(3 Hours)

Marks: 80

Chem - CET-T

(1) Question no.1 is Compulsory.

- (2) Attempt any three quetions out of remaining five questions.
- (3) Assume suitable data and justify the same.
- (4) Figures to the right indicate full marks.





- (i) Distingusih between state and path function by giving three examples of each. 20
- Define compressibility factor. What is it's significance?
- How would you calculate entropy change of a irrerrsible process?
- What is the purpose of doing exergy analysis? Give two examples where exergy analysis is done in a chemical manufacturing plant.
  - Define and explain Joule Thomson effect.
- 1 Kmol of oxygen having average Cp of 32.33 KJ/kg.K undergoes the following changes 20 successively. Find Q, W,  $\Delta$  U and  $\Delta$  H for each step and for entire process. The process is reversible and ideal gas behaviour is assumed.
  - It is expanded iso thermally from 800K and 2.5 MPa to 0.5 MPa (a)
  - It is cooled at constant volume to 400 K. (b).
  - (c) It is further cooled at constant pressure to 300K.
  - It is compressed adiabatically to 2.5 MPa. (d)
  - It is heated at constant pressure to 800K. (e)
- Derive an expression for fugacity cofficient for a gas obeying Redlich Kwong 10 equation of state. Redlich Kwong equation of state is given by:

$$P = \frac{RT}{V - b} \frac{a}{V(v+b)}$$

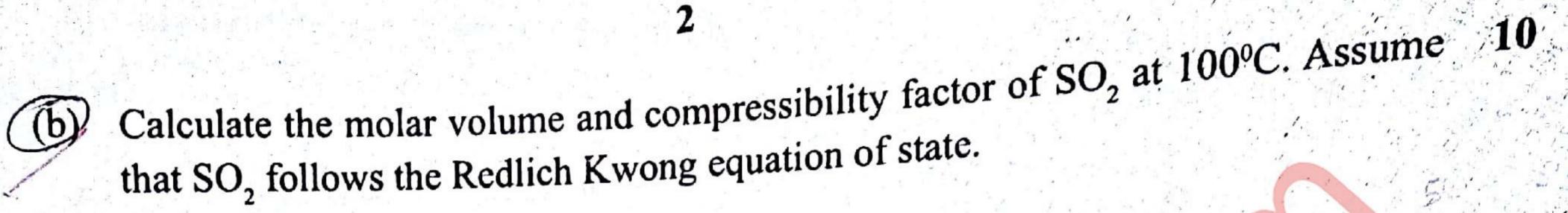
Estimate the enthalpy and entropy departure of n-Hexane at 600K and 800kPa 10 (b) using Van der Waads equation of state.

Data: Tc = 507.4K; Pc = 2969 KPa

Prove that critical compressibility factor for a van der Waals gas is equal to  $\frac{2}{8}$ 

TURN OVER

10



Data: 
$$P = \frac{RT}{V - b} - \frac{a}{V(v + b)}$$
  
Tc = 430.8 K, Pc = 78.8 bar.

- Derive an expression for the thermal efficiency of a Carnot Engine.
  - A lump of steel of mass 10 kg at 630°C is dropped in 100 kg of oil at 35°C. The 10 specific heat of steel and oil are 0.5 KJ/kg.K and 3.5 KJ.kg.K respectively. Calculate the entropy change of steel, oil and the universe. 70
- Write a short note on any four of the following:
  - P-H diagram
  - (b) Maxwell equations
    - **Transient Process**
  - Reduced equation of state
  - Heat Engine anf Heat Pump