

# YAKEEN NEET 2.0

**2026**

**Thermodynamics & Thermochemistry**

**Physical Chemistry**

**Lecture -3**

**By- Amit Mahajan Sir**







## Topics to be covered

- 1 Medics Test, Revision of Last Class
- 2 Heat & Work, First law of Thermodynamics
- 3 Enthalpy, Home work from Modules, Magarmach Practice Questions





## Rules to Attend Class



- 1. Always sit in a peaceful environment with headphone and be ready with your copy and pen.**
- 2. Never ever attend a class from in between or don't join a live class in the middle of the chapter.**
- 3. Make sure to revise the last class before attending the next class & always complete your Magarmach Practice Questions.**
- 4. Never ever engage in chat whether live or recorded on the topic which is not being discussed in current class as by doing so u can be blocked by the admin team or your subscription can be cancelled.**






## Rules to Attend Class



5. Try to make maximum notes during the class if something is left then u can use the notes pdf after the class to complete the remaining class.
6. Always ask your doubts in doubt section to get answer from faculty. Before asking any doubt please check whether same doubt has been asked by someone or not.





There is one big flaw in your Preparation that's name is Backlog ? What do we say to Backlog ?



NOT TODAY !!!

# MEDICS



## **Mastery**

Checks your grasp over  
NEET-level concepts

## **Evaluation**

Judging both knowledge  
and test-smartness

## **Decision Making**

Testing your speed + accuracy under pressure

## **Intuition**

Some answers need gut + logic –  
can you spot the trick?

## **Concepts**

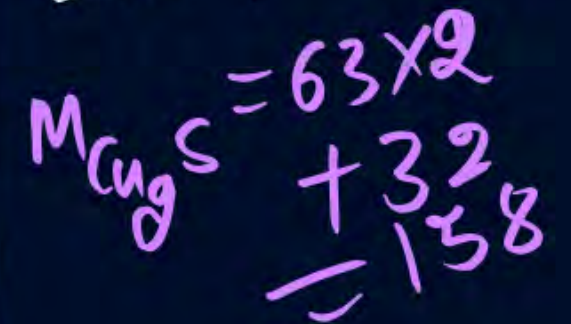
It's all about strong basics –  
no shortcuts here

## **Strategy**

The MEDICS test – built  
for those who heal,  
hustle, and hope.



**[Given, atomic mass of H = 1, N = 14, O = 16, S = 32, K = 39, Cu = 63, I = 127 ]**





QUESTION (JEE Adv. 2018)

3 Pb  $\rightarrow$  2 Chocolate

2 Chocolate  $\rightarrow$  3 Chips  $\frac{207}{\times 3}$



Galena (an ore) is partially oxidised by passing air through it at high temperature. After some time, the passage of air is stopped, but the heating is continued in a closed furnace such that the content undergo self-reduction. The weight (in kg) of Pb produced per kg of  $O_2$  consumed is .....

(Atomic weights in  $g\ mol^{-1}$  :  $O = 16$ ,  $S = 32$ ,  $Pb = 207$ )



$$n_{O_2} = 3 = 1$$

$$n_{Pb} = 3 = 1$$

$$n_{O_2} = \frac{1000}{32} = n_{Pb}$$

$$n_{Pb} = \frac{1000 \times 207}{32 \times 1000} \text{ Kg}$$



# QUESTION (JEE Adv. 2019)

The amount of water produced (in g) in the oxidation of 1 mole of rhombic sulphur by conc.  $\text{HNO}_3$  to a compound with the highest oxidation state of sulphur is..... (Given data: Molar mass of water =  $18 \text{ g mol}^{-1}$ )



1 mole.

16 moles

$$\begin{aligned} \text{mass of H}_2\text{O} &= 16 \times 18 \\ &= 288 \text{ g} \end{aligned}$$



QUESTION (JEE Adv. 2012)

→ Conc.

29.2% (w/w) HCl stock solution has density of  $1.25 \text{ g mL}^{-1}$ . The molecular weight of HCl is  $36.5 \text{ g mol}^{-1}$ . The volume (mL) of stock solution required to prepare a 200 mL solution 0.4 M HCl is .....

Conc. sol<sup>n</sup>

$$V_1 = ?$$

dil sol<sup>n</sup>

$$V_2 = 200 \text{ mL}$$

$$M_2 = 0.4 \text{ M}$$

$$M_1 V_1 = M_2 V_2$$

$$10 \times V_1 = 200 \times 0.4$$

$$V_1 = 8 \text{ mL}$$

$$M_1 = \frac{29.2 \times 1.25 \times 10}{36.5 \times 100}$$

$$= \frac{3650}{365}$$

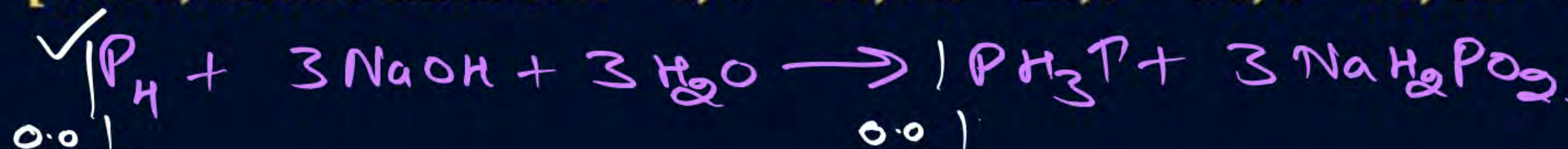
$$= 10 \text{ M}$$



# QUESTION (JEE Adv. 2022)

(Dissolving 1.24 g of white phosphorus in boiling NaOH solution in an inert atmosphere gives a gas Q. The amount of  $\text{CuSO}_4$  (in g) required to completely consume the gas Q is .....

