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Subject: Basic Electromechanical
Sem : 1st Summer

Q5: The roof of an electrically heated home .... home owner if the cost of electricity is \$0.2/kWh.

Solution:

★ Nothing that heat transfer through the roof is by conduction are the area of the roof is

$A = 6m \times 8m = 48m^2$

The steady rate of heat trasfer through the roof is determined to be;

$\dot{Q} = kA(T_1 - T_2)/L = (0.8)(48)(25-0)/0.25$
$= 3840 W = 3.84 kW$

★ The amount of heat lost through the roof during a 10-hours period and it cost are determined from;

$Q = \dot{Q}.\Delta t = (3.84kW)(10h) = 38.4 kWh$

Cost/day = (Amout of energy)(Unit cost of energy)
= (38.4 kWh)(\$0.2/kWh) = \$7.68

Cost/Month = (cos/day) x (30day/moth) = \$ 7.68 x 30 = \$230.4

Q 1 a What is Diode? Differentiate between Half-wave rectification and full wave rectification.

Diode:

A diode is an electronic component that

✓ has two terminal

✓ limits current to one direction.

☆ Diode have an anode & a cathode.

☆ Positive current normally flow from the anode to the cathode.

☆ Diode are useful for protecting circuitry from harmful voltage or current

☆ Diodes are a basic building block of the charge-collecting element in many detectors.

Half wave rectifiction vs Full wave rectifiction

"Full-wave rectifkation" rectifies the negative component of the input voltage to a positive voltage, then converts it into DC (pulse current) utilizing a diode bridge configuration. In contrast "half wave rectification" removes just the negative voltage component using a single diode before converting to DC.

Parameters	Half Wave Rectifier	Full Wave Rectifier
1) Number of diodes used in circuit	1	2 or 4 it varies with type of circuit
2) Maximum efficiency for rectification	40.6%	81.2%
3) Ripple Fator	More	less
4) Transformer utilization factor	0.287	0.693
5) Peak Factor	2	1.414
6) Form Factor	1.57	1.11

Q1 b: A 97.0 g same of gold at 785°C is dropped ------ . ---
---------- --- ------ no change im state of matter. (water specific heat = 4.184 J/g°C.

Solution:

$$-\text{Lose}_{heat} = \text{Gain}_{heat}$$

$$\Rightarrow -[(C_{Au})(\text{mass})(\Delta T)] = (C_{H_2O})(\text{mass})(\Delta T)$$

$$\Rightarrow -[(0.129\ J/g°C)(97g)(T_f - 785°C)] = (4.184\ J/g°C)(323g)(T_f - 15°C)$$

$$\Rightarrow -[(12.5)(T_f - 785°C)] = (1.35 \times 10^3)(T_f - 15°C)$$

$$\Rightarrow -12.5\,T_f + 9.82 \times 10^3 = 1.35 \times 10^3\,T_f - 2.02 \times 10^4$$

$$\Rightarrow 3 \times 10^4 = 1.36 \times 10^3\,T_f$$

$$\Rightarrow T_f = 22.1°C$$

Q2a

Explain the Isobaric process, Isometric process — — — — — — — — — — —
first law of thermodynamics.

Isobaric Process:

An isobaric process is a thermodynamic process taking place at contant pressure. The term isobaric has been derived from the greek words "iso" & "baros" meaning equal pressure.

* An isobaric process is also called constrant pressure process

$P_f = P_i$ ($\Delta P = 0$) & $dP = 0$

Isobaric Process : $\Delta P = 0$

$\Delta Q = \Delta U + \Delta W$ But that $\Delta W = P\Delta V$

Heat in = Wout Increase in internal energy

Heat out = Wout Decrease in internal energy

Isometric prosess:

A constant-volume (isochoric) thermodynamic process in which the system is confined by mechanically rigid boundries.

$$Q_v = U_2 - U_1 = \int_1^2 C_v dT$$

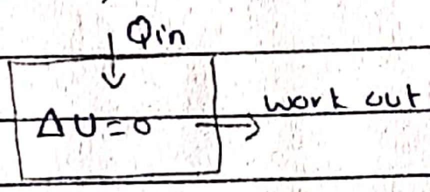
No direct mechanical work can be

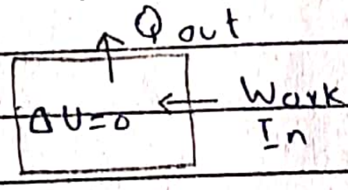
done on the surroundings by a system with rigid boundries; therefore the heat transferret into or out of system equl the change of internal energy sotred in the system.

