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Department	BS civil

★ INU PESHAWAR ★

Q.1 (a)

Ans: Diode :-

→ A diode is an electronic component that;

✓ has two terminals
✓ Limits Current to one direction

→ Diodes have an anode and a Cathode
→ Positive Current normally flows from the anode to the cathode.
→ Diodes are useful for protecting Circuitry from harmful Voltage or Current.
→ Diodes are a basic building block of the charge-collecting element in many detectors.

☞ Difference between Half wave rectification and full wave rectification:-

Half wave and full wave rectifiers are the two categories of rectifier circuits. The crucial difference between half wave and full wave rectifier is that a half wave rectifier converts only one half cycle of the ac input supplied into pulsating dc signal. As against a full wave, rectifier converts both halves of the applied input signal into pulsating dc.

Another Major difference between the two is that the rectification efficiency of half wave rectifier is somewhat less as compared to the full wave rectifier

Comparison chart

Parameters	Halfwave	full wave
Number of diodes used in circuit	1	2 or 4
Maximum efficiency for rectification	40.6 %	81.2 %
Ripple factor	More	less
Basic ripple frequency	f	2f
Voltage regulation	Good	Better as compared to half-wave
Peak factor	2	1.414
Form factor	1.57	1.11
Average current value	I_{max}/π	$2I_{max}/\pi$

Q: 1

Part (b)

Given data:

$T = 785°C$
Mass $= 97.0g$
] Gold

$T = 15.0°C$
Mass $= 323g$
] Water

Required data:

Final Temprature?

Solution:

- Lose heat = Gain heat

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

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

$$-[(2.5)(T_f - 785°C)] = (1.35 \times 10^3)(T_f - 15°C)]$$

$$-12.5\ T_f + 9.82 \times 10^3 = 1.35 \times 10^3\ T_f - 202 \times 10^4$$

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

Result: $T_f = 22.1°C$

Q: 2

Part (a) Explain the Isobaric Process, Isometric process, Isothermal process and adiabatic process on the basis of first law of thermodynamics?

Ans:

ISOCHORIC PROCESS

CONSTANT VOLUME, $\Delta V = 0$, $\Delta W = 0$

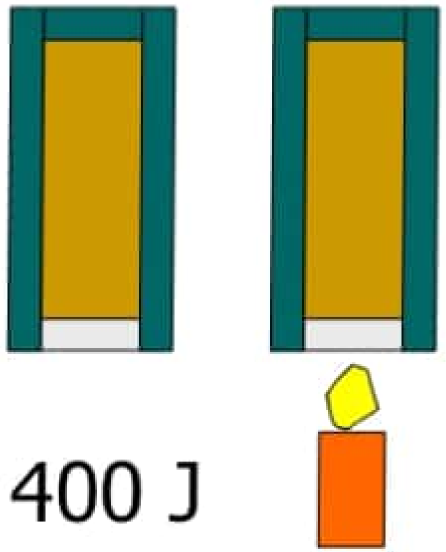
$$\Delta Q = \Delta U + \Delta W^{\,0} \quad \text{so that} \quad \Delta Q = \Delta U$$

