Subject Name:**Elements of Mechanical Engineering**
Course: Diploma Engineering
Branch: Electrical Engineering
Semester: 3RD

1.(A) State Zeroth Law of Thermodynamics.
Ans: The zeroth law of thermodynamics states that if two thermodynamic systems are each in thermal equilibrium with a third system, then they are in thermal equilibrium with each other.

(B) Define State Laws of perfect gases.
Ans: The perfect gas equation states that for a given quantity of gas, the pressure (p) and volume (v) of the gas is directly proportional to its absolute temperature (t).

(C) State Charles's Law.
Ans: Charles's law, a statement that the volume occupied by a fixed amount of gas is directly proportional to its absolute temperature, if the pressure remains constant.

(D) State Gay-Lussac Law.
Ans: Gay-Lussac's Law states that the pressure of a given mass of gas varies directly with the absolute temperature of the gas, when the volume is kept constant.

2. (A) Difference between Wet steam & Dry Saturated steam.
Ans: Wet steam is produced by heating water in a flow through a coil to over 212 **degrees**.
Steam cleaners are the most common use of wet steam, which quickly condenses back to water.

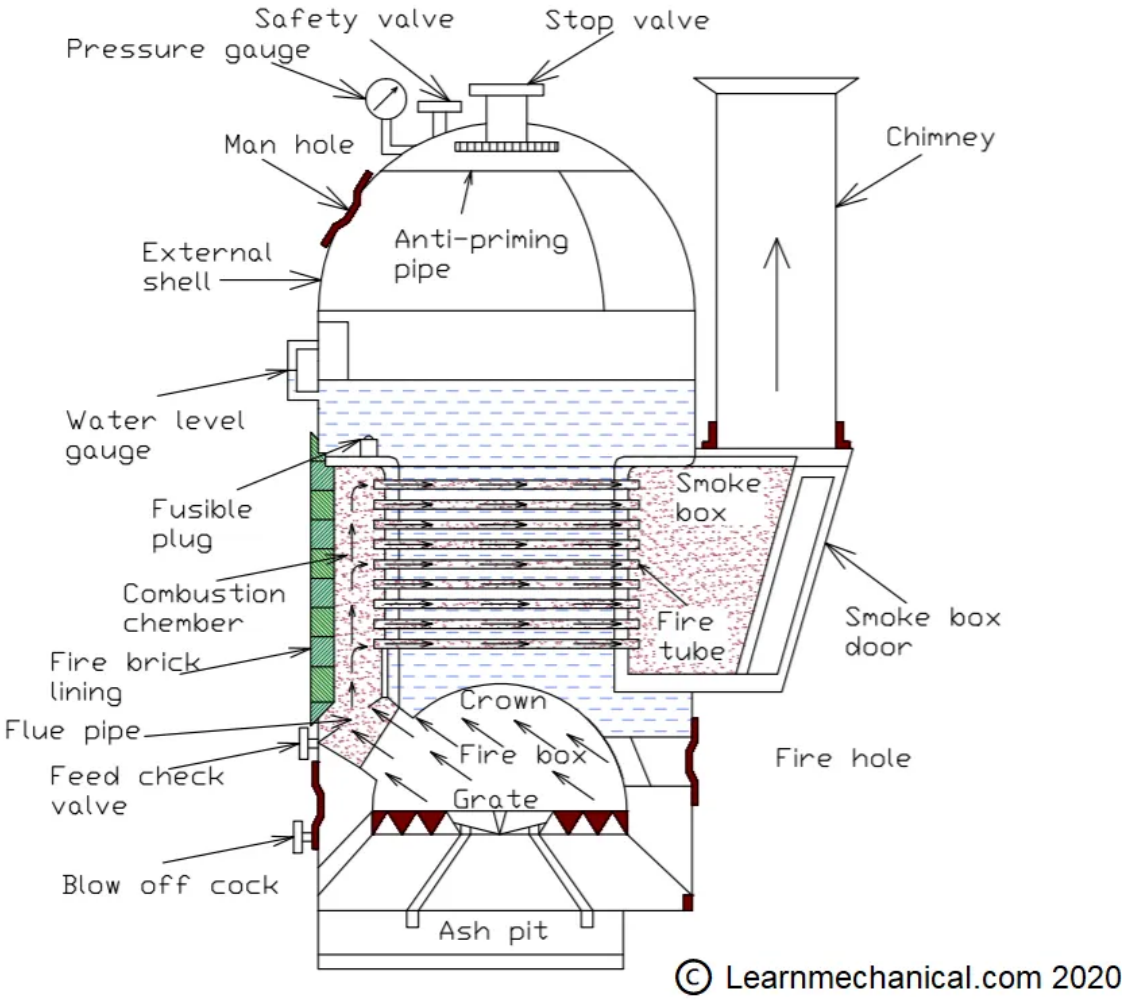
Dry steam, also known as saturated steam, is produced by heating water in a closed chamber.
In industrial applications this type of steam is a significant contributing factor to higher rates of corrosion.

