Department of Electrical Engineering
Mid term exam
Date: 24/08/2020

Course Details

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

Student Details

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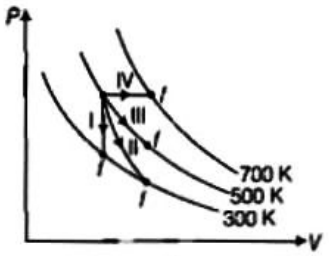
Q1.	(a)	**Express** the temperature of 140 °C on degree Fahrenheit, Rankine and Kelvin scales.	Marks 06 +05
	(b)	**Formulate** the equation highlighting the work done by a gas or vapour in expanding for a constant temperature process.	CLO 1
Q2.		**Analyze** the given figure and match column 1 with the correct option of column 2. 	Marks 08 CLO 1
Q3.	i. ii.	**Outline** the differences between work and heat. **Describe** the meaning of the term $\Delta Q = \Delta W$	Marks 03+03 CLO 1
Q4.		**Explain** the process of throttling.	Marks 05 CLO 1

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

Q #01 (a)

140°C in Fahrenheit :

$\Rightarrow F = {}^{\circ}C \times 9/5 + 32$

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$= \boxed{284}$ Fahrenheit.

140°C in Rankine :

$\Rightarrow R = {}^{\circ}C \times 9/5 + 491.67$

$\Rightarrow R = 140 \times 9/5 + 491.67$

$= \boxed{743.67}$ Rankine

140°C in kelvin :

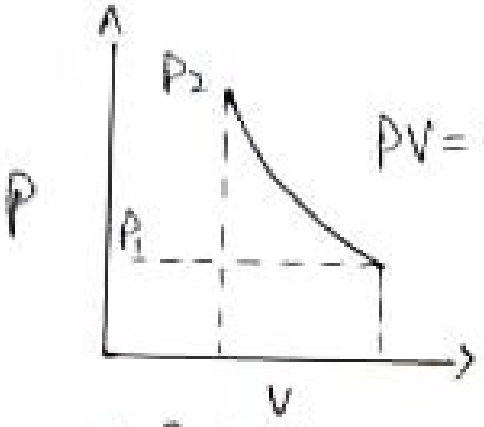
$\Rightarrow K = {}^{\circ}C + 273.15$

$\Rightarrow K = 140 + 273.15$

$= \boxed{413.15}$ kelvin.

Q # 01 (b):

For constant temperature (isothermal process).



Mathematically

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

As $$P_1V_1 = P_2V_2 = PV = C \quad \text{---(ii)}$$

$$\Rightarrow P = C/V$$

eq (i) becomes

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

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

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

As $PV = C$

So $$\boxed{W = P_1V_1 \ln\left(\frac{V_2}{V_1}\right)}$$

Q #02 :

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

Q # 03 (i)

Differences between work and heat:

-> Both heat and work are transient phenomen. Systems never process them but either or both cross the system boundry whenever a system undergoes change of state.

-> Both heat and work are boundry phenomenon. Both are observed only at the boundry and represent energy crossing the boundry

-> Both heat and work are path functions and only depend upon the path followed by a system

-> The main differences is the second law allows work to be transformed fully into heat, but forbids heat to be totally converted into work. If heat could be transformed fully into work it would violate the laws of entropy. The maximum amount of work can attain from heat is given by Carnot efficiency.

-> Heat is the energy associated with the random motion of particle while work is the energy of ordered motion in one direction. Therefore heat is low quality energy and work is high quality energy and this supports the entropy statement of the second law.

Q #03 (ii)

$$\Delta Q = \Delta W$$

The meaning of this term is when ever there is change in Heat added to a system will occur change in work done by system.

Q # 04:

Process of throtting:

Definition: This type of expansion occurs when a gas or vapour is expanded through an aperture of minute dimensions such as a narrow throat or a slightly opened valve.

-> It should be noted that frictional resistance of a fluid in passing through a pipe, varies inversly with the fifth power of the pipes diameter i-e

$$\text{velocity} \propto \frac{1}{d^5}$$

-> During a throtting process no heat is supplied or rejected, no external work is done, and in the case of a perfect gas, there is no alteration in the temperat-ure. Hence, throtting is an expansion under conditions of constant total energy.