



Allowed table and Charts: Non.

Answer the following Questions: "Assume the missing data "

Question (1) (12 Marks)

- (a) Show how the first law of thermodynamics can be applied for a throttle valve and for a nozzle. (4Marks)
- (b) What are the difference between the pure substance and perfect gas? (2 Marks)
- (c) One kg of a gas at 127°C expands adiabatically to 2.6 times of its original volume and temperature of 27°C . The work done during the expansion is 900 kJ/kg. Calculate the two specific heats C_p and C_v . (6 Marks)

Question (2) (8 Marks)

- (a) Discuss briefly the importance of Second Law of Thermodynamics and its applications. (2 Marks)
- (b) Is thermodynamic cycle can have a thermal efficiency of 100% and why? (2 Marks)
- (c) On a hot day a house is need to loosing heat at a rate of 30 kW. A reversible refrigerator maintains the house at 21°C , while the outside temperature is 35°C . Determine the heating cost for the day (12 hours) assuming the price of 0.30 L.E./kW.hr. for electricity. (4 Marks)

Question (3) (14 Marks)

- (a) What is the main assumption of the air standard cycles? (4 Marks)
- (b) Compare between Air standard cycles Otto, Diesel and Dual For the same inlet conditions, the same peak temperature and same heat removal. Comment on your answer (4 Marks)
- (c) In an air Otto cycle, the pressure and temperature at the beginning of compression are 1 bar and 27°C . The cycle produces 1000 kJ/kg of work. If the cycle compression ratio is 8, determine the maximum temperature, the maximum pressure, the cycle thermal efficiency and the mean effective pressure. Take $C_p = 1.005 \text{ kJ/kg.K}$ and $C_v = 0.718 \text{ kJ/kg.K}$. (6 Marks)

Question (4) (16 Marks)

- (a) Discuss with illustrations the following :
- i- Describe the main methods of heat transfer and its main application to increase or decrease the rate of heat transfer.
 - ii- The main characteristics and tests of the lubricating oil.
 - iii- The main types of heavy equipments and power transmission (6 Marks)
- (b) A six-cylinder, 4-stroke gasoline engine is run at a speed of 2520 r.p.m. The area of the indicator diagram of one cylinder is $2.45 \times 10^3 \text{ mm}^2$ and its length is 58.5 mm. The spring constant is $20 \times 10^6 \text{ N/m}^3$. The bore of the cylinders is 140 mm and the piston stroke is 150 mm. Determine the indicated power, assuming that each cylinder contributes an equal power. Also find the mechanical efficiency and the friction power if the mean effective (m.e.p) is 5 bar. (6 Marks)
- (c) A hydraulic lift raises a load of 200 kN every 2 min. If it used water pump discharged water of $0.3 \text{ m}^3/\text{sec}$ at a pressure of 5 bar. What are the number of floors (3 m height) can be estimated, if the lift and pump efficiency are 70% and 80%, respectively. (4 Marks)