# d'doubtnut 

# India's Number 1 Education App 

## CHEMISTRY

## VMC MODULES ENGLISH

## THERMODYNAMICS

## LEVEL-0 (VERY SHORT ANSWER TYPE(1 MARK)

1. The internal energy change $(\Delta U)$ for the reaction $\mathrm{CH}_{4}(\mathrm{~g})+2 \mathrm{O}_{2}(\mathrm{~g}) \rightarrow \mathrm{CO}_{2}(\mathrm{~g})+2 \mathrm{H}_{2} \mathrm{O}(\mathrm{l})$ is $-885 \mathrm{kJmol}^{-1}$ at 298 K . What is $\Delta H$ at 398 K ?

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2. When 0.532 g of benzene $\left(C_{6} H_{6}\right)$, boiling point 353 K , is burnt with excess of oxygen in a constant volume system 22.3 kJ of heat is given out.

Calculate $\Delta H$ for the combustion process $\left(R=8.31 \mathrm{JK}^{-1} \mathrm{~mol}^{-1}\right)$.

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3. $\Delta U^{\circ}$ of combustion of methane is $-\mathrm{XkJmol}^{-1}$. The value of $\Delta H^{\circ}$ is
A. $=\Delta U^{\Theta}$
B. $>\Delta U^{\Theta}$
C. $<\Delta U^{\Theta}$
D. $=0$

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4. The enthalpy change on freezing of 1 mol of water at $5^{\circ} \mathrm{C}$ to ice at $-5^{\circ} \mathrm{C}$ is:
(Given $\Delta_{\mathrm{fus}} H=6 \mathrm{kJmol}^{-1} \mathrm{at}^{\circ}{ }^{\circ} \mathrm{C}$,
$C_{p}\left(\mathrm{H}_{2} \mathrm{O}, l\right)=75.3 \mathrm{Jmol}^{-1} \mathrm{~K}^{-1}$,
$\left.C_{p}\left(H_{2} O, S\right)=36.8 \mathrm{Jmol}^{-1} K^{-1}\right)$

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5. Calculate the entropy change in surroundings when 1.00 mol of $\mathrm{H}_{2} \mathrm{O}_{(l)}$ is formed under standard conditions. $\Delta_{f} H^{\theta}=-286 \mathrm{kJmol}^{-1}$

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6. Although heat is a path function but heat absorbed by the system under certain specific conditions is independent of path. What are those conditions ? Explain.

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1. a. A cylinder of gas is assumed to contain 11.2 kg of butane. If a normal family needs 20000 kJ of energy per day for cooking, how long will the cylinder last? Given that the heat of combustion of butane is $2658 \mathrm{kJmol}^{-1}$.

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2. 18.0 g of water completely vaporises at $100^{\circ} \mathrm{C}$ and 1 bar pressure and the enthalpy change in the process is $40.79 \mathrm{kJmol}^{-1}$. What will be the enthalpy change for vaporising two moles of water under the same conditions ? What is the standard enthalpy of vaporisation for water ?

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3. Calculate the difference between $C_{p}$ and $C_{V}$ for 10 mole of an ideal gas.
4. An ideal gas is allowed to expand against a constant pressure of 2 bar from 10 L to 50 L in one step. Calculate the amount of work done by the gas. If the same expansion were carried out reversibly, will the work done be higher or lower than the earlier case ?
(Give that, 1 L bar = 100 J )

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5. How will you calculate work done on an ideal gas in a compression, when change in pressure is carried out in infinite steps ?

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6. Enthalpy diagram for a particular reaction is given in figure. Is it possible to decide spontaneity of a reaction from given diagram. Explain.


## Reactants

Reaction coordinate

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7. (a) A sample of 1.0 mol of a monoatomic ideal gas is taken through a cyclic process of expansion and compression as shown in figure. What will be the value of $\Delta H$ for the cycle as a whole?
(b) Which quantity out of $\Delta_{r} G$ and $\Delta_{r} G^{\Theta}$ will be zero at equilibrium?



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## LEVEL-O (SHORT ANSWER TYPE-II (3 MAKRS))

1. What will be the work done on an ideal gas enclosed in a cyliner, when it is compressed by a constant external pressure, $p_{\text {ext }}$ in a single step as
shown in figure ? Explain graphically.


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2. Represent the potential energy/enthalpy change in the following processes graphically.
(a) Throwing a stone from the ground to roof.
(b) $\frac{1}{2} \mathrm{H}_{2}(g)+\frac{1}{2} \mathrm{Cl}_{2}(g) \Leftrightarrow \mathrm{HCl}(g) \Delta_{r} H^{\Theta}=-92.32 \mathrm{kJmol}^{-1}$

In which of the processes potential energy/enthalpy change is contributing factor to the spontaneity ?

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3. 1.0 mol of a monoatomic ideal gas is expanded from state (1) to state
(2) as shown in figure. Calculate the work done for the expansion of gas from state (1) to state (2) at 298 K .

4. One moles of an ideal gas which $C_{V}=3 / 2 R$ is heated at a constant pressure of 1 atm from $25^{\circ} \mathrm{C}$ to $100^{\circ} \mathrm{C}$. Calculate $\Delta U, \Delta H$ and the entropy change during the process.
A. 223.5 cal an d372.56 cal
B. 356.76 cal and 356.46 cal
C. 437.3 cal and 357.76 cal
D. 396.5 cal and 436.5 cal

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5. A gas occupies 2 litre at S.T.P. It is provided 300 joule heat so that its becomes 2.5 litre at 1 atm. Calculate change in its internal energy.
A. 330 J
B. 500 J
C. 356.9 J

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6. 100 mL 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 $1 m L$ at this constant pressure. Find $\Delta H$ and $\Delta U$.
A. 200 bar mL, 8000 bar mL
B. $300 \mathrm{barmL}, 7000 \mathrm{bar} \mathrm{mL}$
C. 100 bar mL, 9900 bar mL
D. 350 bar $\mathrm{mL}, 870$ bar mL
7. 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 $1 \times 10^{7} \mathrm{~Pa}$.
a. Calculate $V_{2}$.
b. If there were 2 mol of gas, what must its temperature have been?
A. $0.003,275 \mathrm{~K}$
B. $0.00043,261.13 \mathrm{~K}$
C. $0.0005,300 \mathrm{~K}$
D. $0.00049,353 \mathrm{~K}$

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2. The given figure shown a change of state $A$ to state $C$ by two paths
$A B C$ and $A C$ 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 $10 J$ and amount of heat supplied to change its state to $C$ through the path $A C$ is 200 J.
(c) Amount of heat supplied ot the gas to go from A to B, if internal energy of gas at state $B$ is 10 J .

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3. $14 g$ oxygen at $0^{\circ} \mathrm{C}$ and 10 atm is subjected to reversible adiabatic expansion to a pressure of 1 atm . Calculate the work done in
a. Litre atomsphere.
b. Calorie (given, $C_{P} / C_{V}=1.4$ ).

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

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5. Calculate the entropy change accompanying the conversion of 1 mole of ice at 273.1 K and 1 atm pressure into steam at 373.1 K and 1 atm pressure. At 273.1 K , the molar heat of fusion of ice, $\Delta H_{f}$ is $6.00 \mathrm{~kJ} \mathrm{~mol}^{-1}$ and at 373.1 K , the molar heat of vapourization of water, $\Delta H_{v}$, is 40.6 kJ $\mathrm{mol}^{-1}$. Also assume that the molar heat capacities, $C_{p}$, in the temperature range 373.1 to 273.1 K remains constant. Given that $C_{p}=75.25 \mathrm{mmol}^{-1} \mathrm{~K}^{-1}$ and $\log 13.66=1.1354$.

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

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## LEVEL-1

1. The work done during the expansion of a gas from $4 d m^{3}$ to $6 d m^{3}$ against at constant external pressure of 3 atm is ( $1 \mathrm{~L} \mathrm{~atm}=101.32 \mathrm{~J}$ )
A. -6 J
B. -608 J
C. 304 J
D. -304 J

## Answer: B

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2. In a adiabatic process.
A. $p . \Delta V=0$
B. $q=+W$
C. $\Delta E=q$
D. $q=0$

## Answer: D

3. In an isothermal process for an ideal gas

$$
\text { A. } \mathrm{q}=0 \text { and } \Delta E=0
$$

B. $q \neq 0$ and $\Delta E=0$
C. q=0 and $\Delta E \neq 0$
D. $q \neq 0$ and $\Delta E \neq 0$

## Answer: B

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4. A gas can expand from $100 m L$ to $250 m L$ under a constant pressure of

2 atm. The work done by the gas is
A. 30.83 J
B. 25 J
C. 5 kJ
D. 16 J

## Answer: A

5. What is $\Delta E$ for system that does 500 cal of work on surrounding and 300 cal of heat is absorbed by the system ?
A. -200 cal
B. -300 cal
C. +200 cal
D. +300 cal

## Answer: A

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6. The reaction $A \rightarrow B, \Delta H=+24 k J / m o l e$. For the reaction $B \rightarrow C$, $\Delta H=-18 \mathrm{~kJ} /$ mole. The decreasing order of enthalpy of $A, B, C$ follow the order
A. A,B,C
B. $B, C, A$
C. $C, B, A$
D. $C, A, B$

## Answer: B

## D Watch Video Solution

7. The cooking in refrigerator is due to:
A. Reaction of the refrigerator gas
B. Expansion of ice
C. The expansion of the gas in the refrigerator
D. The work of the compressor

## Answer: C

8. Heat required to raise the temperature of 1 mole of a substance by $1^{\circ}$ C is called
A. Specific heat
B. Molar heat capacity
C. Water equivalent
D. Specific gravity

## Answer: B

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9. An ideal gas expands from $10^{-3} \mathrm{~m}^{3}$ to $10^{-2} \mathrm{~m}^{3}$ at 300 K against a constant pressure of $10^{5} \mathrm{Nm}^{-2}$. The workdone is
A. -900 J
B. -900 kJ
C. 270 kJ
D. +900 kJ

## Answer: A

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10. Match the entries of Column-I with appropriate entries of Column-II and choose the correct option out of the four option (A), (B), (C) and (D).

| Cotumn-I |  | Column-II |  |
| :---: | :--- | :---: | :--- |
| (a) | Isothermal | (p) | $\mathrm{AT}=0$ |
| (b) | Isobaric | (q) | $\mathrm{AV}=0$ |
| (c) | Adiabatic | (r) | $\mathrm{AF}=0$ |
| (d) | Isochonic | (s) | $\mathrm{q}=0$ |

A. $a-p, b-q, c-r, d-s$
B. $a-p, b-r, c-s, d-q$
C. $a-s, b-p, c-r, d-q$
D. a-s, b-p, c-q, d-r

## Answer: B

11. Which of the following is true for an adiabatic process:
A. $\Delta H=0$
B. $\Delta W=0$
C. $d q=0$
D. $\Delta V=0$

## Answer: C

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12. Consider the reaction at 300 K
$\mathrm{C}_{6} \mathrm{H}_{6}(\mathrm{l})+\frac{15}{2} \mathrm{O}_{2}(\mathrm{~g}) \rightarrow 6 \mathrm{CO}_{2}(\mathrm{~g})+3 \mathrm{H}_{2} \mathrm{O}(\mathrm{l}), \Delta \mathrm{H}=-3271 \mathrm{~kJ}$
What is $\Delta U$ for the combustion of 1.5 mole of benzene at $27^{\circ} \mathrm{C}$ ?
A. -3267.25 kJ
B. -4900.88 kJ
C. -4906.5 kJ
D. -3274.75 kJ

## Answer: B

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13. An ideal gas expands against a constant external pressure of 2.0 atmosphere from 20 litre to 40 litre and absorbs 10 kJ of heat from surrounding. What is the change in internal energy of the system? (Given : 1 atm-litre = 101.3 J )
A. 4052 J
B. 5948 J
C. 14052 J
D. 9940 J

## Answer: B

14. For a closed container containing 100 mole of an ideal gas fitted with movable, frictionless, weightless piston operating such that pressure of gas remains constant at 8.21 atm. Which graph represents correct variation of $\log \mathrm{V}$ vs. $\log \mathrm{T}$ where V is in litre and T in kelvin?

(A)
A.

(B)
B.

(C)
C.

D.
(D)

## Answer: A

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15. 10 mole of ideal gas expand isothermally and reversibly from a pressure of 10 atm to 1atm at 300 K . What is the largest mass which can lifted through a height of 100 meter?
A. 31842 kg
B. 58.55 kg
C. 342.58 kg
D. None of these

## Answer: B

16. Under which of the following condition is the relation $\Delta H=\Delta U+P \Delta V$ valid for a closed system at
A. constant pressure
B. constant temperature
C. constant temperature and pressure
D. constant temperature, pressure and composition.

## Answer: A

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17. The work done in ergs for the reversible expansion of one mole of an ideal gas from a volume of 10 litres to a volume of 20 litres at $25^{\circ} \mathrm{C}$ is

$$
\text { A. }-2.303 \times 298 \times 0.082 \log 2
$$

B. $-298 \times 10^{7} \times 8.31 \times 2.303 \log 2$
C. $-2.303 \times 298 \times 0.082 \log 0.5$
D. $-8.31 \times 10^{7} \times 298-2.303 \log 0.5$

## Answer: B

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18. The molar heat capacities at constant pressure (assumed constant with respect to temperature) of $A, B$ and $C$ are in ratio of $3: 1.5: 2.0$. The enthalpy change for the exothermic reaction $A+2 B \rightarrow 3 C$ at 300 K is $\Delta H_{300}$ and $\Delta H_{310}$ and respectively then :
A. $\Delta H_{300}>\Delta H_{310}$
B. $\Delta H_{300}<\Delta H_{310}$
C. $\Delta H_{300}=\Delta H_{310}$
D. If $T_{2}>T_{1}$ then $\Delta H_{310}>\Delta H_{300}$ and if $T_{2}<T_{1}$ then

$$
\Delta H_{310}<\Delta H_{300}
$$

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19. Consider the reaction at 300 K
$C_{6} H_{6}(l)+\frac{15}{2} \mathrm{O}_{2}(g) \rightarrow 6 \mathrm{CO}_{2}(g)+3 \mathrm{H}_{2} O(l), \Delta H=-3271 k J$
What is $\Delta U$ for the combustion of 1.5 mole of benzene at $27^{\circ} C$ ?
A. -3271 kJ
B. -9813 kJ
C. -4906.5 kJ
D. None of these

## Answer: D

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20. Give the name of the following reaction:

$$
\mathrm{C}_{2} \mathrm{H}_{5} \mathrm{Br}+\mathrm{C}_{2} \mathrm{H}_{5} \mathrm{ONa} \rightarrow \mathrm{C}_{2} \mathrm{H}_{5} \mathrm{OC}_{2} \mathrm{H}_{5}+\mathrm{NaBr}
$$

A. -64.81
B. -190.71
C. -209.41
D. -224.38

## Answer: C

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21. One mole of solid Zn is placed in excess of dilute $\mathrm{H}_{2} \mathrm{SO}_{4}$ at $27^{\circ} \mathrm{C}$ in a cylinder fitted with a piston. Find the work done for the process of the area of piston is $500 \mathrm{~cm}^{2}$ and it moves out by 50 cm against a pressure of 1 atm during the reaction.
$Z n(s)+2 H^{+}(a q) \Leftrightarrow Z n^{2+}(a q)+H_{2}(g)$
A. $-1.53 k J$
B. $-2.53 k J$
C. zero
D. $2.53 K J$

## Answer: B

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22. The enthalpy change $(\Delta H)$ for the reaction
$\mathrm{N}_{2}(\mathrm{~g})+3 \mathrm{H}_{2}(\mathrm{~g}) \rightarrow 2 \mathrm{NH}_{3}(\mathrm{~g})$
is -92.38 kJ at 298 K . What is $\Delta U$ at $298 \mathrm{~K} ?\left(R=8.314 j \mathrm{~K}^{-1} \mathrm{~mol}^{-1}\right)$
A. -0.3024
B. -0.6048
C. -0.12
D. None

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23. When 1 g of ice at $0^{\circ} C$ melts to form 1 g of water at $0^{\circ} C$ then, is the latent heat absorbed by the ice or given out by it?
A. $\Delta H=720$ J
B. $\Delta H=1440 \mathrm{cal}$
C. $\Delta H=1.4 \mathrm{Kcal}$
D. $\Delta H=0$

## Answer: B

## D Watch Video Solution

24. 130 g of Zn is dissolved in dilute sulphuric acid in an open beaker.

Find the work done in the process assuming isothermal operation at

300K.
A. -1200 cal
B. -1800 cal
C. +1800 cal
D. none

## Answer: A

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25. The ammount of heat required to raise the temperature of 1 mole of diatomic gas by $1^{\circ} \mathrm{C}$ at constant pressure is 60 cal . The amount of heat which goes as internal energy of the gas is nearly.
A. 60 cal
B. 30 cal
C. 42.8 cal
D. 49.8 cal

## Answer: C

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26. Calculat average molar heat capacity at constant volume of gaseous mixture contained 2 mole of each of two ideal gases $A\left(C_{v, m}=\frac{3}{2} R\right)$ and $B\left(C_{v, m}=\frac{5}{2} R\right)$ :
A. R
B. 2 R
C. 3R
D. 8 R

## Answer: B

27. In the isothermal reversible compression of 52.0 m mol of a perfect gas at $260 K$, the volume of the gas is reduced to one - third of its initial value. Calculate $w$ of this process.
A. 0
B. +123 J
C. -123 J
D. +246 J

## Answer: B

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28. A sample of oxygen gas expands its volume from $3 L$ to $5 L$ against a constant pressure of 3 atm . If work done during expansion be used to heat 10 mole of water initially present at $290 K$, its finally temperature will be ( specific heat capacity of water $=4.18 \mathrm{~J} / k-g$ ):

## A. 292.0 K

B. 298.0 K
C. 290.8 K
D. 293.7 K

## Answer: C

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29. A : Work done by a gas in isothermal expension is more than the work done by the gas in the same expasion adiabatically.
$R$ : Temperature remains constant in isothermal expansion and not in adiabatic expansion.
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.

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30. Determine $\Delta U^{\circ}$ at 300 K for the following reaction using the listed enthalpies of reaction :
$4 \mathrm{CO}(g)+8 \mathrm{H}_{2}(g) \rightarrow 3 \mathrm{CH}_{4}(g)+\mathrm{CO}_{2}(g)+2 \mathrm{H}_{2} \mathrm{O}(l)$
$C($ graphite $)+1 / 2 \mathrm{O}_{2}(g) \rightarrow C O(g), \Delta H_{1}^{\circ}=-110.5 k J$
$C O(g)+1 / 2 \mathrm{O}_{2}(g) \rightarrow \mathrm{CO}_{2}(g), \Delta H_{2}^{\circ}=-282.9 k J$
$H_{2}(g)+1 / 2 \mathrm{O}_{2}(g) \rightarrow H_{2} O(l), \Delta H_{3}^{\circ}=-285.8 k J$
$C($ graphite $)+2 \mathrm{H}_{2}(g) \rightarrow C H_{4}(g), \Delta H_{4}^{\circ}=-74.8 k J$
A. -653.3 kJ
B. -686.2 kJ
C. -747.4 kJ
D. None of these

## Answer: D

31. From the given table answer the following questions:

|  | $\mathrm{CO}(\mathrm{g})$ | $\mathrm{CO}_{2}(\mathrm{~g})$ | $\mathrm{H}_{2} \mathrm{O}(\mathrm{g})$ | $\mathrm{H}_{2}(\mathrm{~g})$ |
| :---: | :---: | :---: | :---: | :---: |
| A, $1^{\text {a }}$ 2 (kcalimole) | -26.42 | -94.05 | -57.8 | 0 |
| 人_i ${ }_{238}$ (kcalimole) | $-32.79$ | $-94.24$ | $-54.64$ | 0 |
| A_3 ${ }_{236}^{u}$ (Cal/K mol) | 47.3 | 51.1 | ? | 31.2 |

Reaction: $\mathrm{H}_{2} \mathrm{O}(\mathrm{g})+\mathrm{CO}_{2}(\mathrm{~g}), \mathrm{H}_{2}(\mathrm{~g})+\mathrm{CO}_{2}(\mathrm{~g})$. Calculate $\mathrm{S}_{298}^{\circ} \mathrm{H}_{2} \mathrm{O}(\mathrm{g})$
A. $-119.47 \mathrm{CaI} / \mathrm{K}$ mole
B. $+119.47 \mathrm{CaI} / \mathrm{K}$ mole
C. $-45.13 \mathrm{Cal} / \mathrm{K}$ mole
D. $+45.13 \mathrm{Cal} / \mathrm{K}$ mole

## Answer: D

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32. Calculate the free energy change at 298 K for the reaction, $B r_{2}(l)+C l_{2}(g) \rightarrow 2 B r C l(g)$. For the reaction $\Delta H^{\circ}=29.3 \mathrm{KJ} \&$ the entropies of $B r_{2}(l), C l_{2}(g) \& B r C l(g)$ at the 298 K are 152.3,223.0,239.7 J $\mathrm{mol}^{-1} \mathrm{~K}^{-1}$ respectively.
A. -1721.8 J
B. -60321.8 J
C. +60321.8 J
D. +1721.8 J

## Answer: A

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33. One mole of an ideal gas is expanded from a volume of 3 L to 5 L under a constant pressure of 1 atm. Calculate the work done by the gas.
A. $\Delta E=0$
B. $\Delta H=0$
C. PV is constant
D. $\Delta S<0$

## Answer: D

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34. For the reaction $2 \mathrm{HgO}(s) \rightarrow 2 \mathrm{Hg}(\mathrm{l})+\mathrm{O}_{2}(g)$
A. $\Delta H>0$ and $\Delta S<0$
B. $\Delta H>O$ and $\Delta S>0$
C. $\Delta H<0$ and $\Delta S<0$
D. $\Delta H<0$ and $\Delta S>0$

## Answer: B

35. Predict which of the following reaction(s) has a positive entropy change?
I. $A g^{+}(a q)+C l^{-}(a q) \rightarrow \mathrm{AgCl}(s)$
II. $\mathrm{NH}_{4} \mathrm{Cl}(\mathrm{s}) \rightarrow \mathrm{NH}_{3}(\mathrm{~g})+\mathrm{HCl}(\mathrm{g})$
III. $2 \mathrm{NH}_{3}(g) \rightarrow \mathrm{N}_{2}(\mathrm{~g})+3 \mathrm{H}_{2}(\mathrm{~g})$
A. I and II
B. III
C. II and III
D. II

## Answer: C

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36. Which of the following is/are state function?
A. Enthalpy
B. Heat
C. Entropy
D. Gibb's fre energy (G)

## Answer: A::C::D

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37. The enthalpy of vaporisation of a liquid is $30 \mathrm{kJmol}^{-1}$ and entropy of vaporisation is $75 \mathrm{Jmol}^{-1} \mathrm{~K}^{-1}$. The boiling point of the liquid at 1 atm is
A. 250 K
B. 400 K
C. 450 K
D. 600 K

## Answer: B

38. When the gas is ideal and process is isothermal, then
A. $P_{1} V_{1}=P_{2} V_{2}$
B. $\Delta H=0$
C. $\Delta W=0$
D. $\Delta H_{1}=\Delta H_{2}$

## Answer: A::B::D

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39. A system absorbs 300 cal of heat, its volume doubles and temperature rises from 273 to $298 k$, the work done on the surrounding is 200 cal . $\Delta E$ for the above reaction is :
A. 100 cal
B. 500 cal
C. -5.00 cal
D. -100 cal

## Answer: A

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40. Temperature of one mole of a gas is increased by $1^{\circ} \mathrm{C}$ at constant pressure. The work done on the system is

A. R
B. 2 R
C. $R / 2$
D. $-R$

Answer: D
41. P-V plot for two gases (assuming ideal) during adiabatic processes are given in the Fig. Plot $A$ and plot $B$ should correspond respectively to:

A. He and $H_{2}$
B. $H_{2}$ and He
C. He and Ne
D. $\mathrm{H}_{2}$ and $\mathrm{Cl}_{2}$

## Answer: B

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42. Calculate the final temperature of a monoatomic ideal gas that is compressed reversible and adiabatically from $16 L$ to $2 L$ at $300 K$ :
A. 600 K
B. 1044.6 K
C. 1200 K
D. 2400 K

## Answer: C

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43. The adsorption of vapours on a clean surface is a spontaneous
A. change in the entropy of the process is highly positive
B. enthalpy change is highly positive
C. change in entropy is zero
D. change in enthalpy is highly negative

## Answer: D

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44. Column-I and Column-II contains four entries each. Entries of Column-I are to be matched with some entries of Column-II.

