KATHMANDU UNIVERSITY
End Semester Examination
February, 2025

Marks Scored:

Level : B.E.
Year : II

Course : CHEG 211
Semester : II

Exam Roll No. :

Time: 30 mins.

F. M. : 10

Registration No.:

Date : 16 FEB 2025

SECTION "A"

[20 Q. × 0.5 = 10 marks]

Choose and encircle the most appropriate option from each set of choices

1. It is desired to bring about a certain change in the state of a system by performing work on the system under adiabatic conditions. Then
   a. The amount of work needed is path-independent.
   b. Work alone cannot bring about such a change of state.
   c. The amount of work needed is independent of path.
   d. For a mechanically reversible system, work done for expansion or compression: $dW = PdV$

2. 1 kg of water when it is vaporized at the constant temperature of 100 °c and the constant pressure of 101.33 kPa. The specific volumes of liquid and vapor water at these conditions are 0.00104 and 1.673 $m^3 . kg^{-1}$, respectively. What is the work done?
   a. 164.5 kJ b. 169.4 kJ c. 168.1 kJ d. 167.5 kJ

3. What does the "degree of freedom" of a system represent?
   a. The number of independent variables that can change without altering the number of phases.
   b. The total number of phases present in a system.
   c. The specific heat capacity of a substance in the system.
   d. The ratio of temperature to pressure in the system.

4. Isothermal compressibility (K) is expressed as:
   (a) $\kappa = -\frac{1}{V}\left(\frac{\partial V}{\partial T}\right)_T$ (b) $\kappa = \frac{1}{V}\left(\frac{\partial V}{\partial T}\right)_T$ (c) $\kappa = -\frac{1}{P}\left(\frac{\partial V}{\partial T}\right)_T$ (d) $\kappa = \frac{1}{P}\left(\frac{\partial V}{\partial T}\right)_T$

5. When is the enthalpy of a system independent of pressure, and the relationship $dH = C_p dT$ holds true?
   a. For all substances at any pressure and temperature.
   b. For real gases at high pressure and low temperature.
   c. Only for liquids and solids under constant pressure.
   d. For the ideal-gas state and real gases at low pressure and high temperature.

6. Which of the following is true for Virial equation of state
   a. Virial coefficients are universal constants.
   b. Virial coeficient B represents three body interactions.
   c. Virial coefficients are functions of temperature only.
   d. For some gases, Virial equations and ideal gas equations are the same.

7. A Carnot cycle consist of the following steps:

a. Two isothermals and two isentropics
b. Two isochorics and two isobarics
c. Two isobarics and two isothermals
d. Two isothermals and two isochorics

8. A reversible heat transfer demands:

a. The temperature difference causing heat transfer tends to zero.
b. The system receiving heat must be at a constant temperature.
c. The system transferring out heat must be at a constant temperature.
d. Both interacting systems must be at constant temperatures.

9. The equation dU = TdS - PdV is applicable to infinitesimal changes occuring in

a. an open system of constant composition
b. a closed system of constant composition
c. an open system with changes in composition
d. a closed system with changes in composition

10. Given that the latent heat of vaporization of water at 100 °c is 2257 $J.g^{-1}$, estimate the latent heat at 300 ^{0}C. Tc for water is 647.1 K.

a. 1365 $J.g^{-1}$ b. 1371 $J.g^{-1}$ c. 1375 $J.g^{-1}$ d. 1380 $J.g^{-1}$

11. What is the definition of residual Gibbs energy (G^R)?

a. $G^R = {}^{G}/_{G^{ig}}$ b. $G^R = G + G^{ig}$ c. $G^R = G - G^{ig}$ d. $G^R = G \times G^{ig}$

Where, ig : ideal gas.

12. Clapeyron equation is:

a. $\frac{dP^{sat}}{dT} = \frac{\Delta V^{lv}}{t\Delta V^{lv}}$ b. $\frac{dP^{sat}}{dT} = \frac{\Delta H^{lv}}{t\Delta V^{lv}}$ c. $\frac{dP^{sat}}{dT} = \frac{\Delta V^{lv}\Delta H^{lv}}{t\Delta V^{lv}}$ d. $\frac{dP^{sat}}{dT} = \Delta V^{lv}\Delta H^{lv}T$

Where, l: liquid, v: liquid

13. The kinetic energy of gas molecules is zero at

a. 0 ^{0}C b. 273 ^{0}C c. 100 ^{0}C d. - 273 ^{0}C

14. Multiple phases at the same temperature (T) and pressure (P) are in equilibrium when:

a. The entropy of each phase is equal
b. The chemical potential of each species is the same in all phases
c. The enthalpy of each phase is maximized
d. The volume of each phase remains constant

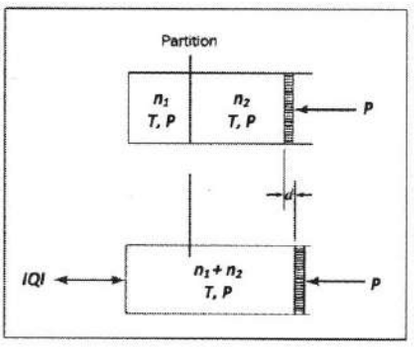
15. For the figure, the total volume change of the system is

a. $\Delta V^t = (n_1 + n_2)V - n_1V_1 - n_2V_2$

b. $\Delta V^t = (n_1 - n_2)V - n_1V_1 - n_2V_2$

c. $\Delta V^t = (n_1)V - n_1V_1 - n_2V_2$

d. $\Delta V^t = (n_2)V - n_1V_1 - n_2V_2$



16. For a closed system composed of known amounts of prescribed chemical species, how many independent variables must be fixed to completely determine the equilibrium state?
a. One b. Two c. Three d. Four

17. Which of the following statements best explains the limitations of Raoult's law?

a. Raoult's law is only valid at very high pressures.
b. Raoult's law applies strictly to systems with chemically dissimilar species.
c. Raoult's law is limited to low to moderate pressures and works best for chemically similar species.
d. Raoult's law is universally applicable to all mixtures, regardless of pressure or chemical composition.

18. In the context of a pressure-temperature (PT) graph, what characterizes retrograde condensation?

a. The formation of a liquid phase upon increasing pressure, followed by vaporization upon further compression.
b. The condensation of liquid upon decreasing pressure, reaching a maximum liquid fraction before re-evaporating.
c. The direct transition from a liquid to a supercritical fluid without passing through a two-phase region.
d. The simultaneous existence of liquid and vapor phases at the critical point, where no further phase separation occurs.

19. The system liquid water in equilibrium with a mixture of water vapor and nitrogen has the following degrees of freedom.

a. 4 b. 3 c. 0 d. 2

20. Criterion of a chemical equilibrium is that the total Gibbs free energy change is:

a. always positive b. always negative c. zero d. Infinity