



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

**CHEMISTRY (US)**

**0439/21**

Paper 2 Multiple Choice (Extended)

**October/November 2017**

**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, Center 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 document consists of **15** printed pages and **1** blank page.



1 Which process causes the greatest increase in the distance between particles?

- A condensation
- B freezing
- C melting
- D sublimation

2 A student put  $25.0\text{ cm}^3$  of dilute hydrochloric acid into an Erlenmeyer flask.

The student added 2.5 g of solid sodium carbonate and measured the change in temperature of the mixture.

Which apparatus does the student need to use to obtain the most accurate results?

- A balance, graduated cylinder, thermometer
- B balance, pipet, stopwatch
- C balance, pipet, thermometer
- D buret, pipet, thermometer

3 The results obtained from a chromatogram are shown.

	distance traveled / cm
solvent	5.0
substance X	3.0
substance Y	2.5

Which row gives the  $R_f$  values of substance X and substance Y?

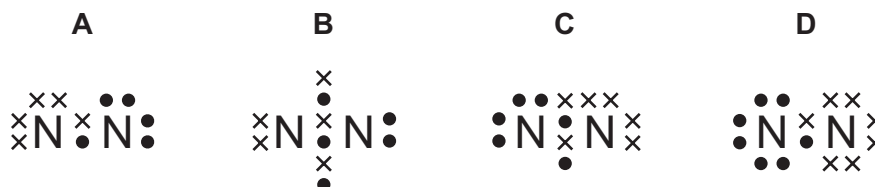
	$R_f$ (X)	$R_f$ (Y)
A	0.5	0.6
B	0.6	0.5
C	1.6	2.0
D	2.0	1.6

4 Two statements about silicon(IV) oxide are given.

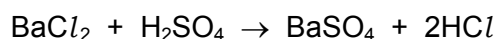
- 1 It is a hard substance.
- 2 It has a macromolecular structure with strong covalent bonds.

Which is correct?

- A** Both statements are correct and statement 2 explains statement 1.
- B** Both statements are correct but statement 2 does not explain statement 1.
- C** Statement 1 is correct but statement 2 is not correct.
- D** Statement 2 is correct but statement 1 is not correct.
- 5 Which statement explains why isotopes of the same element have the same chemical properties?
- A** They have a different number of neutrons in the nucleus.
- B** They have the same number of neutrons in the nucleus.
- C** They have the same number of outer shell electrons.
- D** They have the same number of protons as neutrons.
- 6 Which dot-and-cross diagram shows the outer shell electron arrangement in a molecule of nitrogen?



7 The equation for the reaction between barium chloride solution and dilute sulfuric acid is shown.



Which row shows the state symbols for this equation?

	$\text{BaCl}_2$	$\text{H}_2\text{SO}_4$	$\text{BaSO}_4$	$2\text{HCl}$
<b>A</b>	(aq)	(aq)	(s)	(aq)
<b>B</b>	(aq)	(l)	(s)	(aq)
<b>C</b>	(l)	(aq)	(s)	(l)
<b>D</b>	(aq)	(l)	(aq)	(l)

- 8 A compound is analyzed and found to contain 85.7% carbon and 14.3% hydrogen.

What is its empirical formula?

