CHEMISTRY

BOOKS - P BAHADUR CHEMISTRY (HINGLISH)

THERMODYNAMICS

Exercise

1. During $200J$ work done on the system, $140J$ of heat is given out. Calculate the change in internal energy.

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2. A system does $40J$ work on surrounding as well as gives out $20J$ energy. Calculate the change in internal energy.

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3. A system does $100J$ work on surroundings gy absorbing $150J$ of heat. Calculate the change in internal energy.

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4. A gas absorbs $200J$ of heat and expands against the external pressure of $1.5atm$ from a volume of 0.5 litre to 1.0 litre. Calculate the change in internal energy.

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5. Calculate the work done during the process, when one mole of gas is allowed to expand freely into vacuum.

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6. Two liters of N_2 at $0^\circ C$ and 5 atm pressure is expanded isothermally against a constant external pressure of 1 atm untill the pressure of gas reaches 1 atm. Assuming gas to be ideal, claculate the work of expansion.

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7. The internal energy change in the conversion of 1.0 mole of the calcite form of $CaCO_3$ to the aragonite form is $+0.21KJ$. Calculate the enthalpy change when the pressure is 1.0bar, given the densities of the solids are $2.71gcm^{-3}$ and $2.93gcm^{-3}$ respectively.

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8. Calculate the work done in an open vessel at $300K$, when $112g$ ion reacts with dil. HCl.

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9. A sample of 0.20 mole of a gas at $44^{\circ} C$ and $1.5 atm$ pressure is cooled to $27^{\circ} C$ and compressed to $3.0 atm$. Calculate ΔV. Suppose the original sample of gas was heated at constant volume until its pressure was $3.0 atm$ and then cooled at $27^{\circ} C$, what would have been ΔV?

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10. Consider the reaction $N_2 + 3H_2 \rightarrow 2NH_3$, taking place at $300K$ temperature and constant pressure. For the reaction, $\Delta H = -22.0 kcal$. Calculate the amount of heat released if the reaction is carried out at $400K$ and same constant pressure. Given that: $C_{p(N_2)} = C_{p(H_2)} = 3.5R, C_{p(NH_3)} = 4R$

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11. A sample of argon gas at $1atm$ pressure and $27^{\circ}C$ expands reversibly and adiabatically from $1.25dm^3$ to $2.5dm^3$. Calculate the enthalpy change in the process. Given that $C_{v(m)}$ for Ar is $12.45JK^{-1}mol^{-1}$ and antilog $(0.199) = 1.58.$

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12. One mole of an ideal gas is heated at constant pressure from $0^{\circ}C$ to $100^{\circ}C$.

a. Calculate the work done.

b. If the gas were expanded isothermally and reversibly at $0^{\circ}C$ from $1atm$ to some othe pressure P, what must be the final pressure if the maixmum work is equal to the work in (a)?

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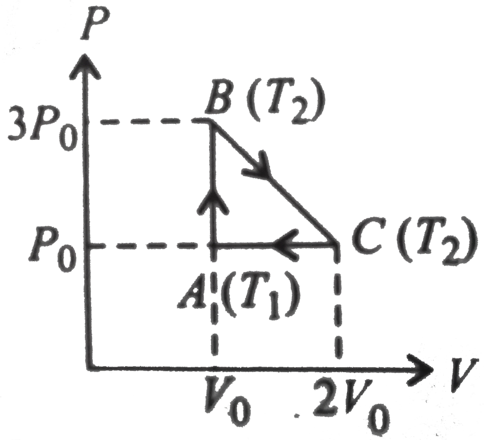
13. One mole of an ideal mono-atomic gas is taken round cyclic process $ABCD$ as shown in figure below. Calculate



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14. Derive a relation showing reversible work of expansion from volume V_1 to V_2 by 'n' moles of a real gas obeying van der waal's equation at temperature T where volume occupied by molecules may be taken as negligible in comparison to total volume of gas.

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15. What work is to be done on 2 mole of a perfect gas at $27^{\circ} C$ if it is compressed reversibly and isothermally from a pressure of $1.01 \times 10^5 Nm^{-2}$ to $5.05 \times 10^6 Nm^{-2}$? Also calculate the free energy change.

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16. Calculate the maximum work done in expanding $16g$ of oxygen at $300K$ occupying volume of $5dm^3$ and isothermally untill the volume become $25dm^3$?

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17. Calculate$q, W, \Delta U$ and ΔH for the isothermal reversible expansion of one mole of an ideal gas from an initial pressure of 1.0 bar to a final pressure of 0.1 bar at a constant temperature of $273K$.

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18. Calculate the change of entropy, $\Delta_r S^{\Theta}$ at $298K$ for the reaction in which urea is formed from NH_3 and CO_2.

$2NH_3(g) + CO_2(g) \rightarrow NH_2CONH_2(aq) + H_2O(l)$

The standard entropies $\left(JK^{-1}mol^{-1}\right)$ are:

$NH_2CONH_2(aq) = 174.0, H_2O(l) = 69.9$

$NH_3(g) = 192.3, CO_2(g) = 213.7$

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19. The enthalpy of vaporisation of liquid diethly ether $-(C_2H_5)_2O$, is $26.0kJmol(-1)$ at its boiling point $(35.0^{\circ}C)$. Calculate ΔS for conversion of : (a) liquid to vapour, and (b) vapour to liquid at $35^{\circ}C$.

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20. Ethanol boils at $78.4^\circ C$ and the enthalpy of vaporisation of ethanol is $42.4kJmol^{-1}$. Calculate the entropy of vaporisation of ethanol.

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21. Calculate the entropy change for the conservation of following: (a) $1g$ ice to water at $273K, \Delta H_f$ for $ice = 6.025kJmol^{-1}$. (b) $36g$ water to vapour at $373K, \Delta H_v$for $H_2O = 40.63kJmol(- 1)$

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22. Given S° for $C_{\text{Graphite}}, H_{2(g)}$ and $CH_{4(g)}$ are $5.70, 130.7$ and $186.3 JK^{-1}mol^{-1}$. Also standard heat of formation of CH_4 is $-74.81 kJmol^{-1}$. Calculate the standard Gibbs energy change for the formation of methane at $298K$.

$C_{\text{Graphite}} + 2H_{2(g)} \rightarrow CH_{4(g)}$

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23. In a fuel cell, methanol if used as fuel and oxygen gas is used as an oxidiser. The reaction is

$$CH_3OH(l) + \frac{3}{2}O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$$

Calculated standard Gibbs free enegry change for the reaction that can be converted into electircal work. If standard enthalpy of combustion for methanol is $-702kJmol^{-1}$, calculate the efficiency of converstion of Gibbs energy into useful work.

$\Delta_f G^{\Theta}$ for CO_2, H_2O, CH_3OH, O_2 is $-394.00, \ -237.00, \ -166.00$and $0kJmol^{-1}$ respectively.

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24. For the water gas reaction:

$C(s) + H_2O(g) \Leftrightarrow CO(g) + H_2(g)$

the standard Gibbs enegry for the reaction at $1000K$ is $-8.1kJmol^{-1}$. Calculate its equilibrium constant.

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25. The standard Gibbs free energies for the reaction at $1773K$ are given below:

$C(s)+O_2(g)\rightarrow CO_2(g), \Delta G^{\ominus} = -380kJmol^{-1}$

$2C(s)+O_2(g)\Leftrightarrow 2CO(g), \Delta G^{\ominus} = -500kJmol^{-1}$

Discuss the possibility of reducing AI_2O_3 and PbO with carbon at this temperature,

$4AI+3O_2(g)\rightarrow 2AI_2O_3(s), \Delta G^{\ominus} = -22500kJmol^{-1}$

$2Pb+O_2(g)\rightarrow 2PbO(s), \Delta G^{\ominus} = -120kJmol^{-1}$

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26. Predict whether it is possible or not to reduce magnesium oxide using carbon at $298K$ according to the reaction.

$MgO(s) + C(s) \to Mg(s) + CO(g)$

$\Delta_r H^{\Theta} = +491.18 kJ mol^{-1}$ and

$\Delta_r S^{\Theta} = 197.67 J K^{-1} mol^{-1}$

If not at what temperature, the reaction becomes spontaneous.

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27. Calculate ΔG^{Θ} for the conversion of oxygen to ozone, $\left(\frac{3}{2}\right) O_2(g) \Leftrightarrow O_3(g) at 298 K$, of K_p for this conversion is 2.47×10^{-29}.

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28. Calculate the equilibrium constant K_p for the reaction given below if $\Delta G^\circ = -10.632$ kJ at $300K$.

$CO_{2(g)} + H_{2(g)} \Leftrightarrow CO_{(g)} + H_2O_{(g)}$

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29. Calculate the value of ΔG at $700K$ for the reaction, $nX \rightarrow mB$. Given that value of $\Delta H = -113kJmol^{-1}$ and $\Delta S = -145JK^{-1}mol^{-1}$.

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30. Calculated the Gibbs energy change on dissolving one mole of sodium chloride at $25^\circ C$.

Lattice $= +777.0kJmol^{-1}$

Hydration of $NaCI = -774.0kJmol^{-1}$

ΔS at $25^{\circ}C = 40JK^{-1}mol^{-1}$

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31. Calculate the standard free energy change for the reaction,

$N_{2(g)} + 3H_{2(g)} \rightarrow 2NH_{3(g)} at 298K.$

Given, $\Delta H^{\circ} = -92.4kJ$ and $\Delta S^{\circ} = -198.3JK^{-1}$.

Also, comment on the result.

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32. For reaction, $N_{2(g)} + 3H_{2(g)} \rightarrow 2NH_{3(g)}$, $\Delta H = -95.4kJ$ and $\Delta S = -198.3JK^{-1}$. Calculate the maximum temperature at which the reaction will proceed in forward direction.

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33. The equilibrium constant for the reaction given below is 2.0×10^{-7} at $300K$. Calculate the standard free energy change for the reaction,

$PCl_{5(g)} \Leftrightarrow PCl_{3(g)} + Cl_{2(g)}$.

Also, calculate the standard entropy change if $\Delta H^{\circ} = 28.40kJmol^{-1}$.

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34. Calculate the Gibbs energy change for the reaction given below:

$Zn_{(s)} + Cu^{2+}_{(s)} \rightarrow Cu_{(s)} + Zn^{2+}_{(aq.)}$

Given that standard Gibbs energy (G°) for $Zn^{2+}_{(aq.)}, Cu^{2+}_{(aq.)}$ are $-147.2kJmol^{-1}$ and $65.0kJmol^{-1}$ respectively.

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35. Calculate the boiling point of water at 24 torr pressure. The average $\Delta H_{vap.}$ over the temperature range is $10.12kcalmol^{-1}$. Will all the water form gaseous state if placed in a closed container, if not then, how wer can convert all the water into vapour state?

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36. Calculate $q, W, \Delta U$ and ΔH for the isothermal reversible expansion of one mole of an ideal gas from an initial pressure of 1.0^{-} to a final pressure of 0.1^{-} at a constant temperature of $273K$.

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37. $10g$ of argon gas is compressed isothermally and reversibly at a temperature of $27^{\circ}C$ from $10L$ to $5L$. Calculate $q, w, \Delta U,$ and ΔH for this process. $R = 2.0 calK^{-1}\text{mol}^{-1}, \log_{10} 2 = 0.30$. Atomic weight of $Ar = 40$.

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38. A sample of argon gas at $1 atm$ pressure and $27^{\circ} C$ expands reversibly and adiabatically from $1.25 dm^3$ to $2.50 dm^3$. Calculate the enthalpy change in this process. C_{vm} for orgon is $12.48 JK^{-1} mol^{-1}$.

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39. $1 mol$ of an ideal gas undergoes reversible isothermal expansion form an initial volume V_1 to a final volume $10 V_1$ and does $10 kJ$ of work. The initial pressure was $1 \times 10^7 Pa$.

a. Calculate V_2.

b. If there were $2mol$ of gas, what must its temperature have been?

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40. Two moles of a perfect gas undergo the following process: (a) A reversible isobaric expansion from (1.0 atm, 20.0 litre) to (1.0 atm,40.0litre). (b) A reversible isochoric change of state from (1.0 atm, 40.0 litre) to (1.0 atm, 40.0 litre). (b) A reversible isochoric change of state from (1.0 atm, 40.0 litre) to (0.5 atm, 40.0 litre). (c) A reversible isothermal compression from (0.5atm, 40.0 litre) to (1.0 atm, 20.0 litre). (i) Sketch with labels each of the process on the same $P-V$ diagram. (ii) Calculate the total work (W) and the total heat change (q) involved in the above process. (iii) What will be the value of ΔU, ΔH and ΔS for the overall process?

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41. A gas expands from $3dm^3$ to $5dm^3$ anainst a constant pressure of $3atm$. The work done during the expansion if used to heat $10mol$ of water at temperature $290K$. Find the final temperature of water, if the specific heat of water $= 4.18g^{-1}K^{-1}$.

