ZHONGHUA SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2020

SECONDARY 4E

Candidate's Name	Class	Register Number
	4E	

CHEMISTRY 6092/01

21 September 2020
1 hour

Additional Materials: OTAS

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

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

Write your name, index number and class on the OTAS in the spaces provided.

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 OTAS.

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.

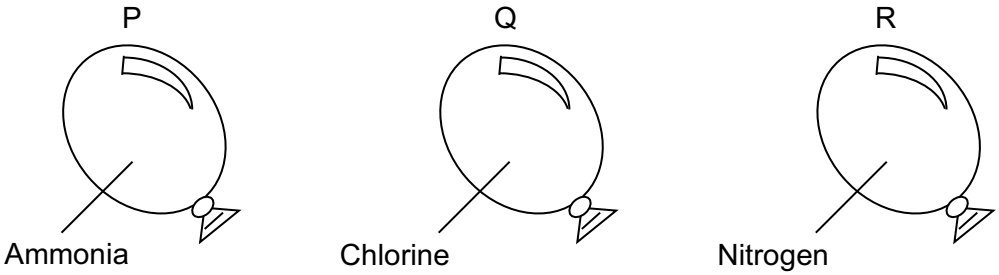
A copy of the Periodic Table is printed on page 15.

Setter: Ms Julia Yeo
Vetter: Ms Ong Lay Hong

This document consists of **15** printed pages, including this cover page.

[Turn over

1 Three balloons, P, Q and R, were inflated to the same size with three different gases, ammonia, chlorine and nitrogen.



Which is the correct order of the sizes of the balloons, starting with the biggest, after a period of 5 hours?

A P, Q, R **B** P, R, Q

C Q, R, P **D** Q, P, R

2 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?

1 Atom **P** and atom **Q** are isotopes.
2 Atom **P** and atom **R** will combine to form a covalent compound.
3 Atom **Q** and atom **S** will combine to form an ionic compound.
4 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 1, 3 and 4 **D** 2, 3 and 4

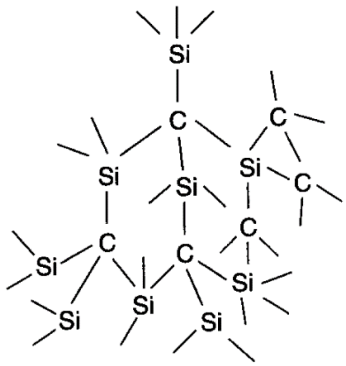
3 Phosphorus trichloride, PCl_3, is a molecule formed when the elements phosphorus and chlorine react together.

How many electrons in the outer shell of the phosphorus and chlorine atoms are not involved in bonding?

A 2 **B** 6

C 18 **D** 20

4 The diagram shows part of the structure of the compound silicon carbide. Which set of information about silicon carbide is correct?



	empirical formula	when strongly heated in oxygen
A	SiC	burns, giving a solid residue only
B	SiC	burns, giving a solid residue and a colourless gas
C	Si_2C	burns, leaving no solid residue
D	SiC_2	burns, giving a solid residue and a colourless gas

5 Which property of nitrogen is explained by the covalent bonds in its molecule?

A Its separation from liquid air by fractional distillation.

B The low reactivity of nitrogen.

C The acidity of nitrogen dioxide.

D The very low boiling point of nitrogen.

6 Cartoon hero, Steel Man, was famous for his shiny armour, a gold-titanium alloy, which allowed him to fly to Mars and back to Earth without melting.

Which of the following best describes the bonding which exists within the structure of his armour?

A Ions and atoms of gold and titanium are held by strong intermolecular forces.

B Ions and atoms of gold and titanium are held by strong attractive forces.

C Ions and electrons of gold and titanium are held by strong attractive forces.

D Ions, atoms and electrons of gold and titanium are held by strong attractive forces.

7 Ammonia burns in oxygen, forming nitrogen and water. The equation is shown below.

$$NH_3\ (g) + 3\ O_2\ (g) \rightarrow 2N_2\ (g) + 6\ H_2O\ (l)$$

If 40.0 cm^3 of ammonia is burnt in 60.0 cm^3 of oxygen, what will be the total volume of gases left after combustion at room temperature and pressure?

