



UNIVERSITY OF MINES AND TECHNOLOGY, TARKWA
SECOND SEMESTER EXAMINATIONS, MAY 2019

COURSE NO: ES 370
COURSE NAME: COMPUTER APPLICATION
CLASS: ES III **TIME:** 3.5 HOURS

Name: _____ Index Number: _____

ANSWER ALL QUESTIONS (60 MARKS)

QUESTION ONE (20 MARKS)

Perchloroethylene (PCE) is an organic chemical that has been introduced into a near by soil as a result of laundry activities around the Chamber of Mines Hall at the University of Mines and Technology, UMaT, Tarkwa. The contaminated soil was sampled and the PCE chemical was determined using the Gas Chromatograph Mass Spectrometer (GCMS) analytical instrument at the ES Department. During the sample preparation, each sample was extracted with 10 mL toluene as a solvent. Standards were also prepared in toluene. The same amount of benzene was added as internal standard to both samples, control and standards. The output data from the GCMS and the corresponding weight of the sample for the analysis are shown in Table 1 below.

Table 1. GCMS analysis results

	Std Conc. [$\mu\text{g/L}$]	Area PCE (ion 166)	Area Benzene (ion 78)	Weight (g)
Std1	1	21546	101015	
Std2	2	43634	103216	
Std3	5	104536	98016	
Std4	10	225066	93015	
Std5	20	437486	110232	
Std6	50	1055636	103261	
Sample1		234536	103213	1.045
Sample2		264556	99563	1.035
Sample3		215764	96104	1.016
Sample4		70835	101546	0.506
Sample5		67458	106040	0.495
Sample6		85271	99150	0.510
CRM [200 $\mu\text{g/kg}$]		209154	96014	0.500

- (a) Determine the standardization relationship by a linear regression analysis and report the 95% confidence intervals for the slope and y-intercept. **(10 marks)**
- (b) Calculate the concentration for each sample in mg/kg. **(5 marks)**
- (c) Sample 1, 2 and 3 are from the same location, likewise 4, 5 and 6. Calculate the RSD% for the two locations. **(3 marks)**
- (d) Evaluate the accuracy for the method using the Certify Reference Material (CRM). **(2 marks)**

HINT: Use the LINEST function in Microsoft Excel and its associated functions to perform an interactive spreadsheet.

QUESTION TWO (20 MARKS)

A pollutant is accidentally released into a lake water at a uniform concentration. The outlet of the lake flows at 45,000 m³/year. The average volume of the lake was found to be 250,000 m³. In the assessment of the pollutant's fate in lake water, the following concentrations for a period of 9 days were obtained as shown in the Table 2 below. Using dynamic pollutant fate and transport modelling in excel, determine the following;

- (i) the model equation, the output graph and the removal rate. **(7 marks)**
- (ii) the half-life of this pollutant in years. **(8 marks)**
- (iii) The amount of the pollutant in the lake 12 days after the contamination has ended. **(5 marks)**

Table 2. Time vs. Pollutant Concentration

Time (day)	Conc. (mg/L)
0	100
1	47.2
3	10.5
5	2.35
7	0.52
9	0.117

QUESTION THREE (20 MARKS)

A water has the following chemical analysis;

Na ⁺	120 ppm	SO ₄ ²⁻	1115 ppm
K ⁺	15 ppm	Cl ⁻	15 ppm
Ca ²⁺	380 ppm	HCO ₃ ⁻	150 ppm
Mg ²⁺	22 ppm		
Sr ²⁺	0.8 ppm	SiO ₂	21 ppm
pH	7.4	Temp	25°C

Using Visual Minteq software on your computer with export to Excel, determine the following;

- The concentrations of the ionic species in mol/L. **(5 marks)**
- The ionic strength of the solution **(2 mark)**
- The total negative and positive charges. Do the charges balance? **(3 marks)**
- The activity coefficient for Sr²⁺ and SO₄²⁻ using the Davies equation **(3 marks)**
- By how much is the water undersaturated or supersaturated with respect to SrSO₄? **(2 mark)**
- State the mineral phases in solution that are undersaturated or supersaturated. By how much are these minerals supersaturated? **(6 marks)**

Note: Credit marks will be awarded to neat presentation of work in an Excel print out.

Examiners: Dr S. Fosu/Dr I. Quaicoe

