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Subject Basic electro mechanical engineering

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Question #1 Part A

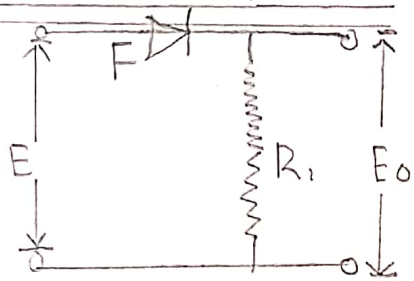
Answer:

Diode:-

A diode is an electronic component that has two terminals, limits current to one direction. diodes have anode and cathode. Positive current normally flows from anode to cathode. diodes are useful for Protecting circuitry from harmful Voltage or current. diodes are a basic building block of charge-collecting element in many detector.

## Half-Wave Rectifier

In, this




→ one diode or one Semi-conductor diode is used.

→ ordinary transformer is used

→ It converts half cycle of applied A.C. Signal into D.C.

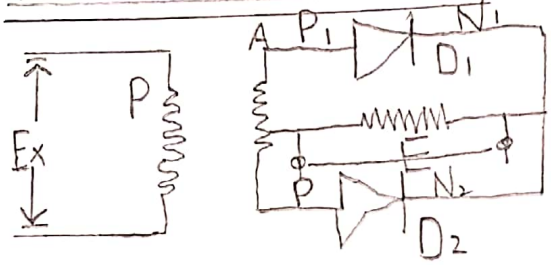
→ The Value of $I_{ms} = \frac{I_o}{2}$.

→ $I_{dc} = \frac{I_o}{\pi}$

→ The Value of ripple factor

$$\gamma = \sqrt{\left(\frac{I_{ms}}{I_{dc}}\right)^2 - 1} = 121\%.$$

## Full Wave Rectifier




In this two diodes or one double diode or two Junction are used.

Centre tap transformer is used.

It converts the whole cycle of applied A.C. signal into D.C.

$$I_{ms} = \frac{I_o}{\sqrt{2}}$$

$$I_{dc} = \frac{2I_o}{\pi}$$

The Value of $\gamma$ in it is 48.2%.

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Question # 1 Part B

Solution:

Required: Find temperature of mixture

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

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

$-[(0.129\,J/g\cdot C)(97\,g)(T_F - 785\,^\circ C)] = [(4.184\,J/g\,^\circ C)(323)(T_F - 15^\circ C)]$

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

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

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

$T_f = 22.1\,C^\circ$

Answer.

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Question 2 Part A P3

Answer:

Isobaric Process:.

An Isobaric process is a thermodynamics process in which the Presure stays constant $\Delta P=0$. the heat transferred to the System does work, but also change the internal energy of the System. using this convention, by the first law of thermodynamics, where W is work, U is internal energy, and Q is heat.

Isometric Process:.

An Isochoric process, also called a constant-volume process an isovolumetric process or an Isometric process is a thermodynamic process during which the Volume of the closed System undergoing such a process remains Constant.

Isothermal Process:.

An Isothermal Process is a thermodynamic process in which the temperature of a System remains constant. the transfer of heat into or out of the System happens so Slowly that thermal equilibrium is maintained.

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## Adiabatic Process:.

An adiabatic process occurs without transferring heat or mass between a thermodynamic System and its Surrounding. unlike an isothermal Process, an adiabatic process transfer energy to the Surroundings only as work.

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Question #2 Part B

Answer:

Solution:-

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

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

$e = 40\%$

Actual $e = 0.5 e_i = 20\%$

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

$$W = eQ_H = 0.20(600J)$$

Work = 120 J

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Question # 3 Part A

Answer:

| Internal Combustion engine | External Combustion engine |
|---|---|
| →Name it Self Says that Combustion take Place inside the cylinder. | Name it self Says that, Combustion take place outside the cylinder. |
| →Temperature is higher. | Temperature is lower. |
| →Pressure is higher. | Pressure is lower. |
| →In Ic engine, piston and Connecting rod is use. | In Ec engine, Stuffing box is use. |
| →efficiency is higher. | efficiency is lower. |
| →lighter in weight. | Heavy in weight. |
| →Ic engine is costly. | Ec engine is cheaper compared to Ic engine. |
| →less time required to start. | More time required to start. |
| →Pressure generated inside the engine is due to combustion of fuel. | Pressure generated inside the engine is due to Steam of water. |
| → Fuel tank required to Store fuel. | Boiler and water storage required to generate Steam. |