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42. Show that the reaction

$CO(g) + (1/2)O_2(g) \rightarrow CO_2(g)$

at $300K$ is spontaneous and exothermic, when the standard entropy change is $-0.094kJmol^{-1}K^{-1}$. The standard Gibbs free energies of formation for $CO_2$and CO are $-394.4$and $-137.2kJmol^{-1}$, respectively.

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43. $100mL$ of a liquid is contained in an insulated container at a pressure of 1bar. The pressure is steeply increased to 100bar. The volume of the liquid is decreased by $1mL$ at this constant pressure. Find ΔH and ΔU.

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44. In which of the following cases entropy decreases?

A. Solid changing to liquid

B. Expansion of gas

C. Crystal dissolves

D. Polymerisation

Answer: D

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45. In a reaction ΔG and ΔH both are positive. The reaction would not be spontaneous if :

A. $\Delta H > T\Delta S$

B. $\Delta S = \frac{\Delta H}{T}$

C. $\Delta H = T\Delta S$

D. All of these

Answer: D

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46. Temperature of $1 mol$ of a gas is increased by 1° at constant pressure. The work done is

A. R

B. $2R$

C. $R/2$

D. $3R$

Answer: A

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47. When a gas is subjected to adiabatic expansion, it gets cooled due to :

A. Fall in temperature

B. Loss in kinetic energy

C. Decrease in velocity

D. Energy spent in doing work

Answer: D

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48. During isothermal expansion of an ideal gas, its:

A. Internal energy increase

B. Enthalpy decrease

C. Internal energy and heat enthalpy remains constant

D. Enthalpy reduces to zero

Answer: C

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49. Change in entropy is negative for

A. Bromine$(l) \rightarrow$ Bromine(g)

B. $C(s) + H_2O(g) \rightarrow CO(g) + H_g$

C. $N_2(g, 10atm) N_2(g, 1atm)$

D. $Fe(1mole, 400K) \rightarrow Fe(1mole, 300K)$

Answer: D

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50. The ΔG in the process of melting of ice at $-15^\circ C$ is :

A. $\Delta Gis - ve$

B. $\Delta Gis + ve$

C. $\Delta G = 0$

D. All of these

Answer: B

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51. A boiled egg show a / an...... in entropy.

A. Increase

B. Decrease

C. No change

D. None of these

Answer: A

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52. For the adiabatic expansion of an ideal gas:

A. $PV^{\gamma} = $ constant

B. $TV^{\gamma - 1} = $ constant

C. $T^{\gamma}P^{1-\gamma} = $ constant

D. All of these

Answer: D

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53. The occurrence of a reaction of impossible if

A. ΔH is $+ve, \Delta S$ is also $+ve$

B. $\Delta His - ve, \Delta S$ is also $-ve$

C. ΔH is $-ve$, ΔS is $+ve$

D. ΔH is $+ve$, ΔS is $-ve$

Answer: D

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54. Which statements is correct?

A. $\left(\frac{\delta H}{\delta T}\right)_P = \left(\frac{\delta U}{\delta T}\right)_V = R$

B. $\left(\frac{\delta H}{\delta T}\right)_P > \left(\frac{\delta U}{\delta T}\right)_V$

C. $\left(\frac{\delta U}{\Delta V}\right)_T$ for ideal gas is zero

D. All of these

Answer: D

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55. An ideal gas undergoing expansion in vacuum shows:

A. $\Delta U = -0$

B. $W = 0$

C. $q = 0$

D. All of these

Answer: D

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56. Human body is an example of:

A. Open system

B. Closed system

C. Isolated system

D. None of these

Answer: A

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57. 1 mole of gas occupying 3 litre volume is expanded against a constant external pressure of 1 atm to a volume of 15 litre. The work done by the system is:

A. $1.215 \times 10^3 J$

B. $12.15 \times 10^3 J$

C. $121.5 \times 10^3 J$

D. None of these

Answer: A

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58. The latent heat of vapourisation of a liquid at $500K$ and $1atm$ pressure is $10kcalmol^{-1}$. What will be change in internal energy of $3mol$ of liquid at same temperature?

A. $13.0cal$

B. $-13.0cal$

C. $27.0cal$

D. $-27.0cal$

Answer: C

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59. One mole of ice is converted into water at $273K$. The entropies of $H_2O(s)$ and $H_2O(l)$ are 38.20 and $60.01Jmol^{-1}K^{-1}$ respectively. The enthalpy change for the conversion is:

A. $59.54Jmol^{-1}$

B. $5954Jmol^{-1}$

C. $595.4Jmol^{-1}$

D. $320.6Jmol^{-1}$

Answer: B

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60. A carnot engine operates between temperatures T and $400K(T > 400K)$. If efficiency of engine is 25%, the temperature T is :

A. $400K$

B. $500K$

C. $533.3K$

D. $600K$

Answer: C

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61. The molar heat capacity for a gas at constant T and P is

A. $\frac{3}{2}R$

B. $\frac{5}{2}R$

C. Depends on gas

D. Infinity (∞)

Answer: D

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62. The work done in an open vessel at $300K$, when $112g$ iron reacts with dil. HCL is:

A. $1200cal$

B. $600cal$

C. $300cal$

D. $200cal$

Answer: A

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63. $16g$ oxygen gas expands at STP to occupy double of its oxygen volume. The work done during the process is:

A. $260kcal$

B. $180kcal$

C. $130 kcal$

D. 272.84 kcal

Answer: D

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64. Heat changes measured in a bomb calorimeter are reported in terms of :

A. ΔG

B. ΔH

C. ΔU

D. $P\Delta V$

Answer: C

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65. One mole of a gas in the state $A(P_1, V_1, T_1)$ is subjected to adiabatic expansion to attain state $B(P_2, V_2, T_2)$. The work done by the gas is:

A. $-\dfrac{R(T_1 - T_2)}{\gamma - 1}$

B. $\dfrac{nR(T_2 - T_1)}{\gamma - 1}$

C. $\dfrac{R(T_2 - T_1)}{1 - \gamma}$

D. $\dfrac{P_2V_2 - P_1V_1}{1 - \gamma}$

Answer: A

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66. During an adiabatic process, the pressure of a gas is found to be proportional to cube of its absolute temperature. The poision's ratio of gas is:

A. $3/2$

B. $7/2$

C. $5/3$

D. $9/7$

Answer: A

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67. For a gas having molar mass M, specific heat at constant pressure can be given as:

A. $\frac{\gamma R}{M(\gamma - 1)}$

B. $\frac{\gamma}{RM}$

C. $\frac{M}{R(\gamma - 1)}$

D. $\frac{\gamma RM}{\gamma + 1}$

Answer: A

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68. If $20kJ$ work is done by the water fall per unit volume of water and $30kJ$ heat was lost per unit volume, the energy change per unit volume of water is:

A. $-5kJ$

B. $-50kJ$

C. $10kJ$

D. $+50kJ$

Answer: C

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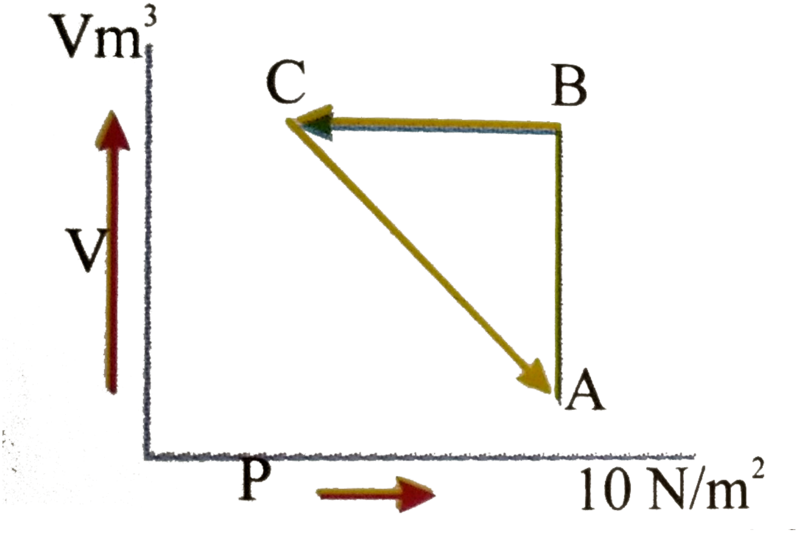
69. An ideal gas is taken through the cycle $A \rightarrow B \rightarrow C \rightarrow A$ As shown in figure. If net heat supplied to the gas in the cycle is 5j. Find the work done by the gas in the process $C \rightarrow A$ in Joule (taken mole value)



A. $-5J$

B. $-10J$

C. $+15J$

D. $-20J$

Answer: A

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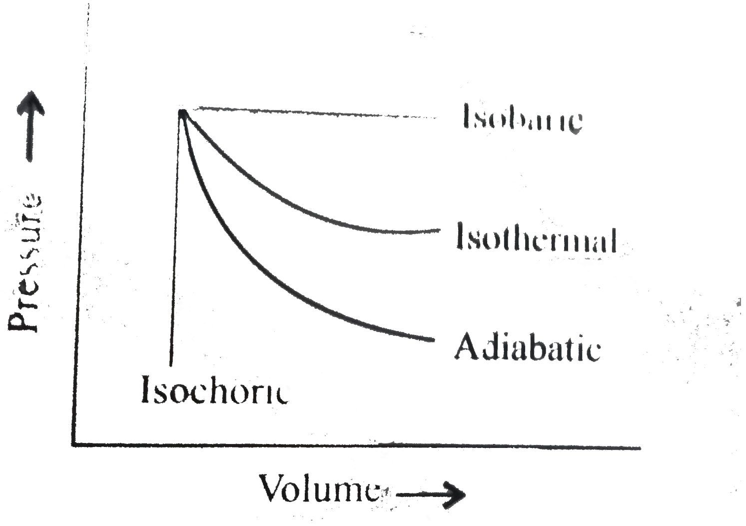
70. The pressure-volume of various thermodynamic process is shown in graphs:



Work is the mole of transference of energy. It has been observed that reversible work done by the system is the maximum obtainable work.

$w_{rev} > w_{irr}$

The works of isothermal and adiabatic processes are different from each other.

$$w_{\text{isothermal reversible}} = 2.303nRT \log_{10}\left(\frac{V_2}{V_1}\right)$$

$$= 2.303nRT\log_{10}\left(\frac{P_2}{P_1}\right)$$

$$w_{\text{adiabatic reversible}} = C_V(T_1 - T_2)$$

If w_1, w_2, w_3 and w_4 are work done in isothermal, adiabatic, isobaric, and isochoric reversible processes, respectively then the correct sequence (for expansion) would be

A. $w_2 > w_1 > w_3$

B. $w_2 > w_3 > w_1$

C. $w_1 > w_2 > w_3$

D. $w_1 > w_3 > w_2$

Answer: D

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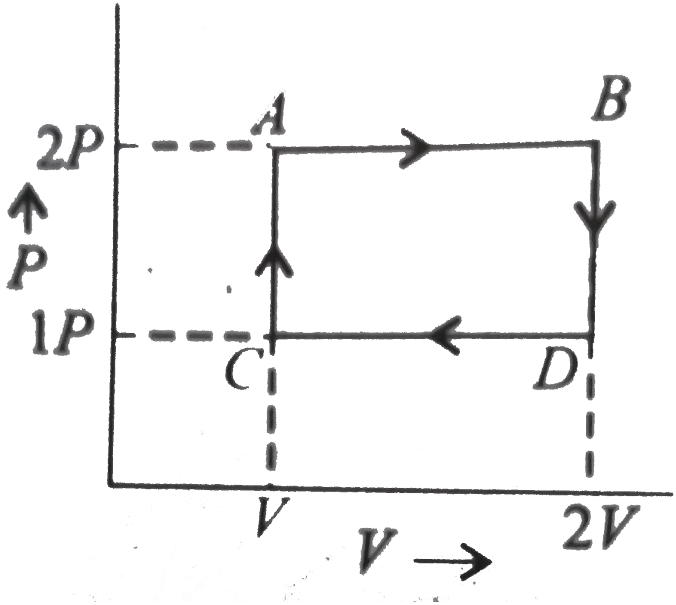
71. An ideal mono-atomic gas follows the path $ABDC$. The work done during the complete cycle is



A. $-PV$

B. $-2PV$

C. $-1/2PV$

D. zero

Answer: A

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72. In a given process on an ideal gas, $dW = 0$ and dQ is negative, then for the gas:

A. The temperature will decrease

B. The volume will increase

C. The pressure will remain constant

D. The temperature will increase

Answer: A

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73. Which of the following pairs of a chemical reaction is certain to result in a spontaneous reaction ?

