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# Micropumps Overview Final Assessment

## Instructor Guide

### Notes to Instructor

The final assessment (FA) is the post-test for the *Micropumps Overview Learning Module*. This assessment should be given completion of the *Micropumps Overview Learning Module*. It can be compared to the knowledge probe to gauge student learning.

Following is a list of the units included in the *Micropumps Overview Learning Module*.

- Micropumps Knowledge Probe (KP) - Pretest
- Micropumps Overview Primary Knowledge
- Diaphragm Pump Activity
- **Capillary Action Activity**
- Micropumps Overview Final Assessment

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### Description

This assessment is to determine your knowledge of macro and micro-sized pumps and their operations. Answer each of the following questions to the best of your knowledge.

1. The basic principle of pumps is to enable fluid flow when there is a \_\_\_\_\_ difference between the pump's input and output.
  - a. temperature
  - b. **pressure**
  - c. volumetric
  - d. temperature and pressure
2. A pump is called a micropump when the pump, its parts or its fluid channels fall within
  - a.  $100 \times 10^{-3}$  to  $1 \times 10^{-3}$  meters
  - b.  $1 \times 10^{-3}$  to  $1 \times 10^{-6}$  meter
  - c.  **$100 \times 10^{-6}$  to  $1 \times 10^{-6}$  meters**
  - d.  $100 \times 10^{-6}$  to  $100 \times 10^{-9}$  meters
3. Which of the following is an example of the capillary effect?
  - a. A paperclip floating on the surface of water
  - b. Liquids flowing through macro-sized channels
  - c. **The separation of solutes in a liquid solution using a paper filter**
  - d. Water running off a surface rather than soaking into the surface

4. Bubblejet printheads consists of an array of \_\_\_\_\_ micropumps.
- Diaphragm
  - Check-valve
  - mechanical
  - non-mechanical**
  - diaphragm and non-mechanical
5. One of the primary differences between macro and micro-sized pumps (other than size), is that micropumps, due to their size, can \_\_\_\_\_, whereas macro-sized pumps cannot.
- move fluids using non-mechanical methods
  - move fluids by exploiting specific physical properties of fluids**
  - use several different types of energy as an input
  - handle hazardous and corrosive fluids
6. Which of the following micropumps is used by the microelectronics industry to cool computer chips?
- Diaphragm pump
  - Piezoelectric Actuated Membrane pump
  - Bubblejet pumps
  - Microscale Ion Driven Airflow pump**
7. The “bubbles” in Bubblejet printheads are created by
- turning on a piezoresistive heater**
  - actuating a piezoelectric crystal
  - pulling up on a diaphragm
  - injecting air into a microchannel
8. A non-mechanical pump used in some inkjet printheads use an oscillating \_\_\_\_\_ to move ink from a reservoir to the paper.
- piezoelectric crystal**
  - piezoresistive heating element
  - silicon nitride cantilever
  - mechanical check-valve
9. Which of the following diameters would yield the fastest flow rate due to capillary action?
- 100 millimeters
  - 10 millimeters
  - 100 micrometers
  - 10 micrometers**
10. In mechanical micropumps \_\_\_\_\_ are used to direct flow in one and only one direction within the pump.
- check valves**
  - diaphragms
  - microchannels
  - electrodes