Problem: *10 kg of fluid per minute goes through a reversible steady flow process. The properties of fluid at the inlet are : $p_1 = 1.5$ bar, $\rho_1 = 26$ kg/m^3, $C_1 = 110$ m/s and $u_1 = 910$ kJ/kg and at the exit are $p_2 = 5.5$ bar, $\rho_2 = 5.5$ kg/m^3, $C_2 = 190$ m/s and $u_2 = 710$ kJ/kg. During the passage, the fluid rejects 55 kJ/s and rises through 55 metres. Determine :*

(i) *The change in enthalpy (Δh) ;*

(ii) *Work done during the process (W).*

Problem: *In a gas turbine unit, the gases flow through the turbine is 15 kg/s and the power developed by the turbine is 12000 kW. The enthalpies of gases at the inlet and outlet are 1260 kJ/kg and 400 kJ/kg respectively, and the velocity of gases at the inlet and outlet are 50 m/s and 110 m/s respectively. Calculate :*

(i) The rate at which heat is rejected to the turbine, and

(ii) The area of the inlet pipe given that the specific volume of the gases at the inlet is 0.45 m^3/kg.

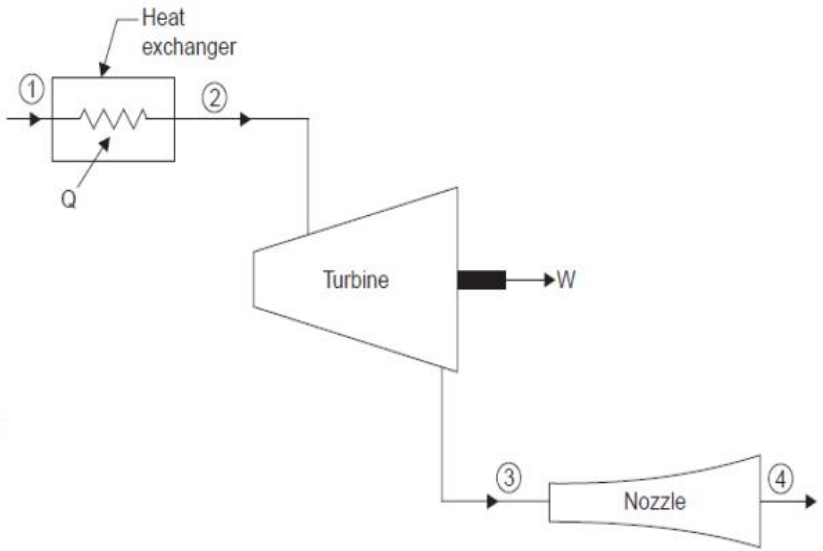
Problem: *Air at a temperature of 20°C passes through a heat exchanger at a velocity of 40 m/s where its temperature is raised to 820°C. It then enters a turbine with same velocity of 40 m/s and expands till the temperature falls to 620°C. On leaving the turbine, the air is taken at a velocity of 55 m/s to a nozzle where it expands until the temperature has fallen to 510°C. If the air flow rate is 2.5 kg/s, calculate :*

(i) Rate of heat transfer to the air in the heat exchanger ;

(ii) The power output from the turbine assuming no heat loss ;

(iii) The velocity at exit from the nozzle, assuming no heat loss.

Take the enthalpy of air as $h = c_p t$, where c_p is the specific heat equal to 1.005 kJ/kg°C and t the temperature.



4 **Problem:** *At the inlet to a certain nozzle the enthalpy of fluid passing is 2800 kJ/kg, and the velocity is 50 m/s. At the discharge end the enthalpy is 2600 kJ/kg. The nozzle is horizontal and there is negligible heat loss from it.*

(i) *Find the velocity at exit of the nozzle.*

(ii) *If the inlet area is 900 cm^2 and the specific volume at inlet is 0.187 m^3/kg, find the mass flow rate.*

(iii) *If the specific volume at the nozzle exit is 0.498 m^3/kg, find the exit area of nozzle.*

Problem: *In an air compressor air flows steadily at the rate of 0.5 kg/s through an air compressor. It enters the compressor at 6 m/s with a pressure of 1 bar and a specific volume of 0.85 m^3/kg and leaves at 5 m/s with a pressure of 7 bar and a specific volume of 0.16 m^3/kg. The internal energy of the air leaving is 90 kJ/kg greater than that of the air entering. Cooling water in a jacket surrounding the cylinder absorbs heat from the air at the rate of 60 kJ/s. Calculate :*

