Total number of printed pages–5

63(FY) SEM–4/MAJ/PHYMAJ2044

2025

PHYSICS

(Major)

Paper : PHYMAJ2044

(Thermal and Statistical Physics)

Full Marks : 50

Pass Marks : 20

Time : Two hours

The figures in the margin indicate full marks for the questions.

1. Choose the correct answer : 1×5=5

   (a) Zeroth law of thermodynamics deals with

   (i) Energy conservation

   (ii) Entropy

   (iii) Thermal equilibrium

   (iv) Work done

(b) The efficiency of Carnot engine

(i) Always less than 100%

(ii) Always greater than 100%

(iii) Always remain constant

(iv) Always depends on the nature of the working substance

(c) The entropy of a reversible process

(i) is less than zero

(ii) is greater than zero

(iii) is a variable parameter

(iv) remain constant

(d) The phase space is a

(i) 3-dimensional space

(ii) 4-dimensional space

(iii) 5-dimensional space

(iv) 6-dimensional space

(e) A perfectly black body is a body that

(i) can radiaters all its wave lengths

(ii) is totally black in colour

(iii) absorbs all the radiation fall on it

(iv) may not be totally black in colour

2. Answer the following questions : ***(any five)*** 2×5=10

(a) Applying first law of thermodynamics, prove that the heat absorbed by a system is equal to the external work done by the system during a cyclic process.

(b) A Carnot engine works between ice point and steam point. Keeping source temperature constant, calculate the sink temperature at which the efficiency of the engine will increase by 30%.

(c) Explain about the un-attainability of absolute temperature.

(d) Write down the first and second Tds equations. 1+1=2

(e) Mention different types of exsembles.

(f) One gram of water is converted to steam. Calculate the change of entropy in this process (Latent heat of steam 540 *cal/gram*).

(g) State Stephan-Boltzmann law of radiation for a perfectly black body and non-perfectly black body. 1+1=2

3. Answer the following questions : ***(any five)*** 5×5=25

(a) Differentiate reversible and irreversible process in thermo-dynamics. Give example of each. 2+2+1

(b) Show that entropy of universe is increasing.

(c) A thermal energy source of 600*K* losses 1500 *KJ* of heat to a sink at *(i)* 400*K* and *(ii)* 500*K*. Calculate in which process the change of entropy is higher than the other. 2½+2½=5

(d) Using Maxwell thermo dynamical relation, establish (symbols have their usual meaning)

$$C_p - C_v = T\left(\frac{\partial P}{\partial T}\right)_v \left(\frac{\partial V}{\partial T}\right)_p$$

(e) Explain the term thermodynamical probability of macrostate. How it is related to probability of occurrence of the state. 3+2=5

(f) State the law of equipartition of energy. Using the law, show that for a perfect gas having n degree of freedom.

$$\gamma = 1 + \frac{2}{n}, \text{ where } \gamma = \frac{C_p}{C_v}$$

(g) Two black bodies A and B at temperatures 500*K* and 600*K* and kept inside an evacuated encloser, whose walls are blackened and temperature is 300*K*.
Calculate the rate of loss of thermal radiation.

4. Answer the following question : ***(any one)*** 10×1=10

(a) Derive Maxwell-Boltzman law of distribution of velocities of the molecules of an ideal gas.

(b) State and derive Rayleigh-Jean's law in term of wave length.

Explain how the theoritical phenomenon of ultraviolet catastrophe is related to Rayleigh-Jean's law. 2+4+4=10

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