1- How do you prepare 0,2 M 250 mL calcium citrate solution from calcium citrate tetrahydrate? Calculate the %(w/v) concentration of this solution.

First part of the question

($Ca_3(C_6H_5O_7)_2.4H_2O$, Ca:40; C:12; O:16; H:1.)

Molecular weight of $Ca_3(C_6H_5O_7)_2.4H_2O$ =570.49 g/mol

M=n/v   0,2=n/0,25 n=0,05

m=n x MW m=0,05 x 570,49 = 28,5245 g

Alternative way for the solution of the first part of the question.

0,2 M means 0,2 mol in 1000 mL

X mol in 250 mL

X=0,05 mol

If 1 mol of calcium citrate tetrahydrate is 570.49 g

0,05 mol of calcium citrate tetrahydrate is 28,5245 g

Preparing the solution

If your balance is analytical (which means capable of weighing 0,1 mg or 0,0001 g you may leave your result as it is.

But if your balance's sensitivity is 0,01 g then you should round your result to 2 digit which is 28.52 g.

Select the appropriately sized flask. Measure and transfer the calculated mass of solid material into the flask, preferably using a funnel to assure no material is lost during transfer. Rinse the sides of the funnel with your solvent (e.g. water for aqueous solutions) down into the flask to capture any residual material adhering to the funnel.

Next, fill the flask about halfway with your solvent, cap the flask and swirl to dissolve the solid material into solution. Once the solid material has been dissolved, fill the flask with your solvent by carefully adding enough solvent to raise the base of the meniscus of the solution to the level of the etched line. Finally, cap, mix, swirl and store your prepared solution until ready to use.

Second part of the question from grams

This solution contains 28,5245 g calcium citrate tetrahydrate in 250 mL solution

If 570.49 g calcium citrate tetrahydrate contains 498,49 g calcium citrate

28,5245 g calcium citrate tetrahydrate contains x g of calcium citrate
24,9245 g

% w/v means grams of solute in a 100 mL solution therefore;

if 24,9245 g calcium citrate	presents	in 250 mL
x g	presents	in 100 mL

x=9,9698 This solution is 9,96% (w/v).

2- How do you prepare 0,04 N 100 mL of Zinc sulfate solution from Zinc sulfate heptahydrate? If you take 5 mL from this solution and diluted to 1L using distilled water what is the % w/v concentration and ppm of the final solution.

Reaktifler	**Formül**	**Tesir Değerliği**
Alüminyum potasyum sülfat	$Al.K(SO_4)_3.12H_2O$	4
Amonyak	NH_3	1
Amonyum hidrojen ortofosfat	$(NH_4)_2HPO_4$	3
Amonyum hidroksit	NH_4OH	1
Amonyum karbonat	$(NH_4)_2CO_3$	2
Amonyum klorür	NH_4Cl	1
Amonyum molibdat	$(NH_4)_6Mo_7O_{24}.4\ H_20$	6
Amonyum okzalat	$(NH_4)_2C_2O_4.H_2O$	2
Amonyum sodyum hidrojen ortofosfat	NH_4NaHPO_4	3
Amonyum sülfat	$(NH_4)_2SO_4$	2

Reaktifler	Formül	Tesir Değerliği
Amonyum tiyosiyanat	NH_4CNS	1
Arsenik (III) oksit	As_2O_3	4
Arsenik trisülfit	As_2S_3	4
Asetik asit	$C_2H_4O_2$	1
Bakır oksit	CuO	2
Bakır sülfat $5H_2O$	$CuSO_4.5H_2O$	2
Baryum hidroksit	$Ba(OH)_2$	2
Baryum karbonat	$BaCO_3$	2
Baryum klorür. $2H_2O$	$BaCl_2.2H_2O$	2
Baryum oksit	BaO	2
Baryum peroksit	BaO_2	2
Borik asit	H_3BO_3	3
Civa (II) klorür	$HgCl_2$	2
Çinko sülfat $7H_2O$	$ZnSO_4\ 7H_2O$	2
Demir (II) sülfat	$FeSO_4.7H_2O$	1
Ferro oksit	FeO	1
Ferro (II) amonyum sülfat	$FeSO_4(NH_4)_2.SO_4.6H_2O$	1
Formik asit	$HCOOH$	1
Fosforik asit	H_3PO_4	3
Gümüş nitrat	$AgNO_3$	1
Hidroferrosiyanik asit	$H_4Fe(CN)_6$	1
Hidrojen peroksit	H_2O_2	2
Hidrojen sülfür	H_2S	2
Hidroklorik asit	HCl	1
İyot	I	1
Kalay klorür	$SnCl_2$	2
Kalay oksit	SnO	2
Kalsiyum hidroksit	$Ca(OH)_2$	2
Kalsiyum karbonat	$CaCO_3$	2
Kalsiyum klorür $6H_2O$	$CaCl_2.6H_2O$	2
Kalsiyum oksit	CaO	2
Krom (VI) oksit	CrO_3	4
Kurşun (IV) – oksit	PbO_2	2
Kükürtdioksit	SO_2	2
Laktik asit	$C_3H_6O_3$	1
Magnezyum karbonat	$MgCO_3$	2
Magnezyum klorür	$MgCl_2$	2
Magnezyum klorür $6H_2O$	$MgCl_2.6H_2O$	2
Malik asit	$C_4H_6O_5$	2

