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# Question #1

## (a)

## Diode:-

A semiconductor device with two terminals, typically allowing the flow of current in one direction only.

or

A thermionic valve having two electrodes an anode and a cathode.

## Difference b/w half wave rectificitation & full wave rectification:-

Full wave rectification rectifies the negative component of the input voltage to a positive voltage, then converts in 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.

## Question #1

## (b)

Sol:-

$$-Lose_{heat} = Gain_{heat}$$

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

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

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

$$-12.5\,T_f + 9.82\times10^{3} = 1.35\times10^{3}\,T_f - 2.02\times10^{4}$$

$$3\times10^{4} = 1.36\times10^{3}\,T_f$$

$$\boxed{T_f = 22.1^{\circ}C}$$

# Question#3

## (a)

## Differences b/w Internal Combustion Engines & External Combustion Engines:-

External combustion engines have a working fluid that is heated by the ~~fuel~~ fuel. Internal combustion engines rely on the explosive power of the fuel with the engine to produce work. In internal combustion engines, the explosion forcefully pushes pistons or expels hot high pressure gas out of the engine at great speeds. Both moving pistons and ejected high speed gas have the ability to do work. In external combustion engines, combustion heats a fluid which, in turn, does all the work.

# Question #3

## (b)

Sol:- $\Delta Q = 0$

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

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

$$P_B = 32.4\ atm$$

or

$$\boxed{P_B = 3284\ kPa}$$

Now finding $T_B$

$\Delta Q = 0$

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

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

# Question # 4

## (a)

| Conduction | Convection |
| --- | --- |
| 1. Transfer of heat is through direct physical contact | 1. Heat is transmitted by currents in a fluid i.e liquid or gas. |
| 2. Conduction takes place as a result of difference in temperature. | 2. Convection happens due to variation in density. |
| 3. Heat transfer is through heated solid substance. | 3. Heat energy is transmitted by way of intermediate medium. |
| 4. Conduction occurs in solids through molecular collision. | 4. Convection occurs in fluids by mass motion of molecules in the same direction |

# Question # 4

## (b)

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

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

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

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

$$+9.75 T_f + 12017.5 \quad +9.75 T_f + 12017.5$$

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$$532.25 T_f = 16258.75$$

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

# Question # 5

Sol:- Noting that heat transfer through the roof is by conduction and area of the roof is:

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

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

$$Q = kA\left(T_1 - T_2\right)/L = (0.8)(48)(25-0)/0.25$$

$$= \boxed{3840\,W = 3.84\,kW}$$

The amount of heat-loss through the roof during a 10-hour period and its cost are determined from;

$$Q = Q\,\Delta t = (3.84\,kW)(10h) = 38.4\,kWh$$

$$\text{Cost/day} = (\text{Amount of energy})(\text{unit cost of energy})$$

$$= (3.84\,kWh)(\$0.2/kWh) = \boxed{\$7.68}$$

$$\text{Cost/month} = (\text{cost/day}) \times (30\,\text{day/month}) = \$7.68 \times 30 = \boxed{\$230.4}$$

# Question #2

## (b)

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

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

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

Actual $e = 0.5e_i = 20\%$

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

$$W = eQ_H$$

$$W = 0.20(600\,J)$$

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

# Question #2

## (a)

## Isobaric Process:-

An isobaric process occurs at constant pressure. Since the pressure is constant, the force exerted is constant and the work done is given as:

$$W = P\Delta V$$

## Isochoric Process:-

An isochoric process is one in which the volume is held constant, meaning that the work done by the system will be zero. The only change will be that a gas gains internal energy.

# Isothermal Process:-

For an ideal gas, the product of pressure and volume (PV) is a constant if the gas is kept at isothermal conditions.

For an ideal gas, the work involved when a gas changes from state A to state B through an isothermal process is given as

$$W_{A \to B} = nRT \ln \frac{V_B}{V_A}$$

# Adiabatic Process:-

The process during which the heat content of the system or certain quantity of the matter remains constant is called adiabatic process.