from the surroundings to the reaction |
| C |  | energy is transferred from the reaction to the surroundings |
| D |  | energy is transferred from the reaction to the surroundings |

14 The equation for the complete combustion of methane is shown.

$$
\mathrm{CH}_{4}(\mathrm{~g})+2 \mathrm{O}_{2}(\mathrm{~g}) \rightarrow \mathrm{CO}_{2}(\mathrm{~g})+2 \mathrm{H}_{2} \mathrm{O}(\mathrm{~g})
$$

The bond energies are shown in the table.

| bond | bond energy <br> in $\mathrm{kJ} / \mathrm{mol}$ |
| :---: | :---: |
| $\mathrm{C}-\mathrm{H}$ | +410 |
| $\mathrm{C}=\mathrm{O}$ | +805 |
| $\mathrm{O}-\mathrm{H}$ | +460 |
| $\mathrm{O}=\mathrm{O}$ | +496 |

What is the energy change for the reaction?
A $-818 \mathrm{~kJ} / \mathrm{mol}$
B $-359 \mathrm{~kJ} / \mathrm{mol}$
C $-323 \mathrm{~kJ} / \mathrm{mol}$
D $+102 \mathrm{~kJ} / \mathrm{mol}$

15 Hydrogen fuel cells can be used to power cars.
Which statements about a fuel cell are correct?
1 The balanced equation for the reaction is $\mathrm{H}_{2}+\mathrm{O}_{2} \rightarrow \mathrm{H}_{2} \mathrm{O}$.
2 The fuel cell generates electricity.
3 In the fuel cell hydrogen is reduced.
4 The reactants are gases at room temperature.
A 1 and 2
B 1 and 3
C 2 and 4
D 3 and 4

16 The apparatus shown is used to measure the rate of a reaction.


Which equation represents a reaction where the rate can be measured using this apparatus?
A $\mathrm{Mg}(\mathrm{s})+2 \mathrm{HCl}(\mathrm{aq}) \rightarrow \mathrm{MgCl}_{2}(\mathrm{aq})+\mathrm{H}_{2}(\mathrm{~g})$
B $\mathrm{HCl}(\mathrm{aq})+\mathrm{NaOH}(\mathrm{aq}) \rightarrow \mathrm{NaCl}(\mathrm{aq})+\mathrm{H}_{2} \mathrm{O}(\mathrm{l})$
C $\mathrm{Fe}(\mathrm{s})+\mathrm{CuSO}_{4}(\mathrm{aq}) \rightarrow \mathrm{Cu}(\mathrm{s})+\mathrm{FeSO}_{4}(\mathrm{aq})$
D $2 \mathrm{Na}(\mathrm{s})+\mathrm{Br}_{2}(\mathrm{l}) \rightarrow 2 \mathrm{NaBr}(\mathrm{s})$

17 P is a hydrated metal salt with a blue colour. When P is heated, water is given off, leaving solid Q.
$R$ is a hydrated metal salt with a pink colour. When $R$ is heated, water is given off, leaving solid $S$.
Which row gives the name of $P$ and the colour of $S$ ?

|  | name of $P$ | colour of S |
| :---: | :---: | :---: |
| A | hydrated cobalt(II) chloride | blue |
| B | hydrated cobalt(II) chloride | white |
| C | hydrated copper(II) sulfate | blue |
| D | hydrated copper(II) sulfate | white |

18 Magnesium reacts with copper(II) oxide to give magnesium oxide and copper.
Which substance is the oxidising agent in this reaction?
A copper
B copper(II) oxide
C magnesium
D magnesium oxide

19 Part of the Periodic Table is shown.
Which element forms an acidic oxide?


20 When aqueous sodium hydroxide is added to a solution of a metal ion, a grey-green precipitate forms, which dissolves in excess to form a dark green solution.

What is the identity of the metal ion?
A chromium(III)
B iron(II)
C iron(III)
D copper(II)

21 Which statements about strong acids are correct?
1 They have a high concentration of $\mathrm{OH}^{-}$ions.
2 They have a pH value of 1.
3 They completely ionise in water.
4 They turn red litmus blue.
A 1 and 3
B 1 and 4
C 2 and 3
D 2 and 4

22 Metal X reacts with non-metal Y to form an ionic compound with the formula $\mathrm{X}_{2} \mathrm{Y}$.
Which statements are correct?
1 X is in Group I of the Periodic Table.
$2 X$ is in Group II of the Periodic Table.
3 Y is in Group VI of the Periodic Table.
4 Y is in Group VII of the Periodic Table.
A 1 and 3
B 1 and 4
C 2 and 3
D 2 and 4

