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SUBJECT : BASIC ELECTRO MECHANICAL

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QUESTION: 01

(a)

What is Diode? Differentiate between half wave rectification and full wave rectification.

ANSWER:

Diode:

A diode is a specialized electronic component with two electrodes called the anode and the cathode. Most diodes are made with semiconductor materials such as silicon, germanium, or selenium. Some diodes are comprised of metal electrodes in a chamber evacuated or filled with a pure elemental gas at low pressure. Diodes can be used as rectifiers, signal limiters, voltage regulators, switches, signal modul-ators, signal mixers etc.

	HALF WAVE	FULL WAVE
→	Half wave rectifier is a low-efficiency rectifier.	Full wave rectifier is a high efficiency rectifier.
→	Half wave rectifier doesnot require centre tapping of the secondary winding of transformer.	Full wave requires centre tapping of the secondary winding of the transformer.
→	Half wave require less electronic components as full wave.	Full wave require more electronic components.
→	Half wave less costly then full wave	Full wave rectifier is costly
→	one diode conducts in each half cycle of input.	Two diode conduct in each half cycle of input.

(b)

Solution:

$T = 785\,^{\circ}C$

mass = 97.0 g

$T = 15.0\,^{\circ}C$

mass = 323 g

- Lose heat = Gain heat

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

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

$$-\left[(12.5)(\bar{T}_F - 785^\circ C)\right] = (1.35\times10^3)(\bar{T}_F - 15^\circ C)$$

$$-12.5\bar{T}_F + 9.82\times10^3 = 1.35\times10^3\bar{T}_F - 2.02\times10^4$$

$$3\times10^4 = 1.36\times10^3\bar{T}_F$$

$$\bar{T}_F = 22.1\ ^\circ C$$

QUESTION: 2

(a)

Explain the isobaric process, isometric process, iso-thermal process and adiabatic.

ANSWER:

Isobaric process:

An isobaric process is a thermodynamic process in which the pressure stays constant $\Delta P = 0$. The heat transferred to the system does work, but also changes 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.

Example: An example of the isobaric process includes the boiling of water to steam or the freezing of water to ice.

Isometric process:

Isometric process is a thermodynamic process during which the volume of the closed system undergoing such a process remains constant.

Example: An example would be to place a closed tin can containing only air into a fire.

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.

Example: changes of state or phase changes of different liquids through the process of melting and evaporation.

Adiabatic process:

An adiabatic process occurs without transferring heat or mass b/w a thermodynamic system and its surroundings. Unlike an isothermal process, an diabatic process transfer energy to the surroundings only as work.

Example: An example of an adiabatic process is the vertical flow of air in the atmosphere.

(b)

Solution:

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

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

$$e = 40\%.$$

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

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

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

$$WORK = 120J$$

QUESTION: 3

(a)

Differentiate b/w internal combustion engine and external combustion engine.

ANSWER:

Internal Combustion	External Combustion
→ Name itself says that combustion takeplace inside the cylinder.	Name itself says that combustion takeplace outside the cylinder.
→ Temperature is higher	Temperature is low
→ pressure is high	pressure is low

→ In IC engine, piston and connecting rod is use.	In EC engine, stuffing box is use.
→ Efficiency is higher	Efficiency is low
→ IC engine is costly	EC engine is chaper 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.

(b)

Solution:

To find 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

$$3284\ kPa$$

Now;

To Find $T_B = ?$

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

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

$$T_B = 810K$$

QUESTION: 04

(a)

Differentiate b/w conduction & convection.

ANSWER:

Conduction	Convection
→ It is the transfer of heat by direct physical contact.	It is the transfer of heat by the motion of a fluid.
→ It is due to temperature difference. Heat flows from higher temperature region to low temperature region.	It is due to difference in density. Heat flows from high density region to low density region.
→ It occurs in solids through	It occurs in fluids by actual

molecular collisions, without actual flow of matter.	flow of matter.
→ It is a slow process	It is also a slow process.
→ it does not obey the laws of reflection and refraction.	It does not obey the laws of reflection and refraction.

(b)

Solution:

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

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

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

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

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

$$532.25\,T_f = 16258.75$$

$$T_f = 30.5\,^{\circ}C.$$

QUESTION: 5

Solution:

The inner and outer surface of the flat concrete roof of an electrically heated home are maintained at specific temperature during a night. The heat loss through the roof and its cost that night are to be determined.

Assumption 1:

Steady operations exists during the entire night since the surface temperature of the roof remain constant at the specified value.

Assumption 2:

Constant properties can be useful for the 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 and the area of the roof is $A = 6m \times 8m = 48m$, the steady rate of heat transfer through the roof is

$$\dot{Q} = K A \frac{T_1 - T_2}{L} = (0.8 W/m^2)(48 m^2)\left(\frac{25 - 0}{0.25 m}\right)$$

$$\dot{Q} = 3.84 KW$$

(b)

The amount of heat lost through the roof during a 10 hours period and its lost is

$$Q = \dot{Q} \Delta t = (3.84 KW)(10 h) = 38.4 KWh$$

Cost = (Amount of energy)(Unit cost of energy)

Cost = (38.4 KWh)(0.2/KWh)

Cost = $7.68
