

Note :

1. Numbers indicate in the right hand side are marks
2. All questions are compulsory.
3. Use of non programmable calculator is allowed.

Q1A: Select the correct option**(12M)**

- 1) In a system of two simple harmonic oscillator, if the motion of one affects the motion of the other the system is said to
a) force oscillator b) coupled oscillator c) free oscillator d) compound oscillator
- 2) The highest velocity attained by a rocket is called.....
a) exhaust velocity b) burnt out velocity c) critical velocity d) random velocity
- 3) Efficiency of Carnot's ideal heat engine is always
a) zero b) equal to 1 c) greater than 1 d) less than 1
- 4) In a carnot cycle, the working reservoir absorbs heat at a _____ temperature.
a) lower b) higher c) constant d) none of the mentioned
- 5) In Otto engine, heat is absorb at constant-----
a) Pressure b) Volume c) temperature d) None
- 6) Hydrogen and Helium at normal temperature show -----
a) heating effect b) Cooling effect c) sometimes heat sometimes cool d) none

Q1B: Answer in one sentence.**(3M)**

- 1) What is Compound pendulum
- 2) Define Entropy
- 3) If Diesel and Otto engine have same compression ratio then which one is more efficient?

Q1C: Fill in the blanks.**(5M)**

- 1) Entropy of a system is always in a reversible system.
- 2) In Carnot's heat engine, is used as a working substance.
- 3) The efficiency of a Diesel engine can be greater than.....
- 4) Moment of force is called.....
- 5) Damping force acting on an oscillator depend on.....

Q. 2A: Answer the following questions (any1)**(8M)**

- 1) Write the equation of motion of the compound pendulum and obtained an expression for its time period.
- 2) Write the equation of motion for rocket motion and derive an expression for maximum velocity attained by rocket

Q. 2B: Answer the following questions (any1)**(8M)**

- 1) Derive the expression for the total angular momentum of a system of particles about a point and show that when it holds for internal forces in a system of particles the angular momentum of the system is conserved.
- 2) Derive the equation of motion of a lightly damped harmonic oscillator. Solve the equation for the displacement.

Q.2 C: Answer the following questions (any1)**(4M)**

- 1) Write the advantages of compound pendulum over a simple pendulum.
- 2) Three particles in a system have position vectors in meters specified as $r_1 = 3\mathbf{i} + 4\mathbf{j} + 2\mathbf{k}$, $r_2 = 3\mathbf{i} + 6\mathbf{j} + 6\mathbf{k}$ and $r_3 = \mathbf{i} + \mathbf{j} + \mathbf{k}$. If the masses of particles are 2 kg each, find the center of mass of the system?

Q.3A: Answer the following questions (any1)**(8M)**

- 1) State and Prove Carnot's theorem
- 2) Derive an expression for the change in entropy of perfect gas in terms of temperature and pressure.

Q3B: Answer the following questions.(any1)**(8M)**

- 1) Derive an expression for efficiency of Carnot engine.
- 2) Using TS diagram, obtain the expression for change in entropy in a reversible process.

Q3 C : Answer the following questions.(any1)**(4M)**

- 1) A Carnot Engine, whose temperature of source is 400K takes 200 calories of heat at this temperature and rejects 150 calories of heat to sink. What is the temperature of the sink? Calculate efficiency of engine.
- 2) An ideal heat engine operates according to Carnot's cycle and receives 600 cal from heat source every cycle. The temperature of the heat source is 400 K and that of the sink 300K. Find The work done by the Carnot cycle and amount of heat rejected to the sink for the cycle.

Q. 4A : Answer the following questions.(any 1)**(8M)**

- 1) Explain the construction and working of Diesel Engine.
- 2) Drive the Clausius Clapeyron's latent heat equation.

Q. 4 B Answer the following questions.(any1)**(8M)**

- 1) Derive the general Maxwell thermodynamical relation.
- 2) Explain the construction and working of Otto engine with neat diagram and derive the expression for efficiency.

Q.4C Answer the following questions.(any1)**(4M)**

- 1) Derive the expression for power and efficiency in steam engine.
- 2) State and explain with example the third law of thermodynamics.

Q. 5: Answer the following questions. (any 4)**(20M)**

- 1) Define logarithmic decrement and obtained the expression for it.
- 2) Distinguish between Otto engine & Diesel engine.
- 3) A 100 gms of water is heated from 30°C to 70°C .Calculate change in entropy.
- 4) A thin circular metal ring of radius 25 cm is suspended from a knife edge and made to oscillate find its period. $g = 980 \text{ cm/s}^2$.
- 5) Explain Rankine cycle with the help of P-V diagram.
- 6) Define Entropy. State and explain the principle of increase of entropy.