13. A system performs work ΔW when an amount of heat is ΔQ added to the system, the corresponding change in the internal energy is ΔU. A unique function of the initial and final states (irrespective of the mode of change) is **[CPMT 1981; J & KCET 2004]**

(a) ΔQ (b) ΔW

(c) ΔU and ΔQ (d) ΔU

14. A container of volume $1m^3$ is divided into two equal compartments by a partition. One of these compartments contains an ideal gas at 300 *K*. The other compartment is vacuum. The whole system is thermally isolated from its surroundings. The partition is removed and the gas expands to occupy the whole volume of the container. Its temperature now would be **[Manipal MEE 1995]**

(a) 300 *K* (b) 239 *K*

(c) 200 *K* (d) 100 *K*

15. 110 *J* of heat is added to a gaseous system, whose internal energy change is 40 *J*, then the amount of external work done is **[CBSE PMT 1993; DPMT 1996, 03; AFMC 1999; JIPMER 2000; MH CET 2000; Pb. PMT 2003]**

(a) 150 *J* (b) 70 *J*

(c) 110 *J* (d) 40 *J*

16. Which of the following is not thermodynamical function **[CBSE PMT 1993; CPMT 2001; DCE 1996; 2001]**

(a) Enthalpy (b) Work done

(c) Gibb's energy (d) Internal energy

17. When the amount of work done is 333 *cal* and change in internal energy is 167 *cal*, then the heat supplied is **[AFMC 1998]**

(a) 166 *cal* (b) 333 *cal*

(c) 500 *cal* (d) 400 *cal*

18. First law thermodynamics states that **[KCET 1999]**

(a) System can do work

(b) System has temperature

(c) System has pressure

(d) Heat is a form of energy

19. A thermo-dynamical system is changed from state (P_1, V_1) to (P_2, V_2) by two different process. The quantity which will remain same will be

(a) ΔQ (b) ΔW

(c) $\Delta Q + \Delta W$ (d) $\Delta Q - \Delta W$

20. In thermodynamic process, 200 *Joules* of heat is given to a gas and 100 *Joules* of work is also done on it. The change in internal energy of the gas is **[AMU (Engg.) 1999]**

(a) 100 *J* (b) 300 *J*

(c) 419 *J* (d) 24 *J*

21. A perfect gas contained in a cylinder is kept in vacuum. If the cylinder suddenly bursts, then the temperature of the gas **[MH CET 1999]**

(a) Remains constant (b) Becomes zero

(c) Increases (d) Decreases

22. If 150 *J* of heat is added to a system and the work done by the system is 110 *J*, then change in internal energy will be **[AMU (Engg.) 1999; BHU 2000]**

(a) 260 *J* (b) 150 *J*

(c) 110 *J* (d) 40 *J*

23. If ΔQ and ΔW represent the heat supplied to the system and the work done on the system respectively, then the first law of thermodynamics can be written as **[Roorkee 2000]**

(a) $\Delta Q = \Delta U + \Delta W$ (b) $\Delta Q = \Delta U - \Delta W$

(c) $\Delta Q = \Delta W - \Delta U$ (d) $\Delta Q = -\Delta W - \Delta U$

where ΔU is the internal energy

24. For free expansion of the gas which of the following is true **[AMU (Med.) 2000]**

(a) $Q = W = 0$ and $\Delta E_{int} = 0$

(b) $Q = 0, W > 0$ and $\Delta E_{int} = -W$

(c) $W = 0, Q > 0,$ and $\Delta E_{int} = Q$

(d) $W > 0, Q < 0$ and $\Delta E_{int} = 0$

25. Which of the following can not determine the state of a thermodynamic system

(a) Pressure and volume

(b) Volume and temperature

(c) Temperature and pressure

(d) Any one of pressure, volume or temperature

26. Which of the following is not a thermodynamics co-ordinate **[AIIMS 2001]**

(a) *P* (b) *T*

(c) *V* (d) *R*

27. In a given process for an ideal gas, $dW = 0$ and $dQ < 0$. Then for the gas **[IIT-JEE (Screening) 2001]**

(a) The temperature will decrease

(b) The volume will increase

(c) The pressure will remain constant

(d) The temperature will increase

28. The specific heat of hydrogen gas at constant pressure is $C_P = 3.4 \times 10^3 cal/kg^oC$ and at constant volume is $C_V = 2.4 \times 10^3 cal/kg^oC$. If one kilogram hydrogen gas is heated from 10^oC to 20^oC at constant pressure, the external work done on the gas to maintain it at constant pressure is **[MP PMT 1995; DPMT 2001]**

(a) 10^5 *cal* (b) 10^4 *cal*

(c) 10^3 *cal* (d) 5×10^3 *cal*

29. Which of the following parameters does not characterize the thermodynamic state of matter **[CPMT 2001; AIEEE 2003]**

(a) Volume (b) Temperature

(c) Pressure (d) Work

30. In a thermodynamic system working substance is ideal gas, its internal energy is in the form of **[MP PMT 2003]**

(a) Kinetic energy only

(b) Kinetic and potential energy

(c) Potential energy

(d) None of these

31. Which of the following statements is correct for any thermodynamic system **[AIEEE 2004]**

(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 process is always zero

32. A system is provided with 200 cal of heat and the work done by the system on the surrounding is 40 *J*. Then its internal energy **[Orissa PMT 2004]**

(a) Increases by 600 *J* (b) Decreases by 800 *J*

(c) Increases by 800 *J* (d) Decreases by 50 *J*

33. In a thermodynamic process, pressure of a fixed mass of a gas is changed in such a manner that the gas molecules gives out 20 *J* of heat and 10 *J* of work is done on the gas. If the initial internal energy of the gas was 40 *J*, then the final internal energy will be **[DPMT 2004]**

(a) 30 *J* (b) 20 *J*

(c) 60 *J* (d) 40 *J*

34. Heat is not being exchanged in a body. If its internal energy is increased, then **[RPMT 2002]**

(a) Its temperature will increase

(b) Its temperature will decrease

(c) Its temperature will remain constant

(d) None of these

35. Out of the following which quantity does not depend on path **[RPET 2002]**

(a) Temperature (b) Energy

(c) Work (d) None of these

36. First law of thermodynamics is a special case of **[CPMT 1985; RPET 2000; DCE 2000; CBSE PMT 2000; AIEEE 2002; AFMC 2002]**

(a) Newton's law

(b) Law of conservation of energy

(c) Charle's law

(d) Law of heat exchange

37. One mole of an ideal monoatomic gas is heated at a constant pressure of one atmosphere from 0^oC to 100^oC. Then the change in the internal energy is **[Pb. PMT 2001]**

[AFMC 2001]

(a) 6.56 *joules* (b) 8.32×10^2 *joules*
(c) 12.48×10^2 *joules* (d) 20.80 *joules*

38. If the ratio of specific heat of a gas at constant pressure to that at constant volume is γ, the change in internal energy of a mass of gas, when the volume changes from V to 2V constant pressure p, is **[CBSE PMT 1998]**

(a) $R/(\gamma-1)$ (b) pV
(c) $pV/(\gamma-1)$ (d) $\gamma pV/(\gamma-1)$

39. If $C_V = 4.96\, cal/mole\, K$, then increase in internal energy when temperature of 2 moles of this gas is increased from 340 K to 342 K **[RPET 1997]**

(a) 27.80 *cal* (b) 19.84 *cal*
(c) 13.90 *cal* (d) 9.92 *cal*

40. Temperature is a measurement of coldness or hotness of an object. This definition is based on **[RPET 2003]**

(a) Zeroth law of thermodynamics
(b) First law of thermodynamics
(c) Second law of thermodynamics
(d) Newton's law of cooling