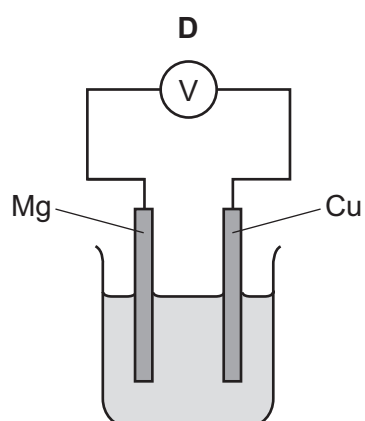
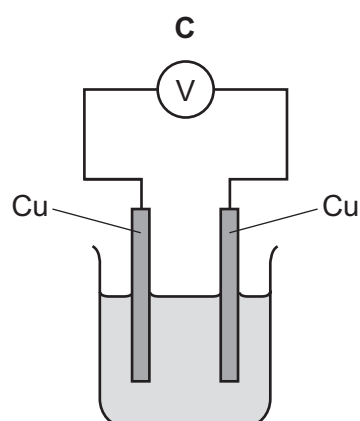
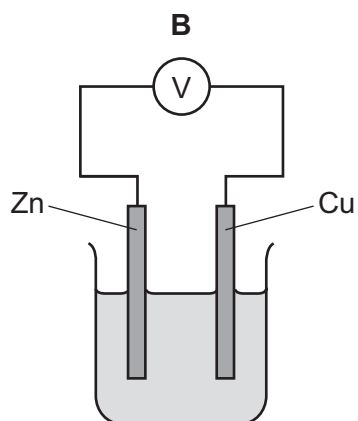
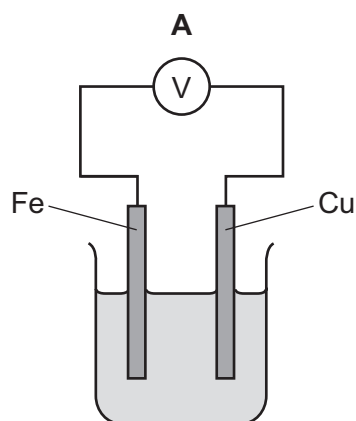
- A CH                      B CH<sub>2</sub>                      C C<sub>2</sub>H<sub>4</sub>                      D C<sub>6</sub>H

- 9 Which statements about the electrolysis of concentrated copper(II) chloride are correct?

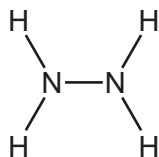
- 1 Electrons are transferred from the cathode to the copper(II) ions.
- 2 Electrons move round the external circuit from the cathode to the anode.
- 3 Chloride ions are attracted to the anode.
- 4 Hydroxide ions transfer electrons to the cathode.

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

- 10 Which metal combination produces the highest voltage reading in the cells shown?



- 11 The compound hydrazine is used as a rocket fuel. It has the structural formula shown.



One of the reactions of hydrazine is shown. This reaction is exothermic.



The bond energies are shown in the table.

	bond energy in kJ/mol
H–H	+436
N–H	+390
N–N	+160
N≡N	+945

What is the energy change for this reaction?

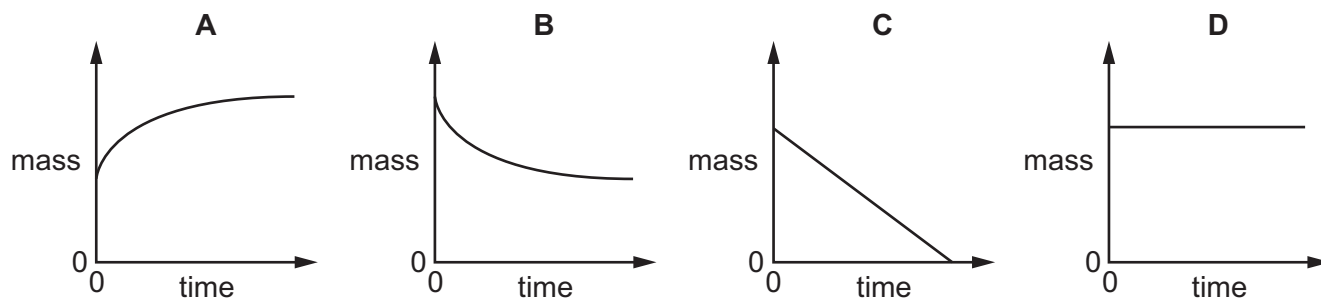
- A** –339 kJ/mol    **B** –97 kJ/mol    **C** +97 kJ/mol    **D** +339 kJ/mol

- 12 Which statement describes an exothermic reaction?

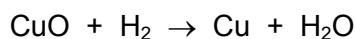
- A** The energy absorbed for bond breaking is greater than the energy released by bond formation.  
**B** The energy absorbed for bond breaking is less than the energy released by bond formation.  
**C** The energy released by bond breaking is greater than the energy absorbed for bond formation.  
**D** The energy released by bond breaking is less than the energy absorbed for bond formation.

