Part B : 10 Structured type, short answer questions (40 minutes)

(250- Marks)

1. (i) Write down the rate equation (differential rate law) for an elementary reaction of the form $A + B \longrightarrow$ products

$A + B \longrightarrow$ වල යන මූලික ප්‍රතික්‍රියාව සඳහා වේග සමීකරණය (අවකලනයට අදාල වේග නියමයට අනුව) (differential rate law) ලියන්න.

(ii) Derive the units of k (rate constant) if the rate of a reaction followed the rate law,

$\frac{d[A]}{dt} = k[A][B]^{2/3}$ යනුවෙන් ප්‍රතික්‍රියාවක් සඳහා වේග සමීකරණය දී ඇතිවිට

එහි වේග නියතය k සඳහා ඒකක වයුත්පන්න කරන්න.

(28 marks)

2. What do you understand by the following terms used in the study of Kinetics?
චාලක විද්‍යාව ඉගෙනීමේදී පහත වචනවලට අදාල අදහස කුමක් වේද?

(i) molecularity /අණුකතාවය

(ii) an elementary reaction /මූලික ප්‍රතික්‍රියාව

(16 marks)

3. A certain reaction [A $\longrightarrow$ P] is found to follow the differential rate law,
[A $\longrightarrow$ P] ප්‍රතික්‍රියාව සඳහා අවකලනමය වේග නියමය අනුව

$$-\frac{d[A]}{dt} = k\,[A]$$

(i) What is the order of this reaction? මෙම ප්‍රතික්‍රියාවේ පෙළ කුමක් ද?

(ii) Write down the expression for half-life of this reaction.
මෙම ප්‍රතික්‍රියාවේ අර්ධ ආයු කාලය සඳහා සමීකරණය ලියන්න.

(16 marks)

4. (i) Write down the Arhennius equation that relates rate constant to the activation energy.
සක්‍රියන ශක්තිය හා වේග නියතය අතර සම්බන්ධතාවය පෙන්වන ආහිනියස් සමීකරණය ලියන්න.

(ii) A certain reaction has a rate constant of 5.70×10^{-5} $mol^{-1}dm^3$ s^{-1} at 27 °C and a rate constant of 2.85×10^{-4} $mol^{-1}dm^3$ s^{-1} at 47 °C. Assuming that the activation energy (E_a) and the pre-exponential factor (A) are constants in the above temperature range, calculate E_a in **kJmol^{-1}** ($R = 8.314$ J mol^{-1} K^{-1})
ප්‍රතික්‍රියාවක 27 °C දී වේග නියතය 5.70×10^{-5} $mol^{-1}dm^3$ s^{-1} නම් ද 47 °C දී වේග නියතය 2.85×10^{-4} $mol^{-1}dm^3$ s^{-1} වේ. සක්‍රියන ශක්තිය (E_a) හා pre-exponential සාධකය (A) නියත යැයි දී ඇති උෂ්ණත්ව පරාසය තුලදී නියත වන්නේ යයි උපකල්පනය කරමින් සක්‍රියන ශක්තිය E_a **kJmol^{-1}** වලින් ගණනය කරන්න.
($R = 8.314$ J mol^{-1} K^{-1})

(40 marks)

5) State the Mathematical expression for the first law of thermodynamics.
තාප ගති විද්‍යාවේ පළමුවන නියමය ගණිතමය ආකාරයෙන් දක්වන්න.

(15 marks)

6) State clearly the type of systems and the conditions under which the following expressions can be applied;
පහත දී ඇති සමීකරණ කුමන තත්ව යටතේ කුමන පද්ධතියකට යෙදිය හැකිද යන්න දක්වන්න.

(i) $\Delta S = q_{rev} / T$

(ii) $\ln T + (\gamma - 1)\ln V = cons\tan t$

(20 marks)

7) Define "Thermal Capacity" of a system by writing down a mathematical expression. Indicate the type of system to which this concept applies.
"තාප ධාරිතාව" යන පදය අර්ථ දක්වමින් ඊට අදාල ගණිතමය සමීකරණය ලියා දක්වන්න. එහිදී කුමන ආකාරයේ පද්ධතියකට භාවිතා කල හැකිද යන්න දක්වන්න.