41. When heat energy of 1500 *Joules*, is supplied to a gas at constant pressure $2.1\times10^5\, N/m^2$, there was an increase in its volume equal to $2.5\times10^{-3}\, m^3$. The increase in internal energy of the gas in Joules is **[EAMCET (Engg.) 1999]**

(a) 450 (b) 525
(c) 975 (d) 2025

42. If heat given to a system is 6 *kcal* and work done is 6 k*J*. Then change in internal energy is **[BHU Med. 2000]**

(a) 19.1 *kJ* (b) 12.5 *kJ*
(c) 25 *kJ* (d) Zero

43. In a thermodynamics process, pressure of a fixed mass of a gas is changed in such a manner that the gas releases 20 *J* of heat and 8*J* of work is done on the gas. If the initial internal energy of the gas was 30*J*. The final internal energy will be **[DPMT 2002]**

(a) 18*J* (b) 9*J*
(c) 4.5*J* (d) 36*J*

44. A monoatomic gas of *n*-moles is heated from temperature T_1 to T_2 under two different conditions (i) at constant volume and (ii) at constant pressure. The change in internal energy of the gas is **[CPMT 2000]**

(a) More for (i)
(b) More for (ii)
(c) Same in both cases
(d) Independent of number of moles

45. The state of a thermodynamic system is represented by **[MH CET 2004]**

(a) Pressure only
(b) Volume only
(c) Pressure, volume and temperature
(d) Number of moles

46. A perfect gas goes from state *A* to another state *B* by absorbing $8\times10^5\, J$ of heat and doing $6.5\times10^5\, J$ of external work. It is now transferred between the same two states in another process in which it absorbs $10^5\, J$ of heat. Then in the second process **[BHU 1997]**

(a) Work done on the gas is $0.5\times10^5\, J$
(b) Work done by gas is $0.5\times10^5\, J$
(c) Work done on gas is $10^5\, J$
(d) Work done by gas is $10^5\, J$

47. If a system undergoes contraction of volume then the work done by the system will be **[BHU 1999]**

(a) Zero (b) Negligible
(c) Negative (d) Positive

48. Which of the following is *incorrect* regarding the first law of thermodynamics **[AIEEE 2005]**

(a) It introduces the concept of the internal energy
(b) It introduces the concept of the entropy
(c) It is not applicable to any cyclic process
(d) None of the above

Isothermal Process

1. For an ideal gas, in an isothermal process **[BHU 1998]**

(a) Heat content remains constant

(b) Heat content and temperature remain constant

(c) Temperature remains constant

(d) None of the above

2. Can two isothermal curves cut each other

(a) Never

(b) Yes

(c) They will cut when temperature is 0°C

(d) Yes, when the pressure is critical pressure

3. In an isothermal expansion **[KCET 2000; AFMC 2001]**

(a) Internal energy of the gas increases

(b) Internal energy of the gas decreases

(c) Internal energy remains unchanged

(d) Average kinetic energy of gas molecule decreases

4. In an isothermal reversible expansion, if the volume of 96 *gm* of oxygen at 27°C is increased from 70 *litres* to 140 *litres*, then the work done by the gas will be

(a) $300\,R\log_{10}2$ (b) $81\,R\log_e 2$

(c) $900\,R\log_{10}2$ (d) $2.3\times 900\,R\log_{10}2$

5. A vessel containing 5 *litres* of a gas at 0.8 *m* pressure is connected to an evacuated vessel of volume 3 *litres*. The resultant pressure inside will be (assuming whole system to be isolated) **[MP PMT 1993]**

(a) 4/3 *m* (b) 0.5 *m*

(c) 2.0 *m* (d) 3/4 *m*

6. For an isothermal expansion of a perfect gas, the value of $\frac{\Delta P}{P}$ is equal **[CPMT 1980]**

(a) $-\gamma^{1/2}\frac{\Delta V}{V}$ (b) $-\frac{\Delta V}{V}$

(c) $-\gamma\frac{\Delta V}{V}$ (d) $-\gamma^2\frac{\Delta V}{V}$

7. The gas law $\frac{PV}{T}=$ constant is true for **[MNR 1974; MP PMT 1984; BHU 1995, 98, 2000]**

(a) Isothermal changes only

(b) Adiabatic changes only

(c) Both isothermal and adiabatic changes

(d) Neither isothermal nor adiabatic changes

8. One mole of O_2 gas having a volume equal to 22.4 *litres* at $0°C$ and 1 atmospheric pressure in compressed isothermally so that its volume reduces to 11.2 *litres*. The work done in this process is **[MP PET 1993; BVP 2003]**

(a) $1672.5\ J$ (b) $1728\ J$

(c) $-1728\ J$ (d) $-1572.5\ J$

9. If a gas is heated at constant pressure, its isothermal compressibility **[MP PET 1984]**

(a) Remains constant

(b) Increases linearly with temperature

(c) Decreases linearly with temperature

(d) Decreases inversely with temperature

10. Work done per mol in an isothermal change is **[RPMT 2004; BCECE 2005]**

(a) $RT\log_{10}\frac{V_2}{V_1}$ (b) $RT\log_{10}\frac{V_1}{V_2}$

(c) $RT\log_e\frac{V_2}{V_1}$ (d) $RT\log_e\frac{V_1}{V_2}$

11. The isothermal Bulk modulus of an ideal gas at pressure P is **[CPMT 1974, 81; UPSEAT 1998; IIT 1998]**

(a) P (b) γP

(c) $P/2$ (d) P/γ

12. In isothermal expansion, the pressure is determined by **[AFMC 1995]**

(a) Temperature only

(b) Compressibility only

(c) Both temperature and compressibility

(d) None of these

13. The isothermal bulk modulus of a perfect gas at normal pressure is **[AFMC 1997]**

(a) $1.013\times10^5\ N/m^2$ (b) $1.013\times10^6\ N/m^2$

(c) $1.,013\times10^{-11}\ N/m^2$ (d) $1.013\times10^{11}\ N/m^2$

14. In an isothermal change, an ideal gas obeys **[EAMCET 1994; CPMT 1999]**

(a) Boyle's law (b) Charle's law

(c) Gaylussac law (d) None of the above

15. In isothermic process, which statement is wrong **[RPMT 1997]**

(a) Temperature is constant

(b) Internal energy is constant

(c) No exchange of energy

(d) (a) and (b) are correct

16. An ideal gas *A* and a real gas *B* have their volumes increased from *V* to 2 *V* under isothermal conditions. The increase in internal energy **[CBSE PMT 1993; JIPMER 2001, 02]**

(a) Will be same in both *A* and *B*

(b) Will be zero in both the gases

(c) Of *B* will be more than that of *A*

(d) Of *A* will be more than that of *B*

17. The specific heat of a gas in an isothermal process is **[AFMC 1998]**

(a) Infinite (b) Zero

(c) Negative (d) Remains constant

18. A thermally insulated container is divided into two parts by a screen. In one part the pressure and temperature are *P* and *T* for an ideal gas filled. In the second part it is vacuum. If now a small hole is created in the screen, then the temperature of the gas will

(a) Decrease (b) Increase

(c) Remain same (d) None of the above

19. A container that suits the occurrence of an isothermal process should be made of

(a) Copper (b) Glass

(c) Wood (d) Cloth

20. In an isothermal process the volume of an ideal gas is halved. One can say that **[MP PMT 2004]**

(a) Internal energy of the system decreases

(b) Work done by the gas is positive

(c) Work done by the gas is negative

(d) Internal energy of the system increases

21. A thermodynamic process in which temperature *T* of the system remains constant though other variable *P* and *V* may change, is called **[Pb. PMT 2004]**

(a) Isochoric process (b) Isothermal process

(c) Isobaric process (d) None of these

22. If an ideal gas is compressed isothermally then **[RPMT 2003]**

(a) No work is done against gas

(b) Heat is relased by the gas

(c) The internal energy of gas will increase

(d) Pressure does not change

23. When an ideal gas in a cylinder was compressed isothermally by a piston, the work done on the gas was found to be 1.5×10^4 *joules*. During this process about **[MP PMT 1987]**

(a) 3.6×10^3 *cal* of heat flowed out from the gas

(b) 3.6×10^3 *cal* of heat flowed into the gas

(c) 1.5×10^4 *cal* of heat flowed into the gas

(d) 1.5×10^4 *cal* of heat flowed out from the gas

24. When heat is given to a gas in an isothermal change, the result will be **[MP PET 1995; RPMT 1997]**

(a) External work done

(b) Rise in temperature

(c) Increase in internal energy

(d) External work done and also rise in temp.

