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Subject :- Basic Electromechanical Engg

Semester :- 12th (Batch 2014)

Submitted to:- Engr. Ashraf Ali

Final term Exam.

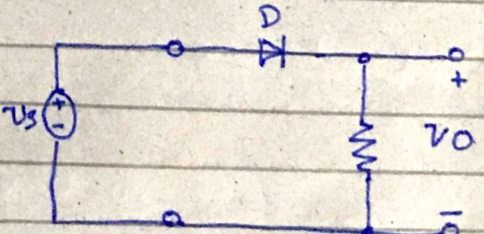
Q.no1
(a) What is Diode? Difference between Half-wave rectification and full-wave

Ans Diode:-
A diode is an Electric component that has two terminals, Limit Current to one direction.
- Diodes have an anode and a cathode.
- Possitive current normally flows from the anode to the cathode.
- Diodes are usefull for protecting circuitry from harmful voltage or current
- Diodes are a basic building blocks of the charge-collecting element in many detectors

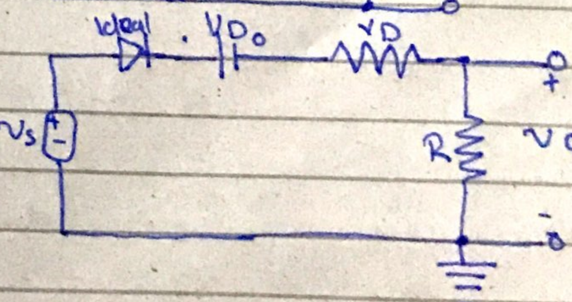
=> Half wave rectification:-

A half wave rectifier is an Electronic Circut which converts only one-half of the AC cycle into pulsating DC. It utilizes only half of AC cycle for the conversion process

(a) Half wave rectifier



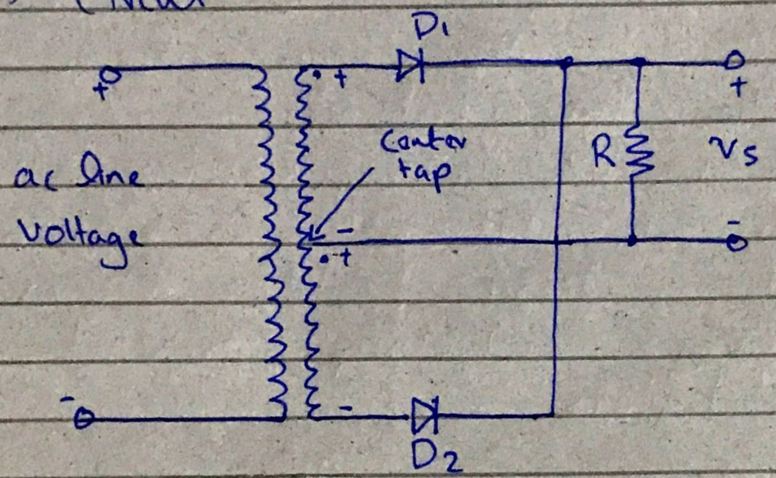
(b) Equivalent circut of the half-wave rectifier with the diode replaced with its battery plus.



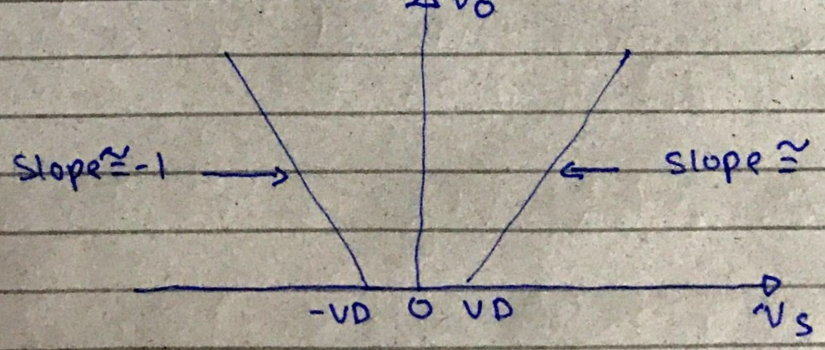
Full Wave Rectification:-

Full wave ~~rectification~~, rectifier is an Electronic circuit which converts entire cycle of AC into Pulsating DC.

(a) Circuit



(b) Transfer characteristic assuming a constant voltage-drop model for diodes

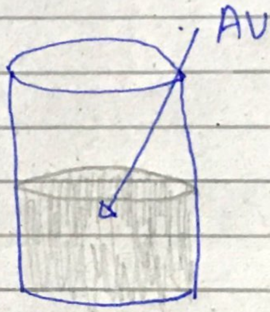


1(b):-

~~What~~
A 97.0g Sample of gold at 785°C is dropped into 323 g of water which has an initial temp of 15°C. If gold has a specific heat of 0.129 J/g°C What is the final temp of the mixture? Assume that the gold experiences no change in state of matter. (water specific heat = 4.184 J/g°C)