A. Exothermic and decreasing disorder

B. Endothermic and decresing disorder

C. Exothermic and increasing disorder

D. Endothermic and increasing disorder

Answer: C

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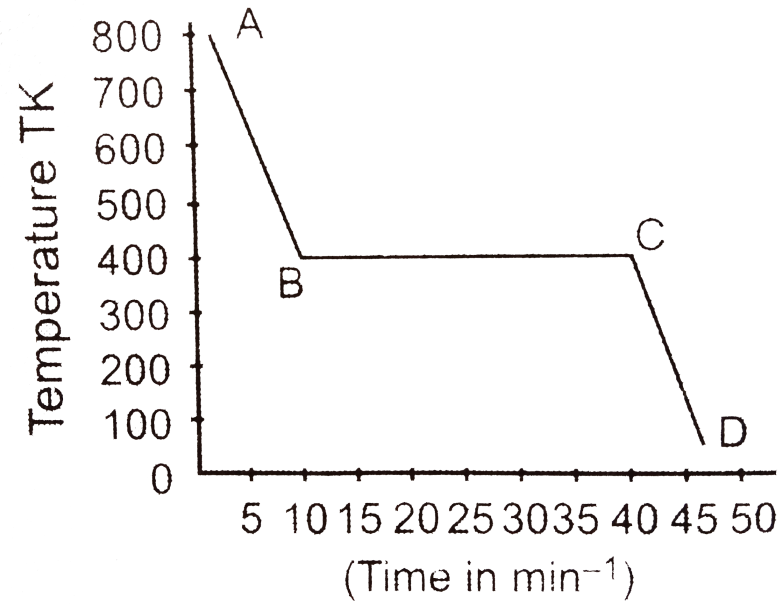
74. One mole of a substance is cooled at the rate of $0.4kJ\min^{-1}$ as shown in the graph. Curve AB, points B

and C and curve CD represent respectively, the cooling of the liquid, start of freezing, completion of freezing and cooling of the solid based on this data. The entropy of fusion in $JmolK^{-1}$ is :



A. 10

B. 20

C. 30

D. 40

Answer: C

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75. If a certain mass of gas is made to undergo separately adiabatic and isothermal expansions to the same pressure, starting form the same initial conditions of temperature and pressure, then, as compared to that of isothermal expansion, in the case of adiabatic expansion, the final

A. Volume and temperature will be higher

B. Volume and temperature will be lower

C. Temperature will be lower but the final volume will be higher

D. Volume will be lower but the final temperature will be higher

Answer: B

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76. If separate samples of argon, methane, nitrogen and ammonia, all at the same initial temperature and pressure and expanded adiabatically to double their original volumes, then which one of these gases will require the greatest quantity of heat to restore the original temperature?

A. Nitrogen

B. Argon

C. Methane

D. Ammonia

Answer: B

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77. The maximum entropy of mixing occurs when hexane and heptane are mixed respectively in the proportion:

A. $8.6g$ and $10.0g$

B. $8.6g$ and $8.6g$

C. $10.0g$ and $8.6g$

D. $10.0g$ and $10.0g$

Answer: A

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78. Select the correct statements about the following reaction:

$Fe + HCL \rightarrow FeCl_2 + H_2$

1. The reaction if carried out in electrochemical cell produces non expansion work

2. The reaction if carried out in a cylinder having piston produces expansion work

3. The current flows from cathode to anode and ΔG° for the reaction is $-ve$

4. The current flows from anode to cathode and ΔG° for the reaction is -ve

A. $1, 2, 3$

B. $1, 2, 4$

C. $1, 3$

D. $2, 4$

Answer: A

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79. Select the correct statements for ideal gases:

1. $\left(\frac{\partial H}{\partial T}\right)_P - \left(\frac{\partial U}{\partial T}\right)_V = R$
2. $\left(\frac{\partial H}{\partial T}\right)_P - \left(\frac{\partial U}{\partial T}\right)_P - \left(\frac{\partial U}{\partial T}\right)_V$ =work done
3. $\left(\frac{\partial U}{\partial V}\right)_T = +ve$
4. $\left(\frac{\partial T}{\partial P}\right)_H = +ve$

A. 1, 2, 3, 4

B. 1, 2, 4

C. 1, 2, 3

D. 1

Answer: A

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80. 1mole each of $CaCl_2, Al_4C_3, Mg_2C_3$ reacts with excess water in separate open flasks work done during the dissolution shows the order:

A. $CaC_2 = Mg_2C_3 < Al_4C_3$

B. $CaC_2 = Mg_2C_3 = Al_4C_3$

C. $Mg_2C_3 < CaC_2 < Al_4C_3$

D. $Mg_2C_3 < Al_4C_3 < CaC_2$

Answer: A

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81. When a bottle of perfume is opened, odorous molecules mix with air and slowly diffuse throughout the entire room. Which is not correct for this process?

A. $\Delta G = \; - ve$

B. $\Delta GH \approx 0$

C. $\Delta S = \; - ve$

D. $\Delta S = \; + ve$

Answer: C

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82. The Gibbs energy change and standard Gibbs energy change for a reaction are same if the reaction quotient Q has value equal to :

A. > 1

B. < 1

C. 0

D. 1

Answer: D

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83. The standard change in Gibbs energy for the reaction:

$H_2O \Leftrightarrow H^+ + OH^-$ at $25^\circ C$ is :

A. $100kJ$

B. $-80kJ$

C. $80kJ$

D. $-100kJ$

Answer: B

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84. Identify the correct statement for change of Gibbs energy for a system (ΔG_{system}) at constant temperature and pressure:

A. If $\Delta G_{Sys}=0$, the system is still moving in a particular direction

B. If $\Delta G_{Sys}=-ve$, the process is non-spontaneous

C. If $\Delta G_{Sys}=+ve$, the process is spontaneous

D. If $\Delta G_{Sys} = 0$, the system has attained equilibrium

Answer: D

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85. A monoatomic gas is suddenly compressed to $1/8$ of its original volume adiabatically. The pressure of gas will change to :

A. 8 times

B. 16 times

C. 32 times

D. $24/5$ times

Answer: C

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86. The enthalpy and entropy change for the reaction,

$Br_2(l) + Cl_2(g) \rightarrow 2BrCl(g)$

are $30KJmol^{-1}$ and $105JK^{-1}mol^{-1}$ respectively. The temperature at which the raction will be in equilibrium is:

A. $450K$

B. $300K$

C. $285.7K$

D. $273K$

Answer: C

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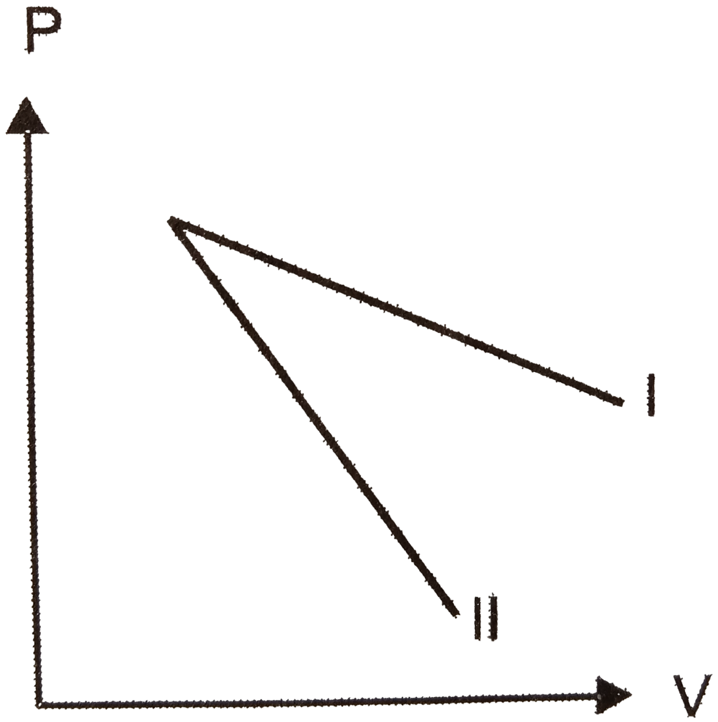
87. $P-V$ plots for two gases during adiabatic expansion are shown in figure. Plot I and II should correspond respectively to :



A. O_2 and N_2

B. O_2 and He

C. He and O_2

D. He and Ar

Answer: B

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88. For an adiabatic expansion of a perfect gas dP/P is equal to :

A. $\frac{dV}{V}$

B. $r. \frac{DV}{V}$

C. $-r. \frac{dV}{V}$

D. $-r^2.\ \frac{dV}{V}$

Answer: C

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89. The poisson's ratio for O_2 is 1.4. Which of the following are correct for O_2?

A. $C_v = \frac{R}{\gamma - 1}$

B. $C_v = 0.156cal$

C. $C_p = \frac{\gamma R}{\gamma + 1}$

D. $C_{V_m} = 5cal$

Answer: C

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90. Which species possesses negative value of specific heat?

A. Ice

B. Water

C. Vapour

D. Saturated vapour

Answer: D

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91. In which process net work done is zero ?

A. Cyclic

B. Isochoric

C. Free expansion

D. Adiabatic

Answer: C

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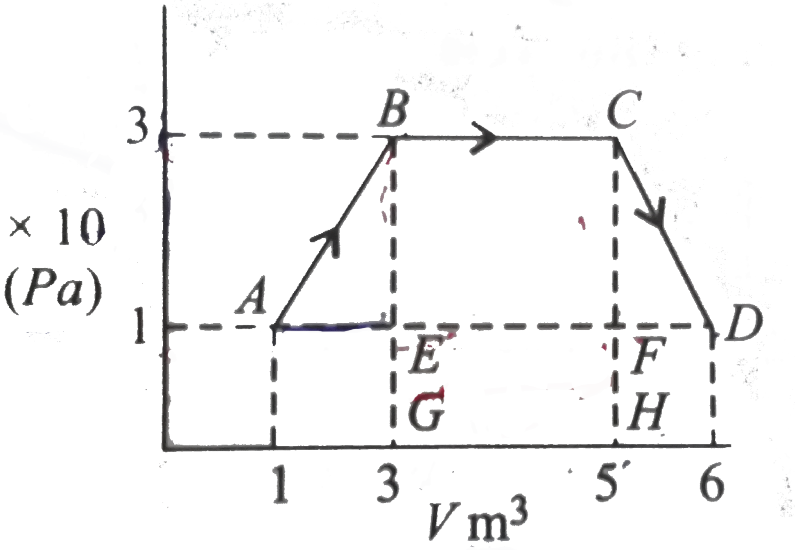
92. The net work done through a series of changes reported in figure for an ideal gas is



A. $-8 \times 10^{5} J$

B. $-12 \times 10^{5} J$

C. $-7 \times 10^{5} J$

D. $6 \times 10^{5} J$

Answer: C

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93. Specific heat of a substance at $m.\,pt.$ or $b.\,pt.$ for isothermal process and specific heat of a substance during adiabatic change respectively are:

A. $0, 0$

B. $0, \infty$

C. $\infty, 0$

D. ∞, ∞

Answer: C

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94. If for the reaction,

$2Mg_{(s)} + O_{2(g)} \rightarrow 2MgO_{(s)}$, at $27^{\circ}C$ $\Delta rH = -1202 kJmol^{-1}$ and $\Delta rS = -217 kJ^{-1} mol^{-1}$. The total entropy change $(\Delta S)_T$ and Gibb's energy change during the course of reaction (ΔrG) are respectively:

A. $3789.66 Jmol^{-1}, -1100 kJ$

B. $3789.66 Jmol^{-1}, -1136.9 kJ$

C. $-1136.9 kJ, 3789.66 Jmol^{-1}$

D. $+1100 J, 3789.66 Jmol^{-1}$

Answer: B

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95. The ratio of slopes of $P-V$ plots for reversible adiabatic process and reversible isothermal process of an ideal gas is equal to :

A. γ

B. $1-\gamma$

C. $\gamma-1$

D. $\frac{1}{\gamma}$

Answer: A

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96. $300K$ a gas $(\gamma = 5/3)$ is compressed suddenly so that its pressure becomes $1/8$ of the original pressure. The final temperature of the gas is :

A. $315K$

B. $130.58K$

C. $327^\circ C$

D. $425K$

Answer: B

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97. Select the incorrect statements for the equillibrium under standard condition:

$H_2O_{(s)} \Leftrightarrow H_2O_{(l)}, \Delta S_1^\circ$

$H_2O_{(l)} \Leftrightarrow H_2O_{(v)}, \Delta S_2^\circ$

$H_2O_{(l)} \Leftrightarrow H_2O_{(v)}, \Delta S_3^\circ$

A. $\Delta S_3^\circ > \Delta S_2^\circ$

B. $\Delta S_1^\circ > \Delta S_2^\circ$

C. $\Delta S_2^\circ > \ > \ > \Delta S_1^\circ$

D. $\Delta S_3^\circ > \Delta S_1^\circ$

Answer: B

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98. Heat of neutralisation of strong acid and strong base under $1 atm$ and $25^{\circ} C$ is $-13.7 kcal$. If standard Gibbs energy change for dissociation of water to H^{+} and OH^{-} is $-19.14 kcal$, the change in standard entropy for dissociation of water is:

A. $18.25 cal K^{-1} mol^{-1}$

B. $110.2 cal K^{-1} mol^{-1}$

C. $-18.25 cal K^{-1} mol^{-1}$

D. $-110.2 cal K^{-1} mol^{-1}$

Answer: B

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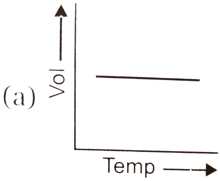
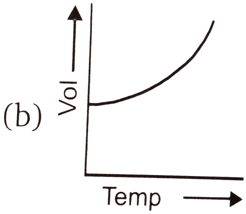
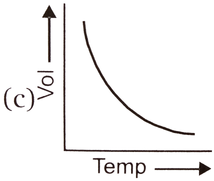
99. The relation between the volume and temperature of a sample of water in the range $0^\circ C$ to $100^\circ C$ is best represented as

A. 