23 The table gives some properties of Group IV elements.

| element | $\frac{\text { density }}{\mathrm{g} / \mathrm{cm}^{3}}$ | boiling point <br> $/{ }^{\circ} \mathrm{C}$ |
| :--- | :---: | :---: |
| carbon | 2.2 | 4827 |
| silicon |  |  |
| germanium | 5.3 | 2830 |
| tin | 5.8 | 2270 |
| lead | 11.3 | 1755 |

Which row describes the properties of silicon?

|  | $\frac{\text { density }}{\mathrm{g} / \mathrm{cm}^{3}}$ | boiling point <br> $/{ }^{\circ} \mathrm{C}$ |
| :---: | :---: | :---: |
| A | 2.3 | 3265 |
| B | 3.1 | 1997 |
| C | 6.2 | 2920 |
| D | 24.6 | 11682 |

24 The metal beryllium does not react with cold water.
It reacts with hydrochloric acid but cannot be extracted from its ore by using carbon.
Where is beryllium placed in the reactivity series?
magnesium
A
zinc
B
iron
C
copper
D

25 Why is cryolite used in the extraction of aluminium from bauxite?
A as a catalyst for the process
B as a solvent for aluminium oxide
C it stops the carbon anodes burning away
D it reduces aluminium ions in aluminium oxide

26 Which statements about the uses of metals are correct?
1 Iron is used to make aircraft because iron has a low density.
2 Copper is used to make electric cables because copper is a good conductor of electricity.

3 Aluminium is used to make brass because aluminium is strong and hard.
4 Iron is mixed with additives to make an alloy used in chemical plant.
A 1 and 2
B 3 and 4
C 1 and 3
D 2 and 4

27 Which row describes the reactions of magnesium hydroxide and magnesium oxide?

|  | effect of heat on hydroxide | effect of heating oxide with carbon |
| :---: | :---: | :---: |
| A | forms magnesium oxide | magnesium and carbon dioxide formed |
| B | forms magnesium oxide | no reaction |
| C | no reaction | magnesium and carbon dioxide formed |
| D | no reaction | no reaction |

28 The properties of an element are listed.
Its melting point is $3414^{\circ} \mathrm{C}$.
Some of its compounds are catalysts.
It has variable oxidation states.
Where is the element found in the Periodic Table?
A alkali metals
B halogens
C noble gases
D transition elements

29 Petrol burns in a car engine to produce waste gases which leave through the car exhaust. One of these waste gases is an oxide of nitrogen.

Which statement describes how this oxide of nitrogen is formed?
A Carbon dioxide reacts with nitrogen in the catalytic converter.
B Nitrogen reacts with oxygen in the car engine.
C Nitrogen reacts with oxygen in the catalytic converter.
D Petrol combines with nitrogen in the car engine.

30 Which combination of chemical compounds can be used to produce the fertiliser shown?


A $\left(\mathrm{NH}_{4}\right)_{3} \mathrm{PO}_{4}, \mathrm{KCl}$
B $\mathrm{NH}_{4} \mathrm{NO}_{3}, \mathrm{Ca}_{3}\left(\mathrm{PO}_{4}\right)_{2}$
C $\mathrm{NH}_{4} \mathrm{NO}_{3}, \mathrm{CO}\left(\mathrm{NH}_{2}\right)_{2}$
D $\mathrm{NH}_{4} \mathrm{NO}_{3}, \mathrm{~K}_{2} \mathrm{SO}_{4},\left(\mathrm{NH}_{4}\right)_{2} \mathrm{SO}_{4}$

31 Which process does not produce carbon dioxide?
A combustion of a hydrocarbon
B photosynthesis
C reaction between an acid and a metal carbonate
D respiration

32 Which substance is used as a bleach in the manufacture of paper?
A carbon dioxide
B nitrogen dioxide
C silicon dioxide
D sulfur dioxide

33 What is an industrial use of calcium carbonate?
A cracking of hydrocarbons
B manufacture of aluminium
C manufacture of cement
D purification of water

34 Propane reacts with chlorine.
Which row shows a condition required for this reaction and identifies the type of reaction?

|  | condition | type of reaction |
| :---: | :---: | :---: |
| A | phosphoric acid catalyst | addition |
| B | phosphoric acid catalyst | substitution |
| C | ultraviolet light | addition |
| D | ultraviolet light | substitution |