Reaktifler	Formül	Tesir Değerliği
Mangan sülfat	$MnSO_4$	2
Manganez peroksit	MnO_2	2
Nitrik asit	HNO_3	1
Oksalik anhidrit	C_2O_3	2
Okzalik asit $2H_2O$	$C_2H_2O_4.\ 2H_2O$	2
Perklorik asit	$HClO_4$	1
Potasyum tiyosiyanat	KSCN	1
Potasyum bikarbonat	$KHCO_3$	1
Potasyum bromür	HBr	1
Potasyum bikromat	$K_2Cr_2O_7$	6
Potasyum hidroksit	KOH	1
Potasyum iyodat	KIO_3	6
Potasyum iyodit	KI	1
Potasyum karbonat	K_2CO_3	2
Potasyum klorür	KCl	1
potasyum nitrat	KNO_3	1
Potasyun nitrit	KNO_2	2
Potasyum permanganat	$KmnO_4$	5
Potasyum siyanür	KCN	1
Potasyun sülfat	K_2SO_4	2
Potasyum sodyum tartarat	$NaKC_4H_40_64H_20)$	2
Potasyum tiyosiyanat	KSCN	1
Potasyum kromat	K_2CrO_4	3
Sitrik asit	$C_6H_8O_7.\ H_2O$	3
Sodyum hidroksit	NaOH	1
Sodyum karbonat	Na_2CO_3	2
Sodyum klorat	$NaClO_3$	6
Sodyum klorür	NaCl	1
Sodyum nitrat	$NaNO_3$	1
Sodyum nitrit	$NaNO_2$	2
Sodyum oksalat	$Na_2C_2O_4$	2
Sodyum oksit	Na_2O	2
Sodyum sülfit	Na_2S	2
Sodyum tiyosülfat	$Na_2S_2O_3.5H_2O$	1
Sodyumbikarbonat	$NaHCO_3$	1
Süksinik asit	$H_2C_4H_4O_4$	2
Sülfürik asit	H_2SO_4	2
Tartarik asit	$C_4H_6O_6$	2

Solution of the first part of the question.

($ZnSO_4.7H_2O$, Zn:65,39; S:32; O:16; H:1.)

First we should convert normality to molarity

N=e x M 0,04= 2 x M M=0,02

0,02 M means 0,02 mol in 1000 mL

0,002 mol in 100 mL

0,002 x MW of $ZnSO_4.7H_2O$ (287.56 g/mol) =

0,57512 g of $ZnSO_4.7H_2O$

Do not forget to explain how you prepare this solution!

Second part of the question from grams

This solution contains 0,57512 g $ZnSO_4.7H_2O$ in 100 mL

287,56 g $ZnSO_4.7H_2O$ contains 161,56 g $ZnSO_4$

0,57512 g $ZnSO_4.7H_2O$ contains x g $ZnSO_4$

X= 0,32312 g $ZnSO_4$ in 100 mL

If 0,32312 g ZnSO4 in 100 mL

X g in 5 mL

X= 0,016156 g

If 0,016156 g $ZnSO_4$ presents in 5 mL solution when diluted to 1 L using distilled water this value does not change.

If 0,016156 g $ZnSO_4$ in 1000 mL

X g in 100 mL

X= 0,0016156 g in 100 mL This solution is %0,0016156 (w/v) or %0,0016.

Third part of the question

If 0,016156 g $ZnSO_4$ in 1000 mL

16,156 mg in 1000 mL

16,156 ppm

3 How do you prepare 0,8 N 500 mL hydrogen peroxide solution from 30% H_2O_2 stock solution d=1,11 g/mL MW=34 g/mol

Solution

1- Convert normality to molarity

N = e x M   0,8 = 2 x M   M=0,4

2- Calculate how many gram do you need to prepare this solution.

0,4 M means 0,4 mol in 1000 mL

0,2 mol in 500 mL

0,2 x 34 = 6,8 g H_2O_2

3- Calculate real density

1 mL H_2O_2 solution contains 1,11 g total matter but only 30% of this matter is H_2O_2

