CHEMISTRY 0620/21
Paper 2 Multiple Choice (Extended) October/November 2016

Additional Materials: Multiple Choice Answer Sheet
Soft clean eraser
Soft pencil (type B or HB is recommended)

45 minutes

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, Centre number and candidate number on the Answer Sheet in the spaces provided unless this has been done for you.
DO NOT WRITE IN ANY BARCODES.

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 separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
A copy of the Periodic Table is printed on page 20.
Electronic calculators may be used.

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 20 printed pages.
1 ‘Particles moving very slowly from an area of higher concentration to an area of lower concentration.’

Which process is being described?

A a liquid being frozen
B a solid melting
C a substance diffusing through a liquid
D a substance diffusing through the air

2 A student mixes 25 cm³ samples of dilute hydrochloric acid with different volumes of aqueous sodium hydroxide.

In each case, the student measures the change in temperature to test if the reaction is exothermic.

Which piece of apparatus is not needed?

A burette  B clock  C pipette  D thermometer
Information about the solubility of four solids, P, Q, R and S, is given in the table.

<table>
<thead>
<tr>
<th></th>
<th>P</th>
<th>Q</th>
<th>R</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>solubility in water</td>
<td>dissolves</td>
<td>insoluble</td>
<td>insoluble</td>
<td>dissolves</td>
</tr>
</tbody>
</table>

A student attempted to separate mixtures of these solids using the following method.

1. Add the mixture to a beaker of water and stir.
2. Filter the mixture.
3. Crystallise one of the solids from the filtrate.

Which of the following mixtures could **not** be separated by this method?

A. a mixture of P and R
B. a mixture of Q and P
C. a mixture of Q and R
D. a mixture of R and S

The table shows information about atoms of three different elements.

<table>
<thead>
<tr>
<th>element</th>
<th>proton number</th>
<th>nucleon number</th>
<th>number of protons</th>
<th>number of neutrons</th>
<th>number of electrons</th>
</tr>
</thead>
<tbody>
<tr>
<td>chlorine</td>
<td>17</td>
<td>35</td>
<td>17</td>
<td>W</td>
<td>17</td>
</tr>
<tr>
<td>chlorine</td>
<td>17</td>
<td>X</td>
<td>17</td>
<td>19</td>
<td>17</td>
</tr>
<tr>
<td>argon</td>
<td>Y</td>
<td>40</td>
<td>18</td>
<td>22</td>
<td>18</td>
</tr>
<tr>
<td>potassium</td>
<td>19</td>
<td>39</td>
<td>19</td>
<td>20</td>
<td>Z</td>
</tr>
</tbody>
</table>

What are the values of W, X, Y and Z?

<table>
<thead>
<tr>
<th></th>
<th>W</th>
<th>X</th>
<th>Y</th>
<th>Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>18</td>
<td>35</td>
<td>18</td>
<td>19</td>
</tr>
<tr>
<td>B</td>
<td>18</td>
<td>36</td>
<td>18</td>
<td>19</td>
</tr>
<tr>
<td>C</td>
<td>19</td>
<td>35</td>
<td>19</td>
<td>18</td>
</tr>
<tr>
<td>D</td>
<td>19</td>
<td>36</td>
<td>19</td>
<td>18</td>
</tr>
</tbody>
</table>
Metal P reacts with non-metal Q to form a compound.

Which process takes place and which type of compound is formed?

<table>
<thead>
<tr>
<th>process</th>
<th>type of compound</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>electrons are transferred from P to Q covalent</td>
</tr>
<tr>
<td>B</td>
<td>electrons are transferred from P to Q ionic</td>
</tr>
<tr>
<td>C</td>
<td>electrons are transferred from Q to P covalent</td>
</tr>
<tr>
<td>D</td>
<td>electrons are transferred from Q to P ionic</td>
</tr>
</tbody>
</table>

The structure of ethanoic acid is shown.

Which diagram shows the arrangement of outer shell electrons in a molecule of ethanoic acid?
7 X is a solid at room temperature.
   X has a high melting point.
   Solid X conducts electricity.

Which diagram shows how the particles are arranged in solid X?

A  

B  

C  

D  

8 Benzene is a liquid with molecular formula C₆H₆.
   Ethene is a gas with molecular formula C₂H₄.

Which statement is correct?

A  1 mole of benzene and 1 mole of ethene contain the same number of atoms.