B. 

C. 

D.

Answer: D

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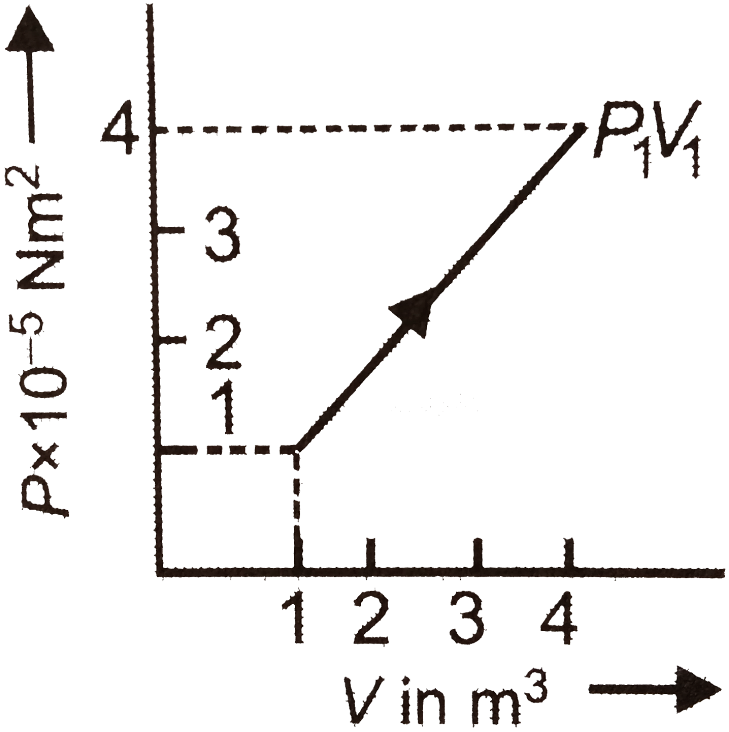
100. The work done in changing the state from (P_0, V_0) to (P_1, V_1) in the following system is :



A. $-7.5 \times 10^{-5} J$

B. $-7.5 \times 10^{5} J$

C. $-7.5 \times 10^5 erg$

D. -7.5×10^{-5} erg

Answer: B

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101. If the pressure on density of a diatomic gas $\left(\gamma = \frac{7}{5}\right)$ in adiabatic process changes from (P, e) to (P', e'), where, $P = 32P'$, then, $\frac{e}{e}$' is equal to :

A. $\frac{1}{128}$

B. $\frac{25}{27}$

C. 128

D. $\frac{1}{12}$

Answer: C

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102. One box containing 1 mole of He is $7/3T_0$ and other box containing 1 mole of a polyatomic gas $(\gamma = 1.33)$ at T_0 are placed together to attain thermal equilibrium. The final temperature T_f. Then :

A. $T_f = \frac{9}{13}T_0$

B. $T_f = \frac{13}{9}T_0$

C. $T_f = \frac{T_0}{2}$

D. $T_f = \frac{3}{2}T_0$

Answer: B

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103. The entropy change in melting $1g$ of ice at $0^{\circ}C$.

(Latent heat of ice is $80 cal g^{-1}$)

A. $23.07 JK^{-1} mol^{-1}$

B. $20.07 JK^{-1} mol^{-1}$

C. $22.07 JK^{-1} mol^{-1}$

D. $21.07 JK^{-1} mol^{-1}$

Answer: C

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104. 50 students sitting in the room of $5 \times 10 \times 3m^3$ dimensions. The air inside the room is at $27^\circ C$ and $1atm$ pressure. If each student loses 100 watt heat per second assuming the walls, ceiling floor, and all the material present inside the room is perfectly insulated as well as neglecting loss of air to the outside as the temperature is raised, how much rise in temperature will be noticed in 10 min ? Given $C_P = \frac{7}{2}R$ for air.

A. $15.90^\circ C$

B. $16.90^\circ C$

C. $14.90^\circ C$

D. $17.90^\circ C$

Answer: B

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105. ΔH and ΔS for the system $H_2O_{(l)} \Leftrightarrow H_2O_{(g)}$ at $1atm$ are $40.63kJmol^{-1}$ and $108.8JK^{-1}mol^{-1}$ respectively. The temperature at which the rates of forward and backward reactions will be same:

A. $273.4K$

B. $325.4K$

C. $373.4K$

D. $225.4K$

Answer: C

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106. Two moles of ideal gas at $27^{\circ}C$ temperature is expanded reversibly from 2 litre to 20 liter. Find entropy change $(R = 2cal/molK)$.

A. zero

B. 9.2

C. 92.2

D. 5

Answer: B

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107. Standard enthalpy and standard entropy change for the oxidation of NH_3 at $298K$ are $-382.64KJmol^{-1}$ and $145.6Jmol^{-1}$ respectively. Standard free energy change for the same reaction at $298K$ is

A. $-439.3kJmol^{-1}$

B. $221.1kJmol^{-1}$

C. $-339.3kJmol^{-1}$

D. $-526.2kJmol^{-1}$

Answer: C

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108. One mole of an ideal gas at $27^{\circ} C$ expanded isothermally from an initial volume of 1 litre to 10 litre. The ΔU for this process is : $\left(R=2 cal K^{-1} mol^{-1}\right)$

A. zero

B. 9 litre-atm

C. $1281.1 cal$

D. $164.7 cal$

Answer: A

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109. The molar heat capacity of water at constant pressure P, is $75 JK^{-1} mol^{-1}$. When $1.0 KJ$ of heat is supplied to $100 g$ of water which is free to expand, the increase in temperature of water is

A. $1.2 K$

B. $4.8 K$

C. $2.4 K$

D. $6.6 K$

Answer: C

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110. An ideal gas heat engine operates in Carnot cycle between $227^\circ C$ and $127^\circ C$. It absorbs $6.0 \times 10^4 cal$ of heat at high temperature. Amount of heat converted to work is :

A. $2.4 \times 10^4 cal$

B. $4.8 \times 10^4 cal$

C. $1.2 \times 10^4 cal$

D. $6.0 \times 10^4 cal$

Answer: C

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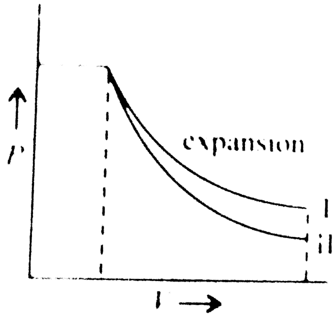
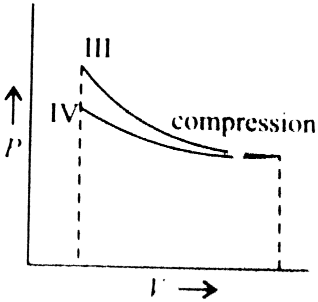
111. Which of the following graphs given below show (s) adiabatic process?





A. I and III

B. II and IV

C. II and III

D. I and IV

Answer: C

112. In an adiabatic expansion of air (assume it a mixture of N_2 and O_2), the volume increases by $5\,\%$. The percentage change in pressure is:

A. $3\,\%$

B. $4\,\%$

C. $6\,\%$

D. $7\,\%$

Answer: D

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113. A monoatomic gas is suddenly compressed to $1/8$ of its original volume adiabatically. The pressure of gas will change to :

A. 8 times

B. 32 times

C. $24/4$ times

D. $40/3$ times

Answer: B

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114. The process of evaporation of a liquid is accompanied by :

A. increase in enthalpy

B. decrease free energy

C. no change in free energy

D. increase in entropy

Answer: A::B::D

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115. All natural processes proceed spontaneously in a direction which :

A. increase entropy

B. increase free energy

C. decrease entropy

D. decrease free energy

Answer: A::D

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116. Which of the following is (are) correct an adiabatic process?

A. $q = W$

B. $\Delta U = q$

C. $q=0$

D. $\Delta U=W$

Answer: C::D

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117. If q is the amount of heat absorbed by the system and W the amount of work done on the system $(+ve)$, the change in the energy of the system is given by:

A. $q=\Delta U+W$

B. $q=\Delta U-W$

C. $\Delta U=q-W$

D. $\Delta U=W+q$

Answer: B::D

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118. Select the correct statements:

A. $P - V$ work is usually negligible for solids and liquids

B. for a closed system with $P - V$ work only, an isobaric proces that has $q = +ve$ must have $\Delta T = +ve$

C. For cyclic process $q = 0$

D. Saturated vapour obey Dalton's law of partial pressure

Answer: A::C::D

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119. In a reaction, ΔH and ΔS both are more than zero. In which of the following cases, the reaction would not be spontaneous?

A. $\Delta H > T\Delta S$

B. $T\Delta S > \Delta H$

C. $\Delta H = T\Delta S$

D. $\Delta G < 0$

Answer: A::C

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120. In which reaction(s), ΔS in negative?

A. $H_2O(l) \rightarrow H_2O(s)$

B. $3O_2(g) \rightarrow 2O_3(g)$

C. $H_2O(l) \rightarrow H_2O(g)$

D. $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$

Answer: A::B::D

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121. For the adiabatic expansion of an ideal gas:

A. $PV^{\gamma} = \text{ constant}$

B. $TV^{\gamma - 1} = \text{ constant}$

C. $T^{\gamma}P^{1 - \gamma} = \text{ constant}$

D. None of these

Answer: A::B::C

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122. The internal energy (U) of an ideal gas decreases by the same amount as the work done by the system:

A. The process must be adiabatic

B. The process must be isothermal

C. The process must be isobaric

D. The temperature must decrease

Answer: A::D

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123. Which has/have a positive value (s) of ΔH?

A. $H_2(g) \rightarrow 2H(g)$

B. $H(g) \rightarrow H^+(g) + e$

C. $H_2(l) \rightarrow H_2O(g)$

D. $H^+(aq) + OH^-(ag) \rightarrow H_2O$

Answer: A::B::C

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124. Which of the following statements is (are) correct?

A. The entropy of the universe increaases and tends towards the maximum value

B. All natural process are irreversible

C. For the isothermal expansion of an ideal gas, ΔH and ΔU are equal

D. All of these

Answer: A::B::C::D

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125. The change in enthalpy for an isobaric gaseous reaction (for an ideal gas system) is (are):

A. $\Delta H = \Delta U + P\Delta V + V\Delta P$

B. $\Delta H = \Delta U + P\Delta V$

C. $\Delta H = \Delta U + \Delta nRT$

D. $\Delta H = \Delta U + PV$

Answer: B::C

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126. When a solid melts, there is/are:

A. an increase in entropy

B. an increase in enthalpy

C. a decrease in internal energy

D. a decrease in enthalpy

Answer: A::B

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127. In which of the following cases is the reaction spontaneous at all temperatures?

A. $\Delta H > 0, \Delta S > 0$

B. $\Delta H < 0, \Delta S > 0$

C. $\Delta H < 0, \Delta S < 0$

D. $\Delta H < 0, \Delta S = 0$

Answer: B::D

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128. Which of the following conditions is (are) favourable for the feasibility of a reaction?

A. $\Delta H = -ve, T\Delta S = +ve$

B. $\Delta H = -ve, T\Delta S = -ve, T\Delta S < \Delta H$

C. $\Delta H = +ve, T\Delta S = +ve, T\Delta S < \Delta H$

D. $\Delta H = +ve, T\Delta S = +ve, T\Delta S > \Delta H$

Answer: A::B::D

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129. In whiich of the following cases, do you consider the increase in entropy take (s) place ?

A. Pure liquid or liquid solutions are formed from solids

B. Gases are formed, either from solids or liquids

C. the number of molecules of gases increase in the course of a chemical reaction

D. The temperature of a substance is increased

Answer: A::B::C::D

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130. In which of the following entropy increases?

A. Rusting of iron

B. Melting of ice

C. Crysttallization of sugar from solution

D. Vaporization of champhor

Answer: A::B::D

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131. During the isothermal expansion of an ideal gas:

A. The internal energy remains unaffacted

B. The temperature remains constant

C. The enthalpy remains unaffected

D. the enthalpy becomes zero

Answer: A::B::C::D

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132. Which of the following are state function?

A. Internal energy

B. Irreversible expansion work

C. Reversible expansion work

D. Molar enthalpy

Answer: A::D

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133. Which are the intensive properties?