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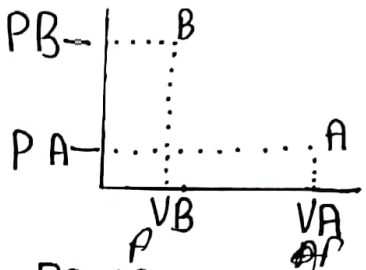
Question # 3 Part B

Answer:-

Solution:-

$$\Delta Q = 0$$




$$P_A V_A = P_B V_B$$

$$\Rightarrow \text{Find } P_B$$

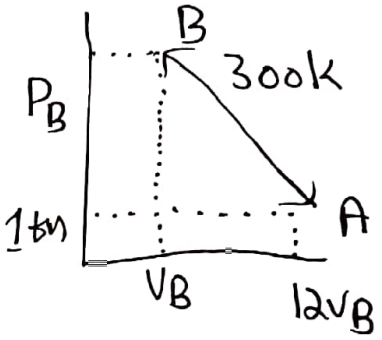
$$P_A V_A = P_B V_B$$

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

$$P_B = 32.4 \text{ atm}$$

OR 3284 KPA

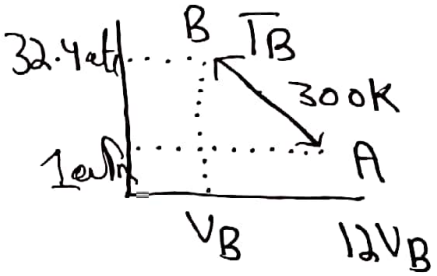
$$\frac{P_A V_A}{T_A} = \frac{P_B V_B}{T_B}$$




$$\Rightarrow \text{Find } T_B$$

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

$$\Rightarrow \frac{(1 \times 12)}{300k} = \frac{(32.4)(1)}{T_B}$$




$$T_B = 810k$$

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Question #4 Part A

Answer:

| Conduction | Convection |
| --- | --- |
| → In conduction, the heat transfer takes place between objects by direct contact. | In convection, the heat transfer takes within the fluid. |
| → The heat transfer takes Place due to the difference in temperature. | The heat transfer due to the difference in density. |
| → The heat transfer in conduction is slow. | The heat transfer in convection is faster. |
| → The heat transfer occurs through a heated Solid object. | The heat transfer occurs through intermediate objects. For example heat transfer between air and water. |
| → It does not follow the law of reflection and re-friction. | It does not allow the law of reflection and refraction. |

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Question # 4 Part B

Answer:

Solution:.

$$\Rightarrow Q_{water} = Q_{pb}$$

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

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

$$\Rightarrow 5225\,T_f - 12017.5 = -9.78\,T_f + 4241.25$$

$$\Rightarrow + \quad 9.75\,T_f + 12017.5 = +9.75\,T_f + 12017.5$$

$$582.25\,T_f = 16258.75$$

$$\boxed{T_f = 30.5^{\circ}C}$$

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Question # 5 P10

Answer:

Solution:

→ Nothing that heat transfer through the roof is by conduction and the area of the roof is

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

The Steady rate of heat transfer through the roof is determined to be,

$Q = kA(T_1 - T_2)/L = (0.8)(4.8)(25-0)/0.25$

$= 384w = 3.84kw$

→ The amount of heat cost through the roof during at 10-hours period and its cost are determined from

$Q = Q\Delta t = (3.84kw)(10h) = 38.4\ kwh$

Cost/day = (Amount of energy)(unit cost of energy).

$\Rightarrow (3.84\ kwh)(\$\ 0.2/1kwh) = 87.68$

Cost/month = cost/day x 30 days

$= 7.68 \times 30 = 8230.4$

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