[Given, atomic mass of H = 1, O = 16, Na = 23, P = 31, S = 32, Cu = 63]



$$\begin{array}{c} 2 \longrightarrow 3 \\ 0.01 \longrightarrow \frac{3}{2} \times 0.01 = 0.015 \end{array}$$

$$\begin{aligned} \text{mass CuSO}_4 &= 0.015 \times 159 \\ &= 2.385 \text{ g} \end{aligned}$$

$$\begin{aligned} n_{\text{P}_4} &= \frac{1.24}{124} \\ &= 0.01 \\ M_{\text{CuSO}_4} &= 63 + 96 \\ &= 159 \end{aligned}$$



# QUESTION (JEE Adv. 2014)

A compound  $\text{H}_2\text{X}$  with molar weight of 80 g is dissolved in a solvent having density of  $0.4 \text{ g ml}^{-1}$ . Assuming no change in volume upon dissolution, the molality of a 3.2 molar solution is

$$M_B = 80 \text{ g}$$

$$n_B = 3.2$$

$$d_{\text{solvent}} = 0.4 \text{ g/ml}$$

$$V_{\text{solvent}} \approx V_{\text{solution}}$$

$$V_{\text{solvent}} = 1000 \text{ ml}$$

$$W_A = 1000 \times 0.4$$

$$= 400 \text{ g}$$

$$m = \frac{n_B \times 1000}{W_A(\text{g})}$$

$$M = 3.2 \text{ M}$$

3.2 moles in 1000 ml sol<sup>n</sup>

$$m = \frac{3.2 \times 1000}{400} = 8 \text{ m}$$





## Revision of Last Class



### ISOTHERMAL PROCESS

AN ISOTHERMAL PROCESS IS A CHANGE OF A SYSTEM, IN WHICH THE TEMPERATURE REMAINS CONSTANT:  $\Delta T = 0$ .

