Cambridge Assessment International Education

Cambridge IGCSE™

CHEMISTRY **0620/22**

Paper 2 Multiple Choice (Extended) **October/November 2023**

45 minutes

You must answer on the multiple choice answer sheet.

You will need: Multiple choice answer sheet
Soft clean eraser
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.

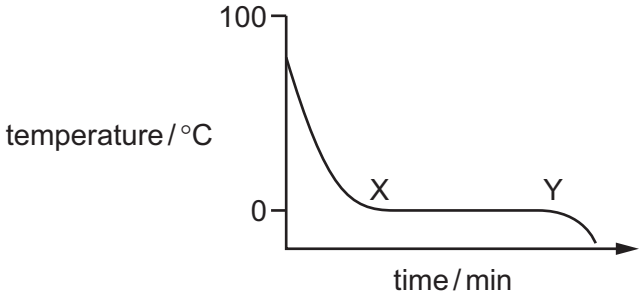
INFORMATION

- 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.

This document has **16** pages.

IB23 11_0620_22/4RP
© UCLES 2023

1 Part of a cooling curve for water is shown.



What is occurring between points X and Y?

A Steam is condensing into water.

B The temperature of the water is decreasing.

C Ice is melting.

D Particles are losing heat to the surroundings.

2 Which statements about clean, dry air are correct?

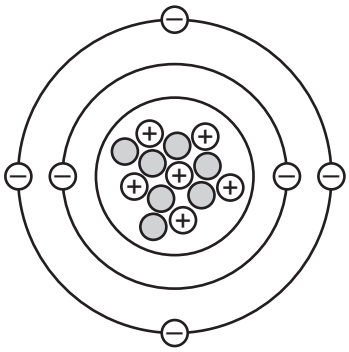
1 It is a mixture of elements only.

2 It is a mixture of elements and compounds.

3 It contains only non-metals.

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

3 A representation of an atom is shown.



What is the nucleon number of this atom?

A 6 **B** 7 **C** 12 **D** 13

4 The percentage abundances of three isotopes in a sample of neon are shown.

isotope	percentage abundance / %
$^{20}_{10}Ne$	90.48
$^{21}_{10}Ne$	0.27
$^{22}_{10}Ne$	9.25

What is the relative atomic mass, A_r, of this sample of neon?

A 10.19 **B** 20.19 **C** 21.00 **D** 30.19

5 Potassium reacts with iodine to form potassium iodide.

Which statement about potassium iodide is correct?

A Each potassium atom shares a pair of electrons with an iodine atom.

B In potassium iodide, the particles of potassium have more protons than electrons.

C Potassium iodide has a high melting point because it is a covalent compound.

D Potassium iodide has a low melting point because it is an ionic compound.

6 Which substance has the lowest melting point?

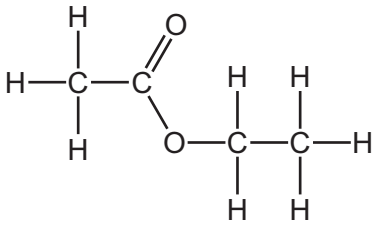
A graphite

B methanol

C silicon(IV) oxide

D sodium chloride

7 The diagram shows the structure of a molecule of ethyl ethanoate.



What is the molecular formula of a molecule of ethyl ethanoate?

A CHO **B** $C_4H_8O_2$ **C** $C_4(H_2)_2(O_2)$ **D** C_2H_4O

8 A hydrocarbon contains 85.7% of carbon by mass.

What is the empirical formula of the hydrocarbon?

A CH_2 **B** CH_4 **C** C_2H_5 **D** C_3H_6

9 The formula of a compound containing element X is $Na_2X_2O_3$.

The relative formula mass of the compound is 158.

What is the relative atomic mass of X?