A 40.0 cm^3 **B** 60.0 cm^3

C 80.0 cm^3 **D** 100.0 cm^3

8 The fertiliser ammonium nitrate is manufactured from ammonia by a two-stage process.

stage 1 $NH_3 + 2O_2 \rightarrow HNO_3 + H_2O$

stage 2 $HNO_3 + NH_3 \rightarrow NH_4NO_3$

What is the maximum mass of fertiliser that can be made if 17 tonnes of ammonia is available?

A 34 tonnes **B** 40 tonnes

C 80 tonnes **D** 97 tonnes

9 In an experiment, 10.0 cm^3 of 0.01 mol/dm^3 copper(II) sulfate solution is mixed with 5.0 cm^3 of 0.01 mol/dm^3 sodium carbonate solution in a flask. The equation is shown below.

$$CuSO_4 + Na_2CO_3 \rightarrow Na_2SO_4 + CuCO_3$$

What is seen in the flask when the reaction was completed?

A A colourless solution only.

B A green precipitate and a blue solution.

C A green precipitate and a colourless solution.

D A white precipitate and a colourless solution.

10 When hydrogen peroxide is used as a bleaching agent, it decomposes to form water and oxygen.

$$2H_2O_2 \rightarrow 2H_2O + O_2$$

When 68 g of hydrogen peroxide decomposes, the volume of oxygen gas collected under room temperature and pressure is 1200 cm^3. What is the percentage purity of hydrogen peroxide?

A 2.5 %

B 5.0 %

C 10.0 %

D 15.0 %

11 A dilute aqueous solution of a strong acid, H**X**, contains molecules of water and the ions H^+ and $\mathbf{X}^-$. Which statement is correct?

A The pH value of the acid is above 7.

B The solution contains a high concentration of H**X** molecules.

C The solution also contains OH^- ions.

D The solution contains more H^+ ions than water molecules.

12 Some statements about acids are given.

1 a 1 mol/dm^3 solution of a strong acid will have a higher pH than a 1 mol/dm^3 solution of a weak acid.
2 pH gives a measure of the H^+ concentration in a solution.
3 universal indicator turns blue when placed in a solution of pH 5.
4 when acids react with metals, hydrogen ions gain electrons.

Which statements about acids are correct?

A 1 and 2

B 1 and 4

C 2 and 4

D 1, 2 and 3

13 Which of the following can be used to distinguish between aqueous zinc nitrate and aqueous calcium chloride?

1 aqueous sodium carbonate
2 aqueous lead(II) nitrate
3 dilute sulfuric acid

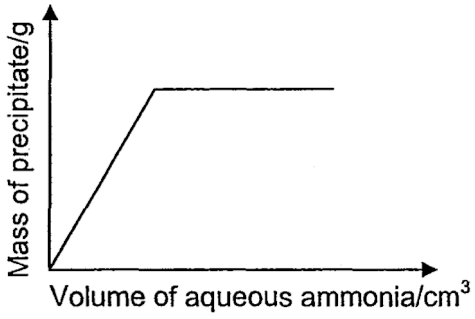
A 2 only

B 1 and 2

C 2 and 3

D 1, 2 and 3

14 An aqueous solution of a salt was placed in a test tube and aqueous ammonia was gradually added from a burette. The mass of the precipitate was obtained when various volumes of aqueous ammonia were added and a graph was obtained as shown.

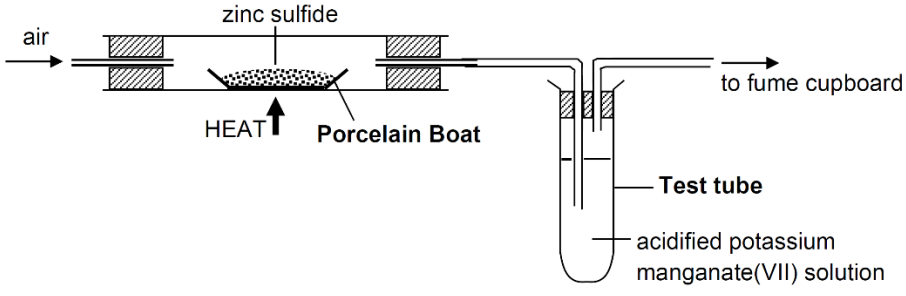


Which salt would show this behaviour?

