



POSTAL BOOK PACKAGE 2026

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MECHANICAL ENGINEERING

Objective Practice Sets

Thermodynamics

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Basic Concepts & Zeroth Law of Thermodynamics

MCQ and NAT Questions

- Q.1** A system and its environment put together constitute
- (a) an adiabatic system
 - (b) an isolated system
 - (c) a segregated system
 - (d) a homogeneous system
- Q.2** A closed system is a
- (a) variable mass and variable energy system
 - (b) fixed mass and variable energy system
 - (c) fixed mass and fixed energy system
 - (d) constant entropy system
- Q.3** A system is said to be in thermodynamic equilibrium if
- (a) it is in mechanical, chemical and thermal equilibrium.
 - (b) it is in thermal equilibrium
 - (c) it is in electrical, chemical and mechanical equilibrium
 - (d) volume is changing and pressure is constant
- Q.4** Diathermic wall means
- (a) it would not allow the flow of heat
 - (b) it would allow the flow of heat
 - (c) there is no such thing as diathermic wall
 - (d) it only allows the flow of mass
- Q.5** An adiabatic boundary is one which
- (a) prevents heat transfer
 - (b) permits heat transfer
 - (c) prevents work transfer
 - (d) permits work transfer
- Q.6** Which one of the following is NOT the correct statement about control volume?
- (a) Matter flows continuously in and out
 - (b) Heat and work flows across the control surface
 - (c) Control volume must be stationary
 - (d) Focusses a definite volume and volume is enclosed by control surface
- Q.7** Which of the following are intensive properties?
- (i) Energy
 - (ii) Specific Energy
 - (iii) Pressure
 - (iv) Density
- (a) (i) and (iii) (b) (i), (ii) and (iii)
(c) (ii), (iii) and (iv) (d) (iii) and (iv)
- Q.8** A quasi-static process is
- (i) a succession of equilibrium states that can be retraced back to initial condition
 - (ii) a succession of equilibrium states that cannot be retraced back to initial condition
 - (iii) infinitely slow
 - (iv) spontaneous
- Which of the above is/are correct?
- (a) (i) and (iv) (b) (ii) and (iii)
(c) (iv) only (d) (i) and (iii)
- Q.9** In macroscopic approach of thermodynamic analysis,
- (i) a certain quantity of matter is considered, without the events occurring at the molecular level being taken into consideration.
 - (ii) a certain quantity of matter is considered, with events occurring at the molecular level being taken into consideration.
 - (iii) is completely independent of the assumptions regarding the nature of the matter.
 - (iv) nature of the matter has implication on the analysis.
- (a) (i) and (iii) are correct
(b) (i) and (iv) are correct
(c) (ii) and (iii) are correct
(d) only (iii) is correct
- Q.10** Consider the following statements:
1. Thermodynamic properties are the macroscopic coordinates significant only for systems existing in states of thermodynamic equilibrium.
 2. Engineering thermodynamic studies about rate of storage, transfer and transformation of energy.

3. Engineering thermodynamics studies about storage, transfer and transformation of energy.

Which of the above statements are correct?

- (a) 3 only (b) 1 and 3
(c) 2 only (d) 1 and 2

Q.11 For an isolated system executing a process

1. no heat transfer takes place
2. no work is done
3. no mass crosses the boundary
4. no chemical reaction takes place within the system

Which of the above statements are correct?

- (a) 1, 2 and 3 (b) 1, 3 and 4
(c) 2, 3 and 4 (d) all of the above

Q.12 Which of the following aspect is NOT true regarding microscopic properties of thermodynamic system?

- (a) a knowledge of the structure of matter is essential.
- (b) a limited number of variables/properties are needed to describe the state of matter.
- (c) the values of these variables cannot be measured.
- (d) statistical averaging is adopted to predict the behaviour of individual fluid particles.

Q.13 The value of an extensive property is extensively dependent on

- (a) mass or extent of the system
- (b) interaction of the system with its surroundings
- (c) path followed by the system in going from one state to another
- (d) nature of boundaries, rigid or flexible

Q.14 Which of the following statements regarding the concept of continuum are correct?

1. Small number of molecules enable meaningful statistical averaging and assignment of property values
 2. Mean free path of the molecules is order of magnitude much lower than system dimensions
 3. Behaviour of individual molecules is disregarded
 4. Mean free path of the molecules approaches the order of magnitude of the system dimensions
- (a) 1 and 3 (b) 2 and 3
(c) 3 and 4 (d) 1 and 4

Q.15 Consider the following statements regarding a pure substance.

1. A pure substance is one that has a homogeneous and invariable chemical composition.
2. It may exist in more than one phase, but the chemical composition is the same in all phases.
3. A mixture of liquid air and gaseous air is a pure substance.
4. A mixture of liquid water and water vapor (steam), and a mixture of ice and liquid water all represent pure substance.

Which of the following statements are correct?

