# HEAT AND THERMODYNAMICS

1. The specific heat of gas in an isothermal process is:
   (a) zero (b) infinite
   (c) negative (d) remains constant
2. In a gas of diatomic molecules, the ratio of the two specific heats of gas $\frac{C_P}{C_V}$ is:
   (a) 1.66 (b) 1.40
   (c) 1.33 (d) 1.00
3. Which of the following parameters does not characterize the thermodynamics state of matter?
   (a) volume (b) temperature
   (c) pressure (d) work
4. Internal energy of ideal gas depends on:
   (a) only pressure
   (b) only volume
   (c) only temperature
   (d) none of these
5. In a thermodynamics system working substances is ideal gas its internal energy is in the form of:
   (a) kinetic energy only
   (b) kinetic and potential energy
   (c) potential energy
   (d) none of the above
6. If the door of a refrigerator is kept open then which of following is true?
   (a) Room is cooled
   (b) Room is heated
   (c) Room is either cooled or heated
   (d) Room is neither cooled nor heated
7. The process in which the heat is not transferred from one state of another, is:
   (a) isothermal process
   (b) adiabatic process
   (c) isobaric process
   (d) isochoric process
8. During an adiabatic process the pressure of gas is found to be proportional to the cube of its soluble temperature. The ratio $\frac{C_p}{C_v}$ for the gas is:
   (a) $\frac{3}{2}$ (b) $\frac{4}{3}$
   (c) 2 (d) $\frac{5}{2}$
9. For an isolated system:
   (a) volume is constant
   (b) pressure is constant
   (c) temperature is constant
   (d) all of these
10. A thermodynamics system is changed from state ($P_1$, $V_1$) to ($P_2$, $V_2$) by two different processes, the quantity which will remain same will be:
    (a) $\Delta Q$ (b) $\Delta W$
    (c) $\Delta Q + \Delta W$ (d) $\Delta Q - \Delta W$
11. An ideal gas undergoes an isothermal change in volume with pressure then:
    (a) $P^{\gamma}V$ = constant
    (b) $PV^{\gamma}$ = constant
    (c) $(PV)^{\gamma}$ = constant
    (d) PV = constant

12. The isothermal bulk modulus of perfect gas at pressure P is given by:

(a) P (b) 2P

(c) $\frac{P}{2}$ (d) $\gamma P$

13. In an adiabatic change, the pressure P and temperature T of a monoatomic gas are related by the relation $P \propto T^C$, where C equals:

(a) $\frac{5}{3}$ (b) $\frac{2}{5}$

(c) $\frac{3}{5}$ (d) $\frac{7}{2}$

14. A block of mass 100 g slides on a rough horizontal surface. If the speed of the block decreases from 10 m/s to 5 m/s the thermal energy developed in the processes is:

(a) 3.75 J (b) 37.5 J

(c) 0.375 J (d) 0.75 J

15. If the heat of 110 J is added to a gaseous system and change in internal energy is 40 J, then the amount of external work done is:

(a) 140 J (b) 70 J

(c) 110 J (d) 150 J

16. The adiabatic elasticity of hydrogen gas ($\gamma$ = 1.4) at NTP is:

(a) $1 \times 10^5 N/m^2$

(b) $1 \times 10^{-8} N/m^2$

(c) $1.4 N/m^2$

(d) $1.4 \times 10^5 N/m^2$

17. 1 mole of a gas with $\gamma = 7/5$ is mixed with 1 mole of gas $\gamma = 5/3$, then the value of $\gamma$ for the resulting mixture is:

(a) 7/5 (b) 2/5

(c) 24/16 (d) 12/7

18. Which statement is incorrect?

(a) All reversible cycles have same efficiency

(b) Reversible cycle has more efficiency than an irreversible on e

(c) Carnot cycle is a reversible one

(d) Carnot cycle has the maximum efficiency in all cycles

19. Heat given to a body which raises its temperature by $1^oC$ is:

(a) water equivalent (b) thermal capacity

(c) specific heat (d) temperature gradient

20. "Heat cannot be itself flow form a body at lower temperature to a body at higher temperature" is a statement of consequence of:

(a) second law of thermodynamics

(b) conservation of momentum

(c) conservation of mass

(d) first law of thermodynamics

21. Which of the following statement is correct for any thermodynamics system?

(a) The internal energy changes in all processes

(b) Internal energy and entropy are state functions

(c) The change in entropy can never be zero

(d) The work done in an adiabatic never be zero

22. Two thermally insulated vessels 1 and 2 are filled with air at temperature ($T_1$, $T_2$), volume ($V_1$, $V_2$) and pressure ($P_1$, $P_2$) respectively. If the valve joining the two vessels is opened, the temperature inside the vessel at equilibrium will be:

(a) $T_1 + T_2$ (b) $(T_1 + T_2)/2$

(c) $\frac{T_1T_2(P_1V_1 + P_2V_2)}{P_1V_1T_2 + P_2V_2T_1}$ (d) $\frac{T_1T_2(P_1V_1 + P_2V_2)}{P_1V_1T_1 + P_2V_2T_2}$

23. Which of the following is incorrect regarding the first law of thermodynamics?

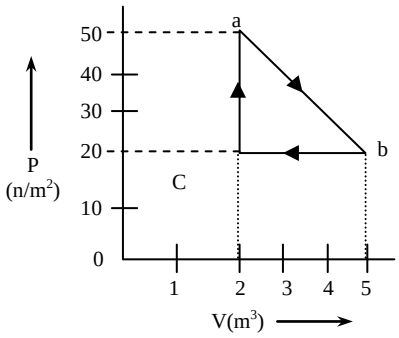
(a) It is not applicable to any cyclic process

(b) It is a restatement of the principle of conservation of energy

(c) It introduces the concept of the internal energy

(d) It introduces the concept of the entropy

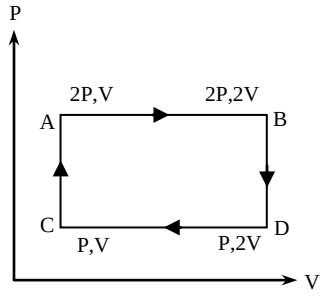
24. The work done form the cycle shown in given figure, will be:




(a) 45 J (b) 54 J

(c) 22.5 J (d) 32.5 J

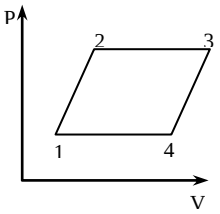
25. An ideal monoatomic gas is taken around the cycle ABCDA as shown in the P-V diagram. The work done during cycle is given by




(a) $\frac{1}{2}$ PV (b) PV

(c) 2PV (d) 4PV

26. Three moles of an ideal monoatomic gas performs a cycle as shown in the figure. The gas temperature in different states are $T_1$ = 400 K, $T_2$ = 800 K, $T_3$ = 2400 K, $T_4$ = 1200 K. What is the work done by the gas during the cycle?




(a) 10 kJ (b) 20 kJ

(c) 5 kJ (d) 8.3 kJ

27. When a gas is allowed to expand suddenly into a vacuum chamber, then:

(a) heat supplied is zero

(b) temperature remains constant

(c) volume does not change

(d) both (a) and (c) are correct

28. During an isothermal expansion of an ideal gas:

(a) its internal energy decreases

(b) its internal energy does not change

(c) the work done by the gas is equal to the quantity of heat absorbed by it

(d) both (b) and (c) are correct

29. If gas is compressed adiabatically:

(a) the internal energy of a gas increases

(b) the internal energy of gas decreases

(c) the internal energy of gas does not change

(d) the work done is positive

30. In a polytropic process, $PV^n$ = constant

(a) If n = 1, process is isothermal

(b) If n = ∞, process is isochoric

(c) If n = 0, process is isobaric

(d) all of the above

31. The inside the outside temperature of a refrigerator are 273 K and 303 K respectively. Assuming that refrigerator cycle is reversible for every joule of work done, the heat delivered to the surrounding will be:

(a) 10 J (b) 20 J

(c) 30 J (d) 50 J

32. In an adiabatic expansion, a gas does 25 J of work while in an adiabatic compression 100 J of work is done on a gas. The change of internal in the two processes respectively are:

(a) 25 J and –100 J (b) –25 J and 100 J

(c) –25 J and –100 J (d) 25 J and 100 J

33. During adiabatic change, specific heat is:

(a) zero (b) greater than zero

(c) less than zero (d) infinity

34. Molar heat capacity is directly related to:

(a) temperature (b) heat energy

(c) molecular structure (d) mass

35. The coefficient of performance, if in a mechanical refrigerator, the lower temperature coils of a evaporator are $-23^{o}C$, and compressed gas in the condenser has a temperature of $77^{o}C$, is:

(a) 70 (b) 20

(c) 0.23 (d) 2.5

**36.** When an ideal diatomic gas is heated at constant pressure, the fraction of the heat energy supplied which increases the internal energy of the gas is

(a) $\frac{2}{5}$ (b) $\frac{3}{5}$

(c) $\frac{3}{7}$ (d) $\frac{5}{7}$

**37.** 1 $cm^3$ of water at its boiling point absorbs 540 calories of heat to become steam with a volume of 167 $cm^3$. If the atmospheric pressure = $1.013 \times 10^5$ $N/m^2$ and the mechanical equivalent of heat = 4.19 J/caloiie, the energy mechanical equivalent of heat = 4.19 J/calorie, the energy spent in this process in overcoming intermolecular forces is

(a) 540 cal (b) 40 cal

(c) 500 cal (d) Zero

**38.** During the melting of a slab of ice at 273 K at atmospheric pressure

(a) Positive work is done by ice-water system on the atmosphere

(b) Positive work is done on the ice-water system by the atmosphere

(c) The internal energy of the ice-water system increases

(d) The internal energy of the ice-water system decreases

**39.** Two identical containers A and B with frictionless pistons contain the same ideal gas at the same temperature and the same volume V. The mass of the gas in A is $m_A$ and that in B is $m_B$. The gas in each cylinder is now allowed to expand isothermally to the same final volume 2V. The changes in the pressure in A and B are found to be $\Delta P$ and $1.5\ \Delta P$ respectively. Then

(a) $4m_A = 9m_B$

(b) $2m_A = 3m_B$

(c) $3m_A = 2m_B$

(d) $9m_A = 3m_B$

**40.** A monoatomic ideal gas, initially at temperature $T_1$, is enclosed in a cylinder fitted with a frictionless piston. The gas is allowed to expand adiabatically to a temperature $T_2$ by releasing the piston suddenly. If $L_1$ and $L_2$ are the lengths of the gas column before and after expansion respectively, then $T_1/T_2$ is given by

(a) $\left(\frac{L_1}{L_2}\right)^{2/3}$ (b) $\frac{L_1}{L_2}$

(c) $\frac{L_2}{L_1}$ (d) $\left(\frac{L_2}{L_1}\right)^{2/3}$

**41.** A closed hollow insulated cylinder is filled with gas at 0°C and also contains an insulated piston of negligible weight and negligible thickness at the middle point. The gas on one side of the piston is heated to 100°C. If the piston moves 5cm, the length of the hollow cylinder is

(a) 13.65 cm (b) 27.3 cm

(c) 38.6 cm (d) 64.6 cm

**42.** A mono atomic gas is supplied the heat Q very slowly keeping the pressure constant. The work done by the gas will be

(a) $\frac{2}{3}Q$ (b) $\frac{3}{5}Q$

(c) $\frac{2}{5}Q$ (d) $\frac{1}{5}Q$

**43.** A gas mixture consists of 2 moles of oxygen and 4 moles argon at temperature T. Neglecting all vibrational modes, the total internal energy of the system is

(a) 4 RT

(b) 15 RT

(c) 9 RT

(d) 11 RT

**44.** An ideal gas expands isothermally from a volume $V_1$ to $V_2$ and then compressed to original volume $V_1$ adiabatically. Initial pressure is $P_1$ and final pressure is $P_3$. The total work done is W. Then

