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C20-M–304

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BOARD DIPLOMA EXAMINATION, (C-20)

OCTOBER/NOVEMBER—2024

DME – THIRD SEMESTER EXAMINATION

BASIC THERMODYNAMICS

Time : 3 Hours] [*Total Marks* : 80

PART—A

3×10=30

Instructions : (1) Answer **all** questions.

(2) Each question carries **three** marks.

(3) Answers should be brief and straight to the point and shall not exceed five simple sentences.

1. What are extensive and intensive properties? Give examples for each.

2. Define the terms *(a)* system, *(b)* boundary and *(c)* universe in connection with a thermodynamic system.

3. State Boyle's law and write the equation for the same between two given states.

4. The density of nitrogen at NTP is 1·25 kg/m^3. Calculate the gas constant for air.

5. Represent the following processes on P-V diagram :

(a) Isothermal process

(b) Adiabatic process

(c) Constant volume process

6. 0·05 m^3 of air at 1·2 bar is compressed isothermally is a volume of 0·016 m^3. Determine the work energy required for compression.

7. Define air standard efficiency.

8. Write three assumptions in the analysis of air standard cycles.

9. State the applications of solid, liquid and gaseous fuels.

10. Define calorific value of a fuel.

PART—B

$8 \times 5 = 40$

Instructions : (1) Answer **all** questions.

(2) Each question carries **eight** marks.

(3) Answers should be comprehensive and criterion for valuation is the content but not the length of the answer.

11. *(a)* A quantity of gas is contained in a frictionless piston-cylinder system. The pressure is given by p = (8·4 V). Where p is in bar, and V is in m^3. The gas expands from initial volume of 0·06 m^3 to 0·3 m^3 and there is a heat transfer of 105 kJ to the gas. Calculate the change in internal energy (kJ).

(OR)

(b) A system undergoes a cycle composed of four processes and the energy transfers are tabulated below. Complete the table and determine the rate of work in kW.

Process	Q (kJ/min)	W (kJ/min)	du (kJ/min)
1-2	320	210	-
2-3	180		260
3-4	–550	-	-
4-1	0	30	-

12. *(a)* One kg of an ideal gas is heated from 20 °C to 100 °C. Assuming R = 285 J/kg-K and γ = 1·39 for the gas, find *(i)* both the specific heats, *(ii)* change in internal energy and *(iii)* change in enthalpy.

(OR)

(b) An oxygen cylinder of 0·45 m^3 capacity contains oxygen at a pressure of 15 bar and temperature 298 K. After releasing some oxygen the pressure in the cylinder is reduced to 5 bar without change of temperature. Find the mass of oxygen released from the cylinder.

13. *(a)* 3 kg of perfect gas is compressed according to the law $pV^{1 \cdot 3}$ = constant and the temperature is raised from 5 °C to 157 °C during the compression. Determine the change of entropy. Take C_p = 1·995 kJ/kg-K and R = 0·287 kJ/kg-K.

(OR)

(b) A certain quantity of gas occupies 0·16 m^3 at 18 °C and pressure 110 kN/m^2. It is compressed isothermally to a pressure of 690 kN/m^2. Determine the change in entropy. Assume the value of characteristic gas constant as 0·3 kJ/kg-K.

14. *(a)* Find the ideal efficiency for a petrol engine 175 mm diameter 300 mm stroke, with clearance volume 0·0022 m^3. Assume ratio of specific heats to be 1·4.

(OR)

(b) A diesel engine has a compression ratio of 14 to 1 and the heat supply is cut-off at 0·06 stroke. Find the air standard efficiency of the cycle. Assume adiabatic ratio as 1·4.

15. *(a)* Explain the working of a Bomb calorimeter with a legible sketch.

(OR)

(b) Find the higher calorific value and lower calorific value of the fuel whose composition by mass is as follows :

Carbon = 91%, Hydrogen = 3%, Sulphur = 0.8%, the remainder being ash.

PART—C

10×1=10

Instructions : (1) Answer the following question.

(2) The question carries **ten** marks.

(3) Answer should be comprehensive and the criterion for valuation is the content but not the length of the answer.

16. A quantity of gas occupies a volume of 0·4 m^3 at a pressure of 140 kN/m^2 and a temperature of 25 °C. The gas is compressed isothermally to a pressure of 450 kN/m^2 and then expanded adiabatically to its initial volume. Determine *(a)* heat transferred during the compression, *(b)* the change in internal energy during expansion and *(c)* the mass of the gas. Assume C_p = 1·0 kJ/kg-K and γ = 1·4.

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