(20 marks)

8) 5 moles of an ideal gas undergoes an isothermal reversible expansion from an initial volume of 10 m^3 to a final volume of 100 m^3 at 300K. Calculate the entropy change for this expansion. ආරම්භක පරිමාව 10 m^3 සිට 100 m^3 දක්වා පරිපූර්ණ වායුවක මෝල 5 ක් සමෝෂ්ණ ප්‍රතිවර්ති ප්‍රසාරණයකට භාජනය කරනු ලැබේ. මෙම ප්‍රසාරණය සඳහා එන්ට්‍රෝපි වෙනස ගණනය කරන්න.

(25 marks)

9) Give the conditions under which real gases approach ideal behavior.
තාත්වික වායු කුමන තත්ත්ව යටතේ පරිපූර්ණ ලෙස හැසිරේ ද ?

(10 marks)

10) The data given below are for the freezing of 150 mol of $H_2O(l)$ into ice at 0^oC under standard atmospheric pressure. 0^oC වූ හා සම්මත වායුගෝලීය පීඩනයේ වූ ජලය $H_2O(l)$ මෝල 150 ක් ඝනිභවනයට අදාල දත්තයන් කිහිපයකි.

Molar enthalpy of fusion of ice under standard atmospheric pressure $= 6.2\ kJ\ mol^{-1}$

සම්මත වායුගෝලීය පීඩනයේදී අයිස්වල විලයනයට අදාල මෝලික එන්තැල්පිය

Molar volume of water at 0^oC/ 0^oC දී ජලය මෝලයක පරිමාව $= 18 \times 10^{-6}\ m^3\ mol^{-1}$

Molar volume of ice at 0^oC / 0^oC දී අයිස් මෝලයක පරිමාව $= 19.6 \times 10^{-6}\ m^3\ mol^{-1}$

Calculate q, w, ΔU, and ΔH for this process.

මෙම ක්‍රියාවලිය සඳහා q, w, ΔU, සහ ΔH ගණනය කරන්න.

(60 marks)

Part B : 10 short answer questions (40 minutes)

1. (i) Write down the rate equation (differential rate law) for an elementary reaction of the form

பின்வரும் வடிவத்தில் அமைந்த ஒரு அடிப்படைத் தாக்கத்திற்கான வீதச் சமன்பாடு (வகையீட்டு வீத விதி-differential rate law) இனைத் தருக.

$$A + B \longrightarrow \text{products}$$

(ii) Derive the units of k (rate constant) if the rate of a reaction followed the rate law,

ஒரு தாக்கத்தின் வீதம்பின்வரும்வீத விதியினைப் பின்பற்றுமாயின்,k (வீத மாறிலி-rate constant)இன் அலகுகளைத் தருவிக்குக.

$$\frac{d[A]}{dt} = k[A][B]^{2/3}$$

(28 marks)

2. What do you understand by the following terms used in the study of Kinetics?

இயக்கவியல் கற்கையில் பயன்படுத்தப்படும் பின்வரும் பதங்களிலிருந்து நீர் விளங்கிக்கொள்வது யாது?

(i) molecularity; மூலக்கூற்றுத்திறன்

(ii) an elementary reaction; அடிப்படைத் தாக்கம்

(16 marks)

3. A certain reaction [A $\longrightarrow$ P] is found to follow the differential rate law,

ஒரு குறித்த தாக்கம் [A $\longrightarrow$ P] ஆனது பின்வரும் வகையீட்டு வீத விதியைப் பின்பற்றுவதாக அறியப்பட்டது.

$$-\frac{d[A]}{dt} = k\,[\mathrm{A}]$$

(i) What is the order of this reaction?

இத் தாக்கத்தின் வரிசை யாது?

(ii) Write down the expression for half-life of this reaction.

இத் தாக்கத்தின் அரைவாழ்வுக்கான வெளிப்பாட்டினைத் தருக.

(16 marks)

4. (i) Write down the Arhennius equation that relates rate constant to the activation energy.
வீத மாறிலியை ஏவற் சக்தியுடன் தொடர்புபடுத்தும் ஆர்கீனியஸ் சமன்பாட்டினைத் தருக.

