

6092/01
CHEMISTRY

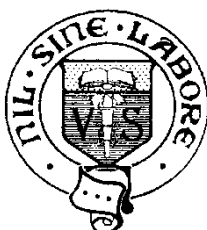
20/4PE/6092/1

PAPER 1

Wednesday

16 September 2020

1 hour

[illegible]

VICTORIA SCHOOL

PRELIMINARY EXAMINATION SECONDARY FOUR

Additional materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Write your name, class and index number on all the work you hand in.

Do not use staples, paper clips, glue or correction fluid.

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 that 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.

The use of an approved scientific calculator is expected, where appropriate.

A copy of Periodic Table is printed on **page 20**.

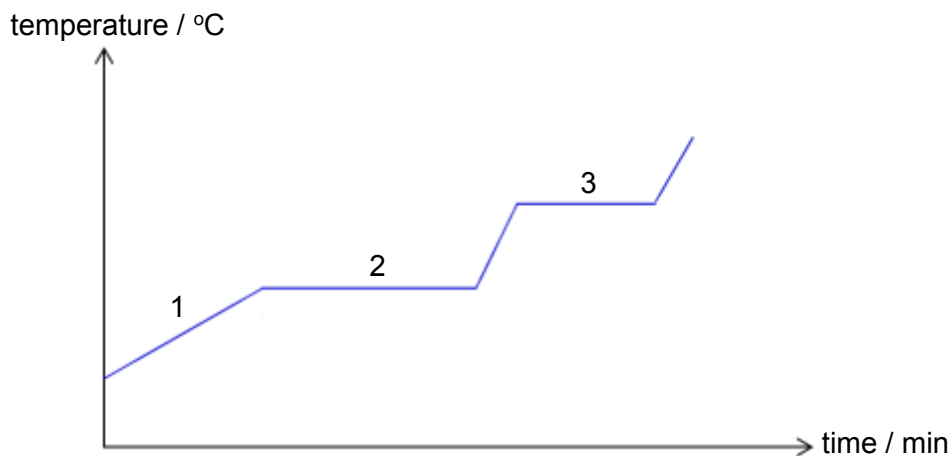
Setter: Lyana Y.

This question paper consists of 20 printed pages, including the cover page.

[Turn Over

2

- 1 The graph below shows the changes in temperature when a mixture containing equal volumes of X (boiling point 78 °C) and Y (boiling point 108 °C) is heated and separated by fractional distillation.

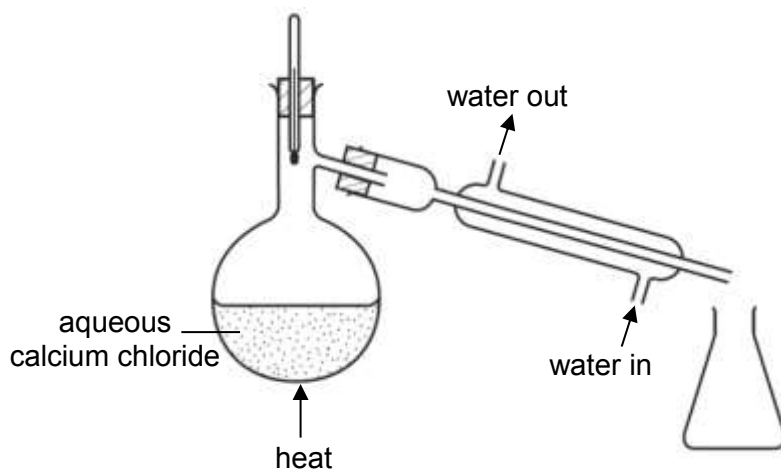


Which of the following describes the concentration of vapours X and Y correctly?

section	concentration of vapours
1	equal X and Y in the distilling flask
2	more X than Y in the condenser
3	more X than Y in the condenser

- A** 2 only
B 1 and 2 only
C 2 and 3 only
D 1, 2 and 3
- 2 Which group of substances contains an element, a mixture and a compound?
- A** air, bronze, sodium chloride
B air, sulfur, copper(II) sulfate
C sulfur, magnesium, bronze
D sulfur, copper(II) sulfate, sodium chloride

