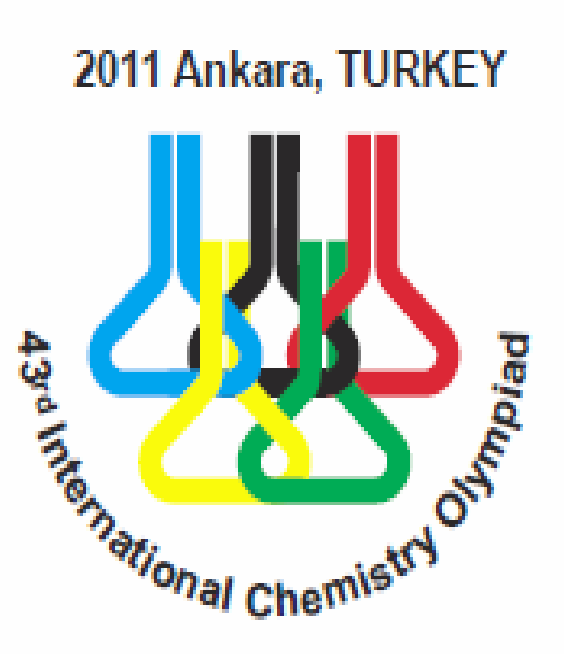
Name: Code:



43rd International Chemistry Olympiad

Practical Tasks Answer Sheets Grading

12 July 2011
Ankara, Turkey

Name: Code:

Task 1 12% of the total

Analysis of Chloride Mixtures

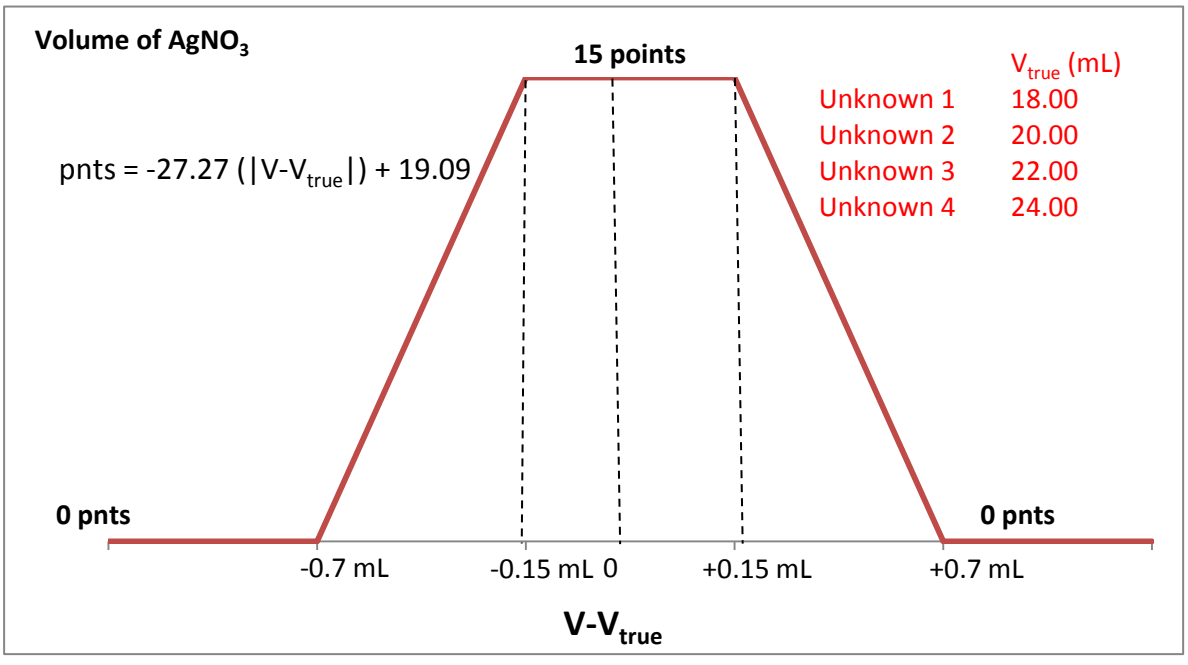
A	B	1	2	3	Task 1	x%
16	16	2	2	6	42	12

A. Determination of total chloride by Fajans Method

Exact concentration of $AgNO_3$ in standard solution = 0.09968 mol/L

Volume of standard $AgNO_3$ solution used

V = mL,



1 point is for correct number of significant figures from reading volumes. (15 +1 points)