35 The pie chart represents the composition of natural gas.
Which sector represents methane?


36 Which statement describes the reaction between ethene and steam?
A a cracking reaction which produces ethane and hydrogen gas as products
B an addition reaction which produces ethanol as the only product
C an oxidation reaction which produces ethanoic acid as the only product
D a slow reaction producing ethanol and carbon dioxide

37 The formula of a hydrocarbon is $\mathrm{C}_{x} \mathrm{H}_{y}$.
The equation for its complete combustion is shown.

$$
\mathrm{C}_{\mathrm{x}} \mathrm{H}_{\mathrm{y}}+8 \mathrm{O}_{2} \rightarrow 5 \mathrm{CO}_{2}+6 \mathrm{H}_{2} \mathrm{O}
$$

What are the values of $x$ and $y$ ?

|  | $x$ | $y$ |
| :---: | ---: | ---: |
| A | 5 | 6 |
| B | 5 | 12 |
| C | 6 | 5 |
| D | 12 | 5 |

38 The formula of an ester is $\mathrm{CH}_{3} \mathrm{CH}_{2} \mathrm{CH}_{2} \mathrm{COOCH}_{2} \mathrm{CH}_{2} \mathrm{CH}_{3}$.
Which acid and alcohol react together to make the ester?

|  | acid | alcohol |
| :---: | :---: | :---: |
| A | butanoic acid | butanol |
| B | butanoic acid | propanol |
| C | propanoic acid | butanol |
| D | propanoic acid | propanol |

39 Molecule 1 undergoes a process to make molecule 2.

$$
\text { molecule } 1 \xrightarrow{\text { process }} \text { molecule } 2
$$

Which row describes the molecules and the process?

|  | molecule 1 | process | molecule 2 |
| :---: | :---: | :---: | :---: |
| A | monomer | cracking | polymer |
| B | monomer | polymerisation | polymer |
| C | small molecule | polymerisation | monomer |
| D | small molecule | cracking | monomer |

40 Which structure represents a protein?


B


C



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The Periodic Table of Elements


| $\begin{gathered} 57 \\ \substack{\text { Lantanum } \\ \text { lantunam } \\ 139} \end{gathered}$ | $\begin{gathered} 58 \\ \begin{array}{c} \text { cefium } \\ 140 \\ 140 \end{array} \end{gathered}$ | $\stackrel{59}{{ }_{\text {praseorymium }}}$ | $\begin{gathered} \quad \begin{array}{c} 60 \\ \text { nd } \\ \text { neocymium } \\ 144 \end{array} \end{gathered}$ | $\underset{\substack{61 \\ \text { promethium }}}{\text { Pm }}$ | $\underset{\substack{62 \\ \text { samarium } \\ 150}}{\substack{\text { Sm }}}$ |  | $\underset{\substack{\text { gadodirium } \\ 157}}{\text { Gd }^{\text {Gd }}}$ | $\begin{gathered} 65 \\ \substack{65 \\ \text { terebium } \\ 159} \\ \hline \end{gathered}$ | $\begin{gathered} 66 \\ \text { Dy } \\ \text { dysposisum } \\ 163 \end{gathered}$ | $\begin{gathered} 67 \\ \begin{array}{c} 60 \\ \text { homium } \\ 165 \end{array} \end{gathered}$ | $\begin{gathered} 68 \\ \substack{68 \\ \text { erbium } \\ 167} \end{gathered}$ |  | $\begin{gathered} 70 \\ \mathrm{Yb} \\ \substack{\text { yyedebium } \\ 173} \end{gathered}$ | $\begin{gathered} 71 \\ \text { Lu } \\ \text { Lutium } \\ 175 \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 89 | 90 | 91 | 92 | ${ }^{93}$ | 94 | 95 | 96 | 97 | ${ }^{98}$ | 99 | 100 | 101 | 102 | 103 |
| Ac actinium | Th <br> thorium | $\underset{\text { probactivium }}{\mathrm{Pa}}$ | $\underset{\text { urarium }}{ }$ | $\mathrm{Np}$ | Pu plutonium | $\underset{\text { amenicium }}{\mathrm{Am}}$ | $\mathrm{Cm}$ | $\underset{\text { berkelium }}{\mathrm{Bk}}$ | $\mathrm{Cf}$ | Es | Fm fempium | $\underset{\text { mendelevium }}{\text { Md }}$ | No nobefium | $\underset{\text { lawencoum }}{\mathrm{Lr}}$ |

The volume of one mole of any gas is $24 \mathrm{dm}^{3}$ at room temperature and pressure (r.t.p.).