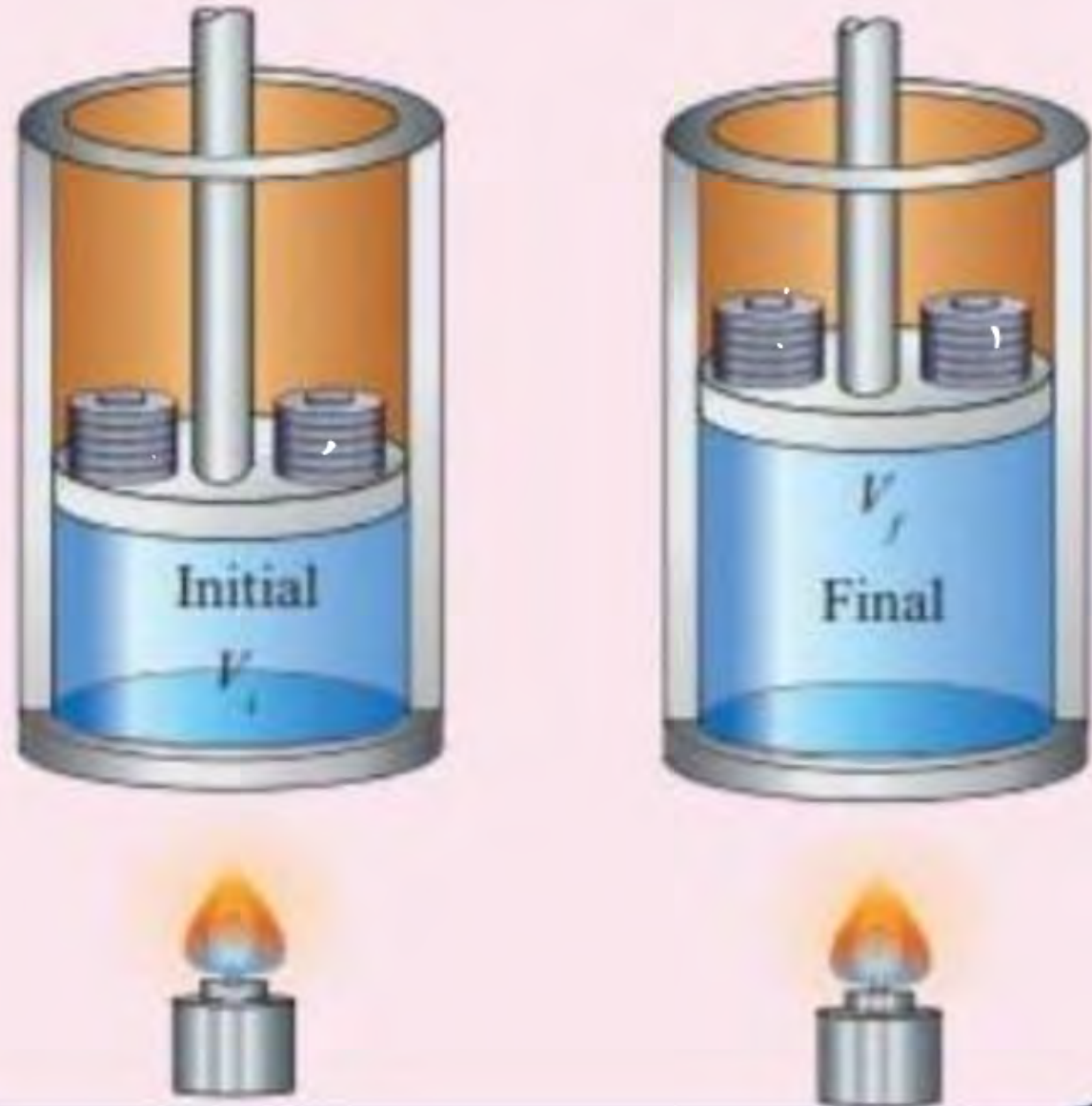


### ADIABATIC PROCESS

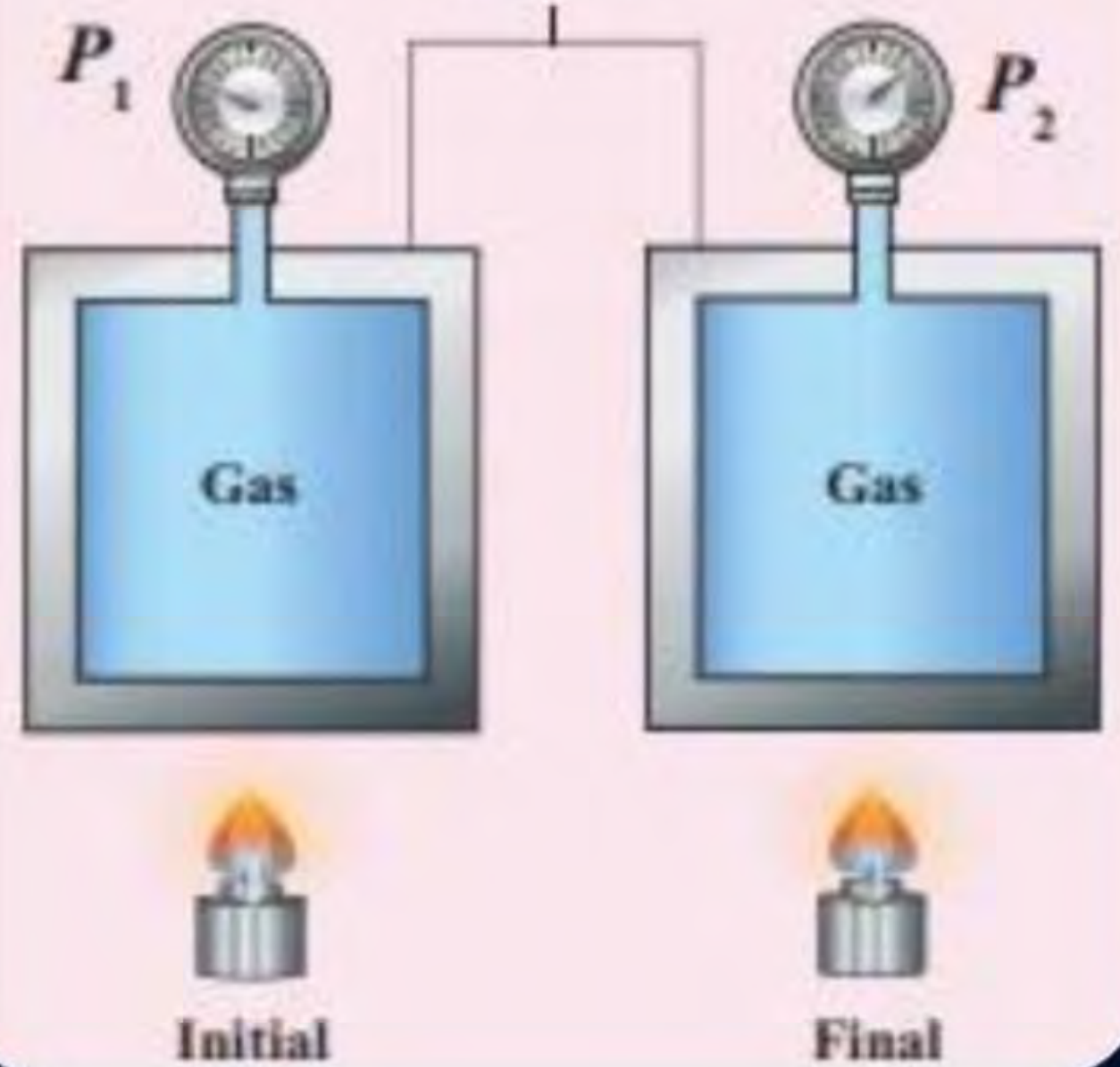
AN ADIABATIC PROCESS IS ONE THAT OCCURS WITHOUT TRANSFER OF HEAT OR MATTER BETWEEN A THERMODYNAMIC SYSTEM AND ITS SURROUNDINGS



