

**PATHLIGHT SCHOOL
PRELIMINARY EXAMINATION
SECONDARY 4 EXPRESS/5 NORMAL (ACADEMIC)**

CHEMISTRY

6092/01

Paper 1 Multiple Choice

August 2020

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

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

Write your Centre number, index number and name on the Answer Sheet in the spaces provided unless this has been done for you.

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.

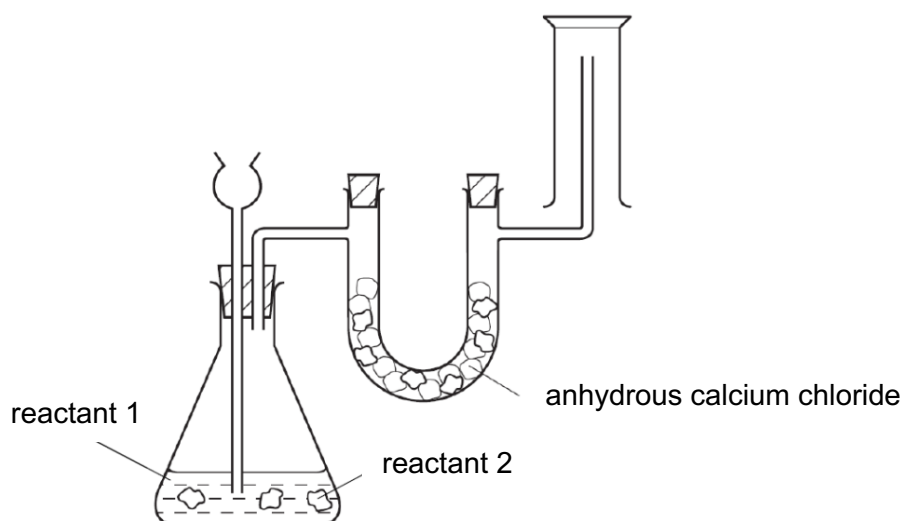
Read the instructions on the Answer Sheet very carefully.

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.

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

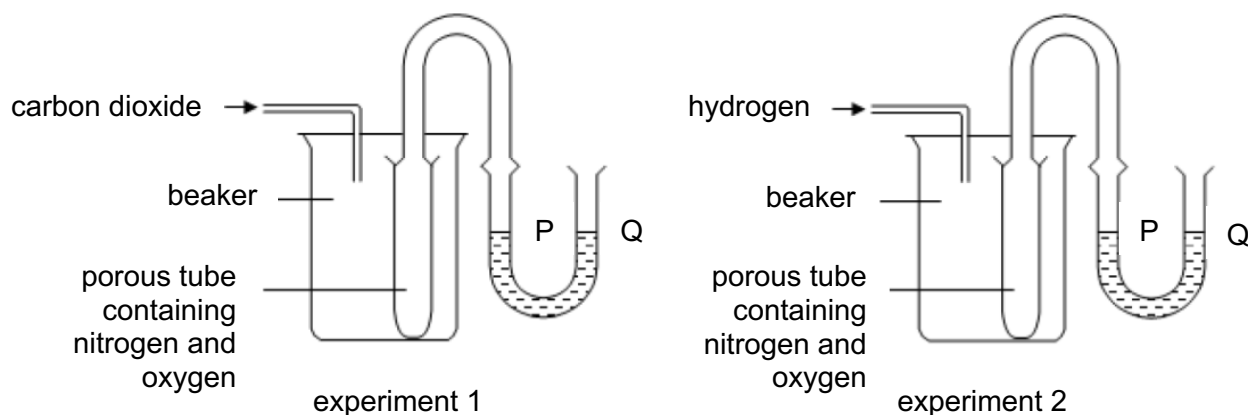
- 1 The diagram shows a simple laboratory apparatus for the preparation and collection of a dry gas.