25. When 1 *gm* of water at 0^oC and $1\times10^5\ N/m^2$ pressure is converted into ice of volume $1.091\ cm^3$, the external work done will be **[RPET 1999]**

(a) 0.0091 *joule* (b) 0.0182 *joule*

(c) – 0.0091 *joule* (d) – 0.0182 *joule*

26. The latent heat of vaporisation of water is 2240 *J/gm*. If the work done in the process of expansion of 1 *g* is 168 *J*, then increase in internal energy is **[Pb. PMT 2000] [Pb. PET 1998; CPMT 2000]**

(a) 2408 *J* (b) 2240 *J*

(c) 2072 *J* (d) 1904 *J*

27. 540 *calories* of heat convert 1 cubic centimeter of water at 100^oC into 1671 cubic centimeter of steam at 100^oC at a pressure of one atmosphere. Then the work done against the atmospheric pressure is nearly

(a) 540 *cal* (b) 40 *cal*

(c) Zero *cal* (d) 500 *cal*

28. One mole of an ideal gas expands at a constant temperature of 300 *K* from an initial volume of 10 *litres* to a final volume of 20 *litres*. The work done in expanding the gas is (R = 8.31 *J/mole-K*) **[MP PMT 1995; UPSEAT 2000]**

(a) 750 *joules* (b) 1728 *joules*

(c) 1500 *joules* (d) 3456 *joules*

29. A cylinder fitted with a piston contains 0.2 *moles* of air at temperature 27°*C*. The piston is pushed so slowly that the air within the cylinder remains in thermal equilibrium with the surroundings. Find the approximate work done by the system if the final volume is twice the initial volume **[BHU (Med.) 2000]**

(a) 543 *J* (b) 345 *J*
(c) 453 *J* (d) 600 *J*

30. The volume of an ideal gas is 1 litre and its pressure is equal to 72*cm* of mercury column. The volume of gas is made 900 cm^3 by compressing it isothermally. The stress of the gas will be **[UPSEAT 1999]**

(a) 8 *cm* (mercury) (b) 7 *cm* (mercury)
(c) 6 *cm* (mercury) (d) 4 *cm* (mercury)

31. During an isothermal expansion of an ideal gas **[UPSEAT 2005]**

(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

Adiabatic Process

1. If a cylinder containing a gas at high pressure explodes, the gas undergoes **[MP PET/PMT 1988]**

(a) Reversible adiabatic change and fall of temperature
(b) Reversible adiabatic change and rise of temperature
(c) Irreversible adiabatic change and fall of temperature
(d) Irreversible adiabatic change and rise of temperature

2. The work done in an adiabatic change in a gas depends only on **[CPMT 1971; MP PMT 2004]**

(a) Change is pressure (b) Change is volume
(c) Change in temperature (d)None of the above

3. In adiabatic expansion **[DPMT 1999]**

(a) $\Delta U = 0$ (b) $\Delta U =$ negative
(c) $\Delta U =$ positive (d) $\Delta W =$ zero

4. The pressure in the tyre of a car is four times the atmospheric pressure at 300 *K*. If this tyre suddenly bursts, its new temperature will be $(\gamma = 1.4)$ **[RPMT 1996; MP PMT 1990]**

(a) $300(4)^{1.4/0.4}$ (b) $300\left(\frac{1}{4}\right)^{-0.4/1.4}$
(c) $300(2)^{-0.4/1.4}$ (d) $300(4)^{-0.4/1.4}$

5. A gas at NTP is suddenly compressed to one-fourth of its original volume. If γ is supposed to be $\frac{3}{2}$, then the final pressure is **[BHU 1995]**

(a) 4 atmosphere (b) $\frac{3}{2}$ atmosphere
(c) 8 atmosphere (d) $\frac{1}{4}$ atmosphere

6. A monoatomic gas $(\gamma = 5/3)$ is suddenly compressed to $\frac{1}{8}$ of its original volume adiabatically, then the pressure of the gas will change to **[CPMT 1976, 83; MP PMT 1994; DPMT 1996; Roorkee 2000; KCET 2000; Pb. PMT 1999, 2001]**

(a) $\frac{24}{5}$
(b) 8
(c) $\frac{40}{3}$
(d) 32 times its initial pressure

7. The pressure and density of a diatomic gas $(\gamma = 7/5)$ change adiabatically from (*P*, *d*) to (*P*', *d*'). If $\frac{d}{d} = 32$, then $\frac{P}{P}$ should be **[CPMT 1982; EAMCET 2001]**

(a) 1/128 (b) 32
(c) 128 (d) None of the above

8. An ideal gas at 27^oC is compressed adiabatically to $\frac{8}{27}$ of its original volume. If $\gamma = \frac{5}{3}$, then the rise in temperature is **[CPMT 1984; CBSE PMT 1999; DPMT 2000; BHU 2001; Pb. PET 2001; UPSEAT 2002, 03; KCET 2003;]**

(a) 450 *K* (b) 375 *K*
(c) 225 *K* (d) 405 *K*

9. Two identical samples of a gas are allowed to expand (i) isothermally (ii) adiabatically. Work done is **[MNR 1998]**

(a) More in the isothermal process

(b) More in the adiabatic process

(c) Neither of them

(d) Equal in both processes

10. Which is the correct statement [MP PMT 1993]

(a) For an isothermal change PV = constant

(b) In an isothermal process the change in internal energy must be equal to the work done

(c) For an adiabatic change $\frac{P_2}{P_1} = \left(\frac{V_2}{V_1}\right)^{\gamma}$, where γ is the ratio of specific heats

(d) In an adiabatic process work done must be equal to the heat entering the system

11. The slopes of isothermal and adiabatic curves are related as [CPMT 1971; BHU 1996; MH CET 1999; UPSEAT 2000; RPET 2003]

(a) Isothermal curve slope = adiabatic curve slope

(b) Isothermal curve slope = $\gamma \times$ adiabatic curve slope

(c) Adiabatic curve slope = $\gamma \times$ isothermal curve slope

(d) Adiabatic curve slope = $\frac{1}{2} \times$ isothermal curve slope

12. Pressure-temperature relationship for an ideal gas undergoing adiabatic change is $(\gamma = C_p / C_v)$ [CPMT 1992; MP PMT 1986, 87, 94, 97; Pb. PET 1998; DCE 2001; MP PET 2001; UPSEAT 1999, 2001; AFMC 2002]

(a) $PT^{\gamma} =$ constant (b) $PT^{-1+\gamma} =$ constant

(c) $P^{\gamma-1}T^{\gamma} =$ constant (d) $P^{1-\gamma}T^{\gamma} =$ constant

13. The amount of work done in an adiabatic expansion from temperature T to T_1 is [MP PMT 1989]

(a) $R(T - T_1)$ (b) $\frac{R}{\gamma - 1}(T - T_1)$

(c) RT (d) $R(T - T_1)(\gamma - 1)$

14. During the adiabatic expansion of 2 moles of a gas, the internal energy of the gas is found to decrease by 2 *joules*, the work done during the process on the gas will be equal to [CPMT 1988]

