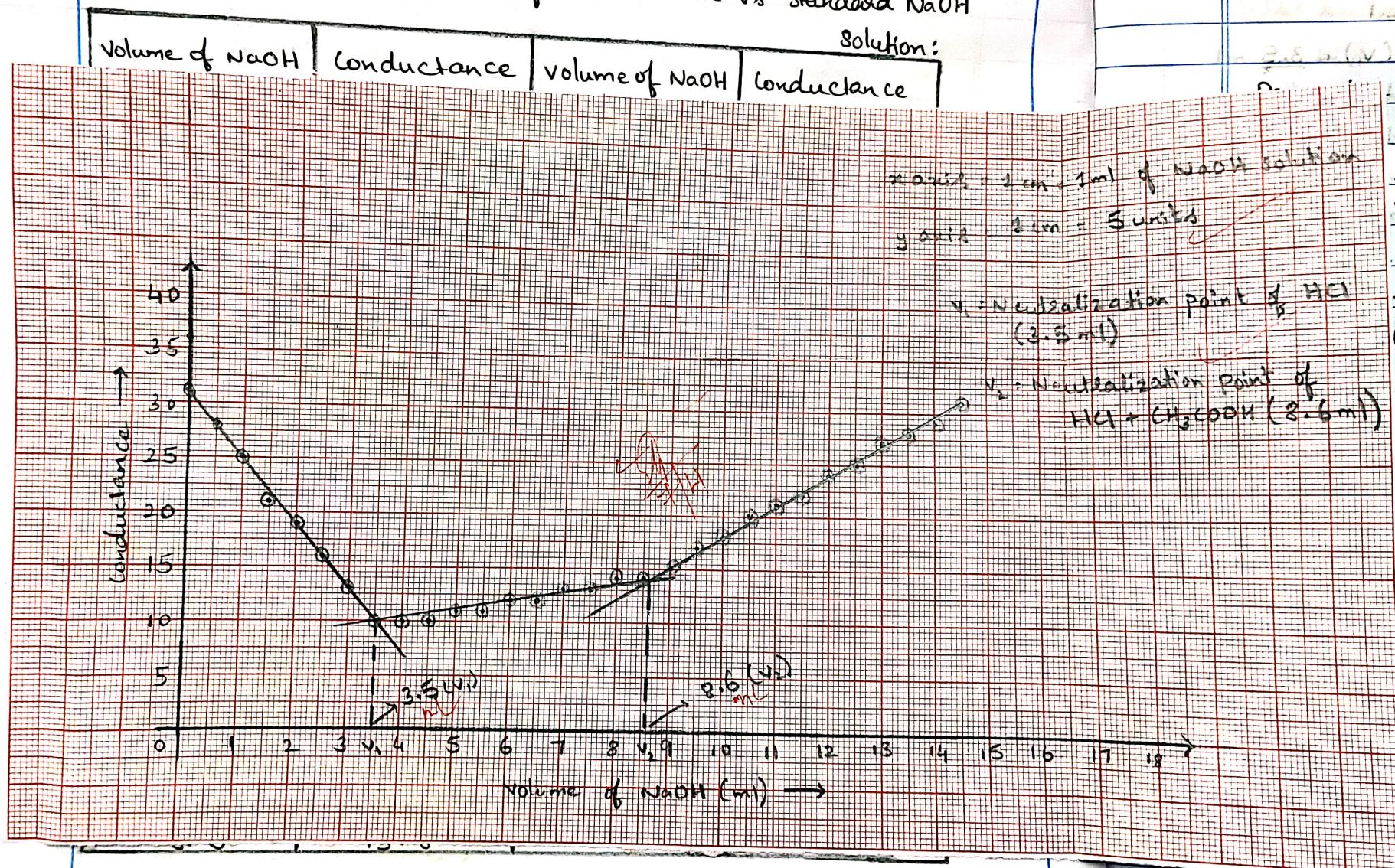


# Observation

conductometric titration of acid mixture Vs standard NaOH

## Experiment-1



Note: Conductivity = conductance × cell constant [cell constant is taken as 1]

