The syllabus is approved for use in England, Wales and Northern Ireland as a Cambridge International Level 1/Level 2 Certificate.

This document consists of 15 printed pages and 1 blank page.
1. Two gas jars are set up as shown.

The lid is removed and the gas jars are left to stand. After some time the contents of both gas jars are brown.

Which process causes this to happen?

A. condensation
B. diffusion
C. evaporation
D. filtration

2. Which piece of apparatus is used to measure variable quantities of liquid in a titration?
3 A sample of a green food colouring was separated into its component colours using paper chromatography.

The results obtained are shown.

What is the $R_\text{f}$ value of the blue spot?

A 0.45  B 0.90  C 1.10  D 2.20

4 In which row are the substances correctly classified?

<table>
<thead>
<tr>
<th></th>
<th>element</th>
<th>compound</th>
<th>mixture</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>brass</td>
<td>sulfur</td>
<td>water</td>
</tr>
<tr>
<td>B</td>
<td>sulfur</td>
<td>brass</td>
<td>water</td>
</tr>
<tr>
<td>C</td>
<td>sulfur</td>
<td>water</td>
<td>brass</td>
</tr>
<tr>
<td>D</td>
<td>water</td>
<td>sulfur</td>
<td>brass</td>
</tr>
</tbody>
</table>

5 Which molecule contains only single covalent bonds?

A $\text{Cl}_2$  B $\text{CO}_2$  C $\text{N}_2$  D $\text{O}_2$
6 Which structure represents the sodium chloride lattice?

A  
\[
\text{Na}^+ \quad \text{Cl}^- \\
\text{Cl}^+ \quad \text{Na}^- \\
\text{Na}^- \quad \text{Cl}^+ \\
\text{Cl}^+ \quad \text{Na}^-
\]

B  
\[
+ \quad - \\
- \quad + \\
+ \quad - \\
- \quad +
\]

C  
\[
- \quad + \\
+ \quad - \\
- \quad + \\
+ \quad -
\]

D  
\[
+ \quad + \\
+ \quad + \\
+ \quad + \\
+ \quad +
\]

7 X and Y are isotopes of the same element. Which statement is correct?

A X and Y have atoms with different numbers of electron shells.
B X and Y have atoms with the same nucleon number.
C X and Y have atoms with the same number of outer shell electrons.
D X and Y have different chemical properties.

8 Which quantities of chemicals will react exactly with no reactants left over?

A 12 g of carbon and 12 g of oxygen
B 12 g of carbon and 48 g of oxygen
C 12 g of magnesium and 16 g of oxygen
D 24 g of magnesium and 16 g of oxygen
9 Magnesium nitride is formed when magnesium burns in air. Magnesium nitride is an ionic compound.

What is the formula of magnesium nitride?

A  MgN₂  B  Mg₂N₂  C  Mg₂N₃  D  Mg₃N₂

10 The electrolysis of concentrated hydrochloric acid is shown.

Which statement describes what happens to the electrons during the electrolysis?

A  They are added to chloride ions.
B  They are added to hydrogen ions.
C  They move through the circuit from positive to negative.
D  They move through the solution from negative to positive.

11 Which reaction does not occur in the extraction of aluminium?

A  Al³⁺ + 3e⁻ → Al
B  2Al₂O₃ + 3C → 4Al + 3CO₂
C  2O²⁻ → O₂ + 4e⁻
D  C + O₂ → CO₂

12 Which substance could not be used as a fuel to heat water in a boiler?

A  ethanol
B  hydrogen
C  methane
D  oxygen
13 Which row describes an endothermic reaction?

<table>
<thead>
<tr>
<th></th>
<th>energy needed to break bonds/kJ</th>
<th>energy released by forming bonds/kJ</th>
<th>temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>400</td>
<td>200</td>
<td>decreases</td>
</tr>
<tr>
<td>B</td>
<td>400</td>
<td>800</td>
<td>decreases</td>
</tr>
<tr>
<td>C</td>
<td>600</td>
<td>200</td>
<td>increases</td>
</tr>
<tr>
<td>D</td>
<td>600</td>
<td>800</td>
<td>increases</td>
</tr>
</tbody>
</table>

14 A reversible reaction is shown.

\[ 2\text{NO}_2(g) \rightleftharpoons \text{N}_2\text{O}_4(g) \quad \Delta H = -58 \text{kJ/mol} \]

Which statement about an equilibrium mixture of \( \text{NO}_2 \) and \( \text{N}_2\text{O}_4 \) is correct?