Which row is correct?

	reactant 1	reactant 2	gas collected
A	aqueous hydrogen peroxide	manganese(IV) oxide	oxygen
B	dilute hydrochloric acid	manganese(IV) oxide	chlorine
C	dilute nitric acid	magnesium	hydrogen
D	dilute sulfuric acid	zinc carbonate	carbon dioxide

- 2 Two experimental set-ups shown below are used to demonstrate diffusion of gases. What changes, if any, to the water levels at P and Q would you expect to see in **both** experiments?



	experiment 1	experiment 2
A	P and Q remain the same	P and Q remain the same
B	P and Q remain the same	Q is higher than P
C	P is higher than Q	Q is higher than P
D	Q is higher than P	Q is higher than P

- 3 Some crystals of a compound were washed, filtered and dried. A melting point determination gave a value of 97°C . The same crystals were then washed and dried again. The melting point this time was found to be 120°C . Which of the following statement explains this observation?
- A** A smaller quantity of crystals was used for the first melting point determination.
B The crystals were impure when the first melting point determination was carried out.
C The crystals were impure when the second melting point determination was carried out.
D The thermometer was faulty and gave inconsistent results.
- 4 When a saturated solution of copper(II) sulfate is allowed to cool from 80°C to room temperature, crystals separate out from the solution.

The following statements were made about crystallisation.

- 1 The concentration of the solution remains the same.
 2 The mass of the dissolved copper(II) sulfate in the solution changes.
 3 The total number of moles of copper(II) sulfate in the mixture remains the same.
 4 The solubility of copper(II) sulfate decreases as the temperature falls.

Which statement(s) is/are correct?

- A** 1 and 2 only
B 1 and 3 only
C 2, 3 and 4 only
D 4 only
- 5 The following table contains information about solids V, W, X, Y and Z.

V is white. It is formed by burning magnesium in oxygen.	W is red and has a constant composition. It decomposes into two elements when heated.
X is coloured grey and is attracted to a magnet. It cannot be decomposed into anything simpler.	Y is speckled green and white. The green particles dissolve in water but the white particles do not.
Z is blue and dissolves in water. Its solution can be separated into three dyes by chromatography.	

Which of the following solids is a mixture?

- A** V and W only
B V, W, Y and Z only
C W, Y and Z
D Y and Z only

- 6 An element Z reacts with bromine to form a substance with a formula of ZBr_3 . The substance is a liquid at room temperature and boils at $50^\circ C$. What could be the electronic structure of Z?

- A** 2.1
B 2.3
C 2.8.5
D 2.8.8.7

- 7 The table below shows the proton and nucleon numbers of atoms P, Q, R and S.

atom	proton number	nucleon number
P	6	14
Q	7	14
R	16	32
S	20	40

Which of the following statements are true?

- Atom P and atom Q are isotopes.
- Atom P and atom R will combine to form a covalent compound.
- Atom Q and atom S will combine to form an ionic compound.
- One mole of the compound formed between atom R and atom S has a mass of 72 g.

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

- 8 The table shows details of the particles present in the following 4 atoms or ions.

atom/ion	number of neutrons	number of electrons
J^-	17	18
K	16	16
L^{2+}	20	18
M	20	17

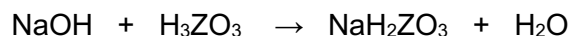
Which of the following atoms is an isotope of J?

- A** K
B L
C M
D none of above

- 9 Which of the following substances could be hydrogen chloride?

	melting point/ $^\circ C$	boiling point/ $^\circ C$	electrical conductivity	
			in molten state	in aqueous state
A	-100	-85	none	good
B	-114	78	none	none
C	190	280	none	insoluble
D	1081	1565	good	good

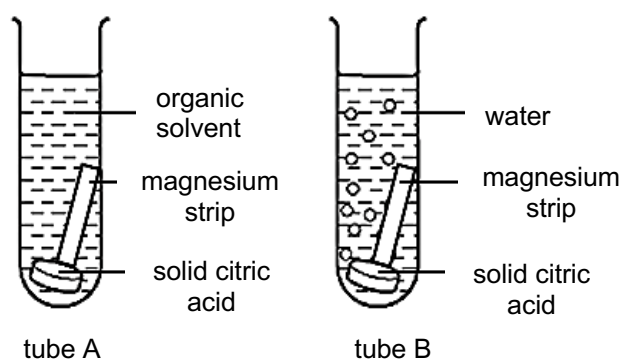
- 10 Complete combustion of a hydrocarbon produces 2.2 g of carbon dioxide and 0.9 g of water. Which of the following is likely to be the formula of this hydrocarbon?
- A** CH₄
B C₂H₄
C C₃H₈
D C₄H₁₀
- 11 The percentage composition by mass of a compound contains 18.05% carbon, 28.50% fluorine and 53.45% chlorine. Which of the following could be the molecular formula of the compound?
- A** CF₃Cl
B CF₂Cl₂
C C₂F₂Cl
D C₂F₂Cl₂
- 12 A solution contains 12.60 g/dm³ of the acid H₃ZO₃. 25.0 cm³ of this solution reacted with 25.0 cm³ of 0.100 mol/dm³ NaOH as shown in the equation.



