



**Cambridge Assessment International Education**  
Cambridge International General Certificate of Secondary Education

**CHEMISTRY**

**0620/21**

Paper 2 Multiple Choice (Extended)

**October/November 2019**

**45 minutes**

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



**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 16.

Electronic calculators may be used.

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

This document consists of **13** printed pages and **3** blank pages.

- 1 Samples of four gases are released in a room at the same time.

The gases are carbon dioxide,  $\text{CO}_2$ , hydrogen chloride,  $\text{HCl}$ , hydrogen sulfide,  $\text{H}_2\text{S}$ , and nitrogen dioxide,  $\text{NO}_2$ .

Which gas diffuses fastest?

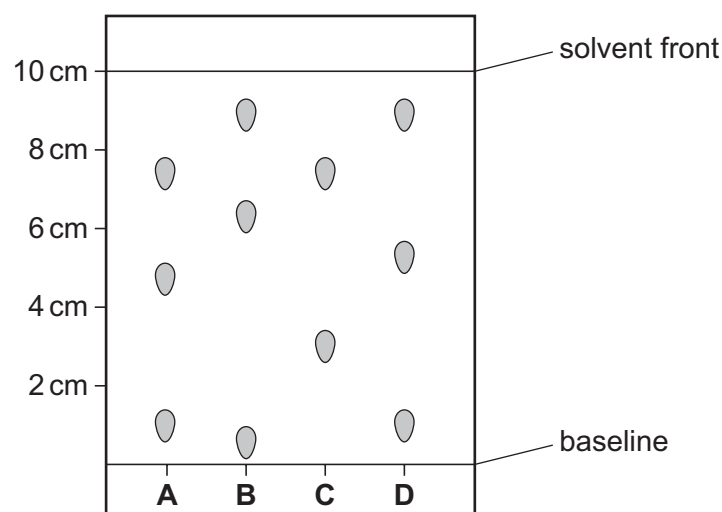
- A carbon dioxide
  - B hydrogen chloride
  - C hydrogen sulfide
  - D nitrogen dioxide
- 2 A student is asked to measure the time taken for 0.4 g of magnesium carbonate to react completely with  $25.0\text{ cm}^3$  of dilute hydrochloric acid.

Which pieces of apparatus does the student need?

- A balance, stop-clock, pipette
  - B balance, stop-clock, thermometer
  - C balance, pipette, thermometer
  - D stop-clock, pipette, thermometer
- 3 Four different food colourings are analysed using chromatography.

The results are shown on the chromatogram. The diagram is not drawn to scale.

Which food colouring contains a component with an  $R_f$  value of 0.3?



4 Which statement about an ionic compound is **not** correct?

- A It conducts electricity when dissolved in water.
- B It has a high melting point due to strong attractive forces between ions.
- C It has a regular lattice of oppositely charged ions in a 'sea of electrons'.
- D The ionic bonds are formed between metallic and non-metallic elements.

5 An isotope of chromium is represented by  $^{52}_{24}\text{Cr}$ .

Which statement about an atom of this isotope of chromium is correct?

- A It contains 24 electrons.
- B It contains 24 neutrons.
- C It contains 28 protons.
- D It contains 52 neutrons.

6 Element X has two isotopes,  $^{12}_6\text{X}$  and  $^{14}_6\text{X}$ .

Which statement about these isotopes is correct?

- A They have different chemical properties because they have different numbers of neutrons.
- B They have the same chemical properties because they have the same number of outer shell electrons.
- C They have the same nucleon number because the sum of the number of protons and electrons is the same.
- D They have different positions in the Periodic Table because they have different numbers of neutrons.

7 How are the structures of diamond and silicon(IV) oxide similar?

- A Molecules of both diamond and silicon(IV) oxide are held together by weak attractive forces.
- B They both contain atoms arranged in planes held together by weak bonds.
- C They both contain ions that are free to move.
- D The carbon in diamond and the silicon in silicon(IV) oxide each have four covalent bonds.

8 Which statement describes the structure of copper?

- A It has a lattice of negative ions in a 'sea of electrons'.
- B It has a lattice of negative ions in a 'sea of protons'.
- C It has a lattice of positive ions in a 'sea of electrons'.
- D It has a lattice of positive ions in a 'sea of protons'.