Therefore 1 mL H_2O_2 solution contains 1,11 x 0,30 =0,333 g H_2O_2

4- Calculate the needed mL of the solute

If 1 mL of solution contains 0,333 g H_2O_2

X mL of solution contains 6,8 g H_2O_2

X=20,42042042042042 mL or x=20,42 mL

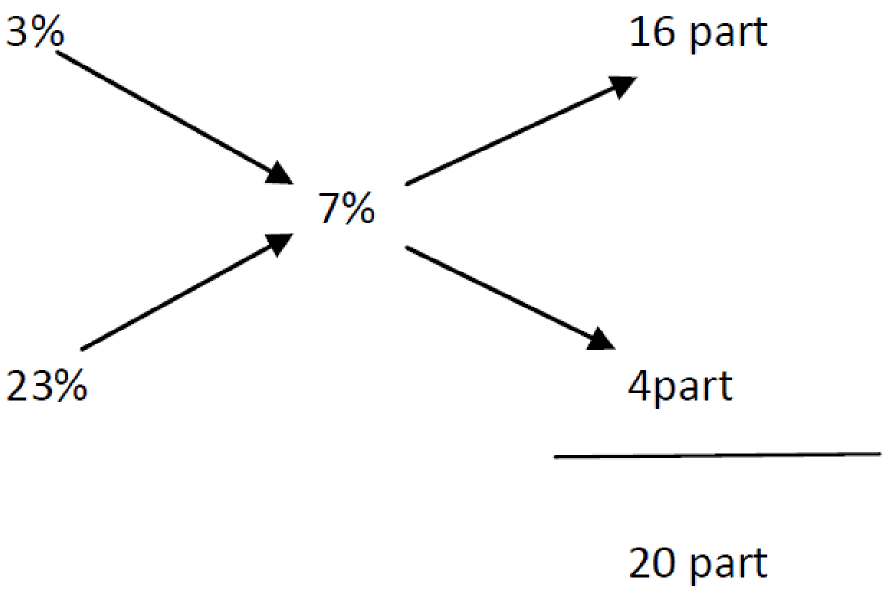
Preparing the solution

Select 500 mL volumetric flask. Measure and transfer the calculated volume of the liquid material into the flask, preferably using a funnel to assure no material is lost during transfer. Rinse the sides of the funnel with your solvent (e.g. water for aqueous solutions) down into the flask to capture any residual material adhering to the funnel. Next, fill the flask about halfway with your solvent, cap the flask and swirl. Then, fill the flask with your solvent by carefully adding enough solvent to raise the base of the meniscus of the solution to the level of the etched line. Finally, cap, mix, swirl and store your prepared solution until ready to use.

This 500 mL solution contains 6,8 g of H_2O_2, therefore %1.36 (w/v) or 13600 ppm

4- How do you prepare 7% (v/v) ethanol solution using 3% and 23 % stock solutions. What is the molarity of this solution (Density of absolute ethanol is 0.789 g/mL)?

For 100 mL final solution.



If 20 part is 100 mL

4 part is x mL

X= 20 mL

In order to prepare this solution we should take 4 part (or 20 mL) from 23% stock solution, transfer it to 100 mL volumetric flask and complete the volume using 3% stock solution.

7% (v/v) means 7 mL of ethanol in 100 mL solution.

If 1 mL of ethanol is 0,789 g

7 mL of ethanol is x g

X= 5,523 g ethanol in 100 mL solution

55,23g ethanol in 1000 mL

55,23/46,07 = 1,1988278 mol or 1,2 M.

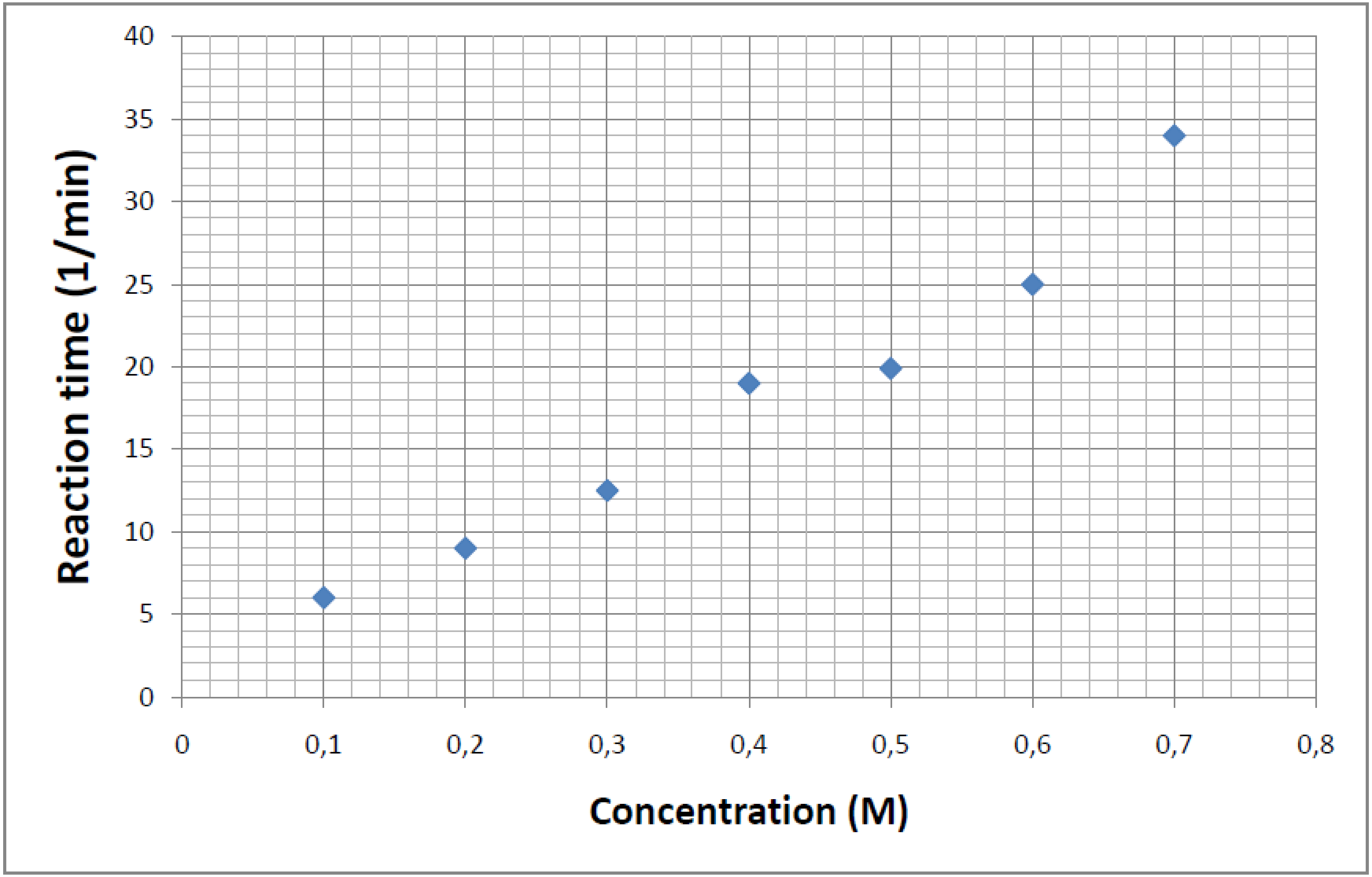
4- The reaction between propionaldehyde and hydrocyanic acid has been studied at 25 °C. In a certain aqueous solution at 25 °C the concentrations at various times were as follows.