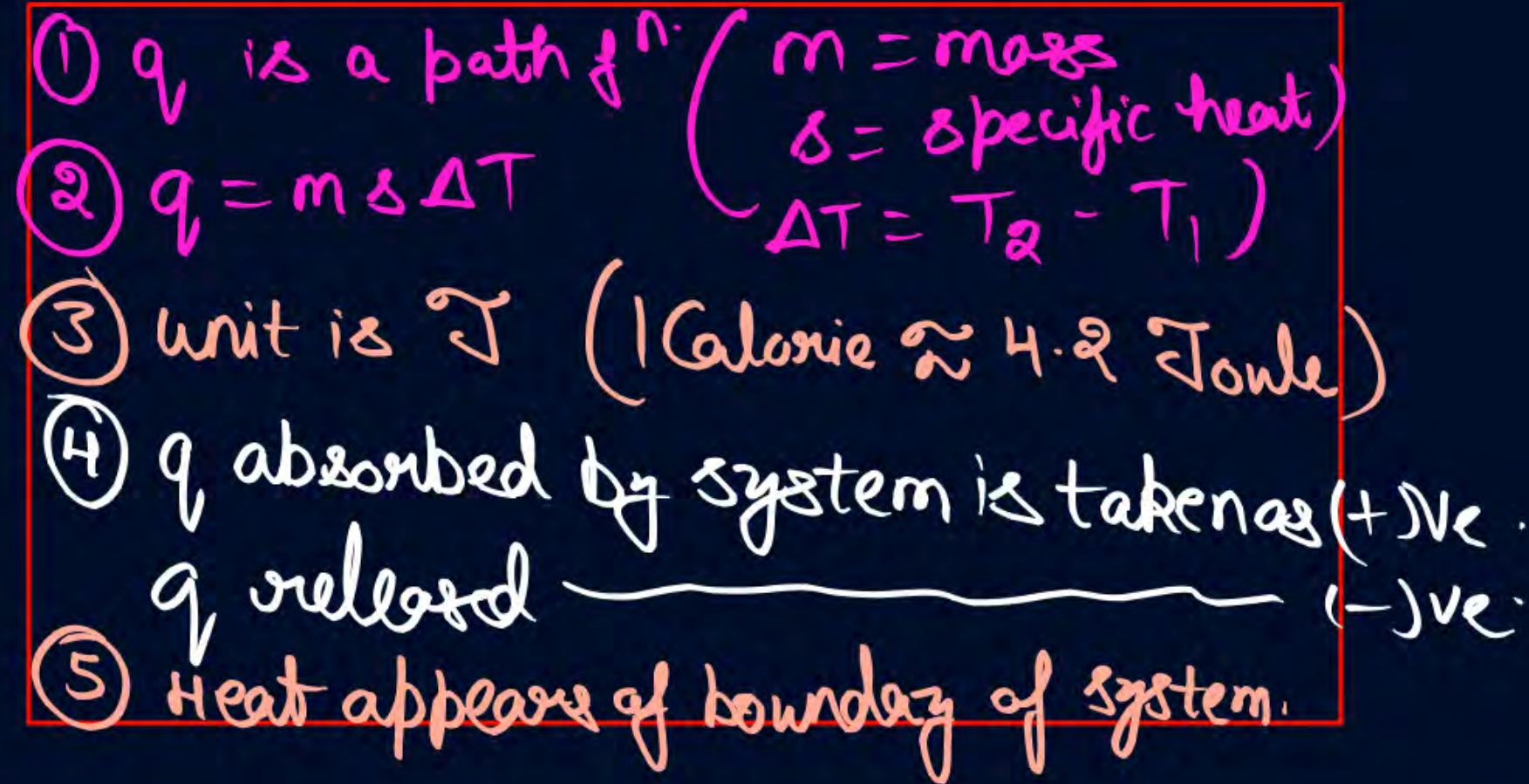
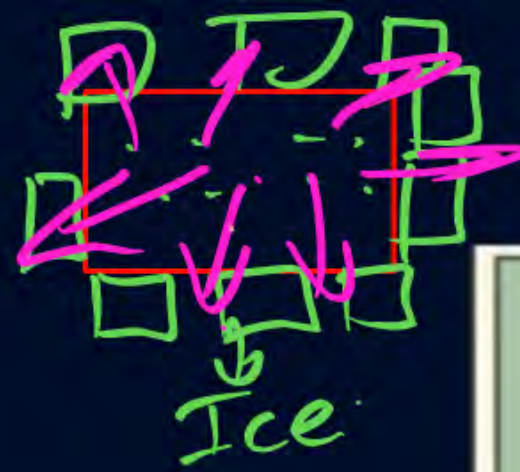
The masses maintain constant pressure in the cylinder



Constant volume container









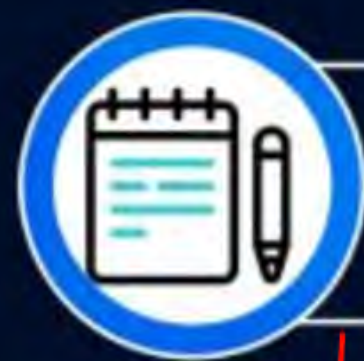
## QUESTION

**When freezing of a liquid takes place in a system:**



- A** May have  $q > 0$  or  $q < 0$  depending on the liquid
- B** Is represented by  $q > 0$
- C** Is represented by  $q < 0$
- D** Has  $q = 0$





## Work (w)



mode of transfer of energy b/w system & surroundings.

$$\delta w = F \cdot dl$$

$$\delta w = P \cdot A dl$$

$$\int \delta w = P_{ext} \int_{v_1}^{v_2} dv$$

$$w = -P_{ext} \Delta V$$





# MIT

① work is path f<sup>n</sup>②  $w = -P_{\text{ext}} \cdot \Delta V$ 

$$\Delta V = V_2 - V_1$$

for reversible  $P_{\text{ext}} \approx P_{\text{int}} (P_{\text{gas}})$ 

$$w = -P_{\text{int}} \Delta V = -\frac{\Delta n_g R T}{\downarrow \text{Chemical } n} = -\frac{n R \Delta T}{\downarrow \text{gas heat or cool}}$$

