TRUE/FALSE

1. Lean systems are operating systems that maximize the value added of each of their activities by paring unnecessary resources and delays from them.
   
   Answer: True
   Reference: Introduction
   Difficulty: Easy
   Keywords: lean, systems, value, added

2. The just-in-time (JIT) philosophy is the belief that cutting inventory and removing non-value-added activities in operations can eliminate waste.
   
   Answer: True
   Reference: Introduction
   Difficulty: Easy
   Keywords: JIT, just, time, value, added, inventory

3. The pull method begins the production of an item in advance of customer needs.
   
   Answer: False
   Reference: Characteristics of Lean Systems for Service and Manufacturing
   Difficulty: Moderate
   Keywords: pull, production

4. The push method begins the production of items in advance of customer needs.
   
   Answer: True
   Reference: Characteristics of Lean Systems for Services and Manufacturing
   Difficulty: Easy
   Keywords: push, production

5. Firms that have highly repetitive processes and well-defined work flows of standardized items often use the push method.
   
   Answer: False
   Reference: Characteristics of Lean Systems for Services and Manufacturing
   Difficulty: Moderate
   Keywords: pull, repetitive, process, flows, standardized
6. A power cord that can be plugged in only one way is an example of a poka-yoke.
   Answer: True
   Reference: Characteristics of Lean Systems for Services and Manufacturing
   Difficulty: Moderate
   Keywords: JIT, just, time, lean, poka-yoke

7. Just-in-time (JIT) systems rely on inspectors to inspect quality into the product.
   Answer: False
   Reference: Characteristics of Lean Systems for Services and Manufacturing
   Difficulty: Moderate
   Keywords: JIT, just, time, quality

8. The Japanese practice of andon means that production does not begin until a card or bin is empty.
   Answer: False
   Reference: Characteristics of Lean Systems for Services and Manufacturing
   Difficulty: Moderate
   Keywords: andon, card, bin

9. The goal of single-digit setup is to have a setup completed in fewer than 10 hours.
   Answer: False
   Reference: Characteristics of Lean Systems for Services and Manufacturing
   Difficulty: Moderate
   Keywords: single, digit, setup

10. Mixed-model assembly is a type of assembly that produces a mix of models in smaller lots.
    Answer: True
    Reference: Characteristics of Lean Systems for Services and Manufacturing
    Difficulty: Moderate
    Keywords: mixed, model, assembly, lot

11. Modularity decreases productivity, so most JIT firms instead strive for part commonality.
    Answer: False
    Reference: Characteristics of Lean Systems for Services and Manufacturing
    Difficulty: Moderate
    Keywords: modularity, commonality, productivity

12. Just-in-time (JIT) systems need close relationships with suppliers.
    Answer: True
    Reference: Characteristics of Lean Systems for Services and Manufacturing
    Difficulty: Moderate
    Keywords: JIT, just, time supplier, relationship

13. Preventive maintenance is typically given very low priority in just-in-time systems.
    Answer: False
    Reference: Characteristics of Lean Systems for Services and Manufacturing
    Difficulty: Moderate
    Keywords: preventive, maintenance, JIT, just, time
14. A five S program includes the activities of “simplify” and “system”.
   Answer: False
   Reference: Characteristics of Lean Systems for Services and Manufacturing
   Difficulty: Moderate
   Keywords: 5S, five, JIT, just, time

15. Kaizen is the Japanese term for continuous improvement.
   Answer: True
   Reference: Continuous Improvement Using a Lean Systems Approach
   Difficulty: Easy
   Keywords: kaizen, quality, improvement

16. A kanban is a card used to control the flow of production in many just-in-time systems.
   Answer: True
   Reference: The Kanban System
   Difficulty: Moderate
   Keywords: kanban, card

17. As the average processing time per container of parts increases, fewer containers are needed in a kanban system.
   Answer: False
   Reference: The Kanban System
   Difficulty: Moderate
   Keywords: modularity, commonality, productivity

18. Use of value stream mapping requires construction of a current state drawing, a future state drawing, and an implementation plan.
   Answer: True
   Reference: Value Stream Mapping
   Difficulty: Easy
   Keywords: value, stream, mapping, drawing, current, future, implementation

19. A value stream map shows the flows of materials and information and the lines of responsibility and authority.
   Answer: False
   Reference: Value Stream Mapping
   Difficulty: Moderate
   Keywords: value, stream, mapping