(a) $P_3 > P_1$, $W > 0$ (b) $P_3 < P_1$, $W < 0$

(c) $P_3 > P_1$, $W < 0$ (d) $P_3 = P_1$, $W = 0$

**45.** Work done by a system under isothermal change from a volume $V_1$ to $V_2$ for a gas which obeys Vander Waal's equation $(V - \beta n)\left(P + \frac{\alpha n^2}{V}\right) = nRT$

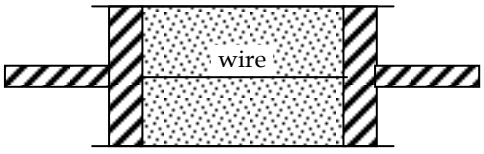
(a) $nRT \log_e\left(\frac{V_2 - n\beta}{V_1 - n\beta}\right) + \alpha n^2\left(\frac{V_1 - V_2}{V_1 V_2}\right)$

(b) $nRT \log_{10}\left(\frac{V_2 - \alpha\beta}{V_1 - \alpha\beta}\right) + \alpha n^2\left(\frac{V_1 - V_2}{V_1 V_2}\right)$

(c) $nRT \log_e\left(\frac{V_2 - n\alpha}{V_1 - n\alpha}\right) + \beta n^2\left(\frac{V_1 - V_2}{V_1 V_2}\right)$

(d) $nRT \log_e\left(\frac{V_1 - n\beta}{V_2 - n\beta}\right) + \alpha n^2\left(\frac{V_1 V_2}{V_1 - V_2}\right)$

**46.** A cylindrical tube of uniform cross-sectional area A is fitted with two air tight frictionless pistons. The pistons are connected to each other by a metallic wire. Initially the pressure of the gas is $P_0$ and temperature is $T_0$, atmospheric pressure is also $P_0$. Now the temperature of the gas is increased to $2T_0$, the tension in the wire will be




(a) $2P_0A$ (b) $P_0A$

(c) $\frac{P_0A}{2}$ (d) $4P_0A$

**47.** The molar heat capacity in a process of a diatomic gas if it does a work of Q/4 when a heat of q is supplied to it is

(a) $\frac{2}{5}R$ (b) $\frac{5}{2}R$

(c) $\frac{10}{3}R$ (d) $\frac{6}{7}R$

**48.** An insulator container contains 4 moles of an ideal diatomic gas at temperature T. Heat Q is supplied to this gas, due to which 2 moles of the gas are dissociated into atoms but temperature of the gas remains constant. Then

(a) Q = 2RT (b) Q = RT

(c) Q = 3RT (d) Q = 4RT

**49.** The volume of air increase by 5% in its adiabatic expansion. The percentage decrease in its pressure will be

(a) 5% (b) 6%

(c) 7% (d) 8%

**50.** The temperature of a hypothetical gas increase to $\sqrt{2}$ times when compressed adiabatically to half the volume. Its equation can be written as

(a) $PV^{3/2}$ = constant (b) $PV^{6/2}$ = constant

(c) $PV^{7/3}$ = constant (d) $PV^{4/3}$ = constant

**ANSWERS KEY**

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|---|---|---|---|---|---|---|---|---|---|
| **1** | B | **11** | D | **21** | B | **31** | A | **41** | D |
| **2** | B | **12** | A | **22** | C | **32** | B | **42** | C |
| **3** | D | **13** | D | **23** | A,D | **33** | A | **43** | D |
| **4** | C | **14** | A | **24** | A | **34** | C | **44** | C |
| **4** | B | **15** | B | **25** | A | **35** | D | **45** | A |
| **6** | B | **16** | D | **26** | B | **36** | D | **46** | B |
| **7** | B | **17** | C | **27** | B | **37** | C | **47** | C |
| **8** | A | **18** | A | **28** | D | **38** | B | **48** | B |
| **9** | D | **19** | B | **29** | A | **39** | C | **49** | C |
| **10** | D | **20** | A | **30** | D | **40** | D | **50** | A |