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SEC: A

Dept: BE (civil)

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Subject: Basic Electro mechanical Engineering.

Q=1 (1)

b):-> mass of object = $m_o = 97g$

Temprature of object = $T_o = 785°C$

Mass of Water = $m_o = 323g$

intial temprature of Water = $T_1 = 15°C$

Specificheat capacity of Water = $C = 4.84\ J/g°C$

Specific heat capacity of object = $C_o = 0.129\ J/g°C$

R. data;

Temprature increasing = $T_h = ?$

Sol:-> By definition of Specific heat capacity

$$C = \frac{\Delta Q}{m \Delta T} \Rightarrow C = \frac{\Delta Q}{m(T_h - T_c)}$$

$$\because \Delta T = T_h - T_c$$

$$\Rightarrow T_h - T_c = \frac{\Delta Q}{mC}$$

$$\Rightarrow T_h = \frac{\Delta Q}{mC} - T_c \longrightarrow (A)$$

$$\Delta Q = mC\Delta T = (97)(0.129)(785)$$

$$\Rightarrow \Delta Q = 9822.7J$$

eq (A) $\Rightarrow T_h = \frac{9822.7J}{(323)(4.184)} + 15$

$$\Rightarrow T_h = 7.3 + 15$$

$$\Rightarrow T_h = 22.3°C$$

Q#2 (b)

Given Data:-

$Q_1 = 600J$, $T_2 = 300K$

$T_1 = 500K$, $\eta = 1/2 (100\%)$

$W = ?$

$$\eta = 1 - \frac{T_2}{T_1}$$

$$\eta = 1 - \frac{300}{500K}$$

$$\eta = \frac{500 - 300}{500}$$

$$\boxed{\eta = 40\%}$$

Given that

Actual $\eta = (0.5\,\eta_{Ideal})$

$$\eta = 1/2 \times 40\%$$

$$\boxed{\eta = 20\%}$$

Now work done will be

$$\eta = \frac{W}{Q_1}$$

$$\Rightarrow W = \eta Q_1$$

$$\Rightarrow W = 20\% \times 600J$$

$$W = \frac{20}{100} \times 600J$$

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

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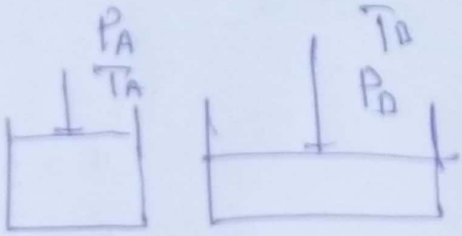
Q#3 (b) Given Data:



$T_A = 300 K$

$P_A = 1 atm$

$V_A = 12 V_B$, $V_B = 1/12 V_A$

$P_B = ?$, $T_B = ?$

For adibatic Compression:

$$P_A V_A^{\gamma} = P_B V_B^{\gamma} \rightarrow (A) \quad \because \gamma = 1.4$$

$$\Rightarrow \frac{P_A . V_A}{T_A} = \frac{P_B . V_B}{T_B} \rightarrow (1)$$

Now $P_A V_A = P_B V_B$

$$\Rightarrow P_B = \left(\frac{P_A V_A}{V_B} \right)^{\gamma} = ~~12 V_B~~$$

$$\Rightarrow P_B = \left(\frac{1 \times 12 V_B}{1 ~~1/12 V_A~~ V_B} \right)^{\gamma}$$

$$P_B = (12)^{1.4}$$

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

from eq (1) $\Rightarrow$ $\frac{P_A V_A}{T_A} = \frac{P_B V_B}{T_B}$

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

$$T_B = \frac{32.4 \times V_B \times 300}{1 \times 12 V_B}$$

$$T_B = \frac{32.4 \times 300}{12}$$

$$\boxed{T_B = 810K}$$

x

Q#5:- Given Data:-

$l = 6m$, $w = 8m$, ~~$\Delta t = 25m$~~

$K = 0.8 w/m°C$, $\Delta t = 10hr$

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

$\boxed{A = 48m^2}$, $T_1 = 25°C$, $T_2 = 0°C$

$Q = ?$, $Cost = ?$

$$Q = KA\left(\frac{T_1 - T_2}{L}\right)$$

$$Q = 0.8 \times 48\left(\frac{25 - 0}{6}\right) = 160$$

$$\boxed{Q = 160Kw}$$

Heat loss during 10hr is

$Q = Q\Delta t$

$Q = 160 \times 10 = 1600 Kwhr$

Now Cost = (amount of energy)(unit cost of energy)

