NeetPreparation

Thermodynamics Important Questions With Answers

NEET Physics 2023

1. An ideal gas with pressure P, volume V and temperature T is expanded isothermally to a volume 2V and a final pressure P_I. The same gas is expanded adiabatically to a volume 2V, the final pressure is PA . In terms of the ratio of the two specific heats for the gas y. the ratio P_I/P_A is:
   a) $2^{\gamma-1}$ b) 1/γ c) 2γ d) 2γ
2. In an adiabatic expansion of a gas, the product of pressure and volume:
   a) increases **b) decreases** c) remains unchanged d) changes erratically

   Solution : -
   In an adiabatic expansion of a gas, temperature of the gas decreases.
   Now, $P_FV_F-P_IV_I=\mu R(T_F-T_I)$
   As $T_F < T_I$, hence $P_FV_F < P_IV_I$
3. The work done W, during an isothermal process in which the gas expands from an initial volume V_1 to a final volume V_2 is given by: (R is gas constant, T is temperature)
   a) RT $\log_e\left(\frac{V_2}{V_1}\right)$ b) 2RT $\log_e\left(\frac{V_1}{V_2}\right)$ c) $R(V_2-V_1)\log_e\left(\frac{T_1}{T_2}\right)$ d) $R(T_2-T_1)\log_e\left(\frac{V_2}{V_1}\right)$
4. If an average person jogs, he produces 14.5 x 10^4 cal min^{-1}. This is removed by the evaporation of sweat. The amount of sweat evaporated per minute (assuming 1 kg requires 580 x 10^3 cal for evaporation) is
   a) 0.25 kg b) 2.25 kg c) 0.05 kg d) 0.20 kg

   Solution : -
   $=\frac{Amount\ of\ sweat\ evaporated\ per\ mintute\ calories\ produced\ per\ mintute}{no.\ of\ calories\ required\ for\ evaporation\ per\ kg}$
   $=\frac{14.5\times10^4}{580\times10^3}$=0.25 kg
5. The efficiency of a Carnot engine working between 800 K and 500 K is:
   a) 0.625 **b) 0.375** c) 0.4 d) 0.5
6. (A) First law of thermodynamics allows many processes which actually don't happen.
   (R) First law of thermodynamics must not be violated for any process to happen.
   a) If both assertion and reason are true and reason is the correct explanation of assertion
   b) If both assertion and reason are true but reason is not the correct explanation of assertion
   c) If assertion is true but reason is false d) If both assertion and reason are false
   e) If assertion is false but reason is true
7. A gas under constant pressure of 4.5 x 10^5 Pa when subjected to 800 kJ of heat, changes the volume from 0.5 m^3 to 2.0 m^3. The change in internal energy of the gas is:
   a) 6.75 x 10^5 J b) 5.25 x 10^5 J c) 3.25 x 10^5 J **d) 1.25 x 10^5 J**

   Solution : -

$P = 4.5 \times 10^5$ Pa; dQ = 800 kJ
$V_1 = 0.5\ m^3$; $V_2 = 2\ m^3$
$dW = P(V_2 - V_1) = 4.5 \times 10^5\ (2-0.5) = 6.75 \times 10^5$ J
Change in internal energy,
dU = dQ-dW
$= 800 \times 10^3 - 6.75 \times 10^5 = 1.25 \times 10^5$ J.

8. Amonoatomic gas at a pressure P, having a volume V expands isothermally to a volume 2 V and then adiabatically to a volume 16 V. The final pressure of the gas is (take γ =5/3)

a) 64 P b) 32 P **c) P/64** d) 16 P

Solution : -
For Isothermal Expansion
$PV = P_2 \times 2V \Rightarrow P_2 = P/2$
For Adiabatic Expansion
$P_2 \times V_2 = P_3 \times V_3$
$P/2\ (2V)^{5/3} = P_3\ (16V)^{5/3}$
$P_3 = \frac{P}{2} \times \left(\frac{2V}{16V}\right)^{\frac{5}{3}} = (P/2) \times (1/8)^{5/3}$
=P/64