A If the pressure is decreased the amount of \( \text{N}_2\text{O}_4 \) increases.
B If the temperature is increased the amount of \( \text{N}_2\text{O}_4 \) increases.
C The rates of formation and decomposition of \( \text{N}_2\text{O}_4 \) are not the same.
D The decomposition of \( \text{N}_2\text{O}_4 \) is an endothermic reaction.

15 Which statement about catalysts in chemical reactions is \textbf{not} correct?

A Catalysts are not used up in the reaction.
B Catalysts increase the energy of the reacting particles.
C Catalysts increase the rate of the reaction.
D Catalysts lower the activation energy.

16 Zinc is extracted from zinc blende by roasting it in air to form zinc oxide.

The zinc oxide is then heated with carbon to form zinc.

The equations for the reactions are shown.

1 \[ 2\text{ZnS} + 3\text{O}_2 \rightarrow 2\text{ZnO} + 2\text{SO}_2 \]

2 \[ \text{ZnO} + \text{C} \rightarrow \text{Zn} + \text{CO} \]

Which statement about reactions 1 and 2 is \textbf{not} correct?

A In reaction 1 the oxidation state of sulfur increases and it is oxidised.
B In reaction 1 the oxidation state of zinc increases and it is oxidised.
C In reaction 2 the carbon acts as a reducing agent and it is oxidised.
D In reaction 2 the oxidation state of zinc decreases and it is reduced.
17 The diagram shows an energy level diagram for a reaction.

The diagram shows that the reaction is ......1...... .

Increasing the temperature increases the rate of reaction. A reason for this is that the ......2....... .

Which words correctly complete gaps 1 and 2?

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>endothermic</td>
<td>activation energy decreases</td>
</tr>
<tr>
<td>B</td>
<td>endothermic</td>
<td>collision rate increases</td>
</tr>
<tr>
<td>C</td>
<td>exothermic</td>
<td>activation energy decreases</td>
</tr>
<tr>
<td>D</td>
<td>exothermic</td>
<td>collision rate increases</td>
</tr>
</tbody>
</table>

18 Concentrated hydrochloric acid is a *strong acid*.

What is meant by the terms ‘strong’ and ‘acid’?

<table>
<thead>
<tr>
<th></th>
<th>strong</th>
<th>acid</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>contains a low proportion of water</td>
<td>accepts protons</td>
</tr>
<tr>
<td>B</td>
<td>contains a low proportion of water</td>
<td>donates protons</td>
</tr>
<tr>
<td>C</td>
<td>fully ionised</td>
<td>accepts protons</td>
</tr>
<tr>
<td>D</td>
<td>fully ionised</td>
<td>donates protons</td>
</tr>
</tbody>
</table>

19 Which oxide is amphoteric?

A aluminium oxide
B calcium oxide
C carbon monoxide
D sodium oxide
20  A salt is made by adding an excess of an insoluble metal oxide to an acid.

How is the excess metal oxide removed from the mixture?

A chromatography  
B crystallisation  
C distillation  
D filtration

21  A substance is heated with aluminium foil in aqueous sodium hydroxide. A gas is produced which turns damp, red litmus paper blue.

Which anion is present in the substance?

A carbonate  
B iodide  
C nitrate  
D sulfate

22  An element does not conduct electricity and exists as diatomic molecules.

Where in the Periodic Table is the element found?

A  
B  
C  
D

23  In the Periodic Table, how does the metallic character of the elements vary from left to right across a period?

A It decreases.  
B It increases.  
C It increases then decreases.  
D It stays the same.
24 The elements in a group of the Periodic Table show the following trends.

