History of MEMS Final Assessment
Instructor Guide

Note to Instructor

This is the assessment of the student's knowledge of MEMS history. There are 15 assessment questions.

The *History of MEMS Learning Module* consists of the following:

- History of MEMS Knowledge Probe (Pre-Quiz)
- History of MEMS Primary Knowledge
- History of MEMS Activity
- New Innovations in MEMS Activity
- **History of MEMS Final Assessment**

This companion Instructor Guide (IG) contains both the questions and answers for the assessment questions.

Introduction

The purpose of this final assessment is to test your knowledge of MEMS history.

This material involves the understanding of the major milestones that have occurred so far to create MEMS technology as we know it today. The assessment also tests your knowledge of major MEMS technologies.

There are fifteen (15) assessment questions.

1. The following MEMS structure was manufactured using which process?
   a. Surface Micromachining
   b. LIGA
   c. Bulk Micromachining
   d. SCREAM

Answer: b. LIGA

These MEMS structures were manufactured using the LIGA process.

2. Which of the following is NOT a micromachining method?
   a. Bulk
   b. Surface
   c. MOEMS
   d. LIGA

Answer: c. MOEMS

MOEMS is an acronym for Micro Opto Electromechanical System, not a process for manufacturing microsystems.

3. The following MEMS device is built using which of the following processes?
   a. Bulk
   b. SUMMiT IV
   c. MOEMS
   d. DRIE

Answer: B - SUMMiT IV

4. What type of bulk etch takes advantage of the crystallographic orientation properties of silicon?

_____

Answer: Anisotropic

*Bulk micromachining an **anisotropic** etch.*

5. The following is an example of what kind of pressure sensor?_____

Answer: Piezoresistive

*The image is an example of a **piezoresistive** pressure sensor.*

6. Which of the following is NOT a MEMS processing technique?
   a. Bulk Micromachining
   b. Surface Micromachining
   c. BioMEMS
   d. LIGA

Answer: c. BioMEMS

BioMEMS is a type of MEMS device used in biological applications, NOT a MEMS processing technique.

7. HP micromachined the first _____ in 1979, a device used in both commercial and personal products.
   a. Resonant gate transistor
   b. Ink-jet nozzle
   c. Crash or inertial sensor
   d. Electrostatic drive motors

Answer: b. inkjet nozzle

8. Who wrote the famous speech entitled "There's Plenty of Room at the Bottom"?
   a. Harvey Nathanson
   b. Kurt Petersen
   c. H. A. Waggener
   d. Richard Feynman

Answer: d. Richard Feynman

Richard Feynman wrote this speech which encouraged the research and development of micro devices.

9. Which of the following was the first batch fabricated MEMS device?
   a. Inkjet nozzle
   b. Resonant gate transistor
   c. Optical switch
   d. Integrated circuit

Answer: b. Resonant gate transistor

The resonant gate transistor was the first batch fabricated MEMS device.

10. Which of the following is NOT a bioMEMS application?
   a. Cell Culture
   b. DNA Arrays
   c. Drug Delivery
   d. Accelerometer

Answer: d. accelerometer

An accelerometer is a MEMS component used in a variety of MEMS and bioMEMS applications.

11. The attraction between molecules, atoms and surfaces is called _____.
   a. Van der Waals
   b. Feynman
   c. Coriolis
   d. Atomic force

Answer: a. Van der Waals

Van der Waals attraction is the attraction between molecules, atoms and surfaces.

12. Dr. Richard Feynman thought that physicists could advance biology research by doing what?
   a. Developing microsurgical devices
   b. Making the electron microscope 100 times better
   c. Overcoming Van der Waals forces
   d. Creating biological computers

Answer: b. Making the electron microscope 100 times better

13. At the end of his speech, how did Dr. Feynman encourage the exploration of "small" technology?

_____

_____

Answer:
By offering a $1000 prize for two achievements:
Putting the information from a page of a book on an area 1/25,000 smaller in linear scale
Making an operating electric motor which fits inside a 1/64 inch cube

14. Dr. Feynman felt that lubrication would most likely NOT be an issue for components in the micro-scale due to _____ in the micro-scale.
.

a. Minimal force and rapid heat loss
b. The types of forces
c. The interactive forces
d. The lack of inertia and friction

Answer: a. minimal force and rapid heat loss

15. Which device did Dr. Feynman think could not be miniaturized?

a. Electron microscope
b. Servo motor
c. Internal combustion engine
d. Pantograph

Answer: c. Internal combustion engine
He thought the internal combustion engine could not be made small.

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