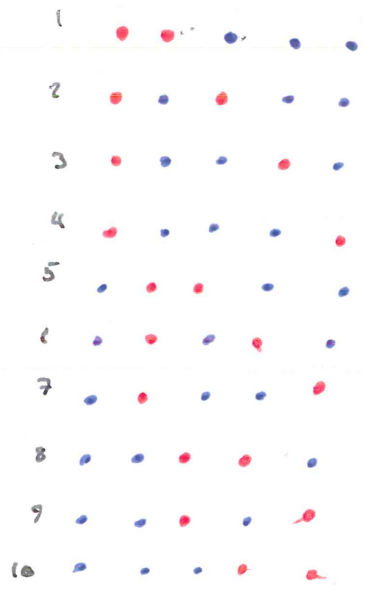
KAPITEL 5

1 Antal partiklar $N = 5$

a) $\uparrow = \bullet$ $\downarrow = \bullet$



b) Yttre magnetfält B.

$$U = \mu B(N - 2n)$$

$n = 2$, $N = 5$ $\Rightarrow U = \mu B(5-4) = \boxed{\mu B}$

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c) $$M = \mu(N_\uparrow - N_\downarrow) = -\mu(N - 2n) = \boxed{-\mu}$$

2

a) $$\Omega(n, N) = \binom{N}{n} = \frac{N!}{n!\,(N-n)!}$$

$N = 5$, $n = 2$ $\Rightarrow$ $$\binom{5}{2} = \frac{5!}{2!(5-2)!} = \frac{5 \cdot 4}{2 \cdot 1} = \boxed{10}$$

b) $\Omega(n, N) = \Omega(N-n, N)$

$$\binom{N}{N-n} = \frac{N!}{(N-(N-n))!\,(N-n)!} = \frac{N!}{n!\,(N-n)!} = \binom{N}{n} = \Omega(n, N) \quad \#$$

Det finns lika många sätt att stoppa två (lika) bollar i fem lådor som det finns att välja tre tomma lådor av fem.

3

$$M = N\frac{\mu^2 B}{kT}$$

Maximal magnetisering: $n = N$ $\left(M = -\mu(N-2n) = \mu N\right)$

Hälften: $M = \frac{\mu N}{2} = N\frac{\mu^2 B}{kT} \Leftrightarrow T = \frac{2\mu B}{k}$

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4 $e^x \approx 1 + x + \frac{1}{2}x^2$

$$M = -\mu N\frac{1-e^x}{1+e^x} = -\mu N\frac{1-(1+x+\frac{1}{2}x^2)}{1+1+x+\frac{1}{2}x^2} = \frac{x+\frac{1}{2}x^2}{2+x+\frac{1}{2}x^2} =$$

$$= \frac{\exp\left(\frac{2\mu B}{kT}\right) + \frac{1}{2}\exp\left(\frac{2\mu B}{kT}\right)^2}{2 + \exp\left(\frac{2\mu B}{kT}\right) + \frac{1}{2}\exp\left(\frac{2\mu B}{kT}\right)^2}$$

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5 $\frac{4cN}{kT}x = \ln\left(\frac{1+x}{1-x}\right)$