(B) Define Superheated steam.

Ans: Superheated steam is steam at a temperature that is higher than its vaporisation (boiling) point at the absolute pressure. It is steam which is formed at the temperature which exceeds that of saturated steam at the same pressure.

(C) Describe Cochran Boiler.

Ans: Cochran Boiler is a multi-tubular vertical fire tube boiler having a number of horizontal fire tubes. It is the modification of a simple vertical boiler where the heating surface has been increased by means of a number of fire tubes. The efficiency of this boiler is much better than the simple vertical boiler.



3. (A) Determine relationship of specific heat of gases at constant volume and constant pressure.

Ans: The pressure and volume components of an ideal gas are represented by an ideal gas equation:

PV= nRT

Where, P= Pressure,
V= Volume
n= no of moles of an ideal gas
R= Gas constant
T= Temperature
A co-relation between Cp and Cv can be derived using the ideal gas equation and the previously derived equations for Cp and Cv.
Heat at constant pressure is given by the equation:
$q_p = C_p \times n \times \Delta T = \Delta H$ ……. (1)
The equation for heat at constant pressure is equal to the change in enthalpy, hence can be denoted as ΔH
Heat at constant volume is given by the equation:
$q_v = C_v \times n \times \Delta T = \Delta U$ …….(2)
This equation of heat at constant volume is equal to the internal energy change (ΔU) experienced by the thermodynamic system.
According to the first law of thermodynamics,
$\Delta H = \Delta U + P\Delta V$ …….(3)
Now, for one mole of an ideal gas, the ideal gas equation can be written as:
$P\Delta V = R\Delta T$ …….. (4)
Substituting equation (4) in (3)
$\Delta H = \Delta U + R\Delta T$……(5)
On substituting the equations (1) and (2) in place of ΔH and ΔU in equation (5), we get,
$C_p \times n \times \Delta T = C_v \times n \times \Delta T + R\Delta T$…….(6)
Dividing the entire equation (6) by ΔT and taking n=1, as the equation is for one mole of an ideal gas. The equation becomes,
$C_p = C_v + R$
$C_p - C_v = R$

(B) Classify Steam Boiler as per different criteria.
Ans: Classification of Steam Boiler:

(i) Fire tube and water tube boilers

(ii) High-, medium-, and low-pressure boilers

(iii) Natural and forced circulation boilers

(iv) Single tube and multi tube boilers

(v) Stationary and portable boilers

(vi) Coal-, oil-, and gas-fired boilers

(vii) Externally fired and internally fired boilers

(C) A student comes to school by a bicycle whose tire is filled with air at a pressure 240 kPa at 27°C. She travels 8 km to reach the school and the temperature of the bicycle tire increases to 39°C. What is the change in pressure in the tire when the student reaches school?

Ans.