Basic Electro-Mechanical Engineering

Summer final Paper

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Section: A

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HAYATABAD, PESHAWAR

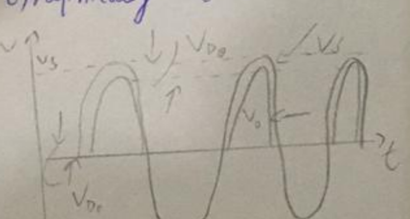
Q.1 (a): What is Diode? Differentiate between Half-wave rectification and Full-wave rectification.

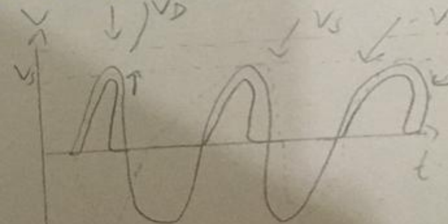
Q:- 1 part (a).
What is Diode? Differentiate between Half-wave and full-wave rectification?

Ans:- DIODE:-
It is defined as "A diode is an electrical component that allows the flow of current in one direction and has two terminals **Anode** and **Cathode** and is known as diode".

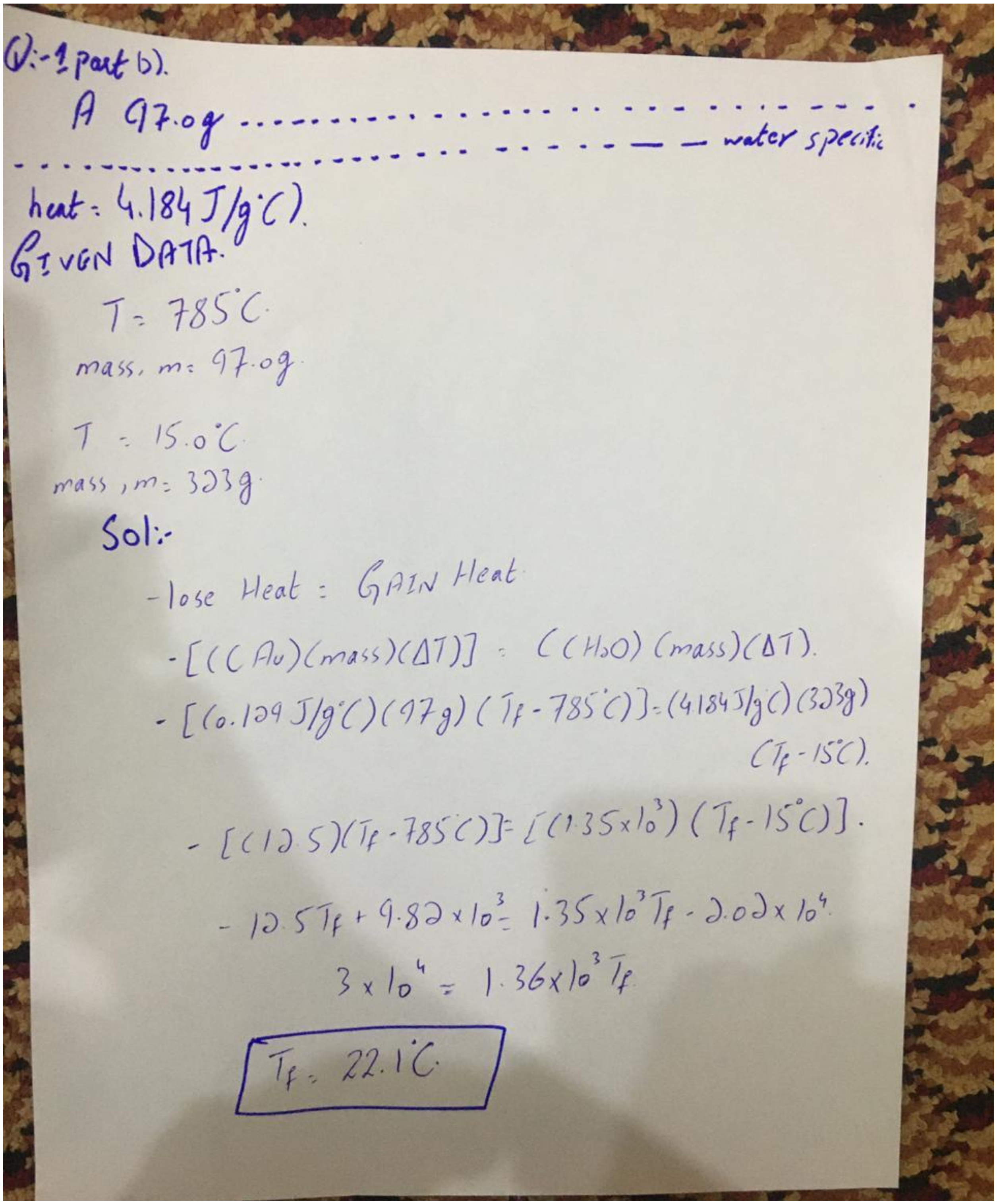
Differentiate between Half-wave And Full-wave rectification.

