Department of Electrical Engineering
Assignment
Date: 20/04/2020

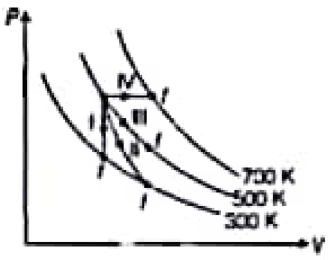
Course Details

Course Title: Thermodynamics **Module:** 02
Instructor: **Total Marks:** 30

Student Details

Name: Hamza **Student ID:** 16469

Q1.	(a)	Express the temperature of 139 °C on degree Fahrenheit, Rankine and Kelvin scales.	Marks 06 CLO 1
	(b)	Derive the equation highlighting the work done by a gas or vapour in expanding for a constant temperature process.	Marks 05 CLO 1
Q2.		Analyze the given figure and match column 1 with the correct option of column 2.	Marks 08 CLO 1



Column 1	Column 2
Process I	Adiabatic
Process II	Isobaric
Process III	Isochoric
Process IV	Isothermal

Q3.	(a)	Hydrogen is compressed under a constant pressure of 5760 lb/ft^2 until its volume is reduced from 28 to 12 ft^3. Calculate the work done in compressing the gas.	Marks 07 CLO 1
	(b)	Differentiate between enthalpy and entropy using examples from daily life.	Marks 04 CLO 1

Name Hamza
I.D 16469

Q1
(a) Express the temperature of 139 °C on degree Fahrenheit, Rankine and Kelvin scales.

Sol:-

Given data:

°C = 139 °C

Required data:

°F = ?
°R = ?
°K = ?

Solution:

As

$°F = (°C \times 1.8) + 32$
$= (139 \times 1.8) + 32$
$= 282.2$

$°F = 282.2$

Now

$°R = °F + 460$
$= 282.2 + 460$
$= 742.2$

$°R = 742.2$

also

$°K = °C + 273$
$= 139 + 273$
$= 412 °K$

$°K = 412 °K$

Hamza
16469

Q1 (b) Derive the equation highlighting the work done by a gas or vapour in expanding for a constant temperature process.

Sol:-

Derivation of the equation for work done in constant temperature process (Isothermal)

$$W = \int_{V_1}^{V_2} P\,dV \quad \text{—— (1)}$$

As $P_1V_1 = P_2V_2 = PV = C$ — (a) ∵ Ratio b/w P and V is constant ($PV = C$)

so $P = \frac{C}{V}$

Eq (1) Become

$$W = \int_{V_1}^{V_2} \frac{C}{V}\,dV$$

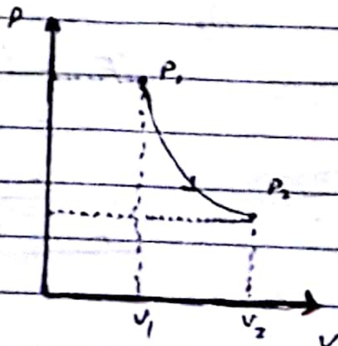
$$= C \int_{V_1}^{V_2} \frac{1}{V}\,dV$$

$$= C \ln V \Big|_{V_1}^{V_2}$$

$$= C[\ln(V_2 - V_1)]$$

$$= C(\ln V_2 - \ln V_1)$$

$$W = C \ln\left(\frac{V_2}{V_1}\right)$$



PV curve

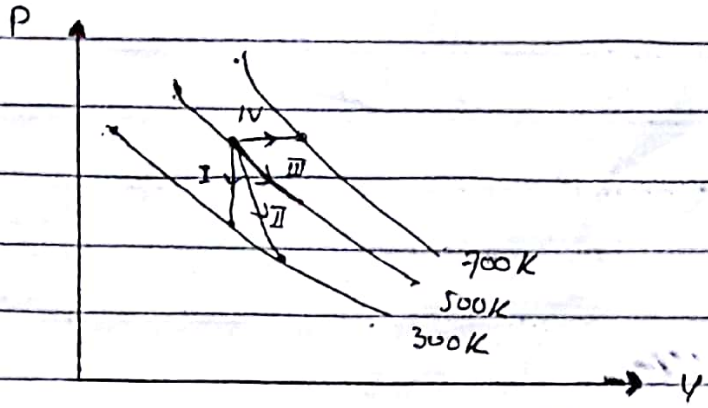
Now Replace "C" with PV as we consider above in eq (a)

so,

$$\boxed{W = P.V \ln\left(\frac{V_2}{V_1}\right)}$$

Hamza
16469

Q 2 Analyze the given figure and match column 1 with the correct option of column 2.