A copper (II) nitrate **B** iron (II) sulfate

C sodium nitrate **D** zinc chloride

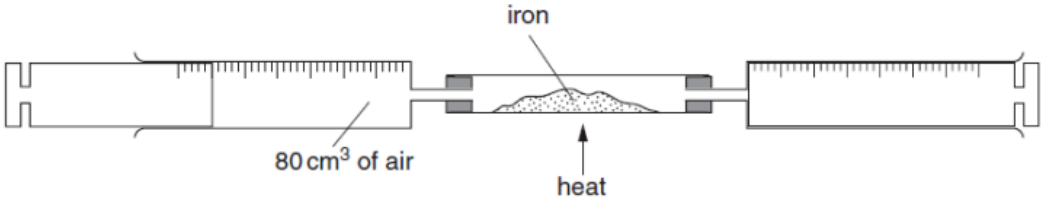
15 Zinc is extracted from its ore, zinc sulfide, which is heated in air to form zinc oxide. This was carried out in a laboratory using the apparatus shown.



What are the observations in the porcelain boat and test tube when zinc sulfide is heated?

	solid in porcelain boat	solution in test tube
A	turns yellow	turns colourless
B	turns yellow	remains purple
C	turns grey	remains purple
D	turns white	turns colourless

16 An 80 cm^3 sample of air is trapped in a syringe. The air is slowly passed over heated iron in a tube until there is no further decrease in volume.



When cooled to its original temperature, what is the volume of gas remaining in the syringe?

A 80 cm^3 **B** 64 cm^3

C 20 cm^3 **D** 16 cm^3

17 The statements below give some information about metals **R**, **S**, **T** and **U**.

- Carbonate of **U** does not decompose on heating.
- Only oxides of **R** and **T** can be reduced by heating with carbon.
- **R** and **S** react with dilute hydrochloric acid but not with cold water.
- **T** reacts with neither dilute hydrochloric acid nor water.

What is the order of increasing reactivity of the four metals?

A T < R < S < U

B T < S < R < U

C U < S < R < T

D U < T < R < S

18 Which pair of substance acts as reducing agents in the blast furnace?

A carbon and oxygen

B carbon monoxide and carbon dioxide

C carbon and carbon monoxide

D carbon dioxide and oxygen

19 Steel is an alloy with a very small percentage of carbon.

Which statement is correct?

A A decrease in the percentage of carbon makes the steel more brittle.

B An increase in the percentage of carbon makes the steel softer.

C Carbon disrupts the metallic structure of iron.

D Iron atoms are the same size as carbon atoms.

20 Metal **P** is more reactive than metal **Q** which is more reactive than metal **R**. The sulfates of **P** and **R** are colourless the sulfate of **Q** is blue.

Which observation is correct when a metal is added to a solution of sulfate?

	metal added	solution of sulfate	colour change
A	R	Q	blue to colourless
B	Q	P	colourless to blue
C	Q	R	blue to colourless
D	P	Q	blue to colourless

21 Which of the following statements regarding the element caesium (proton number 55) are correct?

1 It is a stronger reducing agent than potassium.
2 It reacts with chlorine to form an ionic compound.
3 It has a higher density than sodium.
4 It has a higher melting point than lithium.

A 1 and 2 **B** 1, 2 and 3

C 2 and 3 **D** 1, 2 and 4

22 Which of the following characteristics of elements in a period is incorrect?

A The elements on the left hand side of a period are metals.

B The reducing power of the elements decrease across the period.

C The elements on the right hand side of a period have the lowest melting point.

D When moving across a period, from left to right, the oxides change from acidic to basic.

23 In which of the following reactions does the oxidation state of nitrogen show the greatest increase?

A NH_3 (g) + HCl (g) → NH_4Cl (s)

B $2NH_3$ (g) + 3CuO (s) → N_2 (g) + 3Cu (s) + $3H_2O$ (l)

C $4NO_2$ (g) + O_2 (g) + $2H_2O$ (l) → $4HNO_3$ (l)

D $2NO_3^-$ (aq) + Cu (s) + $4H^+$ (aq) → $2NO_2$ (g) + Cu^{2+} (aq) + $2H_2O$ (l)

24 Which of the following are true for the reaction below?

$$2\ FeCl_3\ (aq) + H_2S\ (g) \rightarrow 2HCl\ (aq) + S\ (s) + 2FeCl_2\ (aq)$$

1 Hydrogen sulfide is reduced to hydrochloric acid.
2 Iron(III) ions gain electrons.
3 The solution changes in colour from yellow brown to pale green.
4 Oxidation state of sulfur decreases.