A 32 **B** 59.5 **C** 64 **D** 119

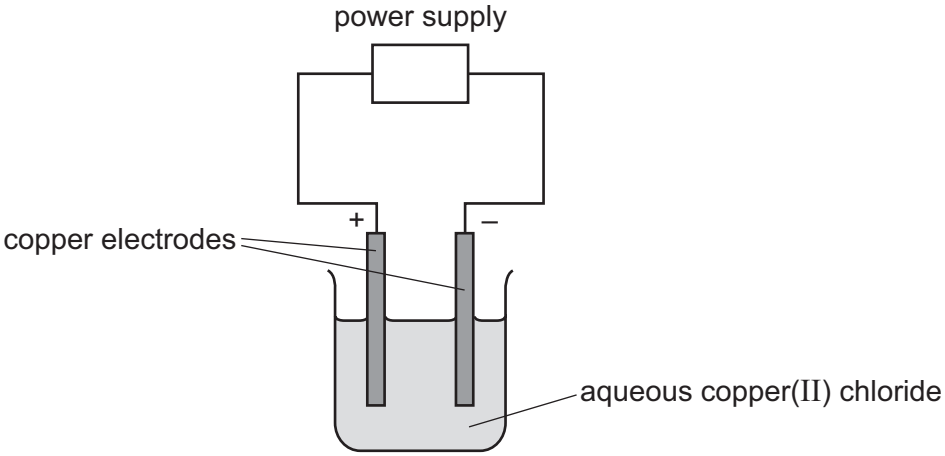
10 Dilute aqueous potassium chloride is electrolysed using platinum electrodes.

Which row identifies the product at each electrode?

	anode	cathode
A	chlorine	hydrogen
B	chlorine	potassium
C	oxygen	hydrogen
D	oxygen	potassium

© UCLES 2023

11 Concentrated aqueous copper(II) chloride is electrolysed using copper electrodes, as shown.



What happens to the mass of each electrode during this process?

	positive electrode	negative electrode
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

12 The initial and final temperatures of four different reactions are measured.

Which reaction is the **least** exothermic?

	initial temperature / °C	final temperature / °C
A	19	25
B	21	18
C	22	17
D	22	26

13 Which equation represents an endothermic reaction?

A $Cl_2(g) \rightarrow 2Cl(g)$

B $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$

C $H(g) + H(g) \rightarrow H_2(g)$

D $2K(s) + 2H_2O(l) \rightarrow 2KOH(aq) + H_2(g)$

14 Methane burns in oxygen to form carbon dioxide and water.

$$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$$

The bond energies are shown.

bond	bond energy in kJ / mol
C–H	410
C–O	360
C=O	805
O–H	460
O–O	146
O=O	496

What is the energy change for this reaction?

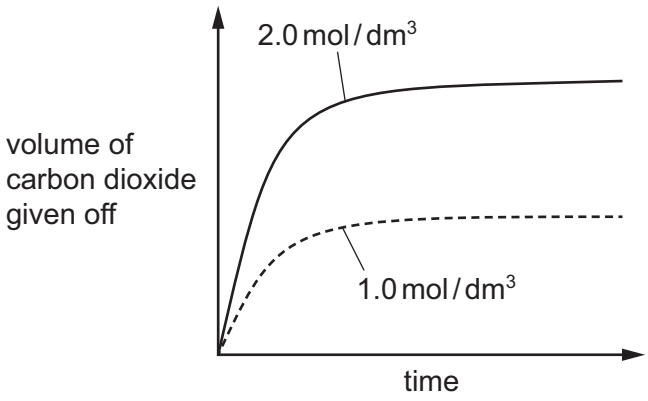
A –818 kJ / mol **B** –102 kJ / mol **C** +102 kJ / mol **D** +818 kJ / mol

© UCLES 2023

15 Hydrochloric acid is added to excess calcium carbonate in two separate experiments.

Two different concentrations of hydrochloric acid are used but the temperature is the same in both experiments.

The graph of the results shows the volume of carbon dioxide gas given off over time.