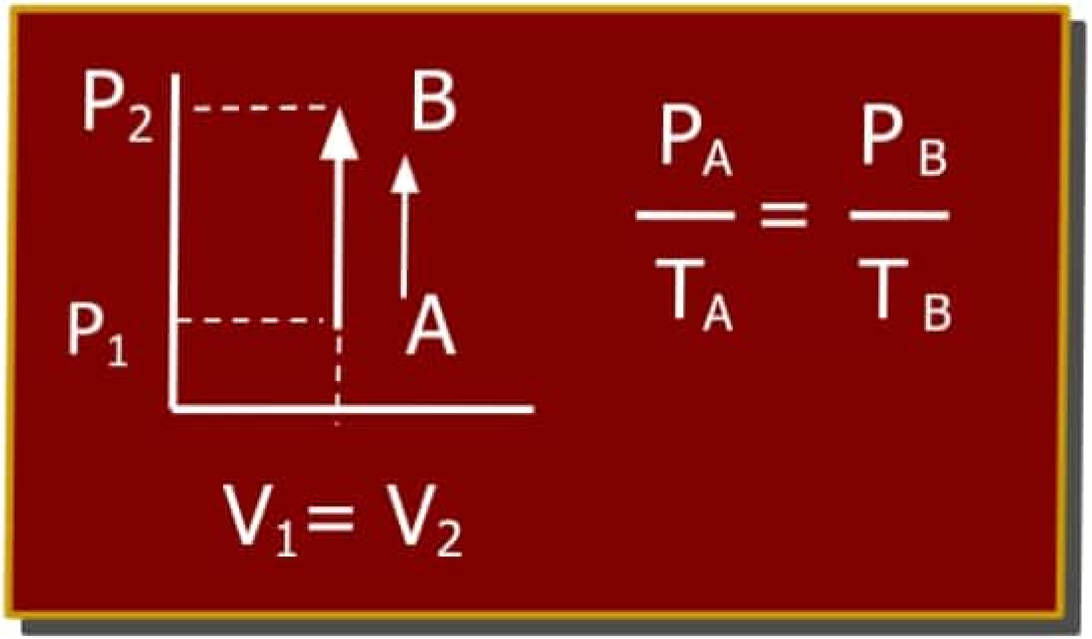
HEAT IN = INCREASE IN INTERNAL ENERGY

HEAT OUT = DECREASE IN INTERNAL ENERGY

ISOCHORIC EXAMPLE

No Change in volume:





Heat input increases P with const. V

400J heat input increases internal energy by 400J and zero work is done.

ISOBARIC PROCESS

CONSTANT PRESSURE, $\Delta P = 0$

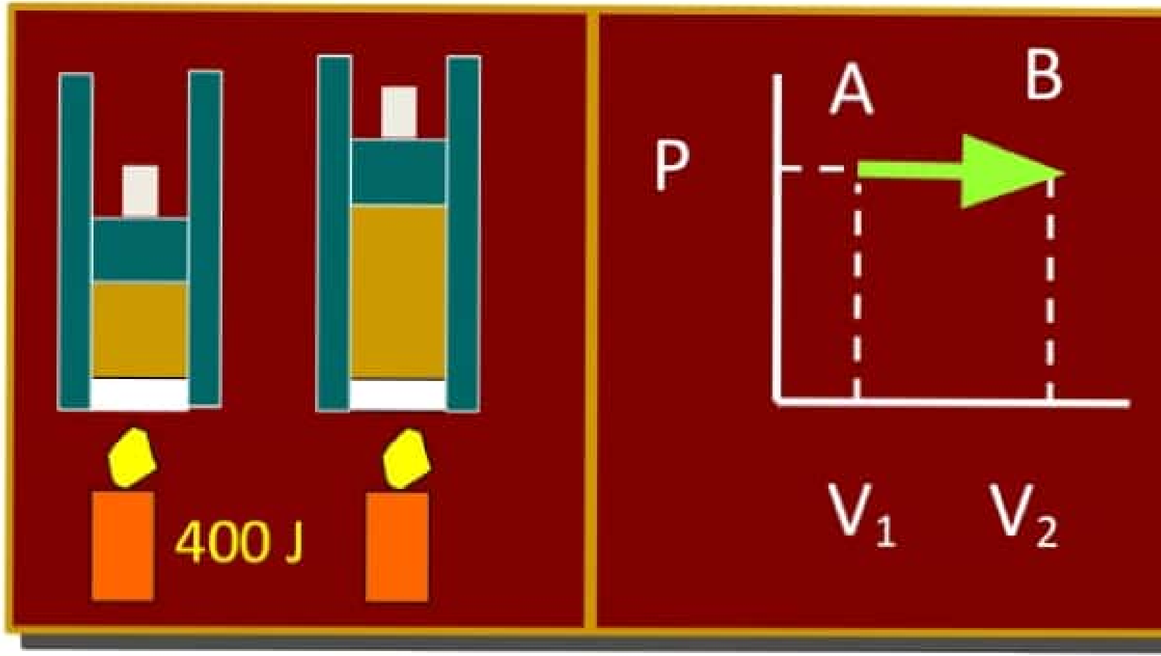
$$\Delta Q = \Delta U + \Delta W \quad \text{But} \quad \Delta W = P\,\Delta V$$