∴ Conductivity = Conductance

of NaOH  
 $(\text{CH}_3\text{COOH})$



## Observation

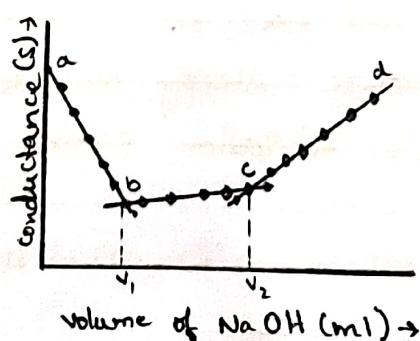
conductometric titration of acid mixture Vs standard NaOH

solution:

| volume of NaOH<br>(ml) | conductance<br>(s) | volume of NaOH<br>(ml) | conductance<br>(s) |
|------------------------|--------------------|------------------------|--------------------|
| 0.0                    | 30.5               | 8.5                    | 14.3               |
| 0.5                    | 27.7               | 9.0                    | 15.1               |
| 1.0                    | 24.5               | 9.5                    | 16.6               |
| 1.5                    | 21.3               | 10.0                   | 18                 |
| 2.0                    | 18.5               | 10.5                   | 19.6               |
| 2.5                    | 15.7               | 11.0                   | 21                 |
| 3.0                    | 13.0               | 11.5                   | 22.4               |
| 3.5                    | 10.4               | 12.0                   | 24                 |
| 4.0                    | 9.6                | 12.5                   | 25.3               |
| 4.5                    | 10.2               | 13.0                   | 26.7               |
| 5.0                    | 10.7               | 13.5                   | 28                 |
| 5.5                    | 11.3               | 14.0                   | 29.2               |
| 6.0                    | 11.8               | 14.5                   | 30.5               |
| 6.5                    | 12.2               |                        |                    |
| 7.0                    | 12.8               |                        |                    |
| 7.5                    | 13.3               |                        |                    |
| 8.0                    | 13.8               |                        |                    |

Note: Conductivity = conductance × cell constant [cell constant is taken as 1]

∴ Conductivity = conductance



v<sub>1</sub> = Neutralization point for HCl

v<sub>2</sub> = Neutralization point for HCl + CH<sub>3</sub>COOH

RNSIT

|   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|
| D | D | M | M | Y | Y | Y | Y |
| 1 | 7 | 0 | 3 | 2 | 0 | 2 | 5 |

### Experiment-1

### Conductometric estimation

Ques. I. (a) In a mixture of acid mixture, how can we find out which acid is present?

Ques. II. (b) How can we determine the concentration of an acid by titration?

Ans. Ques. I (A) DSH will give different patterns of conductance curves for different acids.

Principle: Conductometric estimation is preferable to titration.

Ques. II (B) Measurement of conductance can be employed to determine the neutralization point (end point) of acid-base titration. In conductometric titration, the conductance is measured during titration and there is sudden change in conductance of the solution near the neutralization point. However, the change is not sharp and hence the neutralization point is determined graphically by plotting conductivity against volume of base. The principle underlying conductometric titrations is the replacement of ions of a particular conductivity by ions of different conductivity during titration.

Conductometric titration may be applied for the determination of amount of acids present in an acid mixture. In the titration of mixture of strong acid ( $\text{HCl}$ ) and a weak acid ( $\text{CH}_3\text{COOH}$ ) against strong base ( $\text{NaOH}$ ), the conductivity initially decreases upon adding  $\text{NaOH}$  to acid mixture owing to the substitution of highly mobile  $\text{H}^+$  ion of  $\text{HCl}$  by less mobile  $\text{Na}^+$  ions of  $\text{NaOH}$ . This trend continues till all the  $\text{H}^+$  ions of  $\text{HCl}$  are replaced by  $\text{Na}^+$  ions (i.e. strong acid,  $\text{HCl}$  is neutralized). Continued addition of  $\text{NaOH}$  raises the conductance moderately, as the weak acid ( $\text{CH}_3\text{COOH}$ ) is converted into its salt ( $\text{CH}_3\text{COONa}$ ) and it undergoes dissociation to give  $\text{CH}_3\text{COO}^-$  and  $\text{Na}^+$  ions. Further addition of  $\text{NaOH}$  raises the conductance steeply due to the presence of free  $\text{OH}^-$  ions. A typical titration curve is shown in the figure.



## Calculations:

Strength of standard NaOH solution  $N_{NaOH}$  (given) = 1 N

Volume of acid mixture pipetted out = 25 ml

Volume of NaOH required to neutralize HCl ( $V_1$ ) = 3.5 ml

Volume of NaOH required to neutralize both HCl and  $CH_3COOH$  ( $V_2$ ) = 8.6 ml

Volume of NaOH required to neutralize  $CH_3COOH$  ( $V_2 - V_1$ ) = 5.1 ml

Therefore, the strength of HCl,  $N_{HCl}$ , =  $\frac{1(N_{NaOH}) \times 3.5 (V_1)}{25}$

