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 modulators, 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 fullwave	Full wave require more electronic components.
→ Half wave less costly then fullwave	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:

$T = 785°C$

$mass = 97.0\,g$

$T = 15.0°C$

$mass = 323\,g$

$-\text{lose heat} = \text{gain heat}$

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

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

$$-\left[(12.5)(T_F - 785°C)\right] = (1.35\times10^3)(T_F - 15°C)$$

$$-12.5T_F + 9.82\times10^3 = 1.35\times10^3 T_F - 2.02\times10^4$$

$$3\times10^4 = 1.36\times10^3 T_F$$

$$T_F = 22.1\ °C$$

P.No(b)

Solution:

$Q_{water} = -Q_{pb}$

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

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

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

$+9.75T_b + 12017.5 = +9.75T_b + 12017.5$

$532.25T_b = 16258.75$

$T_b = 30.5^\circ C$ Ans.

P.No 2:

P.No (b)

Solution:

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

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

$e = 40\%$

Actual $e = 0.5e_i = 20\%$

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

$$W = eQ_H$$

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

Work = 120 J

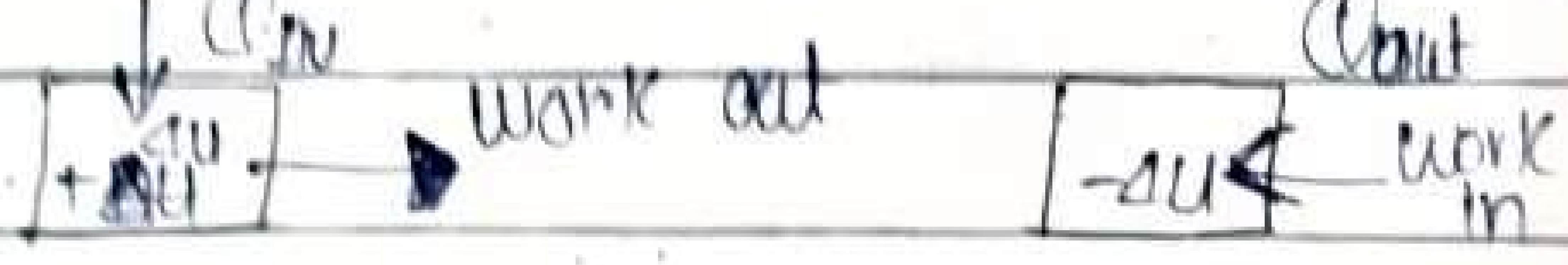
P.No(a)

Ans

ISOBARIC PROCESS

constant Pressure $\Delta P = 0$

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



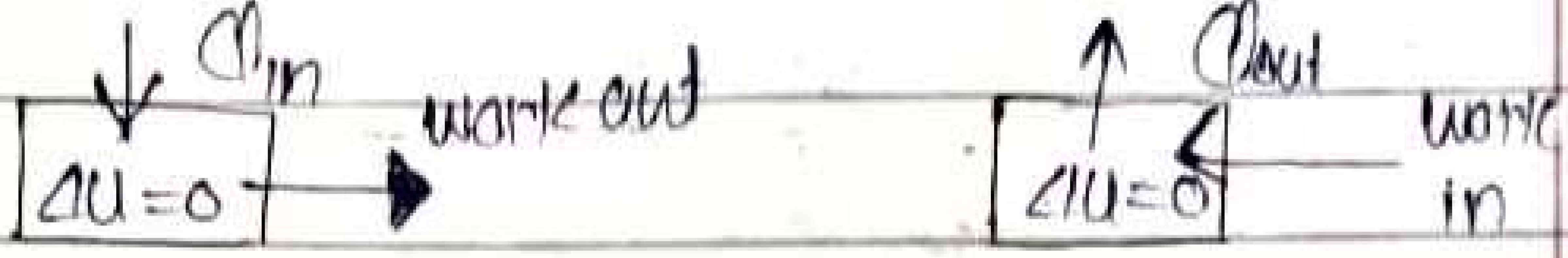
Heat In = Wout + Increase in internal energy.

