

- c. No heat engine has efficiency of unity. Just it. 2
- d. What is Carnot engine? On what factor does the efficiency of Carnot's engine depend? 2
- e. The efficiency of all engine is less than that of Carnot's engine. Justify it. 2
- f. A Carnot engine whose low temperature reservoir is at 27°C has an efficiency of 25%. In order to increase efficiency to 50%, how much the temperature of the high temperature reservoir be increased if the temperature of low temperature reservoir remains constant. 3
- g. The source of reservoir of Carnot engine is at a temperature of 400 K and takes 400 J of heat and rejects 20 J of heat to the sink reservoir in each cycle. What is the efficiency of the engine and temperature of sink? **[Ans: 95%, 42°C]** 3
- h. The efficiency of a Carnot cycle is 15%. If on reducing the temperature of sink by 65°C , the efficiency becomes double. Determine the initial and final temperature between which the cycle is working. **[Ans: 433.3K , 368.33K]** 3
- i. A Carnot engine takes 10^3 Cal of heat from a hot reservoir at 227°C and rejects heat to a reservoir at 27°C . How much work is done by it? **[1680 J]** 2
- j. Explain the working of Carnot engine with the help of PV diagram. 3
- k. A diesel engine performs 2500J of mechanical work and discards 4000J of heat each cycle. How much heat must be supplied to the engine each cycle? What is the thermal efficiency? **[38.46%]** 3
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2. a. Can a room be cooled by leaving the door of an electric refrigerator open in a closed room? 2
- b. State the law of refrigeration. Refrigerator transfers heat from cold body to hot body. Does this violate the second law of thermodynamics? 2
- c. Why will a refrigerator with a fixed amount of food consume more energy in a warm room than in a cold room?
- d. Why must a room air-conditioner be placed in a window? Why cannot it be set on the floor and plugged in?
- e. In a refrigerator, heat from inside at 277K is transferred to a room at 300K. Calculate the heat delivered to the room for each joule of electrical energy consumed. Also, find its efficiency and coefficient of performance. **[Ans: 13 J]**
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3. a. What is calorific value? Write its unit.
- b. The calorific value of petrol is $11.4 \times 10^3 \text{ cal/grm}$. A heat engine consumes 10 kg of petrol in 1 hour. If the power of the engine is 20 KWatts, what is its efficiency? 3
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4. a. Why is petrol engine called as four stroke engine. Explain the working mechanism of petrol engine with the help of PV diagram. 3
- b. Spark plug is not necessary in diesel engine, why? 2
- c. Petrol engine is less efficient than diesel engine. Explain, why? 2
- d. Explain the working of diesel engine with the help of PV diagram. 3
- e. Is it possible to construct a heat engine that create no thermal pollution? Explain? 2
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5. a. What is entropy? Write the mathematical form of change in entropy. 2
- b. Express first law of thermodynamics in terms of entropy. 2
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- c. A Carnot engine working between 300K and 600K has a work output of 800J per cycle. What is the amount of heat energy supplied to the engine from source per cycle? **[1800J]** 2
- d. Sketch block diagram for heat engine and for refrigerator and hence show that a refrigerator is a heat engine working in reverse direction. 2
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