A. Temperature

B. Refractive index

C. Volume

D. Enthalpy reduces to zero

Answer: A::B

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134. Given,

$2Fe_2O_{3(s)} \rightarrow 4Fe_{(s)} + 3O_{2(g)}, \Delta_r G_1^\circ = +1487kJmol^{-1}$

$6CO_{(g)} + 3O_{2(g)} \rightarrow 6CO_{2(g)}, \Delta_r G_2^\circ = 1543.2kJmol^{-1}$

Select the correct statements:

A. $\Delta_r G^\circ$ for reduction of iron oxide by CO is $-56.2kJm^{-1}$

B. Fe_2O_3 cannot be reduced by CO spontaneously

C. Fe_2O_3 can be reduced by CO spontaneously

D. The reduction of Fe_2O_3 takes part in higher part of blast furnace

Answer: A::B::D

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135. Which of the following statements is (are) false?

A. The entropy of the universe decreaase and increases at a periodic rate

B. The entropy of the universe increases and tends towards the maximum value

C. For endothermic spontaneous process, the total entropy change decrease

D. The entropy of the universe decrease and tends to zero

Answer: A::C::D

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136. The work done by 1 mole of ideal gas during an adiabatic process is (are) given by :

A. $W = C_v(T_f - T_i)$

B. $W = \dfrac{P_f V_f}{\gamma - 1}\left[1 + \dfrac{P_f}{P_i}\right]^{\gamma - 1}$

C. $W = \frac{P_f V_f}{\gamma - 1}\left[1 - \left(\frac{P_i}{P_f}\right)^{\frac{\gamma-1}{\gamma}}\right]$

D. $W = \frac{P_f V_f - P_i V_i}{\gamma - 1}$

Answer: A::C::D

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137. For gaseous reactions, if ΔH is the change in enthalpy and ΔU that in internal energy then:

A. ΔH is always greater than ΔU

B. ΔH is always less than ΔU

C. $\Delta H < \Delta U$ only if the number of mole of the gaseous products is less than that of the gaseous reactants

D. $\Delta U < \Delta H$ only if the number of mole of the gaseous reactants is less than that number of the gaseous products

Answer: C::D

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138. Thermodynamic parameters for :

$HX + H_2O \rightarrow H_3O^+ + X^-$ are given for HF, HCL, HBr and HI, which acid (s) will show the forward reaction?

	HF	HCl	HBr	HI
ΔG°	$+16$	-46	-59	-61
ΔH°	-13	-59	-63	-57
$T\Delta S^{\circ}$	-29	-13	-4	$+4$

A. HF

B. HCl

C. HBr

D. HI

Answer: A::B::C::D

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139. In which of the following cases entropy increases?

A. Solid changing to liquid

B. Expansion of gas

C. Crystal dissolves

D. Boiling of an egg

Answer: A::B::C::D

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140. A reaction attains equilibrium state under standard conditions, then:

A. equilibrium constant $K = 1$

B. equilibrium constant $K = 0$

C. $\Delta G^{\circ} = 0$ and $\Delta H^{\circ} = T\Delta S^{\circ}$

D. $\Delta G = 0$ and $\Delta H = T\Delta S$

Answer: A::C::D

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141. The open system (s) is (are) which :

A. can exchange matter with the surroundings

B. can exchange energy with the surroundings

C. can exchange both matter and energy with the surroundings

D. cannot exchange either matter or energy with the surroundings

Answer: A::B::C

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142. Which of the following statements is/are correct?

A. Water in a beaker be made to boil by placing it in a bath of boiling water

B. Water can be made to boil without heating

C. Two pieces of ice stick to each other if they are pressed against each other and released due to regelation

D. Ice can be made to sublimate

Answer: B::C::D

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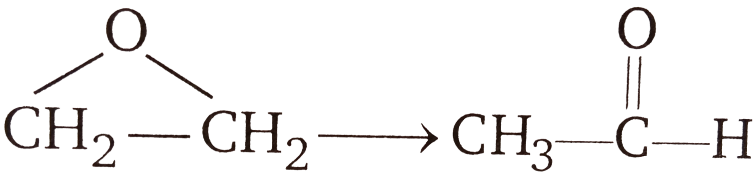
143.



Given: for ethylene oxide ΔH°_f and ΔS° are $-51kJmol^{-1}, 243Jmol^{-1}K^{-1}$ respectively and acetaldehyde ΔH°_f and ΔS° are $-166kJmol^{-1}$ and $266Jmol^{-1}K^{-1}$ respectively, then select the correct statements:

A. ΔH° for the reaction is $-115kJmol^{-1}$

B. $\Delta S^\circ = 0.0236kJmol^{-1}K^{-1}$

C. Reaction is thermodynamically favourable

D. High temperature can favour formation of more product.

Answer: A::B::C::D

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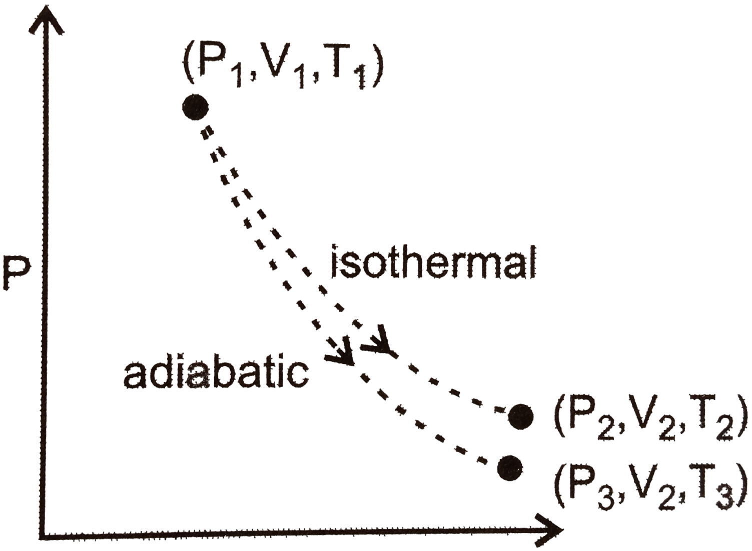
144. The reversible expansion of an ideal gas under adiabatic and isothermal conditions is shown in the figure.

Which of the following statement(s) is (are) correct?



A. $T_1 = T_2$

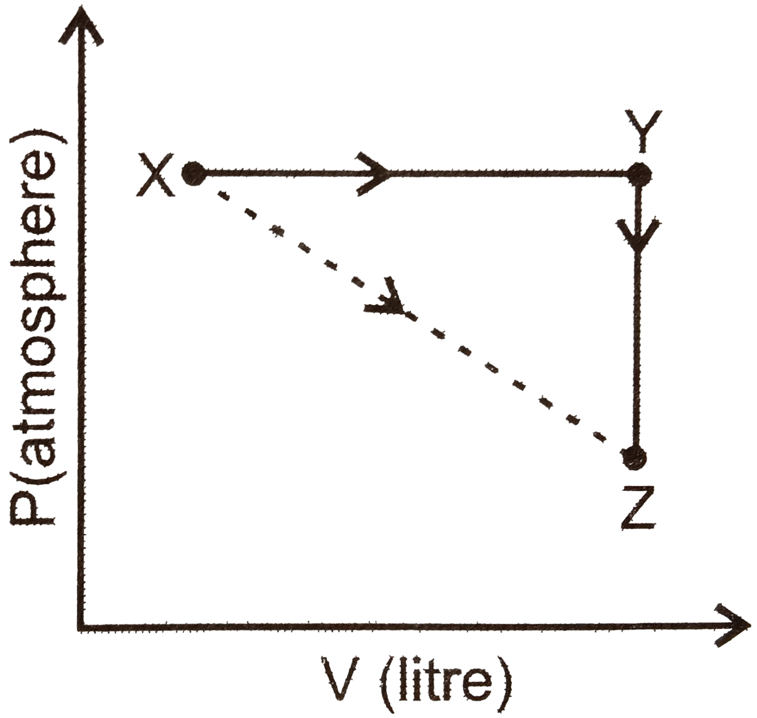
B. $T_3 > T_1$

C. $w_{\text{isothermal}} > w_{\text{adiabatic}}$

D. $\Delta U_{\text{isothermal}} > \Delta U_{\text{adiabatic}}$

Answer: A::D

145. For an ideal gas, consider only $P-V$ work in going from an initial state X to the final state Z. The final state Z can be reached by either of the two paths shown in the figure. Which of the following choice(s) is (are) correct? [Take ΔS as change in entropy and w as work done]



A. $\Delta S_{X \to Z} = \Delta S_{X \to Y} + \Delta S_{Y \to Z}$

B. $w_{X \to Z} = w_{X \to Y} + w_{Y \to Z}$

C. $w_{X \to Y \to Z} = w_{X \to Y}$

D. $\Delta S_{X \to Y \to Z} = \Delta S_{X \to Y}$

Answer: A::C

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146. An endotthermic reaction is non-spontaneous at freezing point of water and becomes feasible at its boiling point, then:

A. $\Delta H = -ve, \Delta S = +ve$

B. Both ΔH and ΔS are $+ve$

C. Both ΔH and ΔS are $-ve$

D. $\Delta H = +ve, \Delta S = -ve$

Answer: b

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147. A heat engine absorbs heat Q_1 at temperature T_1 and Q_2 at temperature T_2 . Work done by the engine is $(Q_1 + Q_2)$. This data:

A. Violets first law of thermodynamics

B. Violets fistl law of thermodynamics if $Q_1 = -ve$

C. Violets first law of thermodynamics if $Q_2 = +ve$

D. Does not violet first law of thermodynamics

Answer: d

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148. In an irreversible process taking place at constant T and P and in which only pressure-volume work is being done, the change in Gibbs free energy (dG) and the change in entropy (dS) satisfy the criteria

A. $(dS)_{V,U}=0, (dG)_{T,P}=0$

B. $(dS)_{V,U}=0, (dG)_{T,P}=+ve$

C. $(dS)_{V,U}=-ve, (dG)_{T,P}=-ve$

D. $(dS)_{V,U}=+ve, (dG)_{T,P}=-ve$

Answer: d

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149. The internal energy change when a system goes fromk state A to B is $40kJmol^{-1}$. If the system goes from A to B by a reversible path and returns to state A by an irreversible path, what would be the net change in internal energy?

A. $< 40kJ$

B. Zero

C. $40kJ$

D. $> 40kJ$

Answer: b

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150. The correct relationship between free energy change in a reaction and the corresponding equilibrium constant K_c is:

A. $\Delta G^\circ = RT \ln K_c$

B. $-\Delta G^\circ = RT \ln K_c$

C. $\Delta G = RT \ln K_c$

D. $-\Delta G = RT \ln K_c$

Answer: b

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151. An ideal gas expands from $1 \times 10^{-3} m^3$ to $1 \times 10^{-2} m^3$ at $300K$ againts a constant pressure of $1 \times 10^5 Nm^{-2}$. The work done is :

A. $900kJ$

B. $-900kJ$

C. $270kJ$

D. $-900kJ$

Answer: d

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152. For a spontaneous reaction, ΔG , equilibrium constant (K) and E^0_{cell} will be respectively:

A. $-ve, \ > 1, \ +ve$

B. $+ve, \ > 1, \ -ve$

C. $-ve, \ < 1, \ -ve$

D. $-ve, \ > 1, \ -ve$

Answer: a

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153. An ideal gas is allowed to expand both reversibly and irreversibly in an isolated system. If T_i is the initial temperature and T_f is the final temperature, which of the following statement is correct ?

A. $(T_f)_{irrev} > (T_f)_{rev}$

B. $T_f > T_i$ for both reversible process but $T_f = T_i$ for irreversible process

C. $(T_f)_{rev} = (T_f)_{rev}$

D. $T_f = T_i$ for both reversible and irreversible process

Answer: a

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154. In conversion of lime-stone to lime,

$CaCO_{3(s)} \rightarrow CaO_{(s)} + CO_{2(g)}$ the values of ΔH°

and ΔS° are $+179.1 kJ mol^{-1}$ and $160.2 J / K$ respectively at $298 K$ and 1 bar. Assuming that ΔH° and ΔS° do not change with temperature, temperature above which conversion of lime-stone to lime will be spontaneous is :

A. $1008 K$

B. $1200 K$

C. $845 K$

D. $1118 K$

Answer: d

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155. Standard entropy of X_2 , Y_2 and XY_3 are $60, 40$ and $50JK^{-1}mol^{-1}$, respectively. For the reaction, $\frac{1}{2}X_2+\frac{3}{2}Y_2 \rightarrow XY_3, \Delta H = -30KJ$, to be at equilibrium, the temperature will be:

A. $1250K$

B. $500K$

C. $750K$

D. $1000K$

Answer: c

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156. Which one of the following statement is false?