Heat Out = Wout + Decrease in internal Energy.

ISOTHERMAL PROCESS

Const Temperature, $\Delta T = 0$, $\Delta U = 0$

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



Net heat input = Work out put

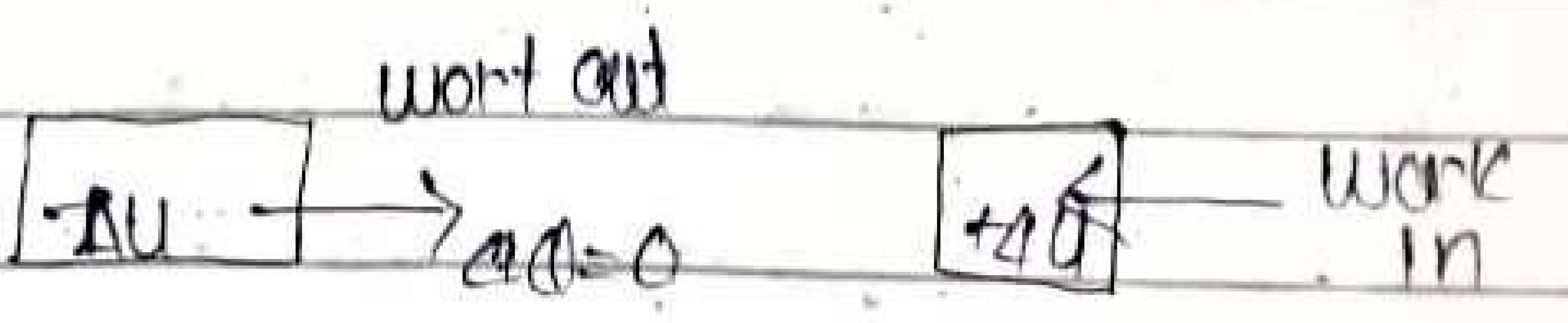
Work Input = Net heat out

ADIABATIC PROCESS

No Heat Exchange, $\Delta Q = 0$

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

$\Delta W = -\Delta U$ $\qquad$ $\Delta U = -\Delta W$



work done at EXPENSE of internal energy INPUT work INCREASES internal energy.

QNo 3:-) (a)

Ans:-)

* Internal combustion engine * (I C E)

The first commorcially succesfull combustion engine was created by E.Lenior in 1860. And then more modified in 1876 by N-Otto.

* External combustion engine * (E C E)

The external combustion engine is working as heat engine where a warking as fluid or gas.

External vs Internal combustion engine

=> The differnce between external and internal combustion engine is quite straighforward and made abuious by the differnce in their names. in external combustion engine the fual is not burned inside the enigne.

=> While in internal combustion engine the combustion chamber lies right in the middle the engine.

=> ECE working fluid that heated while ICE rely explosive power of fual within the engine to produce work.

QNo3:→ (b)

Given data

$T_A = 300\ K$

$P_A = 1\ atm$

$Q = 0\ J$

Volum decresing $1/12$

$\therefore V_A = (12V_B)$

Required data.

$P_B = ?$

$T_B = ?$

Sol:- As we know that

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

putting value

$$(1)(12V_B)^{1.4} = P_B V_B^{1.4}$$

$$\boxed{P_B = 32.4\,atm}$$

we also know that

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

$$T_B = \left(\frac{P_B V_B}{P_A V_A}\right) T_A$$

putting value

$$T_B = \left(\frac{(32.4)(V_B)}{(1)(12V_B)}\right) 300 \Rightarrow \boxed{T_B = 810\,K}$$

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

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

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

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

$$+9.75\,T_f + 12017.5 \qquad +9.75\,T_f + 12017.5$$

$$532.25\,T_f = 16258.75$$

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

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;

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

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

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

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

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

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

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