What is element Z?

- | | |
|------------------|-------------------|
| A arsenic | B nitrogen |
| C silicon | D sulfur |
- 13 Which two processes are involved in the preparation of zinc sulfate crystals from dilute sulfuric acid and zinc oxide?
- A** neutralisation and filtration
B neutralisation and oxidation
C precipitation and filtration
D precipitation and oxidation
- 14 When lead is dropped into dilute sulfuric acid, bubbles of gas evolve at the beginning but eventually stop. What causes the reaction to stop?
- A** A layer of lead(II) oxide on the surface of the lead stops the lead from reacting with the acid.
B A layer of lead(II) sulfate forms around the metal and prevents any further reaction.
C Lead is above hydrogen in the reactivity series and does not react with dilute acid.
D The sulfuric acid is not concentrated enough for the reaction to proceed.

- 15 Two experiments were conducted to investigate the properties of a weak citric acid.



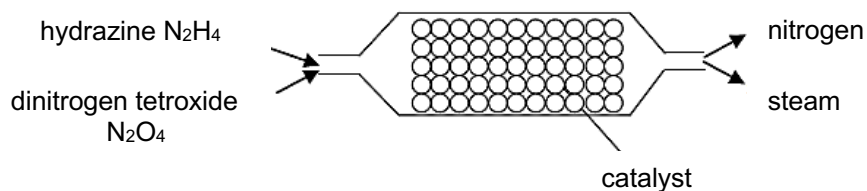
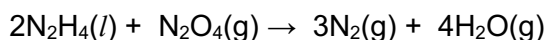
Effervescence was observed in tube B but **not** in tube A. What can be concluded from both experiments?

- A The organic solvent does not produce hydrogen ions.
 - B The organic solvent has similar bonding as the citric acid.
 - C Water is required for all chemical reactions.
 - D Water releases hydrogen ions in citric acid to react with the magnesium strip.
- 16 Bromine reacts with aqueous sodium hydroxide in a redox reaction.



Which statement about this reaction is **not** correct?

- A bromine changes from oxidation state 0 to oxidation state -1
 - B bromine changes from oxidation state 0 to oxidation state +1
 - C hydrogen changes from oxidation state -1 to oxidation state +1
 - D oxygen remains in oxidation state -2
- 17 A rocket can be fuelled by hydrazine burning with excess dinitrogen tetroxide. The reaction in the rocket engine is shown in the following diagram and equation.

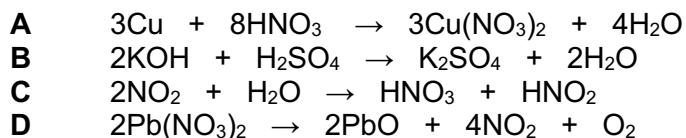


Which of the following take(s) place in the rocket engine?

- 1 The oxidation state of nitrogen increased from -2 in hydrazine to 0 in nitrogen.
- 2 3.5 moles of gaseous products were produced when 1 mole of hydrazine is used.
- 3 Endothermic reaction occurs.

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

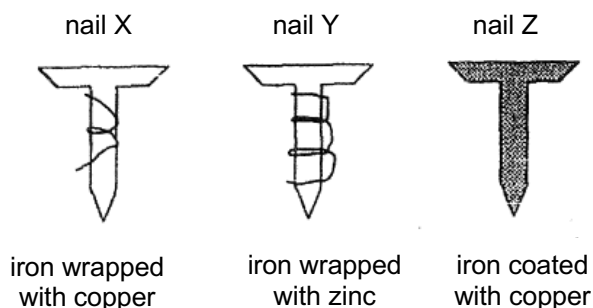
- 18 Disproportionation is a reaction in which the same element is both oxidized and reduced. Which reaction is an example of disproportionation?