9. A given quantity of an ideal gas is at pressure P and absolute temperature T. The isothermal bulk modulus of the gas is:

a) $\frac{2}{3}$P **b) P** c) $\frac{3}{2}$P d) 2P

10. In a heat engine, the temperature of the source and sink are 500 K and 375 K. If the engine consumes 25×10^5 J per cycle, the work done per cycle is:

a) 6.25×10^5 J b) 3×10^5 J c) 2.19×10^5 J d) 4×10^4 J

Solution : -
Here, T_1 = 500 K, Tz = 375 K, $Q_1 = 25 \times 10^5$ J
$\therefore \eta = 1 - \frac{T_2}{T_1} = 1 - \frac{375}{500}$ = 0.25 = 25%
W = η, $Q_1 = 0.25 \times 25 \times 10^5 = 6.25 \times 10^5$ J

11. The radiant energy from the sun, incident normally at the surface of earth is $20 \mathrm{kcal/m^2\ min}$. What would have been the radiant energy, incident normally on the earth, if the sun had a temperature, twice of the present one?

a) $160 \mathrm{kcal/m^2\ min}$ b) $40 \mathrm{kcal/m^2\ min}$ **c)** $320 \mathrm{kcal/m^2\ min}$ d) $80 \mathrm{kcal/m^2\ min}$

Solution : -
Concept Apply Stefan's law
According to Stefan's law, the rate at which an object radiates energy is proportional to the fourth power of its absolute temperature, i.e.,
$E = \mathrm{s}T^4 \text{ or } E \mu T^4 (\text{ s = Stefan's constant })$
so for two different cases, $\frac{E_1}{E_2} = \left(\frac{T_1}{T_2}\right)^4$
Given, $T_1 = T, T_2 = 2T, E_1 = 20 \mathrm{kcal/m^2\ min}$
$\therefore \quad \frac{20}{E_2} = \left(\frac{T}{2T}\right)^4$ or $\frac{20}{E_2} = \frac{1}{16}$
$\therefore E_2 = 20 \times 16 = 320 \mathrm{kcal/m^2\ min}$

12. An ideal gas at 21°C is compressed adiabatically to $\frac{8}{27}$ of its original volume. The rise in temperature is $\left(\gamma = \frac{5}{3}\right)$

a) 475°C b) 402°C c) 275°C **d) 375°C**

Solution : -

In an adiabatic process
P = pressure
V = volume
g = atomicity of gas
$p^{V'} = \text{ constant } \quad \ldots \text{ (i)}$
Now from ideal gas equation,
$pV = RT$ (for one mole)
or
$p = \frac{RT}{V} =$
(R = gas constant)
From Eqs. (i) and (ii), we have
$\left(\frac{RT}{V}\right) V^{\gamma} = \text{ constant}$
$TV^{3-1} = \text{ constant}$
So for two different cases of temperature and volume
So, $T_1 V_1^{-1} - T_2 V_2^{\gamma-1}$
or $\frac{T_2}{T_1} = \left(\frac{V_1}{V_2}\right)^{\gamma-1}$ ......(iv)
Given, $T_1 = 27^{\circ}\mathrm{C}$
$= 27 + 273 = 300\ \mathrm{K}$
Given, $\frac{V_2}{V_1} = \frac{8}{27}, \gamma = \frac{5}{3}$
Substituting in Eq. (i), we get
$\frac{T_2}{300} = \left(\frac{27}{8}\right)^{5/3-1}$
or $\frac{T_2}{300} = \left[\left(\frac{3}{2}\right)^3\right]^{2/3}$ or $\frac{T_2}{300} = \left(\frac{3}{2}\right)^2 = \frac{9}{4}$
$\therefore T_2 = \frac{9}{4} \times 300 = 675\ \mathrm{K} = 402^{\circ}\mathrm{C}$
Thus, rise in temperature
$= T_2 - T_1 = 402 - 27 - 375^{\circ}\mathrm{C}$

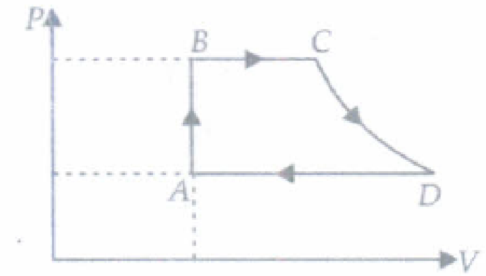
13. If 2 moles of an ideal monatomic gas at temperature T_0 is mixed with 4 moles of another idea! monoatomic gas at temperature $2T_0$, then the temperature of the mixture is:
a) $\frac{5}{3}T_0$ b) $\frac{3}{2}T_0$ c) $\frac{4}{3}T_0$ d) $\frac{5}{4}T_0$