Which row is correct?

	particles in 2.0 mol / dm^3 compared to 1.0 mol / dm^3	
	collision rate	collision energy
A	higher	no change
B	higher	higher
C	lower	no change
D	lower	higher

16 The decomposition of dinitrogen tetroxide, N_2O_4, into nitrogen dioxide, NO_2, is a reversible reaction.

The equation for the reaction is shown.

$$N_2O_4(g) \rightleftharpoons 2NO_2(g)$$

The forward reaction is endothermic.

Which row shows the effect on the position of equilibrium and the rate of the reverse reaction when the temperature is increased?

	position of equilibrium	rate of the reverse reaction
A	shifts to the left	decreases
B	shifts to the left	increases
C	shifts to the right	decreases
D	shifts to the right	increases

17 In a blast furnace, iron(III) oxide is converted to iron and carbon monoxide is converted to carbon dioxide.

$$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$$

What happens to each of these reactants?

A Both iron(III) oxide and carbon monoxide are oxidised.

B Both iron(III) oxide and carbon monoxide are reduced.

C Iron(III) oxide is oxidised and carbon monoxide is reduced.

D Iron(III) oxide is reduced and carbon monoxide is oxidised.

18 Which row describes what happens to Fe^{2+} ions when they are oxidised?

	electron movement	oxidation number of iron
A	they gain electrons	decreases
B	they gain electrons	increases
C	they lose electrons	decreases
D	they lose electrons	increases

19 In which reaction does an acid react with a base?

A Dilute sulfuric acid is added to a piece of magnesium ribbon producing hydrogen.

B Dilute sulfuric acid is added to aqueous barium chloride producing a white precipitate of barium sulfate.

C Aqueous sodium hydroxide is added to aqueous copper(II) sulfate producing a blue precipitate of copper(II) hydroxide.

D Aqueous sodium hydroxide is added to solid ammonium sulfate producing gaseous ammonia.

20 Which element forms an oxide that reacts with an aqueous solution of a base?

A argon

B sulfur

C magnesium

D copper

© UCLES 2023

21 Which method is used to produce insoluble salts?

A addition of excess insoluble base to an acid

B addition of excess metal to an acid

C precipitation using two aqueous solutions

D titration using an acid and an alkali

22 The noble gases are in Group VIII of the Periodic Table.

Some properties of the first four noble gases are shown.

noble gas	boiling point in °C	density in g/dm^3
helium	–267	0.179
neon	–246	0.900
argon	–186	1.782
krypton	–152	3.708

Which row identifies the trends in boiling point and in density as Group VIII is descended?

	boiling point	density
A	decreasing	increasing
B	increasing	increasing
C	decreasing	decreasing
D	increasing	decreasing

23 Some properties of element R are shown.

melting point in °C	98
boiling point in °C	883
reaction with cold water	gives off H_2 gas
reaction when heated with oxygen	burns to give a white solid

In which part of the Periodic Table is R found?

A Group I

B Group VII

C Group VIII

D transition elements

24 Which pair of compounds shows that transition elements have variable oxidation states?

A Cr_2O_3 and $CrBr_3$

B $CuSO_4$ and $CuCl_2$

C Fe_2O_3 and $FeCl_2$

D NiO and $NiCl_2$

25 The list gives the order of some metals and hydrogen in the reactivity series.

Metal X is also included.

most reactive	K
	Mg
	Zn
	H
	X
least reactive	Cu

Which row shows the properties of metal X?

	reacts with dilute acids	oxide reduced by carbon
A	no	no
B	no	yes
C	yes	no
D	yes	yes

26 When zinc is added to an aqueous solution containing magnesium ions, there is no reaction.

Which species has the greatest tendency to lose electrons?

A Mg **B** Mg^{2+} **C** Zn **D** Zn^{2+}

27 Which gas in the air is needed for iron to rust?

A argon

B carbon dioxide

C nitrogen

D oxygen

28 Which coating prevents iron from rusting even when the coating is damaged?

A grease

B paint

C plastic

D zinc

29 Why is limestone added to the blast furnace?

A It neutralises the molten slag produced.

