

- N.B. (1) All questions are compulsory.  
 (2) Figures to the right indicate marks for respective sub questions.  
 (3) Use of **Non-programmable** calculators is **allowed**.  
 (4) Draw **neat labeled diagrams** wherever **necessary**.  
 (5) Symbols used have their usual meaning

Q.1) [A] Choose correct alternative in each of the following. (12)

- (i) A system undergoing forced oscillation will be oscillating at the frequency of \_\_\_\_\_.  
 (a) its natural oscillation (b) the applied periodic force  
 (c) half its natural frequency (d) double its natural frequency
- (ii) The dimensional formula of torque is same as that of \_\_\_\_\_.  
 (a) power (b) angular momentum  
 (c) impulse (d) Kinetic energy
- (iii) All reversible heat engines working between the same temperatures have \_\_\_\_\_ efficiency.  
 (a) same (b) low  
 (c) Different (d) Infinite
- (iv) Entropy is a measure of \_\_\_\_\_.  
 (a) available entropy (b) perfect order  
 (c) Disorder (d) available energy
- (v) In a natural process entropy \_\_\_\_\_.  
 (a) decreases (b) increases  
 (c) remain unchanged (d) None of these
- (vi) In case of substance that contracts on melting,  $dP/dT$  is \_\_\_\_\_.  
 (a) Zero (b) negative  
 (c) Positive (d) one

[B] Answer in One Sentence. (3)

- (i) What is heat engine?  
 (ii) State third law of thermodynamics.  
 (iii) Write the equation for minimum time period of a compound pendulum.

[C] Fill in the blanks. (5)

- (i) The projection of UCM along its any diameter is \_\_\_\_\_.  
 (ii) The total change in entropy of the working substance in a complete reversible cycle is \_\_\_\_\_.  
 (iii) As temperature tends to absolute zero, surface tension becomes \_\_\_\_\_.  
 (iv) The S.I. unit of entropy is \_\_\_\_\_.  
 (v) In Otto engine fuel is used as \_\_\_\_\_.

Q.2) [A] Attempt **any ONE** of the following. (8)

- (i) What is reversible compound pendulum? Derive Bessel's formula to calculate value of 'g' from it.  
 (ii) Obtain the equation of motion for a rocket motion. From this get the expression for maximum velocity.

[B] Attempt **any ONE** of the following. (8)

- (i) Set up the differential equation for a forced damped harmonic oscillator and write the solution for it. Also discuss resonance condition.

- (ii) What is physical pendulum? Obtain an expression for the time period of angular SHM of a physical pendulum.
- [C] Attempt **any ONE** of the following. (4)
- (i) If a particle of mass 0.24 kg is placed in a field of potential  $U = 3x^2$  Joule then the particle performs a S.H.O. Set up the differential equation of a simple harmonic oscillator.
- (ii) A thin circular ring is suspended from a peg so that it can oscillate about it. Determine its period of oscillation if its radius is 10 cm.
- Q.3) [A] Attempt **any ONE** of the following. (8)
- (i) Write a note on “Kelvin’s thermodynamics scale of temperature”.
- (ii) State and prove Carnot’s theorem in thermodynamics.
- [B] Attempt **any ONE** of the following. (8)
- (i) Describe Carnot’s cycle. Derive an expression for the efficiency of Carnot cycle.
- (ii) What is mean by entropy? Give its physical interpretation. Show that entropy remains constant in reversible process.
- [C] Attempt **any ONE** of the following. (4)
- (i) Calculate the change in entropy when 10 grams of ice at  $0^{\circ}\text{C}$  is converted into water at the same temperature. (Given: Latent heat of ice = 80 cal/gram).
- (ii) Efficiency of Carnot’s Cycle changes from  $1/6$  to  $1/3$  when source temperature is raised by 100 K. Calculate the temperature of the sink.
- Q.4) [A] Attempt **any ONE** of the following. (8)
- (i) Explain the principle of working of a Diesel engine with the help of an indicator diagram and obtain an expression for its efficiency.
- (ii) Briefly explain the consequences of the third law of thermodynamics.
- [B] Attempt **any ONE** of the following. (8)
- (i) Explain the construction and working of Steam engine with the help of schematic diagram.
- (ii) What is Joule Thomson effect? Hence explain throttling process.
- [C] Attempt **any ONE** of the following. (4)
- (i) Calculate the latent heat of steam, when water boils at a temperature of  $101^{\circ}\text{C}$  at a pressure of 787 mm of Hg. 1 gram of water occupies  $1601\text{ cm}^3$  on evaporation. [Given:  $J = 4.2 \times 10^7$  ergs/cal].
- (ii) The efficiency of Otto engine is 50%. If the value of  $\gamma$  for the working substance is 1.5, find the compression ratio.
- Q.5) Attempt **any FOUR** of the following. (20)
- (i) What are the advantages of a compound pendulum over simple pendulum?
- (ii) Explain the concept of centre of mass of a system of particles.
- (iii) Write a note on entropy and disorder.
- (iv) State and explain different statements of second law of thermodynamics.
- (v) Compare the Diesel engine and Otto engine.
- (vi) Explain the vapour compression machine with help of schematic diagram..

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