

Answer the following questions

Total Marks 80

أجب عن الأسئلة الآتية:

(Molecular weight of elements, C=12, H=1, S=32 and O=16).

Question No. (1): (15 Marks)

- Explain the concept of an ideal gas as described through the assumptions of kinetic theory of gases?
- Predict the values of the universal gas constant (**R**) in three different units of energy?
- Calculate the density of CO₂ gas at a pressure of 760 mm Hg and at a temperature of 27°C?

Question No. (2): (15 Marks)

- Explain the term: "Internal energy" and describe how it is implied in the first law of thermodynamic?
- Calculate the change in internal energy, (ΔE), when 32 gm of methane gas (CH₄), are expanded from 5.00 liters to 15.00 liters by raising the temperature of the gas, isobarically at 4.92 atm. ? (consider methane behaves as an ideal gas during this process and C_p for methane = $(5.34 + 0.0115 T)$ cal /deg.mole)

Question No. (3): (15 Marks)

- What are the main sources of liquid fuels?
- Calculate the theoretical flame temperature when carbon oxide gas, (CO), is oxidized in 80% excess air to CO₂. The gases enter the converter at 25°C? ($C_{p(O_2)}=8.3+0.0003T$, $C_{p(N_2)}=6.5+0.001T$, $C_{p(CO_2)}=10.3+0.0003T$, and for CO ($\Delta H^\circ_{25^\circ C} = -68$ Kcal/ mole)

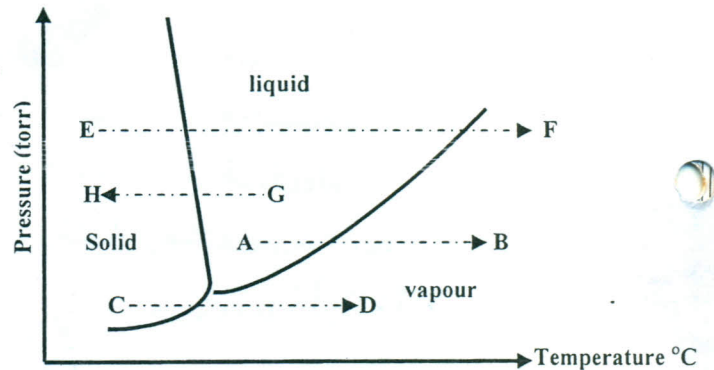
Question No. (4): (15 Marks)

- Explain Raoult's law for ideal solutions and show how deviations from ideality could occur?
- Calculate freezing point and boiling point of a solution containing 10% ethylene glycole (C₂H₆O₂) by weight in water (H₂O)? (Consider for water $k_f = 1.86$ and $k_b = 0.52$)
- A gaseous mixture of hydrogen and oxygen contains 70% and 30% oxygen by volume. If the gaseous mixture at a pressure of 2.5atm.. Find the mole fraction of both hydrogen and oxygen in water, if the given mixture is allowed to saturate water at 30°C, (Henry's constant $H_{H_2} = 55 \times 10^6$, $H_{O_2} = 36 \times 10^6$ mmHg?

Question No. (5): (15 Marks)

- The given figure represents the phase diagram of H₂O, draw the features of heating or cooling curves from the following isobaric paths given in the figure, illustrating the main feature of each curve:

- Path from A to B, (A → B)
- Path from C to D, (C → D)
- Path from E to F, (E → F)
- Path from G to H, (G → H)



- Calculate the boiling point of water, corresponding to a vapor pressure of water is 380 mmHg.?
- At 27°C and 1 atm, N₂O₄ is 20% dissociated into NO₂, find :
 - The equilibrium constant, (K_p);
 - The percent dissociation at 27°C and a total pressure of 0.1atm ?

Question No. (6): (15 Marks)

- Give different five examples of anodic reactions and different four examples of cathodic reactions?
- Based on the relation between electrode potentials and free energy change, derive the Nernst equation?.
- In a simplified flow sheet diagram, explain the main steps of Portland cement manufacture?
- Explain the main features of the kiln used for burning the raw mix to produce Portland cement?
- Explain the main reactions occurring inside the kiln?