

TORORO GIRLS' SCHOOL
SENIOR SIX CHEMISTRY

PAPER ONE

2 HOURS

Attempt all questions

1. (a) State three reasons for the anomalous behavior of fluorine in group(VII) of the periodic table. (3 marks)

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- (b) Write the equation for the reaction between fluorine and
- (i) cold dilute potassium hydroxide solution. (1 ½ marks)

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- (ii) hot concentrated potassium hydroxide solution. (1 ½ marks)

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2. 6.34cm^3 of hydrogen gas were mixed with 7.61cm^3 of chlorine gas at 200K and when equilibrium was established, 5.26cm^3 of hydrogen chloride was present.

- (a) Write
- (i) the equation for the reaction that took place. (1 ½ marks)

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- (ii) the expression for the equilibrium constant, K_c of the reaction. (1 ½ marks)

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(b) Calculate the equilibrium constant K_c for the reaction at 200K.

(3 marks)

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3. Benzene reacts with chloromethane to form methylbenzene.

(a) Write an equation and a mechanism for the reaction between
chloroethane and benzene

(2 marks)

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(b) The substitution reaction occurs more readily with a phenol than with
benzene.

(i) State and explain why the substitution reaction occurs more readily
with phenol compared to benzene.

(2 marks)

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(ii) suggest a structure for the most likely organic product formed in the
substitution reaction of a phenol with excess chloromethane.

(1 mark)

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4. Lithium, a group (I) element and magnesium a group (II) element show diagonal relationship.

(a) What is meant by diagonal relationship? (1 mark)

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(b) State two properties in which lithium resembles magnesium. (2 marks)

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(c) Suggest one pair of elements which show diagonal relationship.

(1 mark)

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5. draw and name the structures of the following molecules or ions.

(4 ½ marks)

Molecule/ ion	structure	Name
Water		
Sulphate		
nitrite		

6. The boiling points of the hydrides of group(VII) elements of the periodic table are given below.

Hydride	HF	HCl	HBr	HI
Boiling point (°C)	+19.5	-85	-67	-37

- (a) State how the boiling points of the hydrides vary. (1 mark)

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- (b) Explain your answer in (i) (3 marks)

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7. The acid dissociation constant, K_a , of hydrocyanic acid, HCN, is $4.9 \times 10^{-10} \text{ mol dm}^{-3}$.

- (i) Write an expression for the acid dissociation constant, K_a , for HCN. (2 marks)

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- (ii) Calculate the pH of a 0.010M solution of hydrocyanic acid, HCN. (3 marks)

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8. (a) Define bond energy. (2 marks)

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- (b) Calculate the standard enthalpy of formation of ethane using the following information.

The standard enthalpy of atomization of carbon is 718 kJ mol^{-1} .

bond	Bond energy/ kJ mol^{-1}
C-C	348
C-H	416
H-H	436

(3 marks)

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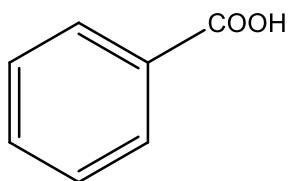
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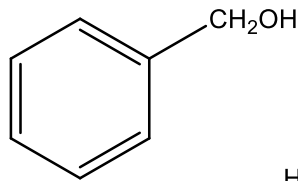
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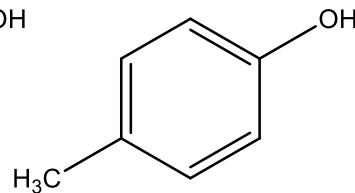
9. A senior six student decided to investigate the reactivity of the hydroxyl group in the three different organic compounds shown below.



Benzoic acid



Phenylmethanol



4-Methylphenol

- (a) Benzoic acid reacts with aqueous sodium hydroxide:

- (i) Write the equation for the reaction between sodium hydroxide and benzoic acid. (1 ½ marks)

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- (ii) State which, if any, of the two compounds above would react with aqueous sodium hydroxide. (1 mark)

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- (b) All the three compounds react with sodium metal to give off hydrogen gas. Write an equation for the reaction between 4-methyphenol with sodium metal. (1 ½ marks)

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- (c) Benzoic acid and phenylmethanol react with each other in the presence of a suitable catalyst. Write an equation and a mechanism for the reaction between benzoic acid with 4-phenylmethanol. (5 marks)

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10. Two isomeric aromatic compounds X and Y have the following percentage composition by mass. $C = 66.4\%$ $H = 5.5\%$ and $Cl = 28.1\%$.