Weight of HCl present in  $1 dm^3$  of acid mixture =  $N_{HCl} \times E_q.wt. \text{ of HCl}$

$$= 0.14 \times 36.5 \text{ g/dm}^3$$

$$= 5.11 \text{ g/dm}^3$$

Strength of  $CH_3COOH$ , N Acetic acid =  $\frac{1(N_{NaOH}) \times 5.1 (V_2 - V_1)}{25}$

Weight of  $CH_3COOH$  present in  $1 dm^3$  of acid mixture =  $N_{Acetic\ acid} \times E_q.wt. \text{ of } CH_3COOH$

$$= 0.204 \times 60 \text{ g/dm}^3$$

$H_2O + CH_3COOH \rightleftharpoons CH_3COO^- + H_3O^+$

$H_3O^+ + OH^- \rightleftharpoons H_2O + H_3O^-$

$CH_3COO^- + H_3O^- \rightleftharpoons CH_3COOH + H_2O$

$CH_3COOH + NaOH \rightleftharpoons CH_3COONa + H_2O$

RNSIT



D D M M Y Y Y Y

### Procedure :

Pipette out 25 ml of given acid mixture into a beaker. Add one test tube distilled water. Place the conductivity cell in the acid mixture solution and connect the cell to the conductivity bridge. Insert a magnetic bead into the acid mixture keep it on the magnetic stirrer and switch on. Note down the initial conductance value of the solution. Fill the burette with standard NaOH solution. Add NaOH from the burette in an increment of 0.5 ml and record the conductance after each addition. The conductance initially decreases and then rises slowly and finally rises sharply. Continue the addition of NaOH until the conductance is almost the same as the initial value.

Plot a graph of conductivity on y-axis against volume of NaOH added on x-axis. In figure, point 'b' corresponds to neutralization of HCl i.e. the volume of NaOH required to neutralize HCl ( $v_1$ ). The point 'c' corresponds to neutralization of both HCl and  $\text{CH}_3\text{COOH}$  ( $v_2$ ). The difference in the volume ( $v_2 - v_1$ ) corresponding to the points 'c' and 'b' volume of NaOH required to neutralize  $\text{CH}_3\text{COOH}$ .

## Result :

- (1) Strength of HCl =  $\frac{0.14}{5.11} \text{ N}$   
(2) Weight of HCl present in  $1 \text{ dm}^3$  of acid mixture =  $5.11 \text{ g/dm}^3$   
(3) Strength of  $\text{CH}_3\text{COOH}$  =  $\frac{0.204}{12.24} \text{ N}$   
(4) Weight of  $\text{CH}_3\text{COOH}$  present in  $1 \text{ dm}^3$  of acid mixture =  $12.24 \text{ g/dm}^3$

|   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|
| D | D | M | M | Y | Y | Y | Y |
|---|---|---|---|---|---|---|---|

### Result:

- 1 Strength of HCl (in molal concentration) by molality = 0.14 N
- 2 Weight of HCl present in  $1 \text{ dm}^3$  of acid mixture =  $5.11 \text{ g/dm}^3$
- 3 Strength of  $\text{CH}_3\text{COOH}$  (in molal concentration) = 0.204 N
- 4 Weight of  $\text{CH}_3\text{COOH}$  present in  $1 \text{ dm}^3$  of acid mixture =  $12.24 \text{ g/dm}^3$ .

(30%)  
SIX

(10) Heat of neutralization of dilute sulfuric acid with dilute NaOH

(10) Heat of neutralization of dilute sulfuric acid with dilute NaOH

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(10) Heat of neutralization of dilute sulfuric acid with dilute NaOH



### Observation & Calculations:

Part A : Preparation of standard di-sodium salt of EDTA solution

Weight of weighing bottle + di-sodium salt of EDTA (m<sub>1</sub>) = 6.3469 g

Weight of empty weighing bottle (m<sub>2</sub>) = 3.6811 g

Weight of di-sodium salt of EDTA crystal transferred (m<sub>1</sub> - m<sub>2</sub>) = 2.6658 g

Molarity of di-sodium salt of EDTA solution =  $\frac{2.6658}{\text{Mol. wt. of di-sodium EDTA (372)}} \times 4$   
 $= 0.0286 \text{ M (A)}$

Part B : Determination of total hardness of water sample

Burette : Standard di-sodium salt of EDTA solution

Conical flask : 25 ml of water sample + 3 ml buffer solution ( $\text{NH}_4\text{Cl} + \text{NH}_4\text{OH}$ )

Indicator : Eriochrome Black-T

Color change : Wine red to clear blue

| Burette reading (ml)                         | Trial 1 | Trial 2 | Trial 3 |
|--|---------|---------|---------|
| Final burette Reading                        | 16.3    | 16.4    | 16.4    |
| Initial burette Reading                      | 0.0     | 0.0     | 0.0     |
| Volume of di-sodium salt of EDTA rundown (B) | 16.3    | 16.4    | 16.4    |

