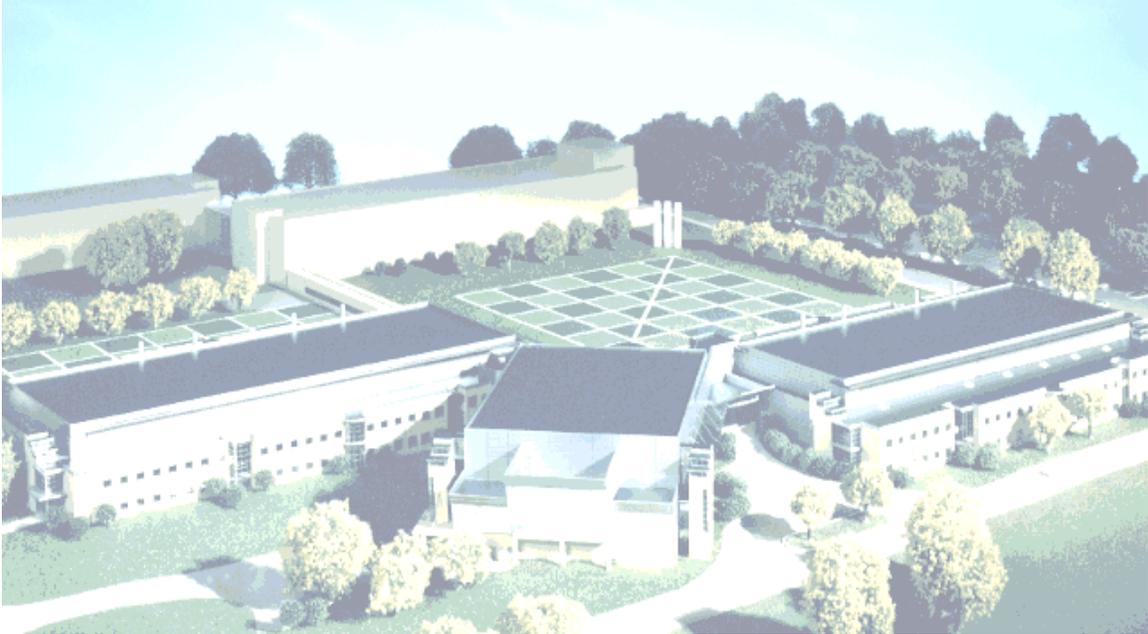


Center for Nanoscale Science and Technology Nanofab Safety Certification Examination



"Our Number One Priority"

This examination will be kept on file in the Nanofab records for one year or until your expiration date. This exam must be taken every year by all Nanofab Cleanroom users, and is administered to all new incoming facility users prior to obtaining access to the Nanofab Cleanroom. Passing grades are given to those who get less than 5 wrong answers. If you miss more than 5 answers you will be contacted by the Nanofab Management to discuss the missed questions. If you miss more than 10 answers you will be required to retake the exam. **This exam is taken at the Nanofab Group Office in Bldg 216 room A153 please contact Jeff Pasternak at x4529 to schedule your exam.**

Your name (print) _____ Answer Sheet _____ Phone Ext. _____

Your name (signature) _____ Division _____

Email: _____ Bldg/Room #: _____

Witness (print) _____

Witness (signature) _____

Date Completed _____ Recertification: Yes No (Please circle one)

Score _____ Pass _____ Fail _____

(Answer all questions completely)

1. All chemical bottles and chemical containers must be labeled with what?
 - The chemical name.
 - Inventory Barcode sticker with owner and hazard information.
2. When temporarily using chemicals in beakers or petri dishes, how do you identify the contents?
 - With the plastic chemical ID labels.
 - Or written on a cleanroom post-it or cloth-wipe.
3. What are the dangers associated with Hydrofluoric Acid?
 - Absorbed through unbroken skin.
 - Fluorine attacks calcium and magnesium in human bones.
 - Looks like water and can be mistaken as something harmless.
 - Initially painless.
 - Can be fatal.
4. What are the dangers associated with Tetramethyl Ammonium Hydroxide?
 - Causes severe burns to exposed area and can cause blindness.
 - Flammable.
5. What are the dangers associated with exposure to an acid such as HCl?
 - Causes severe bodily burns to exposed area and can cause blindness.
6. When performing chemical procedures such as an RCA clean, developing photoresist, or using corrosive materials one must wear the following PPE.
 - Safety Glasses
 - Acid Apron
 - High wrist gloves
 - Full-Face shield
7. Photoresist is considered carcinogenic and is harmful to the human body, and can also be harmful to the human fetus of a pregnant woman if exposed in the following ways.
 - Ingested
 - Inhaled
 - Absorbed through unbroken skin.
8. When do you need to wear safety glasses when working in the Nanofab?
 - At all times.
9. What is the emergency phone number at NIST?
 - Ext. 2222 (NIST Fire Dept).