Cost = (1600Kwhr) ($0.2/Kwhr)

$$\boxed{Cost = 320\$}$$

4) b:-> mass of object $= m_o = 75g$

specific heat capicity $= C_m = 0.13\,J/g°C$

Tamprature $= T = 435°C$

mass of water $= m_w = 125g$

intial Temprature $= T_c = 23°C$

Specific heat capacity of water $= C_m = 4.184$

R. data;

Final temprature of mixture $= T_h = ?$

From difinition of specific heat capacity

$$T_h = \frac{\Delta Q}{mC} + T_c \longrightarrow (A)$$

Here $\Delta Q = m C_m T = (75)(0.13)(435)$

$\Rightarrow \Delta Q = 4241.25\,J$

put values in eq (A)

eq (A) $\Rightarrow T_h = \frac{4241.25}{523} + 23$

$\Rightarrow T_h = 8.11 + 23$

$\Rightarrow T_h = 31.11°C$

Q:1 (a) DIODE:

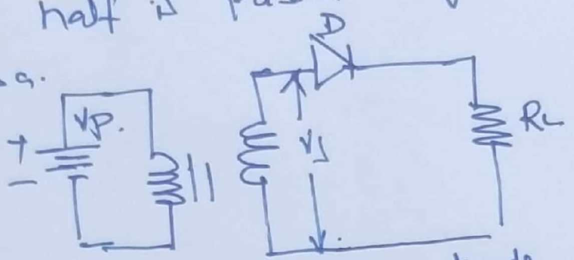
Definition: Diode is a electrical device which converst AC signal into DC sign
or It is also for switching. (Switching device).

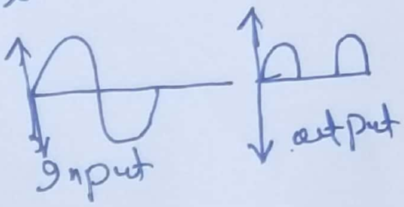
There are two types of rectification:

1) Half wave. rectification
2) Full " ".

1) Half-wave rectification: Half wave rectifier is a CKT that passes only one half of the applied input signal & block the other negative signal.
When +ve half is passed negative will be blocked & vice - versa.

Diagram:

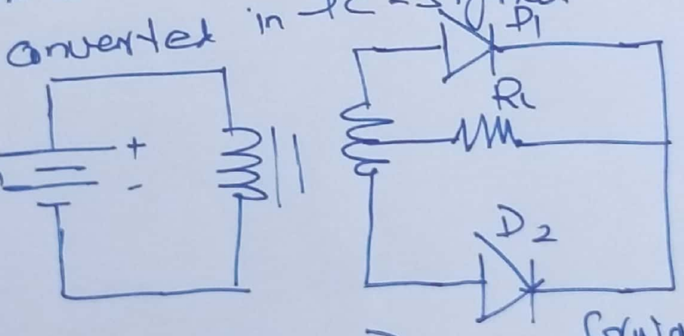




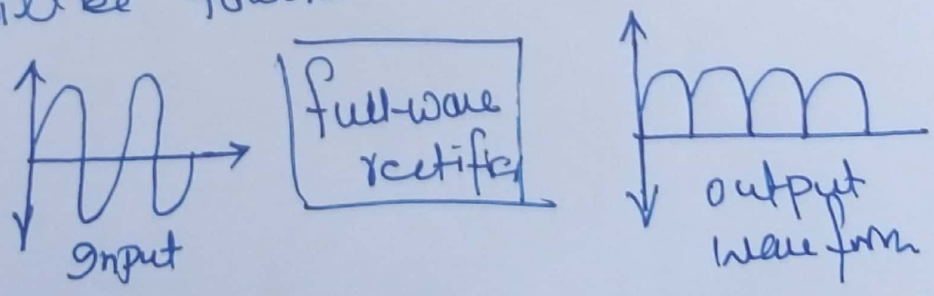
When +ve cycle is applied diode get forward biased and +ve cycle will be passed & when -ve cycle applied diode will be reverse biased & -ve cycle will be blocked. The will be AC-signal will be Blocked.