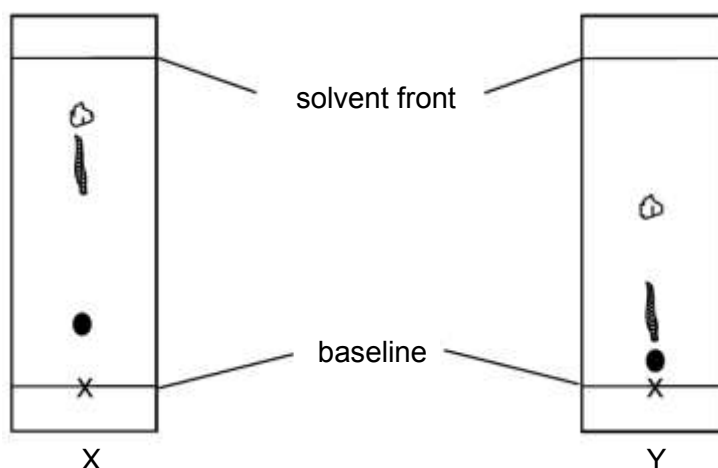
- 3 Aqueous calcium chloride is distilled as shown in the diagram below.



What is the temperature shown by the thermometer and what is left in the distillation flask?

	temperature reading / °C	final contents of distillation flask
A	97	no residue
B	100	white residue
C	103	no residue
D	106	white residue

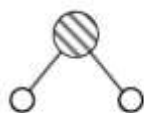
- 4 Two students performed paper chromatography to identify the dyes present in a paint sample. The two chromatograms, X and Y, are shown below.



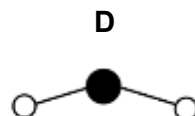
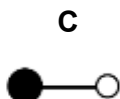
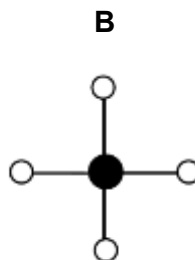
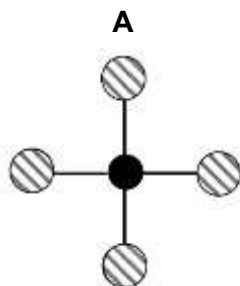
What is a possible explanation for the difference in the two chromatograms?

- A** A more concentrated sample was placed on the baseline of chromatogram X.
- B** A smaller sample size was placed on the baseline of chromatogram Y.
- C** Different solvents were used for chromatograms X and Y.
- D** The experiment was performed for a longer period of time for chromatogram X.

- 5 Which of the following describes the trend of the elements across Period 3 of the Periodic Table?
- 1 decrease in metallic character
 - 2 increase in atomic radius
 - 3 increase in number of valence electrons
- A 2 only
 B 1 and 2 only
 C 1 and 3 only
 D 1, 2 and 3
- 6 Which of the following statements correctly describes the sub-atomic particles present in a germanium atom, $^{70}_{32}\text{Ge}$?
- 1 It has the same number of electrons as a $^{79}_{34}\text{Se}^{2+}$ ion.
 - 2 It has the same number of neutrons as a $^{68}_{30}\text{Zn}$ atom.
 - 3 It has twice the number of protons as a $^{32}_{16}\text{S}^{2-}$ ion.
- A 1 and 2 only
 B 1 and 3 only
 C 2 and 3 only
 D 1, 2 and 3
- 7 The structural diagrams of two molecules, X_2Y and ZY_2 , are shown below.

 X_2Y  ZY_2

Which of the following represents a molecule of a compound formed between X and Z?



- 8 The formula of the nitride of element X is XN .

What is the formula of a compound formed between X and an oxalate ion, $\text{C}_2\text{O}_4^{2-}$?

- A** XC_2O_4
B $\text{X}(\text{C}_2\text{O}_4)_2$
C $\text{X}_2(\text{C}_2\text{O}_4)_3$
D $\text{X}_3\text{C}_2\text{O}_4$

- 9 Elements X, Y and Z are in the same period of the Periodic Table.

The properties of the oxides formed by these elements are shown below.

oxide X	dissolves in dilute hydrochloric acid
oxide Y	dissolves in aqueous sodium hydroxide
oxide Z	dissolves in both dilute hydrochloric acid and aqueous sodium hydroxide

What is the order of the elements X, Y and Z in increasing atomic number?