(a) 1 J (b) $-1\ J$

(c) 2 J (d) – 2 J

15. The adiabatic elasticity of hydrogen gas $(\gamma = 1.4)$ at NTP is [MP PMT 1990]

(a) $1 \times 10^5\ N/m^2$ (b) $1 \times 10^{-8}\ N/m2$

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

16. If γ denotes the ratio of two specific heats of a gas, the ratio of slopes of adiabatic and isothermal PV curves at their point of intersection is [NCERT 1990; MH CET 1999; MP PMT 2000]

(a) $1/\gamma$ (b) γ

(c) $\gamma - 1$ (d) $\gamma + 1$

17. Air in a cylinder is suddenly compressed by a piston, which is then maintained at the same position. With the passage of time [NCERT 1971; DPMT 1995; JIPMER 1997; KCET 2000; AIIMS 2000; MH CET 2001]

(a) The pressure decreases

(b) The pressure increases

(c) The pressure remains the same

(d) The pressure may increase or decrease depending upon the nature of the gas

18. When a gas expands adiabatically [CPMT 1990]

(a) No energy is required for expansion

(b) Energy is required and it comes from the wall of the container of the gas

(c) Internal energy of the gas is used in doing work

(d) Law of conservation of energy does not hold

19. One *gm* mol of a diatomic gas $(\gamma = 1.4)$ is compressed adiabatically so that its temperature rises from $27^{\circ}C$ to $127^{\circ}C$. The work done will be

(a) 2077.5 *joules* (b) 207.5 *joules*

(c) 207.5 *ergs* (d) None of the above

20. Compressed air in the tube of a wheel of a cycle at normal temperature suddenly starts coming out from a puncture. The air inside [NCERT 1970]

(a) Starts becoming hotter

(b) Remains at the same temperature
(c) Starts becoming cooler
(d) May become hotter or cooler depending upon the amount of water vapour present

21. The adiabatic Bulk modulus of a perfect gas at pressure is given by **[CPMT 1982; MH CET 2001]**
(a) P (b) $2P$
(c) $P/2$ (d) γP

22. An adiabatic process occurs at constant **[MNR 1985; AFMC 1996; AIIMS 1999; UPSEAT 1999, 2000; Pb. PET 2004]**
(a) Temperature
(b) Pressure
(c) Heat
(d) Temperature and pressure

23. A polyatomic gas $\left(\gamma = \frac{4}{3}\right)$ is compressed to $\frac{1}{8}$ of its volume adiabatically. If its initial pressure is P_o, its new pressure will be**[MP PET 1994; BHU 1995]**
(a) $8P_o$ (b) $16P_0$
(c) $6P_o$ (d) $2P_o$

24. For adiabatic processes $\left(\gamma = \frac{C_p}{C_v}\right)$ **[KCET 1999; MP PET 1995; CPMT 2003]**
(a) $P^{\gamma} V$ = constant (b) $T^{\gamma} V$= constant
(c) $TV^{\gamma - 1}$ =constant (d) TV^{γ} = constant

25. An ideal gas is expanded adiabatically at an initial temperature of 300 *K* so that its volume is doubled. The final temperature of the hydrogen gas is $(\gamma = 1.40)$ **[MP PMT 1995; DPMT 1999]**
(a) 227.36 *K* (b) 500.30 *K*
(c) 454.76 *K* (d) $-47^o C$

26. A given system undergoes a change in which the work done by the system equals the decrease in its internal energy. The system must have undergone an **[Haryana CEE 1996; UPSEAT 2003]**
(a) Isothermal change (b) Adiabatic change
(c) Isobaric change (d) Isochoric change

27. During the adiabatic expansion of 2 moles of a gas, the internal energy was found to have decreased by 100 *J*. The work done by the gas in this process is **[MP PET 1996, 97]**
(a) Zero (b) –100 *J*
(c) 200 *J* (d) 100 *J*

28. In an adiabatic expansion of a gas initial and final temperatures are T_1 and T_2 respectively, then the change in internal energy of the gas is **[MP PET 1997]**
(a) $\frac{R}{\gamma - 1}(T_2 - T_1)$ (b) $\frac{R}{\gamma - 1}(T_1 - T_2)$
(c) $R(T_1 - T_2)$ (d) Zero

29. Helium at $27^o C$ has a volume of 8 *litres*. It is suddenly compressed to a volume of 1 *litre*. The temperature of the gas will be $[\gamma = 5/3]$ **[CBSE PMT 1993; MP PMT 1999; Pb. PMT 2002]**
(a) $108^o C$ (b) $9327^o C$
(c) $1200^o C$ (d) $927^o C$

30. A cycle tyre bursts suddenly. This represents an **[SCRA 1994]**
(a) Isothermal process (b) Isobaric process
(c) Isochoric process (d) Adiabatic process

31. One mole of helium is adiabatically expanded from its initial state (P_i, V_i, T_i) to its final state (P_f, V_f, T_f). The decrease in the internal energy associated with this expansion is equal to **[SCRA 1994; BHU 2002]**
(a) $C_V(T_i - T_f)$ (b) $C_P(T_i - T_f)$
(c) $\frac{1}{2}(C_P + C_V)(Ti - T_f)$ (d) $(C_P - C_V)(T_i - T_f)$

32. At N.T.P. one mole of diatomic gas is compressed adiabatically to half of its volume $\gamma = 1.41$. The work done on gas will be **[RPET 1997]**
(a) 1280 *J* (b) 1610 *J*
(c) 1815 *J* (d) 2025 *J*

33. For adiabatic process, wrong statement is**[RPMT 1997]**
(a) $dQ = 0$ (b) $dU = -dW$
(c) Q = constant (d) Entropy is not constant

34. A diatomic gas initially at 18°*C* is compressed adiabatically to one-eighth of its original volume. The temperature after compression will be

[Pb. PET 1995; CBSE PMT 1996; CPMT 1999]

(a) $10^o C$ (b) $887^o C$

(c) $668 K$ (d) $144^o C$

35. A gas is being compressed adiabatically. The specific heat of the gas during compression is [SCRA 1996]

(a) Zero (b) Infinite

(c) Finite but non-zero (d) Undefined

36. The process in which no heat enters or leaves the system is termed as [Pb. PET 1996; BHU 1998; BCECE 2003]

(a) Isochoric (b) Isobaric

(c) Isothermal (d) Adiabatic

37. Two moles of an ideal monoatomic gas at $27^o C$ occupies a volume of V. If the gas is expanded adiabatically to the volume $2V$, then the work done by the gas will be $[\gamma = 5/3, R = 8.31 J/mol K]$ [RPET 1999]

(a) $-2767.23 J$ (b) $2767.23 J$

(c) $2500 J$ (d) $-2500 J$

38. At $27^o C$ a gas is suddenly compressed such that its pressure becomes $\frac{1}{8} th$ of original pressure. Temperature of the gas will be $(\gamma = 5/3)$ [BHU 2000]

(a) $420 K$ (b) $327^o C$

(c) $300 K$ (d) $-142^o C$

39. $\Delta U + \Delta W = 0$ is valid for [RPMT 2000]

(a) Adiabatic process (b) Isothermal process

(c) Isobaric process (d) Isochoric process

40. An ideal gas at a pressures of 1 atmosphere and temperature of $27^o C$ is compressed adiabatically until its pressure becomes 8 times the initial pressure, then the final temperature is ($\gamma = 3/2$) [EAMCET (Engg.)2000]

(a) $627^o C$ (b) $527^o C$

(c) $427^o C$ (d) $327^o C$

41. Air is filled in a motor tube at $27^o C$ and at a pressure of 8 atmospheres. The tube suddenly bursts, then temperature of air is [Given γ of air $= 1.5$] [MP PMT 2002]