A. Work is a state function

B. Temperature is a state function

C. Change in the state is completely defined when initial and final states are specified

D. Work appears at the boundary of the system

Answer: a

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157. In thermodynamics, a process is called reversible when

A. surroundings and system changes into each other

B. there is no boundary between system and surroundings

C. The surroundings are always in equilibrium with system

D. The system changes into the surroundings spontaneously

Answer: c

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158. One mole of a non-ideal gas undergoes a change of state $(2.0atm, 3.0L, 95K) \rightarrow (4.0atm, 5.0L, 245K)$

With a change in internal energy $\Delta E = 30L$ atm. The change in enthalpy (ΔH) in the process in L-atm is

A. 40.0

B. 42.3

C. 44.0

D. not defined because pressure is not constant

Answer: c

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159. Two moles of an ideal gas expanded isothermally and reversibly from $1L$ to $10L$ at $300K$. What is the enthalpy change?

A. 11.4

B. -11.4

C. 0

D. 4.8

Answer: c

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160. The enthalpy of vaporisation of a liquid is $30kJmol^{-1}$ and entropy of vaporisation is $75Jmol^{-1}K^{-1}$. The boiling point of the liquid at $1atm$ is :

A. $250K$

B. $400K$

C. $450K$

D. $600K$

Answer: b

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161. When $1mol$ of a monoatomic ideal gas at TK undergoes adiabatic change under a constant external pressure of $1atm$, changes volume from $1L \rightarrow 2L$. The final temperature (in K) would be

A. $\frac{T}{(2)^{2/3}}$

B. $T + \frac{2}{3 \times 0.0821}$

C. T

D. $T - \dfrac{3}{2 \times 0.0821}$

Answer: a

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162. The direct conversion of A to B is difficult, hence it is carried out as

$A \rightarrow C \rightarrow D \rightarrow B$

Given,

$\Delta S_{(A \rightarrow C)} = 50eU, \Delta S_{(C \rightarrow D)} = 30eU, \Delta S_{(B \rightarrow D)} = 20eU$, where eU is entropy unit. Thus the change in entropy in $(A \rightarrow B)$ is:

A. $100eU$

B. $60eU$

C. $-100eU$

D. $-60eU$

Answer: b

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163. For the process $H_2O(l)(1\text{bar}, 373K) \rightarrow H_2O(g)(1\text{bar}, 373K)$ the correct set of thermodynamic parameters is

A. $\Delta G = 0, \Delta S = +ve$

B. $\Delta G = 0, \Delta S = -ve$

C. $\Delta G = +ve, \Delta S = 0$

D. $\Delta G = -ve, \Delta S = 0$

Answer: a

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164. For a particular reversible reaciton at temperature T, ΔH and ΔS were found to be both $+ve$. If T_e is the temperature at equilibrium, the reaciton would be spontaneous when :

A. $T_e > T$

B. $T > T_e$

C. T_e is 5 times T

D. $T = T_e$

Answer: b

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165. The species which by definition has zero standard molar enthalpy of formation at $298K$ is

A. $Br_{2(g)}$

B. $Cl_{2(g)}$

C. $H_2O_{(g)}$

D. $CH_{4(g)}$

Answer: b

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166. The entropy change involved in the isothermal reversible expansion of 2 moles of an ideal gas from a volume of $10dm^3$ to a volume of $100dm^3$ at $27^\circ C$ is

A. $38.3Jmol^{-1}K^{-1}$

B. $35.8Jmol^{-1}K^{-1}$

C. $32.3Jmol^{-1}K^{-1}$

D. $42.3Jmol^{-1}K^{-1}$

Answer: a

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167. In a constant volume calorimeter, $3.5g$ of a gas with molecular weight 28 was burnt in excess oxygen at $298.0K$. The temperature of the calorimeter was found to increase from $298.0K \rightarrow 298.45K$ due to the combustion process. Given that the heat capacity of the calorimeter is $2.5kJK^{-1}$, find the numerical value for the enthalpy of combustion of the gas in $kJmol^{-1}$

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168. Calculate the work done by the system, when $40J$ heat is supplied to it, the internal energy of system increase $32J$.

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169. A gas expands by 0.372 litre against a constant pressure of $1atm$. Find the work done in cal.

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170. In an adiabatic expansion of air (assume it a mixture of N_2 and O_2), the volume increases by 5%. The percentage change in pressure is:

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171. Calculate the work done during the process, when one mole of gas is allowed to expand freely into vacuum.

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172. The temperature of 1 mole helium gas is increased by $1^\circ C$. Find the increase in internal energy.

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173. A gas originally at $1.10 atm$ and $298 K$ underwent a reversible adiabatic expansion to $1.00 atm$ and $287 K$. What is the molar heat capacity of the gas?

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174. Calculate the maximum efficiency of a carnot engine operating between $80^{\circ}C$ to $47^{\circ}C$.

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175. Calculate the ΔH for the isothermal reversible expansion of 1 mole of an ideal gas from initial pressure of 0.1^{-} at a constant temperature at $273K$.

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176. At $27^{\circ}C$ latent heat of I^{-} fusion of a compound is $2.7 \times 10^{3} Jmol^{-1}$. Calculate the entropy change during fusion.

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177. The molar heat capacity of water at constant pressure P is $60JK^{-1}mol^{-1}$. When $1.0kJ$ of heat is supplied to $100g$ of water, which is free to expand, find the increase in temperature of water.

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178. For liquid enthalpy of fusion is $1.435kcalmol^{-1}$ and molar entropy change is $5.26calmol^{-1}K^{-1}$. The melting point of the liquid is

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179. The first law of thermodynamics was given as $q = \Delta U + (-w)$, where q is heat given to a system and ΔU represents increase in internal energy and $-w$ is work done by the system. Various processes such as isothermal, adiabatic, cyclic, isobaric and isochoric process in terms of I law of thermodynamics leads for important results. The molar heat capacity for 1 mole of monoatomic gas is $\frac{3}{2}R$ at constant volume and $\frac{5}{2}R$ at constant pressure.

Which of the following statements are correct? (1) Both work and heat appears at the boundaries of system. (2) Heat given to a system is given $+ve$ sign. (3) Heat given to a system is equal to increase in internal energy under isothermal conditions (4) Heat given to a system is used to increase internal energy under isochoric conditions (5)

Both work and heat are not state functions but their sum $(q+w)$ is state function.

A. $1, 2, 4, 5$

B. $1, 3, 4, 5$

C. $1, 2, 3, 4$

D. $2, 3, 4, 5$

Answer: a

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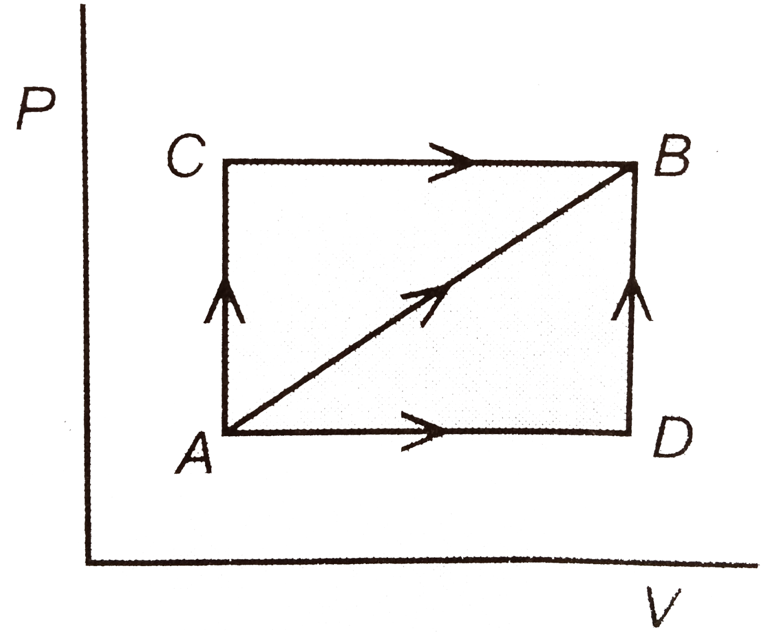
180. The first law of thermodynamics was given as $q=\Delta U+(-w)$, where q is heat given to a system and ΔU represents increase in internal energy and $-w$ is work done by the system. Various processes such as isothermal, adiabatic, cyclic, isobaric and isochoric process in terms of I law of thermodynamics leads for important results. The molar heat capacity for 1 mole of monoatomic gas is $\frac{3}{2}R$ at constant volume and $\frac{5}{2}R$ at constant pressure.

A system is allowed to move from state A to B following path ACB by absorbing $80J$ of heat energy. The work done by the system is $30J$. The work done by the system in reaching state B from A is $10J$ through path ADB,



Which statements are correct?

(1) Increase in internal energy from state A to state B is $50 J$. (2) If path ADB is followed to reach state $B, \Delta U=50 J$. (3) If work done by the system in path AB is $20 J$, the heat absorbed during path $AB=70 J$. (4) The value U_C-U_A is equal to U_D-U_B. (5) Heat absorbed by the system to reach B from A through path ADB is $60 J$.

A. $1, 5$

B. $1, 3, 5$

C. $1, 2, 3, 5$

D. $1, 4, 5$

Answer: c

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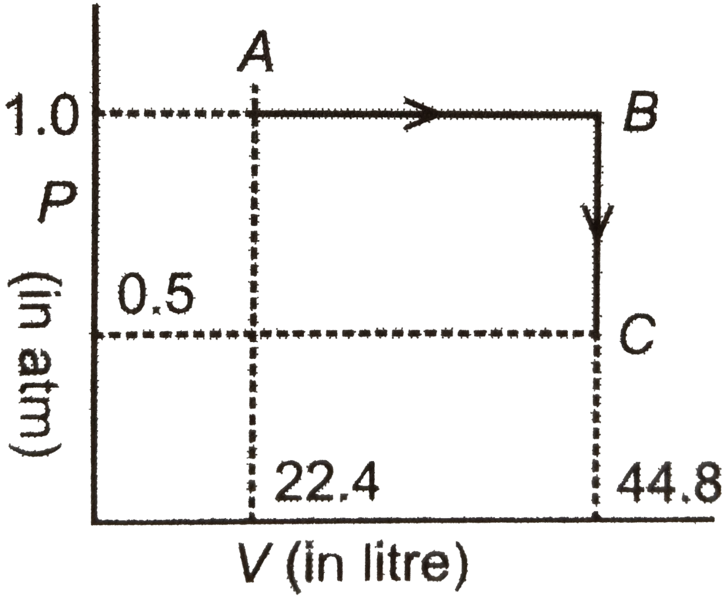
181. The first law of thermodynamics was given as $q = \Delta U + (-w)$, where q is heat given to a system and ΔU represents increase in internal energy and $-w$ is work done by the system. Various processes such as isothermal, adiabatic, cyclic, isobaric and isochoric process in terms of I law of thermodynamics leads for important results. The molar heat capacity for 1 mole of monoatomic gas is $\frac{3}{2}R$ at constant volume and $\frac{5}{2}R$ at constant pressure.

1 mole of a monoatomic gas is expanded through path ABC as shown in figure:



select the correct statements:

A. If specific heat of gas are 0.125 and $0.075 cal/g$ the mol. Wt of gas $= 40$

B. Temperature at point A, B, C are $273, 546$ and $273K$ respectively.

C. Both A and B

D. None of these

Answer: a

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182. Work done by the system in isothermal reversible process is $w_{rev.} = -2.303nRT\log\frac{V_2}{V_1}$. Also in case of adiabatic reversible process work done by the system is given by: $w_{rev.} = \frac{nR}{\gamma - 1}[T_2 - T_1]$. During expansion disorder increases and the increase in disorder is expressed in terms of change in entropy $\Delta S = \frac{q_{rev.}}{T}$. The entropy changes also occurs during transformation of one state to other end expressed as $\Delta S = \Delta \frac{H}{T}$. Both entropy and enthalpy changes obtained for a process were taken as a measure of spontaniety of process but finally it was recommended that decrease in free energy is responsible for spontaniety and $\Delta G = \Delta H - T\Delta S$.

Which statements are correct? (1) The expansion work for a gas into a vacuum is equal to zero. (2) 1 mole of a gas occupying 3 litre volume on expanding to 15 litre at constant pressure of $1 atm$ does expansion work $1.215 kJ$. (3) The maximum work done during expansion of $16 g O_2$ at $300 K$ from $5 dm^3$ to $25 dm^3$ is $2.01 kJ$. (4) The ΔS for

$S \rightarrow L$ is almost negligible in comparision to ΔS for $L \rightarrow G$. (5) $\Delta S = 2.303 nR \log \frac{V_2}{V_1}$. (at constant T)

A. $2, 3, 4, 5$

B. $1, 2, 3, 4, 5$

C. $1, 2$

D. $4, 5$

Answer: b

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183. Work done by the system in isothermal reversible process is $w_{rev.} = -2.303 nRT \log \frac{V_2}{V_1}$. Also in case of adiabatic reversible process work done by the system is given by: $w_{rev.} = \frac{nR}{\gamma - 1}[T_2 - T_1]$. During expansion disorder increases and the increase in disorder is expressed in terms of change in entropy $\Delta S = \frac{q_{rev.}}{T}$. The entropy changes also occurs during transformation of one state to other end expressed as $\Delta S = \Delta \frac{H}{T}$. Both entropy and enthalpy changes obtained for a process were taken as a measure of spontaniety of process but finally it was recommended that decrease in free energy is responsible for spontaniety and $\Delta G = \Delta H - T\Delta S$.