1. The element with the lowest proton number has the lowest reactivity.
2. All the elements in the group form basic oxides.
3. The density of the elements increases down the group.
4. The melting point of the elements decreases down the group.

In which group are the elements found?

A  I   B  IV   C  VI   D  VII

25 Brass is an alloy of two metals.

Which row gives a correct use for the two metals from which brass is made?

<table>
<thead>
<tr>
<th>metal 1</th>
<th>metal 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>A used for electrical wiring</td>
<td>used for galvanising steel</td>
</tr>
<tr>
<td>B used for galvanising steel</td>
<td>used for making aircraft</td>
</tr>
<tr>
<td>C used for making aircraft</td>
<td>used for making cutlery</td>
</tr>
<tr>
<td>D used for making cooking pans</td>
<td>used for electrical wiring</td>
</tr>
</tbody>
</table>

26 Iron is extracted from hematite in the blast furnace.

The hematite contains silicon(IV) oxide (sand) as an impurity.

What reacts with this impurity to remove it?

A calcium oxide
B carbon
C carbon dioxide
D slag

27 The reaction below is called the `thermite reaction`.

\[ 2\text{Al} + \text{Fe}_2\text{O}_3 \rightarrow 2\text{Fe} + \text{Al}_2\text{O}_3 \]

Which pair of substances reacts in a similar way?

A Fe and MgO
B Fe and ZnO
C Mg and CuO
D Zn and Al$_2$O$_3$
28 One method of preventing the rusting of iron is to keep oxygen away from the surface of the metal.

Which way of rust prevention does not use this method?

A coating the iron with grease  
B connecting the iron to a more reactive metal  
C covering the iron with plastic  
D painting the iron

29 The diagram shows how water is treated to make it suitable for drinking.

![Diagram showing stages of water treatment]

What happens in stage 2?

A condensation  
B distillation  
C evaporation  
D filtration

30 Nitrogen monoxide is produced in a car engine when petrol is burnt.

The gases from the car engine are passed through a catalytic converter.

In the catalytic converter the nitrogen monoxide reacts with carbon monoxide to form nitrogen and carbon dioxide.

Which statement is not correct?

A Carbon monoxide is oxidised in the catalytic converter.  
B Carbon monoxide is produced by the complete combustion of petrol.  
C Nitrogen monoxide is formed by the reaction of nitrogen and oxygen.  
D Nitrogen monoxide is reduced in the catalytic converter.

31 Which pollutant gas can be produced as a result of incomplete combustion of octane, \( \text{C}_8\text{H}_{18} \)?

A carbon  
B carbon dioxide  
C carbon monoxide  
D methane
32. Fertilisers are used to provide three elements needed to increase the yield of crops. Which two compounds would provide all three of these elements?

A. ammonium nitrate and calcium phosphate  
B. ammonium nitrate and potassium sulfate  
C. potassium nitrate and calcium phosphate  
D. potassium nitrate and potassium sulfate

33. What is a property of concentrated sulfuric acid but not of dilute sulfuric acid?

A. It is a dehydrating agent.  
B. It neutralises alkalis.  
C. It produces a white precipitate with barium nitrate.  
D. It reacts with metals to give a salt and hydrogen.

34. Why does a farmer put lime (calcium oxide) on the soil?

A. to act as a fertiliser  
B. to kill pests  
C. to make the soil less acidic  
D. to make the soil less alkaline
35 What is the name of fraction X?

A alcohol  
B fuel oil  
C naphtha  
D paraffin

36 Which compounds are alkanes?

<table>
<thead>
<tr>
<th>compound</th>
<th>W</th>
<th>X</th>
<th>Y</th>
<th>Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>formula</td>
<td>C₄H₁₀</td>
<td>C₅H₁₀</td>
<td>C₆H₁₂</td>
<td>C₆H₁₄</td>
</tr>
</tbody>
</table>

A W and X  
B W and Z  
C X and Y  
D Y and Z
37 The statements below are about the alcohol homologous series.

The alcohols have the same ......1...... formula.

The alcohols have ......2...... chemical properties because they have the same ......3...... .