One or more than one entries of Column-I may have the matching with the same entries of Column-II and select the correct answer using the code given below the Columns

| Column-I |  | Column-II |  |
| :--- | :--- | :--- | :--- |
| (A) | Reversible cooling of an ideal gas at constant volume | (p) | $w=0 ; q<0 ; \Delta U<0$ |
| (B) | Reversible isothermal expansion of an ideal gas | (q) | $w<0 ; q>0 ; \Delta u>0$ |
| (C) | Adiabatic expansion of non-ideal gas into vaccum | (r) | $w=0 ; q=0 ; \Delta U=0$ |
| (D) | Reversible melting of sulphur at normal melting point | (s) | $6<0 ; q>0 ; A U=0$ |

A. $a-p, b-s, c-r, d-q$
B. $a-p, b-s, c=s, d-q$
C. $a-s, b-p, c-r, d-q$
D. a-p, b-r, c-r, d-q

Answer: A

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45. Match Column-I with Column-II and select the correct answer using the code given below the Columns

| Column-I |  | Column-II |  |
| :--- | :--- | :---: | :--- |
| (A) | Adiabatic process | (p) | $q=0$ |
| (B) | Isothermal process | (q) | $\Delta 4-0$ |
| (C) | Isoenthalpic process | (r) | $\Delta \mathrm{T}=0$ |
| (D) | Isoentropic process | (s) | $\Delta \Sigma-0$ |

A. $a-r, b-r, c-q, d-s$
B. $a-p, b-r, c-q, d-q$
C. a-p, b-r, c-q, d-s
D. $a-p, b-r, c-s, d-s$

## Answer: C

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46. A process is taking place at constant temperature and pressure. Then
A. $\Delta H=\Delta E$
B. $\Delta H=T \Delta S$
C. $\Delta H=0$
D. $\Delta S=0$

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

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47. In view of the signs of $\Delta_{r} G^{\circ}$ for the following reactions
$\mathrm{PbO}_{2}+\mathrm{Pb} \rightarrow 2 \mathrm{PbO}, \Delta_{r} \mathrm{G}^{\circ}<0$
$\mathrm{SnO}_{2}+\mathrm{Sn} \rightarrow 2 \mathrm{SnO}, \Delta_{r} G^{\circ}>0$
Which oxidation states are more characteristic for lead and tin?
A. For lead +4 , for tin +2
B. for lead +2 , for lin +2
C. for lead +4 , for tin +4
D. for lead +2 , for tin +4

## Answer: D

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48. A plot of $\ln \mathrm{k}$ against $\frac{1}{T}$ (abscissa) is expected to be a straight line with intercept on coordinate axis equal to
A. $\frac{\Delta S^{\circ}}{2.303 R}$
B. $\frac{\Delta S^{\circ}}{R}$
C. $-\frac{\Delta S^{\circ}}{R}$
D. $R \times \Delta S^{\circ}$

## Answer: B

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49. The correct relationship between free energy change in a reaction and the corresponding equilibrium constant, $K_{c}$ is
A. $\Delta S-R T$ in $K_{c}$
B. $-\Delta G=R T \ln K_{c}$
C. $\Delta G^{\circ}=R T \ln$ in $K_{C}$
D. $-\Delta G^{\circ}=R T \ln K_{c}$

Answer: D

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50. For the reaction at 298 K
$A(g)+B(g) \Leftrightarrow C(g)+D(g)$
If $\Delta H^{\circ}=29.8 \mathrm{Kcal}$ and $\Delta S^{\circ}=0.1 \mathrm{KcalK}^{-1}$ then calculate reaction constant (k)
A. 1
B. 0
C. 2
D. 4

## Answer: B

51. एंटोपि का मात्रक है --
A. $J K^{-1} \mathrm{~mol}^{-1}$
B. $\mathrm{Jmol}^{-1}$
C. $J^{-1} R^{-1} \mathrm{~mol}^{-1}$
D. $\mathrm{JRmol}^{-1}$

## Answer: A

## - Watch Video Solution

52. For a system in equilibrium, $\Delta G=0$, under conditions of constant
A. Temperature and pressure
B. Temperature and volume
C. Pressure and volume
D. Energy and volume

## Answer: A

53. Calculate the entropy change for the following reaction
$\mathrm{H}_{2}(\mathrm{~g})+\mathrm{CI}_{2}(\mathrm{~g}) \rightarrow 2 \mathrm{HCI}(\mathrm{g}) \mathrm{at} 298 \mathrm{~K}$
Given $\quad S^{\Theta} H_{2}=131 \mathrm{JK}^{-1} \mathrm{~mol}^{-1}, S^{\Theta} C I_{2}=233 \mathrm{JK}^{-1} \mathrm{~mol}^{-1}, \quad$ and $S^{\Theta} H C I=187 \mathrm{JK}^{-1} \mathrm{~mol}^{-1}$
A. $10 \mathrm{JK}^{-1} \mathrm{~mol}^{-1}$
B. $-20 \mathrm{JK}^{-1} \mathrm{~mol}^{-1}$
C. $167 \mathrm{JK}^{-1} \mathrm{~mol}^{-1}$
D. $-167 \mathrm{JK}^{-1} \mathrm{~mol}^{-1}$

## Answer: A

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54. The free energy for a reaction having $\Delta H=31400 \mathrm{cal}$, $\Delta S=32$ cal $K^{-1} \mathrm{~mol}^{-1}$ at $1000^{\circ} \mathrm{C}$ is:
A. -9336 cal
B. -7386 cal
C. -1936 cal
D. +9336 cal

## Answer: A

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55. Spontaneous adsorption of a gas on solid surface is an exothermic process because
A. $\Delta H$ increase for system
B. $\Delta S$ increases for gas
C. $\Delta H$ decreases for gas
D. $\Delta G$ increases for gas

## Answer: C

56. The enthalpy change for transition of liquid water to steam is 40.8 kJ $\mathrm{mol}^{-1}$ at 373 K . Calculate $\Delta S$ for the process.
A. 209.4
B. 109.4
C. 250
D. -209 A

## Answer: B

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57. Which of the following statements is true?
A. $\Delta G$ is always less than $\Delta H$
B. $\Delta G$ is always more than $\Delta H$
C. $\Delta G$ is always proportional to $\Delta H$
D. $\Delta G$ may be lesser, greater or equal to $\Delta H$

Answer: D

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58. In a reversible process, the value of $\Delta S_{s y s}+\Delta S_{s u r r} i s$
A. $>0$
B. $<0$
C. $\geq 0$
D. $=0$

Answer: D

- Watch Video Solution

59. Consider the following cyclic process.

I. Isothermal , II. Adiabatic , (III) constant pressure process Sum of the work and heat in the above is:
A. zero
B. pV
C. R
D. $-p V$
60. The following diagram represents the ( $p-V$ ) changes of gas. Thus, total work done is:

A. $P_{2}\left(V_{2}-V_{1}\right)+P_{3}\left(V_{3}-V_{2}\right)$
B. $P_{1}\left(V_{2}-V_{1}\right)+P_{3}\left(V_{3}-V_{2}\right)$
C. $P_{2}\left(V_{3}-V_{1}\right)+P_{3}\left(V_{2}-V_{1}\right)$
D. $P_{2}\left(V_{3}-V_{2}\right)+P_{3}\left(V_{2}-V_{1}\right)$

## - Watch Video Solution

61. Which of the following proces is (are) expected to be spontaneous at higher temperature but non-spontaneous at lower temperature?
A. $\mathrm{N}_{2}(\mathrm{~g})+3 \mathrm{H}_{2}(\mathrm{~g}) \rightarrow 2 \mathrm{NH}_{3}(\mathrm{~g})$
B. $\mathrm{H}_{2}(\mathrm{~g}) \rightarrow 2 \mathrm{H}(\mathrm{g})$
C. $\mathrm{CO}_{2}(g)+C(s) \rightarrow 2 \mathrm{CO}(g)$
$\left[\Delta H_{f}^{\Theta}, m, \mathrm{CO}_{2}=-394 \mathrm{~kJ} / \mathrm{mol}, \mathrm{CO}=-212 \mathrm{~kJ} / \mathrm{mol}\right]$
D. $\mathrm{Na}(\mathrm{s}) \rightarrow \mathrm{Na}^{+}(\mathrm{g})+\mathrm{e}^{-}$

## Answer: B::D

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62. Which of the plots of $\ln \mathrm{K}$ vs $\left(\frac{1}{T}\right)$ is/are correct?

A.

B.

C.

D.

Answer: A::B::C::D
63. The value of $\Delta H_{\text {transition }}$ of C (graphite) $\rightarrow \mathrm{C}$ (diamond) is $1.9 \mathrm{~kJ} / \mathrm{mol}$ at $25^{\circ} \mathrm{C}$. Entropy of graphite is higher than entropy of diamond. This implies that :
A. C(diamond) is more thermodyanically stable than C (graphite) at $25^{\circ} \mathrm{C}$
B. C(graphite) is more thermodyanically stable than C (diamond) at $25^{\circ} \mathrm{C}$
C. Diamond will provide more heat on complete combustion at $25^{\circ} \mathrm{C}$
D. $\Delta G_{\text {transition }}$ of C (diamond) $\rightarrow C$ (graphite) is $-v e$.

## Answer: B::C::D

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64. Among the following , the state funcation (s) is (are)
A. Internal energy
B. Molar enthalpy
C. Reversible expansion work
D. Irreversible expansion work

## Answer: A: B

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65. For an endothermic reaction, $\Delta H$ represents the enthalpy of the reaction in $\mathrm{kJ} \mathrm{mol}{ }^{-1}$. The mininum amount of activation energy will be
A. Less than $\Delta H$
B. zero
C. more than $\Delta H$
D. equal to $\Delta H$

## Answer: C

66. Match the following:

| Column I |  | Column II |  |
| :---: | :---: | :---: | :---: |
| (A) | $\begin{aligned} & \left.\mathrm{CO}_{2}(\mathrm{~g})+\mathrm{C}(\mathrm{~s}) \longrightarrow 2 \mathrm{CO} \mathrm{~g}\right) \\ & \left.\Delta_{\mathrm{HH}^{\circ}}: \mathrm{CO}_{2}=-394 \text { and } \mathrm{CO}=220 \mathrm{~kJ} / \mathrm{mal}\right] \end{aligned}$ | (1) | $\Delta_{2} \mathrm{~S}>0$ |
| (B) |  | (2) | $\Delta, H>\Delta$ |
| (C) | $\mathrm{CO}(\mathrm{g})+\mathrm{Cl}_{2}(\mathrm{~g}) \longrightarrow \mathrm{COCl}_{2}(\mathrm{~g})$ | (3) | $\Delta_{2} \mathrm{H}<\Delta_{L}{ }^{\mathrm{J}}$ |
| (D) | $\mathrm{Cl}_{2}(\mathrm{~g}) \longrightarrow 2 \mathrm{Cl}$ (g) | (4) | $\Delta_{t} \mathrm{G}>0$ |

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## 67. Match the Column:

| Column I |  | Column II |  |  |
| :--- | :--- | :--- | :--- | :--- |
| (A) | $H^{-}$adi |  | (1) | $A_{t^{2}}-0$ |


| (B) | $H(g)$ | (2) | $\Delta \Delta^{*}+0$ |
| :--- | :--- | :--- | :--- |
| (C) | $H, G)$ | (3) | $\Delta_{f}{ }^{\circ}-0$ |
| (D) | (s, dian ond | (4) | $\Delta_{ \pm} a^{\circ}<0$ |

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68. For the gas phase reaction,
$P C l_{5}(g) \Leftrightarrow P C l_{3}(g)+C l_{2}(g)$

Which of the following conditions are correct ?
A. $\Delta H<0$ and $\Delta S<0$
B. $\Delta H>0$ and $\Delta H<0$
C. $\Delta H=0$ and $\Delta S<0$
D. $\Delta H>0$ and $\Delta S>0$

## Answer: D

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69. The Haber's process of production of ammonia involves the equilibrium:
$\mathrm{N}_{2}(\mathrm{~g})+3 \mathrm{H}_{2}(\mathrm{~g}) \Leftrightarrow 2 \mathrm{NH}_{2}(\mathrm{~g})$
Assuming $\Delta H^{\circ}$ and $\Delta S^{\circ}$ for the reaction do not change with temperature, which of the statements is true?

$$
\left(\Delta H^{\circ}=-95 k J \text { and } \Delta S^{\circ}=-198 J K^{-1}\right)
$$

A. Ammonia dissociates spontaneously below 500 K
B. Ammonia dissociates spontaneously above 500 K
C. Ammonia dissociates at all temperatures.
D. Ammonia does not dissociates at any temperatures.

## Answer: B

## D Watch Video Solution

70. If a gas, at constant temperature and pressure expands, then its
A. Entropy increases and then decreases
B. Internal enery increases
C. Internal energy remains the same
D. Internal energy decreases

## Answer: C

71. Considering the reaction,
$\mathrm{C}(\mathrm{s})+\mathrm{O}_{2}(\mathrm{~g}) \rightarrow \mathrm{CO}_{2}(\mathrm{~g})+393.5 \mathrm{~kJ}$
the signs of $\Delta H, \Delta S$ and $\Delta G$ respectively are:
A.,,+-
B.,,-+-
C.,,---
D.,,-+ 1

## Answer: D

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72. Considering entropy ( S ) as a thermodynamic parameter, the criterion for the spontaneity of any process is
A. $\Delta S_{\text {system }}+\Delta(S)_{\text {surrounding }}>0$
B. $\Delta S_{\text {system }}-\Delta S_{\text {surroundings }}>0$
C. $\Delta S_{\text {system }}>0$ only
D. $\Delta S_{\text {surrounding }}>0$ only

## Answer: A

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73. Assuming $\Delta H^{\circ}$ and $S^{\circ}$ do not change with temperature. Calculate, the boiling point of liquid A using the thermodynamic data given below.

| Thermodynamic data | A() | $\mathrm{A}(\mathrm{g})$ |
| :--- | :---: | :---: |
| $\Delta_{2} \mathrm{H}^{\circ}(\mathrm{kJ} / \mathrm{mol})$ | -130 | 100 |
| $\mathrm{~S}^{\circ}\left(\mathrm{T} \mathrm{K}^{-1} \mathrm{~mol}^{1}\right)$ | 100 | 200 |

A. 300 K
B. 130 K
C. 150 K
D. 50 K

## Answer: A

74. For a phase change:
$\mathrm{H}_{2} \mathrm{O}(\mathrm{l}) \Leftrightarrow \mathrm{H}_{2} \mathrm{O}(s)$
$0^{\circ} C, 1$ bar
A. $\Delta G=0$
B. $\Delta S=0$
C. $\Delta H=0$ and $\Delta S<0$
D. $\Delta U=0$

## Answer: A

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75. For the process $\mathrm{H}_{2} \mathrm{O}(l)(1 \mathrm{bar}, 373 \mathrm{~K}) \rightarrow \mathrm{H}_{2} \mathrm{O}(\mathrm{g})(1 \mathrm{bar}, 373 \mathrm{~K})$ the correct set of thermodynamic parameters is
A. $\Delta G=0, \Delta S=+v e$
B. $\Delta G=0, \Delta S=-v e$
C. $\Delta G=+v e, \Delta S=0$
D. $\Delta G=-v e, \Delta S=+v e$

## Answer: A

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## LEVEL-2

1. Which of the following regarding the said processes is (are) correct?
A. Expansion of an ideal gas against vaccum is always reversible
B. A spontaneous proces is always irreversible
C. In a reversible thermodynamic process, system always remains in
D. If a system containing ideal gas in a piston udergoes expansion
from a given initial state to the same final volume,the surroundings
loses more heat if expansion is carried out irreversibly rather reversibly

## Answer: B::C::D

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2. Match the following:

| Column I |  | Column II |  |
| :---: | :--- | :---: | :--- |
| (A) | Isothermal processes | (1) | $\Delta U=0$ |
| (B) | Reversible adiabatic process | $(2)$ | $\Delta-0$ |
| (C) | Cyclic process | (3) | $\Delta S-0$ |
| (D) | Isochoric process | (4) | $w=0$ |

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3. A gas expands isothermally against a constant external pressure of 1 atm from a volume of $10 \mathrm{dm}^{3}$ to a volume of $20 \mathrm{dm}^{3}$. It absorbs 800 J of
thermal energy from its surroundings. The $\Delta \mathrm{U}$ is
A. -312 J
B. +123 J
C. -213 J
D. $+231 J$

## Answer: C

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4. In which of the following reactions, the enthalpy is the least ?
A. $\mathrm{CH}_{3} \mathrm{COOH}+\mathrm{NaOH} \rightarrow \mathrm{CH}_{3} \mathrm{COONa}+\mathrm{H}_{2} \mathrm{O}$
B. $\mathrm{HCl}+\mathrm{NH}_{4} \mathrm{OH} \rightarrow \mathrm{NH}_{4} \mathrm{Cl}+\mathrm{H}_{2} \mathrm{O}$
C. $\mathrm{HCl}+\mathrm{NaOH} \rightarrow \mathrm{NaCl}+\mathrm{H}_{2} \mathrm{O}$
D. $\mathrm{HCN}+\mathrm{NH}_{4} \mathrm{OH} \rightarrow \mathrm{NH}_{4} \mathrm{CN}+\mathrm{H}_{2} \mathrm{O}$

## Answer: D

5. Molar entropy change is $16 \mathrm{~J} \mathrm{~mol}^{-1} \mathrm{~K}^{-1}$, the boiling points of the liquid is if molar heat of vaporization is $6 \mathrm{~kJ} / \mathrm{mol}$.
A. $375^{\circ} \mathrm{C}$
B. 375 K
C. 273 K
D. $102^{\circ} \mathrm{C}$

## Answer: B

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6. For the reaction of one mole of zinc dust with one mole of sulphuric acid in a bomb calorimeter, $\Delta U$ and $w$ corresponds to
A. $\Delta U<0, w=0$
B. $\Delta U<0, w<0$
C. $\Delta U>0, w>0$
D. $\Delta U>0, w>0$

## Answer: A

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7. Assuming that water vapour is an ideal gas, the internal energy change $(\Delta U)$ when 1 mol of water is vapourised at 1 bar pressure and $100^{\circ} \mathrm{C}$, (Given: Molar enthalpy of vapourization of water at 1 bar and $373 K=41 \mathrm{kJmol}^{-1}$ and $R=8.3 \mathrm{Jmol}^{-1} \mathrm{~K}^{-1}$ ) will be:
A. $41.00 \mathrm{k} \mathrm{Tmol}^{-1}$
B. $4.100 \mathrm{kJmol}^{-1}$
C. $3.7904 \mathrm{kJmol}^{-1}$
D. $37.904 \mathrm{kJmol}^{-1}$

## Answer: D

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8. A sample of oxgyen gas expands its volume from 3 L to 5 L against a constant pressure of 3 atm. If work done during expansion to used to heat 10 mole of water initially present at 290 K , its final temperature will be (specific heat capacity of water $=4.18 \mathrm{~J} / / \mathrm{K}-\mathrm{g}$ )
A. $292,0 \mathrm{~K}$
B. 290.8 K
C. 298.0 K
D. 293.7 K

## Answer: B

9. If $x$ and $y$ are arbitrary intensive variables, then
A. $(\mathrm{P}+\mathrm{Q})$ is extensive property
B. $P / Q$ is an intensive varibale
C. PQ is an intensive variable
D. $\frac{d P}{d Q}$ is an intensive property.

## Answer: B::C::D

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10. $\Delta E=0$ for which process
A. Cyclic process
B. Isothermal expansion
C. Isochoric process
D. Adiabatic process

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11. What will be the entropy change when two moles of an ideal gas expand reversibly from initial volume of 1 litre to 10 litre at constant temperature of 300 K ?
A. $19.15 \mathrm{JK}^{-1} \mathrm{~mol}^{-1}$
B. $38.27 \mathrm{JK}^{-1} \mathrm{~mol}^{-1}$
C. $11.48 \mathrm{JK}^{-1} \mathrm{~mol}^{-1}$
D. $5.74 \mathrm{kJK}^{-1} \mathrm{~mol}^{-1}$

## Answer: B

12. The state of a mole of an ideal gas changed from state $A$ at pressure $2 P$ and volume $V$ follows four different processes and finally returns to initial state $A$ reversibly as shown below in the graph. By interpreting the graph, answer the following questions.


Which is the kind of process followed from state $A$ to state, $B$ ?
A. isochoric expansion
B. Isobaric expansion
C. Isothermal reversible expansion
D. Isothermal irreversible compression

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13. The state of a mole of an ideal gas changed from state $A$ at pressure $2 P$ and volume $V$ follows four different processes and finally returns to initial state $A$ reversibly as shown below in the graph. By interpreting the graph, answer the following questions.


In state $D$ to state $A$, what kind of process is followed?
A. Isobaric expansion
B. Isobaric compression
C. Isochroic process
D. Isothermal compression

## Answer: C

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14. The state of a mole of an ideal gas changed from state $A$ at pressure $2 P$ and volume $V$ follows four different processes and finally returns to initial state $A$ reversibly as shown below in the graph. By interpreting the graph, answer the following questions.

what would the be total work done by the gas?

$$
\text { A. }-P V
$$

B. PV
C. 0
D. None of these

## Answer: A

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15. The state of a mole of an ideal gas changed from state $A$ at pressure $2 P$ and volume $V$ follows four different processes and finally returns to initial state $A$ reversibly as shown below in the graph. By interpreting the graph, answer the following questions.


What would be the work done in state $B \rightarrow C$ ?
A. $P V$
B. PV
C. 2 PV
D. Zero

## Answer: D

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16. What would be the heat absorbed by the system in the cyclic process?
A. $-2 P V$
B. zero
C. 2PV
D. PV

## Answer: A

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17. A sample consisting of 1 mole of a mono-atomic perfect gas $\left(C_{v}=\frac{3}{2} R\right)$ is taken through the cycle as shown.

#  <br> Volume. V(L) 

Temperature at points (1), (2) and (3), respectively is:
A. $273 \mathrm{~K}, 546 \mathrm{~K}, 273 \mathrm{~K}$
B. $546 \mathrm{~K}, 273 \mathrm{~K}, 273 \mathrm{~K}$
C. $273 \mathrm{~K}, 273 \mathrm{~K}, 273 \mathrm{~K}$
D. $546 \mathrm{~K}, 546 \mathrm{~K}, 273 \mathrm{~K}$

Answer: D
18. A sample consisting of 1 mol of a mono-atomic perfect gas $\left(C_{V}=\frac{3}{2} R\right)$ is taken through the cycle as shown.