HEAT IN = W_{out} + INCREASE IN INTERNAL ENERGY

HEAT OUT = W_{out} + DECREASE IN INTERNAL ENERGY

ISOBARIC EXAMPLE

Constant Pressure

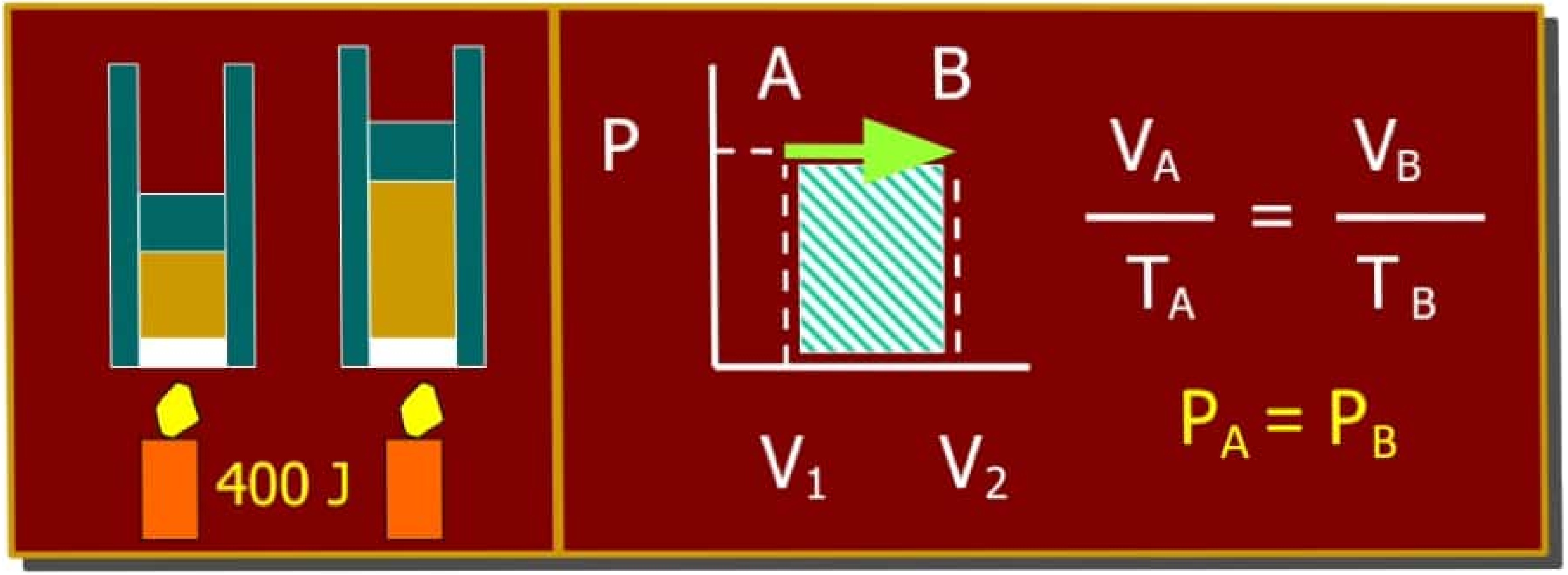


$$\frac{V_A}{T_A} = \frac{V_B}{T_B}$$

Heat input increases *V* with const. *P*

400 J heat does 120 J of work, increasing the internal energy by 280 J.

ISOBARIC WORK



Work = Area under PV curve

$$Work = P\Delta V$$

ISOTHERMAL PROCESS