[HCN]	Reaction time (min)
0,1	0,24
0,2	0,12
0,3	0,08
0,4	0,06
0,5	0,05
0,6	0,04
0,7	0,03

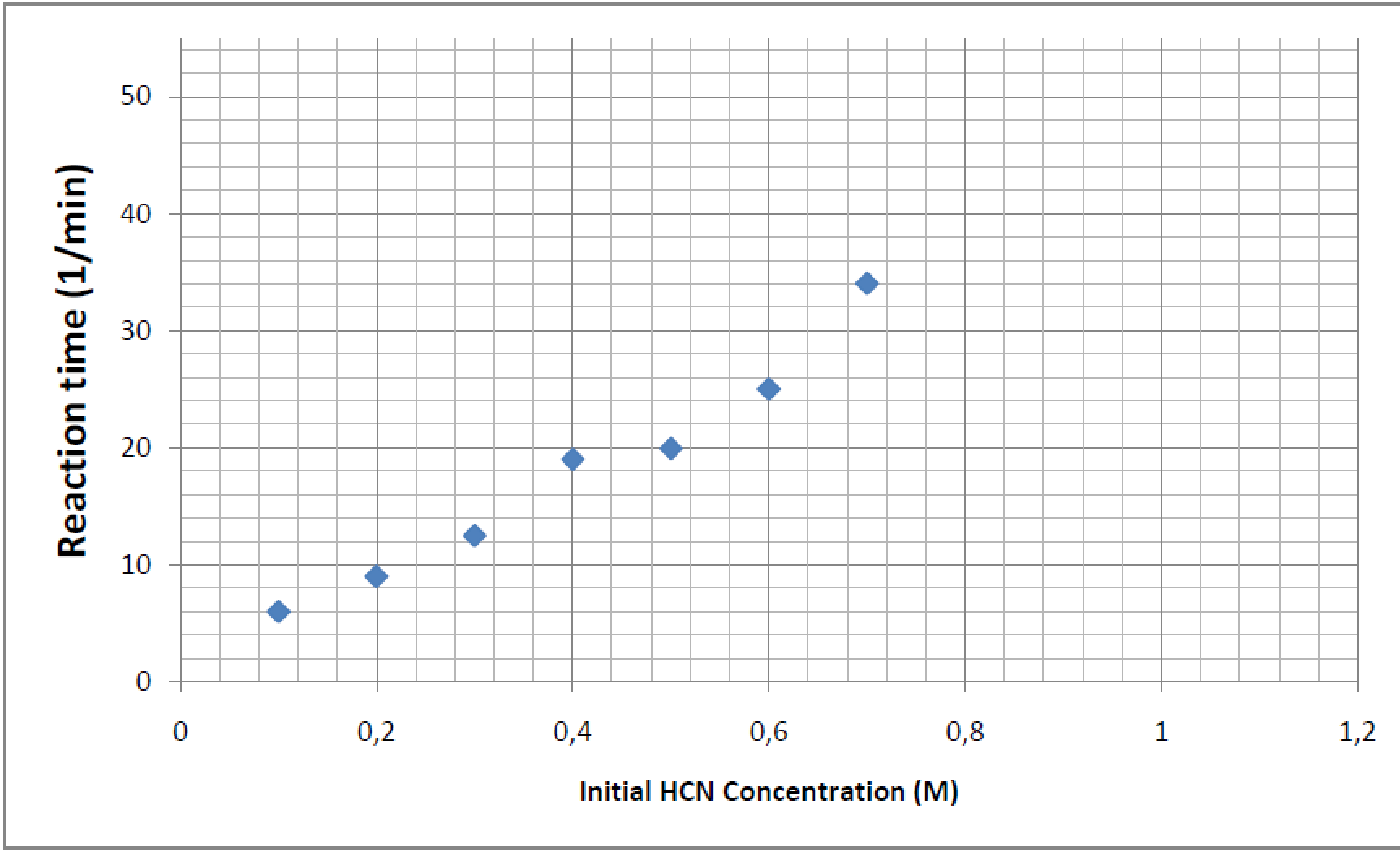
If initial HCN concentration is 1.2M, 0,35M or 0,05 M what is the expected reaction times?