- (a) 3, 2 and 1 only (b) 2, 3 and 4 only
(c) 1 and 4 only (d) 4, 2 and 1 only

Q.16 In a mixture there are 5 gases present. The degree of freedom of the mixture is

- (a) 4 (b) 5
(c) 6 (d) 7

Q.17 A system which is in thermodynamic equilibrium will

- (a) deliver maximum reversible work.
- (b) have maximum thermal efficiency
- (c) deliver both maximum reversible work and have maximum thermal efficiency
- (d) do not deliver anything

Q.18 Consider the following statements and mark the correct answer.

- (a) Cyclic integral of a property can be zero.
- (b) Cyclic integral of a property is always greater than zero
- (c) Cyclic integral of a property is always zero
- (d) Cyclic integral of a property is less than zero

Q.19 Consider the following:

- | | |
|--------------------|--------------|
| 1. Temperature | 2. Viscosity |
| 3. Internal energy | 4. Entropy |
- Which of these are extensive properties?
- (a) 1, 2, 3 and 4 (b) 2 and 4 only
(c) 2 and 3 only (d) 3 and 4 only

Q.20 Zeroth law of thermodynamics state that

- (a) Two thermodynamic system are always in thermal equilibrium with each other.
- (b) If two systems are in thermal equilibrium then the third system will also be in thermal equilibrium

- (c) Two systems not in thermal equilibrium with a third system will also not in thermal equilibrium with each other.
- (d) When two systems are in thermal equilibrium with a third system, they are in thermal equilibrium with each other.

Q.21 Which one of the following correctly defines 1 K, as per the internationally accepted definition of temperature scale ?

- (a) $1/100^{\text{th}}$ of the difference between normal boiling point and normal freezing point water
- (b) $1/273.15^{\text{th}}$ of the normal freezing point of water
- (c) 100 times the difference between the triple point of water and the normal freezing point of water
- (d) $1/273.15^{\text{th}}$ of the triple point of water

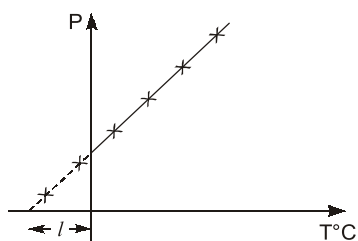
Q.22 Thermocouple is based on

- (a) Joule's effect (b) Peltier effect
- (c) Seebeck effect (d) Boyle's Law

Q.23 An apple loses 4.5 kJ of heat as it cools per $^{\circ}\text{C}$ drop in its temperature. The amount of heat lost from the apple per $^{\circ}\text{F}$ drop in its temperature is

- (a) 1.25 kJ (b) 2.5 kJ
- (c) 5.0 kJ (d) 8.1 kJ

Q.24 Experimental data obtained from a constant-volume-gas thermometer is shown in the figure below. The value of t (in $^{\circ}\text{C}$) is



- (a) 273.15 (b) 1.0
- (c) -100 (d) -273.15

Q.25 A new temperature scale in degrees 'N' is to be defined. The boiling and freezing points on these scale are 400°N and 100°N respectively. What will be the reading on new scale corresponding to 60°C ?

- (a) 120°N (b) 180°N
- (c) 220°N (d) 280°N

Q.26 The constant volume gas thermometer works on the principle that

- (a) at low pressure, the temperature of the gas is independent of its pressure at constant volume
- (b) at high pressure, the temperature of the gas is independent of its pressure at constant volume
- (c) at low pressure, the temperature of the gas is proportional to its pressure at constant volume
- (d) at high pressure, the temperature of the gas is proportional to its pressure at constant volume

Q.27 Which of the following is used for measuring high temperature beyond 1063°C ?

- (a) Platinum-platinum/Rhodium thermocouple
- (b) Electrical resistance thermometer
- (c) Optical method using Planck's law of thermal radiation
- (d) Constant pressure gas thermometer

Q.28 Match the column and select the correct answer using the codes given below:

Thermometric property	Thermometric property
A. Volume	1. Electric-resistance thermometer
B. Resistance	2. Thermocouple
C. Length	3. Mercury-in-glass thermometer
D. Thermal E.M.F.	4. Constant pressure gas thermometer

Codes:

	A	B	C	D
(a)	3	4	2	1
(b)	3	4	1	2
(c)	4	2	3	4
(d)	4	1	3	2

Q.29 The resistance of the windings in a certain motor is found to be 80 ohms at room temperature (25°C). When operating at full load under steady state conditions, the motor is switched off and the resistance of the windings, immediately measured again, is found to be 93 ohms. The windings are made of copper whose resistance at temperature $t^{\circ}\text{C}$ is given by

Answers Basic Concepts & Zeroth Law of Thermodynamics

1. (b) 2. (b) 3. (a) 4. (b) 5. (a) 6. (c) 7. (c) 8. (d) 9. (a)
 10. (b) 11. (a) 12. (d) 13. (a) 14. (b) 15. (d) 16. (c) 17. (d) 18. (c)
 19. (d) 20. (d) 21. (d) 22. (c) 23. (b) 24. (d) 25. (d) 26. (c) 27. (c)
 28. (d) 29. (70.41) 30. (a) 31. (a) 32. (b) 33. (b) 34. (d) 35. (a, c)
 36. (b, c)

Explanations Basic Concepts & Zeroth Law of Thermodynamics**1. (b)**

An isolated system is one in which there is no interaction of system with the surrounding.

for isolated system

$$\delta Q = 0$$

$$\delta W = 0$$

The first law gives

$$\delta Q = \delta U + \delta W$$

$$\delta U = 0$$

$$U = \text{constant}$$

The energy of isolated system is constant.