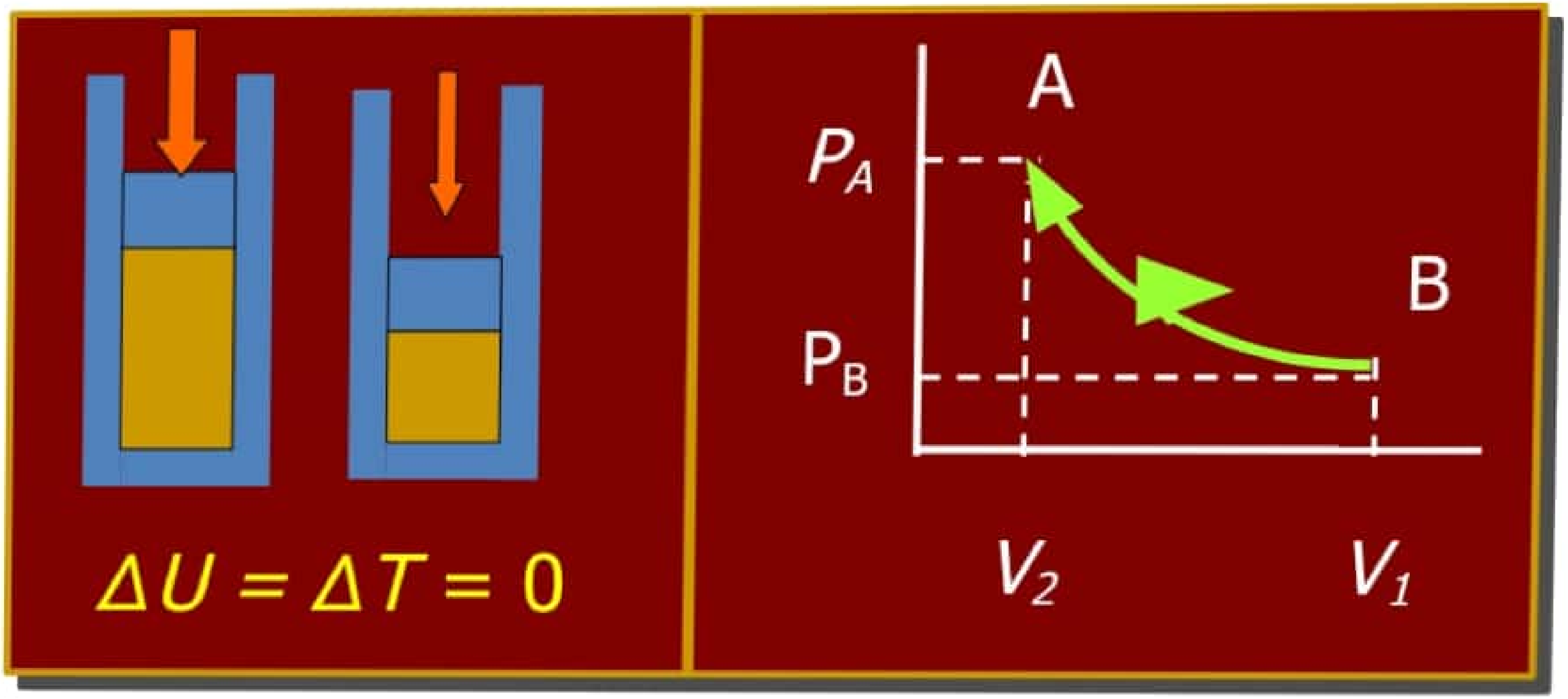
CONST. TEMPERATURE, $\Delta T = 0$, $\Delta U = 0$

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

NET HEAT INPUT = WORK OUTPUT

WORK INPUT = NET HEAT OUT

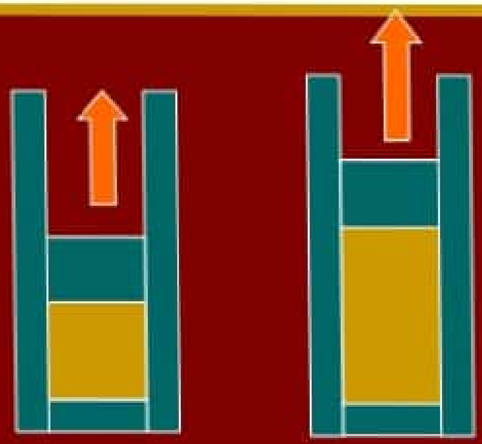
ISOTHERMAL EXAMPLE (Constant T):



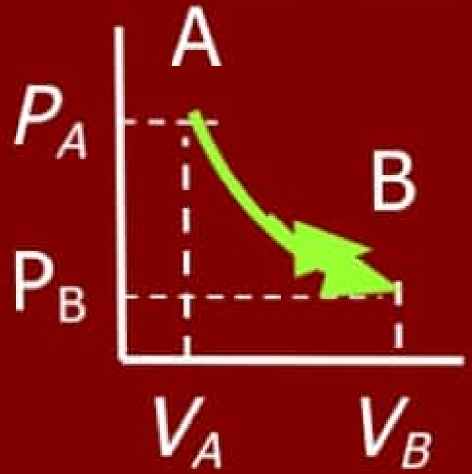
$$P_A V_A = P_B V_B$$

Slow compression at constant temperature: ----- No change in U.