We should draw the graphic of Initial conc. Versus 1/ reaction time

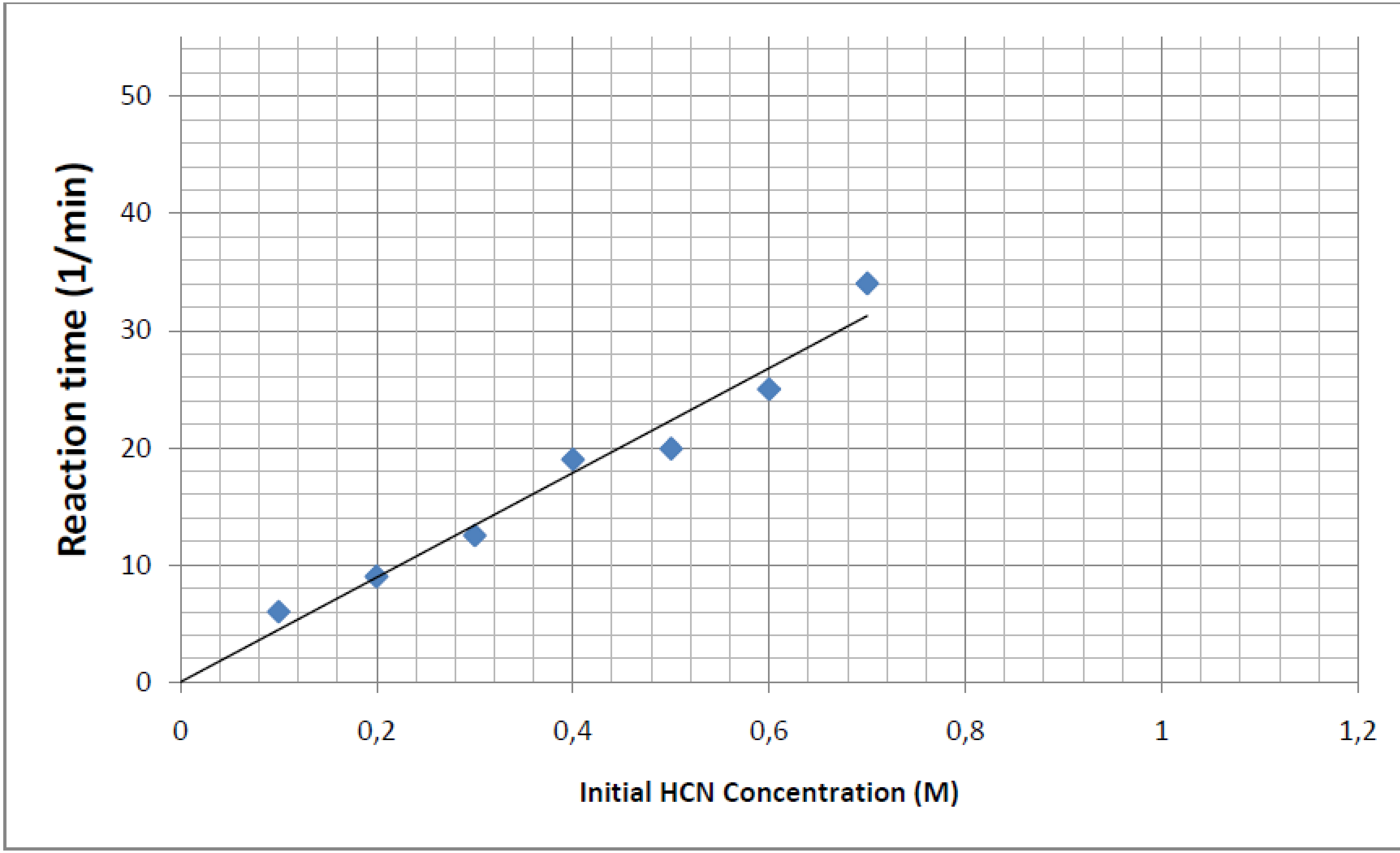
[HCN]	Reaction time (min)	1/Reaction time
0,1	0,24	6
0,2	0,12	9
0,3	0,08	12,5
0,4	0,06	19
0,5	0,05	19,9
0,6	0,04	25
0,7	0,03	34



