Total No. of Questions— 8 [Total No. of Printed Pages— 6

Seat No.	

[5668]-113

S.E. (Mech./Auto) EXAMINATION, 2019

THERMODYNAMICS

(2015 PATTERN)

Time : Two Hours Maximum Marks : 50

N.B. :— (i) Solve four questions, Q. Nos. 1 or 2, Q. Nos. 3 or 4, Q. Nos. 5 or 6, Q. Nos. 7 or 8.

(ii) Answers for the four questions should be written in same answer-book. Attach supplement if required.

(iii) Neat diagrams should be drawn wherever necessary.

(iv) Use of steam tables, Psychrometric chart, Mollier chart, scientific calculator is allowed.

(v) Assume suitable data, if necessary.

(vi) Figures to the right indicate full marks.

1. (a) Define temperature, heat and work. Write SI unit of each. [6]

(b) Explain under which conditions all actual gases can be assumed to behave as ideal gas. [3]

(c) If a process involves no heat transfer and no irreversibilities within the system, then the process is an isentropic process. However, an isentropic process need not be adiabatic or reversible. Explain. [3]

P.T.O.

Or

2. (a) The cop of a Carnot refrigerator is 7 when it rejects heat energy into atmosphere at 27°C. It consumes 150 W of electrical power. Determine the cooling cabinet temperature in degree celsius and refrigerating effect in kW. [6]

(b) Calculate the change in entropy per kg of air in the following cases : [6]

(i) Air expands isothermally from 6 bar to 3 bar.

(ii) Air is compressed to half the volume at constant pressure, and

(iii) Heat is supplied to air at constant volume till its pressure becomes three fold.

Assume suitable data.

3. (a) Consider a large furnace that can supply energy in the form of heat at 1100 kg at a steady rate of 3000 kJ/s. Determine the availability of this energy when the environment temperature is 25°C. What is the unavailable energy in kJ/s ? [7]

(b) With the help of a neat diagram, explain the working of a combined separating and throttling calorimeter used for dryness fraction measurement. [6]

Or

4. (a) Explain how reversed Carnot cycle can be employed to obtain refrigeration, with the help of a schematic diagram, T-S and P-h chart. [7]

(b) A simple Rankine cycle uses steam as the working medium and operates between 50 kPa and 2000 kPa. Determine the quality of steam as it leaves the turbine, thermal efficiency of the cycle, and mass flow rate of steam required to produce 10000 kW power. Compare this efficiency with that of a Carnot cycle operating within the same temperature limits. [6]

5. (a) Write the function of the following devices used on a boiler : [6]

(i) Fusible plug

(ii) High steam and low water safety valve

(iii) Blow off cock

(iv) Feed check valve

(v) Economiser

(vi) Steam trap.

(b) A boiler supplies 5600 kg/h of steam of 750 kN/m^2 and 0.98 dry from feed water at 40°C when using coal at a rate 700 kg/h, having calorific value 31000 kJ/kg. Determine the equivalent evaporation from and at 100°C and the efficiency of this boiler. [7]

Or

6. (a) Explain how boilers can be classified on the basis of the following : [6]

(i) Use

(ii) Tube contents

(iii) Tube shape and position

(iv) Furnace position

(v) Circulation

(vi) Firing.

(b) The following data is recorded during a trial on a boiler : [7]

Duration of trial : 8 hours

Pressure of steam leaving the boiler : 14 bar

Condition of steam leaving the boiler : 0.973 dry

Feed water evaporated : 26700 kg

Temperature of feed water at inlet : 50°C

Mass of coal fired : 4260 kg

Calorific value of coal fired : 28900 kJ/kg

Air supplied per kg of coal fired : 17 kg

Temperature of flue gas leaving boiler : 344°C

Boiler house temperature : 21°C

Specific heat of flue gases at constant pressure : 1.1 kJ/kgK

Determine :

(i) Boiler efficiency

(ii) Equivalent evaporation and

(iii) Heat lost to flue gases.

7. (a) Define the following terms : [6]

(i) DPT

(ii) DBT

(iii) WBT

(iv) Relative Humidity

(v) Specific Humidity

(vi) Saturated Air

(b) Consider a room which contains air at 1 atm., 35°C and 40% relative humidity. Using the psychrometric charts, determine : [6]

(i) The specific humidity

(ii) The enthalpy in kJ/kg dry air

(iii) The wet bulb temperature

(iv) The dew point temperature, and

(v) The specific volume of the air in m^3/kg dry air.