B  1 mole of benzene and 1 mole of ethene both have a volume of 24 dm³ at room temperature and pressure.

C  Both benzene and ethene have the same empirical formula.

D  The number of carbon atoms in 0.5 moles of ethene is equal to the Avogadro constant.

9 Sodium hydrogencarbonate undergoes thermal decomposition as shown.

\[ 2\text{NaHCO}_3 \rightarrow \text{Na}_2\text{CO}_3 + \text{CO}_2 + \text{H}_2\text{O} \]

What is the maximum mass of sodium carbonate that can be made from 0.100 moles of sodium hydrogencarbonate?

A 4.15 g  

B 5.30 g  

C 10.6 g  

D 21.2 g
10 Which apparatus could be used to electroplate an iron nail with copper?

A

B

C

D

key

= copper sheet

= iron nail

aqueous copper(II) sulfate

aqueous iron(II) sulfate
11 The diagram shows a simple cell.

Which two metals produce the highest reading on the voltmeter?

<table>
<thead>
<tr>
<th></th>
<th>X</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>magnesium</td>
<td>copper</td>
</tr>
<tr>
<td>B</td>
<td>magnesium</td>
<td>iron</td>
</tr>
<tr>
<td>C</td>
<td>zinc</td>
<td>copper</td>
</tr>
<tr>
<td>D</td>
<td>zinc</td>
<td>iron</td>
</tr>
</tbody>
</table>

12 When anhydrous copper(II) sulfate is added to water a solution is formed and heat is given out.

Which row shows the temperature change and the type of reaction taking place?

<table>
<thead>
<tr>
<th>temperature change</th>
<th>type of reaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>A decrease</td>
<td>endothermic</td>
</tr>
<tr>
<td>B decrease</td>
<td>exothermic</td>
</tr>
<tr>
<td>C increase</td>
<td>endothermic</td>
</tr>
<tr>
<td>D increase</td>
<td>exothermic</td>
</tr>
</tbody>
</table>
The energy level diagram for a reaction is shown.

Which statement is not correct for this energy level diagram?

A. It could be the energy level diagram for the reaction when petrol is burnt.
B. Less energy is released in bond forming than is needed for bond breaking.
C. The activation energy, $E_a$, has a positive value.
D. The energy change, $\Delta H$, for the reaction is positive.
14 The rate of reaction between magnesium and excess dilute hydrochloric acid was followed by measuring the mass of magnesium present at regular time intervals.

Two experiments were performed.

Both experiments used 0.1 g of magnesium ribbon. The acid in experiment 1 was less concentrated than in experiment 2.

Which graph shows the results of the experiments?

A  

B  

C  

D

15 Which statement explains why coal dust forms an explosive mixture with air?

A  Coal dust catalyses the explosion.

B  Coal dust has a large surface area.

C  Crushing coal increases the concentration of the coal.

D  Crushing coal increases the temperature of the coal.
16 The following reversible reaction takes place in a closed vessel at constant temperature.

\[ P(g) + Q(g) + R(g) \rightleftharpoons S(g) + T(g) \]

When the system has reached equilibrium, more T is added.

After the addition of T, which substances increase in concentration?

A P, Q, R and S
B P and Q only
C P, Q and R only
D S only

17 Four ionic half-equations are shown.

1. \[ \text{Cu}^{2+}(aq) + 2e^- \rightarrow \text{Cu}(s) \]
2. \[ 2\text{I}^-(aq) \rightarrow \text{I}_2(aq) + 2e^- \]
3. \[ \text{Fe}^{2+}(aq) \rightarrow \text{Fe}^{3+}(aq) + e^- \]
4. \[ \text{Cl}_2(g) + 2e^- \rightarrow 2\text{Cl}^-(aq) \]

Which statement is correct?

A In equation 1, copper(II) ions are oxidised to copper.
B In equation 2, iodide ions are reduced to iodine.
C In equation 3, iron(II) ions are oxidised to iron(III) ions.
D In equation 4, chlorine is oxidised to chloride ions.

18 Germanium oxide is a white powder.

Germanium oxide reacts with concentrated hydrochloric acid.

Germanium oxide reacts with concentrated aqueous sodium hydroxide.

Germanium oxide does not dissolve when added to water.

Which type of oxide is germanium oxide?