Given Data:-

T = 785°C
mass = 97°c
T = 15°C
mass = 323g



- Lose heat = Gain heat

$-[(C\ AU)(mass)(\Delta T)] = ((C\ H_2O)(mass)(\Delta T)$

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

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

$-12.5T_f + 9.82 \times 10^3 = 1.35 \times 10^3 T_f - 202 \times 10^4$

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

$T_f = 22.1°C$

Qno2

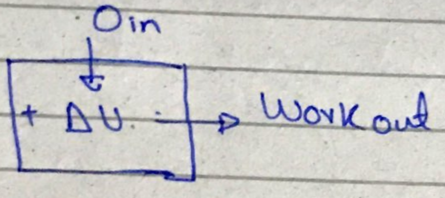
1a) :- Explain the isobaric process, Isometric process, Isothermal process and adiabatic process on the basis of first law of thermodynamics :-

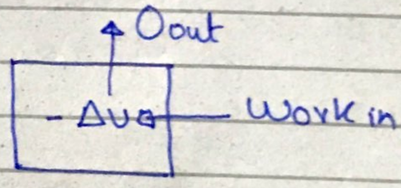
Ans

(a) Isobaric Process:-

Constant Pressure, $\Delta P = 0$

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





Heat in = Wout + Increase in internal Energy

Heat out = Wout + Decrease in internal Energy

(b) Isometric process :-

In this system there is no change in the volume i.e. volume is constant

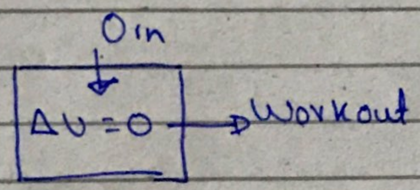
$\Delta Q = \Delta U + \Delta W$

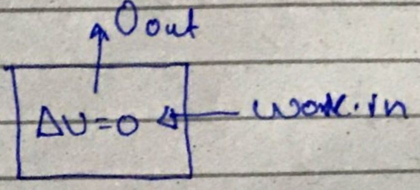
$\Delta Q = \Delta U$

(c) Isothermal Process:-

Const. Temp, $\Delta T = 0$, $\Delta U = 0$

$\Delta Q = \Delta U + \Delta W$ and $\Delta Q = \Delta W$



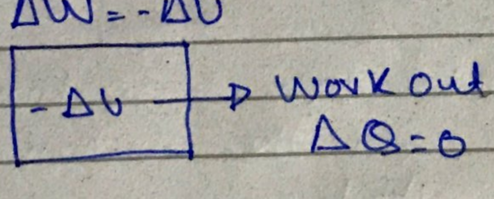


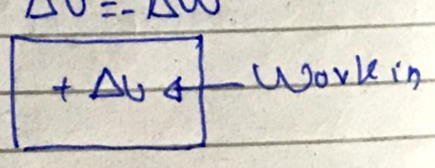
Net Heat Input = Work output
Work input = net heat out

(d) Adiabatic Process:

No heat exchange, $\Delta Q = 0$

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





Work done at expence of internal energy input work increases internal energy.

2(b)
A steam Engine absorb 600J of heat at 500 K and the exhaust temp is 300 K. If the actual efficiency is only half of the ideal efficiency, how much work is done.

Solution:-

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

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

$$e = 40\%$$

Actual $e = 0.5 e_i = 20\%$

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

$$W = e Q_H = 0.20 (600J)$$

$$\boxed{Work = 120 J}$$

Qno3

(a) Differentiate between internal combustion engine and external combustion Engine

Internal Combustinon Engine	External Combustion Engine
① Combustion of fuel take place inside the cylinder	Combustion of fuel takes place outside the cylinder.
② Working fluid maybe petrol, Diesel & Various types of gases	Working fluid is steam
③ Require less space	Require large space
④ Capitral loss is relatively low	Capitial loss is relatively high
⑤ Starting of this engine is quick & Easy	Starting of this Engine requires time
⑥ Thermal Efficiency is high	Thermal Efficiency is low
⑦ Power developed per unit weight of these engine is high	Power developed per unit weight of these engine is low
⑧ fuel cost is relatively high	fuel cost is relatively low

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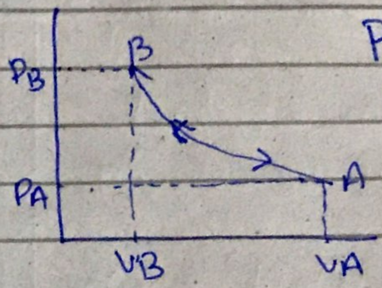
Q 3(b)

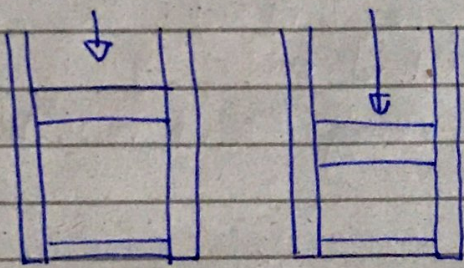
A diatomic gas at 300K and 1atm is compressed adiabatically, decreasing its volume by 1/12 ($V_A = 12V_B$). What is the new pressure and temp ($\gamma = 1.4$