1000 ml of 1M disodium salt of EDTA = 100 g of  $\text{CaCO}_3$

(B) ml of (A)M di-sodium salt of EDTA =  $[16.4 \text{ (B)} \times 0.0286 \text{ (A)} \times 0.1] \text{ g of } \text{CaCO}_3$   
 $= 0.046904 \text{ g } \text{CaCO}_3$

25 ml of water sample contains = 0.046904 g of  $\text{CaCO}_3$  (C)

$10^6 \text{ ml}$  of water sample contains =  $\frac{0.046904 \text{ (C)}}{25} \times 10^6$

= 1876.16 ppm of  $\text{CaCO}_3$

RNSIT

|   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|
| D | D | M | M | Y | Y | Y | Y |
| 2 | 4 | 0 | 3 | 2 | 0 | 2 | 5 |

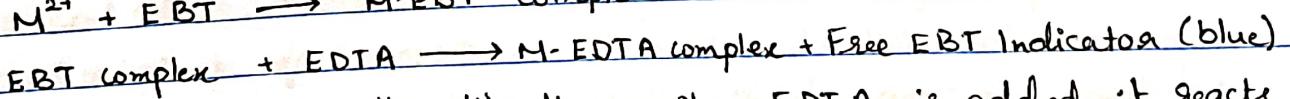
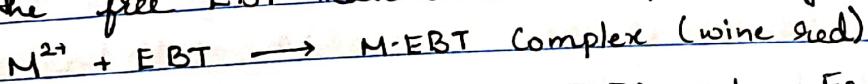
## Experiment - 2 Estimation of Total hardness of Water by EDTA method

### Principle:

The hardness of water is due to the presence of dissolved salts of calcium and magnesium. Hard water does not produce much lather with soap, because  $\text{Ca}^{2+}$  and  $\text{Mg}^{2+}$  ions of hard water react with soap to form precipitate. The total hardness due to Ca and Mg salts is determined by titrating a known volume of the water sample with a standard solution of di-sodium salt of EDTA, (ethylene diamine tetra-acetic acid) using Eriochrome Black-T indicator, at a pH of  $\sim 10$  (using a buffer solution of  $\text{NH}_4\text{OH} - \text{NH}_4\text{Cl}$ ). The reaction between the metal ion ( $\text{M}^{2+} = \text{Ca}^{2+}$  and  $\text{Mg}^{2+}$ ) and the di-sodium salt of EDTA at pH of 10 may be represented as:



The  $\text{H}^+$  ions released, will decrease the pH of the solution. However, the coordination complex between the metal ions and EDTA is stable only at alkaline pH and therefore, a constant pH of 10 is maintained using a buffer solution of  $\text{NH}_4\text{OH} - \text{NH}_4\text{Cl}$ . The indicator Eriochrome black-T (EBT) forms a weak wine-red complex [metal-EBT] with metal ions. The color of the free EBT indicator in the pH range 7-10 is blue.



During the titration, when EDTA is added, it reacts with the free  $\text{Ca}^{2+}$  and  $\text{Mg}^{2+}$  ions to form stable colorless Metal-EDTA complex. When the free  $\text{Ca}^{2+}$  and  $\text{Mg}^{2+}$  ions are just completely consumed, the added EDTA displaces the indicator (EBT) free from metal-EBT complex. The free indicator being blue makes the solution turn from wine red

B 5 3 2 8 0 P.S.

Result: Total hardness of the given water sample = ~~973~~

1876.16 ppm of CaCO<sub>3</sub>

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|   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|
| D | D | M | M | Y | Y | Y | Y |
|---|---|---|---|---|---|---|---|

to blue at the end point. Knowing the volume of standard di-sodium salt of EDTA solution used up in the titration, the hardness of water is calculated in terms of 'parts of  $\text{CaCO}_3$  per million of water' (ppm) [i.e. Parts of  $\text{CaCO}_3$  equivalent per  $10^6$  parts of water].

### Procedure:

#### Part A : Preparation of standard solution of di-sodium salt of EDTA :

Weigh out the given di-sodium salt of EDTA crystals accurately in a weighing bottle. Transfer all the crystals into a clean 250 ml volumetric flask through a funnel. Record the weight of the weighing bottle after transferring the crystals. Add 5 ml of  $\text{NH}_4\text{OH}$  solution. Wash the funnel with distilled water so that all the crystals are transferred quantitatively into the flask. Add adequate quantity (100 ml) of distilled water into the flask to dissolve the crystals completely, and dilute up to 250 ml mark and close the stopper. Mix the solution well for homogeneity. Calculate the molarity of di-sodium salt of EDTA solution.