Solution : -
Let T be the temperature of the mixture.
Then, $U=U_1+U_2$
or $\frac{f}{2}(n_1+n_2)RT=\frac{f}{2}(n_1)(R)(T_0)+\frac{f}{2}(n_2)(R)(2T_0)$
or $(2+4)T=2T_0+8T_0$ $(\because n_1=2, n_2=4)$
$\therefore T=\frac{5}{3}T_0$

14. Two rigid boxes containing different ideal gases are placed on a table. Box A contains one mole of nitrogen at temperature T_0, while box B contains one mole of helium at temperature (7/3)T_0. The boxes are then put into thermal contact with each other and heat flows between them until the gases reach a common final temperature (Ignore the heat capacity of.boxes). Then, the final temperature of the gases T_f in terms of T_0 is:
a) $T_f=\frac{5}{2}T_0$ b) $T_f=\frac{3}{7}T_0$ c) $T_f=\frac{7}{3}T_0$ **d) $T_f=\frac{3}{2}T_0$**

Solution : -
$\Delta U=0$
or $\frac{5}{2}R(T_f-T_0)+1 \times \frac{3}{2}R(T_f-\frac{7}{3}T_0)=0$
$\therefore T_f=\frac{3}{2}T_0$.

15. A cycle followed by an engine (made of one mole of an ideal gas in a cylinder with a piston) is shown in figure. The heat exchanged by the engine with the surroundings at constant volume is (Take C_v = 3/2R)



a) $(P_B - P_A) V_A$ b) $\frac{1}{2}(P_B - P_A) V_A$ **c)** $\frac{3}{2}(P_B - P_A) V_A$ d) $\frac{5}{2}(P_B - P_A) V_A$

Solution : -

In the given figure, portion AB of the cycle shows increase in pressure/temperature of gas at constant volume. Therefore system gains heat from the surroundings, then

$Q_{AB} = U_{AB} = nC_V \Delta T$

$Q_{AB} = 1 \times C_V \times \Delta T = \frac{3}{2} - R(T_B - T_A) = \frac{3}{2}(P_B V_B - P_A V_A)$

$Q_{AB} = \frac{3}{2}(P_B - P_A) V_A \quad (V_A = V_B)$

16. When an ideal diatomic gas (γ = l.4) is heated at constant pressure, what is the fraction (approximate) of the heat energy supplied which increases the internal energy of the gas?

a) 0.2 b) 0.3 c) 0.5 **d) 0.7**

Solution : -

Fraction of heat energy supplied which increases internal energy of gas, will be given as below

f = Requr.re d fraction=$\frac{mC_v dT}{mC_p dT} = \frac{C_v}{C_p}$

Since, C_p/C_v=$\frac{14}{10}$=1.4

Hence, f=$\frac{C_v}{C_p} = \frac{1}{1.4}$=0.7

17. If two bodies at different temperature T_1 and T_2 are brought in thermal contact, the mean temperature is $\frac{T_1+T_2}{2}$, when:

a) mass of two bodies are equal b) pressure on two bodies are equal

c) thermal capacities of two bodies are equal d) volume of two bodies are equal

Solution : -

It is a question based on concept.

18. Two moles of an ideal monoatomic gas occupy a volume 2V at temperature 300 K, it expands to a volume 4V adiabatically, then the final temperature of gas is

a) 179K **b) 189 K** c) 199 K d) 219 K

Solution : -

Since in an adiabatic process $T_1 V_1^{\gamma-1}$=$T_2 V_2^{\gamma-1}$

T_2=$T_1\left(\frac{V_1}{V_2}\right)^{\gamma-1}$=$300\left(\frac{2V}{4V}\right)^{\left(\frac{5}{3}-1\right)}$

[∴V_1 = 2V and V_2 = 4 V for monatomic gas γ = 5/3]

=$300\left(\frac{1}{2}\right)^{2/3} = \frac{300}{2^{2/3}}$=188.98≈189 K

19. While boiling 1 gm of water at pressure 1.013 x 10^5 N/m^3 , its volume becomes 1471cm^3 from 1 cm^3;then work done by the system is:

a) 148.911 J b) 150 J c) 130.24 J d) 120.57 J

Solution : -

At constant pressure:
Work, W =PΔV
= 1. 013 x 10^5 x 1470 x 10^{-6} = 148.911 J.