$$\Delta n_g = n_p(g) - n_r(g)$$

$$R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$$

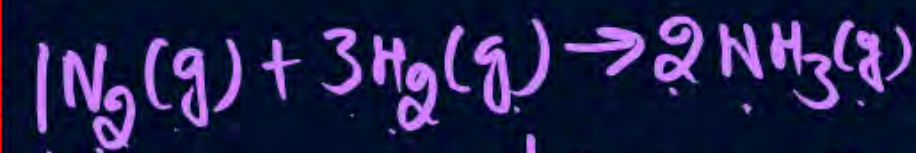
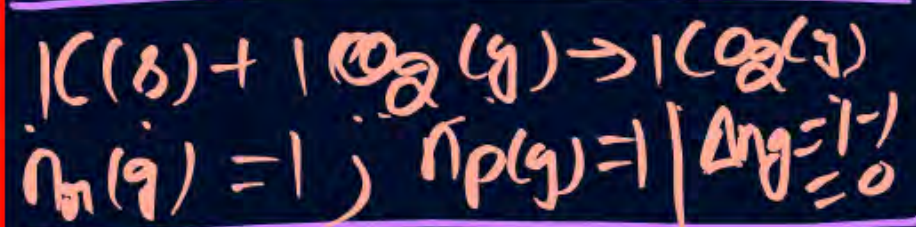
$$\approx \frac{25}{3} \text{ J K}^{-1} \text{ mol}^{-1}$$

$$\approx 2 \text{ Cal K}^{-1} \text{ mol}^{-1}$$

$$PV = nRT$$

$$-P\Delta V = \Delta n_g R T$$

$$P\Delta V = nR\Delta T$$



$$n_r(g) = 1 + 3 = 4 \mid n_p(g) = 2$$

$$\Delta n_g = 2 - 4 = -2$$

if  $\Delta V = (+)\text{ve} \Rightarrow$  gas expansion  $\Rightarrow w = (-)\text{ve} =$  work done by <sup>the</sup> systemif  $\Delta V = (-)\text{ve} \Rightarrow$  gas compression  $\Rightarrow w = (+)\text{ve} =$  work done on the system.③ unit of  $w$  is J

$$1 \text{ atm} \approx 101.3 \text{ J}$$

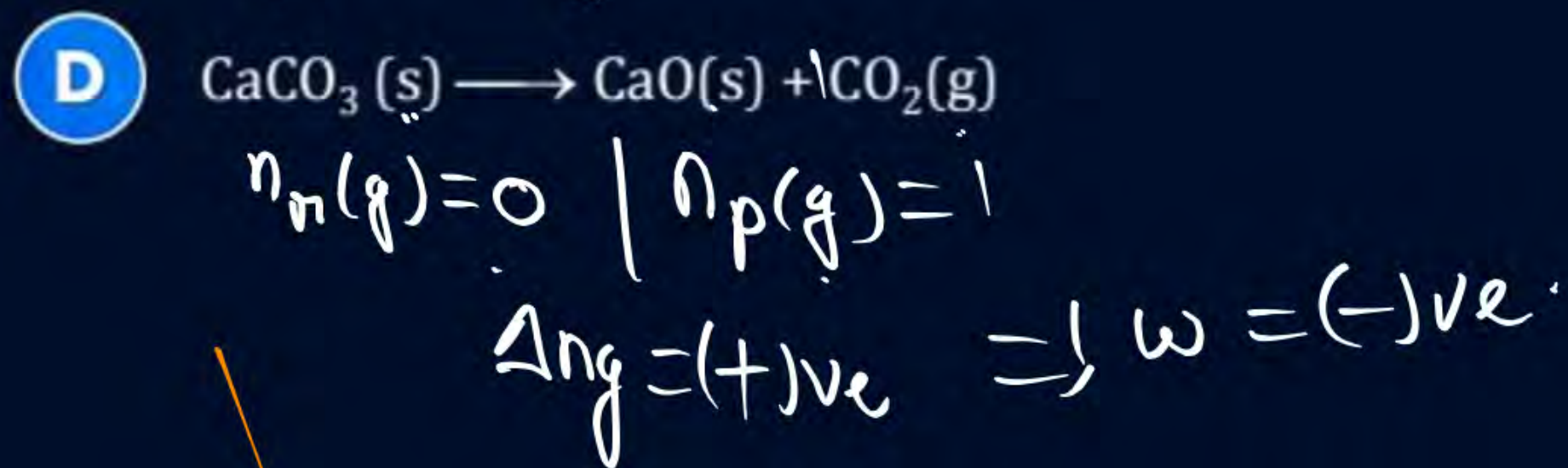
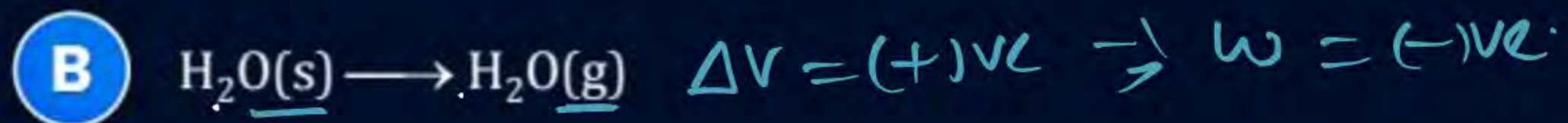
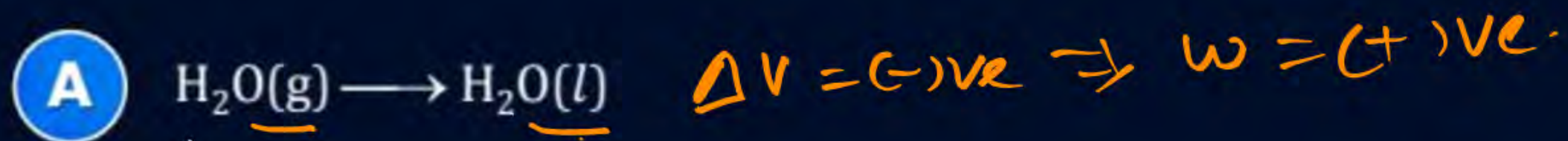
$$1 \text{ L bar} = 100 \text{ J}$$