- 13 The mass of a beaker and its contents is plotted against time.

Which graph represents what happens when sodium carbonate reacts with an excess of dilute hydrochloric acid in an open beaker?



14 Copper(II) oxide reacts with hydrogen.



Which row is correct?

	oxidizing agent	reducing agent
<b>A</b>	$\text{H}_2$	$\text{CuO}$
<b>B</b>	$\text{CuO}$	$\text{H}_2$
<b>C</b>	$\text{H}_2\text{O}$	$\text{Cu}$
<b>D</b>	$\text{Cu}$	$\text{H}_2\text{O}$

15 Ethanoic acid reacts slowly with calcium carbonate.

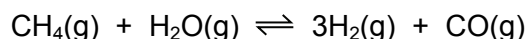
Which statements explain why an increase in temperature increases the rate of the reaction?

- 1 The activation energy of the reaction is decreased.
- 2 There is an increase in collision rate.
- 3 The particles have more energy.
- 4 There will be fewer successful collisions.

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

16 Methane reacts with steam to produce hydrogen and carbon monoxide.

The equation for the reaction is shown.



The reaction is reversible. The forward reaction is endothermic.

Which changes in temperature and pressure increase the equilibrium yield of carbon monoxide?

	temperature	pressure
<b>A</b>	decrease	decrease
<b>B</b>	decrease	increase
<b>C</b>	increase	decrease
<b>D</b>	increase	increase

17 Some properties of four oxides are listed.

Oxide 1 reacts with both acids and alkalis to form salts.

Oxide 2 reacts with acids to form salts but does not react with alkalis.

Oxide 3 reacts with alkalis to form salts but does not react with acids.

Oxide 4 does not react with acids or alkalis.

Which row describes the oxides?

	oxide 1	oxide 2	oxide 3	oxide 4
<b>A</b>	amphoteric	acidic	basic	neutral
<b>B</b>	amphoteric	basic	acidic	neutral
<b>C</b>	neutral	acidic	basic	amphoteric
<b>D</b>	neutral	basic	acidic	amphoteric

18 What is **not** a typical characteristic of acids?

- A** They react with alkalis producing water.
- B** They react with **all** metals producing hydrogen.
- C** They react with carbonates producing carbon dioxide.
- D** They turn blue litmus paper red.

19 Zinc sulfate is made by reacting an excess of zinc oxide with dilute sulfuric acid.

The excess zinc oxide is then removed from the solution.

Which process is used to obtain solid zinc sulfate from the solution?

- A** crystallization
- B** dissolving
- C** filtration
- D** fractional distillation

20 What is used to test for chlorine?

- A** a glowing splint
- B** damp litmus paper
- C** limewater
- D** potassium manganate(VII) solution

**21** Which statements about the trends across a period of the Periodic Table are correct?

- 1 Aluminum is more metallic than sodium.
- 2 Beryllium is more metallic than carbon.
- 3 Boron is more metallic than lithium.
- 4 Magnesium is more metallic than silicon.

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

**22** Astatine is an element in Group VII of the Periodic Table.

Astatine is .....1..... reactive than iodine.

The melting point of astatine is .....2..... than the melting point of iodine.

Astatine is .....3..... in color than bromine.

Which words complete gaps 1, 2 and 3?

	1	2	3
<b>A</b>	less	higher	darker
<b>B</b>	less	lower	lighter
<b>C</b>	more	higher	darker
<b>D</b>	more	lower	lighter

**23** Which row describes the properties of a typical transition element?

	melting point	forms colored compounds	can act as a catalyst
<b>A</b>	high	no	no
<b>B</b>	high	yes	yes
<b>C</b>	low	no	yes
<b>D</b>	low	yes	no

**24** Why is argon gas used to fill electric lamps?

- A** It conducts electricity.
- B** It glows when heated.
- C** It is less dense than air.
- D** It is not reactive.



25 What is a property of **all** metals?

- A conduct electricity
- B hard
- C low melting points
- D react with water

26 Aluminum is extracted by the electrolysis of aluminum oxide.

Which statement is **not** correct?