#### Part B : Determination of total hardness of water sample:

Fill the burette with standard EDTA solution. Pipette out exactly 25 ml of the given water sample into a clean conical flask. Add 3 ml of  $\text{NH}_4\text{Cl} - \text{NH}_4\text{OH}$  buffer mixture ( $\sim \text{pH}=10$ ) and a pinch of Eriochrome black-T indicator. Solution color changes to wine red. Carefully titrate against standard di-sodium salt of EDTA solution. At the end point, Eriochrome black-T changes color from wine red to clear blue. Note down the volume of di-sodium salt of EDTA consumed. Repeat the titration 3 times for concordant values. From the volume of EDTA consumed,

|   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|
| D | D | M | M | Y | Y | Y | Y |
|---|---|---|---|---|---|---|---|

calculate the total hardness of the given water sample.

~~Result: Total hardness of the given water sample =~~

~~1876.16 ppm of  $\text{CaCO}_3$~~

~~29  
28  
27  
26  
25~~

|        |        |      | 12.5 | 0.0 |
|--------|--------|------|------|-----|
| 22.0   | 22.0   | PP.E | 2.0  |     |
| 44.0   | 44.0   | PP.E | 0.5  |     |
| 66.0   | 66.0   | SI.P | 0.5  |     |
| 88.0   | 88.0   | EE.P | 0.5  |     |
| 110.0  | 110.0  | 00.P | 2.5  |     |
| 132.0  | 132.0  | 1F.P | 0.5  |     |
| 154.0  | 154.0  | IP.H | 0.5  |     |
| 176.0  | 176.0  | 0.P  | 0.5  |     |
| 198.0  | 198.0  | EE.H | 0.5  |     |
| 220.0  | 220.0  | SI.H | 0.5  |     |
| 242.0  | 242.0  | EE.H | 0.5  |     |
| 264.0  | 264.0  | 0.P  | 0.5  |     |
| 286.0  | 286.0  | 1F.H | 0.5  |     |
| 308.0  | 308.0  | IP.H | 0.5  |     |
| 330.0  | 330.0  | 0.P  | 0.5  |     |
| 352.0  | 352.0  | EE.H | 0.5  |     |
| 374.0  | 374.0  | SI.H | 0.5  |     |
| 396.0  | 396.0  | EE.H | 0.5  |     |
| 418.0  | 418.0  | 0.P  | 0.5  |     |
| 440.0  | 440.0  | 1F.H | 0.5  |     |
| 462.0  | 462.0  | IP.H | 0.5  |     |
| 484.0  | 484.0  | 0.P  | 0.5  |     |
| 506.0  | 506.0  | EE.H | 0.5  |     |
| 528.0  | 528.0  | SI.H | 0.5  |     |
| 550.0  | 550.0  | EE.H | 0.5  |     |
| 572.0  | 572.0  | 0.P  | 0.5  |     |
| 594.0  | 594.0  | 1F.H | 0.5  |     |
| 616.0  | 616.0  | IP.H | 0.5  |     |
| 638.0  | 638.0  | 0.P  | 0.5  |     |
| 660.0  | 660.0  | EE.H | 0.5  |     |
| 682.0  | 682.0  | SI.H | 0.5  |     |
| 704.0  | 704.0  | EE.H | 0.5  |     |
| 726.0  | 726.0  | 0.P  | 0.5  |     |
| 748.0  | 748.0  | 1F.H | 0.5  |     |
| 770.0  | 770.0  | IP.H | 0.5  |     |
| 792.0  | 792.0  | 0.P  | 0.5  |     |
| 814.0  | 814.0  | EE.H | 0.5  |     |
| 836.0  | 836.0  | SI.H | 0.5  |     |
| 858.0  | 858.0  | EE.H | 0.5  |     |
| 880.0  | 880.0  | 0.P  | 0.5  |     |