- 19 Which of the following combinations below correctly states how the increase in the percentage of carbon in steel affects its properties?

	strength	malleability	melting point	brittleness
A	decrease	increase	increase	decrease
B	increase	decrease	increase	decrease
C	increase	decrease	decrease	increase
D	increase	increase	decrease	decrease

- 20 The diagram below shows an experiment to investigate rusting in iron nails.



Which of the nail(s) above will rust more quickly than iron that is **not** wrapped or coated?

- A** X only
B X and Y only
C Z only
D Y and Z only
- 21 W, X, Y and Z are metals. When various mixtures of one of the metals is heated with a metal oxide, the following results are obtained.

- oxide of Z + W $\rightarrow$ oxide of W + Z
- oxide of X + W $\rightarrow$ no reaction
- oxide of Z + Y $\rightarrow$ oxide of Y + Z
- oxide of W + Y $\rightarrow$ no reaction

Which of the following arrangements shows the metals W, X, Y and Z in order of increasing reactivity?

	least reactive	$\rightarrow$		most reactive
A	X	Y	W	Z
B	Y	Z	W	X
C	W	X	Y	Z
D	Z	Y	W	X

- 22** Three electrochemical cells are set up using copper metal and three unknown metals, U, V and W as electrodes, immersed in dilute sulfuric acid of the same concentration.

The potential differences between the metals are given in the table below.

electrochemical cell	metals used	voltage / V	positive electrode
1	Cu, U	-0.45	U
2	Cu, V	+1.11	Cu
3	Cu, W	+2.71	Cu

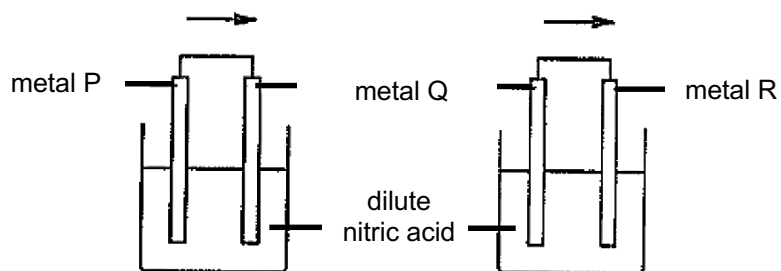
From these results, deduce which arrangement correctly list the metals in the order of decreasing ease of oxidation.

- A** U > V > Cu > W
B U > Cu > V > W
C W > V > U > Cu
D W > Cu > V > U
- 23** Three electrolytic cells are set up. Each cell uses inert electrodes. The electrolytes used for each cell are shown in the table below.

cell 1	concentrated sodium chloride solution
cell 2	molten sodium chloride
cell 3	dilute hydrochloric acid

In which cell(s) is/are a gas formed at both electrodes?

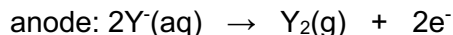
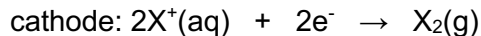
- A** 2 only
B 3 only
C 1 and 2
D 1 and 3
- 24** Two cells were set up as shown in the diagram. The arrow shows the direction of electron flow in the external circuit.



Which set of metals would give the electron flow in the direction shown?

	metal P	metal Q	metal R
A	Ag	Cu	Zn
B	Ag	Zn	Cu
C	Cu	Zn	Ag
D	Zn	Cu	Ag

- 25** A substance was electrolyzed using graphite electrodes and the ionic equations below show the reactions at the electrodes.



What is the identity of this substance?

- A** aqueous potassium chloride
B concentrated aqueous potassium bromide
C dilute sulfuric acid
D molten calcium chloride

- 26** The equations for thermal decomposition of four carbonates are given below.



A 10.0 g sample of each carbonate was heated for 15 minutes. Which carbonate produced the **greatest** mass of carbon dioxide?