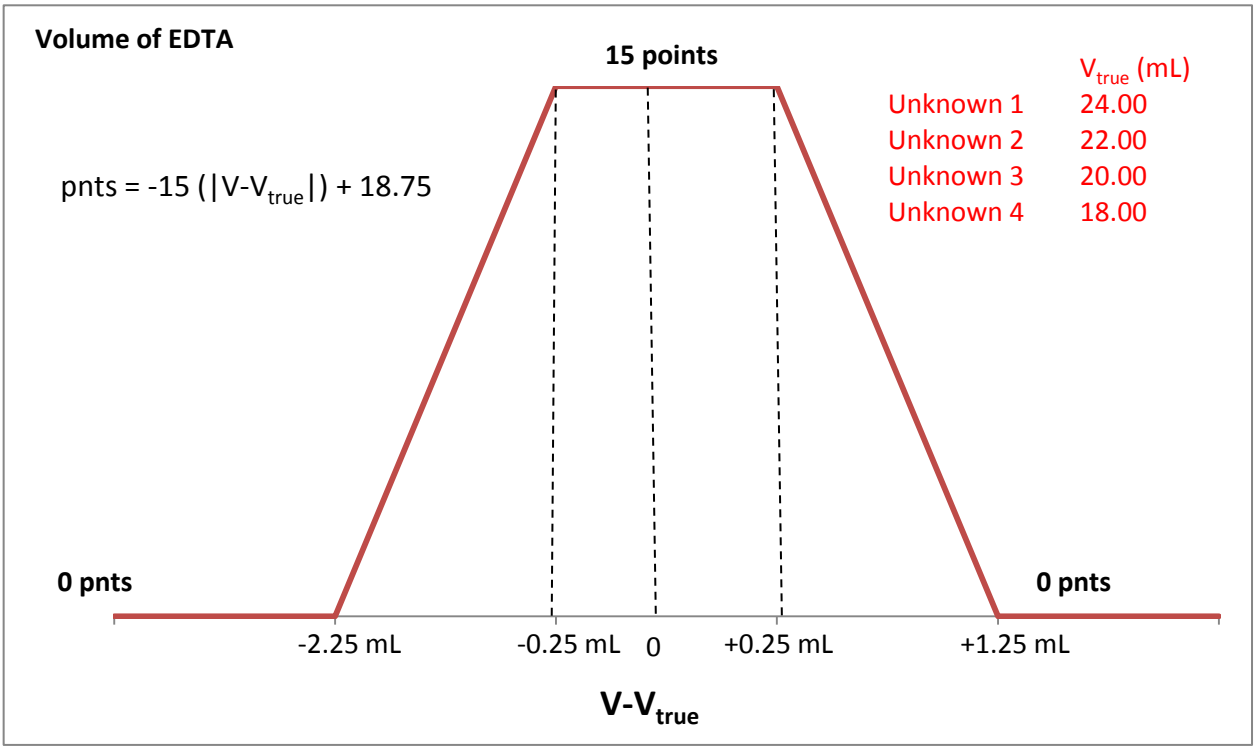
Name: Code:

B. Determination of Mg^{2+} by direct titration with EDTA

Exact concentration of EDTA in standard solution = 0.01019 mol/L

Volume of standard EDTA solution used

V = mL



1 point is for correct number of significant figures from reading volumes. (15+1 points)

Treatment of Data

1.

Total amount of Cl^- ion in 100.0 mL unknown solution = mmol (2 pt, within ±10%)

Unknown 1 17.94
Unknown 2 19.94
Unknown 3 21.93
Unknown 4 23.92

2.

Total amount of Mg^{2+} ion in 100.0 mL unknown solution = mmol (2 pt, within ±10%)

Unknown 1	0.9782
Unknown 2	0.8967
Unknown 3	0.8152
Unknown 4	0.7337

3.