HALF-WAVE RECTIFICATION	FULL-WAVE RECTIFICATION
1). A half-wave rectifier converts only one-half cycle of the ac input supplied into pulsating dc signal.	1) A full-wave rectifier converts both halves of the applied input signal into pulsating dc.
2). Half-wave rectifier shows a unidirectional nature.	2) Full-wave rectifier shows a bidirectional nature.
3). Graphically it is shown as	3) Graphically it is shown as.





(b): A 97.0 g sample of gold at 785°C is dropped into 323 g of water, which has an initial temperature of 15.0°C. If gold has a specific heat of 0.129 J/g°C, what is the final temperature of the mixture? Assume that the gold experiences no change in state of matter.(water specific heat=4.184 J/g°C).



Q:-1 part b).

A 97.0g .... — water specific heat = 4.184 J/g°C).

GIVEN DATA.

$T = 785°C$.

mass, $m = 97.0g$.

$T = 15.0°C$.

mass, $m = 323g$.

Sol:-

-lose Heat = GAIN Heat

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

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

$-[(12.5)(T_f - 785°C)] = [(1.35\times10^3)(T_f - 15°C)]$.

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

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

$T_f = 22.1°C$

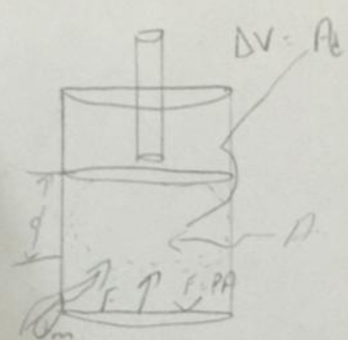
Q.2 (a): Explain the Isobaric process, Isometric process, Isothermal process and adiabatic process on the basis of first law of thermodynamics.

Q:-2 part (a). Explain the Isobaric process, Isometric process, Isothermal process and adiabatic process on the basis of First law of thermodynamics.

Ans- ISOBARIC PROCESS:-

It is defined as "A process by which a gas work on a piston at constant pressure is called an isobaric process."

Graphically it is shown as:-



As we know

$F = PA \rightarrow (i)$

So

$W = Fd \rightarrow (ii)$

Put the value of F in eq (ii), we get

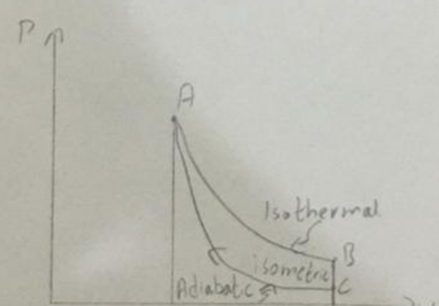
$W = PAd \rightarrow (iii)$

Because the volume of a cylinder is its cross-sectional area A times of its length d, we see that $Ad = \Delta V$, the change in volume. If ΔV is positive then W is positive means that work is done by the gas on outside.

Isometric Process:-

A constant-volume (isometric) thermodynamic process in which the system is confined mechanically rigid boundaries. No direct mechanical work can be done on the surroundings by a system with rigid boundaries, therefore the heat transferred into or out of the system equals the change of internal energy stored in the system. This change in the internal energy, in turn, is a function of the specific heat and the temperature change in the system.

$$Q_v = U_2 - U_1 = \int_1^2 C_v \, dT.$$



ISOTHERMAL PROCESS:-

An isothermal is a change of a system, in which the temperature remains constant $\Delta T = 0$, This typically occurs when a system is in contact with an outside thermal reservoir (heat bath), and the change in the system will occur slowly enough to allow the system to continue to adjust to the temperature of the reservoir through heat exchange.