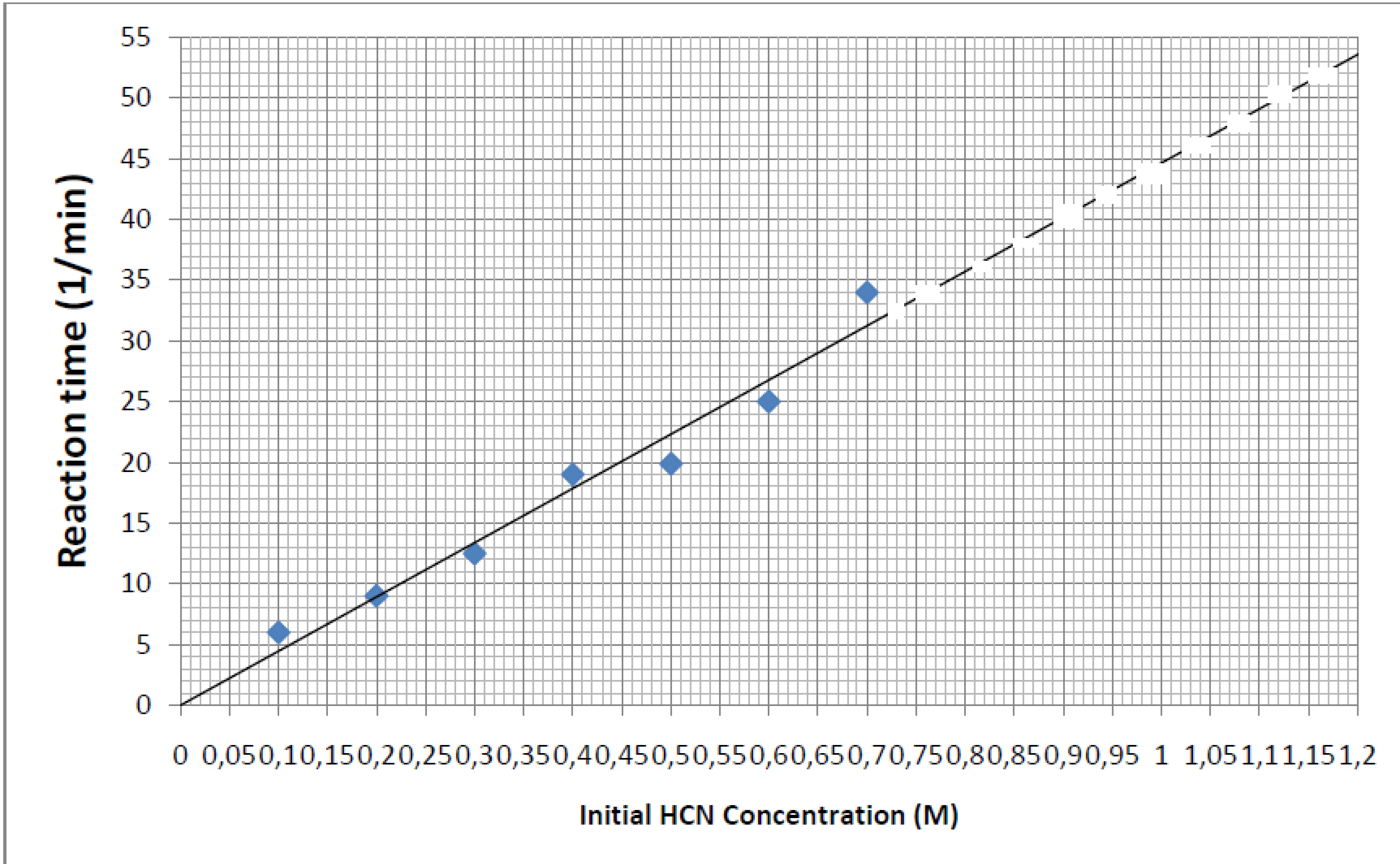
You should carefully choose your limit values. For this problem we have to find out the rate of the reaction with the 1.2 M initial concentration therefore your graphic should include 1.2 M.



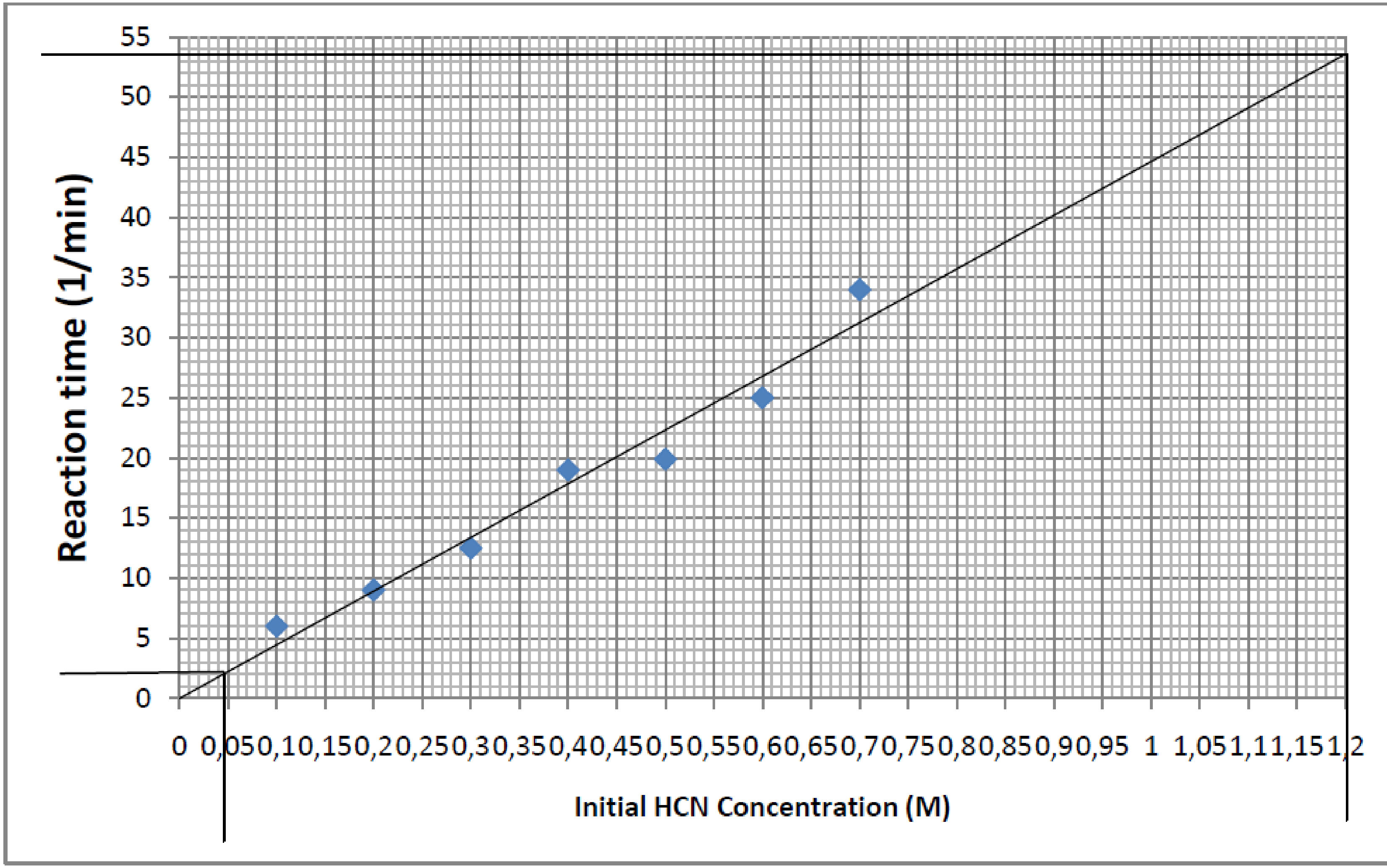
Draw your trend line and find the answers.