Or

8. (a) Show the following air-conditioning processes on a psychrometric chart : [6]

(i) Simple heating and cooling

(ii) Heating with humidification

(iii) Cooling with dehumidification.

(b) Air enters an evaporative cooler at a 1 atm., 35°C and 20% relative humidity. It exists at 80%, relative humidity. Determine the exist temperature of the air and the lowest temperature to which the air can be cooled by this evaporator cooler. [6]

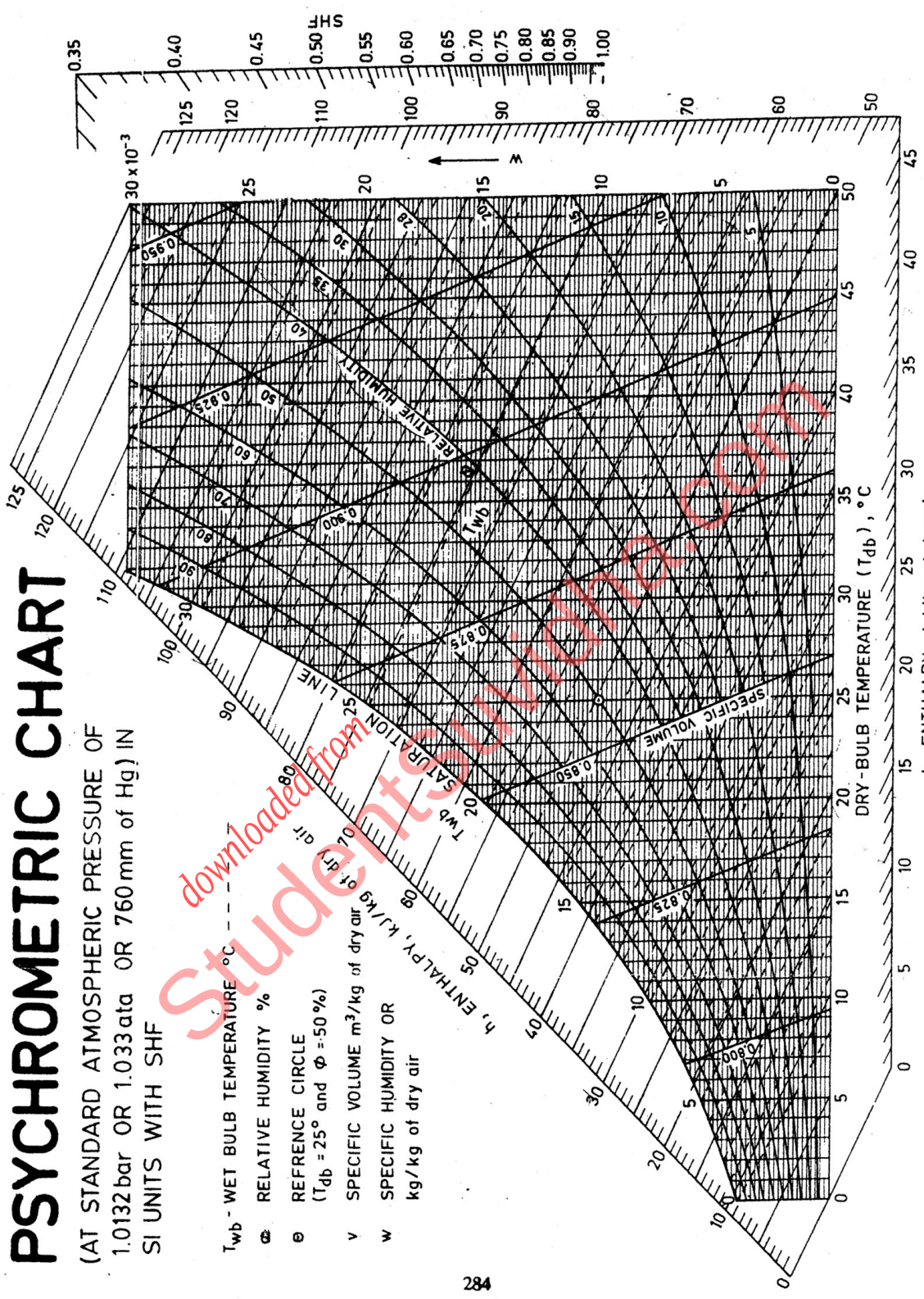

Fig. 9(a) Psychrometric chart on T_{db} - w plane