Chapter 2 Review Questions Answer Key

1. Where does the word *robot* come from and who gave us this term?

   A: The word robot was first used by Karel Capek in 1921 in his play *R.U.R. (Rossum's Universal Robots)*. It comes from the Czech word *robota,* which means drudgery or slave-like labor.

2. What is an industrial robot as defined by RIA?

   A: An industrial robot is an automatically controlled, reprogrammable, multipurpose manipulator, programmable in three or more axes which may be either fixed in place or mobile for use in industrial automation applications.

3. What was the Jacquard loom, who invented it, and when?

   A: In 1804 Joseph-Marie Jacquard invented the Jacquard loom that utilized punch cards and was designed to fit on looms for weaving fabric, creating intricate patterns that could only be done by hand before.

4. When was the first microchip introduced and who invented it?

   A: The creation of the first microchip happened in 1958 by Jacky Kirby.

5. What are three things that Nikola Tesla is famous for?

   A: Some of Tesla's most famous inventions include AC power, the transformer, the AC induction motor (patented as the rotary transformer), the Tesla Coil, and radio-controlled boats.

6. Who created the first industrial robot and when did that happen?

   A: In 1941, the DeVilbiss Company built what many consider the first industrial robot, based on the patented parallel robot design of Willard L. G. Pollard Jr.

7. When did Kawasaki Robotics enter the robotics field?

   A: In 1968, Kawasaki Robotics started producing hydraulically powered robots for Unimation, beginning their rise in the robotics field.

8. What was the first commercially available microcomputer-controlled industrial robot?

   A: The T3 sold by Cincinnati Milacron and designed by Richard Hohn.

9. When did KUKA start producing robots and what was its first model?

   A: 1973 is when KUKA, a German company, joined the robotics industry with the IR 600, which went into Europe's first welding transfer line in a Daimler-Benz plant.

10. Who created the first fully electric microprocessor-controlled robot and to which company was the robot shipped?

    A: In 1974, ASEA (who is now known as ABB and is short for ASEA Brown Boveri due to a merger with BBC, formerly known as Brown Boveri, in 1988) delivered the first fully electric, microprocessor-controlled robot to the Magnussons Company in Sweden.

11. Who invented the first SCARA robot and when?

    A: In 1978 Hiroshi Makino developed the Selective Compliant Articulated Robot Arm (SCARA) in Japan.

12. Which factors led to the increased robot sales and the robotics industry boom in the early 1980s?

    A: A large factor was increasing wages and benefits for the American worker, especial in heavily unionized industries such as automotive and steel. Another big

cost increase came from several years of double digit inflation during the 70s, raising the cost of everything from labor, raw materials, to shipping product. Around this same time, many of the bugs in the early robotic systems had been worked out making the technology easier to work with and stable.

13. What stopped the robotics boom of the early 1980s?

    A: One of the key factors was labor costs began to level off from the drastic increases that began about a decade before in 1975. Another key factor that slowed the robotics market was other forms of industrial automation, or equipment that completes processes with minimal human assistance, became readily available and competitive.

14. What are collaborative robots?

    A: Collaborative robots are designed to work *with* humans instead of separated away from humans and have safety systems that limit the danger to humans by carefully monitoring their surroundings and often slowing down when humans are nearby. Many of these robots have outer skins that are rounded in shape and are made of materials that can help absorb some of the force should an impact occur.

15. What happened in the early 1990s to boost robotic sales once more?

    A: In 1991 advancements in display technology and new microelectronics improved the robot and revived interest in the field, helping to stimulate sales figures that were decreasing towards the end of the 80s.

16. What is a robotic integrator?

    A: Robotic integrators are companies, usually other than the robotic system manufacturer, that specialize in selecting, adapting, installing, and programming

robots for whatever application(s) their client needs. Many of these companies have zero involvement with the development or manufacture of the robotic systems they use as their focus is utilization of the robot.

17. Who introduced the first dual-arm robot?

    A: In 2006, Yaskawa Motoman gave industry a dual-arm robot that resembled a human torso without a head.

18. Who released the first collaborative robot for industry and in which year did it hit the market?

    A: Late in 2012, Rethink released the Baxter robot that works in the industrial environment without the need for a cage.

19. When did ABB's YuMi® first go on the market and which award did it win?

    A: ABB's dual-arm concept prototype became YuMi® (you and me) and it was announced they would be commercially available on April 13, 2015. At the 2016 China International Robot Show (CIROS), ABB's YuMi® collaborative robot was named the 2016 best industrial robot and won a Golden Finger award.

20. What are FANUC's ZDT and FIELD programs?

    A: ZDT, or Zero Down Time, was where they collected data directly for the robotic process to predict failures before they happen and prevent downtime of the system. FANUC also released the Fanuc Intelligent Edge Link and Drive (FIELD) system in 2016 to allow other suppliers to download new applications to FANUC robots in the field. The FIELD system works similarly to the app store for your favorite smartphone, but software developers who wish to use this system will have to pay to play.

21. List the four Ds of robotics and give an example of each as it relates to industry.

    A: Dull, Dirty, Difficult, and Dangerous. Dull – repetitive tasks identical in nature. Dirty – tasks that result in the human operator covered in something and generally reduces job satisfaction. Difficult – tasks that require the worker to move in unnatural ways or handle weight in awkward positions. Dangerous – tasks that pose some form of health threat to the person performing them.

22. What are some of the other factors besides the four Ds or the four Hs that drive industry to use robotics?

    A: Beyond the four Ds of robotics, another good reason for using robots is precision. Precision is performing tasks accurately or exactly within given quality guidelines. Robotic precision creates consistency and repeatability that is difficult for their human counterparts to match. Consistency is the ability to produce the same results or quality each time while repeatability is the ability to perform the same motions within a set tolerance.

    Cost savings is a factor that has helped to drive the integration of robotics into industry.

    Another big draw for using robots in industry is technology, such as the collaborative robots that can work with people, and vision systems that can measure images to capture quality data. Each new trick learned by the robot that makes it easier to work with or gives it an ability humans lack increases the number of units sold. Robots are one of the few systems in industry that boast such a wide range of functionality with nothing more than tooling changes and a new program.