(a) $27.5^o C$ (b) $75^o K$

(c) $150 K$ (d) $150^o C$

42. If $\gamma = 2.5$ and volume is equal to $\frac{1}{8}$ times to the initial volume then pressure P' is equal to (Initial pressure = P) [RPET 2003]

(a) $P' = P$ (b) $P' = 2P$

(c) $P' = P \times (2)^{15/2}$ (d) $P' = 7P$

43. In an adiabatic process, the state of a gas is changed from P_1, V_1, T_1, to P_2, V_2, T_2. Which of the following relation is correct

(a) $T_1 V_1^{\gamma-1} = T_2 V_2^{\gamma-1}$ (b) $P_1 V_1^{\gamma-1} = P_2 V_2^{\gamma-1}$

(c) $T_1 P_1^{\gamma} = T_2 P_2^{\gamma}$ (d) $T_1 V_1^{\gamma} = T_2 V_2^{\gamma}$

44. During an adiabatic process, the pressure of a gas is found to be proportional to the cube of its absolute temperature. The ratio C_p / C_v for the gas is [AIEEE 2003]

(a) $\frac{3}{2}$ (b) $\frac{4}{3}$

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

45. In adiabatic expansion of a gas [BCECE 2001; MP PET 2003]

(a) Its pressure increases

(b) Its temperature falls

(c) Its density increases

(d) Its thermal energy increases

46. One mole of an ideal gas at an initial temperature of T K does 6 R joules of work adiabatically. If the ratio of specific heats of this gas at constant pressure and at constant volume is 5/3, the final temperature of gas will be [CBSE PMT 2004]

(a) $(T + 2.4) K$ (b) $(T - 2.4) K$

(c) $(T + 4) K$ (d) $(T - 4) K$

47. A gas is suddenly compressed to 1/4 th of its original volume at normal temperature. The increase in its temperature is $(\gamma = 1.5)$ [DCE 2004]

(a) 273 K (b) 573 K

(c) 373 K (d) 473 K

48. A gas ($\gamma = 1.3$) is enclosed in an insulated vessel fitted with insulating piston at a pressure of $10^5\ N/m^2$. On suddenly pressing the piston the volume is reduced to half the initial volume. The final pressure of the gas is **[RPET 2002]**

(a) $2^{0.7} \times 10^5$ (b) $2^{1.3} \times 10^5$

(c) $2^{1.4} \times 10^5$ (d) None of these

49. The internal energy of the gas increases In **[MP PMT 1989; RPMT 2001]**

(a) Adiabatic expansion (b) Adiabatic compression

(c) Isothermal expansion (d) Isothermal compression

50. We consider a thermodynamic system. If ΔU represents the increase in its internal energy and W the work done by the system, which of the following statements is true **[CBSE PMT 1998]**

(a) $\Delta U = -W$ in an adiabatic process

(b) $\Delta U = W$ in an isothermal process

(c) $\Delta U = -W$ in an isothermal process

(d) $\Delta U = W$ in an adiabatic process

51. A gas is suddenly compressed to one fourth of its original volume. What will be its final pressure, if its initial pressure is P **[Pb. PET 2002]**

(a) Lesss than P (b) More than P

(c) P (d) Either (a) or (c)

52. A gas for which $\gamma = 1.5$ is suddenly compressed to $\frac{1}{4}th$ of the initial volume. Then the ratio of the final to the initial pressure is **[EAMCET 2001]**

(a) 1 : 16 (b) 1 : 8

(c) 1 : 4 (d) 8 : 1

53. One mole of an ideal gas with $\gamma = 1.4$, is adiabatically compressed so that its temperature rises from 27°*C* to 35°*C*. The change in the internal energy of the gas is ($R = 8.3\ J/mol.K$) **[EAMCET 2001]**

(a) −166 *J* (b) 166 *J*

(c) −168 *J* (d) 168 *J*

54. The volume of a gas is reduced adiabatically to $\frac{1}{4}$ of its volume at 27°*C*, if the value of $\gamma = 1.4$, then the new temperature will be **[DPMT 2000]**

(a) $350 \times 4^{0.4}\ K$ (b) $300 \times 4^{0.4}\ K$

(c) $150 \times 4^{0.4}\ K$ (d) None of these

55. During an adiabatic expansion of 2 moles of a gas, the change in internal energy was found – 50*J*. The work done during the process is **[Pb. PET 1996]**

(a) Zero (b) 100*J*

(c) – 50*J* (d) 50*J*

56. Adiabatic modulus of elasticity of a gas is $2.1 \times 10^5\ N/m^2$. What will be its isothermal modulus of elasticity $\left(\frac{C_p}{C_v} = 1.4\right)$ **[UPSEAT 1999]**

(a) $1.8 \times 10^5\ N/m^2$ (b) $1.5 \times 10^5\ N/m^2$

(c) $1.4 \times 10^5\ N/m^2$ (d) $1.2 \times 10^5\ N/m^2$

57. For an adiabatic expansion of a perfect gas, the value of $\frac{\Delta P}{P}$ is equal to **[CPMT 1983; MP PMT 1990]**

(a) $-\sqrt{\gamma}\frac{\Delta V}{V}$ (b) $-\frac{\Delta V}{V}$

(c) $-\gamma\frac{\Delta V}{V}$ (d) $-\gamma^2\frac{\Delta V}{V}$

Isobaric and Isochoric Processes

1. A gas expands under constant pressure P from volume V_1 to V_2. The work done by the gas is **[CBSE PMT 1990; RPMT 2003]**

(a) $P(V_2 - V_1)$ (b) $P(V_1 - V_2)$

(c) $P(V_1^{\gamma} - V_2^{\gamma})$ (d) $P\frac{V_1V_2}{V_2 - V_1}$

2. When heat in given to a gas in an isobaric process, then **[DPMT 2001]**

(a) The work is done by the gas

(b) Internal energy of the gas increases

(c) Both (a) and (b)

(d) None from (a) and (b)

3. One mole of a perfect gas in a cylinder fitted with a piston has a pressure P, volume V and temperature T. If the temperature is increased by 1 K keeping pressure constant, the increase in volume is

(a) $\frac{2V}{273}$ (b) $\frac{V}{91}$

(c) $\frac{V}{273}$ (d) V

4. A gas is compressed at a constant pressure of $50\ N/m^2$ from a volume of $10\ m^3$ to a volume of

$4m^3$. Energy of 100 *J* then added to the gas by heating. Its internal energy is

[MNR 1994]

(a) Increased by 400 *J* (b) Increased by 200 *J*
(c) Increased by 100 *J* (d) Decreased by 200 *J*

5. Work done by air when it expands from 50 *litres* to 150 *litres* at a constant pressure of 2 atmosphere is

(a) 2×10^4 *joules* (b) 2×100 *joules*
(c) $2\times10^5\times100$ *joules* (d) $2\times10^{-5}\times100$ joules

6. Work done by 0.1 mole of a gas at 27^oC to double its volume at constant pressure is (*R* = 2 *cal mol*$^{-1}$ $^oC^{-1}$)

[EAMCET 1994]

(a) 54 *cal* (b) 600 *cal*
(c) 60 *cal* (d) 546 *cal*

7. Unit mass of a liquid with volume V_1 is completely changed into a gas of volume V_2 at a constant external pressure *P* and temperature *T*. If the latent heat of evaporation for the given mass is *L*, then the increase in the internal energy of the system is **[Roorkee 1999]**

(a) Zero (b) $P(V_2-V_1)$
(c) $L-P(V_2-V_1)$ (d) *L*

8. A gas expands $0.25m^3$ at constant pressure $10^3 N/m^2$, the work done is

[CPMT 1997; UPSEAT 1999; JIPMER 2001, 02]