- A** X, Y, Z
B X, Z, Y
C Y, X, Z
D Y, Z, X

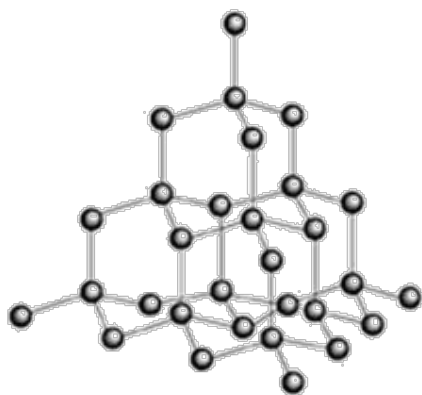
- 10 The table below shows the electrical conductivities of substances W – Z.

substance	electrical conductivity
W	does not conduct under any conditions
X	conducts only in aqueous solution
Y	conducts in both molten and solid states
Z	conducts in both molten and aqueous states

What are the possible identities of substances W – Z?

	W	X	Y	Z
A	AgCl	S	NaCl	Pb
B	HCl	NaCl	C	AgCl
C	S	HCl	Pb	AgCl
D	S	HCl	Pb	NaCl

- 11 The diagrams below show the structures of diamond and graphene, made up of carbon atoms in different arrangements.



diamond



graphene

Which of the following shows the correct properties of diamond and graphene?

	diamond	graphene
A	good electrical conductor	poor electrical conductor
B	poor electrical conductor	poor electrical conductor
C	high melting point	high melting point
D	low melting point	high melting point

- 12 The table below shows the range of colours of an indicator at different pH values.

pH	colour
0 – 2.5	red
2.6 – 5.0	yellow
5.1 – 7.0	orange
7.1 – 14.0	green

Which pair of substances can be distinguished using the indicator above?

- A** aqueous ammonia and aqueous potassium hydroxide
- B** dilute hydrochloric acid and dilute sulfuric acid
- C** dilute hydrochloric acid and water
- D** water and aqueous potassium chloride

- 13** Which of the following statements correctly describes two strong acids, HX and H₂Y, of the same concentration?

- 1 H₂Y has a lower pH than HX.
- 2 The rate of production of carbon dioxide is faster for H₂Y than HX when equal volumes of both acids are reacted with sodium carbonate.
- 3 More hydrogen gas is produced for HX than H₂Y when equal volumes of both acids are reacted with excess magnesium.

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

- 14** The table below shows 3 experiments in which different reactants were added to dilute sulfuric acid to prepare different salts.

experiment	reactant	salt
1	calcium oxide	calcium sulfate
2	zinc oxide	zinc sulfate
3	potassium hydroxide	potassium sulfate

Which experiments will produce a high yield of the salt?

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

- 15** Which air pollutant is correctly matched with its source and effect?

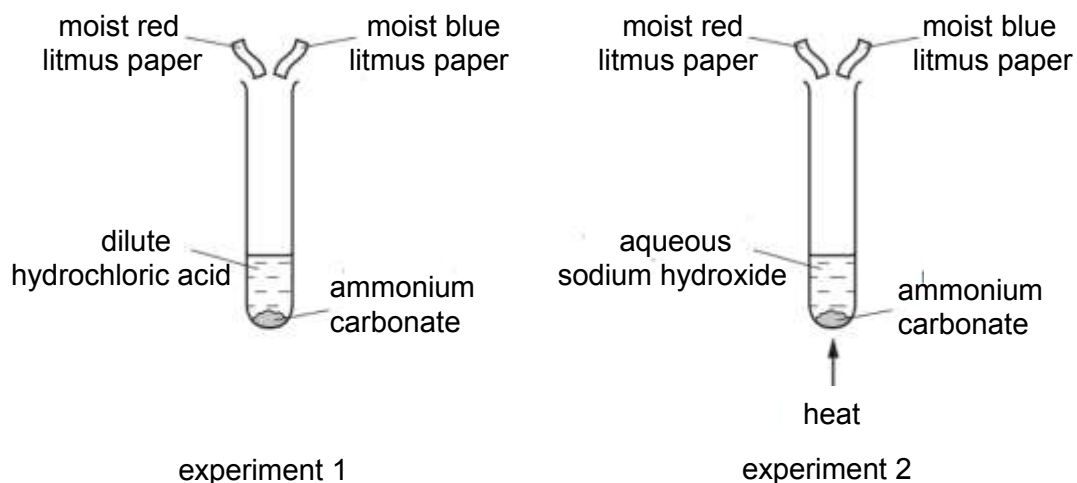
	air pollutant	source	effect
A	carbon monoxide	combustion of fuels	global warming
B	nitrogen dioxide	car engines	acid rain
C	ozone	photochemical smog	ozone layer depletion
D	sulfur dioxide	lightning activity	acid rain

16 Two experiments were carried out as shown in the diagram below.

In experiment 1, ammonium carbonate was added to dilute hydrochloric acid.

