

C 40403

(Pages : 4)

Name.....

Reg. No.....

SIXTH SEMESTER B.Sc. DEGREE EXAMINATION, MARCH 2013

(CCSS)

Physics

PH 6B 16—THERMAL AND STATISTICAL PHYSICS

Time : Three Hours

Maximum : 30 Weightage

Section A

Answer all twelve questions.

1. If  $dQ = dW$  in a thermodynamic process, then process is :  
(a) Adiabatic. (b) Isothermal.  
(c) Isobaric. (d) Isochoric.
2. Which of the following is an extensive quantity ?  
(a) Enthalpy. (b) e.m.f.  
(c) Surface Tension. (d) Pressure.
3. Which of the following is fermions ?  
(a) Electron. (b) Helium.  
(c) Photon. (d) Graviton.
4.  $C_p : C_v : R$  for monoatomic gas is :  
(a) 5 : 3 : 2. (b) 5 : 3 : 1.  
(c) 7 : 5 : 1. (d) 7 : 5 : 2.
5. If  $\gamma$  is the ratio of specific heats of gases and  $f$  is the degree of freedom, then correct relationship :  
(a)  $\gamma = 1 + \frac{f}{2}$ . (b)  $\gamma = 1 + \frac{2}{f}$ .  
(c)  $\gamma = 1 - \frac{2}{f}$ . (d)  $\gamma = 1 - \frac{f}{2}$ .
6. Most effective method for increasing efficiency of Carnot engine is :  
(a) Increase temperature of source. (b) Increase temperature of sink.  
(c) Decrease temperature of source. (d) Decrease temperature of sink.

Turn over

7. Adiabatic curves of oxygen and helium are drawn. Slope of adiabatic for oxygen is 'a' and that for helium is 'b', then  $\frac{a}{b} =$  \_\_\_\_\_.
- (a) 1. (b)  $\frac{7}{5}$ .  
(c)  $\frac{21}{25}$ . (d)  $\frac{35}{15}$ .
8. The process in which enthalpy is a constant is :
- (a) Isothermal isochoric. (b) Isothermal isobaric.  
(c) Adiabatic isochoric. (d) Adiabatic isobaric.
9. Particles which obey Pauli's exclusion principle :
- (a) Boson. (b) Boltzons.  
(c) Fermions. (d) Photons.
10. Mean energy of monoatomic ideal gas molecule is :
- (a)  $\frac{1}{2}kT$ . (b)  $\frac{3}{2}kT$ .  
(c)  $\frac{5}{2}kT$ . (d)  $\frac{7}{2}kT$ .
11. Which of the following is mathematical formulation of second law of Thermodynamics ?
- (a)  $dQ = dw$ . (b)  $dQ = du$ .  
(c)  $dQ = Tds$ . (d)  $dQ = 0$ .
12. Specific heat of a thermodynamic system in an adiabatic expansion :
- (a) Infinity. (b) Zero.  
(c) Finite. (d) None.

(12 × ¼ = 3 weightage)

### Section B

Answer all nine questions.

13. Explain Zeroth law with its significance.
14. Distinguish between intensive and extensive parameters with examples.

15. State Carnot's theorem.
16. State the principle of increase of entropy.
17. Prove that entropy is a state function.
18. What are the conditions for reversibility ?
19. A thermos bottle containing coffee is vigorously shaken. What happens to its internal energy ?
20. What is free expansion ?
21. Can we drive a ship across ocean by utilising internal energy of ocean ? Explain.  
(9 × 1 = 9 weightage)

### Section C

Answer five questions from seven.

22. Prove the relation  $\left(\frac{\partial C_p}{\partial P}\right)_T = -T \left(\frac{\partial^2 V}{\partial T^2}\right)_P$ .
23. Calculate the maximum amount of energy lost per second by radiation by a sphere 10 cm diameter at 227°C when placed in an enclosure at 27°C.  
( $\sigma = 5.67 \times 10^{-8} \text{ Wm}^{-2}\text{k}^{-4}$ )
24. Compare Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac statistics.
25. 1 kg of water at 100°C is dropped into Indian Ocean at 25°C. Calculate change in entropy of universe.
26. Calculate workdone in an isothermal expansion.
27. A Carnot engine with Cold reservoir at 17°C has 30% efficiency, by how much hot reservoir alone be raised in temperature to have 60% efficiency.
28. Calculate and write down the missing term in the given two process.

Process	$Q_j$	$W_j$	$U_{ij}$	$U_{if}$	$dU_j = U_f - V_i$
I	25	10	?	-10	?
II	?	-20	80	?	20

(5 × 2 = 10 weightage)

Turn over

**Section D**

*Answer any two questions from 3.*

29. Define the four thermodynamic potentials. Obtain Maxwell's T.d relations.
30. What is entropy-temperature diagram ? Mention its uses. Obtain the expression for efficiency of Carnot engine using temperature entropy diagram of Carnot cycle.
31. What is meant by adiabatic process ? Derive an expression for it in terms of P and V.

(2 × 4 = 8 weightage)