$\Delta H$ for the overall cycle is
A. $+5.67 \times 10^{3}$ J
B. $-5.67 \times 10^{3}$ J
C. $-11.34 \times 10^{3} \mathrm{~J}$
D. zero

## Answer: D

19. A sample consisting of 1 mol of a mono-atomic perfect gas $\left(C_{V}=\frac{3}{2} R\right)$ is taken through the cycle as shown.

$\Delta U$ for the process $(1 \rightarrow 2)$ is
A. 0.00 J
B. $+3.40 \times 10^{3}$ J
C. -3.40 J
D. $-3.40 \times 10^{3}$ J

## D Watch Video Solution

20. A sample consisting of 1 mol of a mono-atomic perfect gas $\left(C_{V}=\frac{3}{2} R\right)$ is taken through the cycle as shown.

$\Delta U$ for the process $(2 \rightarrow 3)$ is
A. 0.00 J
B. +3.40 kJ
C. -3.40 kJ
D. None of these

## Answer: C

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21. The enthalpy of vaporization of chloroform is $29.4 \mathrm{kJmol}^{-1}$ at its normal boiling point of $61.7^{\circ} \mathrm{C}$. What is the entropy of condensation of chlorofom at this temperature?
A. -57.3 R
B. -10.6 R
C. -1.18 R
D. 10.6 R

## Answer: B

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22. Combustion of sucuose is used by aeroic organisms for providing energy for the life sustaining processes. If all the capturing of energy from the reaction is done through electrical process (non P-V word) then calculate maximum available energy which can be captured by combustion of 34.2 gm of sucrose

Given : $\Delta H_{\text {combustion }}($ sucrose $)=-6000 \mathrm{~kJ} \mathrm{~mol}^{-1}$
$\Delta S_{\text {combustion }}=180 \mathrm{~J} / \mathrm{K}-\mathrm{mol}$ and body temperature is 300 K
A. 600 kJ
B. 594.6 kJ
C. 5.4 kJ
D. 605.4 kJ

## Answer: D

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23. The freezing of any liquid to a solid is expected to have:
A. a positive $\Delta H$ and a positive $\Delta S$
B. a negative $\Delta H$ and a positive $\Delta S$
C. a positive $\Delta H$ and a negative $\Delta S$
D. a negative $\Delta H$ and a negative $\Delta S$.

## Answer: D

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24. Industrial acetylene gas (ethyne: $C_{2} H_{2}$ ) is made by the high temperature decomposition of ethane gas: $C_{2} H_{6}$, at $300^{\circ} \mathrm{C}$, according to the following equation: $\mathrm{C}_{2} \mathrm{H}_{6}(\mathrm{~g}) \rightarrow \mathrm{C}_{2} \mathrm{H}_{5}(\mathrm{~g})+2 \mathrm{H}_{2}(\mathrm{~g})$
A. $\Delta_{r} G^{\circ}>\Delta_{r} H^{\circ}$ and $\Delta_{r} S^{\circ}>0$
B. $\Delta_{r} G^{\circ}<\Delta_{r} H^{\circ}$ and $\Delta_{r} S^{\circ}$ It 0
C. $\Delta_{r} G^{\circ}<\Delta_{r} H^{\circ}$ and $\Delta_{r} S^{\circ}>0$
D. $\Delta_{r} G^{\circ}>\Delta_{r} S^{\circ}<0$

## Answer: C

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25. Which one of the following statements is true
A. For a given transfer of energy, the increase in entropy is directly proportinal to the temperature.
B. $B r_{g}(g)$ has a lower entropy than $B r_{2}$ ?
C. The standard free energy of formation of $\mathrm{Hg}(\mathrm{I})$ is zero .
D. Endothermic reaction wit a neegative entropy change are always non-spontaneous

## Answer: C::D

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26. Calculate the standard free energy change for the formation of methane at 300 K :

C (graphite) $+2 \mathrm{H}_{2}(\mathrm{~g}) \rightarrow \mathrm{CH}_{4}(\mathrm{~g})$
The following data are given:
$\Delta_{f} H^{\Theta}\left(k J m o l^{-1}\right): C H_{4}(g)=-74.81$
$\Delta_{f} S^{\Theta}\left(J^{-1} \mathrm{~mol}^{-1}\right): C($ graphite $)=5.70, H_{2}(g)=130.7 C H_{4}(g)=186.3$
A. $\Delta_{r} G^{\circ}$ is -50.8 kJ and the reactionis driven by enthalpy only
B. $\Delta_{r} G^{\circ}$ is -50.8 kJ and the reaction is driven by entropy only
C. $\Delta_{r} G^{\circ}$ is $+5.0 k J$ and the reaction is driven by enthalpy and entropy
D. $\Delta_{r} G^{\circ}$ is -50.8 kJ and the reaction is driven by enthalpy and entropy

## Answer: A

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27. Given: $\Delta_{f} H^{\circ}(\mathrm{kJ} / \mathrm{mol}) \quad S_{m}^{\circ}(\mathrm{J} / \mathrm{Kmol})$
$\mathrm{CCl}_{4}(\mathrm{l}) \quad-135 \quad 215.4$
$C C l_{4}(g) \quad-103.0 \quad 308.7:$
What is the boiling point of carbon tetrachloride?
A. $8.25^{\circ} \mathrm{C}$
B. $69.97^{\circ} \mathrm{C}$
C. $92.3^{\circ} \mathrm{C}$
D. $45.8^{\circ} \mathrm{C}$

## Answer: B

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28. Calculate the change in molar Gibbs energy of carbon dioxide gas at $20^{\circ} \mathrm{C}$ when it is isothermally compressed from 1.0 bar to 2.0 bar.
A. $2.4 \mathrm{~kJ} / \mathrm{mol}$
B. $-2.4 \mathrm{~kJ} / \mathrm{mol}$
C. $1.7 \mathrm{~kJ} / \mathrm{mol}$
D. $-1.7 \mathrm{~kJ} / \mathrm{mol}$

## Answer: C

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29. Calculate $\Delta_{r} S_{\text {sys }}^{\circ}$ for the following reaction at 373 K :
$\mathrm{CO}(\mathrm{g})+\mathrm{H}_{2} \mathrm{O}(\mathrm{g}) \rightarrow \mathrm{CO}_{2}(\mathrm{~g})+\mathrm{H}_{2}(\mathrm{~g})$
$\Delta_{r} H^{\circ}=-4.1 \times 10^{4} J, \Delta_{r} S^{\circ}(\mathrm{unv})=56 \mathrm{~J} / \mathrm{K}$
A. $-54 \mathrm{~J} / \mathrm{K}$
B. $-166 \mathrm{~J} / \mathrm{K}$
C. $+54 \mathrm{~J} / \mathrm{K}$
D. $+166 \mathrm{~J} / \mathrm{K}$

## Answer: A

30. A certain process releases 64.0 kJ of heat, which is transferred to the surroundings at a constant pressure and a constant temperature of 300 K. For this process $\Delta S_{\text {surr }}$ is:
A. 64.0 kJ
B. -64.0 kJ
C. $-213 \mathrm{~J} / \mathrm{K}$
D. None of these

## Answer: D

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31. Which of the following is (are) correct?
A. Absolute value of heat content of the system can't be determined using calorimetry
B. Absolute value of entropy can't be known
C. Absolute value of internal energy can't be known
D. Absolute value of Gibbs energy can't be determined

## Answer: A::C::D

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32. When ice melts at $1^{\circ} C$ :
A. an increase in entropy
B. a decrease in entropy
C. a decreas in free entropy
D. process is spontaneous

## Answer: A::C::D

33. The standard enthalpy of formation of gaseous $\mathrm{H}_{2} \mathrm{O}$ at 298 K is $-241.82 \mathrm{~kJ} / \mathrm{mol}$. Calculate $\Delta H^{\circ}$ at 373 K given the following values of the molar heat capacities at constant pressure :

$$
H_{2} O(g)=33.58 \mathrm{JK}^{-1} \mathrm{~mol}^{-1}, \quad H_{2}(g)=29.84 \mathrm{JK}^{-1} \mathrm{~mol}^{-1}, \quad O_{2}(g
$$

Assume that the heat capacities are independent of temperature :
A. $-242.6 k \frac{\mathrm{~J}}{\mathrm{~mol}}$
B. $+242.6 \mathrm{~kJ} / \mathrm{mol}$
C. $+24.26 \mathrm{~kJ} / \mathrm{mol}$
D. $-242.6 \mathrm{~J} / \mathrm{mol}$

## Answer: A

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34. Which statements in each of the following paris would you except to have the higher standard molar entropy?
(I) $C_{2} H_{2}(\mathrm{~g})$ or $C_{2} \mathrm{H}_{6}(\mathrm{~g})$, (II) $\mathrm{CO}_{2}(\mathrm{~g})$ or $\mathrm{CO}(\mathrm{g})$, (III) $I_{2}(\mathrm{~s})$ or $I_{2}$ (g)

The correct choice is:
A. $\mathrm{C}_{2} \mathrm{H}_{2}(\mathrm{~g}), \mathrm{CO}_{2}(\mathrm{~g}), \mathrm{I}_{2}(\mathrm{~g})$
B. $C_{2} H_{6}(g), C O(g), I_{2}(g)$
C. $\mathrm{C}_{2} \mathrm{H}_{2}(\mathrm{~g}), \mathrm{CO}_{2}(\mathrm{~g}), \mathrm{I}_{2}(\mathrm{~g})$
D. $C_{2} H_{6}(g), \mathrm{CO}_{2}(g), I_{2}(g)$

## Answer: D

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35. $\Delta H$ for solid to liquid transitions for protein $A$ and $B$ are $2.73 \mathrm{kcal} / \mathrm{mol}$ and $3.0 \mathrm{kcal} / \mathrm{mol}$.The two melting points are $0^{\circ} \mathrm{C}$ and $30^{\circ} C$ respectively. The entropy changes $\Delta S_{A}$ and $\Delta S_{B}$ at two transition temperatures are related as
A. $\Delta S_{A}=\Delta S_{B}$
B. $\Delta S_{A}<\Delta S_{B}$
C. $\Delta S_{A}>\Delta S_{B}$
D. $\Delta S_{B}=\frac{303 \Delta S_{A}}{273}$

## Answer: A

## - Watch Video Solution

36. For the
auto-ionization
of
water
at $25^{\circ} \mathrm{C}, \mathrm{H}_{2} \mathrm{O}(\mathrm{l}) \Leftrightarrow \mathrm{H}^{+}(a q)+\mathrm{OH}^{-}$(aq) equilibrium constant is $10^{-14}$.

What is $\Delta G^{\circ}$ for the process?
A. $8 \times 10^{4} \mathrm{~J}$
B. $3.5 \times 10^{4}$ J
C. $10^{4} \mathrm{~J}$
D. None of these

## Answer: A

37. For a particular reversible reaction at temperature $T, \Delta H$ and $\Delta S$ were found to be both $+v e$. If $T_{e}$ is the temperature at equilibrium, the reaction 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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38. Which of the following reactions defines $\Delta H_{f}^{\circ}$ ?
A. $C$ (diamond) $+\mathrm{O}_{2}(\mathrm{~g}) \rightarrow \mathrm{CO}_{2}(\mathrm{~g})$
B. $\frac{1}{2} H_{2}(g)+\frac{1}{2} F_{2}(g) \rightarrow H F(g)$
C. $\mathrm{H}_{4} \mathrm{P}_{2} \mathrm{O}_{7}+\mathrm{H}_{2} \mathrm{O} \rightarrow 2 \mathrm{H}_{3} \mathrm{PO}_{4}$
D. $\mathrm{SO}_{2}(g)+\frac{1}{2} \mathrm{O}_{2}(\mathrm{~g}) \rightarrow \mathrm{SO}_{3}(\mathrm{~g})$

## Answer: B

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39. The direct conversion of $A$ or $B$ is difficult, hence it is carried out by the following shown path

Given, $\Delta S_{A \rightarrow C}=50 e u, \Delta S_{C \rightarrow D}=30 e u, \Delta S_{B \rightarrow D}=20 e u$


B

Where eu is entropy unit, then $\Delta S_{A \rightarrow B}$ is .
A. +100 eu
B. +60 eu
C. -100 eu
D. -60 eu

## Answer: B

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40. A schematic plot of $\ln K_{e q}$ versus inverse of temperature for a reaction is shown below: The reaction must be:

A. Highly spontaneous at ordinary temperature
B. One with negligible enthalpy change
C. endothermic
D. exothermic

## Answer: D

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41. An endotthermic reaction is non-spontaneous at freezing point of water and becomes feasible at its boiling point, then:
A. $\Delta H$ is $-v e, \Delta S$ is $+v e$
B. $\Delta H$ and $\Delta S$ both are $+v e$
C. $\Delta H$ and $\Delta S$ both are $-v e$
D. $\Delta H$ is $+v e, \Delta S$ is -ve
42. Select the correct statement(s) about entropy S
A. $S_{\text {vapour }}>S_{\text {solid }}>S_{\text {liquid }}$
B. $S_{\text {vapour }}>S_{\text {liquid }}>S_{\text {solid }}$
C. $S_{\text {vapour }}<S_{\text {liquid }}<S_{\text {solid }}$
D. $S_{\text {vapour }}=S_{\text {liquid }}>S_{\text {solid }}$

## Answer: B

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43. A particular reaction at $27^{\circ} C$ for which $\Delta H>0$ and $\Delta S>0$ is found to be non-spontaneous. The reaction may proceed spontaneously if
A. The temperture is decreased
B. The temperature is kept constant
C. The temperature is increased
D. It is carried in open vessel at $27^{\circ} \mathrm{C}$

## Answer: C

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44. For a given reaction, $\Delta H=35.5 \mathrm{kJmol}^{-1}$ and
$\Delta S=83.6 \mathrm{JK}^{-1} \mathrm{~mol}^{-1}$. The reaction is spontaneous at (Assume that
$\Delta H$ and $\Delta S$ do not vary with temperature)
A. 1118 K
B. 1008 K
C. 1200 K
D. 845 K

## Answer: A

45. Standard entropies of $X_{2}, Y_{2}$ and $X Y_{3}$ are60, 40 and $50 \mathrm{JK}^{-1} \mathrm{~mol}^{-1}$ respectively. For the reaction $\frac{1}{2} X_{2}+\frac{3}{2} Y_{2} \Leftrightarrow X Y_{3} \Delta H=-30 K J$ to be at equilibrium, the temperature should be:
A. 1000 K
B. 1250 K
C. 500 K
D. 750 K

## Answer: D

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46. The incorrect expression among the following is
A. $\frac{\Delta G_{\text {system }}}{\Delta S_{\text {Total }}}=-T$
B. In isothermal process, $W_{\text {reversible }}=-n R T \ln \frac{V_{t}}{V_{i}}$
C. $\ln K=\frac{\Delta H^{\circ}-T \Delta S^{\circ}}{R T}$
D. $K=e^{-\Delta G^{\circ} / R T}$

## Answer: C

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47. A reaction has $\Delta H=-33 k J$ and $\Delta S=-58 J / K$. This reaction would be:
A. Spontaneous at all temperature
B. non-spontaneous at all temperatures
C. spontaneous above a certain temperature only
D. spontaneous below a certain temperature only

## Answer: D

48. Animals operate under conditons of constant pressure and most of the process tht maintain life are isothermal (in a broad sense). How much energy is available for sustaining this type of muscular and nervous activity from the combustion of 1 mol of glucose molecules under standard conditons at $37^{\circ} \mathrm{C}$ (blood temperature) ? The entropy change is $+182.4 \mathrm{JK}^{-1}$ for the reaction stated above
$\Delta H_{\text {combustion }}$ [glucose] $=-2808 \mathrm{KJ}$
A. -2754.4 kJ
B. -2864.5 kJ
C. -56.5 kJ
D. -2808 kJ

## Answer: B

49. 10 g of argon is compressed isothermally and reversibly at a temperature of $27^{\circ} C$ from 10 L to 5 L . Calculate , $\mathrm{w}, \Delta E$ and $\Delta H$ for the process. $R=2.0 \mathrm{calK}^{-1} \mathrm{~mol}^{-1}, \log 2=0.30$, At. Wt. of argon $=40$.
A. $\Delta S \equiv 0.36 J K^{-1}$
B. $W=227.97 \mathrm{~J}$
C. $q=-227.97 \mathrm{~J}$
D. $\Delta H=107.28 \mathrm{~J}$

## Answer: A

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50.4 $x^{2}-9=(p x+t)(p x-t)$

In the equation above, p and t are constants. Which of the following could be the value of $p$ ?
A. Finely divided from of CuO kept in excess $O_{2}$ would be completely converted to $\mathrm{Cu}_{2} \mathrm{O}$
B. Finely divided form $\mathrm{Cu}_{2} \mathrm{O}$ of kept in excess $\mathrm{O}_{2}$ would be completely converted to CuO
C. Finely divided form of CuO kept in excess $O_{2}$ would be converted to a mixture of CuO and $\mathrm{Cu}_{2} \mathrm{O}$ (having more of CuO )
D. Finely divided form of CuO kept in excess $O_{2}$ would be converted to a mixture of CuO and $\mathrm{Cu}_{2} \mathrm{O}$ (having more of $\mathrm{Cu}_{2} \mathrm{O}$ )

## Answer: B

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## LEVEL-2 (NUMERICAL VALUE TYPE)

1. One moles of an ideal gas which $C_{V}=3 / 2 R$ is heated at a constant pressure of 1 atm from $25^{\circ} \mathrm{C}$ to $100^{\circ} \mathrm{C}$. Calculate $\Delta U, \Delta H$ and the
entropy change during the process.

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2. The work done by the system is 8 joule, when 40 joule heat is supplied to it. What is the increases in internal energy of system.

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3. A gas expands from $3 d m^{3}$ to $5 d m^{3}$ against a constant pressure of 3 atm. The work done during expansion is used to heat 10 mole of water at temperature 290 K. Calculate final temperature of water. Specific heat of water $=4.184 \mathrm{~J} / \mathrm{g} / \mathrm{K}$.
(given : 1 atm $=101.33 \mathrm{~J}$ )

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4. An ideal monoatomic gas $C_{v}=1.5 R$ initialy at 298 K and $1.013 \times 10^{6}$

Pa. pressure expands adiabatically unit it is a in equilibrium with a constant external pressure of $1.013 \times 10^{5} \mathrm{~Pa}$. Calculate the final temperature of gas.

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5. Calculate the change in entropy for the fusion of 1 mole of ice (water).

The melting point of water is 273 K and molar enthalpy of funsion for water $=6.0 \mathrm{kJmol}^{-1}$

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6. A kettle containing 1 kg of water is heated open to atmosphere until evaporation is complete. The work done during this process is

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7. 70 calories of heat is required to raise the temperature of 2 mole of an ideal gas at constant pressure from $30^{\circ} \mathrm{C}$ to $35^{\circ} \mathrm{C}$. The amount of heat required to raise the temperature of the same gas through the same range at constant volume is


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

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

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10. The molar heat capacity $C$ of water at constant pressure is $75 \mathrm{JK}^{-1} \mathrm{~mol}^{-1}$, 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

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11. one mole of an ideal gas at 300 k in thermal contact with surroundings expands isothermally from 1.0 L to 2.0 L against a constant presses of 3.0 atm. In this process. The change in entropy of surrroundings $(\Delta S)$ in $J^{-1}$ is
( 1 L atm $=101.3 \mathrm{~J})$
12. How many times a diatomic gas should be expanded adiabatically so as to reduce the root mean square velocity to half. :

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13. For the reaction:
$\mathrm{X}_{2} \mathrm{O}_{4}(\mathrm{l}) \rightarrow 2 \mathrm{XO}_{2}(\mathrm{~g})$
$\Delta U=2.1 \mathrm{kcal}, \Delta S=20 \mathrm{cal} \mathrm{K}^{-1} \mathrm{at} 300 \mathrm{~K}$
Hence $\Delta G$ is

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14. The enthalpy of a system increases by 50 kJ when its internal energy is increased by 113 kJ . What is the pressure in $k \mathrm{Nm}^{-2}$ of the system if the volume of gas is reduced by $10^{3} m^{3}$ at constant pressure?

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

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## JEE (MAIN ARCHIVE)

1. For an endothermic reaction, $\Delta H$ represents the enthalpy of the reaction in $\mathrm{kJ} \mathrm{mol}^{-1}$. The mininum amount of activation energy will be
A. less than $\Delta H$
B. zero
C. more than $\Delta H$
D. equal to $\Delta H$

## Answer: C

2. Identify the intensive quantity from the following
A. enthalpy
B. temperature
C. volume
D. refractive index

## Answer: B::D

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3. Which of the following is an endothermic reaction?
A. Combustion of methane
B. Decomposition of water
C. Dehydrogenation of ethane to ethylene
D. Conversion of graphite to diamond

## Answer: B::C::D

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4. A process is called reversible when
A. surroundings and system change inot each other
B. there is no boundary between system and surroundings.
C. the surroundings are always in equilibrium with the system
D. the system changes ito the surroundings spontaneously

## Answer: C

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5. Which one of the following statements is false?
A. Work is a state function
B. Temperature is a state function
C. Change in the state is completely defined when the initial and final states are specified.
D. Work appears at the boundary of the systme

## Answer: A

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6. Two moles of an ideal gas expanded isothermally and reversibly from
$1 L$ to $10 L$ at $300 K$. What is the enthalpy change?
A. 11.4 kJ
B. -11.4 kJ
C. 0 kJ
D. 4.9 kJ

## Answer: C

7. Which of the following statements is/are false?
A. Work is state function
B. Temperature is a state function
C. Change in the state is completely defined when the initial and final states are specified.
D. Work appears at the boundary of the system

## Answer: A

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8. Among the following, the intensive property is (properties are):
A. molar conductivity
B. electromotive force
C. resistance
D. heat capacity

## Answer: A::B

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9. A piston filled with 0.04 mol of an ideal gas expands reversibly from 50.0 mL ot 375 mL at a constant temperature of $37.0^{\circ} \mathrm{C}$.As it does so, it absorbs 208 J of heat. The values of q and w for the process will be $(R=8.314 J / m o l K)(\ln 7.5=2.01)$
A. $q=+208 J, W=-208 J$
B. $q=-208 J, W=-208 J$
C. $q=-208 J, W=208 J$
D. $q=-208 J, W=+208 J$

## Answer: A

10. The standard free energy of formation of $\mathrm{NO}(\mathrm{g})$ is $86.6 \mathrm{~kJ} / \mathrm{mol}$ at 298 K what is the standard free energy of formation of $\mathrm{NO}_{2} g$ at 298 k ?

$$
K_{p}=1.6 \times 10^{12}
$$

A. $R(298) \ln \left(1.6 \times 10^{12}\right)-86600$
B. $86000+R(298) \ln \left(1.6 \times 10^{12}\right)$
C. $86600-\frac{\ln \left(1.6 \times 10^{12}\right)}{R(298)}$
D. $0.5\left[2 \times 86600-R(298) \ln \left(1.6 \times 10^{12}\right)\right]$

## Answer: D

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11. $\Delta U$ is equal to
A. Isothermal work
B. Isochoric work
C. Isobaric work
D. Adiabatic work

## Answer: D

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12. The combination of plots which does not represent isothermal expansion of an ideal gas is :



(B)

A.

B.

C.