2) Full-wave rectification. A full wave rectifier is a CKT that has ability to pass both cycle of input AC signal In other words the over all AC input signal will be converted in DC-signal.

Diagram:



When +ve cycle applied D1 is forward biased and passes, when -ve cycle is applied Diode D2 will be forward biased & passes by D2.



Scanned with CamScanner

Q.2 Isobaric process,

Definition: Isobaric process is a process of thermodynamics taking place at const pressure. The term isobaric derived from "iso" & "baros" meaning equal pressure. As such the const pressure is obtained when volume is expanded or contracted. This basically neutralizes any pressure change due to transfer of heat. This means that no quantities as law of thermodynamics become zero.

Mathematically: $P_f = 0$.

$P_i (\Delta P = 0$ and $dP = 0)$.

$P = P_{atom} + \frac{Mg}{A} = const.$

Example: Boiling of water to steam or freezing of water to ice. In process, a gas either expands or contracts to maintain const pressure & hence the net amount of work is done by the system or on the system. The amount of heat dQ is partly used increasing the temperature dT & partly used in doing external work

$dQ = C_p dT + P dV \rightarrow (A)$

Workdone by Gas is on Isobaric process,

$$W = \int_{V_i}^{V_f} P\, dV \rightarrow (1).$$

$$W = P_i \int_{V_i}^{V_f} dV = P_i (V_f - V_i)$$

$$\boxed{W = P_i \Delta V} \rightarrow (A).$$

→ If $V_f > V_i$ so $\boxed{\Delta V > 0.}$

If $V_f < V_i$ so $\boxed{\Delta V < 0.}$ & workdone by gas is negative.

~~ISOMETRIC PROCESS:~~

ISOTHERMAL PROCESS & Adiabatic process.

Definition:

Isothermal process is a change of system, in which temp. remains const $\Delta T = 0$. This occurs when a system in contact with an outside thermal reservoir and the change in system will occur slowly enough to allow the system to continue to adjust to the temp. of reservoir through heat exchange. In contrast, an adiabatic process is where a system exchanges no heat with its surroundings ($Q = 0$).

Mathematically: $T = $ const.

$\Delta T = 0.$

$dT = 0.$

While in adiabatic process.

$Q = 0.$

Examples: living cells heat engines are carried out isothermally, Melting or evaporations.

Mathematically: $W_{A \to B} = -\int^{V_B} p\,dV.$

$$W_{AB} = -\int_{V_A}^{V_B} p\,dV = -\int_{V_A}^{V_B} \frac{nRT}{V}\,dV = -nRT\int_{V_A}^{V_B} \frac{1}{V}\,dV$$

$$\boxed{W_{A \to B} = -nRT \ln \frac{V_B}{V_A}} \longrightarrow (A)$$

Q:3 Internal combustion Engine & External combustion engine:

i) Internal combustion Engine. In Internal the working fluid consist of combustible fluid placed inside a cylinder these engines, the fluid undergoes combustion inside the cylinder and expands.

External combustion Engine. In external combustion engine the combustion takes place outside the cylinder. Heat then needs to be transfered to the cylinder where work is done.

Example: Steam engine

Difference b/w IC & EC:

1) External combustion engine run smoothly & silently where internal combustion engine are noisy. Noise production due to explosions of cylinder.

2). Working pressure & temperature in external combustion is low whereas in I.C.E working pressure & temperature is high.

3) External combustion engine have 15-20% efficiency whereas I.C.E have 35–60%.

4) External combustion engine requires a boiler & other components to transfer energy. Where as I.C. engines parts are light & compact

CONSTRUCTIONAL DIFFERENCE:

1) External combustion engine cannot be started instantaneously whereas internal combustion engine starting is quick & easy.

2) External, combustion of fuel takes place outside cylinder whereas Internal combustion of fuel takes place inside cylinder

3) Due to low pressure & temp. ordinary alloys can be used for manufacturing & due to high pressure & temperature, special alloys are used for manufacturing of engine cylinder.