20. A monatomic gas is compressed adiabatically to 1/4 th of its original volume, the final pressure of gas in terms of initial pressure P is:
a) 7.08 P b) 8.08 P c) 9.08 P **d) 10.08 P**

Solution : -
The initial pressure and volume of gas are P and V. Now the gas is compressed adiabatically to 1/4th of its original volume, i.e
$V_2 = \frac{V}{4}$
As $P_1 V_1^y = P_2 V_2^y$
or $PV^y = P_2 \left(\frac{V}{4}\right)^y = \frac{P_2 V^y}{4_y}$
$P_2 = 4^y P$

21. The molar specific heat at constant pressure of an ideal gas is (7/2)R. The ratio of specific heat at constant pressure to that at constant volume is:
a) 9/7 **b) 7/5** c) 8/7 d) 5/7

Solution : -
Molar specific heat at constant pressure:
$C_p = \frac{7R}{2}$
Since, $C_p - C_v = R$
or $C_v = C_p - R = \frac{7R}{2} - R = \frac{5R}{2}$
$\therefore \frac{C_p}{C_v} = \frac{(7/2)R}{(5/2)R} = \frac{7}{5}.$

22. Which of the following is not thermodynamical function:
a) Enthalpy **b) Work done** c) Gibb's energy d) Internal energy

Solution : -
Gibbs energy (G) is most useful thermodynamic function of state used when temperature, pressure, and composition of a system are controlled. Internal energy (U) is thermodynamic function of state used when entropy, volume, and composition of system are controlled.
Enthalpy (H) is thermodynamic function of state used when entropy, pressure, and composition of system are controlled and will be in equilibrium when its content of enthalpy reaches minimum value.

23. If in an isothermal process, the volume of an ideal gas is halved, then we can say that:
a) internal energy of the system decreases b) internal energy of the system increases
c) work done by the gas is negative d) work done by the gas is positive

24. Which is not dependent on path?
a) Temperature b) Energy c) Work d) None of these

25. Compressed air in the tube of a wheel of a cycle at normal temperature suddenly starts coming out from a puncture. The air inside:
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.

Solution : -
Compressed air in tube of wheel of cycle normal temperature suddenly starts coming ou from a puncture where air inside the tube becoming cooler which happens as due to lowering of pressure, the temperature inside the tube will fall.

26. One mole of an ideal gas at temperature T_1 expands according to the law (P/V)= constant. Find the work done when the final temperature becomes T_2.

a) $R(T_2-T_1)$ **b) $(R/2)(T_2-T_1)$** c) $(R/4)(T_2-T_1)$ d) $PV(T_2-T_1)$

Solution : -

$W=\int_{V_1}^{V_2} PdV = \int_{V_1}^{V_2} KVdV$ ($\because \frac{P}{V}$ = K= constant)

$\therefore W = \frac{1}{2}K(V_2^2 - V_1^2)$

PV = RT

But P = KV

$\therefore KV^2 = RT$

or $K(v_2^2 - v_1^2) = R(T_2-T_1)$

$\therefore W = \frac{R}{2}(T_2 - T_1)$

27. In the adiabatic compression, the decrease in volume is associated with:

a) increase in temperature and decrease in pressure b) decrease in temperature and increase in pressure

c) decrease in temperature and decrease in pressure

d) increase in temperature and increase in pressure

Solution : -

In adiabatic compression temperature and hence internal energy of the gas increases. In compression pressure will increase.

28. One mole of an ideal monoatomic gas undergoes a process described by the equation PV^3 = constant. The heat capacity of the gas during the process is:

a) R **b) $\frac{3}{2}$R** c) $\frac{5}{2}$R d) 2R

Solution : -

PV^3 = Constant

For a polytropic process, PV^α = Constant

i.e., $\alpha = 3$

Now, we know that

$C=C_v + \frac{R}{1-\alpha} = \frac{3R}{2} + \frac{R}{1-3} = \frac{3R}{2} - \frac{R}{2}$=R

29. Which of the following engines have 100% efficiency?

a) Auto engine b) Internal combustion engine c) Petrol engine **d) Carnot engine**

30. **Assertion:** A constant volume gas thermometer, reads temperature in terms of pressure.

Reason: In this case a plot of pressure Versus temperature gives a straight line.

a) If both assertion and reason are true and reason is the correct explanation of assertion.

b) If both assertion and reason are true but reason is not the correct explanation of assertion.

c) If assertion is true but reason is false. d) If both assertion and reason are false

Solution : -

$PV \propto T$ A gas is used to measure temperature in a constant volume gas thermometer. P oc T (V constant), therefore, a constant volume gas thermometer reads temperature in terms of pressure. A plot of pressure versus temperature gives a straight line.