The melting points of the alcohols ......4...... as the number of carbon atoms increases.

Which words correctly complete gaps 1–4?

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>general</td>
<td>different</td>
<td>functional group</td>
<td>decrease</td>
</tr>
<tr>
<td>B</td>
<td>general</td>
<td>similar</td>
<td>electronic structure</td>
<td>increase</td>
</tr>
<tr>
<td>C</td>
<td>general</td>
<td>similar</td>
<td>functional group</td>
<td>increase</td>
</tr>
<tr>
<td>D</td>
<td>molecular</td>
<td>similar</td>
<td>functional group</td>
<td>increase</td>
</tr>
</tbody>
</table>

38 Which structure represents a compound that dissolves in water to form an acidic solution?

A

B

C

D
39 The partial structure of an addition polymer is shown.

\[
\begin{array}{cccccc}
\text{H} & \text{Cl} & \text{H} & \text{H} & \text{H} & \text{Cl} \\
\text{C} \quad \text{C} \quad \text{C} \quad \text{C} \quad \text{C} \quad \text{C} \\
\text{H} & \text{H} & \text{H} & \text{Cl} & \text{H} & \text{H}
\end{array}
\]

What is the structure of the monomer used to make this polymer?

A  
\[
\begin{array}{cc}
\text{H} & \text{Cl} \\
\text{C} \quad \text{C} \\
\text{Cl} & \text{H}
\end{array}
\]

B  
\[
\begin{array}{cc}
\text{H} & \text{Cl} \\
\text{C} \quad \text{C} \\
\text{H} & \text{H}
\end{array}
\]

C  
\[
\begin{array}{cc}
\text{Cl} & \text{H} \\
\text{C} \quad \text{C} \\
\text{H} & \text{H}
\end{array}
\]

D  
\[
\begin{array}{cc}
\text{H} & \text{Cl} \\
\text{C} \quad \text{C} \\
\text{H} & \text{H}
\end{array}
\]

40 Which statement about polymers is correct?

A  Addition polymers are all biodegradable.

B  Condensation polymers can all be hydrolysed to give amino acids.

C  Condensation polymers only exist in nature.

D  Forming addition polymers produces only one product.
### The Periodic Table of Elements

<table>
<thead>
<tr>
<th>Group</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
<th>VII</th>
<th>VIII</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>H</td>
<td>He</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>Li</td>
<td>Be</td>
<td>B</td>
<td>C</td>
<td>N</td>
<td>O</td>
<td>F</td>
<td>Ne</td>
</tr>
<tr>
<td>III</td>
<td>Na</td>
<td>Mg</td>
<td>Al</td>
<td>Si</td>
<td>P</td>
<td>S</td>
<td>Cl</td>
<td>Ar</td>
</tr>
<tr>
<td>IV</td>
<td>K</td>
<td>Ca</td>
<td>Sc</td>
<td>Ti</td>
<td>V</td>
<td>Cr</td>
<td>Mn</td>
<td>Fe</td>
</tr>
<tr>
<td>V</td>
<td>Rb</td>
<td>Sr</td>
<td>Y</td>
<td>Zr</td>
<td>Nb</td>
<td>Mo</td>
<td>Tc</td>
<td>Ru</td>
</tr>
<tr>
<td>VI</td>
<td>Cs</td>
<td>Ba</td>
<td>La</td>
<td>Hf</td>
<td>Ta</td>
<td>W</td>
<td>Re</td>
<td>Os</td>
</tr>
<tr>
<td>VII</td>
<td>Fr</td>
<td>Ra</td>
<td>Ac</td>
<td>Th</td>
<td>Pa</td>
<td>U</td>
<td>Np</td>
<td>Pu</td>
</tr>
</tbody>
</table>

#### Key

- **atomic number**
- **atomic symbol**
- **name**
- **relative atomic mass**
- **atomic radius (in pm)**
- **atomic mass (in g mol⁻¹)**
- **atomic density (in g cm⁻³)**
- **phase at room temperature and pressure**

### Notes

1. The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).