10. Where are the pass-thru air-locks located and how are they designated?
- Between service chases and the cleanroom work bays.
 - They are designated “Acid only” or “Solvent (Bases) Only”
11. Latex gloves are mainly designed to protect against what?
- They provide MINIMAL chemical protection.
 - They protect your work from human debris.
12. When is a chemical spill considered an emergency and what should you do?
- When the spill presents immediate danger to life and health (IDLH).
 - Evacuate the Nanofab and leave through the nearest exit.
 - Contact HAZMAT (NIST Fire Dept.) at x 2222, or pull the fire pull box.
 - Meet in the small parking lot on South Drive across from the complex.
13. When is a chemical spill considered a non-emergency and what should you do, and give an example of a non-emergency spill?
- When you are *absolutely* sure that no harm is present.
 - Notify Nanofab Staff.
 - Choose one: DeIonized water spill, commercial cleaners, pump oils, etc.
14. When there is an unknown alarm, an unknown odor, or there is an abnormal lab status, what should you do?
- When in doubt, GET OUT! Evacuate.
 - Treat as though it is an emergency.
 - Contact HAZMAT (NIST Fire Dept) at x 2222, or pull the fire pull-box.
 - Meet in the small parking lot on South Drive across from the complex.
15. Who is authorized to turn on hazardous or toxic gases?
- The Nanofab Technicians only!
16. What is the proper method for disposing of chemical waste?
- Do not pour Flammable Solvents or Toxic Organics (e.g., photoresist) down drain.
 - Pour into rinsed empty bottle and label properly with supplied labels.
 - Store bottles that are not full under fume hood.
 - When waste bottle is full place into appropriate pass-thru for pick-up.
17. Where are the spill containment supplies located?
- In the service chases marked spill supplies.
 - In the chemical storage rooms.
18. What type of container should not be used for HF, and why?
- HF cannot be stored in glass.
 - Because HF etches glass.

19. Which is the proper method of diluting acid: acid to water or water to acid, and why?

- **AAA: Always Add Acid, otherwise a possible uncontrolled, exothermic reaction may occur.**

20. What should you do/not do in the case of an alarm or other evacuation procedure?

- **DO NOT stop to remove your gown.**
- **Leave through the nearest exit.**
- **DO NOT exit towards the furnace room B106; this is where the gases are located. Use this exit as a last resort.**
- **Meet in the small parking lot on South Drive in front of the complex.**

21. Where are the Shelter in Place locations for inclement weather or other safety conditions requiring you to take shelter in place?

- **In bldg 216: Marked service galleys on first floor**
- **In bldg 215 cleanroom: Men and Women's locker room**
- **In SubFab 215: Stay in lowest level away from hazardous materials.**

22. Explain three reasons why solvents are considered dangerous?

- **They are absorbed through unbroken skin.**
- **They are stored in fatty tissues, kidneys, and liver, where they are toxic.**
- **They are generally flammable.**

23. Complete the following gas identification table: (7 pts)

Formula	Name	Dangers	Odor
SiH ₄	Silane	Poisonous, pyrophoric	Repulsive
PH ₃	Phosphine	Flammable, Toxic	Garlic or rotten fish
SiH ₂ Cl ₂	Dichlorosilane	Corrosive, pyrophoric	Irritating choking odor
NH ₃	Ammonia	Pungent, Toxic and Corrosive	Pungent
SF ₆	Sulfur Hexafluoride	Asphyxiant	Smells like a burnt match
Cl ₂	Chlorine	Highly Poisonous	Pungent, bleach like odor
BCl ₃	Boron Trichloride	Highly Poisonous	Pungent