For $MgCl_2$ = g/100 mL (2 pt, within ±10%)

Unknown 1	0.09313
Unknown 2	0.08537
Unknown 3	0.07762
Unknown 4	0.06986

For NaCl = g/100 mL (4 pt, within ±10%)

Unknown 1	0.9341
Unknown 2	1.061
Unknown 3	1.186
Unknown 4	1.312

Name: Code:

Task 2

12% of the total

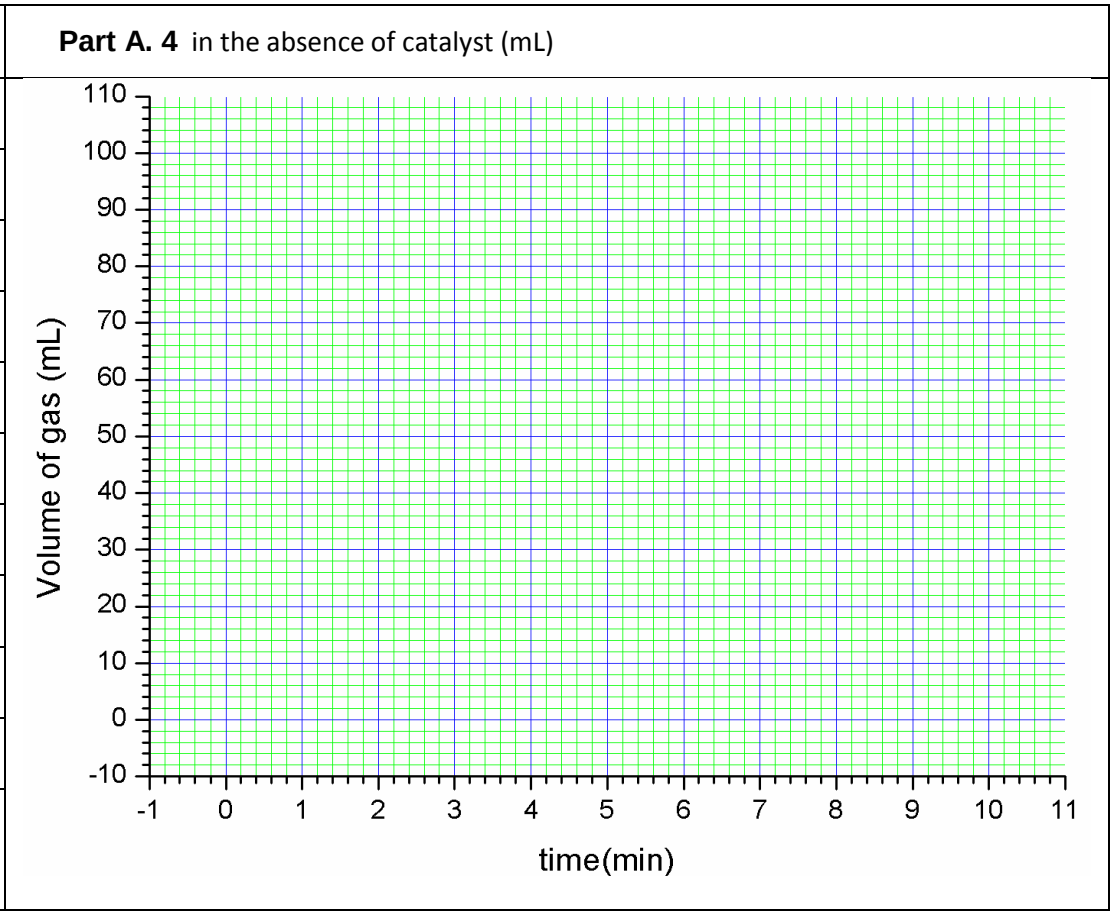
A		B					Task 2	x%
1	2	1	2	3		4		
				i	ii			
3	1	12	2	2	2	2	24	12

Hydrogen generation from ammonia borane

Part A. Reaction of ammonia borane in the absence of catalyst

1. The gas volume versus time data and the graph for the reaction of ammonia borane in the absence of catalyst

Time (min)	V_{gas} (mL)
0	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	



(3 points)
1 point for the graph
If the volume of gas produced stays within the range of 0-2 mL 2 points
>2 mL 1 points
>3 mL 0 points

