Name ……..……..…… **Index No**…….……

School ……... **Candidate's Signature** ……

Date …….....…….

233/3
CHEMISTRY
PAPER 3
(PRACTICAL)

INSTRUCTIONS:

- Write your name and index number in the spaces provided above.
- Answer **ALL** questions in the spaces provided.
- You are **NOT** allowed to start working with the apparatus for the first 15minutes of the $2\frac{1}{4}$ hours allowed for this paper. This time will enable you read through the question paper and make sure you have all the chemicals and apparatus required.
- Mathematical tables and electronic calculators may be used.
- All working **must be** clearly shown where necessary.

FOR EXAMINER'S USE ONLY

Question	Maximum score	Candidate's score
1	22	
2	10	
3	8	
TOTAL SCORE	40	

This paper consists of 8 printed pages Candidates should check to ensure that all pages are printed as indicated and no questions are missing.

1. You are provided with:-
   - 2.2g of solid A, A dibasic acid with the formula H_2X.
   - Solution B, 0.5M aqueous H_2X.
   - Sodium hydroxide, solution C.
   - Solution E, Acidified Potassium Manganate (VII).

   You are required to determine;

   a) i) The molar heat of solution of solid A.
      ii) The heat of reaction of one mole of H_2Xsolution B with Sodium hydroxide solution C.
   b) The heat of reaction of solid A, H_2X with Sodium hydroxide solution C.
   c) How the rate of reaction of the dibasic acid, H_2X and acidified Potassium Manganate (vii) solution A varies with temperature.

<u>Procedure I</u>

Step I

Place $35cm^3$ of distilled water into a 100ml plastic beaker. Measure the initial temperature of the water and record in table 1 below. Add all of solid A at once. Stir the mixture carefully with the thermometer until all the solid dissolves. Measure the final temperature reached. Record it in table 1. (Retain the solution in this step for use in procedure II).

Table I

Final temp ^OC	
Initial temp ^OC	

(2marks)

a) Determine the change in temperature, ΔT. (1mark)

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b) Calculate the;

i) Heat change when the solid H_2X dissolves in water. (Assume the heat capacity of solution is $4.2jg^{-1}{}^0C^{-1}$ and density = g/cm^3) (1mark)

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ii) Number of moles of the acid that were used given that the relative formula mass of H_2X is 126. (1mark)

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iii) Molar heat of solution of acid H_2X, ΔH_1 (1mark)

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Step 2

Place $35cm^3$ of aqueous acid, solution B into a $100cm^3$ clean plastic beaker. Measure the initial temperature and record it in table II below. Measure $35cm^3$ of sodium hydroxide solution C. Add all of the $35cm^3$ of solution C at once to solution B in the beaker. Stir the mixture with the thermometer. Measure the final temperature reached and record in table II.

Table II

Final temp ^OC	
Initial temp ^OC	

(2marks)

c) Determine the change in temperature ΔT_2. (1mark)

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d) Determine the;

i) Heat change of reaction (Assume the heat capacity of solution is $4.2jg^{-1}1^0C^{-1}$and density is $1g/cm^3$). (1mark)

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ii) Number of moles of the acid H_2X, used. (1mark)

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iii) Molar heat of reaction, ΔH_2 of the aqueous acid H_2X, with sodium hydroxide. (1mark)

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e) Calculate the molar heat of reaction, ΔH_3 of the solid dibasic acid H_2X, with aqueous sodium hydroxide solution C. (2marks)

$H_2X_{(S)} + 2OH^-_{(aq)} \qquad 2H_2O_{(l)} + X^{2-}_{(aq)}$

$H_2X_{(s)} \qquad H_2X_{(aq)}$

$Na_2X_{(aq)} + H_2O_{(l)}$

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Procedure II

Transfer the solution obtained in step I of procedure I into a clean 250ml volumetric flask. Add distilled water to make upto the mark label this as solution D. Place solution E in the burette. Run 10.0cm^3 portions of solution E from the burette into four clean test tubes. Place 10.0cm^3 of solution D into a clean boiling tube using a clean 10ml measuring cylinder. Place the boiling tube in a water bath provided and allow its content attain a temperature of 45^0C. Remove the boiling tube from the water bath and add the first portion of solution E and at the same time start a stopwatch. Record the time taken for the purple

colour of the solution to decolorise in table III. Repeat the procedure using the same volumes of solution D and E at temperatures of 55^0C,65^0C and 75^0C to complete table III.

a) Table III

Temperature of solution D^{O}C	45	55	65	75
Time taken for decolorisation (seconds)				
Reciprocal of time, $^1/_t$ (sec^{-1})				

(3 marks)

b) On the grid provided plot a graph of reciprocal of time $^1/_t$ (sec^{-1}) on the y-axis against the temperature of solution D. (3marks)

c) i) From the graph, determine the time taken for decolourisation of the mixture if the temperature of solution D is $60^{O}C$. (1mark)

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ii) How does the rate of reaction of Potassium Manganate(VII) with the dibasic acid H_2X solution vary with the temperature? (1mark)

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2. You are provided with solid H. Carry out the tests below. Record your observation and inferences in the spaces provided.

Put all solid H in a boiling tube. Add about $15cm^3$ of distilled water and shake thoroughly.

i) To about $2cm^3$ of solution H, add sodium hydroxide drop wise until in excess.

Observation	Inferences
(1mark)	(1mark)

ii) To about $2cm^3$ of solution H, add $5cm^3$ of Sodium Sulphate solution.

Observation	Inferences
(1mark)	(1mark)

iii) Dip clean end of glass rod into solution H and place it on the non-luminous flame.

Observation	Inferences
(1mark)	(1mark)

iv) To about $2cm^3$ of solution H, add $1cm^3$ of hydrochloric acid followed by 3 drops of Barium Chloride solution.

Observation	Inferences
(1mark)	(1mark)

v) To about $2cm^3$ of solution H, add 3 drops of acidified Potassium dichromate (VI) solution.

Observation	Inferences
(1mark)	(1mark)

3. You are provided with solid M. Carry out the tests below. Write your observations and inferences in the spaces provided.

a) Put a half of solid M provided in a clean dry test tube, heat gently then strongly.

Observation	Inferences
(1mark)	(1mark)

b) Put the remaining solid into a boiling tube and add about $10cm^3$ of distilled water, shake thoroughly

i) To about $2cm^3$ of the solution M, add 3drops of bromine water.

Observation	Inferences
(1mark)	(1mark)

ii) To about $2cm^3$ of solution M, add 3 drops of acidified potassium dichromate (VI), then warmgently.

Observation	Inferences
(1mark)	(1mark)

iii) To about $2cm^3$ of solution M, add two drops of the universal indicator.

Observation	Inferences
(1mark)	(1mark)