A 2 and 3 **B** 2 and 4

C 3 and 4 **D** 1, 2 and 3

25 The reaction in which the same reactant is both oxidised and reduced is called a *disproportionation* reaction.

Which equation is an example of a *disproportionation* reaction?

A $3Cu + 8HNO_3 \rightarrow 3Cu(NO_3)_2 + 2NO + 4H_2O$

B $Cl_2 + 2NaOH \rightarrow NaCl + NaOCl + H_2O$

C $Fe_2(SO_4)_3 + 2KI \rightarrow 2FeSO_4 + K_2SO_4 + I_2$

D $2Pb(NO_3)_2 \rightarrow 2PbO + 4NO_2 + O_2$

26 When fossil fuels are burnt in a motor car the following gases are emitted from the car's exhaust. Which gases are the result of incomplete combustion?

1 C_8H_{18}
2 CO
3 NO_2
4 SO_2

A 2 only **B** 1 and 2

C 2 and 3 **D** 3 and 4

27 What modifications to a catalytic converter would result in lower concentrations of nitrogen oxides?

A Using smaller exhaust pipes.

B An increase in the surface area of the catalyst in the converter.

C A higher temperature of combustion in the engines.

D An increase in the rate of flow of gas through the converter.

28 The equation for combustion of hydrogen is shown below.

$$2H_2\,(g) + O_2\,(g) \rightarrow 2H_2O\,(g)$$

bond	H – H	O – H	O = O	O – O
Bond energy in KJ/mol	436	463	498	146

What is the enthalpy change of this reaction?

A - 482 KJ/mol

B - 834 KJ/mol

C + 482 KJ/mol

D + 834 KJ/mol

29 The formation of hydrogen chloride from the reaction between hydrogen and chlorine causes the temperature to decrease.

$$H{-}H + Cl{-}Cl \rightarrow 2\ H{-}Cl$$

Which of the following statements is correct?

A The breaking of Cl−Cl bonds releases more energy than the breaking of H−H bonds.

B The number of bonds broken is greater than the number of bonds formed.

C The reactants possess less energy than the products.

D The total energy change in bond breaking is less than that in bond formation.

30 In an experiment, a quantity of electricity plated 0.12 mol of copper metal onto an object, from Cu^{2+} (aq). The same quantity of electricity plated 0.08 mol of gold onto an object. What is the formula of the gold ions?

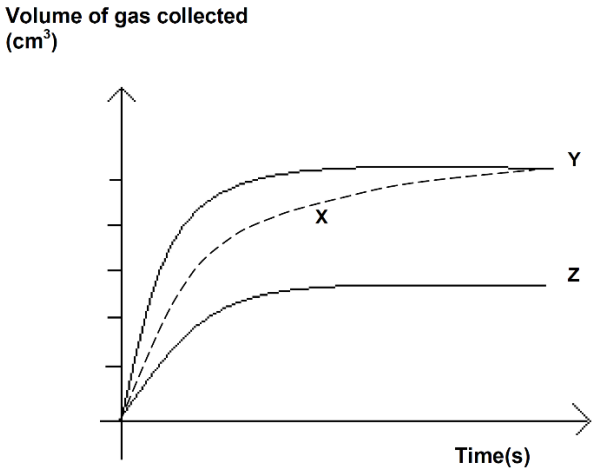
A Au^{+}

B Au^{2+}

C Au^{3+}

D Au^{4+}

31 In the graph, curve X represents the results of the reaction between 50 cm^3 of 0.10 mol/dm^3 dilute hydrochloric acid and excess calcium carbonate at 30 °C.