(i) *The power required to drive the compressor ;*

(ii) *The inlet and output pipe cross-sectional areas.*

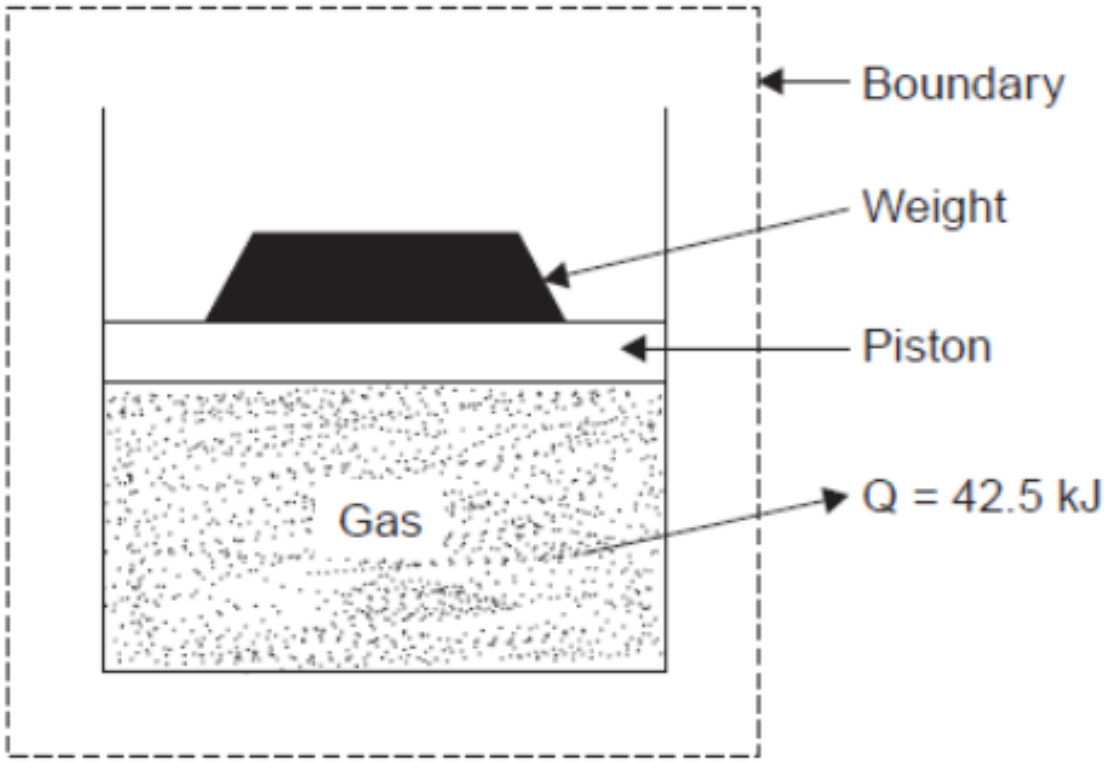
Problem: *A fluid system, contained in a piston and cylinder machine, passes through a complete cycle of four processes. The sum of all heat transferred during a cycle is – 340 kJ. The system completes 200 cycles per min.*

Complete the following table showing the method for each item, and compute the net rate of work output in kW.

Process	*Q (kJ/min)*	*W (kJ/min)*	*ΔE (kJ/min)*
1—2	*0*	*4340*	—
2—3	*42000*	*0*	—
3—4	*– 4200*	—	*– 73200*
4—1	—	—	—

7 **Problem:** *When a stationary mass of gas was compressed without friction at constant pressure its initial state of 0.4 m^3 and 0.105 MPa was found to change to final state of 0.20 m^3 and 0.105 MPa. There was a transfer of 42.5 kJ of heat from the gas during the process.*

How much did the internal energy of the gas change ?



8

Problem: *A centrifugal pump delivers 50 kg of water per second. The inlet and outlet pressures are 1 bar and 4.2 bar respectively. The suction is 2.2 m below the centre of the pump and delivery is 8.5 m above the centre of the pump. The suction and delivery pipe diameters are 20 cm and 10 cm respectively.*

Determine the capacity of the electric motor to run the pump.