ISOTHERMAL EXPANSION (Constant T):



$\Delta U = \Delta T = 0$



$$P_A V_A = P_B V_B$$

$$T_A = T_B$$

400 J of energy is absorbed by gas as 400 J of work is done on gas.

$$\Delta T = \Delta U = 0$$

Isothermal Work

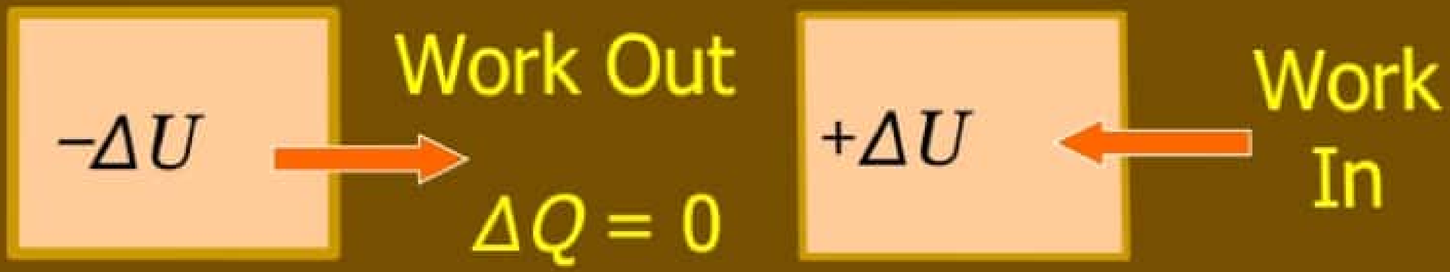
$$W = nRT \ln \frac{V_B}{V_A}$$

ADIABATIC PROCESS

NO HEAT EXCHANGE, $\Delta Q = 0$

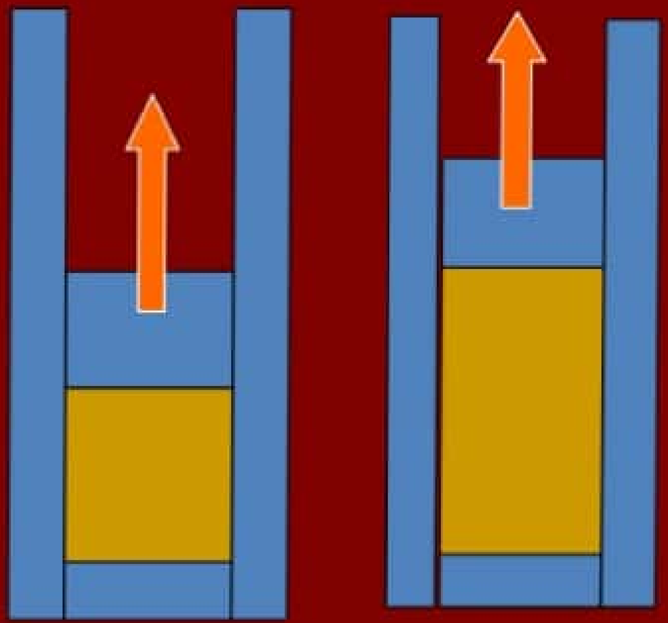
$\Delta Q = \Delta U + \Delta W$; $\Delta W = -\Delta U$ *or* $\Delta U = -\Delta W$

