

**Department of Electrical  
Engineering Final term  
exam**

**Course Title:** Thermodynamics  
**Instructor:** Engr Mujtaba Ihsan Sb

**Module:** 02  
**Total Marks:** 50

**Student Details**

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**Student ID:** 6939

Q1.	(a)	<b>State</b> the following along with their mathematical expressions:	Marks
	i.	The ideal gas law	04+06
	ii.	Dalton's law of partial pressure	CLO 2
	(b)	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. <b>Evaluate</b> the final pressure in units of atm, mmHg and psi.	
Q2.	(a)	You need to buy a refrigerator for your home. <b>Outline</b> the key factors that you will consider while buying the refrigerator.	Marks
			05+08
	(b)	<b>Explain</b> vapour absorption refrigeration system.	CLO 3
Q3.		<b>Distinguish</b> between water tube & fire tube boilers.	Marks
			06
			CLO 3
Q4.		State the meaning of the word "stroke" & <b>describe</b> the working of a 04 stroke engine.	Marks
			12
			CLO 3
Q5.	(a)	<b>Explain</b> the concept of Scavenging.	Marks
			04+05
	(b)	Several provincial governments in Pakistan have banned the use of 02 stroke engines in auto rickshaws. <b>Identify</b> the causes behind this decision.	CLO 3

Q.11)

Q.11: State the following along with their mathematical expression

i) The Ideal Gas Law

ii) Dalton's Law of Partial Pressure

The ideal Gas Law:

The gas constant (R) is mathematical combination of all the individual gas law constant ( $C_b, C_c, C_g, C_d$ )

$$\frac{PV}{nT} = R$$

The ideal Gas law is more commonly written as:

$$PV = nRT$$

The value of R is  $\frac{0.0821 \text{ L}\cdot\text{atm}}{\text{K}\cdot\text{mol}}$

$$PV = nRT$$

When using the equation you must have the following unit

Pressure = atm

Volume = liters

Temperature = K

**Example:**

How many moles of gas are contained in 11.2 liters at 1.00 atm and  $0.0^\circ\text{C}$ ?

(2)

Sol.

$$P = 1.00 \text{ atm}$$

$$V = 11.2 \text{ L}$$

$$T = 273.2 \text{ K}$$

$$n = ?$$

$$PV = nRT$$

$$n = \frac{PV}{RT} \Rightarrow = \frac{(1.00) \left( \frac{11.2}{0.0821} \right)}{(0.0821) (273.2)}$$

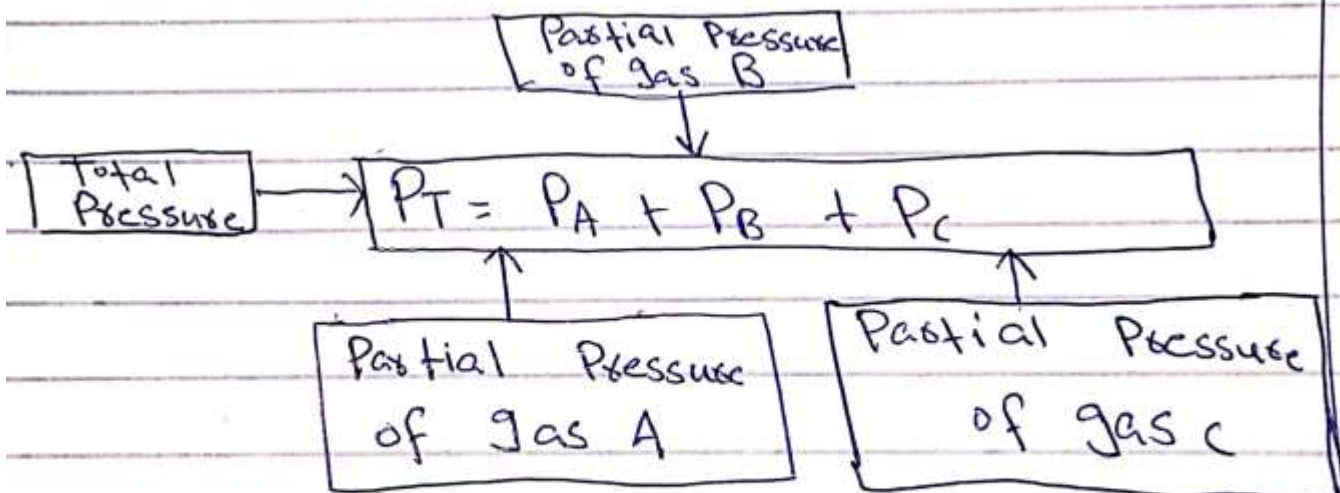
$$n = \frac{11.22}{224.29}$$

$$n = 0.050024$$

ii) Dalton's Law:

Dalton's Law of Partial Pressure states that the total pressure of a mixture of gases is the sum of the partial pressure of its component.

The partial pressure of a gas in a mixture is the pressure that the gas would exert if alone





(3)

Q 11)

Part B)

Given Data:

$$V_1 = 0.6 \text{ L}$$

$$P_1 = 0.4 \text{ atm}$$

$$V_2 = 2.50 \text{ L}$$

$$P_2 = ?$$

Soln.

$$P_1 V_1 = P_2 V_2$$

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

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

$$P_2 = \frac{(0.4 \text{ atm})(0.6 \text{ L})}{(2.50 \text{ L})} = 9.6 \text{ atm}$$

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

Convert mm Hg

$$9.6 \text{ atm}$$

$$1 \text{ atm} = 760 \text{ mm Hg}$$

Convert Psi

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

Q 2.

Ans (A).

Buying a new refrigerator is a big decision. Not only is the refrigerator the backbone of your collection kitchen items, it is also a gathering place for family. Repletion rely on it to keep your fresh food. But time is now follow these simple tips and you will be on your way to great saving.

- i) Consider a Refrigerator with a Top Mounted Freezer
- ii) Purchases an Appropriately Sized Refrigerator
- iii) Consider the Feature that are the most important to you
- iv) Recycle your old Refrigerator
- v) Take advantage of utility Rebates
- vi) Look for the Energy Star



Q (2)

Part (B):

Explain the Vapour absorption Refrigeration System:

Vapour absorption System is an absorption refrigerator is a refrigerator that use a heat source: to provide the energy needed for the cooling process.