31. The internal energy change in a system that has absorbed 2 kcals of heat and done 500 J of work is :

a) 6400 J b) 5400 J **c) 7900 J** d) 8900 J

Solution : -

When a quantity Q of heat is supplied to a system it is used to do an amount of work W by the system and to increase the internal energy of the system by Δu:

$Q=\Delta u + W$

Here, Q given in kilo calories is converted into joule.
Therefore Q = 2 x 1000 x 4.2 J = 8400 J
The increase the internal energy,
Δu = Q - W = 8400 - 500 = 7900 J

32. If c_s be the velocity of sound in air and c be the rms velocity, then:
a) C_s b) $c_S = c$ **c)** $c_S = c\left(\frac{\gamma}{3}\right)^{1/2}$ d) None of these

Solution : -
Velocity of sound (c_s) is given by
$c_s = \sqrt{\frac{\gamma P}{\rho}} \ldots \text{(i)}$
where, p is pressurc, s is density and g is atomicity of gas or ratio of C_p and $C_{v'}$
RMS velocity of gas molecules is given by
$c = \sqrt{\left(\frac{3p}{\rho}\right)} \ldots \text{(ii)}$
From Eqs, (i) and (ii)
$\frac{c_3}{c} = \sqrt{\frac{\gamma p}{\rho} \times \frac{\rho}{3p}} = \sqrt{\frac{\gamma}{3}}$
$\Rightarrow \quad c_s = c \times \sqrt{\left(\frac{\gamma}{3}\right)}$

33. If one mole of a monoatomic gas γ =5/3 is mixed with one mole ofa diatomic gas γ =7/5, what is the value ofy for the mixture?
a) 1.5 b) 1.53 c) 1.60 d) 1.52

Solution : -
$\gamma = \left(\frac{C_p}{C_v}\right)_{average}$
For MA gas: $C_V = \frac{3R}{2}$
For DA gas: $C_V = \frac{5R}{2}$
$\therefore (C_V)_{av} = \frac{\frac{3R}{2} + \frac{5R}{2}}{2}$ =2R
Also, $(C_p)_{av} = (C_v)_{av} + R = 3R$
$\gamma = \left(\frac{C_p}{C_v}\right)_{average} = \frac{3R}{2R}$ =1.5

34. Carnot engine is
a) reversible engine
b) operating between two temperatures T_1 (source) and T_2 (sink) have maximum efficiency
c) consisting of two isothermal processes connected by two adiabatic processes **d) all of these**

35. Which of the following is incorrect regarding the first law of thermodynamics?
a) It introduces the concept of the internal energy **b) It introduces the concept of entropy**
c) It is applicable to any cyclic process d) It is a restatement of the principle of conservation of energy

Solution : -
Statement (b) is incorrect. Concept of entropy is associated with second law of thermodynamics.

36. Check the correct statement.
a) Internal energy is a path function, while heat is not **b) Heat is path function, while internal energy is not**
c) Both heat and internal energy are path functions d) Both heat and internal energy are not path functions

37. Which of the following relations is correct between pressure and temperature?
a) $\mathbf{P^{1-\gamma}T^{\gamma}}$ b) $P^{\gamma}T^{\gamma}$ c) $P^{\gamma}T^{1-\gamma}$ d) $P^{\gamma}T^{\gamma-1}$

38. (A) All processes in which P and V are proportional, take place at constant temperature.
(R) Work done in a thermodynamical process is path independent.
a) If both assertion and reason are true and reason is the correct explanation of assertion
b) If both assertion and reason are true but reason is not the correct explanation of assertion
c) If assertion is true but reason is false **d) If both assertion and reason are false**
e) If assertion is false but reason is true

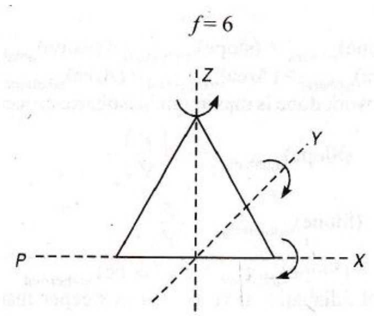
39. A black body is at temperature of 500 K. It emits energy at rate which is proportional to:
a) $(500)^4$ b) $(500)^3$ c) $(500)^2$ d) 500