What are the changes that will produce curve Y and Z?

	curve Y	curve Z
A	50 cm^3 of 0.20 mol/dm^3 dilute HCl at 30 ºC	25 cm^3 of 0.10 mol/dm^3 dilute HCl at 30 ºC
B	50 cm^3 of 0.20 mol/dm^3 dilute HCl at 30 ºC	50 cm^3 of 0.05 mol/dm^3 dilute HCl at 30 ºC
C	50 cm^3 of 0.10 mol/dm^3 dilute HCl at 40 ºC	25 cm^3 of 0.10 mol/dm^3 dilute HCl at 30 ºC
D	50 cm^3 of 0.10 mol/dm^3 dilute HCl at 40 ºC	50 cm^3 of 0.05 mol/dm^3 dilute HCl at 30ºC

32 100 cm^3 of 1.0 mol/dm^3 hydrogen peroxide was left to decompose and the rate of decomposition and the volume of oxygen liberated were measured.

How would the rate of decomposition and the volume of oxygen produced be different if the experiment was repeated with some water added to it?

	rate of decomposition	volume of oxygen
A	decreased	unchanged
B	decreased	decreased
C	increased	increased
D	unchanged	decreased

33 Ammonia is manufactured by the Haber process. Which statement is incorrect?

A High pressure of 200 atm is used to increase yield.

B Each hydrogen molecule reacts with three nitrogen molecules to form two molecules of ammonia.

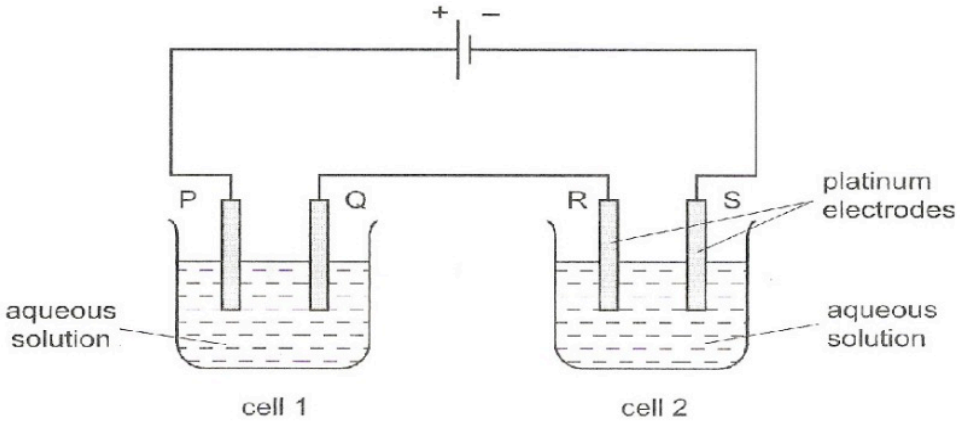
C A low temperature of 450 °C is used.

D The reaction is reversible.

34 A student tries to electroplate an iron ring with nickel. Which of the following combinations are correct?

	electrolyte	anode	cathode
A	iron(II) sulfate solution	iron ring	nickel rod
B	iron(II) sulfate solution	nickel rod	iron ring
C	nickel(II) sulfate solution	iron ring	nickel rod
D	nickel(II) sulfate solution	nickel rod	iron ring

35 In the diagram, each cell contains an aqueous solution of a single salt and all four electrodes are platinum. Electrodes **Q** and **S** increase in mass during the electrolysis but no gas is given off at **Q** or **S**.



If the increase in mass of electrode **Q** is greater than the increase in mass of electrode **S** at the same time, which of the following statements is true?

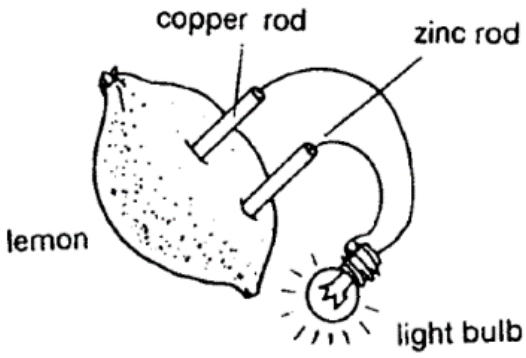
A The loss of mass of electrode **P** is less than the loss of mass of electrode **R**.

B The current flowing in cell 1 is greater than the current flowing in cell 2.