The heat of vaporisation and heat of fusion of H_2O are $540 cal / g$ and $80 cal / g$. This ratio of $\frac{\Delta S_{vap.}}{\Delta S_{\text{fusion}}}$ for water is:

A. 6.75

B. 9.23

C. 4.94

D. 0.2

Answer: c

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184. Work done by the system in isothermal reversible process is $w_{rev.} = -2.303nRT\log\frac{V_2}{V_1}$. Also in case of adiabatic reversible process work done by the system is given by: $w_{rev.} = \frac{nR}{\gamma - 1}[T_2 - T_1]$. During expansion disorder increases and the increase in disorder is expressed in terms of change in entropy $\Delta S = \frac{q_{rev.}}{T}$. The entropy changes also occurs during transformation of one state to other end expressed as $\Delta S = \Delta\frac{H}{T}$. Both entropy and enthalpy changes obtained for a process were taken as a measure of spontaniety of process but finally it was recommended that decrease in free energy is responsible for spontaniety and $\Delta G = \Delta H - T\Delta S$.

$Ag_2O_{(s)} \rightarrow 2Ag_{(s)} + \frac{1}{2}O_{2(g)}$ attains equilibrium at temperature...K is : (The ΔH and ΔS for the reaction are $30.5kJmol^{-1}$ and $66Jmol^{-1}K^{-1}$)

A. 462.12

B. 237

C. 373

D. 273

Answer: a

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185. Work done by the system in isothermal reversible process is $w_{rev.} = -2.303nRT\log\frac{V_2}{V_1}$. Also in case of adiabatic reversible process work done by the system is given by: $w_{rev.} = \frac{nR}{\gamma - 1}[T_2 - T_1]$. During expansion disorder increases and the increase in disorder is expressed in terms of change in entropy $\Delta S = \frac{q_{rev.}}{T}$. The entropy changes also occurs during transformation of one state to other end expressed as $\Delta S = \Delta\frac{H}{T}$. Both entropy and enthalpy changes obtained for a process were taken as a measure of spontaniety of process but finally it was recommended that decrease in free energy is responsible for spontaniety and $\Delta G = \Delta H - T\Delta S$.

A chemical change will definitely be spontaneous if:

A. $\Delta H = -ve, \Delta S = -ve$ and low temperature

B. $\Delta H = +ve, \Delta S = -ve$ and high temperature

C. $\Delta H = -ve, \Delta S = +ve$ and any temperature

D. $\Delta H = +ve, \Delta S = +ve$ and $T\Delta S < \Delta H$

Answer: c

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186. A flask of $1L$ having $NH_3(g)$ at $2.0atm$ and $200K$ is connected with the another flask of volume $800mL$ having $HCI(g)$ at $8atm$ and $200K$ through a narrow tube of negligible volume. The two gases react to form $NH_4(CI(s)$ with evolution of $43kJmol^{-1}$ heat. if heat capacity of $HCI(g)$ at constant volume is $20JK^{-1}mol^{-1}$ and neglecting heat capacity of flask, and volume of solid

NH_4CI formed, calculate the final temperature, and final pressure in the flasks. (Assume $R = 0.08 LatmK^{-1}mol^{-1}$)

A. $5.375J$

B. $4.375kJ$

C. $5.375kJ$

D. $6.375J$

Answer: c

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187. A flask of $1L$ having $NH_3(g)$ at $2.0atm$ and $200K$ is connected with the another flask of volume $800mL$ having

$HCI(g)$ at $8atm$ and $200K$ through a narrow tube of negligible volume. The two gases react to form $NH_4(CI(s)$ with evolution of $43kJmol^{-1}$ heat. if heat capacity of $HCI(g)$ at constant volume is $20JK^{-1}mol^{-1}$ and neglecting heat capacity of flask, and volume of solid NH_4CI formed, calculate the final temperature, and final pressure in the flasks. (Assume $R = 0.08LatmK^{-1}mol^{-1}$)

A. $117.27^\circ C$

B. $1177.27K$

C. $117.72K$

D. $977.27K$

Answer: b

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188. A flask of $1L$ having $NH_3(g)$ at $2.0atm$ and $200K$ is connected with the another flask of volume $800mL$ having $HCI(g)$ at $8atm$ and $200K$ through a narrow tube of negligible volume. The two gases react to form $NH_4(CI(s)$ with evolution of $43kJmol^{-1}$ heat. if heat capacity of $HCI(g)$ at constant volume is $20JK^{-1}mol^{-1}$ and neglecting heat capacity of flask, and volume of solid NH_4CI formed, calculate the final temperature, and final pressure in the flasks. (Assume $R = 0.08LatmK^{-1}mol^{-1}$)

A. $14.39atm$

B. $1.49atm$

C. $16.39 atm$

D. $15.39 atm$

Answer: a

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189. Assertion: Work and internal energy are not state functions.

Reason: The sum of $q + w$ is a state function.

A. S is correct but E is wrong.

B. S is wrong but E are correct and E

C. Both S and E are correct but E is correct explanation of S.

D. Both S and E are correct but E is not correct explanation of S.

Answer: b

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190. Statement: Internal energy of a system is an extensive property.

Explanation: The internal energy of a system depends upon the amount and physical state of the susbtance.

A. S is correct but E is wrong.

B. S is wrong but E are correct and E

C. Both S and E are correct but E is correct explanation of S.

D. Both S and E are correct but E is not correct explanation of S.

Answer: c

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191. Statement: The change in internal energy and change in heat enthalpy does not depend upon the path by which change are brought in.

Explanation: Both ΔE and ΔH are path independent as E and H are state functions.

A. S is correct but E is wrong.

B. S is wrong but E are correct and E

C. Both S and E are correct but E is correct explanation of S.

D. Both S and E are correct but E is not correct explanation of S.

Answer: c

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192. Statement: Both work and heat are manifested by an effect in the surroundings.

Explanation: Work done by $/$ on the system and ΔH appear only at the boundary of system.

A. S is correct but E is wrong.

B. S is wrong but E are correct and E

C. Both S and E are correct but E is correct explanation of S.

D. Both S and E are correct but E is not correct explanation of S.

Answer: c

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193. Assertion: The zeroth law of thermodynamics was know before the first law of thermodynamics.

Reason: The zeroth law concerning thermal equilibrium appeared after three laws $(I, II \text{ and } III)$ of thermodynamics and thus was named zeroth law.

A. S is correct but E is wrong.

B. S is wrong but E are correct and E

C. Both S and E are correct but E is correct explanation of S.

D. Both S and E are correct but E is not correct explanation of S.

Answer: b

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194. Statement: The entropies of $CO, NO, N_2O, Cl_{2(s)}$ are not zero at absolute zero.

Explanation: These are exceptions to III law of thermodynamics.

A. S is correct but E is wrong.

B. S is wrong but E are correct and E

C. Both S and E are correct but E is correct explanation of S.

D. Both S and E are correct but E is not correct explanation of S.

Answer: d

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195. Assertion:Phase transition involves change in internal energy only.

Reason:Phase transition occurs at constant pressure.

A. S is correct but E is wrong.

B. S is wrong but E are correct and E

C. Both S and E are correct but E is correct explanation of S.

D. Both S and E are correct but E is not correct explanation of S.

Answer: b

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196. Assertion:The change in entropy during melting of ice is negligible in comparison to change in entropy during vaporisation.

Reason:The volume occupied by solid and liquids is too less in comparison to volume occupied by gas.

A. S is correct but E is wrong.

B. S is wrong but E are correct and E

C. Both S and E are correct but E is correct explanation of S.

D. Both S and E are correct but E is not correct explanation of S.

Answer: c

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197. Assertion:The SIunit of entropy is$JK^{-1}mol^{-1}$

Reason:$\Delta S=\frac{q_{rev}}{T}$

A. S is correct but E is wrong.

B. S is wrong but E are correct and E

C. Both S and E are correct but E is correct explanation of S.

D. Both S and E are correct but E is not correct explanation of S.

Answer: c

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198. Statement: The thermodynamics functions which determines the spontaneity of a process is the free energy. For a process to be spontaneous, the change in free energy must be negative.

Explanation:The change in free energy is related to the change in enthalpy and change in entropy. the change in entropy for a process must be always positive if it is spontaneous.

A. S is correct but E is wrong.

B. S is wrong but E are correct and E

C. Both S and E are correct but E is correct explanation of S.

D. Both S and E are correct but E is not correct explanation of S.

Answer: a

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199. Statement: In the case of an ideal gas the changes in Gibbs and Helmholtz free energies are equal to each other $(\Delta G = \Delta A)$ for isothermal reversible process.

Explanation: There is no change in internal energies and enthalpies for ideal gas at constant temperature.

A. S is correct but E is wrong.

B. S is wrong but E are correct and E

C. Both S and E are correct but E is correct explanation of S.

D. Both S and E are correct but E is not correct explanation of S.

Answer: c

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200. Assertion (A): For every chemical reaction at equilibrium, standard Gibbs enegry of the reaction is zero. Reason (R) : At constant temperature and pressure chemical reactions are spontaneous in the direction of the decreasing Gibbs energy.

A. S is correct but E is wrong.

B. S is wrong but E are correct and E

C. Both S and E are correct but E is correct explanation of S.

D. Both S and E are correct but E is not correct explanation of S.

Answer: b

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201. Assertion (A) : There is a natural asymmetry between converting work to heat and converting heat of work.

Reason (R) : No process is possible in which the sole result is the absorption of heat from a reservoir and its complete conversion into work.

A. S is correct but E is wrong.

B. S is wrong but E are correct and E

C. Both S and E are correct but E is correct explanation of S.

D. Both S and E are correct but E is not correct explanation of S.

Answer: c

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202. A gas occupies $2L$ at STP. It is provided $300J$ heat so that it volume becomes $2.5L$ at $1atm$. Caluclate the change in its internal enegry.

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203. Calculate the work done during the process, when one mole of gas is allowed to expand freely into vacuum.

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204. $2.8g$ of N_2 gas at $300K$ and $20atm$ was allowed to expand isothermally against a constant external pressure of $1atm$. Calculate ΔU, q, and W for the gas.

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205. At $27^\circ C$, one mole of an ideal gas is compressed isothermally and reversibly from a pressure of 2 atm to 10 atm. Calculate ΔU and q.

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206. One mole of an ideal gas is heated at constant pressure from $0^\circ C$ to $100^\circ C$.

a. Calculate the work done.

b. If the gas were expanded isothermally and reversibly at $0^\circ C$ from $1atm$ to some othe pressure P, what must be the final pressure if the maixmum work is equal to the work in (a)?

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207. $1mol$ of an ideal gas at $25^\circ C$ is subjected to expand reversibly 10 times of its initial volume. Calculate the change in entropy of expansions.

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208. An insulated container is divided into two equal portions. One portion contains as ideal gas at pressure P and tenperature T. The other portion is a perfect vaccum. If a hole is opened between the two portions, claculate

a. the change in internal energy.

b. the change in temperature.

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209. The temperature of a bomb calorimeter was found to rise by $1.617K$ when a current of $3.20A$ was passed for $27s$ from a $12V$ source. Calculate the calorimeter constant.

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210. A flask of $1L$ having $NH_3(g)$ at $2.0atm$ and $200K$ is connected with the another flask of volume $800mL$ having $HCI(g)$ at $8atm$ and $200K$ through a narrow tube of negligible volume. The two gases react to form $NH_4(CI(s)$ with evolution of $43kJmol^{-1}$ heat. if heat capacity of $HCI(g)$ at constant volume is $20JK^{-1}mol^{-1}$ and neglecting heat capacity of flask, and volume of solid NH_4CI formed, calculate the final temperature, and final pressure in the flasks. (Assume $R=0.08LatmK^{-1}mol^{-1})$

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211. The specific heat of a liquid was measured by placing $100g$ of the liquid in a calorimeter. The liquid was heate by an electric immersion coil. The heat capacity of the determined to be $31.4J/K$. With the $100g$ sample placed in the calorimeter, a current of 0.5 ampere was passed through the immersion coil for exactely 3 minutes. the voltage across the terminal of coil was measure to be $1.50V$. the temperature of the sample rose by $0.8^{\circ}C$. find the specific capacity of liquid.

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212. A sample of 3.0 mole of perfect gas at $200K$ and $2.0atm$ is compressed reversibly and adiabatically until the temperature reaches $250K$. Given that molar heat capacity at $27.5JK^{-1}mol^{-1}$ at constant volume calculate $q, W, \Delta U, \Delta H$ and the final pressure and volume.

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213. One mole of a monoatomic ideal gas is heated at constant pressure from $25^{\circ}C$ to $300^{\circ}C$. Calculate the $\Delta H, \Delta U$, work done and entropy change during the process. Given $C_v = \frac{3}{2}R$.