- (a) Calculate the empirical formula of the compounds. (1 mark)

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- (b) 6 grams of either X lowers the freezing point of carbon tetrachloride by 1.418°C . Determine the molecular mass of X. (2 marks)

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- (c) Compound X yields a white precipitate when warmed with aqueous silver nitrate, while Y does not. Suggest a structure for X and give one possible structure for Y. (3 marks)

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- (d) Write an equation and suggest a mechanism for the reaction between X and aqueous sodium hydroxide. (3 marks)

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- 11.(a) The saturated vapor pressures of phenyl amine and water at a number of temperatures are shown below.

Temperature/ $^{\circ}\text{C}$		70	80	90	100
Vapor pressure (10^5 Nm^{-2})	Phenylamine	0.0141	0.0242	0.0584	0.0605
	water	0.311	0.423	0.679	1.010

- (i) By means of a graph find the temperature at which a mixture of phenylamine and water boils at $1.01 \times 10^5 \text{ Nm}^{-2}$. (4 marks)

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- (ii) Calculate the percentage composition of phenyl amine in the distillate. (2 marks)

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- (b) The liquid A distills in steam. At the boiling point, the partial pressures of the two liquids are: $A = 6.59 \times 10^3 Nm^{-2}$ and $H_2O = 9.44 \times 10^4 Nm^{-2}$. If the molar mass of A is $95 g mol^{-1}$. What is the percentage by mass of A in the distillate? (3marks)

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- 12.(a) (i) Write the name and the formula of the principal ore of aluminium. (1 mark)

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- (ii) Outline the steps used to concentrate the ore you have named in a(i) (include relevant equations for the reactions that take place) (5 marks)

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(b) Write equation(s) for the reaction of aluminium with;

(i) concentrated sodium hydroxide solution (1 mark)

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(ii) heated iron(III) oxide (1 mark)

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(iii) concentrated hydrofluoric acid (1 mark)

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13. (a) When bromine is reacted with hot aqueous sodium hydroxide, disproportionation occurs.

(i) What is meant by the term disproportionation. (1 mark)

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(ii) Write an equation to show how bromine undergoes disproportionation. (1 ½ marks)

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(iii) State the change in oxidation states of bromine in the reaction above. (½ marks)

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(b) Explain each of the following:

(i) Chlorine is much more soluble in aqueous sodium hydroxide than in water. (3 marks)

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(ii) Unlike other halogens fluorine liberates oxygen from cold water. (3 marks)

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14.(a) State three properties of eutectic mixture (1 ½ marks)

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(b) The melting of various mixtures of ethanoic acid and water are given in the table below.

% ethanoic acid	0	20	40	60	80	100
Melting point (°C)	0	-10	-20	-19	-1	18

(i) Draw a well labeled melting point-composition diagram of ethanoic acid-water system. (3 marks)

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(ii) Determine the eutectic temperature and composition of the eutectic mixture. (1 mark)

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(iii) Calculate the mass of ice that crystallized out when 135g of a liquid mixture of composition 16% ethanoic acid at 5°C was cooled to -22°C. (1 ½ marks)

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- (c) Briefly explain what happens when a liquid mixture of composition 20% ethanoic acid at 15°C was cooled to -30°C.
(2 marks)

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15. Barium sulphate sparingly dissolves in water:

(a) Write:

- (i) The equation for the solubility of barium sulphate in water.
(1½ marks)

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- (iii) The expression for the solubility product (K_{sp}) of barium sulphate.
(1 mark)

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- (b) A saturated solution of barium sulphate has electrolytic conductivity of $3.73 \times 10^{-6} \text{ ohm}^{-1} \text{ cm}^{-1}$ at room temperature. Calculate the solubility of barium sulphate in g/dm^3 at this temperature
(The electrolytic conductivity of pure water is $1.23 \times 10^{-6} \Omega^{-1} \text{ cm}^{-1}$ and the molar conductivity of barium sulphate at this temperature is $250 \Omega^{-1} \text{ cm}^2 \text{ mol}^{-1}$)
(2½ marks)

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- (c) (i) 0.02M aqueous solution of sodium sulphate was added to the saturated solution in (b). Calculate the percentage of barium sulphate dissolved. (2½ marks)

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- (ii) Comment on your results in (c)(i) above and give a reason for your answer. (1½ marks)

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END