| 902.0  | 902.0  | 1F.H | 0.5  |     |
| 924.0  | 924.0  | IP.H | 0.5  |     |
| 946.0  | 946.0  | 0.P  | 0.5  |     |
| 968.0  | 968.0  | EE.H | 0.5  |     |
| 990.0  | 990.0  | SI.H | 0.5  |     |
| 1012.0 | 1012.0 | EE.H | 0.5  |     |
| 1034.0 | 1034.0 | 0.P  | 0.5  |     |
| 1056.0 | 1056.0 | 1F.H | 0.5  |     |
| 1078.0 | 1078.0 | IP.H | 0.5  |     |
| 1100.0 | 1100.0 | 0.P  | 0.5  |     |
| 1122.0 | 1122.0 | EE.H | 0.5  |     |
| 1144.0 | 1144.0 | SI.H | 0.5  |     |
| 1166.0 | 1166.0 | EE.H | 0.5  |     |
| 1188.0 | 1188.0 | 0.P  | 0.5  |     |
| 1210.0 | 1210.0 | 1F.H | 0.5  |     |
| 1232.0 | 1232.0 | IP.H | 0.5  |     |
| 1254.0 | 1254.0 | 0.P  | 0.5  |     |
| 1276.0 | 1276.0 | EE.H | 0.5  |     |
| 1300.0 | 1300.0 | SI.H | 0.5  |     |
| 1322.0 | 1322.0 | EE.H | 0.5  |     |
| 1344.0 | 1344.0 | 0.P  | 0.5  |     |
| 1366.0 | 1366.0 | 1F.H | 0.5  |     |
| 1388.0 | 1388.0 | IP.H | 0.5  |     |
| 1410.0 | 1410.0 | 0.P  | 0.5  |     |
| 1432.0 | 1432.0 | EE.H | 0.5  |     |
| 1454.0 | 1454.0 | SI.H | 0.5  |     |
| 1476.0 | 1476.0 | EE.H | 0.5  |     |
| 1500.0 | 1500.0 | 0.P  | 0.5  |     |
| 1522.0 | 1522.0 | 1F.H | 0.5  |     |
| 1544.0 | 1544.0 | IP.H | 0.5  |     |
| 1566.0 | 1566.0 | 0.P  | 0.5  |     |
| 1588.0 | 1588.0 | EE.H | 0.5  |     |
| 1610.0 | 1610.0 | SI.H | 0.5  |     |
| 1632.0 | 1632.0 | EE.H | 0.5  |     |
| 1654.0 | 1654.0 | 0.P  | 0.5  |     |
| 1676.0 | 1676.0 | 1F.H | 0.5  |     |
| 1700.0 | 1700.0 | IP.H | 0.5  |     |
| 1722.0 | 1722.0 | 0.P  | 0.5  |     |
| 1744.0 | 1744.0 | EE.H | 0.5  |     |
| 1766.0 | 1766.0 | SI.H | 0.5  |     |
| 1788.0 | 1788.0 | EE.H | 0.5  |     |
| 1810.0 | 1810.0 | 0.P  | 0.5  |     |
| 1832.0 | 1832.0 | 1F.H | 0.5  |     |
| 1854.0 | 1854.0 | IP.H | 0.5  |     |
| 1876.0 | 1876.0 | 0.P  | 0.5  |     |
| 1900.0 | 1900.0 | EE.H | 0.5  |     |
| 1922.0 | 1922.0 | SI.H | 0.5  |     |
| 1944.0 | 1944.0 | EE.H | 0.5  |     |
| 1966.0 | 1966.0 | 0.P  | 0.5  |     |
| 1988.0 | 1988.0 | 1F.H | 0.5  |     |
| 2010.0 | 2010.0 | IP.H | 0.5  |     |
| 2032.0 | 2032.0 | 0.P  | 0.5  |     |
| 2054.0 | 2054.0 | EE.H | 0.5  |     |
| 2076.0 | 2076.0 | SI.H | 0.5  |     |
| 2100.0 | 2100.0 | EE.H | 0.5  |     |
| 2122.0 | 2122.0 | 0.P  | 0.5  |     |
| 2144.0 | 2144.0 | 1F.H | 0.5  |     |
| 2166.0 | 2166.0 | IP.H | 0.5  |     |
| 2188.0 | 2188.0 | 0.P  | 0.5  |     |
| 2210.0 | 2210.0 | EE.H | 0.5  |     |
| 2232.0 | 2232.0 | SI.H | 0.5  |     |
| 2254.0 | 2254.0 | EE.H | 0.5  |     |
| 2276.0 | 2276.0 | 0.P  | 0.5  |     |
| 2300.0 | 2300.0 | 1F.H | 0.5  |     |
| 2322.0 | 2322.0 | IP.H | 0.5  |     |
