Question Bank (Thermodynamics)

1. 5 Kg of air at 40°C and 1 bar is heated in a reversible non-flow constant pressure until the volume is doubled. Find (a) Change in volume (b) work done

   (c) Change in internal energy and (d) Change in enthalpy.

2. 1 kg of gas expands at constant pressure from 0.085 m3 to 0.13 m3. If the initial temperature of the gas is 225°C, find the final temperature, net heat transfer, change in internal energy and the pressure of gas.

3. 3 kg of a gas at 75°C heated at constant volume until its pressure is 2 times is the initial pressure. Determine (i) the final temperature (ii) the heat transfer (iii) change in internal energy and (iv) change in enthalpy

4. A volume of 28 liters of gas at a temperature of 40°C and pressure of 200 kn/m2. It is heated at constant volume process till the temperature becomes 275°C. Find (i) mass of the gas (ii) final pressure and (iii) change in enthalpy.

5. 1 kg of gas has a pressure volume and temperature of 2.5 bar, 0.3 m3 and 100°C respectively. It expands isothermally in a cylinder to pressure of 0.75 bar. Estimate the work done by the gas, change in internal energy, and heat transferred.

6. (a) A heat engine operates between a source at 600°C and a sink at 60°C determine the least rate of heat rejection per KW net output of the engine.

   (b)An inventor claims that is the proposed engine has the following specification: Power developed= 50 KW, fuel burnt=3 Kg/hr, calorific valve of the fuel=75,000kj/kg, temperature limits 27°C and 627 °C .find out whether it is possible or not.

7. Draw and explain a) Heat engine b) refrigerator c) Heat pump d) give the application of entropy.

8. 0.2 kg of air at 1.5 bar and 27°C is compressed to a pressure of 15bar according to the law pv1.25=constant, Determine work done, heat transfer, change in entropy.

9. (a)10 kg of water 90°C mixes with 2.5 kg of water at 20°C under adiabatic conditions. Find the final temperature and entropy generation.

   (b)In certain haet exchanger 45 kg/min of water is to be heated from 60°C to 115°C

   by the hot gases which enter hart exchanger at 225°C at the flow rate of 90kg/min. compute the net change of entropy assume specific heat for water and gases as 4.18 and 1.045 Kj/kg

10. A cyclic heat engine operates between a source temperature 800°C and a sink temperature of 30°. What is the least rate of heat rejection per KW net output of the engine?
11. An inventor claims that is the proposed engine has the following specification: Power developed= 50 KW, fuel burnt=3 Kg/hr, calorific valve of the fuel=75,000kj/kg, temperature limits 27°C and 627 °C .find out whether it is possible or not.

12. In a reheat steam cycle, the maximum steam temperature is limited to773K, the condenser pressure is 10KPa and the quality at turbine exhaust is 0.8778 had been no reheat, the exhaust quality would have been 0.7592. Assuming ideal processes, (i) reheat pressure (ii) the boiler pressure (iii) the cycle efficiency (iv) the steam rate.

13. A cyclic steam power plant is to be designed for a steam temperature at turbine inlet of 633K and an exhaust pressure of 8KPa. After isentropic expansion of steam in the turbine, the moisture content at the turbine exhaust is not to exceed 15%. Determine the greatest allowable steam pressure at the turbine.

14. 1 Kg of steam initially dry saturated at 1.1MPa expands in a cylinder following the law PV1.13=C. The pressure at the end of expansion is 0.1MPa. Determine
    i. The final volume
    ii. Final dryness fraction
    iii. Work done
    iv. The change in internal energy
    v. The heat transferred

15. Steam at a pressure of 2.5MPa and 500°C is expanded in a steam turbine to a pressure 0.05MPa. Determine for Rankine cycle: i. The thermal efficiency of Rankine cycle.

16. [i]. Draw the P-T diagram of a pure substance and label all the phases and phase changes.

    [ii]. What do you understand by dryness fraction? What is its importance?

    [iii]. A rigid tank of 0.03m3 capacity contains wet vapour at 80KPa. If the wet vapour mass is 12Kg, Calculate the heat added and the quality of the mixture when the pressure inside the tank reaches 7MPa.

17. [i]. what are the major problems of Carnot vapour cycle?

    [ii]. what are the methods for improving the performance of Rankine cycle?

    [iii]. Steam enters the turbine at 3MPa and 400°C and is condensed at 10KPa. Some quality of steam leaves the turbine at 0.6MPa and enters open feed water heater. Compute the fraction of the steam extracted per kg of steam and cycle thermal efficiency.

18. The gas neon has a molecular weight of 20.183 and its critical temperature, pressure and volume are 46K, 2.5 MPa and 0.05m3/Kg mol. Reading from a compressibility chart for a reduced pressure if 2 and a reduced temperature of 1.2,the compressibility factor Z is 0.75. What are the corresponding specific volume, pressure, temperature, and reduced volume?

19. Compare the specific volume of steam at 0.9 bar and 550K using Vander Waals equation. Take critical temperature of steam is 647.3K and Critical pressure is 220.9 bar.

20. A perfect gas of 0.5Kg has a pressure of 300KPa, a temperature of 100°C, and a volume of 0.06m3. The gas undergoes an irreversible adiabatic process to a final pressure of 400KPa and final volume of 0.15m3, work done on gas is 50KJ.Find Cp, Cv.

21. A mixture of 2Kg oxygen and 2Kg Argon is in an insulated piston cylinder arrangement at 100Kpa, 300K. The piston now compresses the mixture to half its initial volume. Molecular weight of oxygen is 32 and for argon are 40. Ratio of specific heats for oxygen is 1.39 and for argon is 1.667.

22. A mixture of ideal gases consists of 3Kg nitrogen and 5Kg of carbon dioxide at a pressure of 300KPa and a temperature of 20°C, Find :

    i). The mole fraction of each constituent
    ii) The equivalent molecular weight of the mixture
    iii) The equivalent gas constant of the mixture
    iv) The partial pressures and the partial volumes

23. One Kg of air at 24°C, 70%RH is mixed adiabatically with 2Kg of air at 16°C, 10%RH. Determine final condition of the mixture.

24. The moist air is at 45°C dry bulb temperature and 30°C wet bulb temperature. Calculate

    i. Vapour pressure,
    ii. Dew point temperature,
    iii. Specific humidity,
    iv. Relative humidity,
    v. Degree of saturation,
    vi. Vapour density,
    vii. Enthalpy of mixture.

(h)

25. Atmospheric air with barometric pressure of 1.01325bar has 38°C dry bulb temperature and 28°C wet bulb temperature. Without the aid of psychrometric chart, determine humidity ratio, relative humidity and dew point temperature.