Sol:-

column 1	column 2
Process I	Isochoric
Process II	Adiabatic
Process III	Isothermal
Process IV	Isobaric

Hamza 16469

(4)

Q 3 (a) Hydrogen is compressed under a constant pressure of 5760 lb/ft^2 until its volume is reduced from 28 to 12 ft^3. calculate the work done in compressing the gas.

Sol:-

Given data:

$P = 5760\ lb/ft^2$

$V_1 = 12 ft^3$ and $V_2 = 28 ft^3$

Required data:

$W = ?$

Solution:

As in constant pressure process work done is:

$$\text{work done} = P(V_2 - V_1)$$

$$= 5760(28 - 12)$$

$$= 92160\ ft.lb$$

work done = 92160 ft.lb

Hamza
16469

(5)

Q3 (b) Differentiate between enthalpy and entropy using examples from daily life.

Ans:

Enthalpy:

Enthalphy is equal to the total internal energy of the system plus the product of pressure and volume (work done).

The amount of energy possessed by a thermodynamic system for teransfer between itself and its environment. For example, in a chemical reaction, the change in enthalpy of the system is the heat of the reaction. In a phase change, as from a liquid to a gas, the change in enthalpy of the system is the latent heat of vaporization. In a simple temperature change, the change in enthalpy with each degree is the heat capacity of the system at constant pressure. The German physicist Rudolf J.E. Clausius originated the term in 1850. also Refrigerator compressors and chemical hand warmers are both real-life examples of enthalpy. Both the vaporization of refrigerants in the compressor and the reaction to the iron oxidation in a hand warmer generate a change in heat content under constant pressure.

Hamza 18469

Despite the opposite results they give, both of these reactions obey the law of conservation of energy. When the refrigerant chemicals in the compressor are vaporized, heat is absorbed in an endothermic reaction. In the hand warmer, iron oxidation is an exothermic reaction that releases heat. The total amount of energy in both systems remains the same. Mathematically enthalpy H is identified as U+PV, where U is the internal energy, P is pressure and V is volume. H is measured in joules or British termal units (BTUs).

$H = E + PV$

Entropy:

Entropy is the measure of system's thermal energy per unit temperature that is unavailable for doing useful work.

→ A measure of the disorder that exist in a system is called entropy.
→ A measure of energy in a system or process that is unavailable to do work.
→ In reversible thermodynamic process, entropy is expressed as the heat absorbed or emitted divided by absolute temperature.

The second law of thermodynamics gives a precise definition of a property called entropy. Entropy can be thought of as a measure of how close a system is to

Hamza 16469

equilibrium, it can also be thought of as a measure of the disorder in the system. The law states that the entropy — that is, the disorder — of an isolated system can never decrease. Thus, when an isolated isolated system achieves a configuration of maximum entropy, it can no longer undergo change: It has reached equilibrium. Nature, then, seems to "prefer" disoreder or chaos. It can be shown that the second law stipulates that, in the absense of work, heat cannot be transferred from a region at a lower temperature to one at a higher temperature.

A campfire is an example of entropy. The solid wood burns and becomes ash, smoke and gases, all of which spread energy outwards more easily than the solid fuel. Ice melting, salt or sugar dissolving, making popcorn and boiling water for tea are processes with increasing entropy in your kitchen.

Hamza 16469

Example of enthalpy and entropy:

In a 4 stroke diesel engine, when piston takes the air into cylinder (pulls the air the into cylinder) i.e. performing the first or inlet stroke while moving from top to bottom, it fully fills the cylinder with air then comes the turn of compressing this air and this compression is too much (about the ratio of 1:20) as compared with a 4 stroke petrol engine.

In this process Entropy is decreased i.e. size of air is decreased without removing heat from the air (while Enthalpy remains same), this decrease in Entropy without decreasing Enthalpy i.e without dissipating heat somewhere in the surrounding or nearby matter or environment causes a useful rise in the temperature of air about 600 degree centigrade which is more than enough to burn the diesel sprayed at that very time.