(a) 2.5 *ergs* (b) 250 *J*
(c) 250 *W* (d) 250 *N*

9. Two kg of water is converted into steam by boiling at atmospheric pressure. The volume changes from $2\times10^{-3}m^3$ to $3.34m^3$. The work done by the system is about

(a) – 340 *kJ* (b) – 170 *kJ*
(c) 170 *kJ* (d) 340 *kJ*

10. An ideal gas has volume V_0 at 27^oC. It is heated at constant pressure so that its volume becomes $2V_0$. The final temperature is

(a) 54^oC (b) 32.6^oC
(c) $327\,^\circ C$ (d) 150 *K*

11. If 300 *ml* of a gas at 27^oC is cooled to 7^oC at constant pressure, then its final volume will be

[Pb. PET 1999; BHU 2003; CPMT 2004]

(a) 540 *ml* (b) 350 *ml*
(c) 280 *ml* (d) 135 *ml*

12. Which of the following is correct in terms of increasing work done for the same initial and final state **[RPMT 1996]**

(a) Adiabatic < Isothermal < Isobaric
(b) Isobaric < Adiabatic < Isothermal
(c) Adiabatic < Isobaric < Isothermal
(d) None of these

13. A sample of gas expands from volume V_1 to V_2. The amount of work done by the gas is greatest when the expansion is

[CBSE PMT 1997; AIIMS 1998; JIPMER 2000]

(a) Isothermal (b) Isobaric
(c) Adiabatic (d) Equal in all cases

14. Which of the following is a slow process **[J & K CET 2000]**

(a) Isothermal (b) Adiabatic
(c) Isobaric (d) None of these

15. How much work to be done in decreasing the volume of and ideal gas by an amount of $2.4\times10^{-4}m^3$ at normal temperature and constant normal pressure of $1\times10^5 N/m^2$

[UPSEAT 1999]

(a) 28 *joule* (b) 27 *joule*
(c) 25 *joule* (d) 24 *joule*

16. A Container having 1 mole of a gas at a temperature 27°*C* has a movable piston which maintains at constant pressure in container of 1 *atm*. The gas is compressed until temperature becomes 127°*C*. The work done is (C_p for gas is 7.03 *cal/mol–K*) **[DCE 2005]**

(a) 703 *J* **[Roorkee 2000]** (b) 814 *J*
(c) 121 *J* (d) 2035 *J*

17. In a reversible isochoric change **[NCERT 1990]**

(a) $\Delta W = 0$ (b) $\Delta Q = 0$
(c) $\Delta T = 0$ **[BCECE 2003]** (d) $\Delta U = 0$

18. Entropy of a thermodynamic system does not change when this system is used for

[AIIMS 1995]

(a) Conduction of heat from a hot reservoir to a cold reservoir
(b) Conversion of heat into work isobarically

(c) Conversion of heat into internal energy isochorically
(d) Conversion of work into heat isochorically

19. The work done in which of the following processes is zero **[UPSEAT 2003]**
(a) Isothermal process (b) Adiabatic process
(c) Isochoric process (d) None of these

20. In which thermodynamic process, volume remains same **[Orissa PMT 2004]**
(a) Isobaric (b) Isothermal
(c) Adiabatic (d) Isochoric

21. In an isochoric process if $T_1 = 27^o C$ and $T_2 = 127^o C$, then P_1 / P_2 will be equal to **[RPMT 2003]**
(a) 9 / 59 (b) 2 / 3
(c) 3 / 4 (d) None of these

22. Which is incorrect **[DCE 2001]**
(a) In an isobaric process, $\Delta p = 0$
(b) In an isochoric process, $\Delta W = 0$
(c) In an isothermal process, $\Delta T = 0$
(d) In an isothermal process, $\Delta Q = 0$

23. Which relation is correct for isometric process **[RPMT 2001; BCECE 2003]**
(a) $\Delta Q = \Delta U$ (b) $\Delta W = \Delta U$
(c) $\Delta Q = \Delta W$ (d) None of these

Heat Engine, Refrigerator and Second Law of Thermodynamics

1. A Carnot engine working between $300 K$ and $600K$ has work output of 800 J per cycle. What is amount of heat energy supplied to the engine from source per cycle **[DPMT 1999; Pb. PMT 2002, 05; Kerala PMT 2004]**
(a) 1800 *J/cycle* (b) 1000 *J/cycle*
(c) 2000 *J/cycle* (d) 1600 *J/cycle*

2. The coefficient of performance of a Carnot refrigerator working between $30^o C$ and $0^o C$ is **[UPSEAT 2002]**
(a) 10 (b) 1
(c) 9 (d) 0

3. If the door of a refrigerator is kept open, then which of the following is true **JIPMER 2002; AIEEE 2002; CPMT 2003]**
(a) Room is cooled
(b) Room is heated
(c) Room is either cooled or heated
(d) Room is neither cooled nor heated

4. In a cyclic process, the internal energy of the gas
(a) Increases (b) Decreases
(c) Remains constant (d) Becomes zero

5. Irreversible process is
(a) Adiabatic process
(b) Joule-Thomson expansion
(c) Ideal isothermal process
(d) None of the above

6. For a reversible process, necessary condition is
(a) In the whole cycle of the system, the loss of any type of heat energy should be zero
(b) That the process should be too fast
(c) That the process should be slow so that the working substance should remain in thermal and mechanical equilibrium with the surroundings
(d) The loss of energy should be zero and it should be *quasistatic*

7. In a cyclic process, work done by the system is **[BHU 2002**
(a) Zero
(b) Equal to heat given to the system
(c) More than the heat given to system
(d) Independent of heat given to the system

8. An ideal gas heat engine operates in a Carnot's cycle between $227^o C$ and $127^o C$. It absorbs 6 × 10^4 J at high temperature. The amount of heat converted into work is .... **[KCET 2004]**
(a) $4.8 \times 10^4\ J$ (b) $3.5 \times 10^4\ J$
(c) $1.6 \times 10^4\ J$ (d) $1.2 \times 10^4\ J$

9. An ideal heat engine exhausting heat at $77^o C$ is to have a 30% efficiency. It must take heat at **[BCECE 2004]**
(a) $127^o C$ (b) $227^o C$
(c) $327^o C$ (d) $673^o C$

10. Efficiency of Carnot engine is 100% if **[Pb. PET 2000]** **[DPMT 2001; BHU 2001;**
(a) $T_2 = 273\ K$ (b) $T_2 = 0\ K$

(c) $T_1 = 273\ K$ (d) $T_1 = 0\ K$

11. A Carnot's engine used first an ideal monoatomic gas then an ideal diatomic gas. If the source and sink temperature are $411^o C$ and $69^o C$ respectively and the engine extracts 1000 *J* of heat in each cycle, then area enclosed by the *PV* diagram is **[Pb. PET 2002]**

(a) 100 *J* (b) 300 *J*

(c) 500 *J* (d) 700 *J*

12. A Carnot engine absorbs an amount *Q* of heat from a reservoir at an abosolute temperature *T* and rejects heat to a sink at a temperature of *T*/3. The amount of heat rejected is **[UPSEAT 2004]**

(a) *Q* / 4 (b) *Q* / 3

(c) *Q* / 2 (d) 2*Q* / 3

13. The temperature of sink of Carnot engine is $27^o C$. Efficiency of engine is 25%. Then temperature of source is **[DCE 2002; CPMT 2002]**

(a) $227^o C$ (b) $327^o C$

(c) $127^o C$ (d) $27^o C$

14. The temperature of reservoir of Carnot's engine operating with an efficiency of 70% is 1000*K*. The temperature of its sink is **[DCE 2003]**