D.


## Answer: A

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13. Consider the reversible isothermal expansion of an ideal gas in a closed ststem at two different temeratures $T_{1} \operatorname{and} T_{2}\left(T_{1}<T_{2}\right)$. The correct graphical depiction of the dependence of work done (w) on the final volume (V) is :

A.

B.

C.

D.

## Answer: D

14. The entropy change associated with the conversion of 1 kg of ice at

273 K to water vapours at 383 K is :
(Specific heat of water liquid and water vapour are $4.2 k J K^{-1} \mathrm{~kg}^{-1}$ and $2.0 \mathrm{kJK}^{-1} \mathrm{~kg}^{-1}$, heat of liquid fusion and vapourisation of water are $334 \mathrm{kJkg}^{-1}$ and $2491 \mathrm{kJkg}^{-1}$, respectively ). $\log 273=2.436, \log 373=2.572, \log 383=2.583)$
A. $9.26 \mathrm{kJkg}^{-1} \mathrm{~K}^{-1}$
B. $2.64 \mathrm{kJkg}^{-1} \mathrm{~K}^{-1}$
C. $7.90 \mathrm{kJkg}^{-1} \mathrm{~K}^{-1}$
D. $8.49 \mathrm{kJkg}^{-1} R^{-1}$

## Answer: A

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15. An ideal gas undergoes isothermal compression from $5 m^{3}$ to $1 m^{3}$ against a constant external pressure of $4 \mathrm{Nm}^{-2}$. Heat released in this process is used to increase the temperature of 1 mole of Al. If molar heat capacity of Al is $24 \mathrm{~J} \mathrm{~mol}{ }^{-1} \mathrm{~K}^{-1}$, the temperature of Al increases by
A. $32 K$
B. 2 K
C. 1 K
D. $\frac{2}{3} \mathrm{~K}$

## Answer: D

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16. The process with negative entropy change is
A. Synthesis of ammonia from $\mathrm{N}_{2}$ and $\mathrm{H}_{2}$
B. Dissociation of $\mathrm{CaSO}_{4}$ (s) to $\mathrm{CaO}(\mathrm{s})$ and $\mathrm{SO}_{3}$ (g)
C. Subimation of dry ice
D. Dissolution of iodine in water

## Answer: A

17. Two bolcks to the same metal having same mass and at temperature $T_{1}$ and $T_{2}$ respectively, are brought in contact with each other and allowed to attain thermal equilibrium at constant pressure .The change in entropy , $\Delta S$ for this process is :
A. $2 C_{p} \ln \left[\frac{T_{1}+T_{2}}{2 T_{1} T_{2}}\right]$
B. $2 C_{p} \ln \left[\frac{T_{1}+T_{2}}{4 T_{1} T_{2}}\right]$
C. $2 C_{p} \ln \left[\left(\frac{\left(T_{1}+T_{2}\right)^{1 / 2}}{T_{1} T_{2}}\right)\right]$
D. $C_{p} \ln \left[\left(\frac{\left(T_{1}+T_{2}\right)^{2}}{4 T_{1} T_{2}}\right)\right]$

## Answer: D

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18. for a diatomic ideal gas in a closed system, which of the following plots does not correctly describe the relation between various thermodynamic quantities ?
A.
$\square$
.

B.
C.


D.

## Answer: C

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19. A process has $\Delta H=200 \mathrm{~J} \mathrm{~mol}^{-1}$ and $\Delta S=40 \mathrm{JK}^{-1} \mathrm{~mol}^{-1}$. Out of the values given below, choose the minimum temperature above which the process will be spontaneous :
A. 5 K
B. 12 K
C. 4 K
D. 20 K

## Answer: A

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20. The standard reaction Gibbs energy for a temperature $T$ is given by
$\Delta_{r} G^{\circ}=A-B t$
Where $A$ and $B$ are non-zero constants.
Which of the following is TRUE about this reaction ?
A. Exothermic if $B<0$
B. Exothermic if $A>0$ and $B<0$
C. Endothermic if $A<0$ and $B>0$
D. Endothermic if $A>0$

## Answer: D

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21. The reaction,
$M g O(s)+C(s) \rightarrow M g(s)+C O(g)$, for which $\Delta_{r} H^{\circ}=+491.1 \quad k J \quad \mathrm{~mol}^{-1}$ and $\Delta_{r} S^{\circ}=198.0 \mathrm{JK}^{-1} \mathrm{~mol}^{-1}$, is not feasible at 289 K . Temperature above which reaction will be feasible is :
A. 2480.3 K
B. 1890.0 K
C. 2380.5 K
D. 2040.5 K

## Answer: A

22. In which case, process will be spontaneous at all temperature?
A. $\Delta H<0$ and $\Delta S>0$
B. $\Delta H>0$ and $\Delta S<0$
C. $\Delta H<0$ and $\Delta S<0$
D. $\Delta H>0$ and $\Delta S<0$

## Answer: A

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23. Among the following, the set of parameters that represents path functions is
(A) $q+w(B) q(C) w(D) H-T S$
A. II, III AND IV
B. I,II AND III
C. II AND III

## D. I AND IV

## Answer: C

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24. Maltose on treatment with dilute HCl gives:
A. D-galactose
B. D-Fructose
C. D-glucose and D-Fructose
D. D-glucose

## Answer: D

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25. For silver, $C_{P}\left(J K^{-1} \mathrm{~mol}^{-1}\right)=23+0.01 T$. If the temperature $(T)$ of 3 moles of silver is raised from 300 K to 1000 K at 1 atm pressure, the value of $\Delta H$ will be close to :
A. 21 kJ
B. 13 kJ
C. 16 kJ
D. 62 kJ

## Answer: D

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26. Which of the following is not correct for an ideal gas as per first low of thermodynamics
A. Cyclic process : $q=-w$
B. Adiabacit process: $\Delta U=-w$
C. Isochoric process: $\Delta U=q$
D. Isothermal process: $q=-w$

## Answer: B

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27. During compression of a spring the work done is 10 kJ and 2 kJ escaped to the surroundings as heat. The change in internal energy $\Delta U$ (in kj ) is
A. 8
B. -12
C. 12
D. -8

## Answer: A

28. 5 moles of an ideal gas at 100 K are allowed to undergo reversible compression till its temperature becomes 200 K . If $\Delta U$ is 14 kJ , what is Delta $\mathrm{PV} f$ or thisprocess $\left(\mathrm{R}=8.0 \mathrm{~J} \mathrm{~K}^{\wedge}(-1) \mathrm{mol}^{\wedge}(-1)\right)^{\text {` }}$
A. $\Delta U=14 k J, \Delta(p V)=4 k J$
B. $\Delta U=14 J, \Delta(p V)=0.8 J$
C. $\Delta U=14 k J, \Delta(p V)=18 k J$
D. $\Delta U=28 k J, \Delta(p v)=0.8 k J$

## Answer: A

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29. At constant volume 4 mol of an ideal gas when heated form 300 k to 500 k changes its internal energy by 500 J . The molar heat capacity at constant volume is $\qquad$ .

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30. The true statement amongst the following is :
A. S is a function of temperature but $\Delta S$ is not a function of temperature
B. S is not a function of temperature but $\Delta S$ is a function of temperature
C. Both S and $\Delta S$ are not functions of temperature
D. Both $\Delta S$ and S are functions of temperature

## Answer: d

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31. The magnitude of work done by a gas that undergoes a reversible expansion alog the path $A B C$ shown in the figure is $\qquad$ .

32. $A_{(\mathrm{l})} \rightarrow 2 B_{(\mathrm{g})}$
$\Delta U=2.1 \mathrm{kcal}, \Delta S=20 \mathrm{Cal} / \mathrm{k}, \mathrm{T}=300 \mathrm{~K}$.
Find $\Delta G$ (in kcal )

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1. First law of thermodynamics is not adequare in predicting the direction of the process.

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2. $C_{P}-C_{V}$ for an ideal gas is

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3. The total energy of 1 mol of an ideal monatomic gas at $27^{\circ} \mathrm{C}$ is.

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4. The heat capacity of a diatomic gas is higher than that of a monoatomic gas. (True/False)

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5. A system is if it cannot exchange matter and energy with the surroundings.

## - Watch Video Solution

6. Enthalpy is an $\qquad$ property.

## - Watch Video Solution

7. When $F e_{S}$ is dissovled in aqueous hydrochloric acid in a closed vessel the work done is $\qquad$

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8. A sample of argon gas at 1 atm pressure and $27^{\circ} \mathrm{C}$ expands reversibly and adiabatically from $1.25 d m^{3}$ to $2.50 d m^{3}$. Calculate the enthalpy change in this process $C_{v m}$ for argon is $12.48 \mathrm{JK}^{-1} \mathrm{~mol}^{-1}$.
9. The heat absorbed during the isothermal expansion of an ideal gas against vacuum is zero.

The volume occupied by the molecules of an ideal gas is zero.
A. Statement-I is True, Statement-II is True and Statement-II is a correct
explanation for Statement-ı
B. Statement-I is True, Statement-II is True and Statement-II is NOT a correct explanation for Statement-I
C. Statement-I is True, Statement-II is False
D. Statement-I is False, Statement-II is True

## Answer: b

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10. Show that the reaction $\mathrm{CO}(g)+\frac{1}{2} \mathrm{O}_{2}(g) \rightarrow \mathrm{CO}_{2}(g)$ at 300 K is spontaneous and exothermic, when the standard entropy change is $-0.094 \mathrm{kJmol}^{-1} \mathrm{~K}^{-1}$. The standard Gibbs energies of formation for $\mathrm{CO}_{2}$ and CO are -394.4 and $-137.2 \mathrm{kJmol}^{-1}$, respectively.

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11. When 1-pentyne $(A)$ is treated with 4 N alcoholic KOH at $175^{\circ} \mathrm{C}$, it is converted slowely into an equilibrium mixture of $1.3 \% 1$-pentyne $(A), 95.2 \%$ 2-pentyne $(B)$,and $3.5 \%$ of 1, 2-pentadiene $(C)$. The equilibrium is maintained at $175^{\circ} \mathrm{C}$. Calculate $\Delta G^{\Theta}$ for the following equilibria.
$B \Leftrightarrow A, \Delta G_{1}^{\Theta}=$ ?
$B \Leftrightarrow C, \Delta G_{2}^{\Theta}=$ ?
From the calculated values of $\Delta G_{1}^{\Theta}$ and $\Delta G_{2}^{\Theta}$, indicate the order of stability of $A, B$, and $C$.
12. One mole of a non-ideal gas undergoes a change of state $(2.0 \mathrm{~atm}, 3.0 L, 95 \mathrm{~K}) \rightarrow(4.0 \mathrm{~atm}, 5.0 L, 245 \mathrm{~K})$ with a change in internal energy, $\Delta E=30.0 L-a t m$. The change in enthalpy $(\Delta H)$ of the process in $L-a t m$ is
A. 40
B. 42.3
C. 44
D. not defined, because pressure is not constant

## Answer: c

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13. Two moles of a perfect gas undergo the following processes:
a. A reversible isobaric expansion from (1.0atm, 20.0L) to (1.0atm, 40.0L).
b. A reversible isochroic change of state from (1.0atm, 40.0L) to
(0.5atm, 40.0L)
c. A reversible isothermal expansion from
$(0.5 \mathrm{~atm}, 40.0 \mathrm{~L}) \rightarrow(1.0 \mathrm{~atm}, 20.0 \mathrm{~L})$.
i. Sketch with lables each of the processes 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 values of $\Delta H$ for the overall process?

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14. The molar heat capacity, $C_{v}$ of helium gas is $3 / 2 R$ and is independent of temperature. For hydrogen gas, $C_{v}$ approaches $3 / 2 R$ at very low temperature, equal $5 / 2 R$ at moderate temperature and is higher than $5 / 2 R$ at high temperatures. Give a reason for the temperature dependence of $C_{v}$ in case of hydrogen, in not more than two or three sentences.

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15. The enthalpy of vaporisation of a liquid is $30 \mathrm{kJmol}^{-1}$ and entropy of vaporisation is $75 \mathrm{Jmol}^{-1} \mathrm{~K}^{-1}$. The boiling point of the liquid at 1 atm is :
A. 250 K
B. 400 K
C. 450 K
D. 600 K

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16. An insulated vessel contains 1 mole of a liquid, molar volume 100 mL at 1bar. When liquid is steeply passed to 100bar, volume decreases to 99 mL .

Find $\Delta H$ and $\Delta U$ for the process.

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17. When 1 mol of a monoatomic ideal gas at $T K$ undergoes adiabatic change under a constant external pressure of 1 atm , changes volume from $1 L \rightarrow 2 L$. The final temperature (in K ) would be
A. $\frac{T}{2^{2 / 3}}$
B. $T+\frac{2}{3 \times 0.0821}$
C. T
D. $-\frac{2}{3 \times 0.0821}$

## Answer: d

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18. A monatomic ideal gas undergoes a process in which the ratio of $P$ to
$V$ at any instant is constant and equals 1 . What is the molar heat capacity of the gas?
A. $\frac{4 R}{2}$
B. $\frac{3 R}{2}$
C. $\frac{5 R}{2}$
D. 0

## Answer: a

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19. The direct conversion of $A$ to $B$ is difficult hence it is carried out by the following shown path $\underset{A}{C} \rightarrow \underset{B}{\downarrow \downarrow}$

Given,
$\Delta S_{(A \rightarrow C)}=50 \mathrm{eu}$
$\Delta S_{(C \rightarrow D)}=30 e u$
$\Delta S_{(B \rightarrow D)}=20 e u$
where eu is the entropy unit, then $\Delta S_{(A \rightarrow B)}$ is
A. $+60 e . u$.
B. $+100 e . u$.
C. $-60 e . u$.
D. $-100 e . u$.

## Answer: a

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20. $\mathrm{N}_{2}+3 \mathrm{H}_{2} \Leftrightarrow 2 \mathrm{NH}_{3}$

Which of the following statements is correct if $N_{2}$ added at equilibrium condition?
A. The equilibrium will shift to forward direction because according to lind law of the thermodynamcis the entropy must increase in the direction of spontaneous reaction.
B. The condition for equilibrium is $G_{N_{2}}+3 G_{N H_{3}}=2 G_{N H_{3}}$, where G is Gibbs free energy per mole of the gaseous species measured at that partial pressure. The condition of equilibrium is unaffected by
the ue of catalyst, which increases the rate of both the forward and backward reactions to the same extant.
C. The catalyst will increase the rate of forward reaction by $\alpha$ and that of backward reaction by $\beta$.
D. Catalyst will not alter the rate of either of the reaction.

## Answer: b

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21. The value of $\log _{10} K$ for a reaction $A \Leftrightarrow B$ is (Given:
$\Delta_{f} H_{298 K}^{\Theta}=-54.07 \mathrm{kJmol}^{-1}$,
$\Delta_{r} S_{298 K}^{\Theta}=10 \mathrm{JK}^{=1} \mathrm{~mol}^{-1}$, and $R=8.314 \mathrm{JK}^{-1} \mathrm{~mol}^{-1}$
A. 5
B. 10
C. 95
D. 100

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22. For the process $\mathrm{H}_{2} \mathrm{O}(l)(1 \mathrm{bar}, 373 \mathrm{~K}) \rightarrow \mathrm{H}_{2} \mathrm{O}(g)(1 \mathrm{bar}, 373 \mathrm{~K})$ the correct set of thermodynamic parameters is
A. $\Delta G=0, \Delta S=+v e$
B. $\Delta G=0, \Delta S=-v e$
C. $\Delta G=+v e, \Delta S=0$,
D. $\Delta G=-v e, \Delta S=+v e$

## Answer: a

## D Watch Video Solution

23. 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. Statement-I is true, Statement-II is True and Statement-II is a correct explanation for statement -1
B. Statement $-I$ is true, Statement-II is true and Statement-II is NOT a correct explanation for Statement-I.
C. Statement-I is true, Statement-II is False
D. Statement-I is False, Statement-II is True.

## Answer: d

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24. 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. Statement-I is True, Statement-II is True and Statement-II is a correct
explanation for Statement-ı
B. Statement-I is True, Statement-II is True and Statement-II is NOT a correct explanation for Statement-I.
C. Statement-I is True, Statement-II is False
D. Statement-I is False, Statement-II is True

Answer: b

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25. Among the following the state function(s) is (are):
A. internal energy
B. irreversible expansion work
C. reversible expansion work
D. molar enthalpy

## Answer: AD

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26. One mole of an ideal gas is taken from $a$ to $b$ along two paths denoted by the solid and the dashed lines as shown In the graph below. If the work done along the solid line path is $W_{s}$ and that along the the dotted line path is $w_{d}$, then the integer closest to the ratio $w_{d} / w_{s}$ is

27. To an evacuated vessel with movable piston under external pressure of 1 atm and 0.1 mole of He and 1 mole of an unknown compound (vapour pressure 0.68 atm at $0^{\circ} \mathrm{C}$ ) are introduced. Considering the ideal behaviour, the volume (in litre) of the gases at $0^{\circ} \mathrm{C}$ is close to:

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28. Match the transformation in Column I with appropriate option in

Column II.

| Column I |  | Column II |  |
| :---: | :---: | :---: | :---: |
| (A) | $\mathrm{CO}_{2}(\mathrm{~s}) \rightarrow \mathrm{CO}_{2}(\mathrm{~g})$ | (p) | Phase transition |
| (B) | $\mathrm{CaCO}_{3}(\mathrm{~s}) \rightarrow \mathrm{CaO}(\mathrm{s})+\mathrm{CO}_{2}(\mathrm{~g})$ | (q) | Allotropic change |
| (C) | $\left.2 \mathrm{H}, \mathrm{H}_{2} \mathrm{~g}\right)$ | (r) | $\Delta H$ is positive |
| (D) |  | (s) | $\Delta S$ is positive |
|  |  | (t) | $\Delta S$ is negative |

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29. Match the thermodynamic processes given under column I with the expressions given under column II.
A. Freezing of water at 273 K p. $q=0$ and 1 atm
B. Expansion of 1 mole of an q. $W=0$
ideal gas into a vacuum
under isolated conditions
C. Mixing of equal volumes of
r. $\Delta S_{\text {sys }}<0$
two ideal gases at constant temperature and pressure in an isolated container
D. Reversible heating of $\mathrm{H}_{2}(g)$ s. $\Delta U=0$
at 1 atm from 300 K to 600
K , followed by reversible cooling to 300 K at 1 atm
t. $\Delta G=0$

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30. For an ideal gas, consider only $\mathrm{P}-\mathrm{V}$ 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 $\Delta S$ as change in entropy and w as work done]

A. $\Delta S_{X \rightarrow Z}=\Delta S_{X \rightarrow Y}+\Delta S_{Y \rightarrow Z}$
B. $W_{X \rightarrow Y}=W_{X \rightarrow Y}+W_{Y \rightarrow Z}$
c. $W_{X \rightarrow Y \rightarrow Z}=W_{X \rightarrow Y}$
D. $\Delta S_{X \rightarrow Y \rightarrow Z}=\Delta S_{X \rightarrow Y}$

Answer: ac
31. 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. $\Delta U_{\text {isothermal }}>\Delta U_{\text {adiabatic }}$
32. A fixed mass ' $m$ ' of a gas is subjected to transformation of states from $K$ to $L$ to $M$ to $N$ and back to $K$ as shown in the figure.


The succeeding operations that enable this transformation of states are:
A. heating, cooling, heating, cooling
B. cooling, heating, cooling, heating
C. heating, cooling, cooling, heating
D. cooling, heating, heating, cooling

## Answer: c

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33. The pair of isochoric among the transformation of state is :

A. K to L and L to M
B. L to M and N to K
$C . L$ to $M$ and $M$ to $N$
D. M to N and N to K

## Answer: b

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34. An ideal gas in a thermally insulated vessel at internal pressure $=P_{1}$, volume $=V_{1}$ and absolute temperature $=T_{1}$ expands irreversibly against zero external pressure, as shown in the diagram. The final internal pressure, volume and absolute temperature of the gas are $P_{2}, V_{2}$ and $T_{2}$ respectively. For this expansion.

A. $q=0$
B. $T_{2}=T_{1}$
C. $P_{2} V_{2}=P_{1} V_{1}$
D. $P_{2} V_{2}^{Y}=P_{1} V_{1}^{Y}$

## Answer: abc

## D Watch Video Solution

35. For the process, $\mathrm{H}_{2} \mathrm{O}(l) \rightarrow \mathrm{H}_{2} \mathrm{O}(g)$
A. $\Delta S_{\text {system }}>0$ and $\Delta S_{\text {surrouding }}>0$
B. $\Delta S_{\text {system }}>0$ and $\Delta S_{\text {surrounding }}<0$
C. $\Delta S_{\text {system }}<0$ and $\Delta S_{\text {surrounding }}>0$
D. $\Delta S_{\text {system }}<0$ and $\Delta S_{\text {surrounding }}>0$

## Answer: b

36. Thermal decomposition of gaseous $X_{2}$ to gaseous $X$ at 298 K takes place according to the following equation:
$X(g) \Leftrightarrow 2 X(g)$
The standard reaction Gibbs energy $\Delta_{r} G^{\circ}$, of this reaction is positive. At the start of the reaction, there is one mole of $X_{2}$ and no $X$. As the reaction proceeds, the number of moles of $X$ formed is given by $\beta$. Thus $\beta_{\text {equilibrium }}$ is the number of moles of $X$ formed at equilibrium. The reaction is carried out at a constant total pressure of 2 bar. Consider the gases to behave ideally.
[Given, $R=0.083 L$ bar $K^{-1} \mathrm{~mol}^{-1}$ )
The equilibrium constant $K_{p}$ for this reaction at $298 K$, in terms of $\beta_{\text {equilibrium }}$ is
A. $\frac{8\left(\beta^{2}\right)_{\text {equilibrium }}}{2-\beta_{\text {equilibrium }}}$
B. $\frac{8\left(\beta^{2}\right)_{\text {equilibrium }}}{4-\beta_{\text {equilibrium }}^{2}}$
C. $\frac{4\left(\beta^{2}\right)_{\text {equilibrium }}}{2-\beta_{\text {equilibrium }}}$
D. $\frac{4\left(\beta^{2}\right)_{\text {equilibrium }}}{4-\beta^{2}-(\text { equilibrium })}$

## Answer: b

## - Watch Video Solution

37. Thermal decomposition of gaseous $X_{2}$ to gaseous X at 298 K takes place according to the following equations.

$$
X_{2}(g)+2 X(g)
$$

The standard reaction Gibbs energy, $\Delta_{r} G^{\circ}$, of this reaction is positive. At the start of the reaction, there is one mole of $X_{2}$ and no X . As the reaction procees, the number of moles of X formed is given by $\beta$. Thus, $\beta_{\text {equlibrium }}$ is the number of moles of $X$ formed at equilibrium. The reaction is carried out at a constant total pressure of 2 bar. Consider the gases to behave ideally. (Given: $\mathrm{R}=0.083 \mathrm{~L}$ bar $\mathrm{K}^{-1} \mathrm{~mol}^{-1}$ ).