24. If you accidentally spill acid or other hazardous chemicals on yourself, what should you do?
- Immediately **rinse the affected area** with water using safety showers or eyewash/drench showers.
 - **Remove contaminated clothing** or continue to rinse if contaminated clothing has contacted skin.
 - **Call** x2222 (NIST Fire Dept)
 - **Identify the material** you have been exposed to for proper treatment.
 - Fill out accident report.
25. What is the major hazard associated with vacuum systems?
- **Implosion.**
26. If you come across an unlabeled beaker of some liquid, how should it be treated?
- It should be treated as if it were a dangerous chemical, like HF.
 - The Nanofab Staff must be notified immediately.
27. When working alone after-hours, what safety precautions should you take?
- **Always** receive authorization from the Nanofab Manager.
 - Use the **“buddy system”** (at least two people at all times)
28. What types of chemicals will your cleanroom gown protect you from?
- **None. The gown is not made to protect you from anything, but to help keep the cleanroom clean.**
29. Where are the safety showers and eye rinses located in the lab?
- **Safety Showers and Eyewash stations are located in the class 1000 corridor immediately outside the cleanroom proper.**
 - **Additional eyewash stations are located at the ends of the wet chemistry benches in the chemical bays B101 and B102.**
30. What is the building and room number for the Nanofab?
- **Building 215**
 - **Room D101 (main entrance)**
31. What is the procedure for using the labeled chemical waste neutralizer drains in the chemical bays?
- **Do not use these drains without proper training from the NanoFab Staff.**
 - **Always check the neutralizer status on the computer displays prior to dumping waste.**
 - **Only dump < 750 ml of approved materials listed on the posted charts.**
 - **If you are not absolutely sure what can be safely disposed, contact the NanoFab staff.**

32. What is the NUMBER ONE safety precaution while working in the lab?
- Always know the hazards of what you are doing. If you don't understand them, **STOP AND ASK.**
33. What should you do if you accidentally spill Hydrofluoric (HF) acid on yourself?
- Remove contaminated clothing.
 - Rinse with copious amounts of water.
 - Apply Calcium Gluconate gel.
 - Call x 2222 (NIST Fire Dept).
 - Receive hospital care and fill out an accident report.
34. Where is the Calcium Gluconate gel located?
- Inside the small chemical refrigerators in the yellow-rooms (Photo 1 and Photo 2).
35. Where are the telephones located inside/outside the cleanroom?
- Along the main hallway on the end of the bay walls.
 - In the main lobby room D101.
36. Name three pieces of equipment in the lab where toxic gases are used and **at least one** toxic gas for each tool?
- Low Pressure Chemical Vapor Deposition (LPCVD) - Dichlorosilane (SiH_2Cl_2), Ammonia (NH_3).
 - Plasma Enhanced Chemical Vapor Deposition (PECVD) - Silane (SiH_4), Ammonia (NH_3).
 - Metal Reactive Ion Etch (RIE) - Boron Trichloride (BCl_3), Chlorine (Cl_2).
37. Where is the Hydrofluoric (HF) acid used in the Nanofab?
- In the general and the ultra-clean chemical bays, at the wet benches.
 - Also used inside any acid hood in the cleanroom.
38. What is the main danger when working with XeF_2 (Xenon Difluoride)?
- Inhalation of HF, formed when XeF_2 is exposed to moisture in air.
39. Name a chemical oxidizer that is commonly used in the Nanofab and its associated danger.
- Hydrogen peroxide.
 - Can cause burns to skin and eyes.
40. Where is the Hydrogen Peroxide Stored in the Cleanroom and why?
- In the chemical pass-thru marked "OXIDIZERS" in B101 (Gen. Chem.)
 - Oxidizers support combustion and should be away from flammable chemicals.

41. When working in a chemical fume hood, what should you do to be safe?

- **Do not block** the exhaust returns with wipes or other objects.
- Work well inside the hood past the lip exhaust return.
- Lower the protective sash-window when possible.
- Never put your head into the fume hood with hazardous materials present.