(ii) A certain reaction has a rate constant of 5.70×10^{-5} $mol^{-1}dm^3$ s^{-1} at 27 °C and a rate constant of 2.85×10^{-4} $mol^{-1}dm^3$ s^{-1} at 47 °C. Assuming that the activation energy (E_a) and the pre-exponential factor (A) are constants in the above temperature range, calculate E_a in **kJmol^{-1}** ($R = 8.314$ J mol^{-1} K^{-1})
ஒரு குறித்த தாக்கம் ஆனது,27°C இல் 5.70×10^{-5} mol^{-1} dm^3 s^{-1} எனும் வீத மாறிலியையும்,47°Cஇல் 2.85×10^{-4} mol^{-1} dm^3 s^{-1} எனும் வீத மாறிலியையும் கொண்டுள்ளது. மேற் குறித்த வெப்பநிலை வீச்சில், ஏவற் சக்தியும் (E_a) pre-exponential factor (A)மாறிலிகள் எனக் கருதி,Ea இனை kJ mol^{-1} இல் கணிக்குக. ($R = 8.314$ J mol^{-1} K^{-1})

(40 marks)

5) State the Mathematical expression for the first law of thermodynamics.
வெப்பவியக்கவியலின் முதலாம் விதிக்கான கணித வெளிப்பாட்டினைத் தருக.

(15 marks)

6) State clearly the type of systems and the conditions under which the following expressions can be applied;
எவ் வகை அமைப்புகள் மற்றும் நிலைமைகளின் கீழ் பின்வரும் வெளிப்பாடு பிரயோகிக்கப்பட முடியும் எனத் தெளிவாகக் குறிப்பிடுக

(i) $\Delta S = q_{rev} / T$

(ii) $\ln T + (\gamma - 1)\ln V = cons\tan t$

(20 marks)

7) Define "Thermal Capacity" of a system by writing down a mathematical expression. Indicate the type of system to which this concept applies.
அமைப்பு ஒன்றின் "வெப்பக் கொள்ளளவு" எனும் பதத்தினை கணித வெளிப்பாடு ஒன்றினைப் பயன்படுத்தி வரையறுக்குக. இக் கருத்தினைப் பயன்படுத்தக்கூடிய அமைப்பின் வகையைக் குறிப்பிடுக.

(20 marks)

8) 5 moles of an ideal gas undergoes an isothermal reversible expansion from an initial volume of 10 m^3 to a final volume of 100 m^3 at 300K. Calculate the entropy change for this expansion.

300K இல் உள்ள ஆரம்பக் கனவளவு 10 m^3 ஆகவுள்ள ஒரு இலட்சிய வாயுவின் 5 mol ஆனது இறுதிக் கனவளவு 100 m^3 ஆக அமையும் சமவெப்ப மீளும் விரிவாக்கத்திற்கு உள்ளாகின்றது. இவ் விரிவாக்கத்திற்கான எந்திரப்பி மாற்றத்தினைக் கணிக்குக.

(25 marks)

9) Give the conditions under which real gases approach ideal behavior.

உண்மை வாயுக்கள் இலட்சிய நடத்தையை அண்மிக்கும் நிபந்தனைகளைத் தருக.

(10 marks)

10) The data given below are for the freezing of 150 mol of $H_2O_{(l)}$ into ice at 0°C under standard atmospheric pressure.

Molar enthalpy of fusion of ice under standard atmospheric pressure = 6.2 kJ mol^{-1}

Molar volume of water at 0°C = 18×10^{-6} m^3 mol^{-1}

Molar volume of ice at 0°C = 19.6×10^{-6} m^3 mol^{-1}

Calculate q, w, ΔU, and ΔH for this process.

கீழே தரப்பட்ட தரவுகள் 150 mol $H_2O_{(l)}$ இனை 0°C இல் நியம வளிமண்டல அமுக்கத்தில் பனிக் கட்டியாக உறையவைப்பது தொடர்பானவையாகும்.

நியம வளிமண்டல அமுக்கத்தில் பனிக் கட்டியின் உருகலின் மூலர் வெப்பவுள்ளுறை = 6.2 kJ mol^{-1}

0°C இல் நீரின் மூலர் கனவளவு = 18×10^{-6} m^3 mol^{-1}

0°C இல் பனிக்கட்டியின் மூலர் கனவளவு = 19.6×10^{-6} m^3 mol^{-1}

இச் செய்முறைக்கான q, w, ΔU மற்றும் ΔH என்பவற்றைக் கணிக்குக.