2. Report the volume of gas evolved, $V_{uncatalyzed}$.

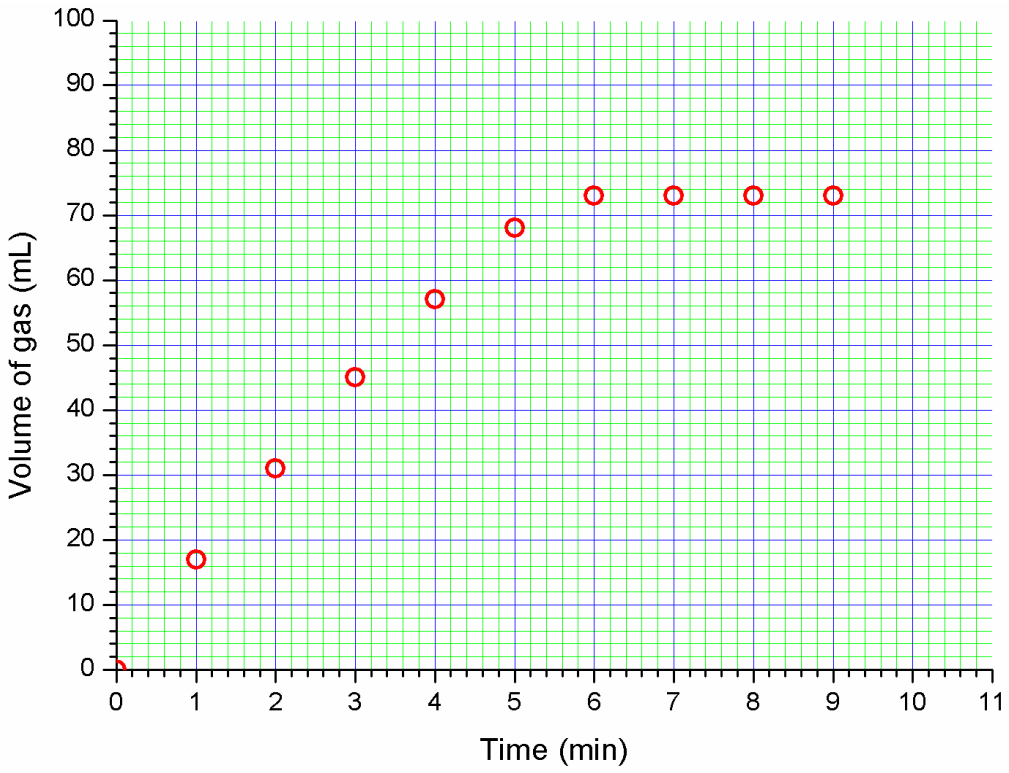
$V_{uncatalyzed}$ = 0 mL (1 point)

Part B. Reaction of ammonia borane in the presence of catalyst

1. The gas volume versus time data and the graph for the reaction of ammonia borane in the presence of catalyst

Time (min)	V_{gas} (mL)
0	0
1	17
2	31
3	45
4	57
5	68
6	73
7	73
8	73
9	73
10	

Part B. Gas volume versus time graph in the presence of catalyst



(12 points)

6 points for $V_{measured} > 0.92\ V_{max}$, Points for volume $= 30\ (V_{measured} - 0.8V_{max})/V_{max}$

6 points for $rate_{measured} > 0.92\ rate_{max}$, Points for rate $= 30\ (rate_{measured} - 0.8rate_{max})/rate_{max}$

2. Calculate the maximum number of moles and the maximum volume (mL) of hydrogen gas which will be evolved theoretically from the hydrolysis of 29.5 mg ammonia borane with a purity of 97% w/w at 25 °C. The atmospheric pressure is 690 torr.

$V(H_2)_{max}$ = mL

(2 points)

3. Calculate the rate of hydrogen generation in your experiment.

i) in mL H2/ min

Rate = mL $H_2 \cdot min^{-1}$

(2 points)

ii) in mmol H2/ min by assuming that the temperature is 25 °C. The atmospheric pressure is 690 torr.

Rate = mmol $H_2 \cdot min^{-1}$

(2 points)

4. Calculate the rate of hydrogen production per mole of palladium in (mol H2)•(mol Pd)-1•(min)-1. The purity of potassium tetrachloropalladate(II) is 98% w/w.

The rate of hydrogen production per mole of palladium = mol $H_2 \cdot (\text{mol Pd})^{-1} \cdot \text{min}^{-1}$

(2 points)

Name: Code:

Task 3

16% of the total

1	2	3	4		Task 3	X%
			i	ii		
5	6	3	12	12	38	16

Synthesis, purification and separation of a diastereomeric mixture

1. Copy (sketch) the TLC1 plate in bag "**TLC1**" on your answer sheet.

1) For the appearance of three spots loaded on the base line,

   1 point.

