

Explanation Chapter 1

1.1 A metal piece is kept in a freezer at -20°C . We want to take it out and heat it until it reaches the temperature of 0°C . What will be the absolute temperature difference between the initial and final states?

- a) 273°C
- b) 273 K
- c) 20 K
- d) 0 K
- e) 293 K

Ans: C. The absolute difference between 273 K (0°C) and 253 K (-20°C) is 20 K .

1.2 The basis for measuring thermodynamic property of temperature is given by the:

- a) zeroth law of thermodynamics
- b) first law of thermodynamics
- c) second law of thermodynamics
- d) third law of thermodynamics
- e) Kelvin-Planck statement

Ans: A.

1.3 Which of the statements is true for a closed system (also called a fixed mass)?

- a) Energy in the form of heat cannot cross the boundaries of the system
- b) Mass as well as energy in the form of heat or work cannot cross the boundaries of the system
- c) Mass as well as energy in the form of heat or work can cross the boundaries of the system
- d) Only energy in the form of heat or work can cross the boundaries of the system
- e) Only mass can cross the boundaries of the system

Ans: D.

1.4 How is a process called during which the entropy remains constant?

- a) Adiabatic
- b) Isothermal
- c) Isobaric
- d) Isochoric
- e) Isentropic

Ans: E.

1.5 How is a process called during which the pressure remains constant?

- a) Isothermal
- b) Adiabatic
- c) Isentropic
- d) Isochoric
- e) Isobaric

Ans: E.

1.6 How is a process called during which the temperature remains constant?

- a) Isobaric
- b) Isochoric
- c) Isentropic
- d) Adiabatic
- e) Isothermal

Ans: E.

1.7 How many properties of a system do we need in order to fully define it?

- a) 1 property
- b) 2 intensive properties
- c) 3 extensive properties
- d) 4 properties
- e) 2 dependent properties

Ans: B. The state postulate says that we only need 2 independent, intensive properties. Therefore, the answer (b) is the closest to the correct definition with small traps around.

1.8 What is the difference between an open and a closed system?

- a) In an open system mass can cross the boundary of the system, in a closed system this is not possible
- b) In a closed system mass can cross the boundary of the system, in an open system this is not possible
- c) In an open system energy in the form of heat can cross the boundary of the system, in a closed system this is not possible
- d) In a closed system energy in the form of heat can cross the boundary of the system, in an open system this is not possible

Ans: A. Definition open & closed system and "Thus the difference is that in a closed system mass can't cross the boundary of the system, while in an open system this is possible."

1.9 An extensive property of a system is one whose value

- a) depends on the mass of the system like volume
- b) does not depend on the mass of the system, like temperature, pressure, etc.
- c) is not dependent on the path followed, but on the state
- d) is dependent on the path followed and not on the state
- e) is always constant

Ans: A. Extensive properties are properties that depend on the mass of the system, like total energy, total volume, total entropy. The opposite are intensive properties. They are not dependent on the mass of the system, like pressure, and temperature. Specific properties are also intensive.

1.10 The atmospheric pressure at the top of a tower is 99.0 kPa and at the bottom of the tower it is 101.0 kPa. Assume the density of air to be 1.2 kg/m³. What is the height of the building?

- a) 17.0 m
- b) 20.4 m
- c) 170 m
- d) 187 m
- e) 204 m

Ans: C. $P_{\text{top}} - P_{\text{bottom}} = \rho gh \rightarrow h = \frac{\Delta P}{\rho g} = (101 - 99) * \frac{10^3}{(1.2 * 9.81)} = 170\text{m}$

1.11 How do the properties of a system change compared to the initial state after it went through a cycle? Think about a piston-cylinder in a car for example.

- a) Temperature and pressure increase, volume decreases
- b) Temperature and pressure increase, volume does not change
- c) Pressure increases, temperature and volume do not change
- d) Volume and pressure increase, temperature decreases
- e) All the properties are the same after a cycle

Ans: E. After a complete cycle, the temperature, volume and pressure return to the same values as they had before the cycle. In PV or TV diagrams this is easily seen.

1.12 Which of the statements is true for an insulated system?

- a) Energy in the form of heat cannot cross the boundaries of the system
- b) Mass as well as energy in the form of heat or work cannot cross the boundaries of the system
- c) Mass as well as energy in the form of heat or work can cross the boundaries of the system
- d) Only energy in the form of heat or work can cross the boundaries of the system
- e) Only mass can cross the boundaries of the system

Ans: A. Mass cannot cross the system boundary and also energy in the form of heat cannot cross the boundaries of the system, but there is a possibility that energy in the form of work can cross the system boundary

1.13 What is the difference between an insulated and an isolated system?

- a) In an insulated system mass can cross the boundary of the system, in an isolated system this is not possible
- b) In an isolated system mass can cross the boundary of the system, in an insulated system this is not possible
- c) In an insulated system energy in the form of work can cross the boundary of the system, in an isolated system this is not possible
- d) In an isolated system energy in the form of work can cross the boundary of the system, in an insulated system this is not possible

Ans: C. Definition closed, isolated and insulated. So the difference is that energy in the form of work can be transferred in an insulated system.

1.14 An intensive property of a system is one whose value

- a) depends on the mass of the system, like volume
- b) does not depend on the mass of the system, like temperature, pressure, etc.
- c) is not dependent on the path followed, but on the state
- d) is dependent on the path followed and not on the state
- e) remains constant.

Ans: B. Intensive properties are properties that are not dependent on the mass of the system, like pressure, and temperature. Specific properties are also intensive. The opposite are extensive properties. They depend on the mass of the system, like total energy, total volume, total entropy.

1.15 The Isochoric process is one in which ...

- a) free expansion takes place
- b) very little mechanical work is done by the system
- c) the specific volume does not change
- d) all parameters remain constant
- e) mass and energy transfer do not take place

Ans: C. In an isochoric process the specific volume is constant.

1.16 Which of the statements is true for an isolated system?

- a) Mass as well as energy in the form of heat or work cannot cross the boundaries of the system
- b) Only mass can cross the boundaries of the system
- c) Only energy in the form of heat or work can cross the boundaries of the system
- d) Mass as well as energy in the form of heat or work can cross the boundaries of the system
- e) Energy in the form of heat cannot cross the boundaries of the system

Ans: A.

1.17 How is a process called during which there is no heat transfer?

- a) Isochoric
- b) Isobaric
- c) Adiabatic
- d) Isothermal
- e) Isentropic

Ans: C.

1.18 How is a process called during which the specific volume remains constant?

- a) Isochoric
- b) Isentropic
- c) Isothermal
- d) Isobaric
- e) Adiabatic

Ans: A.

1.19 Which of the statements is true for an open system (also called a control volume)?

- a) Only mass can cross the boundaries of the system
- b) Mass as well as energy in the form of heat or work can cross the boundaries of the system
- c) Only energy in the form of heat or work can cross the boundaries of the system
- d) Energy in the form of heat cannot cross the boundaries of the system
- e) Mass as well as energy in the form of heat or work cannot cross the boundaries of the system

Ans: B.