### **PeakForce Tapping Mode Exam**

#### **General Knowledge**

1) What is the difference between ScanAsyst and PeakForce QNM? What are the relative advantages/disadvantages of each?

2) Which 3 parameters are controlled by ScanAsyst in full "Auto Control" mode?



3) Draw and label a typical approach/retract force curve (including axes). Indicate the areas of the curve related to determination of the sample's modulus, deformation of the sample, dissipation of the tip's kinetic energy throughout the sample, and adhesion of the tip to the sample. What are typical values (order of magnitude is ok) for the peak force?

4) Which user-controlled parameter determines the relative weight that ScanAsyst assigns to tracking topography versus minimizing feedback noise under full "Auto Control"? What are typical values for this parameter for smooth versus rough samples, and which is typically appropriate for your samples?

5) Why is it not necessary to tune the probe in PeakForce Tapping mode? Is there ever a reason you might want to carry out a tune in PF Tapping mode?



6) What is "Auto Config"? When should you use it?

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7) Why is it often desirable to lower the Engage Setpoint prior to engaging the sample surface? After engaging on the sample surface and determining the optimal PeakForce Setpoint, why should you lower the Engage Setpoint so that it is equal to the PeakForce Setpoint?

- 8) What does each of the following parameters control? How does each affect the quality of the image obtained? Indicate typical values (or ranges) for each parameter. (Note: some of these may be sample/image dependent.)
  - a. Feedback Gain
  - b. PeakForce Setpoint
  - c. LP Deflection BW

- d. PeakForce Amplitude
- e. PeakForce Frequency
- f. Z Limit



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9) Suppose you have a sample deposited on a transparent substrate such as mica. As you manually approach the surface prior to engaging, you can choose to focus on either the sample surface or the tip reflection. What are the relative advantages and disadvantages of each method?

10) Suppose you obtain a new AFM probe from the probe cabinet in the SSL. If you subsequently decide to return the probe to its original box in the cabinet, what should you do to document its status? Why?

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- 11) Before acquiring a large area image, it is often desirable to quickly optimize the scan parameters (e.g., Feedback Gain, PeakForce Amplitude, etc.) while imaging a smaller area. Circle which parameter(s) should be held constant between the two images for this method to work. Explain your reasoning.
  - a. Scan Rate
  - b. Tip Velocity
  - c. Samples/Line

#### **Tool Specific Values**

12) What is the difference between open loop and closed loop scanners? Which kind of scanner is present on the MultiMode 8? The Icon/FastScan? How does this affect AFM operation (in particular, the use of the zoom and offset functions)?

13) What is the maximum scan size in the X and Y directions for **each** AFM head/scanner? Is this affected if you are using offsets? Why or why not? What is the maximum Z range? Explain what limitations this places on samples and the use of large area scans.



14) Suppose you are using a ScanAsyst-Air probe (2 nm nominal radius of curvature) to acquire a 10 μm square (i.e., aspect ratio of 1.0) image. How many Samples/Line should you choose to take full advantage of the image resolution offered by the probe? Suppose instead you are attempting to acquire a 15 μm square image. What is the maximum image resolution achievable (in nm)? What limits/determines this value? 15) Suppose you are acquiring a 10 μm square (i.e., aspect ratio of 1.0) image at a Scan Rate of 5.0 Hz. What is the Tip Velocity? Assuming an image (pixel) resolution of 5,000 Samples/Line, would you be able to acquire a ScanAsyst image at this Scan Rate? Why or why not?

16) What is the nominal noise floor of the system(s) you will be using? What external factors can affect the noise floor and what can be done to minimize them/optimize the Z-resolution of the AFM?



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17) What is the fundamental difference between ScanAsyst and ScanAsyst-HR (i.e., what does "HR" stand for) on the MultiMode 8? What are the differences between the two modes in terms of equipment and consumables used?

18) After maximizing the sum signal and zeroing the horizontal and vertical deflection signals on the MultiMode 8, what can you do to attempt to determine whether the laser spot is indeed hitting the cantilever above the probe tip, rather than farther back towards the base?

19) What is the difference between "Tip Drive" and "Sample Drive"? When is each used? Is it possible to toggle between the two, and if so, how?



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#### Icon/FastScan

20) If the laser spot icon and actual laser spot are offset in the video image on the Dimension Icon/FastScan, what should you do? How can you determine and select the proper laser spot size on the Icon/FastScan?

#### **PeakForce QNM**

21) What 3 things must you do to characterize the probe tip in order to convert qualitative nanomechanical maps into quantitative measurements in PeakForce QNM mode?



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