C The cation of the solution in cell 1 is different from the cation of the solution in cell 2.

D The cation in cell 1 is the same as in cell 2 but the solution in cell 1 is more concentrated than in cell 2.

36 The diagram below shows a 'lemon cell'. Which of the following statements concerning this lemon cell is not correct?



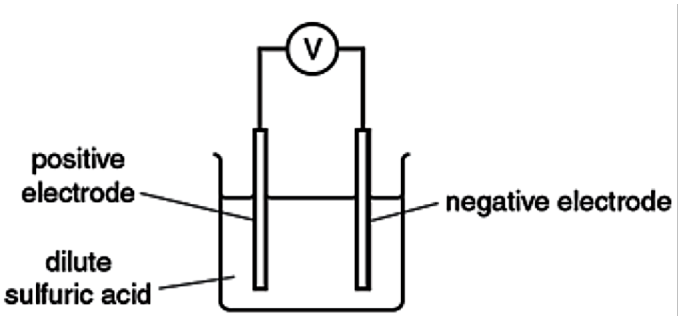
A Electrons flow from zinc rod to copper rod.

B The light bulb will not light up if the copper rod is replaced by a magnesium rod.

C The electrolyte in a lemon cell is the organic acid and mineral salts in the lemon.

D The light bulb will also light up if the lemon is replaced by an orange.

37 Four metals **W**, **X**, **Y** and **Z** were connected in pairs as shown in the diagram below and the voltage was recorded.



The results obtained are recorded in the table below.

cell	metals used	voltage/ V	positive terminal
1	**W** and **X**	1.10	**W**
2	**X** and **Y**	1.46	**Y**
3	**X** and **Z**	0.47	**X**

Which statement is correct?

A **Y** is the most reactive metal.

B The voltage obtained when **W** and **Y** are used is 0.36 V.

C The voltage obtained when **Z** and **Y** are used is 3.03 V.

D **W** can displace metal **Z** form a solution containing cations of **Z**.

38 In which instance is there no change in the concentration of the solution during electrolysis?

A Concentrated sodium chloride solution between carbon electrodes.

B Copper(II) sulfate solution between copper electrodes.

C Copper(II) sulfate solution between platinum electrodes.

D Dilute sodium chloride solution between platinum electrodes.

39 Which statement describes what happens when hydrogen and oxygen are used in a fuel cell?

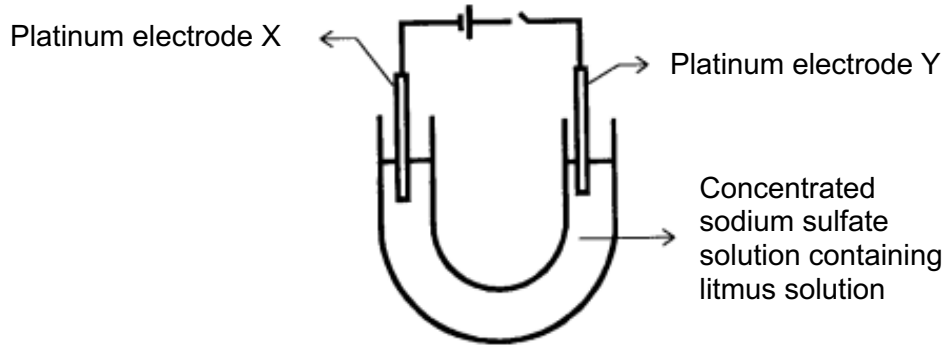
A Hydrogen is burned to form steam.

B Hydrogen is oxidised by losing electrons at the anode.

C Oxygen is oxidised by gaining electrons from hydrogen.

D Electricity is generated due to flow of electrons from cathode to anode.

40 The diagram below shows an electrolysis reaction with concentrated sodium sulfate solution as the electrolyte. Which of the following changes would occur when a current is passed through the solution for some time?



A Oxygen is given off at X and hydrogen is given off at Y.

B Sodium is formed at X and oxygen gas is given off at Y.

C The colour of the solution becomes red around X and blue around Y.

D The colour of the solution becomes blue around X and red around Y.

End of paper

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9		Key proton (atomic) number atomic symbol name relative atomic mass									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 dm^3 at room temperature and pressure (r.t.p.).