For values outside your experimental area extrapolate the answer.



Reaction time (1/min)
55
50
45
40
35
30
25
20
15
10
5
0
0 0,05 0,1 0,15 0,2 0,25 0,3 0,35 0,4 0,45 0,5 0,55 0,6 0,65 0,7 0,75 0,8 0,85 0,9 0,95 1 1,05 1,1 1,15 1,2
Initial HCN Concentration (M)



You can also calculate the slope and determine the graphics equation. For this purpose either use your best fitted experimental data or directly calculate from the trendline.

For graphics intercept at zero y=mx

For graphics not intercept at zero y=mx+c

For this problem when x=0,2 y= 9 y/x= 45 y=45x

$Y=45 \times 1.2 = 54$

You may use computer programs to calculate this value.

$y = 44,64x$

$R^2 = 0,962$

5- Hydrogen peroxide reacts with thiosulfate ion in slightly acidic solution as follows.

$$H_2O_2 + 2S_2O_3^{2-} + 2H^+ \rightarrow 2H_2O + S_4O_6^{2-}$$

This reaction rate is independent of the hydrogen-ion concentration in the pH range 4 to 6. The following data were obtained at 25 ◦C and pH 5.0. Draw the graphic between initial concentration and 1/reaction rate.

Flask	0,5 M H_2O_2	0,1 M $Na_2S_2O_3$	CH_3COOH/ $NaCH_3COOH$ Buffer pH 5	Distilled Water	Reaction rate s
1	10 mL	0mL	50 mL	40 mL	4200
2	10 mL	1 mL	50 mL	39 mL	2900
3	10 mL	2 mL	50 mL	38 mL	2500
4	10 mL	5 mL	50 mL	35 mL	1200
5	10 mL	8mL	50 mL	32 ml	900
6	10 mL	10 mL	50 mL	30 mL	720

First we have to calculate the molarity of $Na_2S_2O_3$ in each flask.

For flask 1 concentration is zero.

For Flask 2 we take 1 mL from 0,1 M solution

0,1 mol 1000 mL

0,0001 mol 1 mL

Then we make up to volume to 100 mL.

0,0001 mol in 100 mL

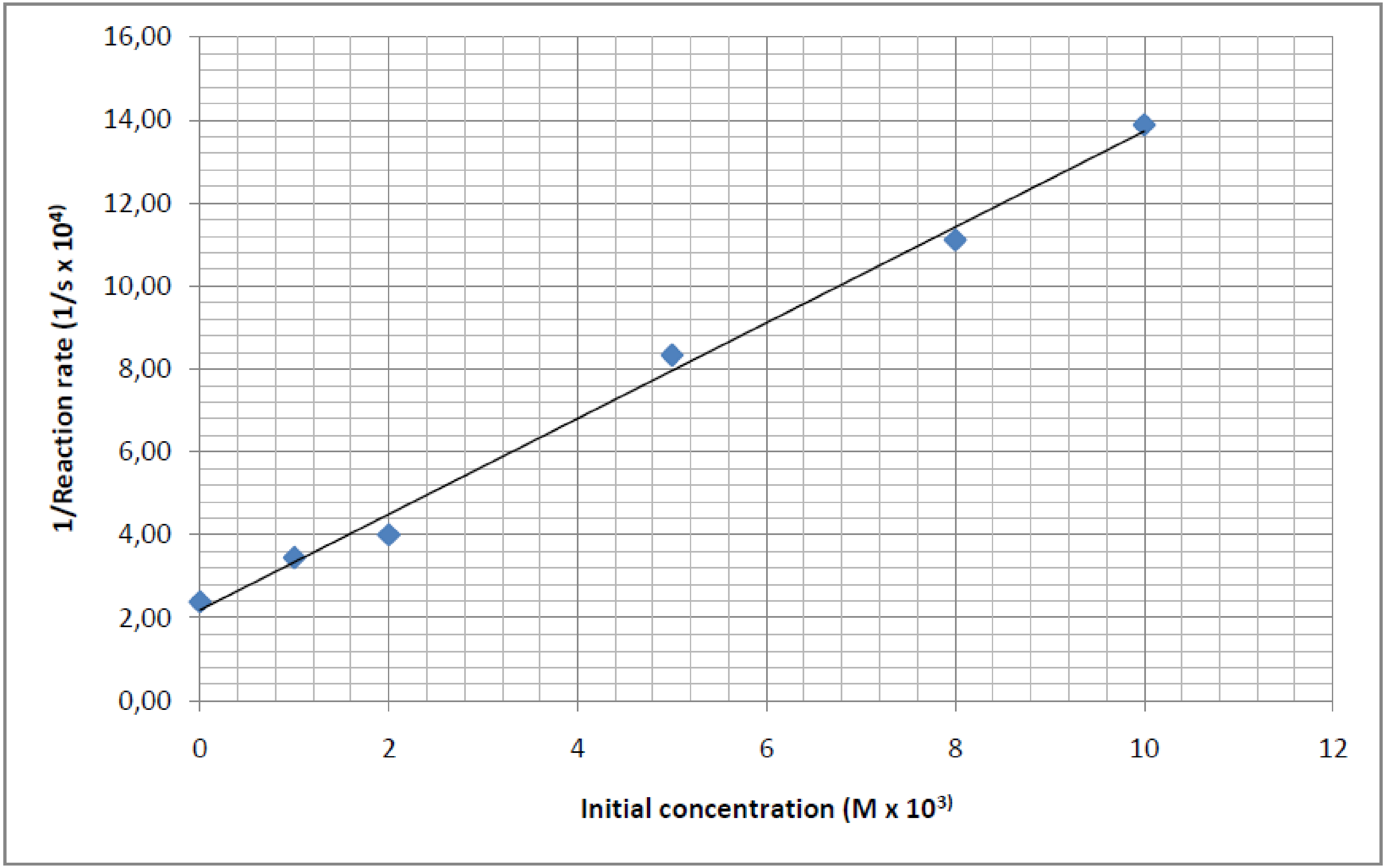
0,001 mol in 1000 mL or 0,001 molar.