20. A JIT II system brings the supplier into the customer’s plant.
   Answer: True
   Reference: JIT II
   Difficulty: Moderate
   Keywords: JIT II, supplier, customer
Chapter 9: Lean Systems

21. One benefit of a lean system is that it reduces space requirements.
   Answer: True
   Reference: Operational Benefits and Implementation Issues
   Difficulty: Moderate
   Keywords: just, time, JIT, space, lean, system

22. One benefit of a lean system is that it increases equipment utilization.
   Answer: True
   Reference: Operational Benefits and Implementation Issues
   Difficulty: Moderate
   Keywords: JIT, just, time, equipment, utilization, lean, system

23. If infrequent, large shipments of purchased items are arranged with suppliers, large inventory savings for these items can be realized.
   Answer: False
   Reference: Operational Benefits and Implementation Issues
   Difficulty: Moderate
   Keywords: shipments, inventory, savings, suppliers

24. Lean systems do not need stable master production schedules.
   Answer: False
   Reference: Operational Benefits and Implementation Issues
   Difficulty: Moderate
   Keywords: JIT, just, time, master, schedule, lean, system

MULTIPLE CHOICE

25. Lean systems try to:
   a. produce product in anticipation of demand.
   b. maximize the value added by each of their activities.
   c. organize production in large lots to minimize the number of setups.
   d. reduce the labor content in all processes.
   Answer: b
   Reference: Introduction
   Difficulty: Moderate
   Keywords: lean, value, added

26. Which of the following is NOT a principle of the Toyota Production System?
   a. All work must be specified as to content.
   b. Every customer–supplier connection must be direct and unambiguous.
   c. All workers must be guaranteed full employment for life.
   d. Any improvements to the system must be made in accordance with the scientific method.
   Answer: c
   Reference: Introduction
   Difficulty: Moderate
   Keywords: principle, TPS, Toyota, production, system
27. The Toyota Production System principle requires that:
   a. goods and services flow to the next available person.
   b. goods and services flow to the next available machine.
   c. all production lot sizes be exactly one.
   d. employees actually doing the work must be actively involved making the improvements in that work.
   Answer: d
   Reference: Introduction
   Difficulty: Moderate
   Keywords: principle, TPS, Toyota, production, system

28. The key to the Toyota Production System is that:
   a. Toyota has built a learning organization over the course of 50 years.
   b. suppliers have an equal say in how the work is to be accomplished.
   c. production schedules are stable and frozen within one month.
   d. management turnover is kept to a minimum by the policy of lifetime employment.
   Answer: a
   Reference: Introduction
   Difficulty: Moderate
   Keywords: learning, TPS, Toyota, production, system, organization

29. The just-in-time (JIT) system is a(n):
   a. management system of people and procedures to fulfill all delivery deadlines.
   b. production system of small-lot manufacturing to reduce work-in-process inventory.
   c. materials management system for removing all inventories.
   d. integrated system of managing resources, information, and decision processes to eliminate waste.
   Answer: d
   Reference: Introduction
   Difficulty: Moderate
   Keywords: JIT, just, time, integrated, system

30. The lean system concept will not work without the proper environment. Which one of the following characteristics is most common to firms that have successfully implemented a lean system?
   a. Uniform assembly schedules
   b. Specialized workforce
   c. High rates of machine failures
   d. Longer setup times
   Answer: a
   Reference: Characteristics of Lean Systems for Services and Manufacturing
   Difficulty: Moderate
   Keywords: JIT, just, time, assembly, schedule, lean, system
31. There are many requirements for the successful implementation of the lean system of production. Which one of the following is not such a requirement?
   a. Uniform assembly schedule
   b. Short setup time
   c. Low machine failure and low defects
   d. Substantial natural resources
   
   **Answer:** d
   
   **Reference:** Characteristics of Lean Systems for Services and Manufacturing
   **Difficulty:** Moderate
   **Keywords:** JIT, just, time, implementation, lean, system

32. Lean systems maintain inventory in small lot sizes because small lot sizes:
   a. increase pipeline inventory, allowing the organization to buffer against demand uncertainties.
   b. increase the quality level of the product.
   c. enable schedules to use machine capacities more efficiently.
   d. increase manufacturing lead time because of the increase in waiting time.
   