A acidic
B amphoteric
C basic
D neutral
19 Hydrogen chloride gas reacts with water to produce an acidic solution. The equation for the reaction is shown.

\[ \text{HCl} + \text{H}_2\text{O} \rightarrow \text{Cl}^- + \text{H}_3\text{O}^+ \]

Which statement describes what happens during the reaction?

A The chloride ion is formed by accepting an electron from the water.
B The hydrogen chloride loses an electron to form the chloride ion.
C The water accepts a proton from the hydrogen chloride.
D The water donates a proton to the hydrogen chloride.

20 The apparatus shown is used to prepare aqueous copper(II) sulfate.

What are X and Y?

<table>
<thead>
<tr>
<th></th>
<th>X</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>copper</td>
<td>aqueous iron(II) sulfate</td>
</tr>
<tr>
<td>B</td>
<td>copper(II) chloride</td>
<td>sulfuric acid</td>
</tr>
<tr>
<td>C</td>
<td>copper(II) oxide</td>
<td>sulfuric acid</td>
</tr>
<tr>
<td>D</td>
<td>sulfur</td>
<td>aqueous copper(II) chloride</td>
</tr>
</tbody>
</table>
21 Information about some silver compounds is shown in the table.

<table>
<thead>
<tr>
<th>compound</th>
<th>formula</th>
<th>solubility in water</th>
</tr>
</thead>
<tbody>
<tr>
<td>silver carbonate</td>
<td>Ag₂CO₃</td>
<td>insoluble</td>
</tr>
<tr>
<td>silver chloride</td>
<td>AgCl</td>
<td>insoluble</td>
</tr>
<tr>
<td>silver nitrate</td>
<td>AgNO₃</td>
<td>soluble</td>
</tr>
<tr>
<td>silver oxide</td>
<td>Ag₂O</td>
<td>insoluble</td>
</tr>
</tbody>
</table>

Which equation shows a reaction which **cannot** be used to make a silver salt?

A  AgNO₃(aq) + HCl(aq) → AgCl(s) + HNO₃(aq)
B  Ag₂O(s) + 2HNO₃(aq) → 2AgNO₃(aq) + H₂O(l)
C  Ag₂CO₃(s) + 2HNO₃(aq) → 2AgNO₃(aq) + H₂O(l) + CO₂(g)
D  2Ag(s) + 2HCl(aq) → 2AgCl(s) + H₂(g)

22 What is **not** a property of Group I metals?

A  They are soft and can be cut with a knife.
B  They react when exposed to oxygen in the air.
C  They produce an acidic solution when they react with water.
D  They react rapidly with water producing hydrogen gas.
23 Four substances, P, Q, R and S, are tested as shown.

<table>
<thead>
<tr>
<th>test</th>
<th>substance</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>Q</td>
</tr>
<tr>
<td>dilute hydrochloric acid added</td>
<td>gas given off which ‘pops’ with a lighted splint</td>
</tr>
<tr>
<td>R</td>
<td>gas given off which turns limewater milky</td>
</tr>
<tr>
<td>S</td>
<td>no reaction</td>
</tr>
</tbody>
</table>

| dilute aqueous sodium hydroxide added and warmed gently | no reaction | no reaction | gas given off which turns damp, red litmus paper blue | no reaction |

What are P, Q, R and S?

<table>
<thead>
<tr>
<th></th>
<th>P</th>
<th>Q</th>
<th>R</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Mg</td>
<td>Na₂CO₃</td>
<td>NH₄Cl</td>
<td>NaCl</td>
</tr>
<tr>
<td>B</td>
<td>Mg</td>
<td>NH₄Cl</td>
<td>Na₂CO₃</td>
<td>NaCl</td>
</tr>
<tr>
<td>C</td>
<td>Mg</td>
<td>Na₂CO₃</td>
<td>NaCl</td>
<td>NH₄Cl</td>
</tr>
<tr>
<td>D</td>
<td>Na₂CO₃</td>
<td>Mg</td>
<td>NaCl</td>
<td>NH₄Cl</td>
</tr>
</tbody>
</table>

24 Which statement about transition elements and their compounds is correct?

A All the transition elements have an oxidation state of +2 only.
B Aqueous solutions of the salts of transition elements are generally coloured.
C Transition elements change from metal to non-metal across the period.
D Transition elements can act as catalysts but their compounds cannot.
### Question 25
Impure iron from the blast furnace is converted to steel as shown.

Which statement about the process is correct?