B It reacts with impurities to form slag.

C It releases carbon dioxide which reduces the iron(III) oxide.

D It removes acidic gases such as carbon dioxide.

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

What occurs at stages J and K?

	J	K
A	distillation	chlorination
B	distillation	filtration
C	filtration	chlorination
D	filtration	distillation

31 Carbon dioxide acts as a greenhouse gas by interacting with a particular type of energy that radiates from the Earth's surface into the atmosphere.

Which type of energy is involved and what happens when this energy interacts with carbon dioxide molecules?

	type of energy involved	what happens
A	thermal	carbon dioxide molecules increase the Earth's energy loss to space
B	thermal	carbon dioxide molecules absorb the energy
C	light	carbon dioxide molecules increase the Earth's energy loss to space
D	light	carbon dioxide molecules absorb the energy

32 Oxides of nitrogen, such as NO and NO_2, are formed in the petrol engines of cars.

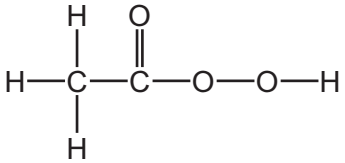
They are removed from the exhaust gases by reactions in the car's catalytic converter.

Which row describes how oxides of nitrogen are formed in a petrol engine and a reaction that happens in the catalytic converter?

	how oxides of nitrogen are formed	a reaction that happens in the catalytic converter
A	by the reaction between nitrogen and oxygen from the air	$2NO + 2CO \rightarrow N_2 + 2CO_2$
B	by the reaction between nitrogen and oxygen from the air	$2NO + 2H_2 \rightarrow N_2 + 2H_2O$
C	by the reaction between nitrogen compounds in petrol and oxygen from the air	$2NO + 2CO \rightarrow N_2 + 2CO_2$
D	by the reaction between nitrogen compounds in petrol and oxygen from the air	$2NO + 2H_2 \rightarrow N_2 + 2H_2O$

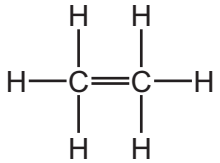
33 Which diagram shows the displayed formula for the named organic compound?

A



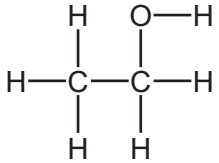
ethanoic acid

B



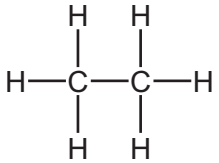
ethene

C



ethanol

D



methane

34 What is the total number of covalent bonds in a molecule of butane, C_4H_{10}?

A 3 **B** 10 **C** 13 **D** 14

35 Propane reacts with chlorine in a substitution reaction.

Which reaction condition is required for the reaction to occur?

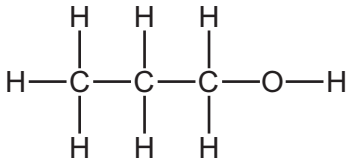
A acid catalyst

B iron catalyst

C temperature of 400 °C

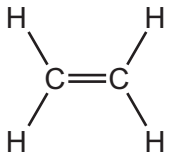
D ultraviolet light

36 The structure of an organic compound is shown.

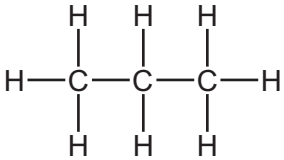


Which structure represents a molecule that reacts with steam to produce this product?

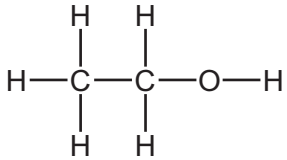
A



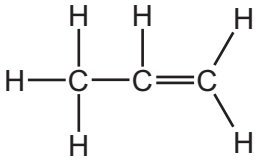
B



C



D



37 Which term describes nylon?

A addition polymer

B natural polymer

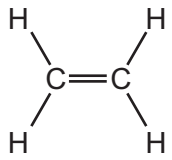
C polyamide

D polyester

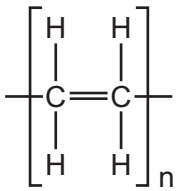
38 Ethene can be polymerised.