- 9 Four fertilisers are each supplied in 100 kg bags.

Which fertiliser supplies the greatest mass of nitrogen per 100 kg bag?

- A ammonium nitrate,  $\text{NH}_4\text{NO}_3$   
 B ammonium phosphate,  $(\text{NH}_4)_3\text{PO}_4$   
 C ammonium sulfate,  $(\text{NH}_4)_2\text{SO}_4$   
 D urea,  $\text{CO}(\text{NH}_2)_2$

- 10 Calcium carbonate reacts with dilute hydrochloric acid.

The equation for the reaction is shown.



1.00 g of calcium carbonate is added to  $50.0 \text{ cm}^3$  of  $0.0500 \text{ mol/dm}^3$  hydrochloric acid.

Which volume of carbon dioxide is made in this reaction?

- A  $30 \text{ cm}^3$       B  $60 \text{ cm}^3$       C  $120 \text{ cm}^3$       D  $240 \text{ cm}^3$

- 11 Which rows correctly show cathode and anode products from the electrolysis of the named electrolyte?

|   | electrolyte                                         | cathode product | anode product |
|---|-----------------------------------------------------|-----------------|---------------|
| 1 | copper(II) sulfate solution using copper electrodes | copper          | oxygen        |
| 2 | molten lead(II) bromide                             | lead            | bromine       |
| 3 | dilute sodium bromide solution                      | hydrogen        | oxygen        |
| 4 | copper(II) sulfate solution using carbon electrodes | hydrogen        | oxygen        |

- A 1 and 2 only      B 1 and 4 only      C 2 and 3 only      D 3 and 4 only

- 12 What are the ionic half-equations for the electrode reactions during the electrolysis of concentrated aqueous sodium chloride?

|   | anode                                                | cathode                                              |
|---|------------------------------------------------------|------------------------------------------------------|
| A | $\text{Cl}_2 + 2\text{e}^- \rightarrow 2\text{Cl}^-$ | $\text{H}_2 \rightarrow 2\text{H}^+ + 2\text{e}^-$   |
| B | $2\text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-$ | $2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$   |
| C | $\text{H}_2 \rightarrow 2\text{H}^+ + 2\text{e}^-$   | $\text{Cl}_2 + 2\text{e}^- \rightarrow 2\text{Cl}^-$ |
| D | $2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$   | $2\text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-$ |

**13** Which statements about endothermic reactions are correct?

- 1 The energy of the products is greater than the energy of the reactants.
- 2 The energy of the reactants is greater than the energy of the products.
- 3 The temperature of the surroundings increases during the reaction.
- 4 The temperature of the surroundings decreases during the reaction.

**A** 1 and 3 only    **B** 1 and 4 only    **C** 2 and 3 only    **D** 2 and 4 only

**14** Which gases are used to generate electricity in a fuel cell?

- A** carbon dioxide and oxygen  
**B** hydrogen and methane  
**C** hydrogen and oxygen  
**D** methane and carbon dioxide

**15** Which is a chemical change?

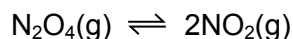
- A** boiling water  
**B** cooking an egg  
**C** dissolving sugar  
**D** melting ice cubes

**16** The rate of reaction between magnesium and dilute hydrochloric acid is increased by increasing the concentration of the acid.

How does this affect the reacting particles?

|          | collision rate of particles | proportion of particles with sufficient energy to react |
|----------|-----------------------------|---------------------------------------------------------|
| <b>A</b> | increases                   | increases                                               |
| <b>B</b> | increases                   | stays the same                                          |
| <b>C</b> | stays the same              | increases                                               |
| <b>D</b> | stays the same              | stays the same                                          |

- 17 Dinitrogen tetroxide,  $\text{N}_2\text{O}_4$ , is converted into nitrogen dioxide,  $\text{NO}_2$ , in a reversible reaction.

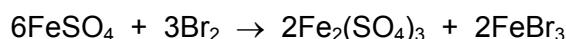


The forward reaction is endothermic.