Solution



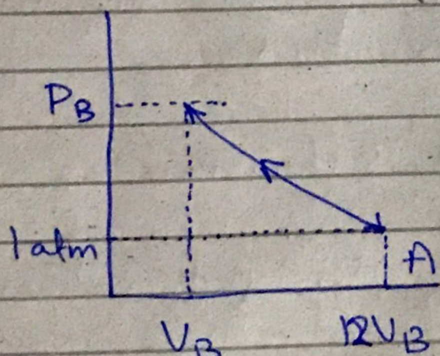
$P_A V_A^\gamma = P_B V_B^\gamma$

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



Solve fo PB

$\Delta Q = 0$



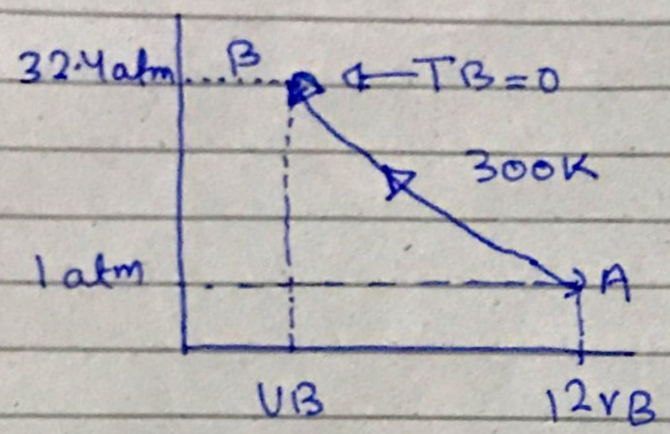
$P_A V_A^\gamma = P_B V_B^\gamma$

Solve for P_B:

$P_B = P_A \left[\frac{V_A}{V_B}\right]^\gamma$

$P_B = 32.4$ atm
or
3284 KPa

Adiabatic find T_B



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

Solve for T_B

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

$(T_B = 810\,k)$

Q no 4

(a) Differentiate between Conduction and convection

Conduction	Convection
(1) Energy transfered by direct contact	Occures in gasses and liquids
(2) Energy flows directly from warmer to cooler objects.	Movement of large number of particles in same direction
(3) Continues until object temp are Equal	Cycle occures while temp difference exist.
(4) Heat transfer is slow	Heat transfer is fast
(5) Heat transfer occours through a heated solid object	Heat transfer occours through intermediate objects. for example heat transfer between air and water

Q no 4

1(B) A 75g peice of lead (specific heat = 0.130 J/g°C), initially at 435°C is set into 125.0g of water (specific heat = 4.18 J/g°C) initially at 23°C. What is the final temp of mixture

Solution:-

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

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

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

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

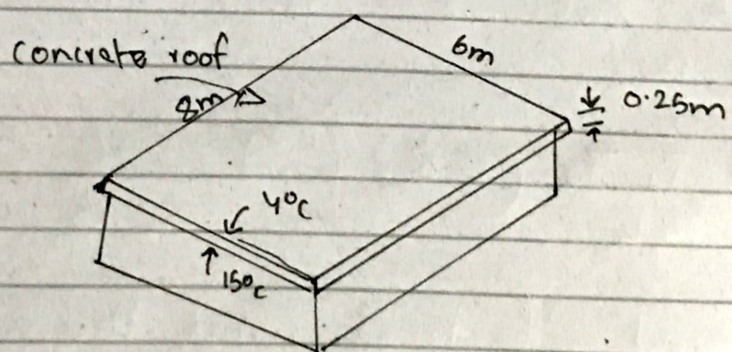
$$+9.75T_f + 12017.5 = +9.75T_f + 12017.5$$

$$532.25T_f = 16258.75$$

$$\boxed{T_f = 30°C}$$

Q no 5:-

The roof of an Electrically heated home is 6m long, 8m wide and 0.25m thick and is made of a flat layer of concrete whose thermal conductivity is k 0.8 W/m.°C. The temp of the inner and the outer surfaces of the roof one night are measured to be 25°C and 0°C, respectively, for a period of 10 hours. Determine the rate of heat loss through the roof that night and the cost of that heat loss to the home owner if the cost of Electricity is $0.2/kWh.



Solution:-

Assumption 1:-

Steady operation exists during the entire night since the surface temp of the roof remains constant at the specified value

Assumption 2:-
Constant properties can be used for roof

Properties:-
The thermal conductivity of the roof is given by $k = 0.8$ W/m·°C

Analysis:- a) Nothing that heat transfer through the roof is by conduction & area of the roof is

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

The steady rate of heat transfer through the roof is

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

(b) The amount of heat lost through the roof during a 10 hour period and its cost are determined from

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

Cost/day = (amount of Energy)(unit cost of Energy)

= (38.4 kWh) ($0.2 kWh) = $7.68

Cost/Month = (cost/day) x (30day/month) = $7.68x30 = $230.4