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| 1. Micro limit switches commonly have an amperage range of \_\_\_\_\_\_\_\_\_\_\_.   |  |  |  | | --- | --- | --- | |  | a. | 1 to 3 amps | |  | b. | 1 to 7 amps | |  | c. | 1 to 10 amps | |  | d. | 1 to 20 amps | |

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| 2. \_\_\_\_\_\_\_ are made up of a solid piece of material that manipulates the flow of electrons without any moving parts.   |  |  |  | | --- | --- | --- | |  | a. | Limit switches | |  | b. | Solid-state devices | |  | c. | Optical encoders | |  | d. | Target flowmeters | |

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| 3. You are setting up a system to detect if fluid is inside a carton so the robot can pick the empty cartons off the line. Which of the following would work for this task?   |  |  |  | | --- | --- | --- | |  | a. | Inductive proximity switch | |  | b. | Capacitive proximity switch | |  | c. | Photoelectric proximity switch | |  | d. | Hall effect sensors | |

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| 4. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are devices activated by contact with an object that changes the state of its contacts when the object exerts a certain amount of force.   |  |  |  | | --- | --- | --- | |  | a. | Limit switches | |  | b. | Inductive proximity switches | |  | c. | Photoelectric proximity switches | |  | d. | Hall effect sensors | |

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| 5. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_use an oscillating magnetic field to detect ferrous metal items.   |  |  |  | | --- | --- | --- | |  | a. | Limit switches | |  | b. | Inductive proximity switches | |  | c. | Photoelectric proximity switches | |  | d. | Hall effect sensors | |

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| 6. \_\_\_\_\_\_\_\_\_\_\_\_\_ photoelectric sensors separate the transmitter and receiver into different units, placed opposite each other.   |  |  |  | | --- | --- | --- | |  | a. | Through-beam | |  | b. | Retroreflective | |  | c. | Diffuse | |  | d. | Light-level detection | |

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| 7. \_\_\_\_\_\_\_\_\_\_\_\_\_ photoelectric sensors place the transmitter and receiver in one assembly and often use something like a bicycle reflector to return the light.   |  |  |  | | --- | --- | --- | |  | a. | Through-beam | |  | b. | Retroreflective | |  | c. | Diffuse | |  | d. | Light-level detection | |

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| 8. When using the amperage draw of the motors to monitor for impact, which of the following statements is true?   |  |  |  | | --- | --- | --- | |  | a. | These systems are complex and require high-level math. | |  | b. | Noise in the system may cause a false shut down. | |  | c. | Excessive payload weight may cause the system to shut down. | |  | d. | All of these are correct. | |

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| 9. \_\_\_\_\_\_\_\_\_\_ are based on the principle of a linear increase in resistance that occurs when a metal is exposed to heat.   |  |  |  | | --- | --- | --- | |  | a. | Thermocouples | |  | b. | RTDs | |  | c. | Thermistors | |  | d. | IR temperature sensors | |

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| 10. \_\_\_\_\_\_\_\_\_\_ are temperature sensors that work off the principle of a small DC millivoltage generated when the junction of two dissimilar metals are heated.   |  |  |  | | --- | --- | --- | |  | a. | Thermocouples | |  | b. | RTDs | |  | c. | Thermistors | |  | d. | IR temperature sensors | |

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| 11. \_\_\_\_\_\_\_\_\_\_ place a disk or similar shape in the fluid and use the force of the fluid flow to deflect the disk and generate a signal.   |  |  |  | | --- | --- | --- | |  | a. | Turbine flowmeters | |  | b. | Target flowmeters | |  | c. | Sail flowmeters | |  | d. | Magnetic flowmeters | |

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| 12. \_\_\_\_\_\_\_\_\_\_ use a propeller-type assembly placed inside the fluid to generate a signal via a magnetic pickup sensor positioned nearby, but outside of the fluid.   |  |  |  | | --- | --- | --- | |  | a. | Turbine flowmeters | |  | b. | Target flowmeters | |  | c. | Sail flowmeters | |  | d. | Magnetic flowmeters | |

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| 13. \_\_\_\_\_\_\_\_\_\_\_\_\_ use a thin membrane, often made of metal in a capsule arrangement, to move the indicator assembly.   |  |  |  | | --- | --- | --- | |  | a. | Bourdon tube gauges | |  | b. | Bellows gauges | |  | c. | Diaphragm gauges | |  | d. | Pressure relief valves | |

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| 14. \_\_\_\_\_\_\_\_\_\_\_\_\_ use a thin-walled, slightly elliptical, cross-sectioned tube bent in a C shape, which is tied directly to the system, to read pressure.   |  |  |  | | --- | --- | --- | |  | a. | Bourdon tube gauges | |  | b. | Bellows gauges | |  | c. | Diaphragm gauges | |  | d. | Pressure relief valves | |

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| 15. \_\_\_\_\_\_\_\_\_\_\_ are similar to photo eyes except that they emit and receive sound instead of light.   |  |  |  | | --- | --- | --- | |  | a. | Sourcing signals | |  | b. | Sinking signals | |  | c. | Optical isolation | |  | d. | Ultrasonic sensors | |

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| 16. \_\_\_\_\_\_\_\_\_\_\_ provide(s) the positive connection or DC voltage to the input module.   |  |  |  | | --- | --- | --- | |  | a. | Sourcing signals | |  | b. | Sinking signals | |  | c. | Optical isolation | |  | d. | Ultrasonic sensors | |

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| 17. What is the difference between a sourcing and a sinking signal? |

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| 18. How does an absolute encoder work? |

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| 19. How do thermocouples work? |

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| 20. What is the benefit of disengaging the axes as opposed to the E-stop method of stopping the robot when impact is detected? |

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| 21. How do we commonly monitor impact today? |

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| 22. What are the six main criteria for selecting a sensor? |