Isothermal Process:

Constant Temperature, $\Delta T = 0$, $\Delta U = 0$

$\Delta Q = \cancel{\Delta U} + \Delta W$ and $\Delta Q = \Delta W$





Net Heat Input = Work out put

Work Input = Net Heat Out

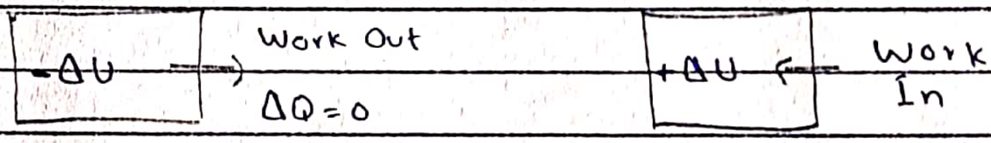
An isothermal process is a thermodynamic process in which the temperature of a system remain constant. The transfer of heat into or out of the system happens so slowly that thermal equlibrium is mentained.

Adiabatic Process:

No Heat Enchange, $\Delta Q = 0$

$\Delta Q = \Delta U + \Delta W$; $\Delta W = -\Delta U$ or $\Delta U = -\Delta W$

$\Delta W = -\Delta U$ $\Delta U = -\Delta W$



Work done at Expense of internal energy

Input work increases internal energy

An adibatic process occurs without transfering heat or mass between a thermodynamic system & its surrounding. Unlike as isothermal process, an adiabatic process transfers energy to the surrounding only as work.

Adiabatic Process equation = $PV^{\gamma} =$ constant

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Q2 b A steam engine absorbs 600J - - -
- - - - - - - - - - - - - - - - . how much
work it done.

$e = 1 - \frac{T_c}{T_H}$

Actual $e = 0.5e_i = 20\%$.

$e = 1 - \frac{300k}{500k}$

$e = \frac{W}{Q_H}$

$e = 40\%$.

$W = eQ_H = 0.20 (600L)$
Work = 120 J

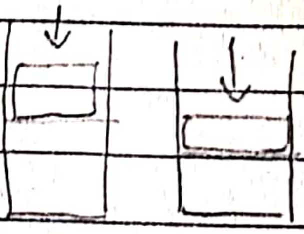
Q3 a Differeniate between internal combution engine & external combustion engine

Internal Combution Engine	External Combution engine
1) Combustion take place outside the cylinder	1) Combustion take place inside the cylinder
2) Tempervstur is higher	2) Temperature is lower.
3) Pressure in higher	3) Pressure in lower
4) Efficiency is higher	4) Efficiency is lower.
5) Lighter in weight.	5) Heavy in weight.

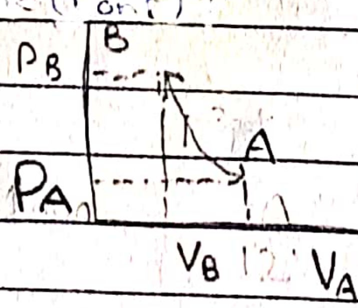
6) In IC engine, piston & connecting rod is use.	6) In EC engine, stuffing box is use
7) IC engine is costly	7) IC engine is cheaper as compered to external combusion engine.
8) Less time required to start	8) More time required to start.
9) Pressure generated inside the engine is due to combustion of fuel.	9) Pressure generated inside the engine is due to steam of water
10) Fuel tank required to store fuel.	10) Boiler & water storage required to generate steam

Q3 b A diatomic gas at 300k - - - - - - - - - - - - - - - - What is the pressure & temperature? (γ - 1.4).