| 2344.0 | 2344.0 | 0.P  | 0.5  |     |
| 2366.0 | 2366.0 | EE.H | 0.5  |     |
| 2388.0 | 2388.0 | SI.H | 0.5  |     |
| 2410.0 | 2410.0 | EE.H | 0.5  |     |
| 2432.0 | 2432.0 | 0.P  | 0.5  |     |
| 2454.0 | 2454.0 | 1F.H | 0.5  |     |
| 2476.0 | 2476.0 | IP.H | 0.5  |     |
| 2500.0 | 2500.0 | 0.P  | 0.5  |     |
| 2522.0 | 2522.0 | EE.H | 0.5  |     |
| 2544.0 | 2544.0 | SI.H | 0.5  |     |
| 2566.0 | 2566.0 | EE.H | 0.5  |     |
| 2588.0 | 2588.0 | 0.P  | 0.5  |     |
| 2610.0 | 2610.0 | 1F.H | 0.5  |     |
| 2632.0 | 2632.0 | IP.H | 0.5  |     |
| 2654.0 | 2654.0 | 0.P  | 0.5  |     |
| 2676.0 | 2676.0 | EE.H | 0.5  |     |
| 2700.0 | 2700.0 | SI.H | 0.5  |     |
| 2722.0 | 2722.0 | EE.H | 0.5  |     |
| 2744.0 | 2744.0 | 0.P  | 0.5  |     |
| 2766.0 | 2766.0 | 1F.H | 0.5  |     |
| 2788.0 | 2788.0 | IP.H | 0.5  |     |
| 2810.0 | 2810.0 | 0.P  | 0.5  |     |
| 2832.0 | 2832.0 | EE.H | 0.5  |     |
| 2854.0 | 2854.0 | SI.H | 0.5  |     |
| 2876.0 | 2876.0 | EE.H | 0.5  |     |
| 2900.0 | 2900.0 | 0.P  | 0.5  |     |
| 2922.0 | 2922.0 | 1F.H | 0.5  |     |
| 2944.0 | 2944.0 | IP.H | 0.5  |     |
| 2966.0 | 2966.0 | 0.P  | 0.5  |     |
| 2988.0 | 2988.0 | EE.H | 0.5  |     |
| 3010.0 | 3010.0 | SI.H | 0.5  |     |
| 3032.0 | 3032.0 | EE.H | 0.5  |     |
| 3054.0 | 3054.0 | 0.P  | 0.5  |     |
| 3076.0 | 3076.0 | 1F.H | 0.5  |     |
| 3100.0 | 3100.0 | IP.H | 0.5  |     |
| 3122.0 | 3122.0 | 0.P  | 0.5  |     |
| 3144.0 | 3144.0 | EE.H | 0.5  |     |
| 3166.0 | 3166.0 | SI.H | 0.5  |     |
| 3188.0 | 3188.0 | EE.H | 0.5  |     |
| 3210.0 | 3210.0 | 0.P  | 0.5  |     |
| 3232.0 | 3232.0 | 1F.H | 0.5  |     |
| 3254.0 | 3254.0 | IP.H | 0.5  |     |
| 3276.0 | 3276.0 | 0.P  | 0.5  |     |
| 3300.0 | 3300.0 | EE.H | 0.5  |     |
| 3322.0 | 3322.0 | SI.H | 0.5  |     |
| 3344.0 | 3344.0 | EE.H | 0.5  |     |
| 3366.0 | 3366.0 | 0.P  | 0.5  |     |
| 3388.0 | 3388.0 | 1F.H | 0.5  |     |
| 3410.0 | 3410.0 | IP.H | 0.5  |     |
| 3432.0 | 3432.0 | 0.P  | 0.5  |     |
| 3454.0 | 3454.0 | EE.H | 0.5  |     |
| 3476.0 | 3476.0 | SI.H | 0.5  |     |
| 3500.0 | 3500.0 | EE.H | 0.5  |     |
| 3522.0 | 3522.0 | 0.P  | 0.5  |     |
| 3544.0 | 3544.0 | 1F.H | 0.5  |     |
| 3566.0 | 3566.0 | IP.H | 0.5  |     |
| 3588.0 | 3588.0 | 0.P  | 0.5  |     |
| 3610.0 | 3610.0 | EE.H | 0.5  |     |
| 3632.0 | 3632.0 | SI.H | 0.5  |     |
| 3654.0 | 3654.0 | EE.H | 0.5  |     |
| 3676.0 | 3676.0 | 0.P  | 0.5  |     |
| 3700.0 | 3700.0 | 1F.H | 0.5  |     |
| 3722.0 | 3722.0 | IP.H | 0.5  |     |
| 3744.0 | 3744.0 | 0.P  | 0.5  |     |
| 3766.0 | 3766.0 | EE.H | 0.5  |     |
| 3788.0 | 3788.0 | SI.H | 0.5  |     |