In experiment 2, ammonium carbonate was added to aqueous sodium hydroxide.

The gases evolved from both experiments were tested with moist litmus papers.



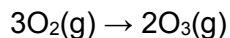
Which of the following indicates the colours of the moist litmus papers at the end of the reaction?

	1	2
A	blue	blue
B	blue	red
C	red	blue
D	red	red

17 Which of the following is numerically equal to the Avogadro constant?

- A** number of atoms in 1 mole of hydrogen gas, H_2
- B** number of electrons in 1 mole of helium gas, He
- C** number of ions in 1 mole of sodium chloride, NaCl
- D** number of molecules in 1 mole of oxygen gas, O_2

- 18 Oxygen gas can be converted into ozone by passing it through an electric discharge.



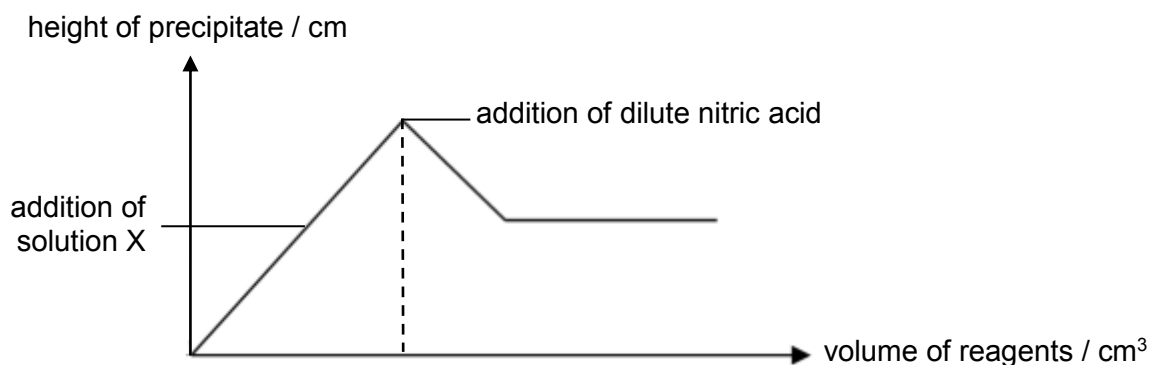
In an experiment, 300 cm³ of oxygen gas was used but only 10% was converted into ozone.

What is the total volume of gases present at the end of the experiment?

- A 200 cm³
- B 210 cm³
- C 290 cm³
- D 300 cm³

- 19 The graph below shows how the height of the precipitate formed changes when solution X is gradually added to solution Y.

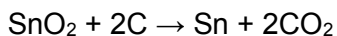
The height of the precipitate then decreases when dilute nitric acid is added to the mixture.



What can be solution X and the anions present in solution Y?

	solution X	anions in Y
A	aqueous barium nitrate	chloride, carbonate
B	aqueous barium nitrate	iodide, sulfate
C	aqueous silver nitrate	chloride, carbonate
D	aqueous silver nitrate	iodide, sulfate

- 20** Tin is extracted from its ore, SnO_2 , by reducing it with carbon in a furnace. The equation for the reaction is shown below.



What is the percentage purity of tin ore if 600 g of the tin ore is reduced to produce 82 g of tin?

[A_r of Sn: 119, M_r of SnO_2 : 151]

- A** $\frac{82}{119} \times \frac{151}{600} \times 100$
- B** $\frac{82}{119} \times \frac{600}{151} \times 100$
- C** $\frac{119}{82} \times \frac{151}{600} \times 100$
- D** $\frac{119}{82} \times \frac{600}{151} \times 100$
- 21** Which equation shows the greatest change in oxidation number for nitrogen?
- A** $4\text{NH}_3 + 5\text{O}_2 \rightarrow 4\text{NO} + 6\text{H}_2\text{O}$
- B** $3\text{NO}_2 + \text{H}_2\text{O} \rightarrow 2\text{HNO}_3 + \text{NO}$
- C** $2\text{NO} + \text{O}_2 \rightarrow 2\text{NO}_2$
- D** $4\text{NH}_3 + 6\text{NO} \rightarrow 5\text{N}_2 + 6\text{H}_2\text{O}$
- 22** Hydrogen peroxide was added separately to aqueous potassium iodide and acidified potassium manganate(VII).