The equilibrium constant $K_{p}$ for this reaction at 298 K , in terms of $\beta_{\text {equilibrium }}$, is
A. Decrease in the total pressure will result in formation of more moles of gaseous $X$
B. At the start of the reaction, dissociation of gaseous $X_{2}$ takes place spontaneously
C. $\beta_{\text {equilibrium }}=0.7$
D. $K_{c}=1$

## Answer: a

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38. The standard state Gibbs free energies of formation of ) C(graphite and C (diamond) at $\mathrm{T}=298 \mathrm{~K}$ are
$\Delta_{f} G^{\circ}[\mathrm{C}($ graphite $)]=0 \mathrm{kJmol}^{-1}$
$\Delta_{f} G^{\circ}[\mathrm{C}($ diamond $)]=2.9 \mathrm{kmol}^{-1}$
The standard state means that the pressure should be 1 bar, and substance should be pure at a given temperature. The conversion of graphite [ ) C(graphite ] to diamond [C(diamond)] reduces its volume by
$2 \times 10^{-6} \mathrm{~m}^{3} \mathrm{~mol}^{-1}$. If ) $\mathrm{C}($ graphite is converted to $\mathrm{C}($ diamond) isothermally at $\mathrm{T}=298 \mathrm{~K}$, the pressure at which ) C(graphite is in equilibrium with $C$ (diamond), is
[Useful information: $1 \mathrm{~J}=1 \mathrm{kgm}^{2} \mathrm{~s}^{-2}, 1 \mathrm{~Pa}=1 \mathrm{kgm}^{-1} \mathrm{~s}^{-2}, 1 \mathrm{bar}=10^{5} \mathrm{~Pa}$ ]
A. 14501 bar
B. 29001 bar
C. 1450 bar
D. 58001 bar

## Answer: a

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39. For a reaction taking place in a container in equilibrium with its surroundings, the effect of temperature on its equilibrium constant Kin terms of change in entropy is described by
A. With increase in temperature, the value of K for exothermic reaction decreases because the entropy change of the system is positive
B. With increase in temperature, the value of K for endothermic reaction increases because unfavourable change in entropy of the surroundings decreases
C. With increase in temperature, the value of K for endothermic reaction increases because the entropy change of the system is negative
D. With increase in temperature, the value of K for exothermic reaction decreases because favourable change in entropy of the surroundings decreases

## Answer: bd

40. A thermo-dynamical system is changed from state $\left(P_{1}, V_{1}\right)$ to $\left(P_{2}, V_{2}\right)$ by two different process. The quantity which will remain same will be
A. The work done on the gas is maximum when it is compressed irreversibly from $\left(p_{2}, V_{2}\right)$ to ( $p_{1}, V_{1}$ ) against constant pressure $p_{1}$.
B. The change in internal energy of the gas is (i) zero, if it explained reversibly with $T_{1}=T_{2}$, and (ii) positive, if it is expanded reversibly under adiabatic conditions with $T_{1} \neq T_{2}$.
C. If the expansion is carried out freely, it is simultaneously both isothermal as well as adiabatic
D. The work done by the gas is less when it is expanded reversibly from $V_{1}$ to $V_{2}$ under adiabatic conditions as compared to that when expanded reversibly from $V_{1}$ to $V_{2}$ under isothermal conditions.

## Answer: acd

41. Which of the following lines correctly show the temperature dependence of equilibrium constant, K , for an exothermic reaction ?

A. C and D
B. A and D
C. A and B
D. B and C

## Answer: c

42. An ideal gas undergoes a cyclic process as shown in figure .

A. $-5 k \mathrm{Jmol}^{-1}$
B. $5 \mathrm{kJmol}^{-1}$
C. $18 \mathrm{kJmol}^{-1}$
D. $-18 \mathrm{kJmol}^{-1}$

Answer: b

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43. A reversible cyclic process for an ideal gas is shown below. Here, P, V, and $T$ are pressure, volume and temperature, respectively. The thermodynamic parameters $\mathrm{q}, \mathrm{w}, \mathrm{H}$ and U are heat, work, enthalpy and internal energy, respectively.


The correct option (s) is (are)
A. $q_{A C}=\Delta U_{B C}$
B. $W_{B C}=P_{2}\left(V_{2}-V_{1}\right)$ and $q_{B C}=\Delta H_{A C}$
C. $\Delta H_{C A}<\Delta U_{C A}$ and $q_{A C}=\Delta U_{B C}$
D. $q_{B C}=\Delta U_{A C}$ and $\Delta H_{C A}>\Delta U_{C A}$

Answer: bc

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44. For a reaction $A \rightarrow P$, the plots of [A] and [P] with time at temperatures $T_{1}$ and $T_{2}$ are given below.


If $T_{1}>T_{2}$, the correct statements is (are):
(Assume $\Delta H^{\Theta}$ and $\Delta S^{\Theta}$ are independent of temperature and ratio of in K at $T_{1}$ to $\ln \mathrm{K}$ at $T_{2}$ is greater than $\frac{T_{2}}{T_{1}}$. Here $\mathrm{H}, \mathrm{S}, \mathrm{G}$ and K are enthalpy, entropy, Gibbs energy and equilibrium constant, respectively).
A. $\Delta H^{\Theta}<0, \Delta S^{\Theta}<0$
B. $\Delta G^{\Theta}<0, \Delta H^{\Theta}>0$
C. $\Delta G^{\Theta}<0, \Delta S^{\Theta}<0$
D. $\Delta G^{\Theta}<0, \Delta S^{\Theta}>0$

## Answer: ac

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## Fundamental

1. Temperature and heat are not :-
A. Extensive properties
B. Intensive properties
C. Intensive and extensive properties respectively
D. Extensive and intensive properties respectively

## Answer: D

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2. Both q \& w are $\qquad$ function \& $q+w$ is a $\qquad$ function :-
A. State, Path
B. State, State
C. Path, State
D. Path, Path

## Answer: C

3. $q=-w$ is not true for :-
A. Isothermal process
B. Adiabatic process
C. Cyclic process
D. Options (1) and (3)

## Answer: B

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4. Two moles of an ideal gas expand spontaneouly into vacuum. The work done is :-
A. Zero
B. 2J
C. 4 J
D. $\mathrm{BJ}^{\mathrm{J}}$

## Answer: A

5. For the reversible isothermal expansion of one mole of an ideal gas at 300 K , from a volume of $10 \mathrm{dm}^{3}$ to $20 \mathrm{dm}^{3}, \Delta H$ is -
A. 1.73 kJ
B. $-1.73 k J$
C. 3.46 kJ
D. Zero

## Answer: D

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6. An adiabatic reversible process is one in which?
A. Temperature of the system is not change
B. The system is not closed to heat transfer
C. There is no change in entropy
D. There is no net work done

## Answer: C

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7. A well stoppered thermoflask contains some ice cubes. This is an example of a-
A. Closed system
B. Open system
C. Non-thermodynamic system
D. Isolated system

## Answer: C

8. The work done by a system is 8 Joule, when 40 joule heat is supplied to it .What is the increase in internal energy of the system?
A. 32 J
B. 40 J
C. 48 J
D. $-32 J$

## Answer: A

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9. For a gaseous reaction, $A(g)+3 B(g) \rightarrow 3 C(g)+3 D(g), \Delta U$ is 17 kcal at $27^{\circ} \mathrm{C}$. Assuming $R=2 \mathrm{cal} \quad \mathrm{K}^{-1} \mathrm{~mol}^{-1}$, the value of $\Delta H$ for the above reaction is:
A. 15.8 kcal
B. 18.2 kcal
C. 20.0 kcal
D. 16.4 kcal

## Answer: B

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10. Difference between the heats of reaction at constant pressure and a constant volume for the reaction $2 \mathrm{C}_{6} \mathrm{H}_{6}(\mathrm{l})+15 \mathrm{O}_{2}(\mathrm{~g}) \rightarrow 12 \mathrm{CO}_{2}(\mathrm{~g})+6 \mathrm{H}_{2} \mathrm{O}(\mathrm{l})$ at $25^{\circ} \mathrm{C}$ in $k J$ is
A. +7.43
B. +3.72
C. -7.43
D. -3.72

## Answer: C

11. The enthalpy of vaporisation of water at $100^{\circ} \mathrm{C}$ is $40.63 \mathrm{~K} \mathrm{Jmol}^{-1}$. The value $\Delta E$ for the process would be :-
A. $37.53 \mathrm{~kJ} \mathrm{~mol}^{-1}$
B. $39.08 \mathrm{~kJ} \mathrm{~mol}^{-1}$
C. $42.19 \mathrm{~kJ} \mathrm{~mol}^{-1}$
D. $43.73 \mathrm{~kJ} \mathrm{~mol}^{-1}$

## Answer: A

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12. For $\mathrm{CaCO}_{3}(s) \rightarrow \mathrm{CaO}(s)+\mathrm{CO}_{2}(g)$ at $977^{\circ} \mathrm{C}, \Delta H=174 \mathrm{KJ} / \mathrm{mol}$, then $\Delta E$ is :-
A. 163 kJ
B. 163.6 Kj
C. 186.4 kJ
D. 180 kJ

## Answer: B

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13. For the gaseous reaction involving the complete combustion of isobutane
A. $\triangle H=\triangle E$
B. $\triangle H>\triangle E$
C. $\triangle H=\triangle E=0$
D. $\triangle H<\triangle E$

## Answer: D

14. Which statement is true for reversible processes?
A. It takes place in a single step
B. Driving force is much greater than opposing force
C. Work obtained is maximum
D. There is no work done in such processes

## Answer: C

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15. Molar heat capacity of water in equilibrium with ice at constant pressure is
A. Zero
B. Infinity
C. $40.50 k J K^{-1} \mathrm{~mol}^{-1}$
D. $75.48 J^{-1} \mathrm{~mol}^{-1}$

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16. Change in entropy is negative for
A. $B r(l) \rightarrow B r(g)$
B. $\mathrm{C}(\mathrm{s})+\mathrm{H}_{2} \mathrm{O}(g) \rightarrow \mathrm{CO}(g)+\mathrm{H}_{2}(g)$
C. $N_{2}(g, 10 \mathrm{~atm}) \rightarrow N_{2},(g, 1 \mathrm{~atm})$
D. $F e($ at 400 K$) \rightarrow F e($ at 300 K$)$

## Answer: D

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17. When the egg is hard boiled, there is
A. Increase in disorder
B. Decrease in disorder
C. No change in disorder
D. $\triangle G$ is negati ve

## Answer: A

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18. 5 mol of an ideal gas expand reversibly from a volume of $8 d m^{3}$ to $80 \mathrm{dm}^{3}$ at an temperature of $27^{\circ} \mathrm{C}$. Calculate the change in entropy.
A. $-95.73 J K^{-1}$
B. $95.93 J K^{-1}$
C. $-41.57 J K^{-1}$
D. $41.57 J^{-1}$

## Answer: C

19. For the reaction $\mathrm{Ag}_{2} \mathrm{O}(s) \rightarrow 2 \mathrm{Ag}(s)+1 / 2 \mathrm{O}_{2}(g)$ the value of $\Delta H=30.56 \mathrm{~K} \mathrm{Jmol}^{-1}$ and $\Delta S=66 \mathrm{JK}^{-1} \mathrm{~mol}^{-1}$. The temperature at which the free energy change for the reaction will be zero is :-
A. 373 k
B. 413 k
C. 463 k
D. 493 k

## Answer: C

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20. If $\Delta G^{\circ}>0$ for a reaction then :
A. $K_{p}>1$
B. $K_{p}<1$
C. Products dominate in the equilibrium mixture
D. $K_{p}=2$

## Answer: B

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21. For a reaction at $25^{\circ} C$ enthalpy change $(\Delta H)$ and entropy change $(\Delta S)$ are $-11.7 \mathrm{KJmol}^{-1}$ and $-105 \mathrm{Jmol}^{-1} \mathrm{~K}^{-1}$, respectively. Find out whether this reaction is spontaneous or not?
A. Spontaneous
B. Non spontaneous
C. At equilibrium
D. Unpredictable

## Answer: B

22. Calculate the enthalpy of vaporisation per mole for ethanol. Given, $\Delta S=109.8 \mathrm{JK}^{-1} \mathrm{~mol}^{-1}$ and boiling point of ethanol is $78.5^{\circ} \mathrm{C}$.
A. $\triangle H_{\text {vap }}=\left(\triangle S_{\text {vap }}\right)(T)$
B. $38.594 \mathrm{kJmol}^{-1}$
C. $3.85 \mathrm{kJmol}^{-1}$
D. Insufficient data

## Answer: B

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23. The equilibrium constant for a reaction is 10 . What will be the value of $\Delta G^{\circ} ? R=8.314 \mathrm{JK}^{-1} \mathrm{~mol}^{-1}, T=300 \mathrm{~K}$.
A. $+5.527 \mathrm{~kJ} \mathrm{~mol}^{-1}$
B. $-5.527 \mathrm{~kJ} \mathrm{~mol}^{-1}$
C. $+55.27 \mathrm{~kJ} \mathrm{~mol}^{-1}$
D. $-55.27 \mathrm{~kJ} \mathrm{~mol}^{-1}$

## Answer: B

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24. If $S^{\circ}$ for $H_{2}, C l_{2}$ and HCl are $0.13,0.22$ and $0.19 \mathrm{KJ} \mathrm{K}^{-1} \mathrm{~mol}^{-1}$ respectively. The total change in standard entropy for the reaction $\mathrm{H}_{2}+\mathrm{Cl}_{2} \rightarrow 2 \mathrm{HCl}$ is :-
A. $30 \mathrm{JK}^{-1} \mathrm{~mol}^{-1}$
B. $40 \mathrm{JK}^{-1} \mathrm{~mol}^{-1}$
C. $60 \mathrm{JK}^{-1} \mathrm{~mol}^{-1}$
D. $20 \mathrm{JK}^{-1} \mathrm{~mol}^{-1}$

## Answer: A

25. For the process $\mathrm{CO}_{2(s)} \rightarrow \mathrm{CO}_{2(\mathrm{~g})}$
A. Both $\triangle H$ and $\triangle S$ are positive
B. $\triangle H$ is negative and $\triangle S$ is positive
C. $\triangle H$ is +ve and $\triangle S$ is negative
D. Both $\triangle H$ and $\triangle S$ are negative

## Answer: A

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26. Evaporation of water is
A. A process in which neither heat is evolved nor ab sorbed
B. A process accompained by chemical reaction
C. An exothermic change
D. An endothermic change

## Answer: D

## D Watch Video Solution

27. The formation of water from $H_{2}(g)$ and $O_{2}(g)$ is an exothermic process because :
A. The chemical energy of $H_{2}(g)$ and $O_{2}(g)$ is mere than that of water
B. The chemical ener gy of $H_{2}(g)$ and $O_{2}(g)$ is less than that of water
C. The temperature of $H_{2}(g)$ and $O_{2}(g)$ is higher than that of water
D. The temperature of $H_{2}(g)$ and $O_{2}(g)$ is lower th an that of water

## Answer: A

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28. In which of the following cases entropy decreases?
A. Solid changing to liquid
B. Expansion of a gas
C. polymerisation
D. All of these

## Answer: C

## - Watch Video Solution

29. If $\mathrm{C}_{6} \mathrm{H}_{12} \mathrm{O}_{6}(\mathrm{~s})+9 \mathrm{O}_{2}(\mathrm{~g}) \rightarrow 6 \mathrm{CO}_{2}(\mathrm{~g})+6 \mathrm{H}_{2} \mathrm{O}(\mathrm{g}), \Delta \mathrm{H}=-680$

Kcal The weight of $\mathrm{CO}_{2}(\mathrm{~g})$ produced when 170 Kcal of heat is evolved in the combustion of glucose is :-
A. 265 gm
B. 66 gm
C. 11 gm
D. 64 gm

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30. Heat of combustion of $\mathrm{CH}_{4}, \mathrm{C}_{2} H_{6}, \mathrm{C}_{2} H_{4}$ and $\mathrm{C}_{2} H_{2}$ gases are -212.8, $-212.8,-373.0,-337.0$ and -310.5 Kcal respectively at the same temperature.

The best fuel among these gases is :
A. $\mathrm{CH}_{4}$
B. $C_{2} H_{6}$
C. $C_{2} H_{4}$
D. $\mathrm{C}_{2} \mathrm{H}_{2}$

## Answer: A

31. Which of the following values of heat of formation does indicate that the product is least stable ?

- 94 kcal
- 231.5 kcal
+64.8 kcal .
$+21.4 \mathrm{kcal}$
A. -94 Kcal
B. -231.5 Kcal
C. +21.4 Kcal
D. +64.8 Kcal


## Answer: D

## D Watch Video Solution

32. The standard molar heat of formation of ethane, $\mathrm{CO}_{2}$ and water are respectively $-21.1,-94.1$ and $-68.3 k c a l$. The standard molar heat of
combustion of ethane will be:
A. 372 Kcal
B. 162 Kcal
C. -240 Kcal
D. 183.5 Kcal

## Answer: A

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33. Given that standard heat enthalpy of $\mathrm{CH}_{4}, \mathrm{C}_{2} \mathrm{H}_{4}$ and $\mathrm{C}_{3} \mathrm{H}_{8}$ are -17.9, 12.5, $-24.8 \mathrm{Kcal} / \mathrm{mol}$. The $\Delta H$ for $\mathrm{CH}_{4}+\mathrm{C}_{2} H \rightarrow \mathrm{C}_{3} H_{8}$ is :
A. -55.2 Kcal
B. -30.2 Kcal
C. 55.2 Kcal
D. -19.4 Kcal

## Answer: D

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34. If enthalpies of formation of $\mathrm{C}_{2} \mathrm{H}_{4}(\mathrm{~g}), \mathrm{CO}_{2}(\mathrm{~g})$ and $\mathrm{H}_{2} \mathrm{O}(\mathrm{l})$ at $25^{\circ} \mathrm{C}$ and 1 atm pressure are $52,-394$ and $-286 \mathrm{KJ} / \mathrm{mol}$, the enthalpy of combustion of ethane is equal to
A. $+1412 \mathrm{~kJ} \mathrm{~mole}^{-1}$
B. $-1412 \mathrm{~kJ} \mathrm{~mole}^{-1}$
C. $+142.2 \mathrm{~kJ} \mathrm{~mole}^{-1}$
D. $-141.2 \mathrm{~kJ} \mathrm{~mole}^{-1}$

## Answer: B

$S+3 / 2 O_{2} \rightarrow S_{3}+2 \mathrm{x} k c a l$ and $\mathrm{SO}_{2}+1 / 2 \mathrm{O}_{2} \rightarrow \mathrm{SO}_{3}+y$ kcal, heat of formation of $\mathrm{SO}_{2}$ is
A. $(2 x+y)$
B. $-(2 x-y)$
C. $x+y$
D. $2 x / y$

## Answer: B

## - Watch Video Solution

36. Given that:

$$
2 C(s)+O_{2}(g) \rightarrow 2 C O_{2}(g) \quad(\Delta H=-787 k J) \ldots \text { (i) }
$$

$$
H_{2}(g)+1 / 2 O_{2}(g) \rightarrow H_{2} O(l) \quad(\Delta H=-286 k J) \ldots(\mathrm{ii})
$$

$$
C_{2} H_{2}+2 \frac{1}{2} O_{2}(g) \rightarrow 2 \mathrm{CO}_{2}(g)+\mathrm{H}_{2} O(l) \quad(\Delta H=-1310 k J) \ldots(\mathrm{iii})
$$

The heat of formation of acetylene is:
A. $+1802 k J$
B. -1802 kJ
C. -800 kJ
D. +237 kJ

## Answer: D

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37. Form the thermochemical reactions.
$\mathrm{C}($ graphite $)+1 / 2 \mathrm{O}_{2}(g) \rightarrow \mathrm{CO}(g), \triangle H=-110.5 k J$
$\mathrm{CO}(g)+1 / 2 \mathrm{O}_{2}(g) \rightarrow \mathrm{CO}_{2}(g), \triangle H=-283.2 k J$
The enthalpy ofreaction of C (graphite) $+\mathrm{O}_{2}(\mathrm{~g}) \rightarrow \mathrm{CO}_{2}$ is
A. 393.3 kJ
B. $-393.7 k J$
C. $-172.7 k J$
D. +172.7 kJ

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38. Find the heat change in the reaction:
$\mathrm{NH}_{3}(\mathrm{~g})+\mathrm{HCI}(\mathrm{g}) \rightarrow \mathrm{NH}_{4} \mathrm{CI}(\mathrm{s})$
from the following data
$\mathrm{NH}_{3}(\mathrm{~g})+a q \rightarrow \mathrm{NH}_{3}(a q) \triangle H=-8.4 K C a l$
$\mathrm{HCl}(\mathrm{g})+a q \rightarrow \mathrm{HCl}(a q) \triangle H=-17.3 \mathrm{KCal}$
$\mathrm{NH}_{3}(a q)+\mathrm{HCl}(a q) \rightarrow \mathrm{NH}_{4} \mathrm{Cl}(\mathrm{aq}) \triangle \mathrm{H}=-12.5 \mathrm{KCal}$
$\mathrm{NH}_{4} \mathrm{Cl}(\mathrm{s})+\mathrm{aq} \rightarrow \mathrm{NH}_{4} \mathrm{Cl}(\mathrm{aq}) \triangle \mathrm{H}=+3.9 \mathrm{Kcal}$
A. -42.1
B. -34.3
C. +34.3
D. 42.1

## Answer: A

39. The heat of combustion of ethanol determinal in a bomb calorimeter is -670.48 K . Cals mole ${ }^{-1}$ at $25^{\circ} \mathrm{C}$. What is $\Delta H$ at $25^{\circ} \mathrm{C}$ for the reaction :-
A. -335.24 Kcal
B. -671.08 Kcal
C. -670.48 Kcal
D. +670.48 Kcal

## Answer: B

## - Watch Video Solution

40. Heat of formation of $\mathrm{CO}_{2}$ is -94.0 K . cal. What would be the quantity of heat liberated, when 3 g of graphite is burnt in excess of oxygen :-
A. 23.5 Kcal
B. 2.35 Kcal
C. 94.0 Kcal
D. 31.3 Kcal

## Answer: A

## - Watch Video Solution

41. On complete combustion of 2 gm methane 26575 cals heat is generated. The heat of formation of methane will be (given heat of formation of $\mathrm{CO}_{2}$ and $\mathrm{H}_{2} \mathrm{O}$ are-97000 and - 68000 cais respectivvely) :
A. +20400 cal
B. +20600 cal
C. -20400 cal
D. -2000 cal

## Answer: C

42. The heat of solution of anhydrous $\mathrm{CuSO}_{4}$ and $\mathrm{CuSO}_{4} \cdot 5 \mathrm{H}_{2} \mathrm{O}$ are -15.89 and $2.80 \mathrm{Kcal} \mathrm{mol}^{-1}$ respectively. What will be the heat of hydration of anhydrous $\mathrm{CuSO}_{4}$ ?
A. -18.69 Kcal
B. 18.69 Kcal
C. -28.96 Kcal
D. 28.96 Kcal

## Answer: A

## - Watch Video Solution

43. $X g$ of ethanal was subjected to combustion in a bomb calorimeter and the heat produced is $Y J$. Then
A. $\triangle E_{(\text {combustion })}=-X J$
B. $\triangle E_{(\text {combustion })}=-Y J$
C. $\triangle E_{(\text {combustion })}=\frac{44 Y}{X} \mathrm{~J} \mathrm{~mol}^{-1}$
D. $\triangle E_{(\text {combustion })}=\frac{44 Y}{X} \mathrm{~J} \mathrm{~mol}^{-1}$

## Answer: D

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44. The heats of combustion of yellow P and red P are $-9.91 k J$ and -8.78 kJ respectively. The heat of transition of yellow to red phosphorus is
A. $-18.69 k J$
B. $+1.313 k J$
C. $+18.69 k J$
D. -1.13 kJ