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214. Calculate the final temperature of a sample of CO_2 gas$(16g)$ that is expanded reversibly and adiabatically from 0.5 litre to 2.0 litre at $298K$. Also calculate the work done by the gas. If $C_{v.m}$ for CO_2 is $42JK^{-1}mol^{-1}$. Calculate the enthalpy change in the process. (take C_p / C_v for $CO_2 as 1.33$)

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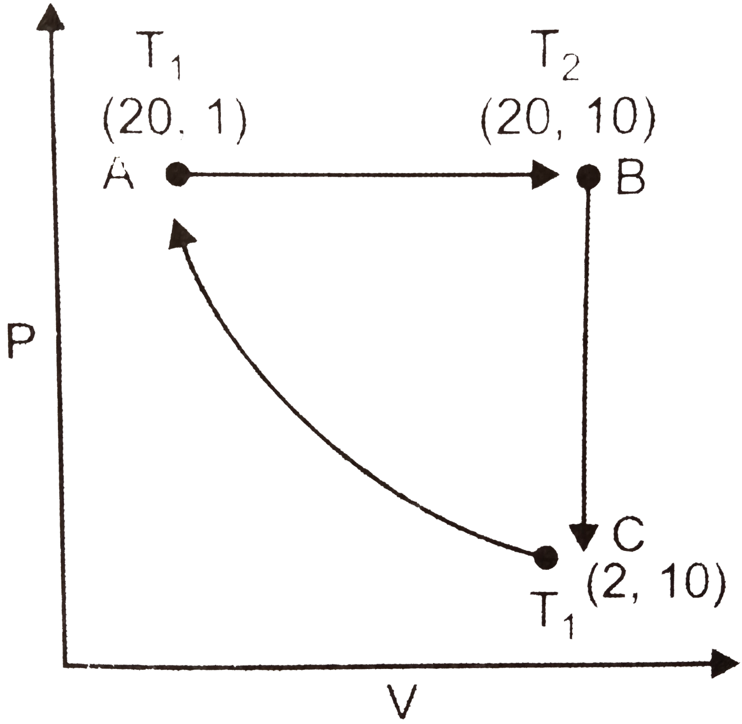
215. One mole of a perfect gas is put through a cycle consisting of the following three reversible steps:



(CA) isothermal compression from 2 atm and 10 litre to $20 atm$ and 1 litre.

(AB) Isobaric expansion to return the gas to the original volume of 10 litre with T going from T_1 to T_2.

(BC) Cooling at constnat volume to bring the gas to the original pressure and temperature. the steps are shown schematically in the figure shown.

(a) Calculate T_1 and T_2.

(b) Calculate ΔU, q and W in calories, for each step and for the cycle.

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216. $1g$ of water changes from liquid to vapour phase at constant pressure of 1 atmosphere, the volume increases from $1mL$ to $1671mL$. The heat of vaporisation at this pressure is $540cal / g$. Find the:

(a) Work done (in J)during phase change.

(b) Increase in internal energy of water.

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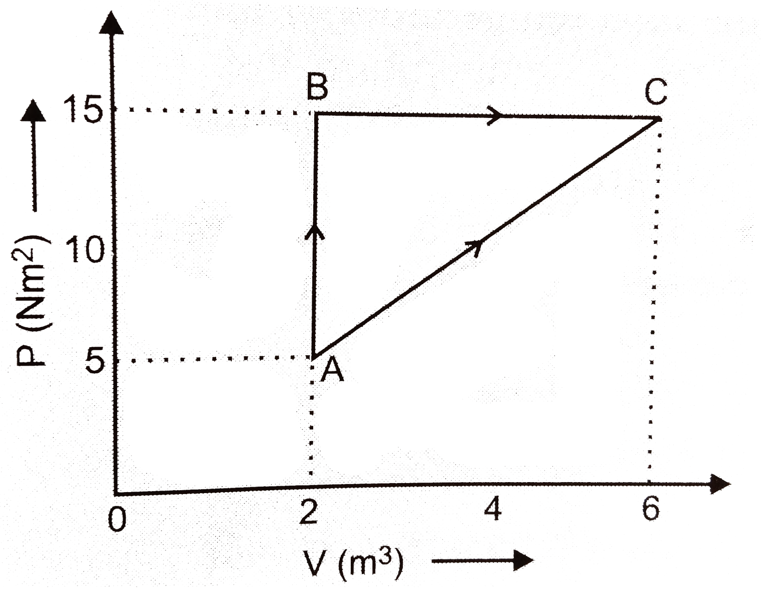
217. The given figure shown a change of state A to state C by two paths ABC and AC for an ideal gas. Calculate the :



(a) Path along which work done is least.

(b) Internal energy at C if the internal energy of gas at A is $10J$ and amount of heat supplied to change its state to C through the path AC is $200J$.

(c) Amount of heat supplied ot the gas to go from A to B, if internal energy of gas at state B is $10J$.

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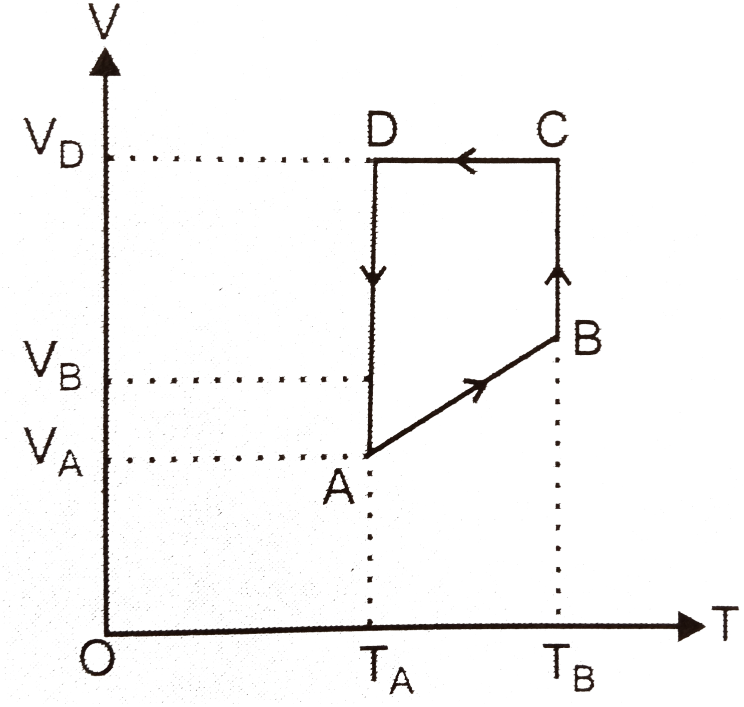
218. A monoatomic ideal gas of two moles is taken through a cyclic process starting from A as shown in figure. The volume ratios are $\frac{V_B}{V_A} = 2$ and $\frac{V_D}{V_A} = 4$. If the temperature T_A at A is $27^\circ C$, calculate:



(a) The temperature of the gas at point B.

(b) Heat absorbed or released by the gas in each process.

(c) The total work done by the gas during complete cycle.

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219. Two moles of helium gas $(r = 5/3)$ are initially at a temperature of $27^{\circ}C$ and occupy a volume of 20 litre. The gas is first expanded at constant pressure until the volume is doubled. It then undergoes adiabatic change until the temperature returns to its intial value.

(a) Sketch the process on $P - V$ diagram.

(b) What are final pressure and final volume of gas?

(c) What is the work done by the gas?

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220. An ideal gas has a specific heat at constant pressure $C_p = \frac{5}{2}R$. The gas is kept in a closed vessel of volume $0.0083m^3$, at temperature of $300K$ and pressure $1.6 \times 10^6 N/M^2$. An amount of $2.49 \times 10^4 J$ of energy is supplied to the gas. calculate the final temperature and pressure of the gas.

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221. A strip of magnesium of mass $15g$ is droped into an opean beaker of dilute hydrochloric acid. Calculate the work done by the system as a result of reaction. The atmospheric pressure is $1.0atm$ and temperature is $25^\circ C$. Also calculate the work done if the reaction is carried out in closed beaker.

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222. Calculate the work done when $56g$ of iron reacts with hydrochloric acid in (a) a closed vessel of fixed volume and (b)an open beaker at $25^\circ C$.

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223. The internal energy change in the conversion of 1.0 mole of the calcite form of $CaCO_3$ to the aragonite form is $+0.21KJ$. Calculate the enthalpy change when the pressure is 1.0bar, given the densities of the solids are $2.71gcm^{-3}$ and $2.93gcm^{-3}$ respectively.

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224. Calculate the work done when a system raises a colume of water of radius $5.0mm$ through $10cm$.

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225. A bulb of 100 watt is switched on in a room of dimensions $5 \times 4 \times 3m^3$. What will be the increases in temperature of room after 15 minute, if specific heat of iar at room temperature and 1 atm is $0.71Jg^{-1}K^{-1}$ and heat capacity of four walls and the roof is $50 \times 10^3 JK^{-1}$? (Density of air $1.22 \times 10^{-6} kgmL^{-1}$)

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226. For a reaction $M_2O_{(g)} \rightarrow 2M_{(s)} + \frac{1}{2}O_{2(g)}$, $\Delta H = 30kJmol^{-1}$ and $\Delta S = 0.07kJmol^{-1}$ at $1atm$. Calculate up to which temperature, the reaction would not be spontaneous.

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227. Consider a class room of dimesions $5 \times 10 \times 3m^3$ at temperature $20^\circ C$ and pressure $1atm$. There are 20 peoples in the room, each losing energy at the average of $150W$. Assuming that the walls, ceiling, floor, and furniture perfectly insulated and none of them absorbing heat, how much time will be needed for rising the temperature of air in the room to body temperature, i.e., $37^\circ C$? For air $C_P = \frac{7}{2}R$. Loss of air to outside as the temperature rises may be neglected.

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228. An athelete in a gymansium room lifts a $50kg$ mass through a vertical distance of $2.0m$, $g = 9.8ms^{-2}$. The mass is allowed to fall through 2.0 m distance while coupled to an electrical generator. The electrical generator produces an equal amount of electrical work. this electrical work is used to produce aluminium by hall's process involving the change, $Al_2O_3(\text{molten}) + 3C_{(s)} \rightarrow 2Al_{(l)} + 3CO_{(g)}$

The reaction require standard free energy change equal to $593kJ$. how many times must the athelete lift $50kg$ mass and to drop and couple with generator to produce sufficient Gibbs free energy to produce $27gAl$?

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229. An aeroplane weighing $63,000kg$ flies up from sea level to a height of 8000 meter. Its engine run with pure normal octane (C_8H_{18}) has a 30% efficiency. Calculate the fuel cost of the flight if octane sells at $Rs. 3$ per litre. Given density of octane $= 0.705 gmL^{-1}$, heat of combustion of octane $= 1300 kcal mol^{-1} (g = 981 m/s^2)$

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230. Titanium metal is extensively used in aerospace industry because the metal imparts strength to structures but does not unduly add to their masses. The metal is produced by the reduction of $TiCl_{4(l)}$ which in turn is produced from mineral rutile $[TiO_{2(s)}]$. can the following reaction for production of $TiCl_{4(l)}$ be carried out at $25^\circ C$?

$TiO_{2(s)} + 2Cl_{2(g)} \rightarrow TiCl_{4(l)} + O_{2(g)}$

Given that H_f° for $TiO_{2(s)}, TiCl_{4(l)}, Cl_{2(g)}$ and $O_{2(g)}$ are $-944.7, -804.2, 0.0, 0.0 kJmol^{-1}$. also S° for $TiO_{2(g)}, TiCl_{4(l)}, Cl_{2(g)}$ and $O_{2(g)}$ are $50.3, 252.3, 233.0, 205.1 Jmol^{-1}K^{-1}$ respectively.

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231. A lead bullet weighing $18.0g$ and travelling at $500m/s$ is embedded in a wooden block of $1.0kg$. If both the bullet and the block were initially at $25.0^\circ C$, what is the final temperature of the block containing bullet? Assume no temperature loss to the surrounding. (Heat capacity of wood $= 0.5 kcalkg^{-1}K^{-1}$, heat capacity of lead $= 0.030 kcalkg^{-1}K^{-1}$)

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232. The standard enthalpy and entropy changes for the reaction in equilibrium for the forward direction are given below:

$CO_{(g)} + H_2O_{(g)} \Leftrightarrow CO_{2(g)} + H_{2(g)}$

$\Delta H^{\circ}_{300K} = -41.16 kJmol^{-1}$

$\Delta S^{\circ}_{300K} = -4.24 \times 10^{-2} kJmol^{-1}$

$\Delta H^{\circ}_{1200K} = -32.93 KJmol^{-1}$

$\Delta S^{\circ}_{1200K} = -2.96 \times 10^{-2} kJmol^{-1}$

Calculate K_p at each temperature and predict the direction of reaction at $300K$ and $1200K$, when $P_{CO} = P_{CO_2} = P_{H_2} = P_{H_2O} = 1$ atm at initial state.

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