

Cambright Solved Paper

i≣ Tags	2023	CIE IGCSE	Chemistry	May/June	P4	V2
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1 A list of oxides, A to H, is shown.

Α	calcium oxide
в	aluminium oxide
С	silicon(IV) oxide
D	sulfur dioxide
Е	carbon dioxide
F	iron(III) oxide
G	silver oxide
н	carbon monoxide
Ans Eac	ower the following questions about the oxides, A to H . In letter may be used once, more than once or not at all.
Sta	te which of the oxides, A to H :
(a)	is responsible for acid rain
	D [1]
(b)	has a giant covalent structure
	C [1]
(c)	is a reducing agent in the blast furnace
	H [1]
(d)	is the main constituent of bauxite
. ,	B
	[1]
(e)	is the main impurity in iron ore
(e)	is the main impurity in iron ore
(e)	is the main impurity in iron ore C
(e) (f)	is the main impurity in iron ore C [1] can be reduced by heating with copper.
(e) (f)	is the main impurity in iron ore C [1] can be reduced by heating with copper. G [1]
(e) (f)	is the main impurity in iron ore C [1] can be reduced by heating with copper. G [1]

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2 Fluorine, chlorine and bromine are in Group VII of the Periodic Table.

(a)	State the name given to Group VII elements.	
	Halogens	[1]

(b) Explain why Group VII elements have similar chemical properties.
They have the same number of electrons on their outer shell
[1]

(c) Complete Table 2.1 to show the colour and state at r.t.p. of some Group VII elements.

Table 2.1

element	colour	state at r.t.p.
fluorine	pale yellow	gas
chlorine	pale yellow-green	gas
bromine	orange-brown	liquid

[3]

(d) Bromine has two naturally occurring isotopes, ⁷⁹Br and ⁸¹Br.

- (i) State the term given to the numbers 79 and 81 in these isotopes of bromine. mass number [1]
- (ii) Complete Table 2.2 to show the number of protons, neutrons and electrons in the atom and ion of bromine shown.

	⁷⁹ Br	⁸¹ Br ⁻
protons	35	35
neutrons	44	46
electrons	35	36

Table 2.2

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(iii) Table 2.3 shows the relative abundances of the two naturally occurring isotopes of bromine.

	Table	2.3				
	isotope	⁷⁹ Br	⁸¹ Br			
	relative abundance	55%	45%			
Calculate the relative atomic mass of bromine to one decimal place.						
(mass number of isotope 1 x relative abundance) + (mass number of isotope 2 x relative abundance)	= relative atomic mass	(79	9 x 55) + 	(81 x 45) = 0	79.9	
100		relativ	e atomic i	mass =	79.9	[2]

- (e) Chlorine displaces bromine from aqueous potassium bromide but does **not** displace fluorine from aqueous sodium fluoride.
 - (i) Write the symbol equation for the reaction between chlorine and aqueous potassium bromide.

$$Cl_2 + 2KBr = 2KCl + Br_2$$

Chlorine is less reactive than fluorine [1]

(f) Aqueous silver nitrate is a colourless solution containing Ag⁺(aq) ions.

- (i) Describe what is seen when aqueous silver nitrate is added to aqueous sodium chloride. A white precipitate is formed (silver chloride forms a white precipitate) [1]
- (ii) Write the ionic equation for the reaction between aqueous silver nitrate and aqueous sodium chloride.

Include state symbols.

$$Ag^+(aq)+Cl^-(aq)
ightarrow AgCl(s)$$

......[3]

[Total: 18]

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3 Over 200 million tonnes of sulfuric acid are manufactured every year.

(a)	State the name of the process used to manufacture sulfuric acid.	
	Contact Process	[1]

(b) Part of the manufacture of sulfuric acid involves converting sulfur dioxide to sulfur trioxide.

- (i) Describe two methods by which sulfur dioxide is obtained.
 - 1 Roasting Sulphide ores in air
 - 2 Burning sulfur in air [2]

The conversion of sulfur dioxide to sulfur trioxide is a reversible reaction which can reach equilibrium.

 $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$

(ii) State two features of an equilibrium.

 $_1$ The rate of the forward reaction is equal to the rate of the backward reaction

2 The concentration of the reactions and the products remains constant

(iii) State the typical conditions and name the catalyst used in the conversion of sulfur dioxide to sulfur trioxide.

temperature°C	
pressure kPa	a

catalyst vanadium oxide

[3]

[2]

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(iv) Complete Table 3.1 to show the effect, if any, when the following changes are applied to the conversion of sulfur dioxide to sulfur trioxide.

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$$

The forward reaction is exothermic.

Only use the words increases, decreases or no change.

Fol	Table 3.1 lows general principle for rate of read	Based on the rules of equilibrium (Le Chatelier's principle)
change	effect on the rate of the forward reaction	effect on the concentration of $SO_3(g)$ at equilibrium
temperature decreases	decreases	increases
pressure increases	increases	increases
no catalyst	decreases	decreases

[4]

(v)	Explain in terms of collision theory why reducing the temperature decreases the rate of the forward reaction.
	When the temperature is reduced, the kinetic energy of the particles decreases
	Since speed decreases, t <mark>he frequency of collisions decreases</mark> and a lower
	propotion of particles collide with energy equal to or above activation energy so
	there are less succesful reactions and the rate of the reaction is reduced.
	[3]

(c) Sulfuric acid contains $SO_4^{\frac{2}{4}}$ ions.

The oxidation number of O atoms in SO_4^{2-} ions is -2.

Determine the oxidation number of S atoms in SO_4^{2-} ions. Show your working.

The total oxidation state of the ion is -2 as that is the charge on the ion.

So the combined oxidation states of the 4 Oxygen and Sulfur is -2.