## Answer: D

## D Watch Video Solution

45. The heats of combustion of $\mathrm{C}_{2} \mathrm{H}_{4}, \mathrm{C}_{2} \mathrm{H}_{6}$ and $\mathrm{H}_{2}$ gases are -1409.5 KJ, -1558.3 KJ and -285.6 KJ respectively. The heat of hydrogenation of ethene is
A. $-136.8 k J$
B. -13.67 kJ
C. 273.6 kJ
D. 1.368 kJ

## Answer: A

46. Equal volumes of $1 M H C I$ and $1 M_{2} S_{4}$ are neutralised by 1 MNaOH solution and $x$ and $y k J /$ equivalent of heat are liberated, respectively. Which of the following relations is correct?
A. $x=y$
B. $x=0.5 y$
C. $x=0.4 y$
D. $x=2.5 y$

## Answer: B

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47. The enthalpy changes at 298 K in successive breaking of $O-H$ bonds of water are
$\mathrm{H}_{2} \mathrm{O}(\mathrm{g}) \rightarrow \mathrm{H}(\mathrm{g})+\mathrm{OH}(\mathrm{g}), \Delta H=498 \mathrm{~kJ} \mathrm{~mol}{ }^{-1}$
$O H(g) \rightarrow H(g)+O(g), \Delta H=428 k J \mathrm{~mol}^{-1}$
The bond enthalpy of $O-H$ bond is:
A. $498 \mathrm{~kJ} \mathrm{~mol}^{-1}$
B. $428 \mathrm{~kJ} \mathrm{~mol}^{-1}$
C. $70 \mathrm{~kJ} \mathrm{~mol}^{-1}$
D. $463 \mathrm{~kJ} \mathrm{~mol}^{-1}$

## Answer: D

## - Watch Video Solution

48. The standard heat of formation of carbon disulphide (I) given that standard heat of combustion of carbon (s), sulphur (s) and carbon disulphide (I) are -393.3, -293.72 and $-1108.76 \mathrm{~K} \mathrm{Jmol}^{-1}$ respectively is A. $-128.02 \mathrm{~kJ} \mathrm{~mol}^{-1}$
B. $+12.802 \mathrm{~kJ} \mathrm{~mol}^{-1}$
C. $+128.02 \mathrm{~kJ} \mathrm{~mol}^{-1}$
D. $-12.802 \mathrm{~kJ} \mathrm{~mol}^{-1}$

## Answer: C

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49. If water is formed from $\mathrm{H}^{+}$ions and $\mathrm{OH}^{-}$the heat of formation of water is :
A. 13.7 Kcal
B. 13.7 Kcal
C. -63.4 Kcal
D. More data required

## Answer: A

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50. The bond energies of $F_{2}, C l_{2}, B r_{2}$ and $I_{2}$ are 155.4, 243.6, 193.2 and
$151.2 \mathrm{Kjmol}^{-1}$ respectively. The strongest bond is :
A. F-F
B. $\mathrm{Cl}-\mathrm{Cl}$
C. $\mathrm{Br}-\mathrm{Br}$
D. I-I

## Answer: B

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## Enable

1. Consider the following reactions :
(a) $H_{(a q)}^{+}+\mathrm{OH}_{(a q)}^{-}=H_{2} O_{(l)}, \Delta H=-X_{1} \mathrm{~kJ} \mathrm{~mol}^{-1}$
(b) $H_{2(g)}+\frac{1}{2} O_{2(g)}=H_{2} O_{(l)}, \Delta H=-X_{2} \mathrm{~kJ} \mathrm{~mol}^{-1}$
(c ) $\mathrm{CO}_{2(g)}+H_{2(g)}=\mathrm{CO}_{(g)}+\mathrm{H}_{2} O_{(l)}-X_{3} \mathrm{~kJ} \mathrm{~mol}^{-1}$
(d) $\mathrm{C}_{2} \mathrm{H}_{2(g)}+\frac{5}{2} \mathrm{O}_{2(g)}=2 \mathrm{CO}_{2(g)}+\mathrm{H}_{2} \mathrm{O}_{(l)}+\mathrm{X}_{4} \mathrm{~kJ} \mathrm{~mol}{ }^{-1}$

Enthalpy of formation of $\mathrm{H}_{2} \mathrm{O}_{(l)}$ is:
A. $+X_{3} \mathrm{kJmol}^{-1}$
B. $-X_{-4} \mathrm{kJmol}^{-1}$
C. $+X_{1} \mathrm{kJmol}^{-1}$
D. $-X_{2} \mathrm{kJmol}^{-1}$

## Answer: D

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2. Given that bond energies of $\mathrm{H}-\mathrm{H}$ and $\mathrm{Cl}-\mathrm{Cl}$ are $430 \mathrm{~kJ} \mathrm{~mol}^{-1}$ and 240 kJ $\mathrm{mol}^{-1}$ respectively and $\Delta_{f} H$ for HCl is $-90 \mathrm{~kJ} \mathrm{~mol}{ }^{-1}$. Bond enthalpy of HCl is :
A. $380 \mathrm{~kJ} \mathrm{~mol}^{-1}$
B. $425 \mathrm{~kJ} \mathrm{~mol}^{-1}$
C. $245 \mathrm{~kJ} \mathrm{~mol}^{-1}$
D. $290 \mathrm{~kJ} \mathrm{~mol}^{-1}$

## D Watch Video Solution

3. Identify the correct statement for change of Gibbs free energy for a system $\left(\Delta G_{\text {system }}\right)$ at constant temperature and pressure.
A. If $\left(\triangle G_{\text {system }}\right)<0$, the process is not spontaneous
B. If $\left(\triangle G_{\text {system }}\right)>0$, the process is spontaneous
C. If $\left(\triangle G_{\text {system }}\right)=0$, the system has attained equillibrium
D. If $\left(\triangle G_{\text {system }}\right)=0$ the system is still moving in a particular direction

## Answer: C

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4. The enthalpy and entropy change for the reaction,
$B r_{2}(l)+C l_{2}(g) \rightarrow 2 B r C l(g)$
are $30 \mathrm{KJmol}^{-1}$ and $105 \mathrm{JK}^{-1} \mathrm{~mol}^{-1}$ respectively. The temperature at which the reaction will be in equilibrium is:
A. 300 K
B. 285.7 K
C. 273 K
D. 450 K

## Answer: B

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5. Which of the following pairs of a chemical reaction is certain to result in a spontaneous reaction?
A. exothermic and increasing disorder
B. exothermic and decreasing disorder
C. endothermic and increasing disorder
D. endothermic and decreasing disorder

## Answer: A

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6. A reaction occurs spontaneouly if
A. $T \triangle S<\triangle H$ are both $\triangle H$ and $\triangle S$ are + ve
B. $T \triangle S>\triangle H$ is +Ve and $\triangle S$ is -ve
C. $T \triangle S>\triangle H$ and $\perp h \triangle H$ and $\triangle S$ are +ve
D. $T \triangle S=\triangle H$ and $\quad$ both $\quad \triangle H$ and $\triangle S$ are + ve

## Answer: C

7. Standard enthalpy and standard entropy changes for the oxidation of ammonia at 298 K are $-582.64 \mathrm{kJmol}^{-1}$ and $-150.6 \mathrm{Jmol}^{-1} \mathrm{k}^{-1}$, respectively. Standard Gibb's energy change for the same reaction at 298 K is
A. $-221.1 \mathrm{~kJ} \mathrm{~mol}^{-1}$
B. $-339.3 \mathrm{~kJ} \mathrm{~mol}^{-1}$
C. $-439.3 \mathrm{~kJ} \mathrm{~mol}^{-1}$
D. $-523.2 \mathrm{~kJ} \mathrm{~mol}^{-1}$

## Answer: B

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8. Considering entropy $(\mathrm{S})$ as a thermodynamic parameter, the criterion for the spontaneity of any process is
A. $S_{\text {system }}+\triangle S_{\text {surroundings }}>0$
B. $S_{\text {system }}-\triangle S_{\text {surroundings }}>0$
C. $S_{\text {system }}>0$ only
D. $S_{\text {surroundings }}>0$ only

## Answer: A

## - Watch Video Solution

9. For which one of the following equations $\Delta H_{r}^{\circ}$ equal to $\Delta H_{f}^{\circ}$ for the product ?
A. $N_{2}(g)+O_{3}(g) \rightarrow N_{2} O_{3}(g)$
B. $\mathrm{CH}_{4}(\mathrm{~g})+2 \mathrm{Cl}_{2}(\mathrm{~g}) \rightarrow \mathrm{CH}_{2} \mathrm{Cl}_{2}(\mathrm{l})+2 \mathrm{HCl}(\mathrm{g})$
C. $\mathrm{Xe}(\mathrm{g})+2 \mathrm{~F}_{2}(\mathrm{~g}) \rightarrow \mathrm{XeF}_{4}(g)$
D. $2 \mathrm{CO}_{g}+\mathrm{O}_{2}(\mathrm{~g}) \rightarrow 2 \mathrm{CO}_{2}(\mathrm{~g})$

## Answer: C

10. 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 $(d G)$ and the change in entropy $(d S)$ satisfy the criteria
A. $(\triangle S)_{V E}=0,(\triangle G)_{T, P}=0$
B. $(\triangle S)_{V, E}=0,(\triangle G)_{T, P}>0$
C. $(\triangle S)_{V, E}<0,(\triangle G)_{T, P}<0$
D. $(\triangle S)_{V, E}>0,(\triangle G)_{T, P}<0$

## Answer: D

## - Watch Video Solution

11. The internal energy change when a system goes fromk state $A$ to $B$ is $40 \mathrm{kJmol}^{-1}$. 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. $<40 k J$
B. Zero
C. 40 kJ
D. $>40 \mathrm{~kJ}$

## Answer: B

## - Watch Video Solution

12. If a $298 K$ the bond energies of $C-H, C-C, C=C$ and $H-H$ bonds are respectivly $414,347,615 \mathrm{KJmol}^{-1}$, the vlaue of enthalpy change for the reaction

$$
\mathrm{H}_{2} \mathrm{C}=\mathrm{CH}_{2}(\mathrm{~g})+\mathrm{H}_{2}(\mathrm{~g})+\mathrm{H}_{2}(\mathrm{~g}) \rightarrow \mathrm{H}_{3} \mathrm{C}-\mathrm{CH}_{3}(\mathrm{~g}) \text { at } 298 \mathrm{~K} \text { will be }
$$

A. $+124 k J$
B. $-125 k J$
C. $+250 k J$
D. -250 kJ

## D Watch Video Solution

13. In a closed insulated container a liquid is stirred with a paddle to increase the temperature, which of the following is true?
A. $\triangle E=W \neq 0, q=0$
B. $\triangle E=W=0, q \neq 0$
C. $\triangle E=0, W=q \neq 0$
D. $W=0, \triangle E=q \neq 0$

## Answer: A

## - Watch Video Solution

14. When 1 mole gas is heated at constant volume, temperature is raised from 298 to 308 K. Heat supplied to the gas in 500 J . Then, which
statement is correct ?
A. $q=w=500 J, \triangle U=0$
B. $q=\triangle U=500 J, w=0$
C. $q=w=500 J, \triangle U=0$
D. $\triangle U=0, q=w=500 J$

## Answer: B

## - Watch Video Solution

15. A gas occupies 2 litre at STP. It is provided 300 joule heat so that its volume becomes 2.5 litre at 1atm. Calculate change in its internal energy.
A. 211.11J
B. 249.35J
C. 217.21J
D. 217.41J

## Answer: B

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16. In order to decompose 9 grams of water 142.5 KJ heat is required. Hence the enthalpy of formation of water is
A. $+285 k J$
B. $-285 k J$
C. $+142.5 k J$
D. $-142.5 k J$

## Answer: B

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17. $2 \mathrm{Zn}+\mathrm{O}_{2} \rightarrow 2 \mathrm{ZnO} \Delta G^{\circ}=-616 \mathrm{~J}$
$2 Z n+S_{2} \rightarrow 2 Z n S \Delta G^{\circ}=-293 J$
$S_{2}+2 \mathrm{O}_{2} \rightarrow 2 \mathrm{SO}_{2} \Delta G^{\circ}=0408 \mathrm{~J}$
$\Delta G^{\circ}$ for the following reaction is:
$2 \mathrm{ZnS}+3 \mathrm{O}_{2} \rightarrow 2 \mathrm{ZnO}+2 \mathrm{SO}_{2}$
A. -731 J
B. $-1317 J$
C. -501 J
D. +731 J

## Answer: A

## - Watch Video Solution

18. Entropy change involve in conversation of 1 mole of liquid water at 373 Kto vapour at the same temperature (latent heat of vaporisation of water=2.257kJg ${ }^{-1}$ )
A. $105.9 \mathrm{JK}^{-1}$
B. $107.9 \mathrm{JK}^{-1}$
C. $108.9 \mathrm{JK}^{-1}$
D. $109.9 \mathrm{JK}^{-1}$

## Answer: C

## - Watch Video Solution

19. Heat of neutralization of strong acid against strong base is constant and is equal to
A. 13.7 kcal
B. 57 kJ
C. $5.7 \times 10^{4} J$
D. All of the above

## Answer: D

20. The free energy change for a reversible reaction at equilibrium is:
zero
small positive
small negative
large positive.
A. Large positive
B. Small negative
C. Small positive
D. Zero

## Answer: D

## - Watch Video Solution

21. When enthalpy and entropy change for a chemical reaction are $-2.5 \times 10^{3}$ cals and 7.4 cals $K^{-1}$ respectively. Predict that reaction at 298 K is
A. Spontaneous
B. Reversible
C. Irreversible
D. Non-spontaneotus

## Answer: A

## D Watch Video Solution

22. What is the free energy change, ' $\Delta G$ ' When 1.0 mole of water at $100^{\circ} \mathrm{C}$ and 1 atm pressure is converted into steam at $100^{\circ} \mathrm{C}$ and 1 atm pressure
A. 549 cal
B. -9800 cal
C. 9800 cal
D. 0 cal

## Answer: D

## D Watch Video Solution

23. The combustion enthalpies of carbon, hydrogen and methane are $-395.5 \mathrm{~kJ} \mathrm{~mol}^{-1},-285.8 \mathrm{kJmol}^{-1}$ and $-890.4 \mathrm{kJmol}^{-1}$ respectively at 25
. The value of standard formation enthalpy of methane at that temperature is $\qquad$ .
A. $890.4 \mathrm{~kJ} \mathrm{~mol}^{-1}$
B. $-298.8 \mathrm{~kJ} \mathrm{~mol}^{-1}$
C. $-76.7 \mathrm{~kJ} \mathrm{~mol}^{-1}$
D. $-107.7 \mathrm{~kJ} \mathrm{~mol}^{-1}$

## Answer: C

## - Watch Video Solution

24. Identify the correct statement regarding entropy
A. At $0^{\circ} C$, the entropy of a perfectly crystalline substance is taken to be zero.
B. At absolute zero of temperature, the entropy of a perfectly crystal line substance is + ve.
C. At absolute zero of temperature, the antropy of all crystalline substances is taken to be zero.
D. At absolute zero of temperature, the entropy of a perfectly crystal line substance is taken to be zero.

## Answer: D

## - Watch Video Solution

25. Equal volumes of methanoic acid and sodium hydroxide are mixed. If $x$ is the heat of formation of water from its ions then heat evolved on

## neutralisation is

A. More than $x$
B. Equal to $x$
C. Twice of $x$
D. Less than x

## Answer: D

## - Watch Video Solution

26. The neutralization of a strong acid by a strong base liberates an amount of energy per mole of $H^{+}$that
A. Depends upon which acid and base are involved.
B. Depends upon the temperature at which the reaction takes place.
C. Depends upon which catalyst is used.
D. Is always the same.

## Answer: D

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27. The equilibrium constant of a reaction at 298 K is $5 \times 10^{-3}$ and at 1000 K is $2 \times 10^{-5}$ What is the sign of $\triangle H$ for the reaction.
A. $\triangle H=0$
B. $\triangle H$ is negative
C. $\triangle H$ is positive
D. None of these

## Answer: B

## - Watch Video Solution

28. In an isochoric process the increase in internal energy is
A. Equal to the heat absorbed
B. Equal to the heat evolved
C. Equal to the work done
D. Equal to the sum of the heat absorbed and work done

## Answer: A

## - Watch Video Solution

29. In the complete oombustion of butanol $\mathrm{C}_{4} \mathrm{H}_{9} \mathrm{OH}(\mathrm{I})$, if $\triangle H$ is enthalpy of combustion and $A E$ is the heat of combustion at constant volume, then
A. $\triangle H<\triangle E$
B. $\triangle H=\triangle E$
C. $\triangle H>\triangle E$
D. $\triangle H, \triangle$ relation cannot be predicted

## D Watch Video Solution

30. The enthalpy change of a reaction does not depend upon
A. The state of reactants and products
B. Nature of reactants and products
C. Different intermediate reaction
D. Initial and final enthalpy change of a reaction

## Answer: C

## - Watch Video Solution

31. Which of the following expression represents, the first law of thermodynamics ?
A. $\triangle E=-q+W$
B. $\triangle E=-q-W$
C. $\triangle E=q+W$
D. $\triangle E=-q-W$

## Answer: C

## - Watch Video Solution

32. The dependence of Gibbs free energy on pressure for an isothermal process of an ideal gas is given by
A. $\triangle G_{r}=n R T \frac{\ln P_{2}}{P_{1}}$
B. $\triangle G_{T}=n R T \frac{\ln V_{2}{ }^{\prime}}{V_{1}}$
C. $\triangle G_{T}=n R T \frac{\ln P_{1}}{P_{2}}$
D. $\triangle G_{T}=n R T \frac{\log V_{1}}{V_{2}}$
33. For a reaction to occur spontaneously
A. ( $\triangle H-T \triangle S)$ must be negative
B. $(\triangle H+T \triangle S)$ must be negative
C. $\triangle H$ must be negative
D. $\triangle S$ must be negative

## Answer: A

## - Watch Video Solution

34. If enthalpies of formation of $\mathrm{C}_{2} \mathrm{H}_{4}(\mathrm{~g}), \mathrm{CO}_{2}(\mathrm{~g})$ and $\mathrm{H}_{2} \mathrm{O}(\mathrm{l})$ at $25^{\circ} \mathrm{C}$ and 1 atm pressure are $52,-394$ and $-286 \mathrm{KJ} / \mathrm{mol}$, the enthalpy of combustion of ethane is equal to
35. For an ideal diatomic gas:
A. $C_{P}=\frac{7}{2} R$
B. $C_{P}=\frac{3}{2} R$
C. $C_{P}=\frac{5}{2} R$
D. $C_{v}=\frac{3}{2} R$

## Answer: A

## - Watch Video Solution

36. When a solid changes into liquid, the entropy
A. Becomes zero
B. Remains the same
C. Increases
D. Decreases

## Answer: D

## D Watch Video Solution

37. In which of the following entropy increases?
A. Crystallization of sucrose from solution
B. Rusting of iron
C. Melting of ice
D. Vaporization of camphor

## Answer: A

## - Watch Video Solution

38. For an exothermic reaction
A. $H_{p}$ of the products is less than $H_{r}$ of the reactants
B. $H_{p}$ of the products is more than $H_{r}$ of the reactants
C. $H_{p}$ of the products is equal to $H_{r}$ of the reactants
D. $\triangle H$ is always positive

## Answer: A

## - Watch Video Solution

39. The enthalpy change for the transition of liquid water to steam, $\Delta_{\text {vap }} \mathrm{H}=37.3 \mathrm{~kJ} \mathrm{~mol}^{-1}$ at 373 K . The entropy change for the process is
$\qquad$ .
A. $119.9 \mathrm{Jmol}^{-1} \mathrm{~K}^{-1}$
B. $37.3 \mathrm{Jmol}^{-1} K^{-1}$
C. $100 \mathrm{Jmol}^{-1} \mathrm{~K}^{-1}$
D. $74.6 \mathrm{Jmol}^{-1} \mathrm{~K}^{-1}$

## Answer: C

40. In the combustion of 2.0 g of methane 25 kcal heat is liberated, heat of combustion of methane would be $\qquad$ .
A. 100 Kcal
B. 200 Kcal
C. 300 Kcal
D. 4000 Kcal

## Answer: B

## - Watch Video Solution

41. The combustion reaction occuring in an automobile is $2 \mathrm{C}_{8} \mathrm{H}_{18}+25 \mathrm{O}_{2}(\mathrm{~g}) \rightarrow 16 \mathrm{CO}_{2}(\mathrm{~g})+18 \mathrm{H}_{2} \mathrm{O}(\mathrm{g}) \quad$ This reaction is accompanied with signs of change in enthalpy, entropy and gibbs free energy
A.,,+-+
B.,,-+-
C.,,-++
D.,,++-

## Answer: B

## - Watch Video Solution

42. At constant $T$ and $P$, Which of the following statements is correct for the reaction,
$\mathrm{CO}(G)+\frac{1}{2} \mathrm{O}_{2}(g) \rightarrow \mathrm{CO}_{2}(g)$,
A. $\triangle H$ is independent of the physical state of the reactants of that compound
B. $\triangle H>\triangle E$
C. $\triangle H<\triangle E$
D. $\triangle H=\triangle E$

## Answer: C

## D Watch Video Solution

43. The heat of formations of $C O_{(g)}$ and $\mathrm{CO}_{2(g)}$ are -26.4 kcal and -94.0 kcal respectively. The heat of combustion of carbon monoxide will be $\qquad$ .
A. +26.4 Kcal
B. -67.6 Kcal
C. -120.6 Kcal
D. +52.8 Kcal

## Answer: B

44. The value of heat generated when 36.5 gm of HCl and 40 gm of NaOH reacts during neutralization
A. 76.5 Kcal
B. 13.7 Kcal
C. More than 13.7 Kcal
D. 108 Kcal

## Answer: B

## - Watch Video Solution

45. In the reaction,
$\mathrm{CO}_{2}(g)+\mathrm{H}_{2}(g) \rightarrow \mathrm{CO}(g)+\mathrm{H}_{2} \mathrm{O}(g), \quad \Delta H=2.8 k J$
$\Delta H$ represents :
A. Heat of formation
B. Heat of combustion
C. Heat of neutralization
D. Heat of reaction

## Answer: D

## - Watch Video Solution

46. The heat of formation is the change in enthalpy accompanying the formation of a substance fiom its elements at 298 K and 1 atm pressure. Since the anthalpies of elements are taken to be zero, the heat of formation ( $\triangle H$ ) of compounds
A. always negative
B. Is always positive
C. May be negative or positive
D.