(60 marks)

The Open University of Sri Lanka

CMU1220/CME3220 – Basic Principles of Chemistry
(CAT) Assignment Test II - 2015/ 2016

This question paper consists of 2 **PARTS A & B.**
PART A carries 10 multiple choice questions
PART B carries **TEN** short answer structured type questions.

ANSWER ALL QUESTIONS

Registration Number: | | | | | | | | | | |

INSTRUCTIONS:

Each item is a statement or question that may be answered by one of the five responses given. There is only **one best** answer to every question. Mark a cross (**X**) over the most suitable answer.

1.	1	2	3	4	5	2.	1	2	3	4	5	3.	1	2	3	4	5
4.	1	2	3	4	5	5.	1	2	3	4	5	6.	1	2	3	4	5
7.	1	2	3	4	5	8.	1	2	3	4	5	9.	1	2	3	4	5
10.	1	2	3	4	5												

Unattempte Questions		Correct Answers		Wrong Answers		Marks	

THE OPEN UNIVERSITY OF SRI LANKA
B.Sc. Degree Programme Department of Chemistry
CMU 1220/ CME3220 – Basic Principles of Chemistry
CAT II – 2015/2016
Answer Guide

Part I - M.C.Q.

1) 3	**2) 4**	**3) 5**	**4) 2**	**5) 3**
6) 4	**7) 1**	**8) 1**	**9) 5**	**10) 1**

Part II

1. (i) $-\frac{d[A]}{dt} = k[A][B]$

(ii)

$$\frac{d[A]}{dt} = k[A][B]^{2/3}$$

$$k = \frac{mol\ dm^{-3}}{s(mol\ dm^{-3})(mol\ dm^{-3})^{\frac{2}{3}}} = mol^{-\frac{2}{3}}\ dm^2 s^{-1}$$

(Derivation – steps must be shown)

2. (i) molecularity – the sum of the number of reactant molecules (or the numerical value of the sum of the stoichiometric coefficients of the reactants) as appearing in the balanced equation of an **elementary reaction**

(ii) an elementary reaction – one step reaction

3. (i) One (1)

(ii)

$$t_{\frac{1}{2}} = \frac{\ln 2}{k}$$

4. (i) $k = Ae^{-\frac{E_a}{RT}}$

(ii) $28.5 \times 10^{-5} = Ae^{-\frac{E_a}{R320}}$ -----(1) $\quad 5.70 \times 10^{-5} = Ae^{-\frac{E_a}{R300}}$ ----(2)

---1/---2 gives $\quad 5 = \frac{e^{-\frac{E_a}{R320}}}{e^{-\frac{E_a}{R300}}} = e^{\frac{E_a}{R300} - \frac{E_a}{R320}}$

$$\ln 5 = \frac{E_a}{8.314}\left(\frac{1}{300} - \frac{1}{320}\right)$$

On simplifying, $E_a = 64.23$ kJ mol^{-1}

5. $du = dq + dw$

du – change in internal energy
dq – heat change
dw – work done

6. i) Reversible, Isothermal

ii) Ideal gas, reversible, adiabatic

7. $C = dq / dT$

Homogenous system

8. $\Delta S = nR \ln (V_2/V_1)$

$= 5 \text{ mol} \times 8.314 \text{ J K}^{-1} \text{mol}^{-1} \times \ln (100/10)$

$= 5 \times 8.314 \times 2.303 \log 10$

$= 95.74 \text{ J K}^{-1}$

9. At higher temperatures and lower pressure

10. $q = q_p = \Delta H$

$= -6.2 \text{ kJ mol}^{-1} \times 150 \text{ mol}$

$= -930 \text{ kJ}$

$w = - P (V_{ice} - V_{water})$

$= - 10^5 \text{ Pa} \times 150(19.6 - 18) \times 10^{-6} \text{ m}^3$

$= - 0.024 \text{ kJ}$

$\Delta u = q + w$

$= -930 \text{ kJ} - 0.024 \text{ kJ}$

$= -930.024 \text{ kJ}$