## QUESTION



Predict sign of work done in following reactions at constant pressure







# First Law of Thermodynamics



$U_1$



$U_1 + q$



$U_1 + q + w = U_2$

$$U_1 + q + w = U_2$$

$$U_2 - U_1 = \Delta U = q + w$$

First law of Thermodynamics means that:



Energy absorbed = Energy Released



#MIT



$$\textcircled{1} \Delta U = q + w$$

for isothermal process or Cyclic process  
 $\Delta T = 0$  as  $\Delta U = 0$

$$0 = q + w \Rightarrow q = -w$$

for adiabatic process  
 $q = 0$

$$\Delta U = w$$

for Isochoric process

$$\Delta V = 0 \Rightarrow w = -P \Delta V \Rightarrow w = 0$$

$$\Delta U = q_v = \text{Heat Change at Constt. Volume}$$

for isobaric process

$$\Delta P = 0$$

$$\Delta U = q_p + w$$

$q_p = \text{Heat Change at Constt. Pressure}$





## QUESTION

Out of the following, correct statements is :

- ☐ A  $W$  is a state function
- ☐ B  $q = 0$  for every cyclic process
- ☒ C  $\Delta U = 0$  for every cyclic process
- ☐ D None of these



# QUESTION

A system is provided 50 J of heat and work done on the system is 10 J. The change in internal energy during the process is :

- ☐ A 40 J
- ☒ B 60 J
- ☐ C 80 J
- ☐ D 50 J

$$q = +50 \text{ J}$$

$$w = +10 \text{ J}$$

$$\begin{aligned} \Delta U &= q + w \\ &= 50 + 10 \\ &= 60 \text{ J} \end{aligned}$$



## QUESTION

The heat change at constant volume ( $q_v$ ) is equal to

- ☒ A  $\Delta U$
- ☐ B  $\Delta H$
- ☐ C  $RT$
- ☐ D  $\Delta G$



## QUESTION

Neither  $q$  nor  $w$  is a state function but their sum is a state function, why?

$$q + w = \underline{\Delta U}$$



# QUESTION



298 K



2 mole of zinc is dissolved in HCl at 25°C. Work done in an open vessel is



$$w = -\Delta n_g \checkmark \checkmark R \checkmark T \checkmark$$

$$= -2 \times \frac{8.314}{3} \times 298 \text{ J}$$



## QUESTION



The work done during the expansion of gas from a volume of 4 dm<sup>3</sup> to 6 dm<sup>3</sup> against a constant external pressure of 3 atm. is-

☒ A - 608 J

☐ B + 304 J

☐ C - 304 J

☐ D - 6 J

$$V_1 = 4 \text{ dm}^3 = 4 \text{ L} \quad \Delta V = 6 - 4 = 2$$

$$V_2 = 6 \text{ dm}^3 = 6 \text{ L}$$

$$P_{\text{ext.}} = 3 \text{ atm}$$

$$W = -P_{\text{ext.}} \Delta V$$

$$= -3(\times 2) \text{ Latm} = -6 \times 101.3 \text{ J} \approx -608 \text{ J}$$



## QUESTION



Which one of the following equations does not correctly represent the first law of thermodynamics for the given process involving an ideal gas? (Assume non-expansion work is zero)

- A** Cyclic process :  $q = -W$   
 $\uparrow \Delta U = 0$
- B** Adiabatic process :  $\Delta U = -W$   
 $\uparrow q = 0$   
 $\Delta U = q + w$
- C** Isochoric process :  $\Delta U = q$   
 $\downarrow \Delta V = 0 \Rightarrow w = 0$
- D** Isothermal process :  $q = -W$



## QUESTION



An ideal gas is allowed to expand from 1 L to 10 L against a constant external pressure of 1 bar. The work done in kJ is

**A** - 9.0

**B** + 10.0

**C** - 0.9

**D** - 2.0

$$\begin{aligned}
 P_{\text{ext}} &= 1 \text{ bar} & W &= -P_{\text{ext}} \cdot \Delta V \\
 V_1 &= 1 \text{ L} & &= -1 \times 9 \text{ L bar} \\
 V_2 &= 10 \text{ L} & &= \frac{-9 \times 100 \text{ kJ}}{1000} = -0.9 \text{ kJ} \\
 \Delta V &= 10 - 1 = 9
 \end{aligned}$$



## QUESTION



0.5 moles of gas A and x moles of gas B exert a pressure of 200 Pa in a container of volume  $10\text{m}^3$  at 1000 K. Given R is the gas constant in  $\text{JK}^{-1} \text{mol}^{-1}$ , x is