## Answer: C

47. An isolated system is that system in which
A. There is no exchange of energy with the is zero
B. There is exchange of mass and energy with the surroundings
C. There is no exchange of mass or energy with the surroundings
D. There is exchange of mass with the surroundings

## Answer: C

## - Watch Video Solution

48. Which of the following statement is true regarding the entropy of the universe?
A. Increases and tends towards $m$ aximum value
B. Decreases and tends to be zero
C. Remains constant
D. Decreases and increases with a periodic rate

## Answer: A

## - Watch Video Solution

49. In a reversible isothermal process, the change in internal energy is:
A. Zero
B. Positive
C. Negative
D. Unpredictable

## Answer: A

## D Watch Video Solution

## Efficient

1. Which of the following expressions is true for an ideal gas ?
A. $\left(\frac{\delta V}{\delta T}\right)_{P}=0$
B. $\left(\frac{\delta P}{\delta T}\right)_{V}=0$
c. $\left(\frac{\delta E}{\delta T}\right)_{T}=0$
D. $\left(\frac{\delta E}{\delta T}\right)_{V}=0$

## Answer: C

## - Watch Video Solution

2. The expression $[\delta U / \delta T]_{V}$ represents
A. Heat capacity at constant volume
B. Heat capacity at constant pressure
C. Enthalpy change
D. Entropy change

## Answer: A

## D Watch Video Solution

3. Vibrational energy is
A. Partially potential and partially kinetic
B. Only potential
C. Only electronic
D. Only kinetic

## Answer: A

## - Watch Video Solution

4. The work done by the system in a cyclic process involving one mole of an ideal monoatomic gas is $-50 \mathrm{~kJ} /$ cycle. The heat absorbed by system per cycle is
A. Zero
B. 50 kJ
C. $-50 k J$
D. 250 kJ

## Answer: B

## - Watch Video Solution

5. The enthalpy of reaction,
$H_{2}(g)+\frac{1}{2} O_{2}(g) \rightarrow H_{2} O(g)$ is $\Delta H_{1}$
and that of $\mathrm{H}_{2}(g)+\frac{1}{2} \mathrm{O}_{2}(g) \rightarrow \mathrm{H}_{2} \mathrm{O}(l)$ is $\Delta H_{2}$. Then
A. $\triangle H_{1}>\triangle H_{2}$
B. $\triangle H_{1}=\triangle H_{2}$
C. $\triangle H_{1}<\triangle H_{2}$
D. $\triangle H_{1}+\triangle H_{2}=0$

## Answer: C

## - Watch Video Solution

6. "The resultant heat change in a reaction is the same whether it takes place in one or several stages." This statement is called
A. Lavoisier and Laplace law
B. Hess's law
C. Le-chatelier principle
D. Joule's law

## Answer: B

## D Watch Video Solution

7. $\mathrm{NH}_{3}(g)+3 \mathrm{Cl}_{2}(g) \rightarrow \mathrm{NCl}_{3}(g)+3 \mathrm{HCl}(g), \quad \Delta H_{1}$
$\mathrm{N}_{2}(g)+3 \mathrm{H}_{2}(g) \rightarrow 2 \mathrm{NH}_{3}(g), \quad \Delta \mathrm{H}_{2}$

## $\mathrm{H}_{2}(\mathrm{~g})+\mathrm{Cl}_{2}(\mathrm{~g}) \rightarrow 2 \mathrm{HCl}(\mathrm{g})$, $\Delta H_{3}$

The heat of formation of $\mathrm{NCl3}(\mathrm{~g})$ in the terms of $\Delta H_{1}, \Delta H_{2}$ and $\Delta H_{3}$ is
A. $\triangle H_{f}=-\triangle H_{1}+\frac{\triangle H_{2}}{2}-\frac{3}{2} \triangle H_{3}$
B. $\triangle H_{f}=\triangle H_{1}+\frac{\triangle H_{2}}{2}-\frac{3}{2} \triangle H_{3}$
C. $\triangle H_{f}=\triangle H_{1}-\frac{\triangle H_{2}}{2}-\frac{3}{2} \triangle H_{3}$
D. $\triangle H_{f}=\triangle H_{1}+\frac{\triangle H_{2}}{2}-\triangle H_{3}$

## Answer: A

## - Watch Video Solution

8. Which of the following molecules does not have zero entropy even at zero kelvin? $\mathrm{CO}, \mathrm{CO}_{2}, \mathrm{NaCl}, \mathrm{NO}$
A. $\mathrm{CO}, \mathrm{CO}_{2}$
B. $\mathrm{CO}, \mathrm{NO}$
C. $\mathrm{CO}_{2}, \mathrm{NaCl}$
D. NaCl

## Answer: B

## - Watch Video Solution

9. If $\triangle H_{f}\left(C_{2} H_{5}-S-C_{2} H_{5}\right)=-147 \mathrm{~kJ} /$ mole and
$\triangle H_{f}\left(C_{2} H_{5}-S-S-C_{2} H_{5}\right)=-202 \mathrm{Kj} /$ mole and
'triangleH_(f) (S) (g)=+ $223 \mathrm{~kJ} /$ mole then the $\mathrm{S}-\mathrm{S}$ bond energy will be
A. 168 kJ
B. 126 kJ
C. 278 kJ
D. 572 kJ

## Answer: C

## - Watch Video Solution

10. How much energy must be supplied to change 36 g of ice at $0^{\circ} \mathrm{C}$ to water at room temperature $25^{\circ} C$ ?

Data for water
$\Delta H_{\text {fusion }}^{\circ}$
$6.01 \mathrm{~kJ} / \mathrm{mol}$
$C_{P}$ liquid
4.18JK ${ }^{-1} g^{-1}$
A. 12 kJ
B. 16 kJ
C. 19 kJ
D. 22 kJ

## Answer: B

## - Watch Video Solution

11. Consider the values of $\Delta H\left(\operatorname{inkJmol}{ }^{-}\right)$and for $\Delta S\left(\mathrm{inmol}^{-} K^{-1}\right)$ given for four different reactions. For which reaction will $\Delta G$ increases the most (becoming more positive) when the temperature is increased form $0^{\circ} \mathrm{Cto} 25^{\circ} \mathrm{C}$ ?
A. $\triangle H^{\circ}=50, \triangle S^{\circ}=50$
B. $\triangle H^{\circ}=90, \triangle S^{\circ}=20$
C. $\triangle H^{\circ}=-20, \triangle S^{\circ}=-50$
D. $\triangle H^{\circ}=-90, \triangle S^{\circ}=-20$

## Answer: C

## - Watch Video Solution

12. The enthalpy of neutralisation of a strong acid by a string base is $-57.32 \mathrm{kJmol}^{-1}$. The enthalpy of formation of water is $-285.84 \mathrm{kJmol}^{-1}$. The enthalpy of formation of hydroxyl ion is
A. $+228.52 \mathrm{~kJ} / \mathrm{mole}$
B. $-114.26 \mathrm{~kJ} / \mathrm{mole}$
C. $-228.52 \mathrm{~kJ} / \mathrm{mole}$
D. $+114.26 \mathrm{~kJ} / \mathrm{mole}$

## Answer: C

## - Watch Video Solution

13. Consider the following two reactions :
(i) Propene $+H_{2} \rightarrow$ Propane, $\Delta H_{1}$
(ii) Cyclopropane $+H_{2} \rightarrow$ Propane, $\Delta H_{2}$

Then, $\Delta H_{2}-\Delta H_{1}$ will be
A. Zero
B. $2 B E_{C-C}-B E_{C-C}$
C. $B E_{C=C}$
D. $2 B E_{C=C}-B E_{C-C}$

## Answer: B

## D Watch Video Solution

14. Match the thermodynamic property given in column I with its correct cxpression given in column II

| Column I |  | Column II |  |
| :--- | :--- | :--- | :--- |
| (A) | $\Delta \mathrm{G}$ | (i) | $-\mathrm{RT} \ln \mathrm{K}$ |
| (B) | $\Delta \mathrm{S}^{0}$ | (ii) | -nFE |
| (C) | $\Delta \mathrm{H}^{\circ}$ | (iii) | $\mathrm{RT}^{2}\left(\frac{\mathrm{~d} \ln \mathrm{~K}}{\mathrm{dT}}\right)_{\mathrm{P}}$ |
| (D) | $\Delta \mathrm{G}^{0}$ | (iv) | $-\left(\frac{\mathrm{d} \Delta \mathrm{G}}{\mathrm{dT}}\right)_{\mathrm{P}}$ |

Select the correct answer:
A. $\begin{array}{llll}A & B & C & D\end{array}$
A. $I$ ii $i i i \quad i v$
B. $\begin{array}{llll}A & B & C\end{array}$
B. $i i$ iv iii $i$
C. $\begin{array}{lllll}A & B & C & D\end{array}$
iv ii iii $i$
D. $\begin{array}{llll}A & B & C & D \\ I & i i & i v & i i i\end{array}$

Answer: B
15. An ideal gas is taken around the cycle $A B C A$ as shown below:


Work done in the cyclic process is
A. $12 P_{1} V_{1}$
B. $6 P_{1} V_{1}$
C. $3 P_{1} V_{1}$
D. Zero
16. Which among the following is not an exact differential?
A. $\mathrm{Q}(\mathrm{dQ}=$ heat absorbed)
B. U ( $\mathrm{dU}=$ Internal energy change)
C. S (dS = Entropy change)
D. G (dG = Gibbs free energy change)

## Answer: A

## - Watch Video Solution

17. A gas expands adiabatically at constant pressure such that:
$T \propto \frac{1}{\sqrt{V}}$
The value of $\gamma$ i.e., $\left(C_{P} / C_{V}\right)$ of the gas will be:
A. 1.3
B. 1.5
C. 1.7
D. 2

## Answer: B

## D Watch Video Solution

18. In the Haber 's process of ammonia manufacture:
$\mathrm{N}_{2}(\mathrm{~g})+3 \mathrm{H}_{2}(\mathrm{~g}) \rightarrow 2 \mathrm{NH}_{3}(\mathrm{~g}), \triangle \mathrm{H}_{298 \mathrm{~K}}^{\circ}=-92.2 \mathrm{~kJ}$ If $N_{2}(g), H_{2}(g)$ and $\mathrm{NH}_{3}(\mathrm{~g})$ have $C_{p}\left(\mathrm{JK}^{-1} \mathrm{~mol}^{-1}\right)$ values 29.1, 28.8 and 35.1 respectively then if $C_{p}$ is independent of temperature, the reaction at $100^{\circ} \mathrm{C}$ as compared to that of $25^{\circ} \mathrm{C}$ will be
A. More endothermic
B. Less endothermic
C. Less exothermic
D. More exothermic

## Answer: D

## - Watch Video Solution

19. In $C_{2} H_{4}$ energies of formation of $(C=C)$ and $(C-C)$ are -145 $\mathrm{kJ} / \mathrm{mol}$ and $-80 \mathrm{~kJ} / \mathrm{mol}$ respectively. What is the enthalpy change w hen ethylene polymerises to form polythene?
A. $+650 \mathrm{~kJ} /$ mole
B. $1.5 \mathrm{~kJ} / \mathrm{mole}$
C. $-650 \mathrm{~kJ} / \mathrm{mole}$
D. $-65 \mathrm{~kJ} / \mathrm{mole}$

## Answer: B

20. If 150 kJ of energy is needed for muscular work to walk a distance of one km , then how much of glucose one has to consume to walk a distance of 5 km . Provided only $30 \%$ energy is available for muscular work. The enthalpy of combustion of glucose is $3000 \mathrm{kJmol}^{-1}$
A. 75 g
B. 30 g
C. 180 g
D. 150 g

## Answer: D

## - Watch Video Solution

21. A mol of $A l_{3} C_{4}(s)$ reacts with water in a closed vessel at $27^{\circ} C$ against atmospheric pressure, work is doens
A. -1800 cal
B. -600 cal
C. +1800 cal
D. zero

## Answer: D

## - Watch Video Solution

22. $\triangle G^{\circ}$ and $\triangle H^{\circ}$ for a reaction at 300 K are $-66.9 \mathrm{~kJ} /$ mole and 41.8 $\mathrm{kJ} /$ mole respectively. $\triangle G^{\circ}$ for the same reaction at 330 K is
A. -25.1 kJ
B. +25.1 kJ
C. 118.7 kJ
D. $-69.4 k J$

## Answer: D

23. A gaseous reaction was carried out first keeping the volume constant and then keeping the pressure constant. In the second experiment, there was an increase in volume. The heats of reaction were different because
A. In the first case energy was spent to keep the volume constant
B. In the second case energy was spent to expand the gases
C. Specific heats of compressed gases is more
D. Specific heats of rarefied gases is more

## Answer: B

## - Watch Video Solution

24. The standard entropies of $C O_{2(g)}, C_{(s)}$, and $O_{2(g)}$ are 213.5, 5.740 and $205 \mathrm{JK}^{-1}$ respectively. The standard entropy of formation of $\mathrm{CO}_{2}$ is
A. $1.86 J K^{-1}$
B. $1.96 \mathrm{JK}^{-1}$
C. $2.81 J K^{-1}$
D. $2.86 J K^{-1}$

## Answer: C

## - Watch Video Solution

25. Calcualte $\Delta H_{f}^{\circ}$ for chloride ion from the following data:
$\frac{1}{2} \mathrm{H}_{2}(\mathrm{~g})+\frac{1}{2} \mathrm{Cl}_{2}(\mathrm{~g}) \rightarrow \mathrm{HCl}(\mathrm{g}), \Delta H_{f}^{\circ}=-92.4 \mathrm{~kJ}$
$\mathrm{HCl}(\mathrm{g})+n \mathrm{H}_{2} \mathrm{O} \rightarrow \mathrm{H}^{+}(a q)+\mathrm{Cl}^{-}(a q), \Delta H_{f}^{\circ}$ of $H^{+}(\mathrm{aq})=0.0 \mathrm{~kJ}$
A. -40.0 Kcal
B. +40.0 Kcal
C. +17.9 Kcal
D. +22.1 Kcal

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26. 

$M g(s)+2 H C l(a q) \rightarrow \mathrm{MgCl}_{2}(a q)+H_{2}(g), \Delta_{r} H^{\circ}=-467 k J / m o l$ $M g O(s)+2 H C l(a q) \rightarrow \mathrm{MgCl}_{2}(a q)+\mathrm{H}_{2} O(l), \Delta_{r} H^{\circ}=-151 \mathrm{~kJ} / \mathrm{mol} W$

According to the information, and given the fact that for water,
$\Delta_{f} H^{\circ}=-286 k J / m o l$ what is the $\Delta_{f} H^{\circ}$ for $\mathrm{MgO}(\mathrm{s}) ?$
A. $-904 \mathrm{~kJ} / /$ mole
B. $-602 \mathrm{~kJ} / / \mathrm{mole}$
C. $-334 \mathrm{~kJ} / /$ mole
D. $-30 \mathrm{~kJ} / / \mathrm{mole}$

## Answer: B

27. Given the experimental information below:
$2 \mathrm{Sr}(\mathrm{s})+\mathrm{O}_{2}(g) \rightarrow 2 \mathrm{SrO}(\mathrm{s}), \quad \Delta_{r} H^{\circ}=-1180 \mathrm{~kJ} / \mathrm{mol}$
$\mathrm{SrCO}_{3}(\mathrm{~s}) \rightarrow \mathrm{CO}_{2}(\mathrm{~g})+\mathrm{SrO}(\mathrm{s}) \Delta_{r} \mathrm{H}^{\circ}=234 \mathrm{~kJ} / \mathrm{mol}$
$2 \mathrm{O}_{2}(\mathrm{~g})+2 \mathrm{C}(\mathrm{s}) \rightarrow 2 \mathrm{CO}_{2}(\mathrm{~g}), \quad \Delta_{r} \mathrm{H}^{\circ}=-788 \mathrm{~kJ} / \mathrm{mol}$
Calculate the enthalpy change $\Delta_{r} H^{\circ}$ for the formation of 1.0 mol of strontium carbonate, the material that gives red color in fireworks, from its elements.
$\mathrm{Sr}(\mathrm{s})+\frac{3}{2} \mathrm{O}_{2}(\mathrm{~g})+\mathrm{C}($ graphite $) \rightarrow \mathrm{SrCO}_{3}(s)$.
A. $-740 \mathrm{Kj} / \mathrm{mol}$
B. $+714 \mathrm{Kj} / \mathrm{mol}$
C. $-1218 \mathrm{Kj} / \mathrm{mol}$
D. $-2436 \mathrm{Kj} / \mathrm{mol}$

## Answer: C

28. What is the heat of reaction for the following reaction?
$\mathrm{CH}_{4}(\mathrm{~g})+\mathrm{NH}_{3}(\mathrm{~g}) \rightarrow 3 \mathrm{H}_{2}(\mathrm{~g})+\mathrm{HCN}(\mathrm{g})$
Use the following thermodynamic data in $\mathrm{kJ} /$ mole

$$
N_{2}(G)+3 H_{2}(g) \rightarrow 2 N H_{3}(g), \triangle_{r} H^{\circ}=-91.8
$$

$$
C(s)+2 H_{2}(g) \rightarrow C H_{3}(g), \triangle_{r} H^{\circ}=+74.9
$$

$$
H_{2}(g)+2 C(s)+N_{2}(g) \rightarrow 2 H C N(g), \triangle_{r} H^{\circ}=+261
$$

A. 299.3 kJ
B. 256 kJ
C. $-149.5 k J$
D. 101.5 kJ

## Answer: D

## - Watch Video Solution

29. 25.0 mL of 1.0 M HCl is combined with 35.0 mL of 0.5 M NaOH . The initial temperatures of the solutions is $25^{\circ} \mathrm{C}$, the density of the solution is $1.0 \mathrm{~g} / \mathrm{mL}$, the specific heat capacity of the solution is $4.184 \mathrm{~J} / \mathrm{g} .{ }^{\circ} \mathrm{C}$, the
reaction is completed in insulated beaker, and the standard enthalpy of reaction for $\mathrm{H}^{+}(a q)+\mathrm{OH}^{-}(a q) \rightarrow \mathrm{H}_{2} \mathrm{O}(\mathrm{l})$ is $-56 \mathrm{~kJ} / \mathrm{mol}$. What is the final temperature of the solution?
A. $27^{\circ} C$
B. $25.223^{\circ} \mathrm{C}$
C. $30.1^{\circ} \mathrm{C}$
D. $32.8^{\circ} \mathrm{C}$

## Answer: B

## - Watch Video Solution

30. The reaction $3 O_{2}(g) \rightarrow 2 O_{3}(g), \Delta_{r} H>0$. What can be concluded about average energy per bond in $O_{2}$ and $O_{3}$ ?
A. The average energy per bond in $O_{2}$ is greater than the average bond energy per bond in $O_{3}$
B. The average energy per bond in $O_{2}$ is less than the average bond energy per bond in $O_{3}$
C. The average energy per bond in $O_{2}$ is same as the average bond average per bond in $O_{3}$
D. No conclusion can be drawn about the average bond energies from this information alone.

## Answer: A

## - Watch Video Solution

31. When 5.0 mL of a 1.0 M HCl solution is mixed with 5.0 mL of a 0.1 M NaOH solution, temperature of solution is increased by $2^{\circ} C$ predicted accurately from this observation?
A. If 10 ml of same HCl is mixed with 10 ml of same NAOH , temperature rise will be $4^{\circ} C$
B. If 10 ml of 0.05 M HCl is mixed with 10 ml of 0.05 M NaCl the temperature rise will be $2{ }^{\circ} \mathrm{C}$
C. If 5 ml of 0.1 MHCl is mixed with 5 ml of 0.1 M NH solution, the temeprature rise will be less than $2^{\circ} \mathrm{C}$
D. If 5 ml of $0.1 \mathrm{MCH}_{3} \mathrm{COOH}$ is mixed with 5 ml 0.1 M NaOH the temperature rise will be more than $2{ }^{\circ} \mathrm{C}$

## Answer: C

## - Watch Video Solution

32. Which of the following reactions doesn't represent the standard state enthalpy of formation reaction?
A. $\frac{1}{2} H_{2}(g)+\frac{1}{2} C l_{2}(g) \rightarrow H C l(g)$
B. $X e(g)+2 F_{2}(g) \rightarrow X e F_{4}(g)$
C. $\frac{1}{2} C l_{2}(g)+\frac{3}{2} F_{2}(g) \rightarrow C l F_{3}(g)$
D. $\mathrm{Kr}(g)+F_{2}(g) \rightarrow K r F_{2}(s)$

## Answer: B

## - Watch Video Solution

33. What can be accurately predicted for the isomerization reaction between gaseous penta-1,4-diene and gaseous penta-1.3-diene?
A. The process is exothermic
B. Enthalpy change of the reaction is same as resonance energy of the
product
C. Magnitude of enthalpy of combustion of product is more than that of the reactant
D. Combustion of the reactant will be exothermic while the same for the products will bc endothermic.
34. At $5 \times 10^{5}$ bar pressure density of diamond and graphite are $3 \mathrm{~g} / \mathrm{cc}$ and $2 g / c c$ respectively, at certain temperature 'T'. Find the value of $\Delta U-\Delta H$ for the conversion of 1 mole of graphite to 1 mole of diamond at temperature ' T ' :
A. $100 \mathrm{~kJ} /$ mole
B. $50 \mathrm{~kJ} / \mathrm{mole}$
C. $-100 \mathrm{~kJ} / \mathrm{mole}$
D. $300 \mathrm{~kJ} / \mathrm{mole}$

## Answer: A

## - Watch Video Solution

35. The enthalpies of neutralization of a weak base $A O H$ and a strong base BOH by HCl are $-12250 \mathrm{cal} / \mathrm{mol}$ and $-13000 \mathrm{cal} / \mathrm{mol}$ respectively. When
one mole of HCl is added to a solution containing 1 mole of AOH and 1 mole of BOH , the enthalpy change was $-12500 \mathrm{cal} / \mathrm{mol}$. In what ratio is the acid distribution between AOH and BOH ?
A. $2: 1$
B. 2: 3
C. 1: 2
D. $4: 5$

## Answer: A

## D Watch Video Solution

36. What is the bond enthalpy of $X e-F$ bond ?
$X e F_{4}(g) \rightarrow X e^{+}(g)+F^{-}(g)+F_{2}(g)+F(g), \quad \Delta_{r} H=292 \mathrm{kcal} / \mathrm{mol}$
Given : Ionization energy of $X e=279 \mathrm{kcal} / \mathrm{mol}$
B. $E .(F-F)=38 \mathrm{kcal} / \mathrm{mol}$, Electron affinity of $\mathrm{F}=85 \mathrm{kcal} / \mathrm{mol}$
A. $24 \mathrm{Kcal} / \mathrm{mole}$
B. $34 \mathrm{Kcal} / \mathrm{mole}$
C. $8.5 \mathrm{Kcal} / \mathrm{mole}$
D. $16.3 \mathrm{Kcal} / \mathrm{mole}$

## Answer: B

## D Watch Video Solution

37. Combustion of sucuose is used by aeroic organisms for providing energy for the life sustaining processes. If all the capturing of energy from the reaction is done through electrical process (non P-V word) then calculate maximum available energy which can be captured by combustion of 34.2 gm of sucrose

Given : $\Delta H_{\text {combustion }}($ sucrose $)=-6000 \mathrm{~kJ} \mathrm{~mol}^{-1}$
$\Delta S_{\text {combustion }}=180 \mathrm{~J} / \mathrm{K}-\mathrm{mol}$ and body temperature is 300 K
A. 600 kJ
B. 594.6 kJ
C. 5.4 kJ
D. 605.4 kJ

## Answer: D

## - Watch Video Solution

38. The freezing of any liquid to a solid is expected to have:
A. a positive $\triangle H$ and a positive $\triangle S$
B. a negative $\triangle H$ and a positive $\triangle S$
C. a positive $\triangle H$ and a negative $\triangle S$
D. a negative $\triangle H$ and a negative $\triangle S$

## Answer: D

39. The enthalpy of neutralization is about 57.3 kJ for the pair
A. HCl and $\mathrm{NH}_{4} \mathrm{OH}$
B. $\mathrm{NH}_{4} \mathrm{OH}$ and $\mathrm{HNO}_{3}$
C. HCl and NaOH
D. $\mathrm{CH}_{3} \mathrm{COOH}$ and NaOH

## Answer: C

## - Watch Video Solution

40. Consider the reaction below at 298 K ,
$C($ graphite $)+2 H_{2}(g) \rightarrow C H_{4}(G)$
$\triangle_{f} H^{\circ}(\mathrm{Kj} / \mathrm{mol})-74.9$
$S_{m}^{\circ}(\mathrm{J} / \mathrm{mol}-\mathrm{K})+5.6+130.7+186.3$
Which statement below is correct?
A. $\triangle_{r} G^{\circ}$ is -50.8 kJ and the reaction is driven by enthalpy only
B. $\triangle_{r} G^{\circ}$ is -50.8 kJ and the reaction is driven by entropy only
C. $\triangle_{r} G^{\circ}$ is +50.8 kJ and the reaction is driven by both enthalpy and entropy
D. $\triangle_{r} G^{\circ}$ is $-50,8 \mathrm{~kJ}$ and the reaction is driven by both enthalpy and entropy

## Answer: A

## - Watch Video Solution

41. Given $\triangle_{r} H^{\circ}(\mathrm{kJ} / \mathrm{mol}) S_{m}^{\circ}(\mathrm{J} / \mathrm{mol}-\mathrm{K})$
$C C l_{4}(l)-135.4 \quad 214.4$
$C C l_{4}(g)-103.0 \quad 308.7$
The boiling point of carbon tetrachloride is
A. $8.25^{\circ} \mathrm{C}$
B. $70.5^{\circ} \mathrm{C}$
C. $92.3^{\circ} \mathrm{C}$
D. $45.8^{\circ} \mathrm{C}$

## Answer: B

## - Watch Video Solution

42. Calculate the change in molar Gibbs energy of carbon dioxide gas at
$20^{\circ} \mathrm{C}$ when it is isothermally compressed from 1.0 bar to 2.0 bar.
A. $2.4 \mathrm{~kJ} / \mathrm{mole}$
B. $-2.4 \mathrm{~kJ} / \mathrm{mole}$
C. $1.7 \mathrm{~kJ} /$ mole
D. $-1.7 \mathrm{~kJ} / \mathrm{mole}$

## Answer: C

## - Watch Video Solution

43. What will be the value of $\triangle_{r} S_{\text {sys }}^{\circ}$ for the following reaction at 373 K :

$$
\mathrm{CO}(g)+\mathrm{H}_{2} \mathrm{O}(g) \rightarrow \mathrm{CO}_{2}(g)+\mathrm{H}_{2}(g) \triangle_{r} H^{\circ}=-4.5 \times 10^{4} J, \triangle_{r} S_{\mathrm{univ}}^{\circ}
$$

A. $+178 \frac{\mathrm{~J}}{\mathrm{~K}}$
B. $-166 \frac{\mathrm{~J}}{K}$
C. $-178 \frac{\mathrm{~J}}{\mathrm{~K}}$
D. $+166 \frac{\mathrm{~J}}{\mathrm{~K}}$

## Answer: A

## - Watch Video Solution

44. A certain process releases 64.0 kJ of heat, which is transferred to the surroundings at a constant pressure and a constant temperature of 300 K. For this process $\Delta S_{\text {surr }}$ is:
A. 64 kJ
B. $-64 k J$
C. $-213 J / K$
D. $213 \mathrm{~J} / \mathrm{K}$

## Answer: D

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45. A certain homogenous gas-phase reaction is exothermic and proceeds with an increase in the number of moles of gas. Which of the following statements concerning this reaction is true?
A. This reaction is spontancous at lower temperatures but nonspontancous at higher temperatures.
B. This reaction is is non-spontaneous over all possible temperatures
C. This reaction is is spontancous over all possible temperatures
D. There is a temperature at which this reaction can be at equilibrium where all species are present at standard concentrations.