Simply, we can say that in isothermal process

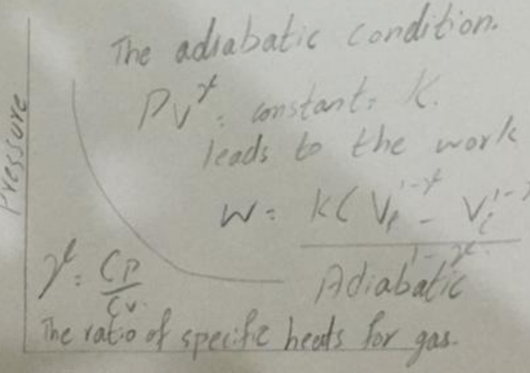
$T = \text{constant}$.

$\Delta T = 0$.

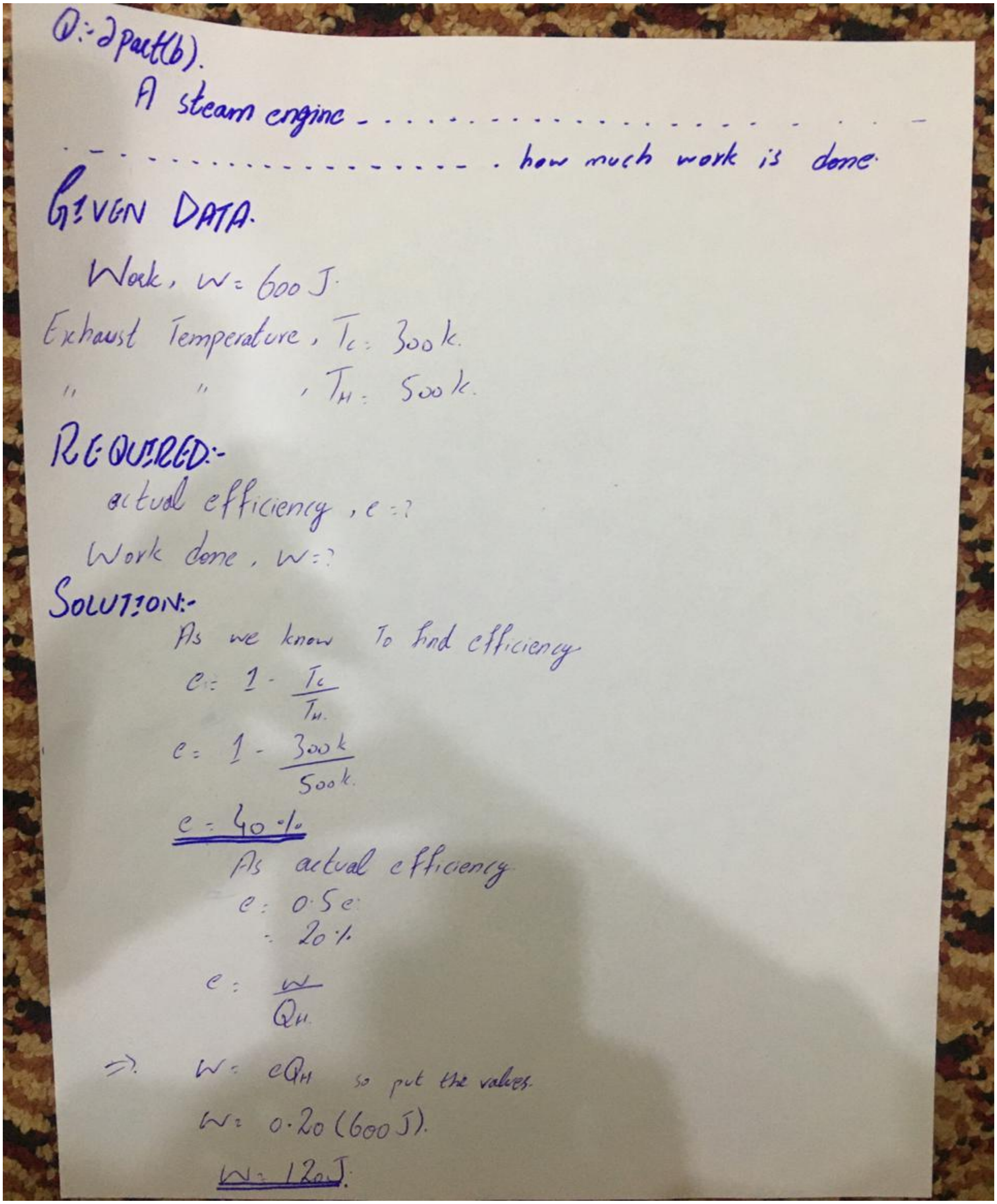
$dT = 0$.