A. Acidic oxides are added to remove alkaline impurities.
B. Coke is added as a reducing agent.
C. Oxygen is blown in to oxidise the impure iron.
D. The steel produced contains less carbon than the impure iron.

### Question 26
The ionic equations represent the reactions between four metals, P, Q, R and S, and solutions of the salts of the same metals.

\[
\begin{align*}
P + Q^{2+} &\rightarrow \text{no reaction} \\
R + P^{2+} &\rightarrow R^{2+} + P \\
Q + S^{2+} &\rightarrow Q^{2+} + S \\
S + P^{2+} &\rightarrow S^{2+} + P \\
S + R^{2+} &\rightarrow S^{2+} + R \\
S + Q^{2+} &\rightarrow \text{no reaction}
\end{align*}
\]

What is the correct order of reactivity of the metals?

<table>
<thead>
<tr>
<th>most</th>
<th></th>
<th>least</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>P</td>
<td>R</td>
</tr>
<tr>
<td>B</td>
<td>Q</td>
<td>R</td>
</tr>
<tr>
<td>C</td>
<td>Q</td>
<td>S</td>
</tr>
<tr>
<td>D</td>
<td>S</td>
<td>Q</td>
</tr>
</tbody>
</table>
27 Aluminium is extracted by electrolysis.

From which ore is aluminium extracted and at which electrode is aluminium deposited during electrolysis?

<table>
<thead>
<tr>
<th></th>
<th>ore</th>
<th>electrode</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>bauxite</td>
<td>negative</td>
</tr>
<tr>
<td>B</td>
<td>bauxite</td>
<td>positive</td>
</tr>
<tr>
<td>C</td>
<td>cryolite</td>
<td>negative</td>
</tr>
<tr>
<td>D</td>
<td>cryolite</td>
<td>positive</td>
</tr>
</tbody>
</table>

28 Zinc oxide can be reacted with carbon to produce zinc metal.

Which equation for this reaction is correct?

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

B \[ 2\text{ZnO} + 2\text{C} \rightarrow 2\text{Zn} + 2\text{CO}_2 \]

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

D \[ \text{ZnO} + 2\text{C} \rightarrow \text{Zn} + 2\text{CO}_2 \]

29 Air is a mixture of gases.

Which gas is present in the largest amount?

A argon

B carbon dioxide

C nitrogen

D oxygen

30 Which information about carbon dioxide and methane is correct?

<table>
<thead>
<tr>
<th></th>
<th>carbon dioxide</th>
<th>methane</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>formed when vegetation decomposes</td>
<td>✓</td>
</tr>
<tr>
<td>B</td>
<td>greenhouse gas</td>
<td>✓</td>
</tr>
<tr>
<td>C</td>
<td>present in unpolluted air</td>
<td>✗</td>
</tr>
<tr>
<td>D</td>
<td>produced during respiration</td>
<td>✗</td>
</tr>
</tbody>
</table>
31 Underwater steel pipes can be protected from corrosion by attaching magnesium blocks to them. Which equation represents the reaction that prevents corrosion?

A  $\text{Fe} \rightarrow \text{Fe}^{2+} + 2\text{e}^{-}$  
B  $\text{Fe}^{2+} \rightarrow \text{Fe}^{3+} + \text{e}^{-}$  
C  $\text{Mg} \rightarrow \text{Mg}^{2+} + 2\text{e}^{-}$  
D  $\text{Mg}^{2+} + 2\text{e}^{-} \rightarrow \text{Mg}$

32 Ammonia is manufactured by the Haber process. The reaction is exothermic.

$$\text{N}_2(g) + 3\text{H}_2(g) \rightleftharpoons 2\text{NH}_3(g) \quad \Delta H = -92 \text{ kJ/mol}$$

Which statement about the Haber process is correct?

A  The reaction is irreversible and produces only one product.  
B  The reaction is reversible and produces less ammonia at high pressure.  
C  The reaction is reversible and produces less ammonia at high temperature.  
D  The reaction is slow because a catalyst is not used in the Haber process.

33 Sulfuric acid is manufactured by the Contact process.

The most important reaction takes place in the presence of a catalyst.

What are the reactants and the catalyst for this reaction?