Which conditions give the highest equilibrium yield of nitrogen dioxide?

|          | pressure<br>/atmospheres | temperature |
|----------|--------------------------|-------------|
| <b>A</b> | 2                        | high        |
| <b>B</b> | 2                        | low         |
| <b>C</b> | 50                       | high        |
| <b>D</b> | 50                       | low         |

- 18 The equation for the reaction between iron(II) sulfate and bromine is shown.



Which row identifies the oxidising agent and the reducing agent?

|          | oxidising agent              | reducing agent               |
|----------|------------------------------|------------------------------|
| <b>A</b> | $\text{Br}_2$                | $\text{FeSO}_4$              |
| <b>B</b> | $\text{FeSO}_4$              | $\text{Br}_2$                |
| <b>C</b> | $\text{FeBr}_3$              | $\text{Fe}_2(\text{SO}_4)_3$ |
| <b>D</b> | $\text{Fe}_2(\text{SO}_4)_3$ | $\text{FeBr}_3$              |

- 19 Which statement about amphoteric oxides is correct?

- A** They are made by combining an acidic oxide with a basic oxide.
- B** They react with water to give a solution of pH 7.
- C** They react with both acids and bases.
- D** They do not react with acids or bases.

- 20 Carbonic acid is a weak acid formed when carbon dioxide dissolves in water.

What is the pH of the solution?

- A** 1                      **B** 5                      **C** 7                      **D** 9

**21** A method used to make copper(II) sulfate crystals is shown.

- 1 Place dilute sulfuric acid in a beaker.
- 2 Warm the acid.
- 3 Add copper(II) oxide until it is in excess.
- 4 Filter the mixture.
- 5 Evaporate the filtrate until crystals start to form.
- 6 Leave the filtrate to cool.

What are the purposes of step 3 and step 4?

|          | step 3                                | step 4                                   |
|----------|---------------------------------------|------------------------------------------|
| <b>A</b> | to ensure all of the acid has reacted | to obtain solid copper(II) sulfate       |
| <b>B</b> | to ensure all of the acid has reacted | to remove the excess of copper(II) oxide |
| <b>C</b> | to speed up the reaction              | to obtain solid copper(II) sulfate       |
| <b>D</b> | to speed up the reaction              | to remove the excess of copper(II) oxide |

**22** Lead(II) sulfate is an insoluble salt.

Which process is **not** used to prepare a pure sample of this salt?

- A** crystallisation  
**B** drying  
**C** filtration  
**D** precipitation

**23** Part of the Periodic Table is shown.

Which element is used to provide an inert atmosphere?

A simplified periodic table with 18 columns and 4 rows. The columns are grouped into four sets of three. Element A is in the first column of the second row. Element B is in the second column of the third row. Element C is in the third column of the third row. Element D is in the second column of the fourth row.

- 24 Which pair of elements reacts together most violently?
- A chlorine and lithium
  - B chlorine and potassium
  - C iodine and lithium
  - D iodine and potassium
- 25 Which pair of compounds shows that transition elements have variable oxidation states?
- A  $\text{Cr}_2\text{O}_3$  and  $\text{CrBr}_3$
  - B  $\text{CuSO}_4$  and  $\text{CuCl}_2$
  - C  $\text{Fe}_2\text{O}_3$  and  $\text{FeCl}_2$
  - D  $\text{NiO}$  and  $\text{NiCl}_2$
- 26 Some properties of substance X are listed.
- It conducts electricity when molten.
  - It has a high melting point.
  - It burns in oxygen and the oxide dissolves in water to give a solution with pH 11.

What is X?

- A a covalent compound
  - B a macromolecule
  - C a metal
  - D an ionic compound
- 27 Which statement is correct?
- A Aluminium is used in the manufacture of aircraft because it has a high density.
  - B Copper is used for cooking utensils because it is a good conductor of heat.
  - C Mild steel is used for car bodies because it is resistant to corrosion.
  - D Stainless steel is used for cutlery because it is a conductor of electricity.

**28** Iron rusts but aluminium does not easily corrode.

Which statement explains why aluminium does **not** easily corrode?

- A** It is an alloy.
- B** It is below iron in the reactivity series.
- C** It is not a transition element.
- D** Its surface is protected by an oxide layer.