**Principle:**

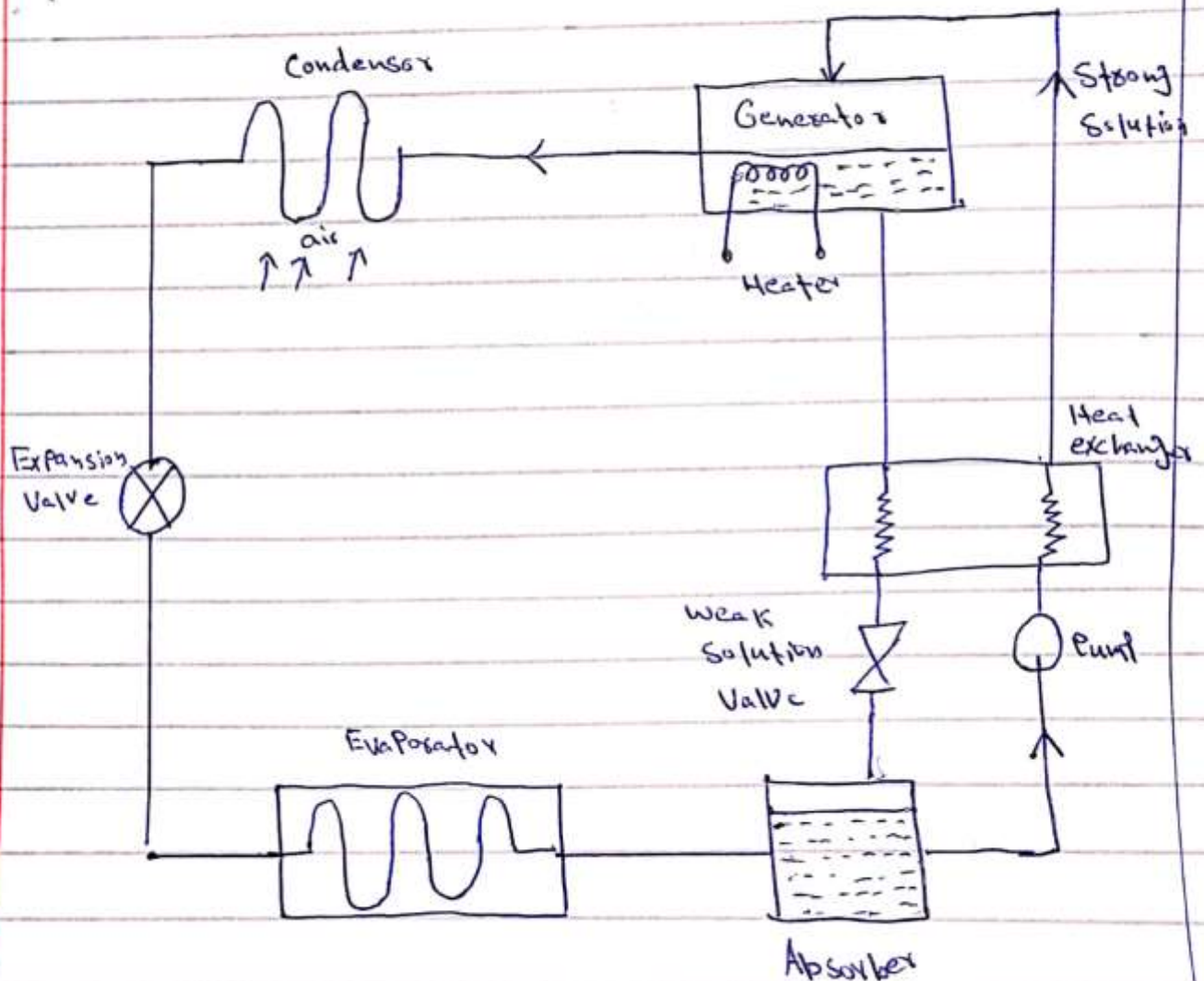
Here the heat energy is utilized to achieve the refrigeration. An electric heater or steam is used to add the heat to the refrigerant for its evaporation. Also an absorber a pump and a generator are used to complete the cycle.

**Construction:**

A throttle valve is connected b/w an evaporator and a condenser. One pump is connected b/w an absorber and a separator. Water is filled in the absorber and it is connected to the evaporator. The evaporator is kept in the storage room. The separator is connected to the condenser. Both Condensers and

(8)

Evaporator consist of Pipe in coil form to provide more contact surface area for the refrigerant. Argument are made to circulate the cold water around the Condenser and in the absorber. An electric heater is house in the separator. Trays may be positioned to collect the exist water near by the absorber and Condenser. A receiver is connected in b/w the Condenser and the throttle valve





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### Working:

Dry ammonia vapour from the evaporator enters the absorber containing water where it is absorbed by the water become a strong ammonia solution. With an increase in temperature the heat generated during this process is removed to some extent by circulating cold water through a pipe. otherwise absorbing capacity reduce with hot water. The strong ammonia solution is now pumped by a pump to the generator. Where it is heated by an electric coil. As a result ammonia vaporize and separates out from the water it is then driven out from the solution to the condenser where it is condensed and return to the liquid state. The liquid ammonia is then collected in the receiver. The high pressure liquid ammonia is then pass through the throttle valve where it is expanded with decreases in temperature and pressure. Later it enters the evaporator kept in the storage room.



Q 3:

Distinguish b/w water tube and Fire Tube boilers

i) Fire Tube Boiler:

These type of boilers consist of a nest of tubes through which hot gases flow. The tubes being surrounded by water. Since the contact area b/w the water and hot gases is greater than in the case of shell and tube type, hence it has the ability to generate larger quantities of steam. It has efficiency difficulty greater than shell and tube type. Velox boiler is a modern fire tube boiler.

Water Tube Boiler:

These are the most efficient boiler. Water runs in the tube and the hot gases surround it. Hence the heat transfer area is low value.



Ques:

State the meaning of the word Stroke and describe the Working of a 4 Stroke engine.