Solution : -
According to Stefan's law, energy emitted

$$E\mu T^4$$
$$E = \mathrm{s}T^4 = (\mathrm{s} = \text{ Stefan's conśtant })$$
$$\therefore \quad E\mu(500)^4$$

40. The degrees of freedom of a molecule of a triatomic gas are:
a) 2 b) 4 **c) 6** d) 8

Solution : -
The molecule of a triatomic gas has a tendency of rotating about any of three coordinate axes. So, it has 6 degrees of freedom, 3 translational and 3 rotational. At high enough temperature a triatomic molecule has 2 vibrational degree of freedom. But as temperature requirement is not given, so we answer simply by assuming triatomic gas molecule at room temperature.
Thus,



(3 translational + 3 rotational) at roorn temperature.

41. A polyatomic gas with n degrees of freedom has a mean kinetic energy per molecule given by:
a) $\frac{nKT}{N}$ b) $\frac{nKT}{2N}$ **c)** $\frac{nKT}{2}$ d) $\frac{3KT}{2}$

42. A Carnot engine with sink's temperature at 17°C has 50% efficiency. By how much should its source temperature be changed to increase its efficiency to 60%?
a) 225 K b) 128^0C c) 580 K **d) 145 K** e) 145^0C

Solution : -
$\eta=1-\frac{T_2}{T_1}$
Initially, $\frac{50}{100}=1-\frac{273+17}{T_1}$
or $\frac{290}{T_1}=\frac{1}{2}$ or T_1=580 K
Finally, $\frac{60}{100}=1-\frac{273+17}{T_1}$ or $\frac{290}{T_1'}=\frac{2}{5}$ or T_1'=725 K
∴ Change in source temperature = (725 - 580) K = 145 K

43. The efficiency of the reversible heat engine is η_r and that of irreversible heat engine is η_I. Which of the following relations is/are correct?
a) $\eta_r > \eta_I$ b) $\eta_r < \eta_I$ c) $\eta_r = \eta_I$ d) $\eta_r > 1$ and $\eta_I < 1$

Solution : -

The efficiency of reversible engine is always greater than that of irreversible engine. In case of irreversible engine, a part of the energy may be dissipated against friction, etc.

44. I gm of an ideal gas expands isothermally, heat flow will be:

a) from the gas to outside atmosphere **b) from outside atmosphere to gas** c) zero d) both (a) and (b)

45. In which process will the internal energy of the gas increase?

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

46. The number of translational degree of freedom for a diatomic gas is:

a) 2 **b) 3** c) 5 d) 6

Solution : -

Number of degree of freedom of a dynamical system is obtained by subtracting the number of independent relations from the total number of coordinates required to specify the positions of constituent particles of the system.

If A= number of particles in the system.

R= number of independent relations among the particles.

N= number of degree of freedom of the system, then N=3 A-R

Each monoatomic, diatomic and triatomic gas has three translatory degree of freedom.

47. A thermodynamical system goes from state

(i) P_1,V to $2P_1$V (ii) P_1,V to P_1, 2V then the work done in the two cases is:

a) (i) zero (ii) zero **b) (i) zero (ii) P_1V** c) (i) P_1V (ii) zero d) (i) P_1V (ii) P_1V

48. (A) If heat is supplied to an ideal gas in an isothermal process, the internal energy of the gas increases.

(R) When an ideal gas expands adiabatically, it does positive work and its internal energy increases.

a) If both assertion and reason are true and reason is the correct explanation of assertion

b) If both assertion and reason are true but reason is not the correct explanation of assertion

c) If assertion is true but reason is false **d) If both assertion and reason are false**

e) If assertion is false but reason is true

49. The possibility of increase in the temperature of a gas without adding heat to it happens in

a) adiabatic expansion b) isothermal expansion **c) adiabatic compression** d) isothermal compression

Solution : -

In adiabatic process

$dQ = 0 \Rightarrow dU+dW=0$ or $dU=-dW$

In the process of compression, work is done on the gas therefore dW is negative. Hence dU is positive i.e. internal energy of gas increases and therefore temperature of the gas also increases.

50. (A) In isothermal process whole of the heat energy supplied to a system is converted into work.

(R) According to first law of thermodynamics $Q=W+\Delta U$

a) If both assertion and reason are true and reason is the correct explanation of assertion

b) If both assertion and reason are true but reason is not the correct explanation of assertion

c) If assertion is true but reason is false d) If both assertion and reason are false

e) If assertion is false but reason is true