4) Steam engine, steam turbine & Sterling engine are example of external combustion

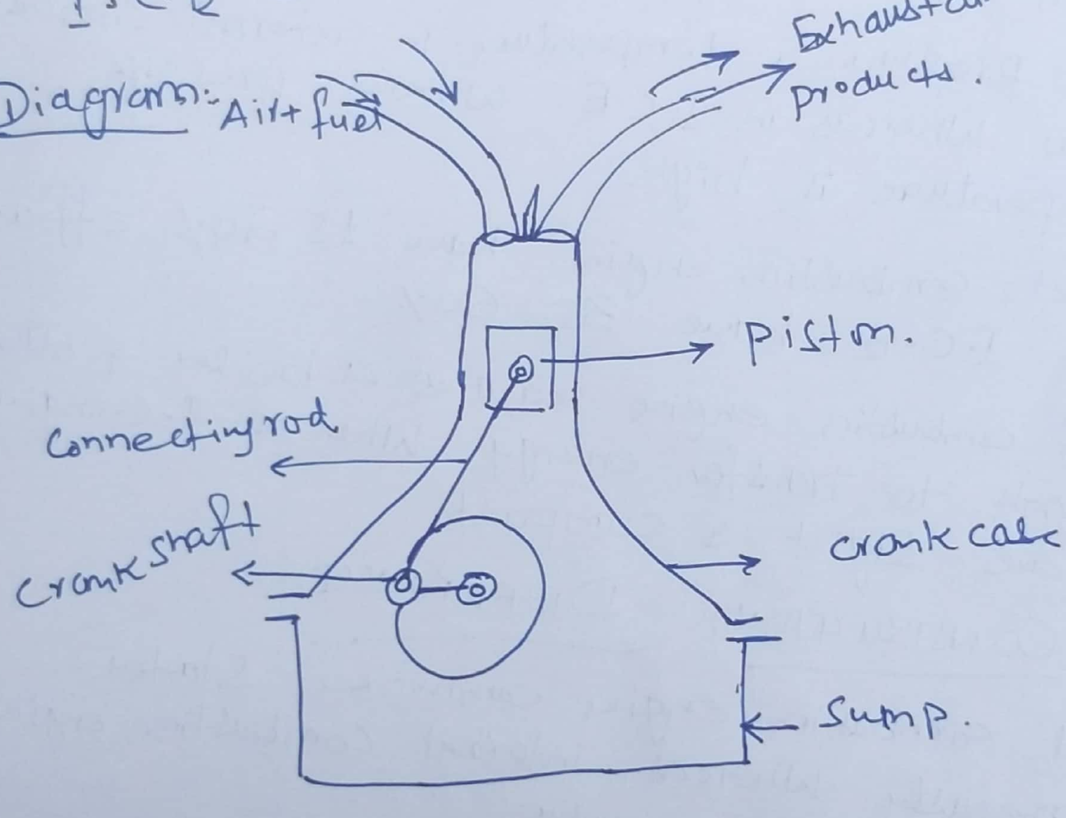
example of external combustion
Petrol, Diesel, Wrankle are example of internal combustion engine.

5) Weight of external combustion engine is high as compared to I.C.E.

6) Cost of External is high whereas I.C.E is cheap.

7) large space is required for external whereas I.C.E does not need large space.

Diagram:-



Q:4 Differentiate b/w conduction & Convection.

Definition: conduction transfer heat via direct molecular collision. A Area of greater Kinetic energy will transfer thermal energy to an Area of low Kinetic energy. High speed particles will collide with lower speed particles. the slower speed particles will increase in kinetic energy as a result. conduction is most common form of heat transfer and occurs via physical contact.

Example: To place your hand against a window or place metal into an open flame.

Equation: $Q = K \cdot A[(T_{hot} - T_{cold})]/d$ → Ⓐ.

Q = heat transfer per unit

K = Thermal conductivity of barrier.

A = heat transfer Area.

T_{hot} = Temperature of hot region

T_{cold} = Temperature of cold region.

d = thickness of barrier.

CONVECTION: When a fluid is heated and then travel away from source, it carries thermal energy along. This type of heat is called convection. The fluid above a hot surface expands, becomes less dense and rises. At molecular level, molecules expands upon introduction of thermal energy. As tem. of given fluid mass increase, the volume of fluid must increases by same factor. This effect causes displacements. As immediate hot air rises it pushes denser colder air down.

Mathematical Equation:

$Q = hc \cdot A(Ts - Tf) \rightarrow$ (A).

Q = heat transfered per unit.

hc = Convective heat transfer co-efficient

A = heat-Transfer Area of surface.

Ts = temp. of surface

Tf = Temperature of fluid