ADIABATIC PROCESS:-

An adiabatic process is one in which no heat is gained or lost by the system. The first law of thermodynamics with $Q = 0$, shows that all the change in internal energy is in the form of work done. This puts a constraint on the heat engine process leading to the adiabatic condition. This condition can be used to derive the expression for the work done, during an adiabatic process.



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



Q:- 2 part(b).

A steam engine ....

.... how much work is done.

GIVEN DATA.

Work, $W = 600\ J$.

Exhaust Temperature, $T_c = 300\ k$.

" " , $T_H = 500\ k$.

REQUIRED:-

actual efficiency, $e = ?$

Work done, $W = ?$

SOLUTION:-

As we know To find efficiency

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

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

$e = 40\ \%$

As actual efficiency

$e = 0.5e$

$= 20\ \%$

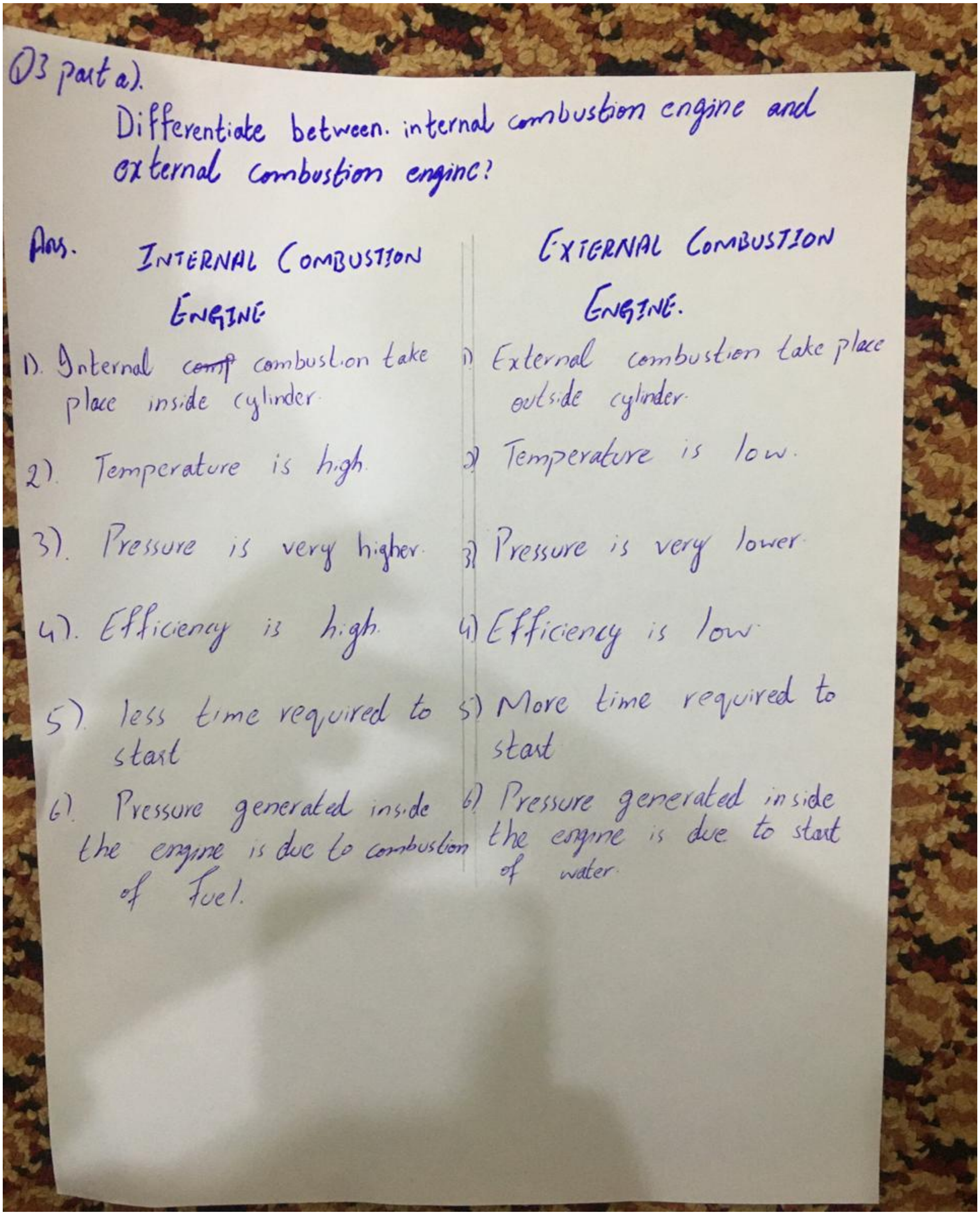
$e = \frac{W}{Q_H}$

$\Rightarrow W = eQ_H$ so put the values.

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

$W = 120\ J$.

Q.3 (a): Differeniate between internal combustion engine and external combustion engine



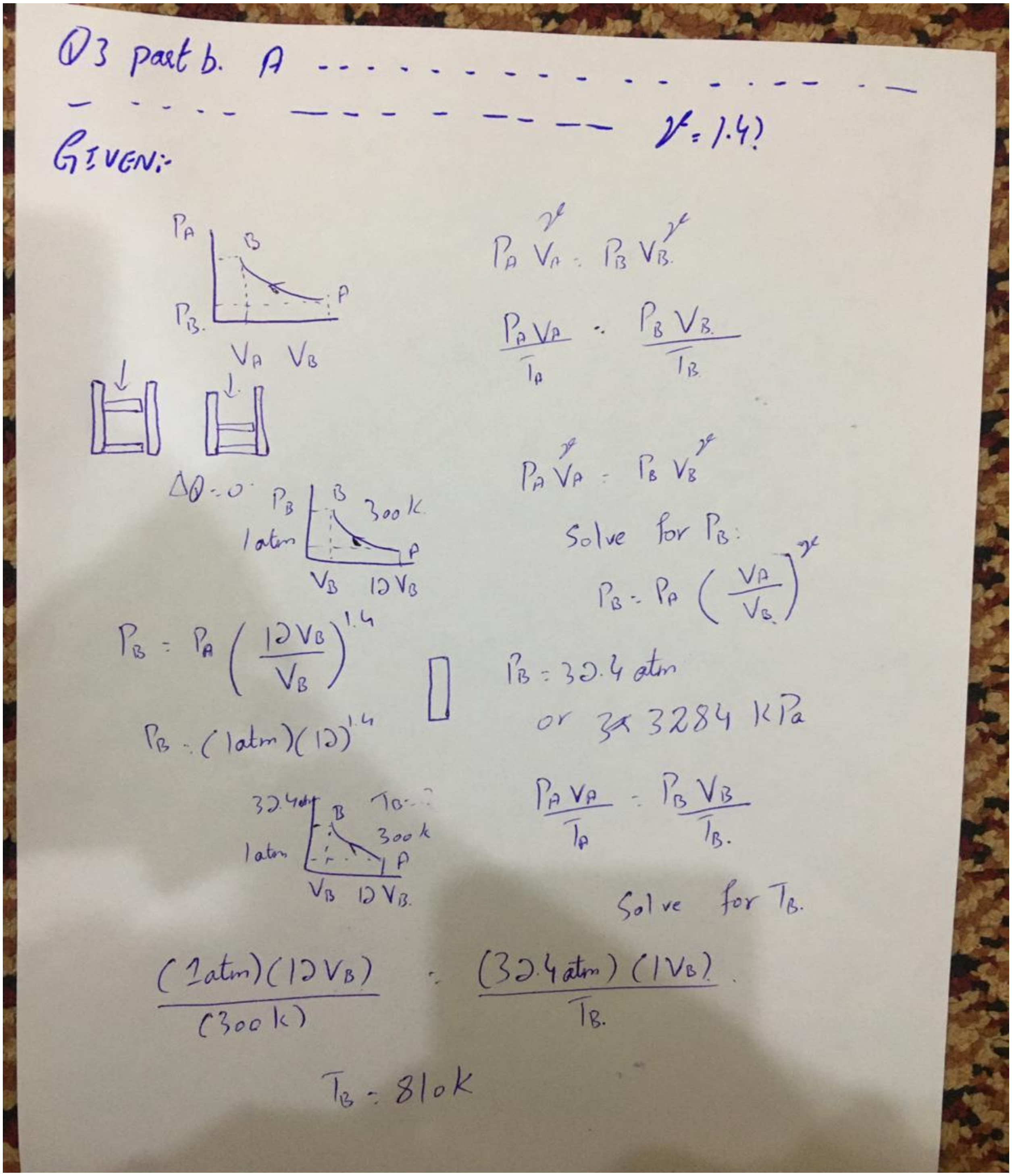
Q3 part a).

