



Jerusalem Science Contest 5785

Nanotechnology

Test 3

Form – A

Answer Key

- 1) **What is the primary goal of nanocharacterization?**
 - a) To observe biological samples at the cellular level
 - b) To study materials at the atomic and molecular scale**
 - c) To develop new chemical compounds
 - d) To enhance optical imaging techniques

- 2) **Which of the following techniques is most commonly used for imaging the surface of nanomaterials?**
 - a) Transmission Electron Microscopy (TEM)
 - b) Scanning Electron Microscopy (SEM)**
 - c) FTIR Spectroscopy
 - d) X-ray Diffraction (XRD)

- 3) **Energy Dispersive X-ray Spectroscopy (EDX) is used to:**
 - a) Measure the mechanical properties of nanomaterials.
 - b) Analyze the chemical composition of a sample.**
 - c) Image the surface topography of nanostructures.
 - d) Determine the electrical conductivity of materials.

- 4) **What does the resolution of a scanning electron microscope (SEM) primarily depend on?**
 - a) The wavelength of the electrons used**
 - b) The sample's composition
 - c) The detector type
 - d) The magnification setting

- 5) **Which of the following nanocharacterization techniques can provide atomic resolution?**
 - a) Scanning Tunneling Microscopy (STM)**
 - b) Optical Microscopy
 - c) X-ray Diffraction (XRD)
 - d) Dynamic Light Scattering (DLS)

6) **X-ray diffraction (XRD) is primarily used to:**

- a) Analyze the chemical composition of nanomaterials.
- b) Determine the crystalline structure of materials.**
- c) Measure the thermal properties of materials.
- d) Image the morphology of nanoparticles.

7) **Which technique is best suited for analyzing the electrical properties of nanomaterials?**

- a) Atomic Force Microscopy (AFM)
- b) Scanning Tunneling Microscopy (STM)**
- c) Raman Spectroscopy
- d) Energy Dispersive X-ray Spectroscopy (EDX)

8) **Atomic Force Microscopy (AFM) can be used to measure:**

- a) The chemical composition of nanomaterials.
- b) The surface roughness of nanostructures.**
- c) The crystallographic orientation of materials.
- d) The magnetic properties of nanoparticles.

9) **In Scanning Tunneling Microscopy (STM), the image of the sample is obtained by:**

- a) Scattering light off the sample.
- b) Detecting electrons emitted from the sample.
- c) Measuring the tunneling current between the tip and the sample.**
- d) Recording X-ray emission from the sample.

10) **The smallest movie in the world was created by:**

- a) Scanning Electron Microscopy (SEM).
- b) Focused Ion Beam (FIB).
- c) X-ray Photoelectron Spectroscopy (XPS).
- d) Scanning Tunneling Microscopy (STM)**

11) **Energy Dispersive X-ray Spectroscopy (EDX) can be performed in conjunction with which of the following techniques?**

- a) Atomic Force Microscopy (AFM)
- b) Scanning Electron Microscopy (SEM)**
- c) Raman Spectroscopy
- d) Nuclear Magnetic Resonance (NMR)

12) **Which of the following is a limitation of Transmission Electron Microscopy (TEM)?**

- a) Limited to analyzing surface features only.
- b) Inability to analyze organic materials.
- c) Requires very thin samples.**
- d) Low resolution compared to other techniques.

- 13) **Raman Spectroscopy is most useful for:**
- a) Imaging the surface topography of materials.
 - b) Measuring the thermal conductivity of nanomaterials.
 - c) *Determining the vibrational modes of molecules.***
 - d) Analyzing the magnetic properties of nanoparticles.
- 14) In Atomic Force Microscopy (AFM), which of the following is true about the operation of the microscope?
- a) The tip scans the surface while always being in direct contact with the sample.
 - b) The microscope uses electron beams to generate an image.
 - c) *The cantilever deflection is measured using a laser beam.***
 - d) AFM is primarily used to analyze chemical composition.
- 15) **X-ray Photoelectron Spectroscopy (XPS) is used to determine:**
- a) *The elemental composition and chemical state of materials.***
 - b) The surface roughness of nanostructures.
 - c) The optical properties of nanomaterials.
 - d) The mechanical properties of nanoparticles.
- 16) **What broader lesson do we learn from the Torah's prohibition in the verse, "When you besiege a city for many days to wage war against it to capture it, you shall not destroy its trees by wielding an ax against them" (Devarim 20:19)?**
- a) Do not destroy anything capable of producing human food.
 - b) *Do not make destructive and wasteful changes to the natural world.***
 - c) Minimize any damage done during wartime.
 - d) It is a mitzvah to create more available means for human sustenance.
- 17) **What ethical conduct does the Midrash derive from the verse, "See G-d's work, for who can fix what he has ruined" (Koheles 7:13)?**
- a) That you see God's work by studying nature.
 - b) That you study the laws of the Torah well so that you not make mistakes.
 - c) *That you not ruin and destroy G-d's world.***
 - d) That you fix whatever you have ruined in the world.
- 18) **What is one of the lessons we learn from the description in the Torah of the very first man's role in the world?**
- a) *Hashem wants us to utilize and manipulate the world's natural resources to benefit the world.***
 - b) Hashem wants us to be carnivores.
 - c) Hashem gives us permission to use the natural resources of the world however we want, even if we wish to destroy them.
 - d) All of the above.

19) **Where is the first place in the Torah where we find an indication that mankind is charged with developing the world's resources?**

- a) Bereishis 1:1: In the beginning of God's creating the heaven and the earth...
- b) Bereishis 1:11: And God said, "Let the earth sprout vegetation: plants that produce seeds, fruit trees of every kind that bear fruit with the seed in it on the earth." And it was so.
- c) Bereishis 1:28: God blessed them and God said to them, "Be fertile and increase, fill the earth and master it; and rule the fish of the sea, the birds of the sky, and all the living things that creep on earth."**
- d) Bereishis 2:15: Now God took the man, and He placed him in the Garden of Eden to work it and to guard it.

20) **What law in the Torah is discussed by the authorities as a possible reason to prohibit certain applications of nanotechnology, such as the formation of new species of living organisms?**

- a) The mitzvah of "be fruitful and multiple."
- b) The mitzvah to love G-d.
- c) The prohibition of "Lo Tashchi."
- d) The prohibition of Kil'ayim.**