- A Aluminum ions are oxidised at the cathode.
- B Carbon dioxide is made at the anode.
- C Cryolite is added to lower the melting point of the aluminum oxide.
- D The electrodes are made from graphite.

27 Which row describes how the metals are used?

	mixed with zinc to form brass	used to galvanize iron
A	aluminum	tin
B	aluminum	zinc
C	copper	tin
D	copper	zinc

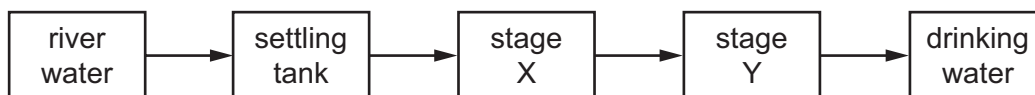
28 Information about the nitrates and carbonates of two metals, Q and R, is shown.

	appearance	solubility in water	effect of heat
nitrate of Q	white solid	soluble	colorless gas evolved which relights a glowing splint
carbonate of Q	white solid	soluble	no reaction
nitrate of R	white solid	soluble	brown gas evolved
carbonate of R	white solid	insoluble	colorless gas evolved which turns limewater milky

Which statement is correct?

- A** Q is calcium and R is magnesium.
- B** Q is magnesium and R is sodium.
- C** Q is potassium and R is copper.
- D** Q is sodium and R is calcium.

29 The flow chart shows stages in the treatment of river water to produce drinking water.



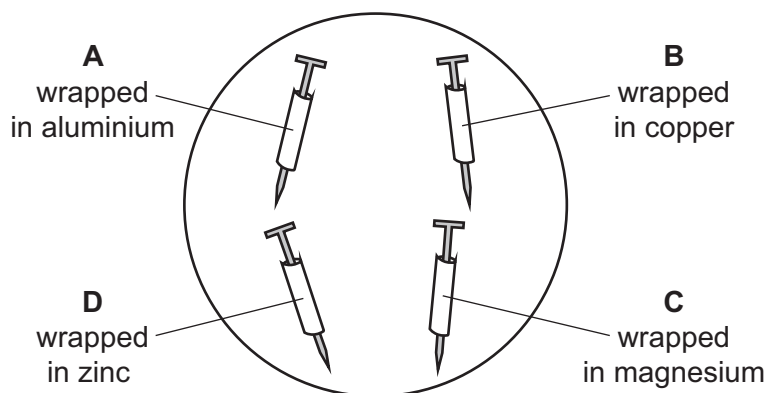
What occurs at stages X and Y?

	X	Y
<b>A</b>	distillation	chlorination
<b>B</b>	distillation	filtration
<b>C</b>	filtration	chlorination
<b>D</b>	filtration	distillation

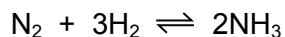
30 Four iron nails had different metals wrapped around them.

The nails were placed in an open dish filled with water and left for a week.

Which iron nail has no protection against rusting?



31 Ammonia is made by the Haber process.



What are the sources of the nitrogen and hydrogen used in the Haber process?

	nitrogen	hydrogen
<b>A</b>	fertilizers	reacting methane with steam
<b>B</b>	fertilizers	the air
<b>C</b>	the air	reacting methane with steam
<b>D</b>	the air	the air

32 Which process does **not** produce carbon dioxide?

- A** combustion of alkanes
- B** photosynthesis
- C** respiration
- D** thermal decomposition of limestone

33 Which row shows the conditions used in the manufacture of sulfuric acid by the Contact process?

	temperature /°C	pressure /atm	catalyst
<b>A</b>	40	200	Fe
<b>B</b>	40	200	V <sub>2</sub> O <sub>5</sub>
<b>C</b>	400	2	Fe
<b>D</b>	400	2	V <sub>2</sub> O <sub>5</sub>

