

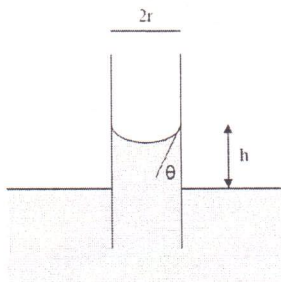
AS-74.3136 Introduction to Microsystems

Examination 12.05.2008

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No Books are allowed in the exam! All questions are of equal value.

1. a) What are microsystems?
b) What is the difference between Microsystems and microelectronics?
2. What is Lithography? Explain the difference between Lithography and Etching.
3. a) Describe what is the concept of scaling effect?
b) What are adhesion forces?
4. What is the working principle of piezoelectric material? Describe different types of Piezoelectric-actuators.
5. Draw the diagram of capacitive accelerometer (1 degrees-of-freedom) and explain the working principle.
6. What is a micromanipulator? What is a mobile microrobot? Explain how to classify the two types.
7. Describe the working principle of an AFM.
8. Give three examples of microsystem technology in automotive applications.
9. Consider a circular tube which penetrates a surface of water. As a result of *capillarity*, water has a tendency to rise to the tube.



The *contact angle* θ is assumed to be 67.5° .

For water-air surface tension in room

temperature, $\gamma \approx 72 \times 10^{-3} \text{ N/m}$.

($\text{Sin}(67.5^\circ) \approx 0.92$, $\text{Cos}(67.5^\circ) \approx 0.38$)

- a) Derive an equation for the height h by considering force balance.
- b) With the given values, determine the capillary rise in a tube of radius $r = 0,25 \text{ mm}$.

10. Consider the plate capacitor in the Figure below: length= L , cross-sectional area= A , gap= d . Apply voltage V across the capacitor. These are all constant.

- Write down the expression for the capacitance C , when the lower plate has moved horizontally distance x .
- Derive the equation for force F , when the lower plate has moved horizontally distance x . Recall that the energy stored in the capacitor is $W = \frac{1}{2}CV^2$
- Derive the scaling laws of a) and b). What is the consequence if the whole device is proportionally reduced 10 times?