<table>
<thead>
<tr>
<th>reactants</th>
<th>catalyst</th>
</tr>
</thead>
<tbody>
<tr>
<td>A  sulfur and oxygen</td>
<td>vanadium(V) oxide</td>
</tr>
<tr>
<td>B  sulfur dioxide and oxygen</td>
<td>vanadium(V) oxide</td>
</tr>
<tr>
<td>C  sulfur dioxide and steam</td>
<td>iron</td>
</tr>
<tr>
<td>D  sulfur trioxide and water</td>
<td>platinum</td>
</tr>
</tbody>
</table>
34 Which box corresponds to limestone?

- **Does limestone contain carbon?**
  - yes
  - no

- **Does limestone burn?**
  - yes
  - no

A: yes, no
B: yes, no
C: yes, no
D: yes, no

35 Petroleum is an important fossil fuel.

Which row correctly describes petroleum?

<table>
<thead>
<tr>
<th>type of substance</th>
<th>composition</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>compound, mainly hydrocarbons</td>
</tr>
<tr>
<td>B</td>
<td>compound, only hydrogen and carbon</td>
</tr>
<tr>
<td>C</td>
<td>mixture, mainly hydrocarbons</td>
</tr>
<tr>
<td>D</td>
<td>mixture, only hydrogen and carbon</td>
</tr>
</tbody>
</table>

36 Butane reacts as shown.

\[
\text{butane} \xrightarrow{\text{catalyst and heat}} \text{butene} + \text{hydrogen}
\]

What is this type of reaction?

- A combustion
- B cracking
- C polymerisation
- D reduction
37 Substance Z has the following characteristics.

1. It burns in an excess of oxygen to form carbon dioxide and water.
2. It is oxidised by air to form a liquid smelling of vinegar.
3. It reacts with carboxylic acids to form esters.

What is substance Z?
A ethane
B ethanoic acid
C ethanol
D ethyl ethanoate

38 Ethanol is manufactured by the catalytic addition of steam to ethene and by fermentation.

Which row shows an advantage and a disadvantage of using the catalytic addition of steam to ethene compared to fermentation?

<table>
<thead>
<tr>
<th></th>
<th>advantage</th>
<th>disadvantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>fast</td>
<td>the product is impure</td>
</tr>
<tr>
<td>B</td>
<td>fast</td>
<td>uses non-renewable materials</td>
</tr>
<tr>
<td>C</td>
<td>the product is pure</td>
<td>slow</td>
</tr>
<tr>
<td>D</td>
<td>uses renewable materials</td>
<td>slow</td>
</tr>
</tbody>
</table>

39 The partial structure of addition polymer X is shown.

Which monomer is used to form polymer X?
A CH<sub>2</sub>=CH<sub>2</sub>
B CH<sub>3</sub>CH=CH<sub>2</sub>
C CH<sub>3</sub>CH=CHCH<sub>3</sub>
D CH<sub>3</sub>CH<sub>2</sub>CH=CH<sub>2</sub>
40 The diagram shows the partial structure of Terylene.

From which pair of compounds is it made?

A  \( \overset{\text{O}}{\text{H}} - \text{C} - \overset{\text{O}}{} - \text{C} - \overset{\text{O}}{\text{H}} \)  +  \( \overset{\text{O}}{\text{H}} - \text{C} - \overset{\text{O}}{} - \text{OH} \)

B  \( \overset{\text{O}}{\text{H}} - \text{C} - \overset{\text{O}}{} - \text{OH} \)  +  \( \overset{\text{O}}{\text{H}} - \overset{\text{O}}{\text{C}} - \text{OH} \)

C  \( \overset{\text{O}}{\text{H}} - \overset{\text{O}}{\text{O}} - \overset{\text{O}}{\text{H}} \)  +  \( \overset{\text{O}}{\text{H}} - \overset{\text{O}}{\text{C}} - \text{OH} \)

D  \( \overset{\text{O}}{\text{H}} - \overset{\text{O}}{\text{C}} - \overset{\text{O}}{} - \text{C} - \overset{\text{O}}{\text{H}} \)  +  \( \overset{\text{O}}{\text{H}} - \overset{\text{O}}{\text{C}} - \text{C} - \overset{\text{O}}{\text{H}} \)
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>I</td>
<td>H</td>
<td>He</td>
<td>Li</td>
<td>Be</td>
<td>B</td>
<td>C</td>
<td>N</td>
<td>O</td>
</tr>
<tr>
<td>II</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>III</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>IV</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>V</td>
<td>K</td>
<td>Ca</td>
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</tbody>
</table>

Key:
- Atomic number
- Atomic symbol
- Name
- Relative atomic mass

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