Chapter 11 Review Questions Answer Key

1. What is preventative maintenance?

   A: Preventative maintenance is the practice of changing out parts and doing repairs in a scheduled fashion *before* the equipment breaks down or quits working.

2. How do we determine when PM tasks are due?

   A: We schedule PM tasks based on the previous performance of equipment. At some point, the equipment runs under normal operating conditions and someone keeps careful records of part failures.

3. What are some of the common electrical PM tasks?

   A: Tightening connections, replacing wires, replacing motors, clean or replace encoders, checking cooling fans, reseating electronic cards, voltage and amperage checks, and replacing batteries.

4. What are some of the common fluid power PM tasks?

   A: Checking the oil for contaminants, checking for leaks, changing filters, checking accumulator charge, cleaning valves, looking for signs of wear on hoses, filling lubricators, checking mufflers for proper operation, and draining pneumatic tanks.

5. Why should you never tighten a cable when the robot is powered up?

   A: There is a high probability of generating a false signal that can cause the robot to move suddenly in response, which could cause damage to robot or equipment around the system and hurt or kill you if you are in the work envelope of the robot.

6. What are some of the dangers of an arc flash?

   A: The heat produced can exceed 35,000°F or 19,500°C, approximately four times the surface temperature of the sun, which is hot enough to vaporize copper and cause

instant second and third-degree burns. When copper goes from a solid to vapor it expands to 67,000 times its original volume, able to drive shrapnel at a staggering 700 miles per hour plus or 1,130 Kilometers per hour plus. The pressure waves created by an arc blast, which is what we call an arc flash explosion, can exceed 2,160 ft./lbs^2 which is well over the 1720 ft./lbs^2 that causes massive internal injuries and death. To help put this in perspective, a 50-kA arc fault generates enough force to accelerate a 170 pound or 75 kg person standing two feet away from the blast at 330 ft./s^2 or 100 m/s^2, literally blowing them away from the event and adding to the misery as they bounce off whatever is in the way, likely with internal injuries such as collapsed lungs or crushed organs. And if that wasn't enough, it also generates intense, blinding light and sound waves exceeding 140 decibels, enough to rupture unprotected ear drums.

7. What are some of the events that can cause an arc flash?

   A: There are several things that can cause arc flash events, but the short of it is two power leads short between one another, possibly involving ground as well, and generate a huge amount of current flow. The longer the flow continues, the greater the damage and chances for arc blast. Some of the big causes are tools or conductive parts touching two lines at once, closing into faulted lines (ones that pop breakers or melt fuses), and loose or damaged connections. Conductive dusts and other impurities can also create a bridge between power leads and start the disaster. Arc flashes tend to occur inside the electrical cabinet when movement occurs such as, door or cover removal/installation, switch contact opening/closing, and person driven movement including test equipment use or reaching in with anything conductive.

8. What is the commonly recommended PPE for arc flash and where would you check to see if anything has changed?

   A: This kit includes:

   - Arc-rated long-sleeve shirt with arc pants OR arc-rated coveralls, all at a minimum arc rating of 8 cal/cm^2
   - Flash arc suit hood OR arc-rated face shield and arc-rated balaclava
   - Standard PPE including, hard hat, electrical gloves, leather protective gloves, leather work boots with safety toe, safety glasses, and ear plugs that go into the ear canal

   More information can be found in the NFPA 70E book.

9. What is reactive maintenance?

   A: Sooner or later something is bound to go wrong and at that point we enter a reactive maintenance mode where we have to figure out what is wrong and do something to get the system back into normal running condition.

10. What is troubleshooting and what are the main steps in this process?

    A: Troubleshooting is the logical process of determining the cause and correcting faults in a system or process.

    - Analyze the problem
    - Gather information
    - Find a solution
    - How to respond to continued problems

11. What are some of the things we do during the data-gathering phase of troubleshooting?

    A: As we figure out what is wrong with the system we want to look for things such as; where did it stop in the program, what was it doing, is anything out of place, did the operator report any strange sounds, are there signs of damage, what alarms does the system have, and anything else to give us clues. We can also use our senses to look, listen, feel, and possibly smell clues to the issue. Another common way to find out more about serious problems is to track power or signal and find where it stops.

12. What are the five guidelines to keep in mind if the troubleshooting solution does not work?

    A: *Guideline 1:* Do not get frustrated.

    Guideline 2: Reevaluate the information, adding in what you have learned.

    Guideline 3: Try, try again.

    Guideline 4: "Once you eliminate the impossible, whatever remains, no matter how improbable, must be the truth" (Doyle, 2012).

    Guideline 5: Back to the drawing board.

13. What are the five steps in crash recovery?

    A: • First: determine why the robot crashed

    • Second: get the robot clear of the crash or impact area

    • Third: determine how to prevent another crash

    • Fourth: check the alignment of all equipment involved in the crash

    • Fifth: determine what to do with the parts involved in the crash

14. What are the benefits of taking pictures before you start a repair?

    A: This will give you a visual roadmap back to the original system configuration and help with any questions you may have. I have used this many times myself to help me remember how the system was wired, where everything went, how something looked before I took it apart, how hoses or cables were routed, and so on.

15. What is the benefit of taking good notes during the repair process?

    A: Often during repairs, we learn better ways to do things, track down information that did not come with the equipment, or make other discoveries that can help later. This information is very beneficial six months or a year later when you run into a similar problem, but forget exactly what you did to fix it.

16. What is the potential problem with just swapping out parts and not looking for the root cause?

    A: The truth of the matter is everything faults out for a reason and simply changing parts may not be enough to remove the root cause of the problem. There are times that part swapping only addresses the symptoms and not the cause of the problems. To truly fix the robot or other equipment, we have to figure out why it failed in the first place. Failure to do this can result in repeated damage to certain components and a possible cascade effect where the second or third time other components and systems are damaged as well.

17. What are some of the precautions to take when repairs are finished and the robot is ready for a trial run?

    A: Check the system for tools, spare parts, and foreign objects before putting on the covers. Make sure everyone is clear and all the covers are in place. After power up,

check for any alarms or unusual action by the system. The last and perhaps most important check, is to load in the proper program and start the robot back into normal operation.