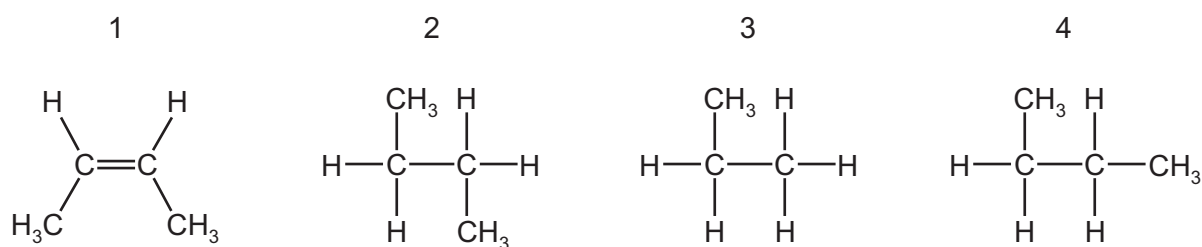
34 Some marble chips (calcium carbonate) are heated strongly and substances X and Y are formed.

Substance X is a white solid that reacts with water, giving out heat. Substance Y is a colorless gas.

What are substances X and Y?

	X	Y
<b>A</b>	calcium chloride	oxygen
<b>B</b>	calcium hydroxide	carbon dioxide
<b>C</b>	calcium oxide	carbon dioxide
<b>D</b>	calcium sulfate	oxygen

35 The structures of some organic molecules are shown.



Which structures represent an alkane with four carbon atoms?

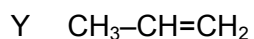
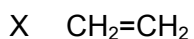
- A** 1 only      **B** 2 and 3      **C** 2 and 4      **D** 3 and 4

- 36 Some of the fractions obtained from the fractional distillation of petroleum are used as fuels for vehicles.

Which two fractions are used as fuels for vehicles?

- A** bitumen fraction and gasoline fraction  
**B** bitumen fraction and naphtha fraction  
**C** gasoline fraction and kerosene fraction  
**D** kerosene fraction and lubricating fraction

- 37 X, Y and Z are three hydrocarbons.

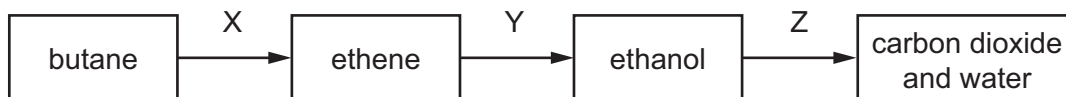


What do compounds X, Y and Z have in common?

- 1 They are all alkenes.
- 2 They are all part of the same homologous series.
- 3 They all have the same boiling point.

- A** 1, 2 and 3      **B** 1 and 2 only      **C** 1 and 3 only      **D** 2 and 3 only

- 38 The diagram shows a reaction sequence.



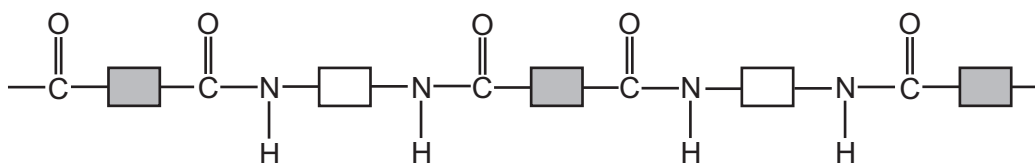
Which row names the processes X, Y and Z?

	X	Y	Z
<b>A</b>	cracking	fermentation	respiration
<b>B</b>	cracking	hydration	combustion
<b>C</b>	distillation	fermentation	respiration
<b>D</b>	distillation	hydration	combustion

- 39 Which pair of compounds can be used to prepare  $\text{CH}_3\text{CH}_2\text{COOCH}_2\text{CH}_3$ ?

- A** ethanoic acid and ethanol  
**B** ethanoic acid and propanol  
**C** propanoic acid and ethanol  
**D** propanoic acid and propanol

40 The structure of a synthetic polymer is shown.



The structure shows that it is a .....1..... . It is formed by .....2..... polymerization.

Which words complete gaps 1 and 2?

	1	2
<b>A</b>	polyamide	addition
<b>B</b>	polyamide	condensation
<b>C</b>	polyester	addition
<b>D</b>	polyester	condensation

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