## The free energy landscape for the metal A joined up approach to teaching and learning mathematics

•	What is significant	about the points	where the black	curve intercepts wit	h the $x$ axis?
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• When the applied field H is equal to 0 at how many points does the black line intercept with the x axis? What happens as the the inverse temperature is increased?

• Describe the shape of the green curve when H=0 and when (a) T<0.5 and when (b) T>0.5. How does the shape of this curve differ in these two regimes? What happens to the derivative of the free energy with respect to  $\langle M \rangle$  at H=0 when T=0.5?

• What happens to the shape of the green curve when  $H \neq 0$ . Comment on the behavior of the turning points and the way this number changes with field strength and temperature.

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 $\bullet$  Given what you have discussed explain how the magnetization behaves as you move from the T>0.5 regime to the T<0.5 regime in the absense of an applied field

• How does the magnetisation behave as the temperature is increased in the presence of an applied magentic field?