The iodide ions were oxidised and the manganate(VII) ions were reduced.

Which of the following shows the correct colour changes that had taken place?

	potassium iodide	potassium manganate(VII)
A	brown to colourless	orange to green
B	brown to colourless	purple to colourless
C	colourless to brown	orange to green
D	colourless to brown	purple to colourless

- 23** The table below shows the results when halogens X, Y and Z are added to different halide solutions containing X^- , Y^- and Z^- ions.

halogen	$X^-(aq)$	$Y^-(aq)$	$Z^-(aq)$
X_2	-	no reaction	no reaction
Y_2	X_2 formed	-	Z_2 formed
Z_2	X_2 formed	no reaction	-

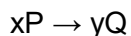
Which of the following shows the halide ions in decreasing order of their strength as reducing agents?

- A** X^- , Y^- , Z^-
B X^- , Z^- , Y^-
C Y^- , Z^- , X^-
D Z^- , X^- , Y^-

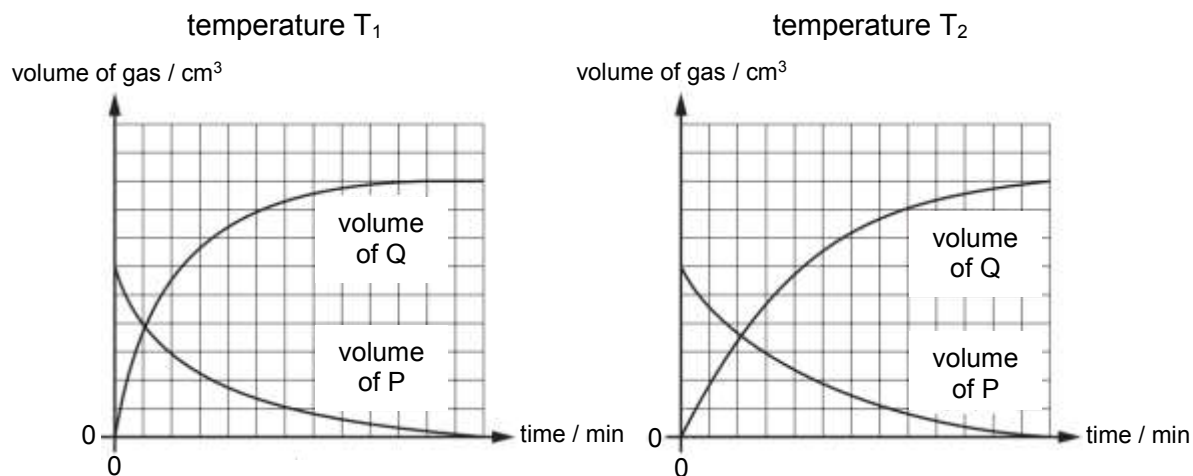
- 24** Which of the following substances is likely to be a transition metal?

	melting point / $^{\circ}C$	density / $g\ cm^{-3}$	number of chlorides
A	-7	3.10	2
B	113	2.07	1
C	1083	8.92	2
D	1521	1.12	1

- 25 Gas P decomposes to form gas Q as shown in the equation below.



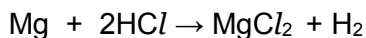
Two experiments are conducted to investigate how different temperatures affect the rate of decomposition of gas P. The results of the experiments are shown below.