2) For the well developed and separated spots on the TLC.

   2 points

3) For the solvent front line and the base line

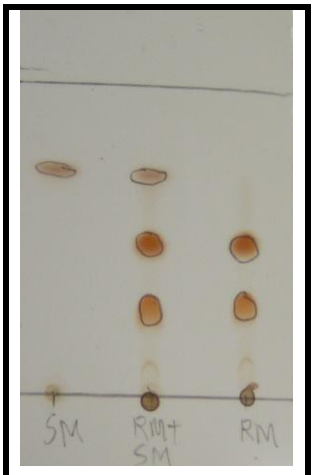
   1 point

4) For the accurate representation of the sketch of the TLC plate.

   1 point

5 points

TLC1



2. Copy (sketch) the TLC2 plate in bag "**TLC2**" on your answer sheet.

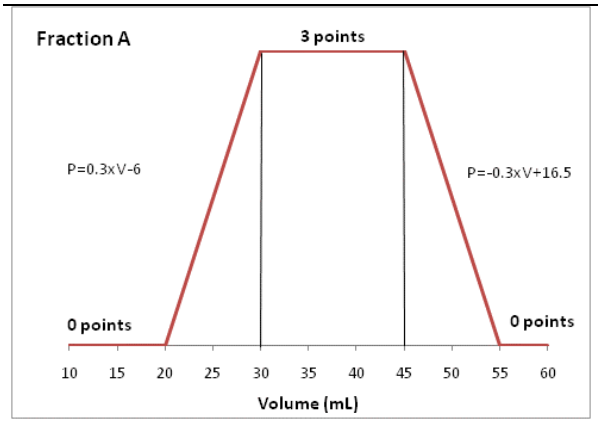
1) For the appearance of three spots loaded on the base line. 1 point. 2) For the well developed and separated spots on the TLC. 2 points 3) For the solvent front line and the base line 1 point 4) For the accurate representation of the sketch of the TLC plate. 1 point 5) For the absence of fraction **B** in fraction **A** and vice versa. 1 point 6 points	TLC2 

3. Determine and record the R_f values of the spots on the TLC2 plate in bag "**TLC2**."

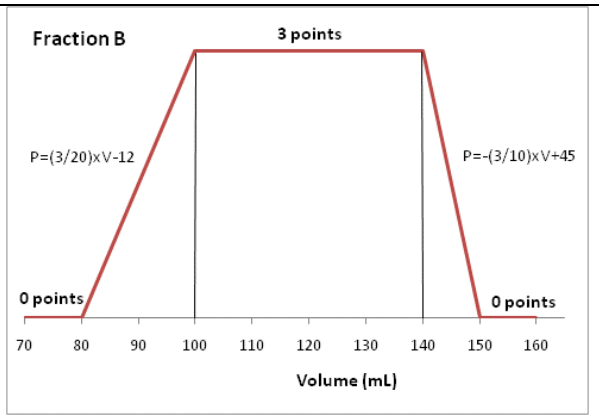
Spots	R_f value
Fraction **A**	0.40-0.50
Fraction **B**	0.20-0.30
Starting material (**SM**)	0.65-0.75 3 points

4. Measure and record the volume and absorbance values for fraction **A** and fraction **B**.

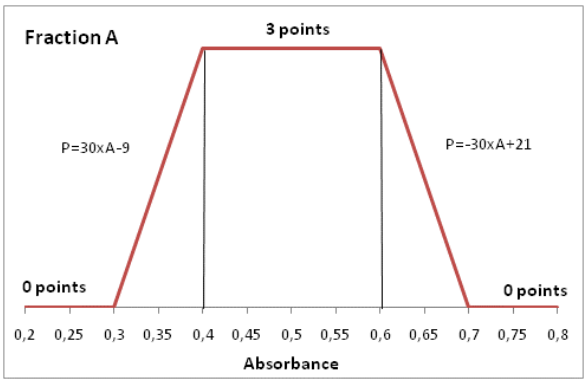
Sample	Volume	Absorbance
Fraction **A**	mL 3 points	3 points
Fraction **B**	mL 3 points	3 points



