PhysicsByAaryan

CSIR NET . GATE . JEST . BARC - Physics

Phase transitions - CSIR NET Physics PYQs

Thermodynamics . All PYQs (2015-2025) with answer key

6 questions . Answer key included

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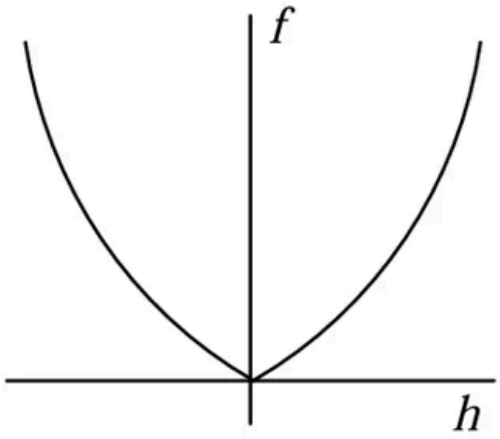
Q1. [Dec 2015] . 5.0 marks

Thermodynamics > Phase transitions

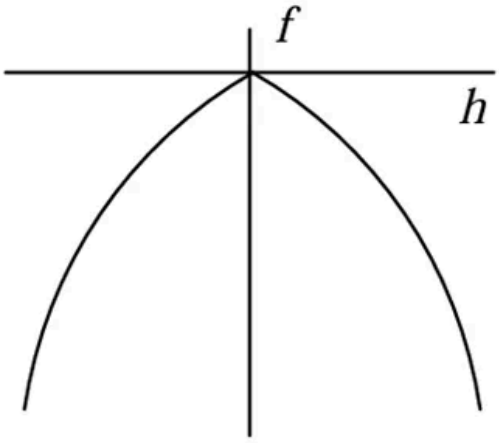
CSIR NET	2015 Dec	5 M

Which of the following graphs shows the qualitative dependence of the free energy $f(h,T)$ of a ferromagnet in an external magnetic field h, and at a fixed temperature $T < T_C$, where T_C is the critical temperature?

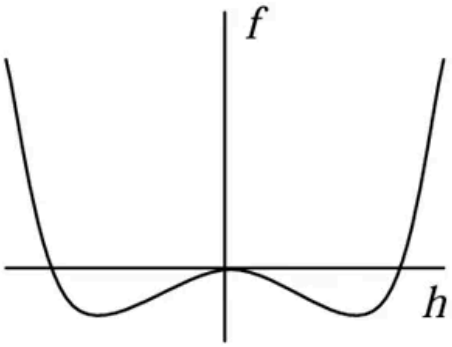
1.



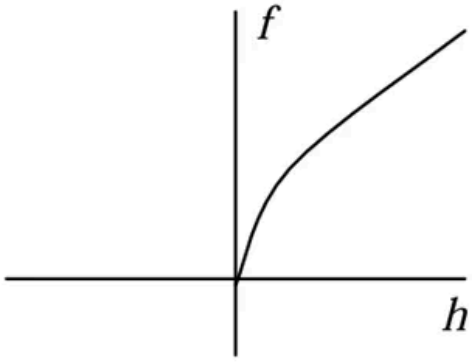
2.



3.



4.



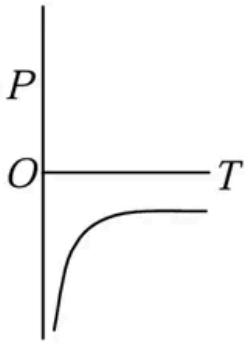
Q2. [June 2015] . 3.5 marks

Thermodynamics > Phase transitions

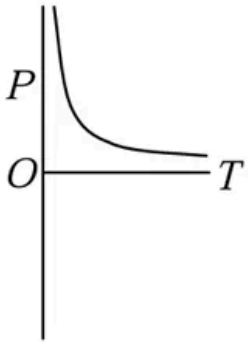
CSIR NET	2015 June	3.5 M

The condition for the liquid and vapour phases of a fluid to be in equilibrium is given by the approximate equation $\frac{dP}{dT} \approx \frac{Q_l}{Tv_{\text{vap}}}$ (Clausius-Clayperon equation), where v_{vap} is the volume per particle in the vapour phase, and Q_l is the latent heat, which may be taken to be a constant. If the vapour obeys ideal gas law, which of the following plots is correct?