- A** barium carbonate
B calcium carbonate
C magnesium carbonate
D strontium carbonate

- 27** The positions of four elements are shown in the outline of part of the Periodic Table.

Element X has a high melting point and is a good conductor of electricity. It forms chlorides XC and XC_2 . Which element is X?

[illegible]

- 28** Elements S and T are in Group VII of the Periodic Table. S is a liquid at room temperature. T is a solid at room temperature. Which statement(s) is/are correct?

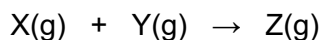
1	Atoms of T have more protons than atoms of S.
2	Molecules of T have more atoms than molecules of S.
3	T displaces S from aqueous solutions of S^- ions.

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

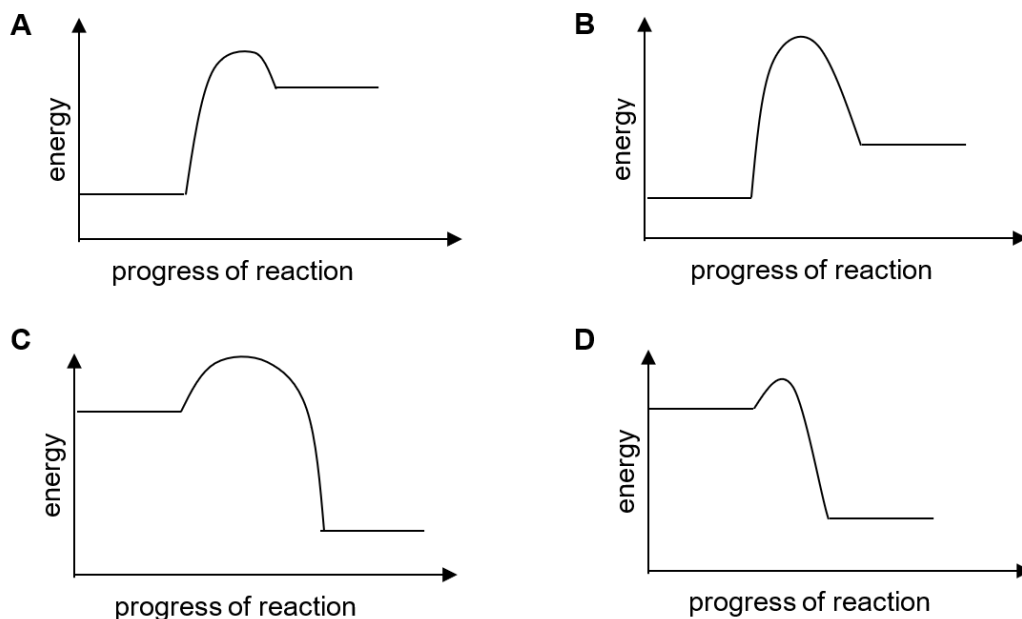
- 29 What is the effect of particle size of reactants on the activation energy and enthalpy change of a reaction?

	activation energy	enthalpy change
A	decreases	decreases
B	decreases	no change
C	no change	decreases
D	no change	no change

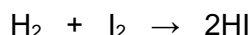
- 30 Four reactions represented by the equation are studied at room temperature and pressure.



Which is the correct energy profile diagram for the reaction that would proceed the most rapidly?



- 31 The formation of hydrogen iodide from hydrogen and iodine is an endothermic reaction as shown in the following equation.



Which statement can be deduced from this information?

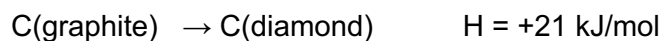
- A** The energy change in bond formation is less than that of bond breaking.
B The formation of H–I bonds absorbs energy.
C The number of bonds broken is more than the number of bonds formed.
D The product has less energy compared to the reactants.
- 32 Nitrogen(II) oxide and chlorine react accordingly to the equation shown below.



The activation energy for the forward reaction is 62 kJ.
 What is the activation energy for the reverse reaction?