(a) 300 *K* (b) 400 *K*

(c) 500 *K* (d) 700 *K*

15. In a Carnot engine, when $T_2 = 0^o C$ and $T_1 = 200^o C$, its efficiency is η_1 and when $T_1 = 0\ ^o C$ and $T_2 = -200\ ^o C$, Its efficiency is η_2, then what is η_1 / η_2 **[DCE 2004]**

(a) 0.577 (b) 0.733

(c) 0.638 (d) Can not be calculated

16. The efficiency of Carnot's engine operating between reservoirs, maintained at temperatures $27^o C$ and $-123^o C$, is **[DPMT 2002, 03; BVP 2004]**

(a) 50% (b) 24%

(c) 0.75% (d) 0.4%

17. A Carnot engine operates between $227^o C$ and $27^o C$. Efficiency of the engine will be **[DCE 1999; BHU 2004]**

(a) $\frac{1}{3}$ (b) $\frac{2}{5}$

(c) $\frac{3}{4}$ (d) $\frac{3}{5}$

18. A measure of the degree of disorder of a system is known as **[Pb. PET 1997; MH CET 1999]**

(a) Isobaric (b) Isotropy

(c) Enthalpy (d) Entropy

19. A carnot engine has the same efficiency between 800 *K* to 500 *K* and *x K* to 600 *K*. The value of *x* is **[Pb. PMT 1996; CPMT 1996]**

(a) 1000 *K* (b) 960 *K*

(c) 846 *K* (d) 754 *K*

20. A scientist says that the efficiency of his heat engine which operates at source temperature 127°*C* and sink temperature 27°*C* is 26%, then **[CBSE PMT 2001]**

(a) It is impossible

(b) It is possible but less probable

(c) It is quite probable

(d) Data are incomplete

21. A Carnot's engine is made to work between 200°*C* and 0°*C* first and then between 0°*C* and –200°*C*. The ratio of efficiencies of the engine in the two cases is **[KCET 2002]**

(a) 1.73 : 1 (b) 1 : 1.73

(c) 1 : 1 (d) 1 : 2

22. Efficiency of a Carnot engine is 50% when temperature of outlet is 500 *K*. In order to increase efficiency up to 60% keeping temperature of intake the same what is temperature of outlet **[CBSE PMT 2002]**

(a) 200 *K* (b) 400 *K*

(c) 600 *K* (d) 800 *K*

23. Even Carnot engine cannot give 100% efficiency because we cannot **[AIEEE 2002]**

(a) Prevent radiation

(b) Find ideal sources

(c) Reach absolute zero temperature

(d) Eliminate friction

24. "Heat cannot by itself flow from a body at lower temperature to a body at higher temperature" is a statement or consequence of **[AIEEE 2003, EAMCET (Med.) 2003]**

(a) Second law of thermodynamics
(b) Conservation of momentum
(c) Conservation of mass
(d) First law of thermodynamics

25. A Carnot engine takes $3\times10^6\ cal$. of heat from a reservoir at 627°*C*, and gives it to a sink at 27°*C*. The work done by the engine is **[AIEEE 2003]**

(a) $4.2\times10^6\ J$ (b) $8.4\times10^6\ J$
(c) $16.8\times10^6\ J$ (d) Zero

26. The first operation involved in a Carnot cycle is **[AFMC 1998]**

(a) Isothermal expansion (b)Adiabatic expansion
(c) Isothermal compression(d) Adiabatic compression

27. For which combination of working temperatures the efficiency of Carnot's engine is highest **[KCET 2000]**

(a) 80 *K*, 60 *K* (b) 100 *K*, 80 *K*
(c) 60 *K*, 40 *K* (d) 40 *K*, 20 *K*

28. The efficiency of Carnot engine when source temperature is T_1 and sink temperature is T_2 will be **[DCE 2000]**

(a) $\frac{T_1 - T_2}{T_1}$ (b) $\frac{T_2 - T_1}{T_2}$
(c) $\frac{T_1 - T_2}{T_2}$ (d) $\frac{T_1}{T_2}$

29. An ideal heat engine working between temperature T_1 and T_2 has an efficiency η, the new efficiency if both the source and sink temperature are doubled, will be **[DPMT 2000]**

(a) $\frac{\eta}{2}$ (b) η
(c) 2η (d) 3η

30. An ideal refrigerator has a freezer at a temperature of $-13°C$. The coefficient of performance of the engine is 5. The temperature of the air (to which heat is rejected) will be **[BHU 2000; CPMT 2002]**

(a) 325°*C* (b) 325*K*
(c) 39°*C* (d) 320°*C*

31. In a mechanical refrigerator, the low temperature coils are at a temperature of – 23°*C* and the compressed gas in the condenser has a temperature of 27°*C*. The theoretical coefficient of performance is **[UPSEAT 2001]**

(a) 5 (b) 8
(c) 6 (d) 6.5

32. An engine is supposed to operate between two reservoirs at temperature 727°*C* and 227°*C*. The maximum possible efficiency of such an engine is **[UPSEAT 2005]**

(a) 1/2 (b) 1/4
(c) 3/4 (d) 1

33. An ideal gas heat engine operates in Carnot cycle between 227°*C* and 127°*C*. It absorbs 6×10^4 *cals* of heat at higher temperature. Amount of heat converted to work is **[CBSE PMT 2005]**

(a) 2.4×10^4 *cal* (b) 6×10^4 *cal*
(c) 1.2×10^4 *cal* (d) 4.8×10^4 *cal*

34. Which of the following processes is reversible **[CBSE PMT 2005]**

(a) Transfer of heat by radiation
(b) Electrical heating of a nichrome wire
(c) Transfer of heat by conduction
(d) Isothermal compression

CT Critical Thinking

Objective Questions

1. 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 **[IIT 1990; UPSEAT 1998; RPET 2000]**

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

2. $1\,cm^3$ of water at its boiling point absorbs 540 calories of heat to become steam with a volume of $1671\,cm^3$.If the atmospheric pressure = $1.013 x 10^5\ N/m^2$ and the mechanical equivalent of heat = $4.19\ J/calorie$, the energy spent in this process in overcoming intermolecular forces is **[MP PET 1999, 2001; Orissa JEE 2002]**

(a) 540 *cal* (b) 40 *cal*

(c) 500 *cal* (d) Zero

3. During the melting of a slab of ice at 273 *K* at atmospheric pressure **[IIT 1998]**

(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

4. 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 2*V*. The changes in the pressure in *A* and *B* are found to be ΔP and 1.5 ΔP respectively. Then **[IIT 1998]**

(a) $4m_A = 9m_B$ (b) $2m_A = 3m_B$

(c) $3m_A = 2m_B$ (d) $9m_A = 3m_B$

5. 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 **[IIT-JEE (Screening) 2000]**

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

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

6. A closed hollow insulated cylinder is filled with gas at 0^oC 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^oC. If the piston moves $5\,cm$, the length of the hollow cylinder is **[EAMCET 2001]**

(a) 13.65 *cm* (b) 27.3 *cm*

(c) 38.6 *cm* (d) 64.6 *cm*

7. A mono atomic gas is supplied the heat *Q* very slowly keeping the pressure constant. The work done by the gas will be **[BHU 2003; CPMT 2004]**

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

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

8. 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 **[IIT 1999; UPSEAT 2003]**

(a) 4 *RT* (b) 15 *RT*

(c) 9 *RT* (d) 11 *RT*

9. 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 **[IIT-JEE (Screening) 2004]**

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

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

10. 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 $(V - \beta n)\left(P + \frac{\alpha n^2}{V}\right) = nRT$