| 3810.0 | 3810.0 | EE.H | 0.5  |     |
| 3832.0 | 3832.0 | 0.P  | 0.5  |     |
| 3854.0 | 3854.0 | 1F.H | 0.5  |     |
| 3876.0 | 3876.0 | IP.H | 0.5  |     |
| 3900.0 | 3900.0 | 0.P  | 0.5  |     |
| 3922.0 | 3922.0 | EE.H | 0.5  |     |
| 3944.0 | 3944.0 | SI.H | 0.5  |     |
| 3966.0 | 3966.0 | EE.H | 0.5  |     |
| 3988.0 | 3988.0 | 0.P  | 0.5  |     |
| 4010.0 | 4010.0 | 1F.H | 0.5  |     |
| 4032.0 | 4032.0 | IP.H | 0.5  |     |
| 4054.0 | 4054.0 | 0.P  | 0.5  |     |
| 4076.0 | 4076.0 | EE.H | 0.5  |     |
| 4100.0 | 4100.0 | SI.H | 0.5  |     |
| 4122.0 | 4122.0 | EE.H | 0.5  |     |
| 4144.0 | 4144.0 | 0.P  | 0.5  |     |
| 4166.0 | 4166.0 | 1F.H | 0.5  |     |
| 4188.0 | 4188.0 | IP.H | 0.5  |     |
| 4210.0 | 4210.0 | 0.P  | 0.5  |     |
| 4232.0 | 4232.0 | EE.H | 0.5  |     |
| 4254.0 | 4254.0 | SI.H | 0.5  |     |
| 4276.0 | 4276.0 | EE.H | 0.5  |     |
| 4300.0 | 4300.0 | 0.P  | 0.5  |     |
| 4322.0 | 4322.0 | 1F.H | 0.5  |     |
| 4344.0 | 4344.0 | IP.H | 0.5  |     |
| 4366.0 | 4366.0 | 0.P  | 0.5  |     |
| 4388.0 | 4388.0 | EE.H | 0.5  |     |
| 4410.0 | 4410.0 | SI.H | 0.5  |     |
| 4432.0 | 4432.0 | EE.H | 0.5  |     |
| 4454.0 | 4454.0 | 0.P  | 0.5  |     |
| 4476.0 | 4476.0 | 1F.H | 0.5  |     |
| 4500.0 | 4500.0 | IP.H | 0.5  |     |
| 4522.0 | 4522.0 | 0.P  | 0.5  |     |
| 4544.0 | 4544.0 | EE.H | 0.5  |     |
| 4566.0 | 4566.0 | SI.H | 0.5  |     |
| 4588.0 | 4588.0 | EE.H | 0.5  |     |
| 4610.0 | 4610.0 | 0.P  | 0.5  |     |
| 4632.0 | 4632.0 | 1F.H | 0.5  |     |
| 4654.0 | 4654.0 | IP.H | 0.5  |     |
| 4676.0 | 4676.0 | 0.P  | 0.5  |     |
| 4700.0 | 4700.0 | EE.H | 0.5  |     |
| 4722.0 | 4722.0 | SI.H | 0.5  |     |
| 4744.0 | 4744.0 | EE.H | 0.5  |     |
| 4766.0 | 4766.0 | 0.P  | 0.5  |     |
| 4788.0 | 4788.0 | 1F.H | 0.5  |     |
| 4810.0 | 4810.0 | IP.H | 0.5  |     |
| 4832.0 | 4832.0 | 0.P  | 0.5  |     |
| 4854.0 | 4854.0 | EE.H | 0.5  |     |
| 4876.0 | 4876.0 | SI.H | 0.5  |     |
| 4900.0 | 4900.0 | EE.H | 0.5  |     |
| 4922.0 | 4922.0 | 0.P  | 0.5  |     |
| 4944.0 | 4944.0 | 1F.H | 0.5  |     |
| 4966.0 | 4966.0 | IP.H | 0.5  |     |
| 4988.0 | 4988.0 | 0.P  | 0.5  |     |
| 5010.0 | 5010.0 | EE.H | 0.5  |     |
| 5032.0 | 5032.0 | SI.H | 0.5  |     |
| 5054.0 | 5054.0 | EE.H | 0.5  |     |
| 5076.0 | 5076.0 | 0.P  | 0.5  |     |
| 5100.0 | 5100.0 | 1F.H | 0.5  |     |
| 5122.0 | 5122.0 | IP.H | 0.5  |     |
| 5144.0 | 5144.0 | 0.P  | 0.5  |     |
| 5166.0 | 5166.0 | EE.H | 0.5  |     |
| 5188.0 | 5188.0 | SI.H | 0.5  |     |
| 5210.0 | 5210.0 | EE.H | 0.5  |     |
| 5232.0 | 5232.0 | 0.P  | 0.5  |     |
| 5254.0 | 5254.0 |      |      |     |