Which diagram represents the structure of the product formed?

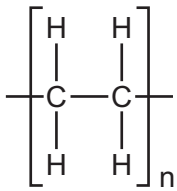
A



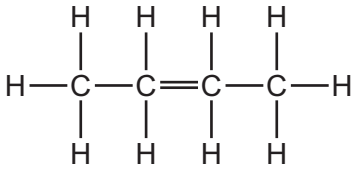
B



C



D



39 An acid–base titration is described.

- 25.0 cm^3 of dilute aqueous alkali is put into a conical flask.
- Indicator is added to the flask.
- Dilute acid is added to the aqueous alkali until the indicator changes colour.
- The volume of acid used is then recorded.

Which use of apparatus is correct?

A The 25.0 cm^3 of aqueous alkali is measured using a volumetric pipette.

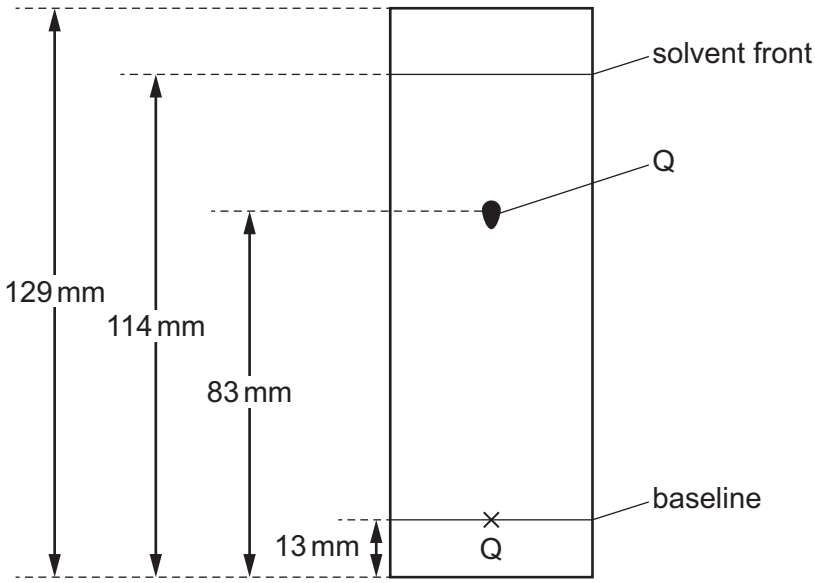
B The 25.0 cm^3 of aqueous alkali is measured using the lines on the conical flask.

C The volume of acid is measured using a measuring cylinder.

D The volume of acid is measured using a volumetric pipette.

40 Substance Q is investigated using chromatography.

The chromatogram is shown. The diagram is not drawn to scale.



What is the R_f value of Q?

A 0.60 **B** 0.64 **C** 0.69 **D** 0.72

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge Assessment International Education Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cambridgeinternational.org after the live examination series.

Cambridge Assessment International Education is part of Cambridge Assessment. Cambridge Assessment is the brand name of the University of Cambridge Local Examinations Syndicate (UCLES), which is a department of the University of Cambridge.

© UCLES 2023

The Periodic Table of Elements

Key

atomic number
atomic symbol
name
relative atomic mass

Group																	
I	II											III	IV	V	VI	VII	VIII
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium –	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57–71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89–103 actinoids	104 Rf rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –	113 Nh nihonium –	114 Fl flerovium –	115 Mc moscovium –	116 Lv livermorium –	117 Ts tennessine –	118 Og oganesson –

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 europium 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
actinoids	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 dm^3 at room temperature and pressure (r.t.p.).

© UCLES 2023