

073206T4CHE

CHEMICAL ENGINEERING TECHNOLOGY LEVEL 6

ENG/OS/CE/CR/02/6

Perform Process Quality Control

July/August 2025



**TVET CURRICULUM DEVELOPMENT, ASSESSMENT AND CERTIFICATION
COUNCIL (TVET CDACC)**

PRACTICE ASSESSMENT

Time: 3 HOURS

INSTRUCTIONS TO CANDIDATE:

1. You are required to perform the following task:
 - i) **Task 1:** Determine the concentration of solution X using a Colorimeter
2. You have been provided with the following resources for the practical tasks:
 - Colorimeter
 - Cuvette (with cap)
 - 2 beakers of 100 mL
 - 10 mL Graduated cylinder
 - 6 test tubes
 - Test tube rack
 - Gloves

- Mask
- Safety goggles
- 0.001 M potassium permanganate (KMnO_4) solution
- Solution X (potassium permanganate solution of unknown concentration)
- 100 mL of distilled water
- 6 labels
- Tissue paper
- Graph paper

Note:

- All cuvettes should be wiped clean and dry on the outside with a tissue.
- Handle cuvettes only by the top edge of the ridged sides.
- All solutions should be free of bubbles.
- Always position the cuvette so that the light beam will pass through

Procedure

- First, select the appropriate wavelength on the color of potassium permanganate (KMnO_4)
- Calibrate the Colorimeter with a clear cuvette containing distilled water
- Label the six clean, dry, test tubes as blank, Std 1, Std 2, Std 3, Std 4, Std 5
- Add 1, 2, 3, 4 and 5 mL of 0.001 M KMnO_4 solution into Test Tubes Std 1, Std 2, Std 3, Std 4 and Std 5, respectively, as shown in Table 1.
- Add 10, 9, 8, 7, 6 and 5 mL of distilled water into Test Tubes Blank, Std 1, Std 2, Std 3, Std 4 and Std 5, respectively, as shown in Table 1.
- Thoroughly mix each solution with a stirring rod. Clean and dry the stirring rod between stirrings.
- Calculate the concentration of the solutions in the test tubes using equation 1 and complete Table 1

$$C_1 V_1 = C_2 V_2 \quad (1)$$

Where:

C_1 : The concentration of the starting solution

V_1 : The volume of the starting solution

C_2 : The concentration of the final solution

V_2 : The volume of the final solution

Table 1

Standard	Volume of 0.001 M KMnO_4 (mL)	Volume of H_2O (mL)	Final Volume of solution (mL)	Concentration (M)
Blank	0	10	10	0
Std 1	1	9	10	
Std 2	2	8	10	
Std 3	3	7	10	
Std 4	4	6	10	
Std 5	5	5	10	

- h) Empty the water from the cuvette used during calibration
- i) Using the solution in test tube Std 1, rinse the cuvette twice with approximately 1 mL amounts of solution from the test tube, and then fill the cuvette with the solution. Cap the cuvette.
- j) Wipe the outside of the cuvette with a paper, place the cuvette in the calorimeter and close the lid
- k) Take the reading of transmittance and record the data in Table 2
- l) Similarly, take the transmittance reading for the remaining samples Std 2 through Std 5
- m) Fill the absorbance column in Table 2 for standards Std 1 through Std 5
- n) Plot a graph of absorbance against concentration
- o) Measure about 10 mL of the solution X into a clean, dry, test tube.
- p) Rinse the cuvette twice with approximately 1 mL amounts of the solution X and then fill the cuvette with the solution X.
- q) Cap the cuvette. Wipe the outside with a tissue and place the cuvette in the Colorimeter and close the Colorimeter lid.
- r) Take the transmittance reading and record in Table 2
- s) Determine the corresponding absorbance and record it in Table 2
- t) Use your graph to determine the concentration of the solution X

Table 2

Standard	Concentration (M)	Transmittance T (%)	Absorbance = $-\log_{10}\left(\frac{T(\%) }{100}\right)$
Blank	0	100	0
Std 1			
Std 2			
Std 3			
Std 4			
Std 5			
Solution <i>X</i>			