**A**  $\frac{2R}{4-R}$

**B**  $\frac{4-R}{2R}$

**C**  $\frac{4+R}{2R}$

**D**  $\frac{2R}{4+R}$

$$\begin{aligned} n_A &= 0.5 \\ n_B &= x \end{aligned} \quad \left. \begin{array}{l} n_A = 0.5 \\ n_B = x \end{array} \right\} 0.5 + x$$

$$P = 200 \text{ Pa}$$

$$V = 10 \text{ m}^3$$

$$T = 1000 \text{ K}$$

$$PV = nRT$$

$$200 \times 10 = (0.5 + x)R \times 1000$$

$$2 = (0.5 + x)R$$

$$2 = 0.5R + xR$$

$$2 \left( \frac{2 - 0.5R}{R} \right) = x$$

$$\frac{2}{0.5 + x} =$$

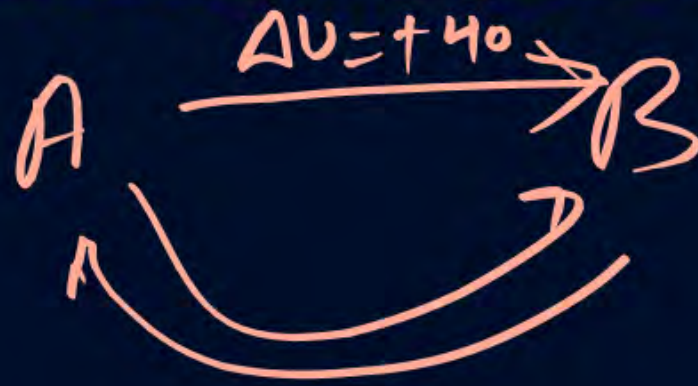


## QUESTION



The internal energy change when a system goes from state A to B is 40 kJ/mol. 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 kJ
- ☐ B > 40 kJ
- ☐ C < 40 kJ
- ☐ D zero




$$\Delta U = 0$$



## QUESTION



Which 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 <sup>Final</sup> states are specified.
- ☐ **D** Work appears at the boundary of the system



## QUESTION

$\Delta U$  is equal to:

- ☒ **A** adiabatic work
- ☐ **B** isothermal work
- ☐ **C** isochoric work
- ☐ **D** isobaric work

$$q=0$$
$$\Delta U = w$$





## Enthalpy (H)

Heat Change at Constt. Pressure.

$$H = U + PV$$

$$\begin{array}{ccc} R & \longrightarrow & P \\ H_R = U_R + PV_R & & H_P = U_P + PV_P \end{array}$$

$$\begin{aligned} \Delta H &= H_P - H_R \\ &= U_P + PV_P - (U_R + PV_R) \\ &= \underline{U_P + PV_P} - \underline{U_R - PV_R} \end{aligned}$$

## Enthalpy (Energy) Change

- Exothermic reactions

$-\Delta H$



- Endothermic reactions

$+\Delta H$







## Enthalpy (H)

$$P\Delta V = nR\Delta T = \Delta n_g RT$$



$$\Delta H = \Delta U + \underline{P\Delta V} \text{ or } \underline{nR\Delta T} \text{ or } \underline{\Delta n_g RT}$$

$$\Delta U = q_p + w$$

$$\Delta U = \Delta H - P\Delta V$$

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





## QUESTION – (AIIMS 2016)

Choose the reaction in which  $\Delta H$  is not equal to  $\Delta U$ ?

- A**  $\text{C}_{(\text{graphite})} + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g})$
- B**  $\text{C}_2\text{H}_4(\text{g}) + \text{H}_2(\text{g}) \rightarrow \text{C}_2\text{H}_6(\text{g})$
- C**  $2\text{C}_{(\text{graphite})} + \text{H}_2(\text{g}) \rightarrow \text{C}_2\text{H}_2(\text{g})$
- D**  $\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \rightarrow 2\text{HI}(\text{g})$



## QUESTION – (NEET 2023)

Which amongst the following options is the correct relation between change in enthalpy and change in internal energy?

- A**  $\Delta H + \Delta U = \Delta nR$
- B**  $\Delta H = \Delta U - \Delta n_g RT$
- C**  $\Delta H = \Delta U + \Delta n_g RT$
- D**  $\Delta H - \Delta U = -\Delta nRT$



## QUESTION – (AIIMS 2007)

Calculate change in internal energy if  $\Delta H = -92.2$  kJ,  $P = 40$  atm and  $\Delta V = -1$  L

- A**  $-42$  kJ
- B**  $-88$  kJ
- C**  $+88$  kJ
- D**  $+42$  kJ



## QUESTION – (AIIMS 2006)

The enthalpy change ( $\Delta H$ ) for the reaction,  $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightarrow 2\text{NH}_3(\text{g})$  is  $-92.38 \text{ kJ}$  at  $298 \text{ K}$ . The internal energy change  $\Delta U$  at  $298 \text{ K}$  is:

- A**  $-92.38 \text{ kJ}$
- B**  $-87.42 \text{ kJ}$
- C**  $97.34 \text{ kJ}$
- D**  $-89.9 \text{ kJ}$



## QUESTION – (AIIMS 2018, 2014)

**Assertion: For a reaction  $2\text{NH}_3(\text{g}) \rightarrow \text{N}_2(\text{g}) + 3\text{H}_2(\text{g})$ ;  $\Delta H > \Delta E$**

**Reason: Enthalpy change is always greater than internal energy change.**

- A** If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
- B** If both Assertion and Reason are correct but Reason is not the correct explanation of Assertion.
- C** If Assertion is correct but Reason is incorrect.
- D** If both the Assertion and Reason are incorrect.





