Problem 1 (AFM)
You are performing an AFM measurement of CNTs on a surface.

a) What is the “apparent” or “measured” radius (width) \( \rho \) of a CNT of radius \( r \) if the diameter of the AFM tip is \( R \)? Derive an algebraic expression for \( \rho \), showing all relevant steps.

b) Can a carbon nanotube of diameter 1 nm lying on a flat surface be “detected” by your AFM with a Si\(_3\)N\(_4\) tip radius of 10 nm? Can it be “resolved”? Discuss qualitatively the difference between resolution and detection.

Problem 2 (CNT Properties for AFM)
The Euler buckling force for a carbon nanotube is given by:

\[
F_{\text{EULER}} = \frac{\pi^2 Y I}{L^2}
\]

where \( Y \) is the Young’s modulus of the nanotube, \( I \) is the moment of the cross-sectional area of the carbon nanotube about the “neutral axis”, and \( L \) is the length of the carbon nanotube. Please calculate \( F_{\text{EULER}} \) for a nanotube 3 micron long, and 3 nm in diameter.

Problem 3 (Nanowire Synthesis)
Please identify a specific nanowire and find the following things (as concise as possible):

a) Material or material compositions?

b) Specific the property(ies) that you are interested and why on these nanowires?

c) Describe the synthesis method to make these nanowires (figure illustration is preferred)?

Problem 4 (Nanowire Assembly & Integration)
Please find and list at least 5 different ways to assemble (and integrate) nanowires into a working system/device/. Please use simple illustration to explain the assembly mechanisms.