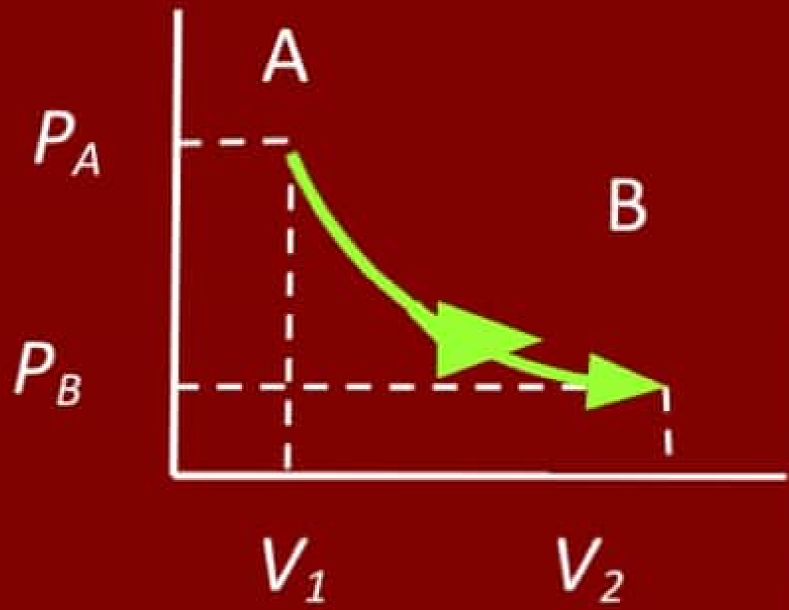
$\Delta W = -\Delta U$ $\Delta U = -\Delta W$



Work done at EXPENSE of internal energy INPUT Work INCREASES internal energy

ADIABATIC EXAMPLE





Insulated Walls: $\Delta Q = 0$

Expanding gas does work with zero heat loss. Work = $-\Delta U$

Q: 2

Part (B)

A steam engine absorbs 600J of heat at 500 K and the exhaust temprature is 300 K. If the actual efficiency is only half of the ideal efficiency, how much work is done

Solution:

$T_C = 300\,K$

$T_H = 500\,K$

$Q_H = 600\,j$

As we know that

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

Putting values

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

$e = 40\%$

Actual $e = 0.5 e_i = 20\%$

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

By rearranging

$W = eQ_H$

Putting values

$W = 0.20\ (600\ J)$

$W = 120\ j$

Work = 120 j

Result:

Hence the required result

$W = 120\ j.$

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Q:3
(a) Differeniate b/w Internal Combustion engine and external Combustion Engine

No	Internal Combustion Engine	External Combustion Engine
1)	Name it self says that, combustion take place inside the cylinder.	→ Name it self says that, combustion take place outside the cylinder
2)	Temperature is high	→ Temperature is low
3)	Pressure is higher	→ Pressure is lower.
4)	In IC engine, piston and connecting rod is use	→ In EC engine, stuffing box is use
5)	Efficiency is higher	→ Efficiency is lower.
6)	Lighter in weight	→ ~~Higher~~ Heavy in weight.
7)	IC engine is costly	→ EC engine is cheaper
8)	Less Time required to start	→ More time required to Start.
9)	Pressure generated inside the engine is due to combustion of fuel,	→ Pressure generated inside the engine is due to Steam of water.
10)	Fuel Tank required to Store fuel.	→ Boiler and water Storage required to generate Steam.

Q: 3

Part (b):

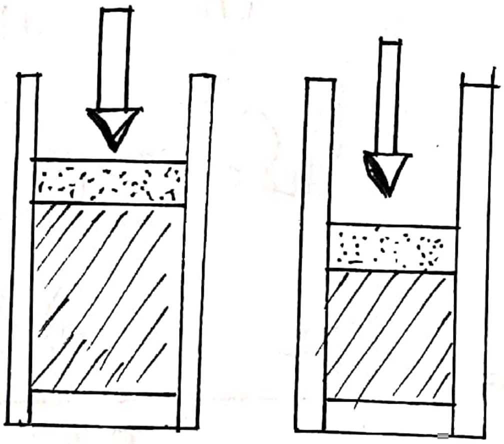
Problem: A diatomic gas at 300 K and 1 atm is compressed adiabatically, decreasing its volume by 1/2 $\cdot (V_A = 12V_B)$