## Home work from modules



Solve all questions of 1st law of Thermodynamics





## Magarmach Practice Questions ( MPQ )





## QUESTION – (AIIMS 2003)

**Assertion:**  $\Delta H$  and  $\Delta E$  are almost same for the reaction  $\text{N}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{NO}(\text{g})$

**Reason:** All reactants and products are gases.

- A** If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
- B** If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
- C** If the Assertion is correct but Reason is incorrect.
- D** If both the Assertion and Reason are incorrect.
- E** If the Assertion is incorrect but the Reason is correct.



## QUESTION – (AIPMT 1990)

If  $\Delta H$  is the change in enthalpy and  $\Delta E$ , the change in internal energy accompanying a gaseous reaction, then

- A**  $\Delta H$  is always greater than  $\Delta E$
- B**  $\Delta H < \Delta E$  only if the number of moles of the products is greater than the number of moles of the reactants
- C**  $\Delta H$  is always less than  $\Delta E$
- D**  $\Delta H < \Delta E$  only if the number of moles of products is less than the number of moles of the reactants



## QUESTION – (AIIMS 2002)

**Assertion: Absolute values of internal energy of substances cannot be determined.**

**Reason: It is impossible to determine exact values of constituent energies of the substances.**

- A** If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
- B** If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
- C** If the Assertion is correct but Reason is incorrect.
- D** If both the Assertion and Reason are incorrect.
- E** If the Assertion is incorrect but the Reason is correct.



**QUESTION – (AIIMS 2001)**

**In the exothermic reaction, the enthalpy of reaction is always:**

- A** zero
- B** positive
- C** negative
- D** none of these



**QUESTION\* – (NCERT Exemplar)**

**In an exothermic reaction, heat is evolved and system loses heat to the surrounding. For such system**

- A**  $q_p$  will be negative
- B**  $\Delta_r H$  will be negative
- C**  $q_p$  will be positive
- D**  $\Delta_r H$  will be positive



## QUESTION

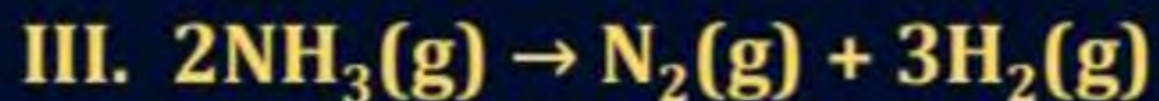
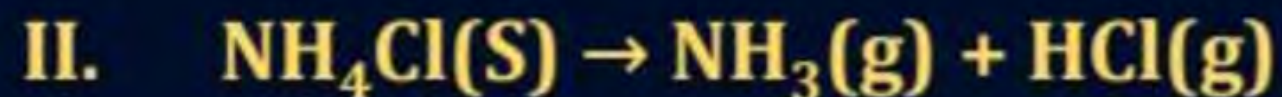
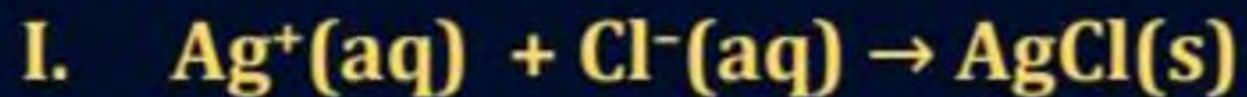
**When freezing of a liquid takes place in a system:**

- A** may have  $q > 0$  or  $q < 0$  depending on the liquid
- B** is represented by  $q > 0$
- C** is represented by  $q < 0$
- D** has  $q = 0$



## QUESTION

Determine which of the following reactions taking place at constant pressure represents system that do work on the surrounding environment



A

I

B

III

C

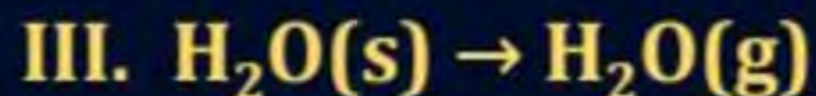
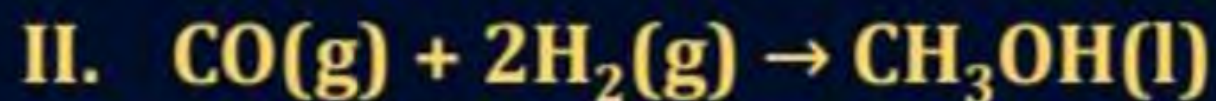
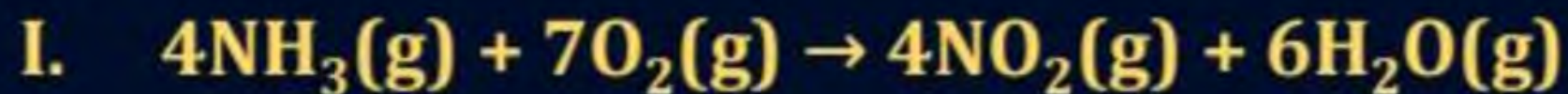
II and III

D

I and II

## QUESTION

Determine which of the following reactions taking place at constant pressure represents surrounding that do work on the system environment



A III, IV

B II and III

C II, IV

D I and II, IV



## QUESTION

Temperature of 1 mole of a gas is increased by  $2^{\circ}\text{C}$  at constant pressure, work done is :

- A**  $R$
- B**  $2R$
- C**  $R/2$
- D**  $3R$

## QUESTION

**A sample of an ideal gas is expanded  $1 \text{ m}^3$  to  $3 \text{ m}^3$  in a reversible process for which  $P = KV^2$ , with  $K = 6 \text{ bar/m}^6$ . Work done by the gas is:**

- A** 5200 kJ
- B** 15600 kJ
- C** 52 kJ
- D** 5267.6 kJ



**THANK**  
**YOU**