Applied Thermodynamics

2 Marks Question and Answers

Unit I - Laws of Thermodynamics

1. What is meant by thermodynamics system? How do you classify it?

Thermodynamic system is defined as the any space or matter or group of matter where the energy transfer or energy conversions are studied.

It may be classified into three types.

(a) open system

(b) closed system

(c) isolated system

2. What is meant by closed system? Give an example.

When a system has only heat and work transfer, but there is no mass transfer, it is called as closed system.

Example: piston and cylinder arrangement.

3. Define open system. Give an example

When a system has heat, work and mass transfer, it is called as open system

Example: Air compressor

4. Distinguish between open and closed system

s.no	Open system	Closed system
1	Only heat and work will transfer	In addition to heat and work tranfer
2	System boundry is fixed ond	System boundry mayor may not change
3	Ex :piston and cylinder arrangement, Thermal power plant	Air compressor,boiler

5. Define isolated system

Isolated system not affected by the system by surrounding .There is no heat and work and mass transfer takes place .In this system total energy remains constant.

Example: Entire Universe.

6. Define specific heat capacity at constant pressure.

It is defined as the amount of heat transfer required raising or lowering the temperature of the unit mass of the substance through one degree when the pressure kept constant. It is denoted by Cp.

7. Define specific heat capacity at constant volume.

It is defined as the amount of heat transfer required raising or lowering the temperature of the unit mass of the substance through one degree when the volume kept constant. It is denoted by Cv.

8. What is meant by surrounding?

Any other matter out side of the system boundary is called as surrounding.

9. What is boundary?

System and surrounding are separated by an imaginary line is called boundary.

10. What is meant by thermodynamic property?

Thermodynamic property is any characteristic of a substance which is used to identify the state of the system and can be measured, when the system remains in an equilibrium state.

11. How do you classify the property?

Thermodynamic property can be classified into types

1. Intensive or Intrinsic and
2. Extensive and Extrinsic property.

12. Define intensive and extensive properties. **(Nov/Dec 2016)**

Intensive properties:

The properties which are independent on the mass of the system is called intensive properties

Eg: Pressure, Temperature, specific Volume.

Extensive properties:

Eg: Total energy, Total volume, weight.

13. When a system is said to be in" Thermodynamic equilibrium ?

When a system is in Thermodynamic equilibrium, it should be satisfy the following three conditions

(a)Mechanical Equilibrium – Pressure remains constant.

(b)Thermal Equilibrium – Temperature remains constant. (c)Chemical Equilibrium – There is no chemical reaction.

14. Define Zeroth law and first law of thermodynamics. **(Nov/Dec 2017) (April/May 2017)**

Zeroth law of thermodynamics states that when two system are separately in thermal equilibrium with a third system, then they themselves are in thermal equilibrium with each other.First law of thermodynamics states that when system undergoes a cyclic process, net heat transfer is equal to work transfer. dQ = dW

15. State corollaries first law of thermodynamics.

Corollaries I

There exists a property of a closed system such that a change in its value is equal to the difference between the heat supplied and the work done during any change of state.

Corollaries II

The internal energy of a closed system remains unchanged system is isolated from its surrounding.

Corollaries III

A perpetual motion machine of first kind is impossible.

16. What is meant by "perpetual Motion machine of First kind?

PMM of the first kind delivers work continuously without any input. IT violates first law of thermodynamics. it is impossible to construct an engine working with this principle.

17. What is mean by control volume and control surface? **(Nov/Dec 2018)**

Control Volume:

In continuum mechanics and thermodynamics, a control volume is a mathematical abstraction employed in the process of creating mathematical models of physical processes. ... At steady state, a control volume can be thought of as an arbitrary volume in which the mass of the continuum remains constant.

Control Surface:

A control volume is a fixed region in space chosen for the thermodynamic study of mass balances for flowing systems. The control surface is the boundary of the control volume.

18. Using Knudsen number define continuum. **(Nov/Dec 2018)**

The Knudsen number (Kn) is a dimensionless number defined as the ratio of the molecular mean free path length to a representative physical length scale.

19. Prove that for an isolated system, there is no change in internal energy.

For any isolated system, there is no heat, work and mass transfer.

$$Q = W = 0$$

According to the firstlaw of thermodynamics,

$$Q = W + \Delta U$$

$$\Delta U = 0$$

20. What is meant by reversible and irreversible process? **(May/June 2016)**

A process is said to the reversible, it should trace the same path in the reverse direction when the process is reversed, and it is possible only when the system passes through a continuous series of equilibrium state if a system does not pass through continuous equilibrium state, then the system is

said to be irreversible.

22. What is meant by point and path function? **(Nov/Dec 2018)**

Point function:

The quantity which is independent on the process or path followed by the system is known as point function.

Ex: Pressure, volume, temperature etc

Path function:

The quantity which is dependent on the process or path followed by the system is known as path function. Ex: Heat transfer, Work transfer.

23. What is quasi - static process?

The process is said to be quasi-static, it should proceed infinite slow and follow continuous serious of equilibrium ststes. Therefore, the quasi - static process may be a reversible process.

24. Define the term internal energy?

Internal energy of a gas is the energy stored in a gas due to its molecular interactions. It is also defined as the energy possessed by a gas at a given temperature.

25. What is meant by thermodynamic work?

It is the work done by the system when the energy transferred across the boundary of the system. It is mainly due to intensive properly difference between the system and surrounding.

28. Prove that the difference in specific heat capacities equal to Cp - Cv = R.

Consider a gas heated at constant pressure heat supplied, $Q = mC_p (T_2-T_1)$

Work done, $W = p (V_2-V_1) = mR (T_2-T_1)$

Change in internal energy, $\Delta U = mC_v (T_2-T_1)$

According to the first law of thermodynamics, $Q = W+\Delta U$

$$mC_p (T_2-T_1) = mR (T_2-T_1)+ mC_v (T_2-T_1)$$

$$C_p = R+C_v$$

$$C_p - C_v = R$$

29. What is the work transfer in free expansion process? And why? **(Nov/Dec 2018)**

The Joule expansion (also called free expansion) is an irreversible process in thermodynamics in which a volume of gas is kept in one side of a thermally isolated container (via a small partition), with the other side of the container being evacuated.

work is the transfer of energy between the system and surroundings when there are imbalanced forces between them. In the case of free expansion the gas expands against no force at all hence no work is done.

30. Define the terms equilibrium, path and process. **(April/May 2018)**

A thermodynamic process path is the path or series of states through which a system passes from an initial equilibrium state to a final equilibrium state and can be viewed graphically on a pressure-volume (P-V), pressure-temperature (P-T), and temperature-entropy (T-s) diagrams.

31. Write the steady flow energy equation for turbine. **(April/May 2018)**

Steady state steady flow process. For negligible change in kinetic and potential energies through the control volume, If the control volume is well insulated (i.e. adiabatic), then, q = 0. For steady flow devices, such as turbines, compressors and pumps, is power transmitted through a shaft.

32. What is a steady flow process? **(Nov/Dec 2017)**

Steady flow process is a process where: the fluid properties can change from point to point in the control volume but remains the same at any fixed point during the whole process. A steady-flow process is characterized by the following: No properties within the control volume change with time.

33. Should the automobile radiator be analyzed as a closed system or as an open system? Explain.**(Nov/Dec 2016)**

Radiator. The radiator allows the mass flow through it (hot coolant goes in and cold coolant comes out) as well as the heat transfer (hot coolant passes heat to the air). Hence a radiator will be considered as an open system. In other hand the whole cooling system allows heat transfer only, so called closed system.