	S + (4 x O) = -2	+6
Replacing O with it's oxidation number (-2)		oxidation number =[2]
	S + (4 x -2) = -2 S + -8 = -2 S = -2 + 8 S = 6	[Total: 17]
∴ The oxidatio	n number of Sulphur in the ion is +6	
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4	Solid sodium hydroxide is a base which dissolves to form an aqueous solution, NaOH(aq).			
(a) State what is meant by the term base.				
		A base is a proton acceptor	[1]	
	(b)	State the term given to a base which dissolves to form an aqueous solution.		
		Alkali	[1]	
	(c)	State the colour of thymolphthalein in NaOH(aq).		
		Blue	[1]	
	(d)	Complete the word equation for the reaction of NaOH(aq) with ammonium chloride.		
sodium + ammonium → sodium + ammonia + water hydroxide + chloride → chloride				
			[3]	
(e) Some metal oxides react with NaOH(aq).				
(i) State the term given to metal oxides which react with bases such as NaOH(aq).				
		amphoteric oxides	[1]	
		(ii) Name a metal oxide which reacts with NaOH(aq).		
		zinc oxide	[1]	
			[1]	

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(f) Ethanoic acid, CH_3COOH , is a weak acid.

(i) Complete the dot-and-cross diagram in Fig. 4.1 of a molecule of ethanoic acid.



(iii) Complete the symbol equation to show the dissociation of ethanoic acid.

 $CH_3COOH \rightleftharpoons CH_3COO^- + H^+$

(iv) Write the ionic equation for the reaction when an acid neutralises a soluble base.

 $H^+ + OH^- o H_2 O$

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(g) In a titration, 25.0 cm^3 of $0.0800 \text{ mol}/\text{dm}^3$ aqueous potassium hydroxide, KOH(aq), is neutralised by 20.0 cm^3 of dilute sulfuric acid, $H_2SO_4(aq)$.

 $2\text{KOH}(\text{aq}) + \text{H}_2\text{SO}_4(\text{aq}) \rightarrow \text{K}_2\text{SO}_4(\text{aq}) + 2\text{H}_2\text{O}(\text{I})$

Calculate the concentration of H_2SO_4 , in g/dm³ using the following steps.

Calculate the number of moles of KOH used.

conc=mol/vol $25cm^3/1000=0.025dm^3$ $0.08mol/dm^3=mol/0.0.25dm^3$

0.08 imes 0.025 = mol

$$mol = 0.002$$

• Determine the number of moles of H₂SO₄ which react with the KOH.

$$2KOH + H_2SO_4
ightarrow K_2SO_4 + 2H_2O$$

The ratio of moles of pottasium hydroxide to the moles of sulphuric acid is 2:1

$$0.002/2 = 0.001$$

so 0.002 moles of KOH would be neutralized by 0.001 moles of sulphuric acid .

Calculate the concentration of H₂SO₄ in mol/dm³.

conc = mol/vol

 $20 cm^3/1000 = 0.002 dm^3$

 $conc=0.001mol/0.002dm^3$

 $conc = 0.5 mol/dm^3$

• Calculate the concentration of H₂SO₄ in g/dm³.

we need to find 0.5mol of sulphuric acid in grams to find out the conc

$$mol=mass/M_r$$
 $M_r=(2 imes 1)+(1 imes 32)+(4 imes 16)$

$M_r = 98$

0.005 = mass/98

$$0.005 imes 98=mass=0.49g$$

$$conc=0.49g/dm^3$$

	g/dm ³
	[5]

[Total: 21]

10							
Pro	pane	e and propene both react with chlorine.					
(a)	Wh ato	en a molecule of propane, C_3H_{a} , reacts with chlorine in the presence of ultraviolet light, one m of hydrogen is replaced by one atom of chlorine.					
(i) St ate		State the term given to reactions in which one atom in an alkane is replaced by another atom.					
		Substitution reaction [1]					
	(ii)	State the purpose of ultraviolet light in this reaction.					
		To provide activation energy for the reaction [1]					
(iii)	State the term given to any reaction which requires ultraviolet light.					
		Photochemical reaction [1]					
(iv)	Write the symbol equation for the reaction between propane and chlorine.					
		$C_3H_8+Cl_2 ightarrow C_3H_7Cl+HCl$					
(b)	Am	nolecule of propene, $C_{3}H_{6}$, is unsaturated and will react with chlorine at room temperature.					
	(i)	State why propene is an unsaturated molecule. It has a double bond between carbons, which is more than a single bond [1]					

(ii) Give the structural formula of the product of this reaction.



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	(c)	Propene undergoes addition reactions with There are two possible products, A and B	th steam. 3.			
		Draw the displayed formula and name each product.				
		displayed formula of product A	Н Н Н H-C-C-C-H H ОНН			
		displayed formula of product B	Н Н Н H-C-C-C-O-H H Н Н			
		name of product B propan-1-ol				
				[4]		
				[Total: 11]		
			de Arc			
6	Car	boxylic acids can be converted to esters.				

- (a) Name the ester formed when butanoic acid, CH₃CH₂CH₂COOH, reacts with ethanol, CH₃CH₂OH. ethyl butanoate [1]
- (b) Identify the other product formed in this reaction. water [1]
- (c) Deduce the empirical formula of the ester formed.



The molecular formula of ethyl butanoate is

$C_6H_{12}O_2$

When it given in it's simplest form (divided by 2) we get:

 C_3H_6O

......[1]





(i) Circle one repeat unit of this polymer.

[1]

(ii) Draw the structures of the monomers which make up PET. Draw the functional groups using displayed formulae.

(iii) State the type of polymerisation used in making PET.

Condensation polymerization [1]

[Total: 7]

[2]

Additional notes

If you find any errors or mistakes within this paper, please contact us and we will fix them as soon as possible.