Which of the following is correct?

	x	y	temperature
A	2	3	T ₁ is higher than T ₂
B	2	3	T ₂ is higher than T ₁
C	3	2	T ₁ is higher than T ₂
D	3	2	T ₂ is higher than T ₁

- 26 The volume of gas produced from the reaction between 0.400 g of powdered magnesium and 100 cm³ of 0.100 mol dm⁻³ dilute hydrochloric acid was recorded at regular intervals as shown in the table below.



time / s	30	60	90	120	150	180	210	240
volume of gas / cm ³	44	70	88	101	110	116	120	120

Which of the following explains the reaction correctly?

	number of collisions over time	end of reaction
A	fewer collisions between reacting particles	magnesium is used up
B	fewer collisions between reacting particles	hydrochloric acid is used up
C	more collisions between reacting particles	magnesium is used up
D	more collisions between reacting particles	hydrochloric acid is used up

27 Some reactions and bond energy values are shown in the table below.

- 1 $\text{Br}_2 \rightarrow 2\text{Br}$
- 2 $2\text{Cl} \rightarrow \text{Cl}_2$
- 3 $\text{CH}_3 + \text{Cl} \rightarrow \text{CH}_3\text{Cl}$
- 4 $\text{CH}_4 \rightarrow \text{CH}_3 + \text{H}$

bond	bond energy / kJ mol^{-1}
C – H	410
C – Cl	340
Cl – Cl	244
Br – Br	193

What is the order of the enthalpy change of the reactions from the most exothermic to the most endothermic?

- A** 1, 2, 3, 4
- B** 2, 3, 4, 1
- C** 3, 2, 1, 4
- D** 4, 1, 2, 3

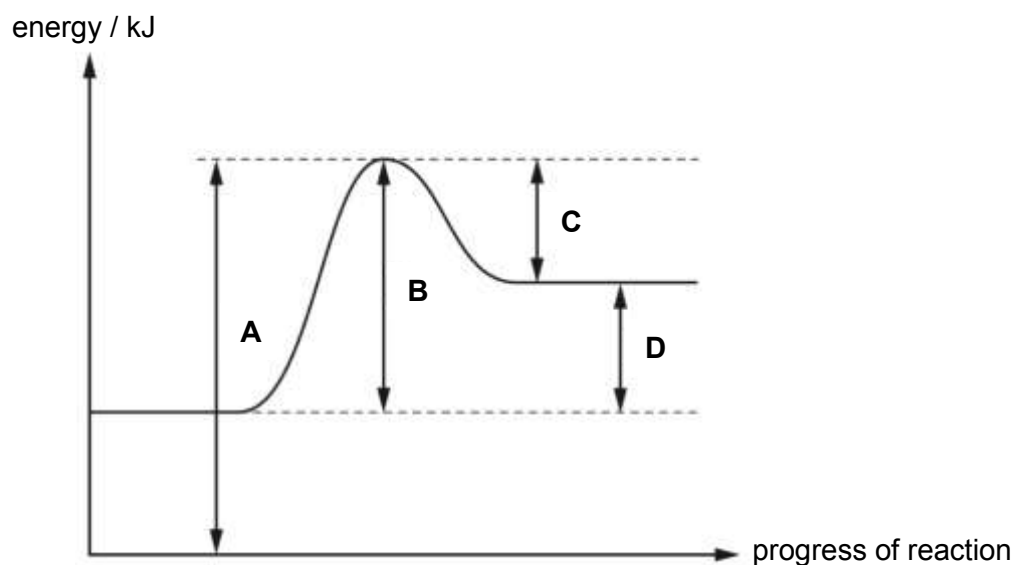
28 Ammonia gas is produced industrially during the Haber Process.

Which of the following statements about the Haber Process is not correct?

- A** One of the reactants is obtained from liquefied air.
- B** The optimum pressure for the reaction is 450 atm.
- C** The catalyst remains unchanged at the end of the reaction.
- D** The reaction is reversible.

29 The diagram below shows the energy profile diagram of a reaction.

Which arrow represents the activation energy of an exothermic reaction?



30 Iron is extracted from its ore using the blast furnace.

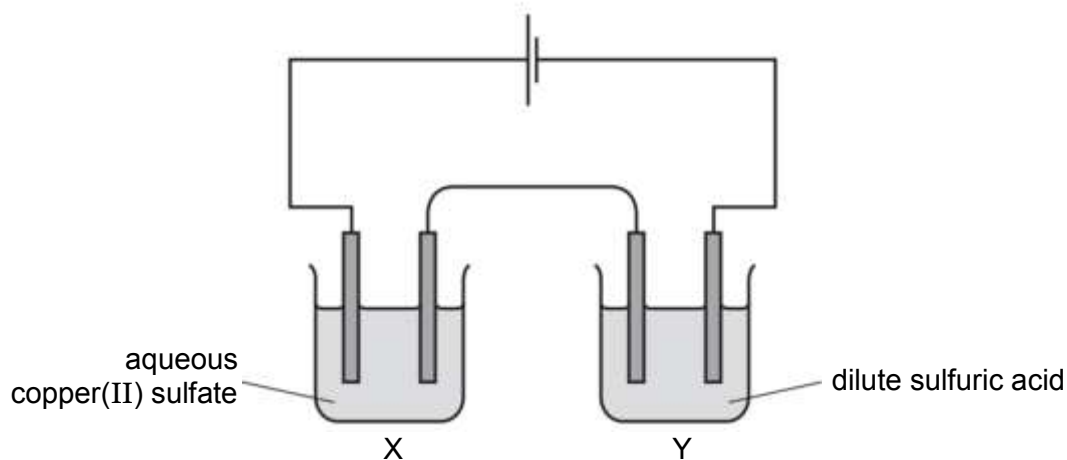
Which of the following statements about the blast furnace is not correct?

- A** Carbon monoxide is the reducing agent in the extraction of iron.
- B** Limestone is added to remove the sand present in iron ore.
- C** Molten slag is tapped off from the bottom of the furnace as it is denser.
- D** Nitrogen is one of the waste gases which escapes from the furnace.

31 Which of the following does not match the type of steel to its use?

	type of steel	use
A	low carbon steel	car bodies
B	low carbon steel	knives
C	stainless steel	cutlery
D	stainless steel	surgical instruments

- 32 The diagram below shows an electrolysis experiment using inert electrodes.



Which of the following indicates the concentration of the electrolytes in X and Y after some time?

	X	Y
A	unchanged	unchanged
B	unchanged	changes
C	changes	unchanged
D	changes	changes

- 33 Samples of solid magnesium carbonate were placed in crucibles X and Y.

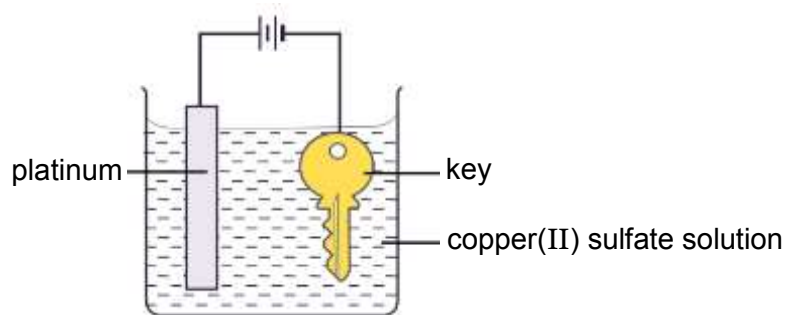
Crucible X was heated strongly until there was no further change in mass while crucible Y was not heated.

Dilute hydrochloric acid was then added to both crucibles.

Which of the following describes the observations in crucibles X and Y?

	X	Y
A	effervescence	effervescence
B	effervescence	no effervescence
C	no effervescence	effervescence
D	no effervescence	no effervescence

- 34 The diagram below shows the electroplating of a metal key using a platinum electrode.



The mass of the key before and after electroplating is shown in the table below.

mass of key before electroplating / g	23.6
mass of key after electroplating / g	24.4

What is the volume of gas liberated at the platinum electrode?

- A** 75 cm³
B 150 cm³
C 300 cm³
D 600 cm³

- 35 The table below shows the reactions of four metals, P, Q, R and S, with steam, dilute hydrochloric acid and cold water.

metal	reaction with		
	steam	dilute hydrochloric acid	cold water
P	no	yes	no
Q	yes	yes	yes
R	yes	yes	no
S	no	no	no

What is the arrangement of the four metals in decreasing order of reactivity?

- A** S, P, R, Q
B S, R, P, Q
C Q, P, R, S
D Q, R, P, S

- 36** The table below shows the changes in mass of an iron bar when it is placed in solutions X and Y.

solution	initial mass of iron bar / g	mass of iron bar after 20 minutes / g
X	6	5
Y	6	5

What are possible identities of solutions X and Y?

	X	Y
A	copper(II) sulfate	silver nitrate
B	dilute hydrochloric acid	sodium chloride
C	iron(II) chloride	calcium chloride
D	magnesium chloride	dilute sulfuric acid

- 37** The diagram below shows a boat made from iron.

Some magnesium blocks are attached to the iron below the water line.



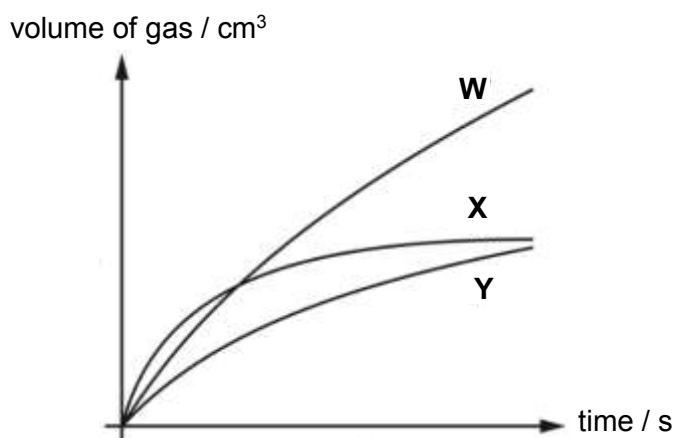
How does the magnesium stop the iron boat from rusting?

- A** Magnesium forms an alloy with the iron.
- B** Magnesium corrodes in preference to the iron.
- C** Magnesium prevents oxygen in the water from reacting with iron.
- D** Magnesium reacts to form a protective coating of magnesium oxide on the iron.

- 38** Three different experiments were conducted by reacting excess magnesium with equal volumes of dilute sulfuric acid.

experiment	reaction conditions
1	magnesium strip
2	magnesium powder
3	magnesium strip, acid concentration doubled

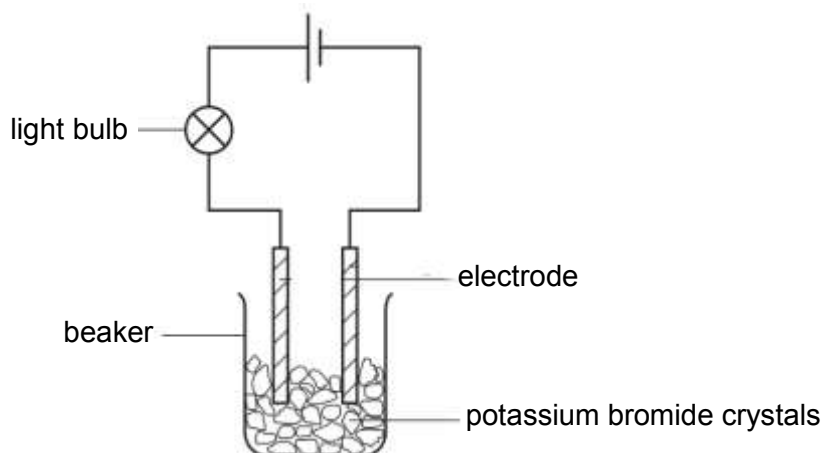
For each experiment, the volume of hydrogen gas produced was measured. The graphs for the three experiments are shown below.



Which of the following shows the graphs of the experiments 1, 2 and 3?

	1	2	3
A	W	X	Y
B	X	Y	W
C	Y	W	X
D	Y	X	W

- 39** The bulb in the set-up below did not light up when potassium bromide crystals were used. The bulb lighted up when distilled water was added to the beaker.

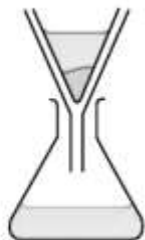


Which of the following statements best explains the above?

- A** Potassium bromide dissolves to form delocalised mobile electrons in the electrolyte.
 - B** Potassium bromide dissolves to form mobile ions in the electrolyte.
 - C** Water dissociates fully to form mobile ions in the electrolyte.
 - D** Water molecules move to conduct electricity in the electrolyte.
- 40** Which apparatus is necessary to prepare a pure and dry sample of copper(II) sulfate crystals?



1



2



3

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

End of Paper

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The Periodic Table of Elements

Group																		
I	II	1 H hydrogen 1										III	IV	V	VI	VII	0	
Key proton (atomic) number atomic symbol name relative atomic mass																		
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 -	114 Fl flerovium -	116 Lv livermorium -				
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 dm³ at room temperature and pressure (r.t.p.).