- A** - 62 kJ
B 24 kJ
C 38 kJ
D 100 kJ

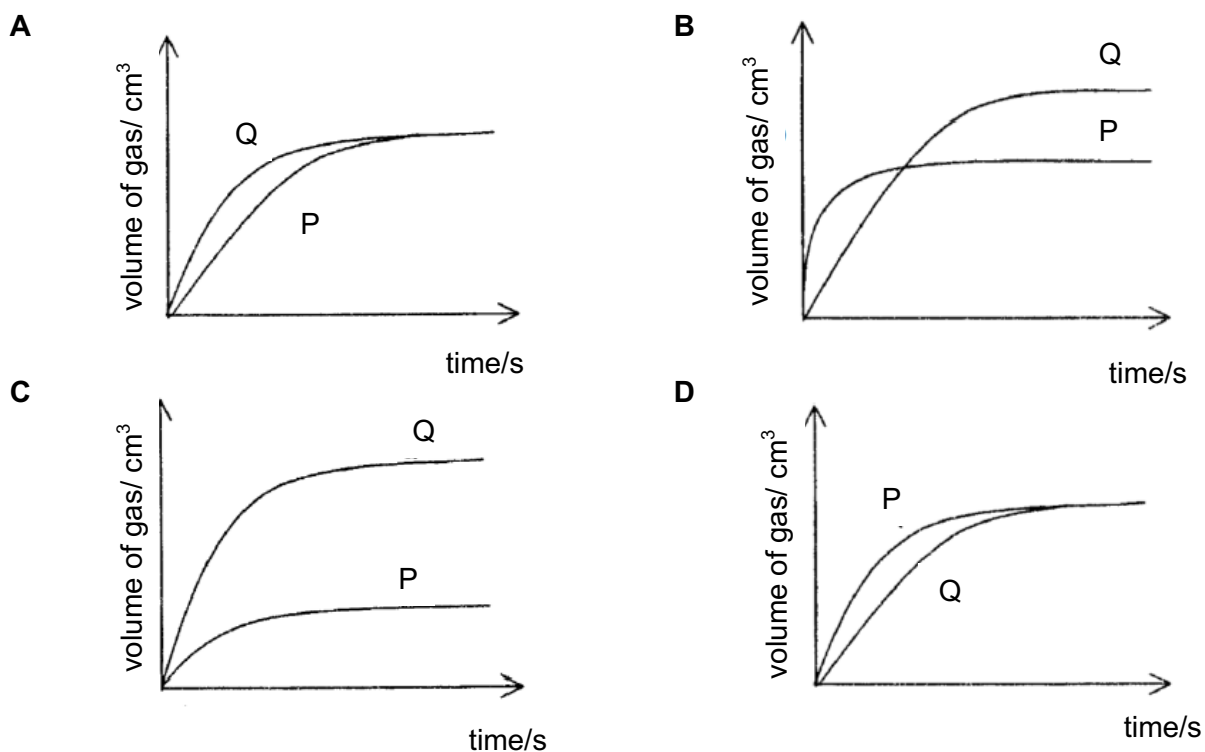
- 33 The conversion of graphite to diamond involves a small enthalpy change as shown.



However, the production of synthetic diamonds using this reaction is very difficult. Which statement helps to explain this?

- A Diamond has a larger number of covalent bonds than graphite.
 B Only exothermic reactions can occur readily.
 C The activation energy of the reaction is large.
 D The reaction between diamond and graphite is reversible.
- 34 The effect of temperature and concentration on the rate of reaction between excess solid zinc carbonate and dilute nitric acid was investigated. The table below shows the conditions used for the two experiments, P and Q. Which graph shows how the volume of gas varied with time in experiment P and Q?

experiment	temperature /°C	concentration of acid/ mol/dm ³	volume of acid used /cm ³
P	35	2.00	50
Q	25	1.00	150



- 35 The main reason farmers do **not** add calcium hydroxide and ammonium nitrate fertiliser to the soil at the same time is because

- A the calcium hydroxide prevents the absorption of fertiliser.
 B the fertiliser would lose nitrogen in the form of ammonia gas.
 C the soil would become too acidic.
 D the soil would become too alkaline.

- 36 An excess of aqueous lead(II) nitrate is added to aqueous barium chloride. The precipitate is removed by filtration. What are the main ions in the filtrate?