**29** Which statement about the extraction of aluminium is correct?

- A** Aluminium is formed at the cathode during the electrolysis of aluminium oxide.
- B** Hematite is mainly aluminium oxide.
- C** Molten cryolite is used to raise the melting point of the aluminium oxide.
- D** Oxygen gains electrons at the anode during the electrolysis of aluminium oxide.

**30** River water contains soluble impurities, insoluble impurities and bacteria.

River water is made safe to drink by filtration and chlorination.

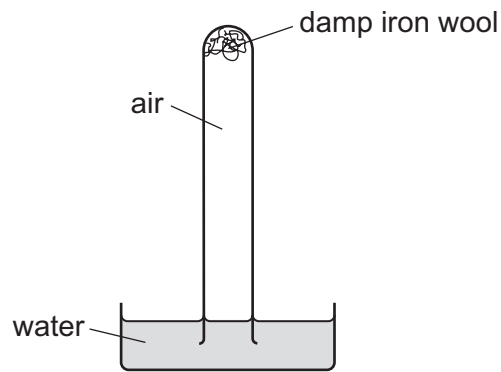
Which statement is correct?

- A** Filtration removes bacteria and insoluble impurities, and chlorination removes soluble impurities.
- B** Filtration removes insoluble impurities, and chlorination kills the bacteria.
- C** Filtration removes soluble and insoluble impurities, and chlorination kills the bacteria.
- D** Filtration removes soluble impurities and bacteria, and chlorination removes insoluble impurities.

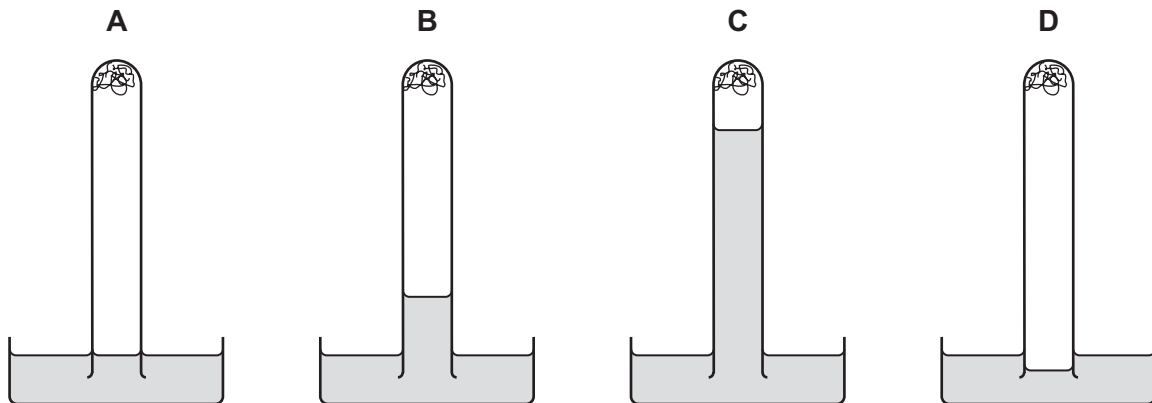
**31** Which physical property is used to separate the nitrogen and oxygen from air?

- A** boiling point
- B** density
- C** electrical conductivity
- D** molecular mass

**32** The apparatus shown is set up and left for a week.



Which diagram shows the level of the water at the end of the week?



**33** Which statement about the carbon cycle is correct?

- A** Carbon is absorbed from the atmosphere by combustion and released into it by respiration.
- B** Carbon is absorbed from the atmosphere by photosynthesis and released into it by combustion.
- C** Carbon is absorbed from the atmosphere by both respiration and combustion.
- D** Carbon is released into the atmosphere by both photosynthesis and respiration.

**34** Ammonium sulfate is used as a fertiliser.

It is made from ammonia and sulfuric acid.

Which words complete gaps 1, 2 and 3?