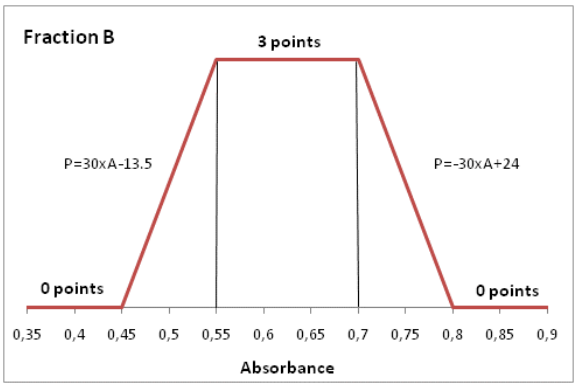
If 20.0 mL ≤ volume 0.0 point
If 20.0 mL ≤ volume < 30.0 mL, 0.0-3.0 points
If 30.0 mL ≤ volume < 45.0 mL, 3.0 points
If 45.0 ≤ volume < 55.0 mL, 3.0-0.0 points
If 55.0 ≤ volume 0.0 points



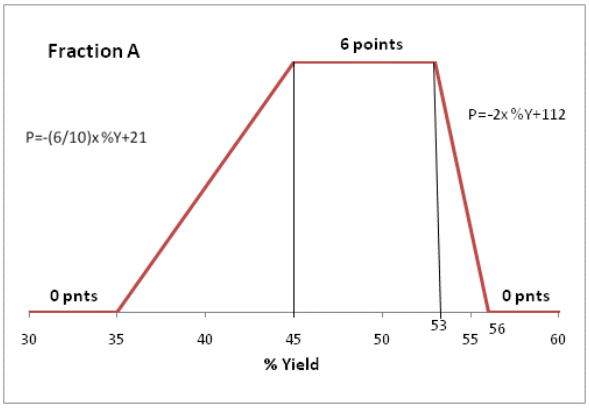
If 80.0 mL ≤ volume 0.0 points
If 80.0 mL < volume ≤100.0 mL, 0.0-3.0 points
If 100.0 ≤ volume < 140.0 mL, 3.0 points
If 140.0 ≤ volume < 150.0 mL, 3.0-0.0 points
If volume ≥ 150.0 mL, 0.0 points



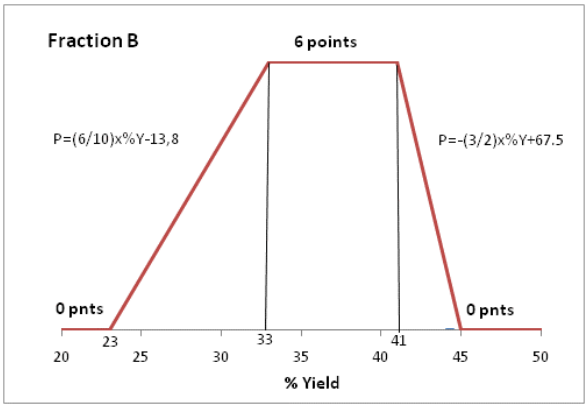
If absorbance < 0.30, 0 points
If 0,30 ≤ absorbance < 0.40, 0-3 point
If 0,40 ≤ absorbance < 0.60, 3.0 points
If 0,60≤ absorbance < 0.70, 3-0 points
If absorbance ≥ 0.75, 0 points



If absorbance < 0.45, 0 points
If 0.45 ≤ absorbance < 0.55, 0-3 point
If 0.55 ≤ absorbance < 0.70, 3.0 points
If 0,70 ≤ absorbance < 0.80, 3.0-0.0 points
If absorbance ≥ 0.8, 0.0 points



If %yield < 35, 0.0 points
If 35.0 ≤ %yield < 45.0, 0-6 points
If 45.0 ≤ %yield < 53.0, 6 points
If 53.0 ≤ %yield < 56.0, 6-0 points
If %yield ≥ 56, 0 points



If %yield < 23, 0.0 points
If 23.0 ≤ %yield < 33.0, 0-6 points
If 33.0 ≤ %yield < 41.0, 6 points
If 41.0 ≤ %yield < 44, 6-0 points
If %yield ≥ 45, 0 point

Name: Code: