RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES

B.Sc. Honors in Chemistry
Third Year - Semester I Examination – July / August 2023

CHE 3120 – CALCULATIONS IN CHEMISTRY

Answer all questions. **Time: One (01) hour**

Symbols have their usual meaning.
Use of a non-programmable calculator is permitted.

1. a) Considering the complex number, $-6 + 6i$

   i) Find the argument

   ii) Express in polar form

   iii) Plot as a point in the complex plane

(30 marks)

b) If $y = (1 + x)^5$

Find $\frac{dy}{dx}$

(10 marks)

c) Prove that,

$$C_P - C_V = \left(\frac{\partial V}{\partial T}\right)_P \left[P + \left(\frac{\partial U}{\partial V}\right)_T\right]$$

Given that

$$H = U + PV$$

$$U = f(V, T)$$

$$H = f(P, T)$$

(20 marks)

d) If pressure (P), volume (V), and temperature (T) of a gas is represented by

$$\left(P + \frac{a}{V^2}\right)(V - b) = RT$$

Show that

$$\left[\frac{\partial}{\partial V}\left(\frac{\partial P}{\partial T}\right)_V\right]_T = \left[\frac{\partial}{\partial T}\left(\frac{\partial P}{\partial V}\right)_T\right]_V$$

(20 marks)

e) The Clausius–Clapeyron equation for liquid–vapour equilibrium is

$$\frac{d \ln P}{d T} = \frac{\Delta H_{vap}}{RT^2}$$

If the enthalpy of vaporization, ΔH_{vap}, is constant in the temperature range T_1 to T_2 show, by integrating both sides of the equation with respect to T, that

$$\ln\left(\frac{P_2}{P_1}\right) = \frac{\Delta H_{vap}}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

Where $P_1 = P\,T_1$ and $P_2 = P\,T_2$.

(20 marks)

– END –