2020-21

Time - 3 hours
Full Marks – 60

*Answer **all groups** as per instructions.*
Figures in the right hand margin indicate marks.
Candidates are required to answer
in their own words as far as practicable.

Group-A

1. Answer all questions. [1x8]

   a) In what type of expansion, gas peforms zero work?

   b) Can whole of work be converted into work?

   c) What is the net entropy change in a Carnot's cycle?

   d) Does C_v vary with volume for a perfect gas?

   e) Define critical pressure.

   f) What is the relation between Calorie and Joule?

   g) Does efficiency of a heat engine depend on nature of working substance?

   h) Define a surface film.

Group-B

2. Answer any eight of the following questions within two or three sentences each. [$1\frac{1}{2}$x8]

   a) Write first law of thermodynamics in mathematical form.

   b) The efficiency of a heat engine cannot be 100%? Explain.

   c) Why $C_p > C_v$?

   d) What is the entropy of combination of two systems with entropies S_1 and S_2?

   e) What is enthalpy?

   f) Define temperature of inversion.

g) Why a gas has two specific heats?

h) How is ratio of two specific heats of a gas related to degrees of freedom?

i) What is compressibility factor?

j) What are the units of second Virial coefficients?

GROUP-C

3. Write notes on any eight of the followings within 75 words: [2x8]

a) What are the limitations of the first law of thermodynamics?

b) A reversible engine converts one-sixth of heat input into work. When sink temperature is reduced by 62K, its efficiency is doubled. Find temperature of the source.

c) Distinguish between intensive and extensive parameters.

d) What is the physical significance of Gibb's function?

e) State the conclusions of porus plug experiment.

f) What are the values of C_p and C_v for a diatomic gas?

g) How mean free path varies with density of gas?

h) What is collision probability? How is it related to mean free path?

i) Express Vander Waal's equation of state in Virial form.

j) Show that for a gas obeying Vander Waal's equation of state

$$\frac{RT_c}{P_cV_c} = \frac{8}{3}.$$

GROUP- D

4. Answer any four questions within 500 words each. [6x4]

a) What is T-S diagram? Using it, derive the expression for efficiency of Carnot's engine.

b) i) Prove that the entropy of a thermodynamic system remains constant in any reversible process.

ii) What is the significance of $DS \geq 0$ in relation to entropy?

c) Define Helmholtz function and Gibb's function. Derive thermodynamical relation between them.

d) Discuss the variation of C_v with volume and variation of C_p with pressure using Maxwell's relation. Find the expression for C_p - C_v for one mole of an ideal gas.

e) State Joule-Thomson effect. Discuss the porus plug experiment and discuss the practical utility of this effect.

f) Calculate the average and root mean square speed of the molecules obeying M-B statistics.

g) Explain the reasons for modification of perfect gas equation. Derive and discuss Vander Waal's equation of state of a gas.

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