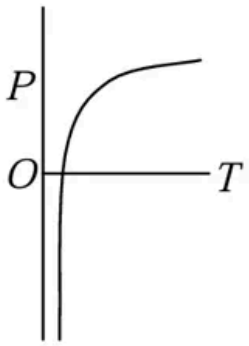
(a)



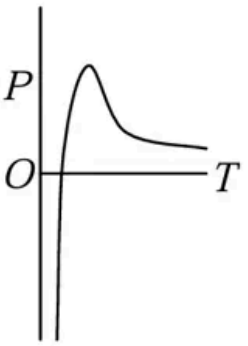
(b)



(c)



(d)



Q3. [June 2018] . 5.0 marks

Thermodynamics > Phase transitions

CSIR NET	2018 June	5M

The pressure P of a system of N particles contained in a volume V at a temperature T is given by $P = nk_BT - \frac{1}{2}an^2 + \frac{1}{6}bn^3$, where n is the number density and a and b are temperature independent constants. If the system exhibits a gas-liquid transition, the critical temperature is

1. $\frac{a}{bk_B}$
2. $\frac{a}{2b^2k_B}$
3. $\frac{a^2}{2bk_B}$
4. $\frac{a^2}{b^2k_B}$

Q4. [June 2019] . 5.0 marks

Thermodynamics > Phase transitions

CSIR NET	2019 June	5M

The free energy of a magnetic system, as a function of its magnetization m, is $F = \frac{1}{2}am^2 - \frac{1}{4}bm^4 + \frac{1}{6}m^6$. where a and b are positive constants.

At a fixed value of a, the critical value of b, above which the minimum of F will be at a nonzero value of magnetization, is

1. $\sqrt{\frac{10a}{3}}$
2. $\sqrt{\frac{16a}{3}}$
3. $\frac{10}{3}\sqrt{a}$
4. $\frac{16}{3}\sqrt{a}$

Q5. [Dec 2023] . 5.0 marks

Thermodynamics > Phase transitions

CSIR NET	2023 Dec	5 M

The work done on a material to change its magnetization M in an external field H is $dW = HdM$. Its Gibbs free energy is

$$G(T,H) = -\left(\gamma T + \frac{aH^2}{2T}\right)$$

where $\gamma, a > 0$ are constants. The material is in equilibrium at a temperature $T = T_0$ and in an external field $H = H_0$. If the field is decreased to $\frac{H_0}{2}$ adiabatically and reversibly, the temperature changes to

1. $2T_0$
2. $\frac{T_0}{2}$
3. $\left(\frac{a}{2\gamma}\right)^{\frac{1}{4}}\sqrt{H_0T_0}$
4. $\left(\frac{a}{\gamma}\right)^{\frac{1}{4}}\sqrt{H_0T_0}$

Q6. [June 2023] . 5.0 marks

Thermodynamics > Phase transitions

CSIR NET	2023 June	5M

A layer of ice has formed on a very deep lake. The temperature of water, as well as that of ice at the ice-water interface, are $0^{\circ}C$, whereas the temperature of the air above is $-10^{\circ}C$. The thickness $L(t)$ of the ice increases with time t. Assuming that all physical properties of air and ice are independent of temperature, $L(t) \sim L_0 t^{\alpha}$ for large t. The value of α is

1. 1/4
2. 1/3
3. 1/2
4. 1

Answer Key

6 questions . Subject and topic for quick revision

Q. No	Subject	Topic	Answer
Q1	Thermodynamics	Phase transitions	**2**
Q2	Thermodynamics	Phase transitions	**1&3**
Q3	Thermodynamics	Phase transitions	**3**
Q4	Thermodynamics	Phase transitions	**2**
Q5	Thermodynamics	Phase transitions	**2**
Q6	Thermodynamics	Phase transitions	**3**

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