Differentiate between. internal combustion engine and external combustion engine?

Ans.

INTERNAL COMBUSTION ENGINE	EXTERNAL COMBUSTION ENGINE.
1). Internal ~~comp~~ combustion take place inside cylinder	1) External combustion take place outside cylinder
2). Temperature is high	2) Temperature is low.
3). Pressure is very higher.	3) Pressure is very lower
4). Efficiency is high	4) Efficiency is low
5) less time required to start	5) More time required to start
6). Pressure generated inside the engine is due to combustion of fuel.	6) Pressure generated inside the engine is due to start of water.

(b): A diatomic gas at 300 K and 1 atm is compressed adiabatically, decreasing its volume by 1/12. ($V_A = 12V_B$). What is the new pressure and temperature? ($\gamma = 1.4$).


Q3 part b. A - $\gamma = 1.4$)

GIVEN:-

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

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

$\Delta Q = 0$

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

Solve for P_B:

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

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

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

$P_B = 32.4$ atm

or 3284 kPa

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

Solve for T_B.

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

$T_B = 810 k$

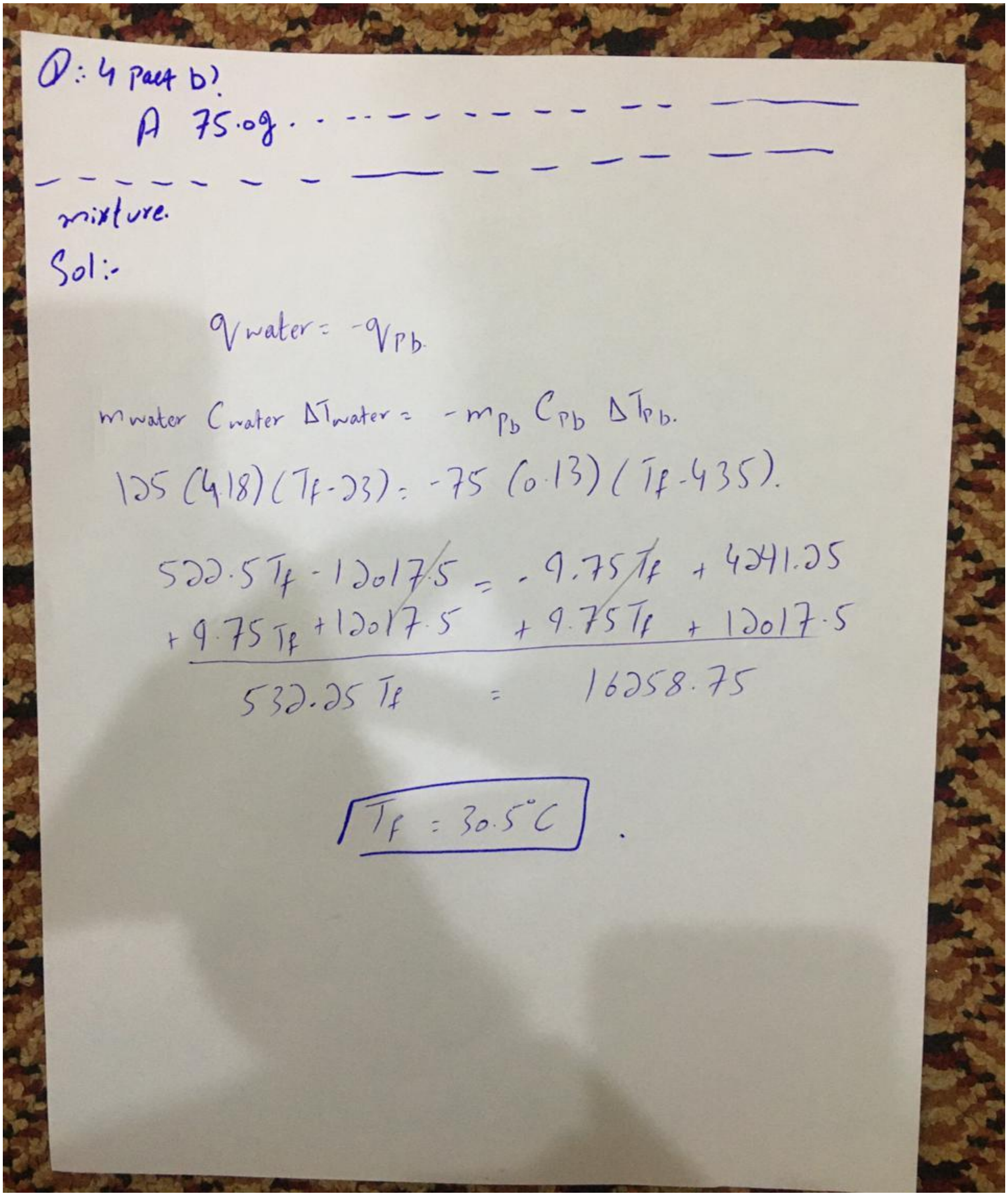
Q.4 (a): Differentiate between conduction and convection.

Q4). Part (a). Differentiate between conduction and convection.

Ans:-

CONDUCTION	CONVECTION.
1) In conduction the heat transfer take place between objects by direct content.	1) In convection the heat transfer takes place within Fluid.