## Answer: C

## D Watch Video Solution

46. Which of the following proceeds with decrea se in entropy?
A. Boiling of an egg
B. Combustion of benzene at $27^{\circ} \mathrm{C}$
C. Dissolution of sugar in water
D. Calcination of solid $\mathrm{CaCO}_{3}$

## Answer: B

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47. The standard enthalpy of formation of gaseous $H_{2} \mathrm{O}$ at 298 K is $-241.82 \mathrm{~kJ} / \mathrm{mol}$. Calculate $\Delta H^{\circ}$ at 373 K given the following values of the molar heat capacities at constant pressure :
$H_{2} O(g)=33.58 \mathrm{JK}^{-1} \mathrm{~mol}^{-1}, \quad H_{2}(g)=29.84 \mathrm{JK}^{-1} \mathrm{~mol}^{-1}, \quad O_{2}(g$
Assume that the heat capacities are independent of temperature :
A. $-242.6 \mathrm{~kJ} / \mathrm{mole}$
B. $+242.6 \mathrm{~kJ} / \mathrm{mole}$
C. $+24.26 \mathrm{~kJ} / \mathrm{mole}$
D. $-242.6 \mathrm{~J} / \mathrm{mole}$

## Answer: A

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48. $\Delta_{r} H^{\circ}$ for solid-to-liquid transitions for proteins A and B are 2.73 Kcal $\mathrm{mol}^{-1}$ and $3.03 \mathrm{kcal} \mathrm{mol}^{-1}$. The two melting points are $0^{\circ} \mathrm{C}$ and $30^{\circ} \mathrm{C}$ respectively. The entropy changes $\Delta S_{A}$ and $\Delta S_{B}$ at two transition temperatures are related as:
A. $\triangle S_{A}=\triangle S_{B}$
B. $\triangle S_{A}>\triangle S_{B}$
C.
D. $\triangle S_{B}=\frac{303 \triangle S_{A}}{273}$

## Answer: A

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Impeccable

1. Calculate the work done when 1 mol of an ideal gas is compressed reversibly from 1 bar to 4 bar at a constant temperature of 300 K
A. 4.01 kJ
B. $-8.02 k J$
C. 18.02 kJ
D. 3.45 kJ

## Answer: D

2. Consider the following reactions:
I. $C(s)+\frac{1}{2} O_{2}(g) \rightarrow C O(g), \quad \Delta H_{1}=x_{1}$
II. $\mathrm{CO}(g)+\frac{1}{2} \mathrm{O}_{2}(g) \rightarrow \mathrm{CO}_{2}(g), \quad \Delta H_{2}=x_{2}$
III. $C(s)+\mathrm{CO}_{2}(g) \rightarrow 2 \mathrm{CO}(g), \quad \Delta H_{3}=x_{3}$

Select the correct statements:
A. Heat of formation of $\mathrm{CO}_{2}$ is (a +b )
B. Heat of combustion of $C$ is ( $a+b$ )
C. $\triangle H_{3}=\triangle H_{1}=\triangle_{2}$
D. All the above are correct statements

## Answer: D

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3. An endothermic reaction has a positive internal energy change $\triangle U$. In such a case, what is the minimum value that activation energy can have ?
A. $\triangle U$
B. $\triangle=\triangle H+\triangle n R T$
C. $\triangle U=\triangle H-\triangle n R T$
D. $\triangle U=\triangle E_{a}+R T$

## Answer: A

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4. The heat of atomisation of $\mathrm{PH}_{3}(g)$ and $P_{2} H_{4}(g)$ are $953 \mathrm{kJmol}^{-1}$ and $1485 \mathrm{kJmol}^{-1}$ respectively. The $\mathrm{P}-\mathrm{P}$ bond energy in $\mathrm{kJmol}^{-1}$ is:
A. 213
B. 426
C. 318
D. 1272

## Answer: A

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5. Given that $\Delta h_{f}(H)=218 \mathrm{~kJ} / \mathrm{mol}$. Express the $H-H$ bond energy in Kcal/mol
A. 52.15
B. 911
C. 104
D. 52153

## Answer: C

6. The heat change for the following reaction at 298 K and constant pressure is +7.3 kcal
$A \circ B(s) \rightarrow 2 A(s)+\frac{1}{2} B_{2}(g), \Delta H=+7.3 \mathrm{kcal}$
The heat change at constant volume would be
A. +7.3 Kcal
B. more than 7.3 Kcal
C. less than 7.3 Kcal
D. zero

## Answer: C

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7. Entropy changesh for the process, $\mathrm{H}_{2} \mathrm{O}(l) \rightarrow \mathrm{H}_{2} \mathrm{O}$ at normal pressure and 274 K are given below
$S_{\text {system }}=-22.13, \triangle S_{\text {surr }}=+22.05$, the process is non spontaneous because
A. $\triangle S_{\text {system }}$ is $-v e$
B. $\triangle S_{\text {surr }}$ is $+v e$
C. $\triangle S_{\mathrm{u}}$ is $-v e$
D. $\triangle S_{\text {system }} \neq \triangle S_{\text {surr }}$

## Answer: C

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8. A process is called reversible when
A. surrounding and system change into each other
B. there is no boundry between system and surrounding
C. the surrounding are always in equlibrium with the systeme
D. the sytem changes into surroundings spontaneously

## Answer: C

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9. The incorrect statemetns amgong the following is
A. The entropy of the universe remains constant
B. Heat cannot be completely converted into work
C. The absoltute entropy of a perferctly cystaline solid at absolute
zero temperature is zero
D. The total energy of an isolates system remains contant

## Answer: A

## D Watch Video Solution

10. Under which of the following sets of conditions, $\triangle G$ is always negative ?
A. $\triangle H=-v e$ and $\triangle S=+v e$
B. $\triangle H=-v e$ and $\triangle S=-v e$
C. $\triangle H=+v e$ and $\triangle S=+v e$
D. $\triangle H=+v e$ and $\triangle S=-v e$

## Answer: A

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11. The second law of thermodynamic states that in a cyclic process,
A. work cannot be converted into heat
B. heat cannot be converted into work
C. work cannot be completely converted into heat
D. heat cannot be completely converted into work

## Answer: D

12. When 400 mL of 0.2 N solution ofa weak acid is neutralized by a dilute aqueous solution of sodium hydroxide un der standard conditions, 4.4 kJ amount of heat is liberated. Therefore, the standard enthalpy of neutralization of this weak acid in $\mathrm{kJ} \mathrm{equiv}^{-1}$ is
A. -11
B. -44
C. -55
D. -22

## Answer: C

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13. Equal volumes of molar hydrochloric acid and sulphuric acid are neutralised by dilute NaOH solution and x kcal and v kcal of heat are liberated respectively. Which of the following is true?
A. $x=y$
B. $x=\frac{y}{2}$
C. $x=2 y$
D. $x=3 y$

## Answer: B

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14. for an endothermic reaction, energy of activation is $E_{\alpha}$ and Enthalpy of raction is $\Delta H$ (both of these in $\mathrm{kj} / \mathrm{mol}$ ). Minimum value of $E_{\alpha}$ will be
A. equal to zero
B. less than $\triangle H$
C. equal to $\triangle H$
D. more than $\triangle H$
15. Which equation is correct for adiabatic process ?
A. $Q=+W$
B. $\mathrm{Q}=0$
C. $\triangle E=Q$
D. $P+\triangle V=0$

## Answer: B

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16. For a given reaction, $\Delta H=35.5 \mathrm{kJmol}^{-1}$ and
$\Delta S=83.6 \mathrm{JK}^{-1} \mathrm{~mol}^{-1}$. The reaction is spontaneous at (Assume that
$\Delta H$ and $\Delta S$ do not vary with temperature)

$$
\text { A. } T<425 K
$$

B. $T>425 K$
C. all temperature
D. $T>298 K$

## Answer: B

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17. If W is the amount of work done by the system and q is the amount of heat supplied to the system, identify the type of the system
A. isolated system
B. closed system
C. Open system
D. system with thermally conducting walls

## Answer: B

18. Thermodynamically the most stable form of carbon is
(a) diamond , (b) graphite
(c) fullerenes, (d) coal
A. diamond
B. graphite
C. fullerenes
D. coal

## Answer: A

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19. If 1 mole of an ideal gas expands isothermally at $37^{\circ} C$ from 15 litres to 25 litres, the maximum work obtained is :
A. 12.87 L-atm
B. $6.43 \mathrm{~L}-\mathrm{atm}$
C. $8.57 \mathrm{~L}-\mathrm{atm}$
D. $2.92 \mathrm{~L}-\mathrm{atm}$

## Answer: A

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20. The pressure of a gas is 100 k Pa. if it is compressed from $1 \mathrm{~m}^{3}$ to $10 d m^{3}$, find the work done.
A. 990 J
B. 9990 J
C. 9900 J
D. 99000 J

## Answer: D

21. The heat liberated when 1.89 g of benzoic acid is burnt in a bomb calorimeter at $25^{\circ} \mathrm{C}$ and it increases the temperature of 18.94 kg of water by $0.632^{\circ} \mathrm{C}$. If the specific heat of water at $25^{\circ} \mathrm{C}$ is $0.998 \mathrm{cal} / \mathrm{g}-\mathrm{deg}$, the value of the heat of combustion of benzoic acid is
A. 881.1 kcal
B. 771.4 kcal
C. 921.1 kcal
D. 871.2 kcal

## Answer: B

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22. The heat of combustion of liquid ethanol is -327.0 kcal calculate the heat of formation of ethanol. Given that the heats of formation of $\mathrm{CO}_{2}(\mathrm{~g})$ and $\mathrm{H}_{2} \mathrm{O}(\mathrm{l})$ are -94.0 kcal and -68.4 kcal respectively.
A. $-212.4 k \mathrm{cal}$
B. +212.4 kcal
C. -249.2 kcal
D. +249.2 kcal

## Answer: A

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23. The amount of heat evolved when $500 \mathrm{~cm}^{3} 0.1 \mathrm{MHCl}$ is mixed with $200 \mathrm{~cm}^{3}$ of 0.2 MNaOH is
A. 2.292 kJ
B. 1.292 kJ
C. 0.292 kJ
D. 3.392 kJ
24. The heats of neutralisation of four acids $a, b, c$ and $d$ when neutralised against a common base are 13.7, 9.4, 11.2 and 12.4 kcal respectively. The weakest among these acids is
A. A
B. B
C. C
D. D

## Answer: B

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25. According to the second law of thermodynamics, a process (reaction) is spontaneous, if during the process
A. $\triangle S_{\text {universe }}>0$
B. $\triangle S_{\text {universe }}=0$
C. $\triangle H_{\text {system }}>0$
D. $\triangle S_{\text {universe }}=\triangle S_{\text {system }}$

## Answer: A

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26. Calculate the free energy change for the following reaction at 300 K . $2 \mathrm{CuO}_{(s)} \rightarrow \mathrm{Cu}_{2} \mathrm{O}_{(s)}+\frac{1}{2} \mathrm{O}_{2(g)}$ Given $\Delta \mathrm{H}=145.6 \mathrm{kJmol}^{-1}$ and $\Delta S=116 . \mathrm{JK}^{-1} \mathrm{~mol}^{-1}$
A. $110.8 \mathrm{~kJ} \mathrm{~mol}^{-1}$
B. $221.5 \mathrm{~kJ} \mathrm{~mol}^{-1}$
C. $55.4 \mathrm{~kJ} \mathrm{~mol}^{-1}$
D. $145.6 \mathrm{~kJ} \mathrm{~mol}^{-1}$

## D Watch Video Solution

27. Which one of the following is correct?
A. $-\triangle G=\triangle H-T \triangle S$
B. $\triangle H=\triangle H-T \triangle S$
C. $\triangle S=\frac{1}{T}[\triangle G-\triangle H]$
D. $\triangle S=\frac{1}{T}[\triangle H-\triangle G]$

## Answer: D

## - Watch Video Solution

28. Which of the following is correct option for free expansion of an ideal gas under adiabatic condition?
A. $q=0, \triangle T<0, w \neq 0$
B. $q=0, \triangle T \neq 0, w=0$
C. $q \neq 0, \triangle T=0, w=0$
D. $q=0, \triangle T=0, w=0$

## Answer: D

## - Watch Video Solution

29. Enthalpy change for the reaction,
$4 \mathrm{H}(\mathrm{g}) \rightarrow 2 \mathrm{H}_{2}(\mathrm{~g})$ is -869.6 kJ
The dissociation energy of $\mathrm{H}-\mathrm{H}$ bond is
A. +217.4 kJ
B. -434.8 kJ
C. -869.6 kJ
D. +434.8 kJ

## Answer: D

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30. If the enthalpy change for the transition of liquid water to steam is $300 \mathrm{~kJ} \mathrm{~mol}{ }^{-1}$ at $27^{\circ} \mathrm{C}$, the entropy change for the proces would be
A. $1000 \mathrm{JK}^{-1} \mathrm{~mol}^{-1}$
B. $10 \mathrm{JK}^{-1} \mathrm{~mol}^{-1}$
C. $1.0 \mathrm{JK}^{-1} \mathrm{~mol}^{-1}$
D. $0.1 \mathrm{JK}^{-1} \mathrm{~mol}^{-1}$

## Answer: A

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31. Based on the first law of thermodynamics, which one of the following is correct?
A. For an isothermal process $q=+w$
B. For an isochoric process, $\triangle U=-q$
C. For an adiabatic process, $\triangle U=-w$
D. For a cyclic process, $q=-w$

## Answer: D

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32. The enthalpy of solution of sodium chloride is $4 \mathrm{~kJ} \mathrm{~mol}^{-1}$ and its enthalpy of hydration of ions is $-784 \mathrm{~kJ} \mathrm{~mol}^{-1}$. What will be the lattice enthalpy of sodium chloride?
A. +788
B. +4
C. +98
D. +780

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33. Which reaction, with the following values of $\Delta H, \Delta S$, at 400 K is spontaneous and endothermic?
A. $\triangle H=-48 k J, \triangle S=+135 J / K$
B. $\triangle H=-48 k J, \triangle S=-135 J / K$
C. $\triangle H=+48 k J, \triangle S=+135 J / K$
D. $\triangle H=-48 k J, \triangle S=-135 J / K$

## Answer: C

## D Watch Video Solution

34. Enthalpy of vapourization of benzene is $+35.3 \mathrm{kJmol}^{-1}$ at its boiling point of $80^{\circ} \mathrm{C}$. The entropy change in the transition of the vapour to
liquid at its boiling points [in $K^{-1} \mathrm{~mol}^{-1}$ ] is
A. -100
B. +100
C. +342
D. -342

## Answer: A

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35. For the reversible reaction.
$A(s)+B(g) \Leftrightarrow C(g)+D(g), \triangle G^{\circ}=-350 k J$
Which one of the following statement is true?
A. The reaction is thermodynamically non-feasible
B. the entropy change is negative
C. Equilibrium constant is greater than one
D. The reaction should be instantaneous

## Answer: C

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36. A reaction is spontaneous at low temperature but non- spontaneous at high temperature. Which of the following is true for the reaction?
A. $\triangle H>0, \triangle S>0$
B. $\triangle H<0, \triangle S>0$
C. $\triangle H>0, \triangle S=0$
D. $\triangle H<0, \triangle S<0$

## Answer: D

## D Watch Video Solution

37. A reaction having equal energies of activation for forward and reverse reactions has
A. $\triangle H=\triangle G=\triangle S=0$
B. $\triangle S=0$
C. $\triangle G=0$
D. $\triangle H=0$

## Answer: D

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38. Which of the following statements is correct for the spontaneous adsorption of a gas ?
A. $\triangle S$ is positive and, therefore, $\triangle H$ should be negative.
B. $\triangle S$ is positive and, therefore, $\triangle H$ should also be highly positive.
C. $\triangle S$ is negative and, therefore, $\triangle H$ should be highly positive.
D. $\triangle S$ is negative and therefore, $\triangle H$ should be highly negative.

## Answer: D

## - Watch Video Solution

39. For the reaction:
$\mathrm{X}_{2} \mathrm{O}_{4}(\mathrm{l}) \rightarrow 2 \mathrm{XO}_{2}(\mathrm{~g})$
$\Delta U=2.1 \mathrm{kcal}, \Delta S=20 \mathrm{cal} K^{-1} \mathrm{at} 300 \mathrm{~K}$
Hence $\Delta G$ is
A. 9.3 kcal
B. -9.3 kcal
C. 2.7 kcal
D. -2.7 kcal
40. Which of the following statements is correct for a reversible process in a state of equilibrium ?
A. $\triangle G=2.30 R T \log K$
B. $\triangle G^{\circ}=--2.30 R T \log K$
C. $\triangle G^{\circ}=2.30 R T \log K$
D. $\triangle G=-2.30 R T \log K$

## Answer: D

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41. The heat of combustion of carbon to $\mathrm{CO}_{2}$ is $-395.5 \mathrm{~kJ} / \mathrm{mol}$. The heat released upon the formation of $35.2 g$ of $\mathrm{CO}_{2}$ from carbon and oxygen gas is
B. $-3.15 k J$
C. $-315 k J$
D. $+315 k J$

## Answer: C

## - Watch Video Solution

42. The correct thermodynamic conditions for the spontaneous reaction at all temperature is
A. $\triangle H<0$ and $\triangle S<0$
B. $\triangle H<$ and $\triangle S=0$
C. $\triangle H>0$ and $\triangle S<0$
D. $\triangle H<0$ and $\triangle S>0$

## Answer: D

43. Consider the following liquid-vapour equilibrium Liquid $\Leftrightarrow$ Vapour

Which of the following relations is correct?
A. $\frac{d \ln P}{d T}=\frac{\triangle H_{v}}{R T^{2}}$
B. $\frac{d \ln P}{d T^{2}}=\frac{\triangle H_{v}}{R T^{2}}$
c. $\frac{d \ln P}{d T}=\frac{-\triangle H_{v}}{R T}$
D. $\frac{d \ln P}{d T}=\frac{-\triangle H_{v}}{T^{2}}$

## Answer: A

## - Watch Video Solution

44. What is the amount of work done when 0.5 mole of methane, $\mathrm{CH}_{4}(\mathrm{~g})$ is subjected to combustion at 300 K ? (given, $R=8.314 \mathrm{Jk}^{-1} \mathrm{~mol}^{-1}$ )
A. $-2494 J$
B. $-4988 J$
C. +4988 J
D. +2494 J

## Answer: D

## - Watch Video Solution

45. Which one of the following is incorrect for ideal solution ?
A. $\triangle H_{\text {mix }}=0$
B. $\triangle U_{\text {mix }}=0$
C. $\triangle P=\triangle_{\text {observed }}-P_{\text {calculated }}=0$
D. $\triangle G_{\text {mix }}=0$

## Answer: B

46. For a sample of perfect gas when its pressure is changed isothermally from $p_{i}$ to $p_{f}$, the entropy change is given by
A. $\triangle S=n R \ln \left(\frac{p_{f}}{p_{i}}\right)$
B. $\triangle S=n R \ln \left(\frac{p_{i}}{p_{f}}\right)$
C. $\triangle S=n R T \ln \left(\frac{p_{f}}{p_{i}}\right)$
D. $\triangle S=R T \ln \left(\frac{p_{f}}{p_{i}}\right)$

## Answer: B

## - Watch Video Solution

47. If the $E_{\text {cell }}^{\circ}$ for a given reaction has a negative value, which of the following gives the correct relationships for the values of $\Delta G^{\circ}$ and $K_{e q}$ ?
A. $\triangle G^{\circ}>0, K_{e q}<1$
B. $\triangle G^{\circ}>0, K_{e q}>1$
C. $\triangle G^{\circ}<0, K_{e q}>1$
D. $\triangle G^{\circ}<0, K_{e q}<1$

## Answer: C

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48. A gas is allowed to expand in a well insulated container against a constant external pressure of 2.5 atm from an initial volume of 2.50 L to a final volume of 4.50 L . The change in internal energy $\Delta U$ of the gas in joules will be
A. 1136.25J
B. -500 J
C. -505 J
D. +505 J

## Answer: B