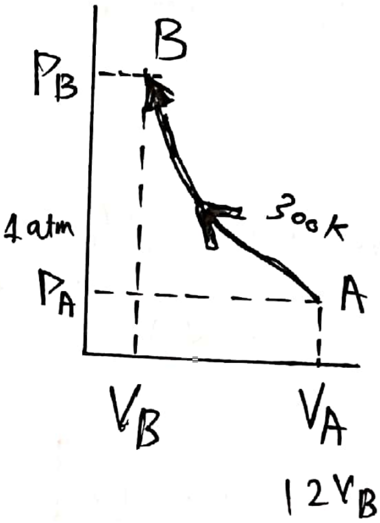
Required data:

What is the new pressure and temprature ?

Solution:

$$\gamma = 1.4$$





$$\Delta Q = 0$$

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

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

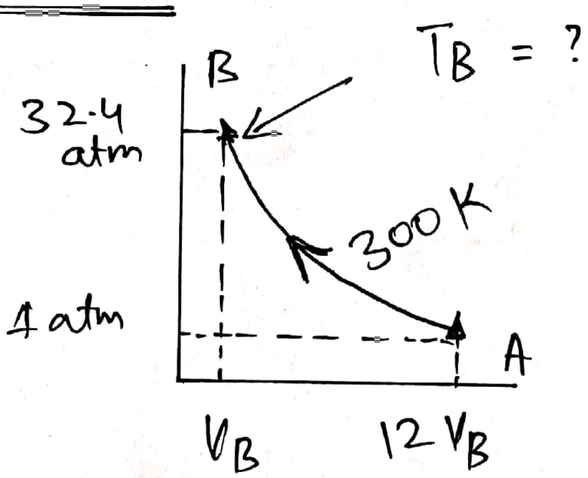
$$P_B = P_A \left(\frac{V_A}{V_B} \right)^{\gamma}$$

$$P_B = P_A \left[\frac{12 V_B}{V_B} \right]^{1.4}$$

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

$$\boxed{P_B = 32.4\ \text{atm} \quad \text{or} \quad 3284\ \text{KPa}}$$

Find T_B



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

Solve for T_B

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

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

Q:4

(a) Differeniate b/w conduction & convection.

Conduction	Convection
Energy transferred by direct contact	Occurs in gases and liquids.
Energy flows directly from warmer to cooler objects	Movement of large number of particles in same direction.
Continues until object tempratures are equal	Cycle occurs while temperature difference exist.

Q: 4

(b)

Given DATA:

lead Mass = 75.0 g

Specific heat = 0.130 J/g°c

Initial temp = 435 °c

Water Mass = 125 g

Required data:-

Final Temprature = ?

Solution:

$$Q_{Water} = -Q_{Pb}$$

$$m_{Water}\, c_{Water}\, \Delta T_{Water} = -(m_{Pb}\, c_{Pb}\, \Delta T_{Pb})$$

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

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

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

$$532.25\,T_f = 16258.75$$

Result: $T_f = 30.5\,°c$

Q:5

Problem:

Given Data:

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

Thickness = 0.25 m

$K = 0.8\, W/m \cdot {}^\circ C$

$T_1 = 25^\circ C$

$T_2 = 0^\circ C$

Time period = 10 hours

Required Data:

Determine the rate of heat loss through the roof that night and the cost of that heat loss to the home owner if the cost of electricity is \$0.2/k Wh.

Solution:

Noting 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 ;

$$Q = KA(T_1 - T_2)/L$$

Putting Values

$$Q = (0.8)(48)(25-0)/0.25$$

$$Q = 3840 W = 3.84 KW$$

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

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

$$Q = Q.\Delta t = (3.84 KW)(10 h)$$

$$\boxed{Q = 38.4 KWh}$$

$$\text{Cost/day} = (\text{Amount of Energy})(\text{Unit cost of E})$$

$$= (38.4\ \text{KWh})(\$0.2/\text{KWh})$$

$$\boxed{\text{Cost/day} = \$7.68}$$

$$\text{Cost/Month} = (\text{Cost/day}) \times (30\ \text{day/month})$$

$$= \$7.68 \times 30$$

$$\boxed{\text{Cost/Month} = \$230.4}$$