A Pb^{2+} and NO_3^- only
 B Ba^{2+} and NO_3^- only
 C Ba^{2+} , Cl^- and NO_3^-
 D Ba^{2+} , Pb^{2+} and NO_3^-

- 37 The table compares the properties of Group I elements with those of transition elements. Which row in the table is correct?

	Group I elements	transition elements
A	low catalytic activity	high catalytic activity
B	low electrical conductivity	high electrical conductivity
C	high density	low density
D	high melting point	low melting point

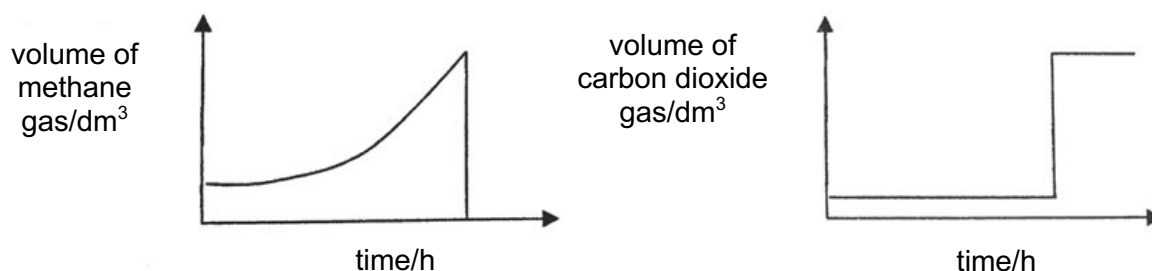
- 38 The table below shows the results of experiments that measure the volume of dilute sulfuric acid required to neutralise the mass of sodium hydroxide pellets dissolved in the volume of water given.

experiment	volume of sulfuric acid needed for neutralisation / cm^3	mass of sodium hydroxide / g	volume of water / cm^3
I	20	1	20
II	20	2	40
III	40	2	20
IV	V	1	40

From these results, what volume, V cm^3 of sulfuric acid is needed to neutralise the sodium hydroxide in the experiment IV?

A 10
 B 15
 C 20
 D 40

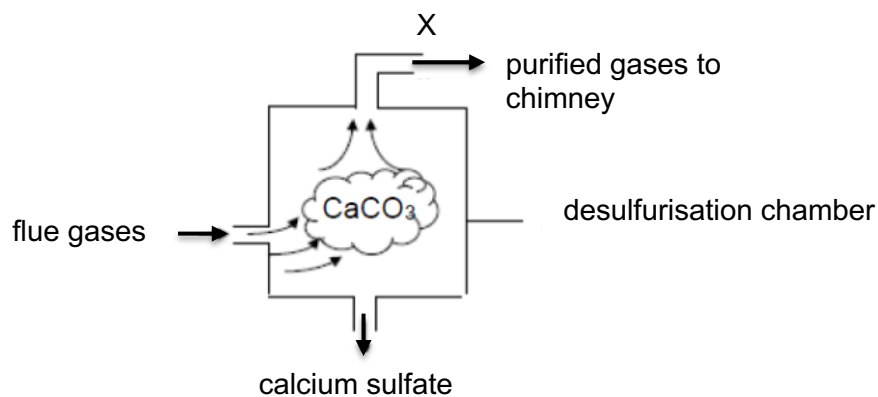
- 39 The graphs show how the volume of methane and carbon dioxide in air inside a coal mine changes with time.



What is likely to cause the sudden change shown in the graphs?

A A mixture of methane and air exploded.
 B Methane reacts with carbon dioxide in the coal mine.
 C The coal mine was ventilated by having fresh air being blown in.
 D The temperature in the coal mine was lowered in the night.

- 40 The diagram below shows a simplified process of desulfurisation.



Which of the following observations at outlet X best describes the nature of the purified gases?

- A** Gases formed white precipitate in limewater.
- B** Gases turned moist red litmus paper blue.
- C** Gases turned potassium iodide solution brown.
- D** Gases turned acidified potassium manganate(VII) colourless.

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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					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	50 Sn tin 119	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	82 Pb lead 207	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	euporium	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	–

actinoids

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