**STROKE:**

A Stroke is movement of the Piston from Top dead center (TDC) to bottom dead center (BDC) or from BDC to TDC.

**Cycle:**

It is a series of event that repeat themselves.

**Four Stroke Engine:**

Four-Stroke Cycle engine work on four stroke principle. There are four strokes in one cycle of such engine. Four-Stroke Cycle engine is also called four-cycle engine.

**Intake Stroke:**

**Intake Stroke:**

On the intake stroke the piston is moving down due to which a vacuum is produced inside the cylinder. The intake valve is open. Therefore atmospheric pressure pushes the fresh air fuel mixture in the cylinder through the intake valve.



## Compression Stroke:

When the Piston reaches the B.D.C. on the intake Stroke the intake Valve close. then the Piston moves up ~~tho~~ on the Compression. Stroke. During this Stroke both the Valve are closed. Therefore no air-fuel mixture enter or gas out of the cylinder. Therefore when the Piston moves up the mixture inside the cylinder. In modern engine it is compressed to one eight or one-ninth of the original volume. The amount to which the air-fuel mixture is compressed is called Compression ratio.

## Power Stroke:

During the Compression Stroke, the Piston moves up when it gets near TDC. The Spark Plug produces a spark which ignites the compressed air-fuel mixture. Due to which the temperature and the Pressure of gas rises. The Pressure become about 600 Psi which push the Piston down. As during this Stroke. we obtain Power Therefore it is called Power Stroke.

## Exhaust Stroke:

During the Power stroke as the piston reaches BDC the exhaust valve opens, then the piston moves up on exhaust stroke. When the piston moves up, it pushes out the burnt gases from the cylinder through the exhaust valve. When the piston reaches T.D.C. the exhaust valve closes and the intake valve opens for the second cycle.

Q 5:

Part (A)

Explain the concept of Scavenging:

The process of expulsion of burnt gases and the entering of fresh air-fuel mixture is known as scavenging.



11/11

The Scavenging in two stroke engine is different than of four-stroke cycle engine. The slope of two stroke engine is slightly different. It is somewhat Pearl-shaped. It do not contain Camshaft, Push rods, sockets chain and Valves. Instead of these have three parts i.e Exhaust Port, intake Port and Transfer Port.

\* The cycle of two stroke is completed in one revolution of Crankshaft while in four-stroke engine cycle is completed in two revolution of Crankshaft. So it means that two stroke engine provide more power as compared to four stroke engine.

\* As two stroke engine produce more power as compared to four stroke engine. So its weight to power ratio is less while its power to weight ratio is more.

\*Q 15)

Part (B):

## Rickshaw and the Environment

\* Vehicular emission is one of the principal anthropogenic source of

air pollution.

\* Major problem for physical and mental health.

\* Since 1960 world motor cycle has been increasing faster than its

Population

\* Problem acute in big city

\* According to a 2011 WHO report Quetta takes 4<sup>th</sup> place, Peshawar 6<sup>th</sup> and Lahore 10<sup>th</sup> on the most polluted city of world

\* About 6000 rickshaws operating open.

\* According to the city district government environmental department



(13) (14)

Two-Stroke Rickshaws are causing 65% of the total Vehicular ~~Part~~ Pollution in Lahore.

The major air pollutants due to heavy traffic are the following gases

- i) Nitrogen dioxide
- ii) Sulphur dioxide
- iii) Carbon monoxide
- iv) lead

Parameter	Reading	WHO
Ozone	127.40 $\mu\text{g}/\text{m}^3$	100 $\mu\text{g}/\text{m}^3$
SO <sub>2</sub>	56.40 $\mu\text{g}/\text{m}^3$	200 $\mu\text{g}/\text{m}^3$
NO <sub>2</sub>	112.50 $\mu\text{g}/\text{m}^3$	250 $\mu\text{g}/\text{m}^3$

Emission level in Lahore are 3 times the safety level set by WHO. Regarding noise pollution, certain sites in Karachi have noise of 120 decibels against the 80 to 85 dB maximum limit for humans. 40% of traffic cops had a high hearing level while 70% of

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of Rickshaw drivers had partial hearing impairment. Ratio was expected due to incomplete combustion by two stroke engine.