

Department of Electrical Engineering
Sessional Assignment
Date: 06/05/2020

Course Details

Course Title: Thermodynamics **Module:** 02
Instructor: _____ **Total Marks:** 20

Student Details

Name: Hamza **Student ID:** 16469

Q1.		Let the initial volume of the gas in a container be 06 liters and the initial pressure be 04 atm. The piston is compressed at a constant temperature to a new final volume of 2.50 L. Evaluate the final pressure in units of atm, mmHg and psi.	Marks 06 CLO 2
Q2.		State the following statement as True or False and also give the reason for your answer: "There is a direct relationship between air pressure and altitude".	Marks 03 CLO 2
Q3.		A volume of 8 ft ³ of steam at a pressure of 100 lb-f/in ² is expanded hyperbolically to a pressure of 18.3 lb-f/in ² Calculate the work done by steam.	Marks 06 CLO 1
Q4.	i. ii.	Outline the differences between work and heat. Describe the meaning of the term $\Delta Q = \Delta W$	Marks 03+02 CLO 1

Q1

Let the initial volume of the gas in a container be 0.6 ltrs and the initial pressure be 04 atm. The piston is compressed at a constant temperature to a new final volume of 2.50 ltrs. Evaluate the final pressure in units of atm, mmHg and Psi.

Sol:-

$$V_1 = 6.00 \text{ L} \quad , \quad V_2 = 2.50 \text{ L}$$

$$P_1 = 4 \text{ atm} \quad , \quad P_2 = ?$$

we know that

$$P_1 V_1 = P_2 V_2$$

Rearrange the above equation & get P_2 .

$$P_2 = \frac{P_1 V_1}{V_2}$$

$$= \frac{(4)(6.00)}{(2.50)} = 9.6 \text{ atm}$$

$$\boxed{P_2 = 9.6 \text{ atm}}$$

$$1 \text{ atm} = 760 \text{ mmHg}$$

$$9.6 \text{ atm} = ?$$

$$P_2 = \frac{760^{\text{mmHg}} \times 9.6 \text{ atm}}{1 \text{ atm}} = 7296 \text{ mmHg}$$

Q1

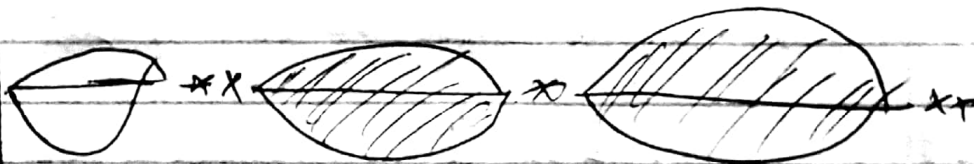
$$P_2 = 7296 \text{ mm Hg}$$

$$1 \text{ atm} = 14.7 \text{ PSI}$$

$$9.6 \text{ batu} = ?$$

$$P_2 = \frac{14.7 \text{ PSI} \times 9.6 \text{ batu}}{1 \text{ atm}}$$

$$P_2 = 141.12 \text{ PSI}$$



Q2

Ans:-

"There is a direct relationship between air pressure and altitude."

The above statement is false.

Reason:-

The relationship between altitude and atmospheric pressure is ~~inverse~~ inverse because as the elevation

increases from sea level the atmospheric pressure decreases.

Explanation:

The two have an inverse relationship, that is, when elevation increases, atmospheric pressure decreases.

This is due to the amount of air on top of you at your current elevation.

At lower elevations, you have more air above you, and thus more pressure.

At higher elevations, you have less air above you, and thus less pressure.

At high elevation food takes longer time to cook due to low pressure, so at high altitude pressure cooker is used to cook food.

Q3

A volume of 8 ft^3 of steam at a pressure of 100 lb.f/in^2 is expanded hyperbolically to a pressure of 18.3 lb.f/in^2 . Calculate the work done by steam.

Sol:-

Given data

$$V_1 = 8 \text{ ft}^3$$

$$P_1 = 100 \text{ lb.f/in}^2$$

$$P_2 = 18.3 \text{ lb.f/in}^2$$

Required data

$$W = ?$$

Solution

First of all we find V_2 for further calculation

and we know that

$$P_1 V_1 = P_2 V_2$$

$$V_2 = \frac{P_1 V_1}{P_2}$$

$$= \frac{(100)(8)}{18.3}$$

$$V_2 = 43.72 \text{ ft}^3$$

5

Now for work done:

we ~~can~~ know that work done
in hyperbolic process is,

$$W = P_1 V_1 \ln \left(\frac{V_2}{V_1} \right)$$

$$= (100)(8) \ln \left(\frac{45.72}{8} \right)$$

$$= 1358.6913$$

$$= 1358.6913 \times 144 \text{ ft}\cdot\text{lb}\cdot\text{f}$$

$$W = 195651.5468 \text{ ft}\cdot\text{lb}\cdot\text{f}$$

Q11

Work :

- ① The energy which is added to the system in such a way, that a difference of temperature is not directly involved, is known as work.
- ② Work is high grade energy.
- ③ Energy transferred by all other means except temperature difference.
- ④ Work done by the system is +ve and on the system is -ive.
- ⑤ Work is the amount of energy transferred by a force acting through a distance.
- ⑥ Requires force and displacement.
- ⑦ $W > 0$ when a gas is compressed. Energy is transferred into the system.
- ⑧ $W < 0$ when a gas expands. Energy is transferred out of the system.
- ⑨ The efficiency of the transfer of work to heat is higher.

Heat :

① Heat is a form of energy which flows from hotter body to the colder body due to temperature difference between them.

② Heat is low grade energy

③ Energy transferred by virtue of temperature difference.

④ Heat received by the system is +ive and rejected is -ive

⑤ Heat is form of energy

⑥ Requires temperature difference

⑦

⑦ $Q > 0$ when the environment is at a higher temperature than the system. Energy is transferred into the system.

⑧ $Q < 0$ when the system is at a higher temperature than the environment. Energy is transferred out of the system.

⑨ The efficiency of the transfer of heat to work is lower.

Q4
(ii)

Sol

$$\Delta Q = \Delta W$$

It means that heat supplied is used in doing useful work, or all the heat absorbed by the system is used in doing some useful work by the system.

isothermal and cyclic process explain the equation very well.

According to cyclic process

initial internal energy = final internal energy

$$U_A = U_B$$

$$U_B - U_A = 0$$

$$\boxed{\Delta U = 0}$$

So, from 1st law of thermodynamics

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

$$\Rightarrow \Delta Q = 0 + \Delta W$$

$$\Rightarrow \boxed{\Delta Q = \Delta W}$$

(9)

So all the heat absorbed from surrounding by the system is totally involved in work.