2. (b)

A closed system is a system of fixed mass. There is no mass transfer across the system boundary. There may be energy transfer in or out of the system.

3. (a)

A system is said to be in thermodynamic equilibrium if it is in:

1. Thermal equilibrium (equality of temperature)
2. Mechanical equilibrium (equality of force/pressure)
3. Chemical equilibrium (equality of chemical potential)

5. (a)

An adiabatic boundary is one which prevents heat transfer.

6. (c)

Control volume is a volume which is surrounding the device to be analysed. From the boundary of control volume, both mass and energy (in the form of heat and work) can cross.

7. (c)

Intensive properties are independent of size or mass, external pressure, temperature, density, thermal conductivity, etc. All specific properties like specific volume, specific internal energy, specific enthalpy, specific entropy are intensive properties.

8. (d)

A quasi-static process is a succession of equilibrium states that can be retraced back to initial condition. It is carried out in infinitely slow manner so that every point passes through equilibrium states.

9. (a)

In macroscopic approach of thermodynamic analysis, individual molecular behaviour is not taken into consideration, but the average behaviour of molecules is taken into consideration. So (i) and (iii) statements are correct.

10. (b)

- Thermodynamic properties are the macroscopic coordinates significant only for systems existing in states of thermodynamic equilibrium.
- Engineering thermodynamics studies about storage transfer and transformation of energy, not the rate of all these.

11. (a)

The isolated system is one in which there is no interaction between the system and surrounding. It is of fixed mass and energy, and there is no mass or energy transfer across the system boundary. However there might be chemical reaction taking place within the system.

12. (d)

In microscopic approach, individual molecular behaviour is taken into consideration. So, the statement regarding microscopic properties of thermodynamic system that statistical averaging is adopted to predict the behaviour of individual fluid particles, is not true.

14. (b)

In the concept of continuum, even a very small quantity of a system is assumed to contain large number of molecules so that statistical averaging is meaningful and a property value can be assigned to it. Disregarding the behaviour of individual molecules, matter is here treated as continuous. The concept of continuum loses validity when the mean free path of the molecules approaches the order of magnitude of the dimensions of the system.

15. (d)

A pure substance is one that has a homogeneous and invariable chemical composition. It may exist in more than one phase, but the chemical composition is the same in all phases. Thus, liquid water, a mixture of liquid water and water vapor (steam), and a mixture of ice and liquid water are all pure substances; every phase has the same chemical composition. In contrast, a mixture of liquid air and gaseous air is not a pure substance because the composition of the liquid phase is different from that of the vapor phase.

16. (c)

According to Gibb's phase rule.

$$P + F = C + 2$$

if $P = \text{No. of phases} = 1 \text{ (gas)}$

$C = \text{No. of components} = n$

$$1 + F = n + 2$$

$$F = n + 1$$

Here $n = \text{No. of components} = 5$

$$F = 5 + 1 = 6$$

17. (d)

A system in thermodynamic equilibrium will have same properties as its surroundings so it won't deliver anything by interacting with its surroundings.

18. (c)

For a cyclic process, the initial and final states of the system are the same and hence, the change in any property is zero, i.e.

$$\oint dV = 0, \quad \oint dp = 0,$$

$$\oint dT = 0$$

where the symbol \oint denotes the cyclic integral for the closed path. Therefore, the cyclic integral of a property is always zero.

20. (d)

Zeroth law of thermodynamics state that when a body A is in thermal equilibrium with body B and body B is in thermal equilibrium with body C separately, then A and C are in thermal equilibrium.

21. (d)

1 K = 1/273.15th of the triple point of water

22. (c)

Thermocouple is based on principle of Seebeck effect. If two different metals are joined at two different junctions which are kept at different temperature then an emf is generated between the two junctions which is directly proportional to the temperature difference between them. According to Seebeck effect,

$$\text{EMF} \propto T_2 - T_1$$

23. (b)

$$Q \text{ per } ^\circ\text{C} = 4.5 \text{ kJ}$$

$$Q \text{ per } ^\circ\text{F} = \frac{Q \text{ per } ^\circ\text{C}}{1.8} = \frac{4.5}{1.8} = 2.5 \text{ kJ}$$

24. (d)

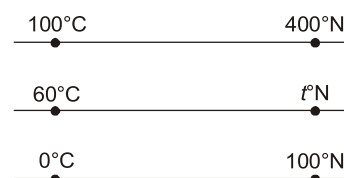
We know, $K = ^\circ\text{C} + 273.15$

But Kelvin scale has minimum value zero,

$$^\circ\text{C} = -273.15$$

So, the value of I is $-273.15 ^\circ\text{C}$

25. (d)



From figure it can be written as,