2) Heat transfer of conduction is slow.	2) Heat transfer of convection is Faster.
3) It does not follow the law of reflection or refraction.	3) It does not follow the laws.
4) The heat transfer takes place due to the difference in temperature.	4) The heat transfer occurs due to difference in density.

(b): A 75.0 g piece of lead (specific heat = 0.130 J/g.°C), initially at 435°C is set into 125.0 g of water (specific heat = 4.18 J/g.°C), initially at 23.0°C. What is the final temperature of the mixture?



Q: 4 part b)

A 75.0g . . . .

mixture.

Sol:-

$$q_{water} = -q_{Pb}$$

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

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

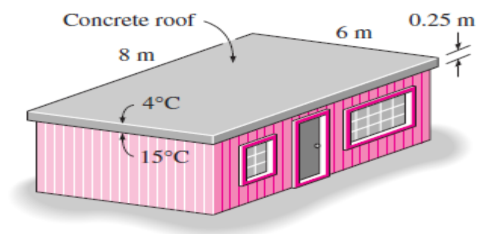
$$522.5 T_f - 12017.5 = -9.75 T_f + 4241.25$$

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

$$532.25 T_f = 16258.75$$

$$\boxed{T_f = 30.5°C}$$

Q.5: The roof of an electrically heated home is 6 m long, 8 m wide,and 0.25 m thick, and is made of a flat layer of concrete whose thermal conductivity is k 0.8 W/m · °C . The temperatures of the inner and the outer surfaces of the roof one night are measured to be 25°C and 0°C, respectively, for a period of 10 hours.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/kWh.



Q5 The roof - - - ——————

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$ $0.2/k wh.

Sol:-

a). Nothing that heat transfer through the roof is by conduction and the area of the roof is:

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

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

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

$= 3840\,W$

$= \boxed{3.84\,kW}$.