The .....1..... is made by the .....2..... process in which .....3..... is used as a catalyst.

|          | 1             | 2       | 3                 |
|----------|---------------|---------|-------------------|
| <b>A</b> | ammonia       | Contact | iron              |
| <b>B</b> | ammonia       | Haber   | vanadium(V) oxide |
| <b>C</b> | sulfuric acid | Contact | vanadium(V) oxide |
| <b>D</b> | sulfuric acid | Haber   | iron              |

**35** Which process is used to obtain lime from limestone?

- A** cracking
- B** fractional distillation
- C** neutralisation
- D** thermal decomposition

**36** Petroleum is separated by fractional distillation.

Which statement about the fractions produced is correct?

- A** Bottled gas for heating and cooking is obtained from the naphtha fraction.
- B** Diesel oil is used as a fuel for jet aircraft.
- C** Substances used to make polishes are obtained from the lubricating fraction.
- D** The kerosene fraction contains many useful waxes.

**37** Which products are obtained by the cracking of an alkane?

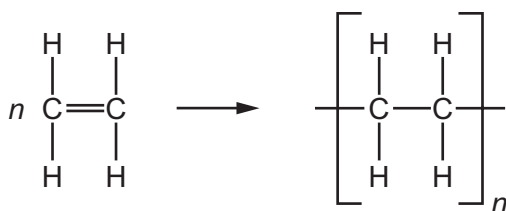
|          | alkene | hydrogen | water |
|----------|--------|----------|-------|
| <b>A</b> | ✓      | ✓        | ✓     |
| <b>B</b> | ✓      | ✓        | x     |
| <b>C</b> | ✓      | x        | ✓     |
| <b>D</b> | x      | ✓        | ✓     |

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

Which statement describes an advantage of fermentation compared to the catalytic addition of steam to ethene?

- A** Fermentation is a more rapid reaction.
- B** Fermentation produces a purer product.
- C** Fermentation uses a higher temperature.
- D** Fermentation uses renewable resources.

**39** The diagram shows the structure of a monomer and of the polymer made from it.



What are the monomer and polymer?

|          | monomer | polymer      |
|----------|---------|--------------|
| <b>A</b> | ethane  | poly(ethane) |
| <b>B</b> | ethane  | poly(ethene) |
| <b>C</b> | ethene  | poly(ethane) |
| <b>D</b> | ethene  | poly(ethene) |

**40** Which polymers possess the same linkage?

- A** nylon and protein
- B** protein and starch
- C** starch and nylon
- D** nylon and *Terylene*

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## lanthanoids

|    |    |           |     |    |    |         |     |    |    |              |     |    |    |           |     |    |    |            |   |    |    |           |     |    |    |           |     |    |    |            |     |    |    |           |     |    |    |             |     |    |    |             |     |     |    |         |     |     |    |             |     |     |    |           |     |     |    |            |     |
|----|----|-----------|-----|----|----|---------|-----|----|----|--------------|-----|----|----|-----------|-----|----|----|------------|---|----|----|-----------|-----|----|----|-----------|-----|----|----|------------|-----|----|----|-----------|-----|----|----|-------------|-----|----|----|-------------|-----|-----|----|---------|-----|-----|----|-------------|-----|-----|----|-----------|-----|-----|----|------------|-----|
| 57 | La | lanthanum | 139 | 58 | Ce | cerium  | 140 | 59 | Pr | praseodymium | 141 | 60 | Nd | neodymium | 144 | 61 | Pm | promethium | — | 62 | Sm | samarium  | 150 | 63 | Eu | europlum  | 152 | 64 | Gd | gadolinium | 157 | 65 | Tb | terbium   | 159 | 66 | Dy | dysprosium  | 163 | 67 | Ho | holmium     | 165 | 68  | Er | erbium  | 167 | 69  | Tm | thulium     | 169 | 70  | Yb | ytterbium | 173 | 71  | Lu | lutetium   | 175 |
| 89 | Ac | actinium  | —   | 90 | Th | thorium | 232 | 91 | Pa | protactinium | 231 | 92 | U  | uranium   | 238 | 93 | Np | neptunium  | — | 94 | Pu | plutonium | —   | 95 | Am | americium | —   | 96 | Cm | curium     | —   | 97 | Bk | berkelium | —   | 98 | Cf | californium | —   | 99 | Es | einsteinium | —   | 100 | Fm | fermium | —   | 101 | Md | mendelevium | —   | 102 | No | nobelium  | —   | 103 | Lr | lawrencium | —   |

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