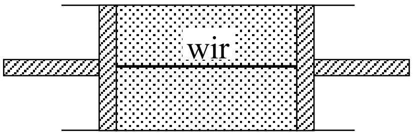
(a) $nRT\log_e\left(\frac{V_2 - n\beta}{V_1 - n\beta}\right) + \alpha\, n^2\left(\frac{V_1 - V_2}{V_1V_2}\right)$

(b) $nRT\log_{10}\left(\frac{V_2 - \alpha\beta}{V_1 - \alpha\beta}\right) + \alpha\, n^2\left(\frac{V_1 - V_2}{V_1V_2}\right)$

(c) $nRT\log_e\left(\frac{V_2 - n\alpha}{V_1 - n\alpha}\right) + \beta\, n^2\left(\frac{V_1 - V_2}{V_1V_2}\right)$

(d) $nRT\log_e\left(\frac{V_1 - n\beta}{V_2 - n\beta}\right) + \alpha\, n^2\left(\frac{V_1V_2}{V_1 - V_2}\right)$

11. 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) $4P_0A$

12. The molar heat capacity in a process of a diatomic gas if it does a work of $\frac{Q}{4}$ 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) $\frac{6}{7}R$

13. 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) $Q = 4RT$

14. The volume of air increases by 5% in its adiabatic expansion. The percentage decrease in its pressure will be

(a) 5% (b) 6%

(c) 7% (d) 8%

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

(a) $PV^{3/2}$ = constant (b) $PV^{5/2}$ = constant

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

16. Two Carnot engines A and B are operated in succession. The first one, A receives heat from a source at $T_1 = 800K$ and rejects to sink at T_2K. The second engine B receives heat rejected by the first engine and rejects to another sink at $T_3 = 300K$. If the work outputs of two engines are equal, then the value of T_2 is

(a) $100K$ (b) $300K$

(c) $550K$ (d) $700K$

17. When an ideal monoatomic gas is heated at constant pressure, fraction of heat energy supplied which increases the internal energy of gas, is **[AIIMS 1995]**

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

(c) $\frac{3}{7}$ (d) $\frac{3}{4}$

18. When an ideal gas $(\gamma = 5/3)$ is heated under constant pressure, then what percentage of given heat energy will be utilised in doing external work **[RPET 1999]**

(a) 40 % (b) 30 %

(c) 60 % (d) 20 %

19. Which one of the following gases possesses the largest internal energy **[SCRA 1998]**

(a) 2 moles of helium occupying $1m^3$ at 300 K

(b) 56 kg of nitrogen at $107 Nm^{-2}$ and 300 K

(c) 8 grams of oxygen at 8 atm and 300 K

(d) 6×10^{26} molecules of argon occupying $40m^3$ at 900 K

20. Two samples A and B of a gas initially at the same pressure and temperature are compressed from volume V to $V/2$ (A isothermally and adiabatically). The final pressure of A is **[MP PET 1996, 99; MP PMT 1997, 99]**

(a) Greater than the final pressure of B

(b) Equal to the final pressure of B

(c) Less than the final pressure of B

(d) Twice the final pressure of B

21. Initial pressure and volume of a gas are P and V respectively. First it is expanded isothermally to volume $4V$ and then compressed adiabatically to volume V. The final pressure of gas will be **[CBSE PMT 1999]**

(a) $1P$ (b) $2P$

(c) $4P$ (d) $8P$

22. A thermally insulated rigid container contains an ideal gas heated by a filament of resistance 100 Ω through a current of 1A for 5 min then change in internal energy is **[IIT-JEE (Screening) 2005]**

(a) 0 kJ (b) 10 kJ
(c) 20 kJ (d) 30 kJ

23. A reversible engine converts one-sixth of the heat input into work. When the temperature of the sink is reduced by 62°C, the efficiency of the engine is doubled. The temperatures of the source and sink are **[CBSE PMT 2000]**

(a) 80°C, 37°C (b) 95°C, 28°C
(c) 90°C, 37°C (d) 99°C, 37°C

24. An engineer claims to have made an engine delivering 10 kW power with fuel consumption of 1 g/sec. The calorific value of the fuel is 2 $kcal/g$. Is the claim of the engineer **[J & K CET 2000]**

(a) Valid
(b) Invalid
(c) Depends on engine design
(d) Depends of the load

25. Find the change in the entropy in the following process 100 gm of ice at 0°C melts when dropped in a bucket of water at 50°C (Assume temperature of water does not change) **[BHU (Med.) 2000]**

(a) – 4.5 cal/K (b) + 4.5 cal/K
(c) +5.4 cal/K (d) – 5.4 cal/K

26. An ideal gas expands in such a manner that its pressure and volume can be related by equation $PV^2 =$ constant. During this process, the gas is **[UPSEAT 2002]**

(a) Heated
(b) Cooled
(c) Neither heated nor cooled
(d) First heated and then cooled

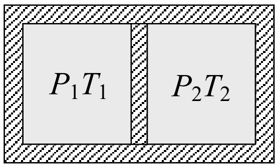
27. A Carnot engine whose low temperature reservoir is at 7°C has an efficiency of 50%. It is desired to increase the efficiency to 70%. By how many degrees should the temperature of the high temperature reservoir be increased **[UPSEAT 2005]**

(a) 840 K (b) 280 K
(c) 560 K (d) 380 K

28. P-V diagram of a diatomic gas is a straight line passing through origin. The molar heat capacity of the gas in the process will be

(a) 4 R (b) 2.5 R
(c) 3 R (d) $\frac{4R}{3}$

29. Following figure shows on adiabatic cylindrical container of volume V_0 divided by an adiabatic smooth piston (area of cross-section = A) in two equal parts. An ideal gas $(C_P / C_V = \gamma)$ is at pressure P_1 and temperature T_1 in left part and gas at pressure P_2 and temperature T_2 in right part. The piston is slowly displaced and released at a position where it can stay in equilibrium. The final pressure of the two parts will be (Suppose x = displacement of the piston)



(a) P_2 (b) P_1
(c) $\frac{P_1\left(\frac{V_0}{2}\right)^\gamma}{\left(\frac{V_0}{2}+Ax\right)^\gamma}$ (d) $\frac{P_2\left(\frac{V_0}{2}\right)^\gamma}{\left(\frac{V_0}{2}+Ax\right)^\gamma}$

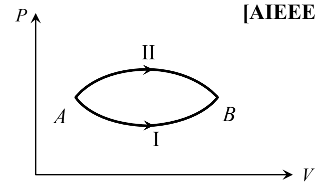
30. Two cylinders A and B fitted with pistons contain equal amounts of an ideal diatomic gas at 300 K. The piston of A is free to move while that of B is held fixed. The same amount of heat is given to the gas in each cylinder. If the rise in temperature of the gas in A is 30 K, then the rise in temperature of the gas in B is **[IIT 1998]**

(a) 30 K (b) 18 K
(c) 50 K (d) 42 K

GQ Graphical Questions

1. A system goes from A to B via two processes I and II as shown in figure. If ΔU_1 and ΔU_2 are the changes in internal energies in the processes I and II respectively, then

[AIEEE 2005]



(a) $\Delta U_{II} > \Delta U_I$

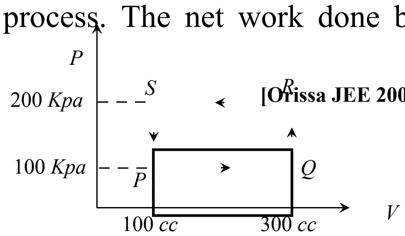
(b) $\Delta U_{II} < \Delta U_I$

(c) $\Delta U_I = \Delta U_{II}$

(d) Relation between ΔU_I and ΔU_{II} can not be determined

2. A thermodynamic system is taken through the cycle $PQRSP$ process. The net work done by the system is

[Orissa JEE 2002]



(a) 20 J

(b) – 20 J

(c) 400 J

(d) – 374 J