Since this value is hard to write down we can use mmolar (mM) or exponential value 1×10^{-3} M

Other values are proportional with the second value.

Flask	0,5 M H_2O_2	0,1 M $Na_2S_2O_3$	CH_3COOH/ $NaCH_3COOH$ Buffer pH 5	Distilled Water	[$Na_2S_2O_3$] M	Reaction rate s	1/Reaction rate s-1
1	10 mL	0mL	50 mL	40 mL	0	4200	0,000238
2	10 mL	1 mL	50 mL	39 mL	0,001	2900	0,000345
3	10 mL	2 mL	50 mL	38 mL	0,002	2500	0,000400
4	10 mL	5 mL	50 mL	35 mL	0,003	1200	0,000833
5	10 mL	8mL	50 mL	32 ml	0,008	900	0,001111
6	10 mL	10 mL	50 mL	30 mL	0,010	720	0,001389

Flask	0,5 M H_2O_2	0,1 M $Na_2S_2O_3$	CH_3COOH/ $NaCH_3COOH$ Buffer pH 5	Distilled Water	[$Na_2S_2O_3$] M	Reaction rate s	1/Reaction rate s^{-1}
1	10 mL	0mL	50 mL	40 mL	0	4200	$2,38 x10^{-4}$
2	10 mL	1 mL	50 mL	39 mL	$1 x 10^{-3}$	2900	$3,45 x 10^{-4}$
3	10 mL	2 mL	50 mL	38 mL	$2 x 10^{-3}$	2500	$4x10^{-4}$
4	10 mL	5 mL	50 mL	35 mL	$5 x 10^{-3}$	1200	$8,33 x 10^{-4}$
5	10 mL	8mL	50 mL	32 ml	$8 x 10^{-3}$	900	$11,11x10^{-4}$
6	10 mL	10 mL	50 mL	30 mL	$10 x 10^{-3}$	720	$13,89 x 10^{-4}$



In order to determine graphics equation we have to know the slope ans interceptions.

Y=mx+c

y = 1,154x + 2,193

R^2 = 0,994

If you add 250 mL of %3 (w/v) sodium acetate (mw 82 g/mol) to 0,4 M 300 mL acetic acid (mw 60 g/mol) solution (pKa acetic acid= 4,76);

a- What would be the final pH of the resulting buffer solution?

%3 → 3g 100 mL → 7,5 g 250 mL → 0,09146 mol CH_3COONa in 250 mL

0,4M → 0,4 mol in 1000 mL → 0,12 mol CH_3COOH in 300 mL

300 mL + 250 mL = 550 mL

pH= pKa + log [salt]/[Acid] → pH= 4,76 + log [(0,09146mol /550 mL)]/[(0,12 mol/550 mL)]

pH = 4,76 - 0,11795 = 4,642

b- if 5 mL of 0,1 M HCl is added to this buffer solution what would be the final pH?

0,1 M HCl → 0,1 mol H^+ in 1000 mL → 0,0005 mol H^+ in 5 mL

Toplam Hacim 250 + 300 + 5 = 555 mL

HA → A^- + H^+

or

CH3COOH → $CH3COO^-$ + H^+

if H^+ is added to the solution equilbrium shifted to the reactants

CH3COOH ← → $CH3COO^-$ + H^+

A mole → B mole +x mole added

A + x mol → B - x mole

0,12 mol + 0,005 mol/ 555 mL 0,09146 - 0,005 mol/555 mL

0,1205 mol CH3COOH/555 mL 0,09096 mol $CH3COO^-$ /555 mL

pH = pKa + log [0,09096/555)]/[(0,1205/555) = 4,6379

pH decreases by 0,004 if 5 mL 0,1 M HCl added!

c-if 5 mL 0,1 M HCl added to 550 mL of water what will be the pH of the solution?

0,0005 mol HCl in 555 mL → 0,0009 mol HCl in 1000 mL → 0,0009 M

pH=-log (0,0009)= 3,0458

pH decreases by 1,5962 (dont forget pH scale is logorithmic!)