Adiabatic (Const)



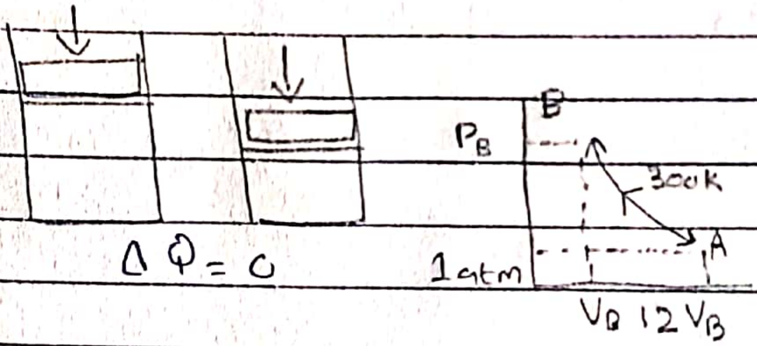
$\Delta Q = 0$



$P_A V_A^{\gamma} = P_B V_B^{\gamma}$

$\frac{P_A V_A}{T_A} = \frac{P_B V_B}{T_B}$

ADIABATIC (Cont): F P_B



$P_A V_A^{\gamma} = P_B V_B^{\gamma}$

Solving for P_B:

$$P_B = P_A \left(\frac{V_A}{V_B}\right)^{\gamma}$$

$$P_B = P_A \left(\frac{12V_B}{V_B}\right)^{1.4}$$

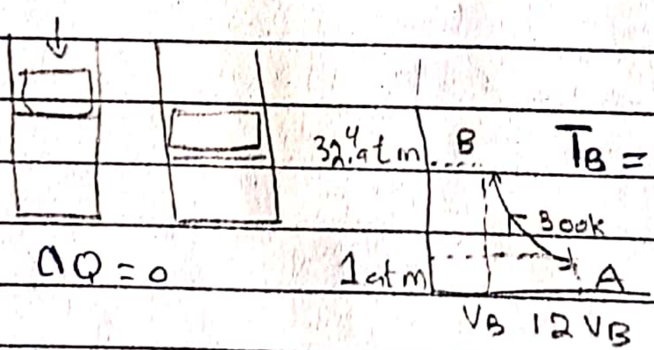
$$P_B = (1\,atm)(12)^{1.4}$$

$P_B = 32.4\ atm$

or

$3284\ kPa$

ADIABATIC (Cont.): Find T_B



$T_B = ?$

$$\frac{P_A V_A}{T_A} = \frac{P_B V_B}{T_B}$$

Solve for T_B

$$\frac{(1\,atm)(12V_B)}{300K} = \frac{(32.4\,atm)(1V_B)}{T_B}$$

$T_B = 810K$

Q4a Differentiate between conduction and convection.

Conduction	Convection
1) It is the transfer of heat by direct physical contant.	1) It is the transfer of heat by the motion of fluid.
2) It is due to temperature difference. Heat flows from high temperature region to low temperature region.	2) It is due to difference is density. Heat flows from low density region to high density region
3) It occurs is solids through molecular collisions, without actual flow of matter	3) It occurs in fluid by actual flow of matter.
4) Continues until object temperature are equal	4) Cycle occurs while temperature difference exists
5) The energy is tranmitted directly molecule to molecule.	5) Transfer of internal energy by the movement of molecules.

Q4 b A 75.0 g piece of lead - What is the final temperature of the mixture?

Solution

$$Q_{water} = -Q_{Pb}$$

$$m_{water} C_{water} \Delta T_{water} = -(m_{Pb} C_{Pb} \Delta T_{Pb}$$

$$125(4.18)(T_f - 23) = -75(0.13)(T_f - 435)$$

$$522.5 T_f - 12017.5 = -9.75 T_f + 4241.25$$
$$+9.75 T_f + 12017.5 \qquad +9.75 T_f + 12017.5$$

$$532.25 T_f = 16258.75$$

$$T_f = \frac{16258.75}{532.25}$$

$T_f = 30.5°C$