   **Answer:** c
   
   **Reference:** Characteristics of Lean Systems for Services and Manufacturing
   **Difficulty:** Moderate
   **Keywords:** JIT, just, time, lot, size, lean, system

33. Lean systems use the standardization of components because standardization:
   a. decreases the demand for each component.
   b. increases worker productivity.
   c. allows for small lot sizes more easily.
   d. decreases repeatability.
   
   **Answer:** b
   
   **Reference:** Characteristics of Lean Systems for Services and Manufacturing
   **Difficulty:** Moderate
   **Keywords:** JIT, just, time, standardized, components, lean, system

34. Mistake-proofing is known by the term:
   a. andon.
   b. muda.
   c. jidoka.
   d. poká-yoke.
   
   **Answer:** d
   
   **Reference:** Characteristics of Lean Systems for Services and Manufacturing
   **Difficulty:** Moderate
   **Keywords:** poká-yoke, mistake proofing

35. Keyed connectors that fit together only the proper way are an example of:
   a. andon.
   b. jidoka.
   c. poká-yoke.
   d. muda.
   
   **Answer:** c
   
   **Reference:** Characteristics of Lean Systems for Services and Manufacturing
   **Difficulty:** Moderate
   **Keywords:** poká-yoke, mistake proofing
36. Which of the following describes the technique of poka-yoke?
   a. A green light in a production area signals that processing is proceeding normally but a red light indicates that problems exist.
   b. An airline pilot reviews a pre-flight checklist to make sure everything is ready for takeoff.
   c. Every hour a worker takes a small sample of the product and inspects it.
   d. A purchasing agent and a supplier work together to ensure that shipments arrive on time.
   Answer: b
   Reference: Characteristics of Lean Systems for Services and Manufacturing
   Difficulty: Moderate
   Keywords: poka-yoke, mistake proofing

37. Justin Thyme used to run one batch each of 500 As, 300Bs and 100Cs every month but now he runs a batch of 5As, 3Bs, and 1C every half day:
   a. now that he embraces mixed-model assembly.
   b. now that he has andon lights installed at the appropriate work centers.
   c. thanks to the his employer’s move away from single-digit setups.
   d. in order to increase muda.
   Answer: a
   Reference: Characteristics of Lean Systems for Services and Manufacturing
   Difficulty: Moderate
   Keywords: mixed-model, assembly

38. What did the production manager say to the pile of scrapped material?
   a. “Hello muda.”
   b. “Hello fadduh.”
   c. “We need more kanbans.”
   d. “JIT II Brute?”
   Answer: a
   Reference: Characteristics of Lean Systems for Services and Manufacturing
   Difficulty: Easy
   Keywords: muda, waste

39. In lean systems, if a defective product is found, which of the following is generally NOT done?
   a. The production line is stopped.
   b. The defective unit is passed on to the next workstation.
   c. The defective unit is returned to the worker responsible for creating the defect.
   d. The production line is made aware of the problem without stopping the line.
   Answer: b
   Reference: Characteristics of Lean Systems for Services and Manufacturing
   Difficulty: Moderate
   Keywords: JIT, just, time, defects, defective, lean, system
40. Companies using lean systems generally have:
   a. many suppliers to ensure that material shortages never occur.
   b. suppliers that are located nearby to decrease delivery lead time.
   c. suppliers that are willing to accept short-term contracts.
   d. suppliers who are low-cost producers.
   **Answer:** b
   **Reference:** Characteristics of Lean Systems for Services and Manufacturing
   **Difficulty:** Moderate
   **Keywords:** JIT, just, time suppliers, lead, time, lean, system

41. The one-worker, multiple machines approach functions as:
   a. a one-person production line.
   b. a production bottleneck.
   c. a poka-yoke device.
   d. a way to create uniform workstation loads.
   **Answer:** a
   **Reference:** Characteristics of Lean Systems for Services and Manufacturing
   **Difficulty:** Moderate
   **Keywords:** OWMM, worker, machine

42. Weeding out unnecessary items, neatly arranging what’s left, and cleaning the work area are components of:
   a. a kanban system.
   b. JIT III systems
   c. mixed-model assembly.
   d. a 5S program.
   **Answer:** d
   **Reference:** Characteristics of Lean Systems for Services and Manufacturing
   **Difficulty:** Moderate
   **Keywords:** 5S, Five S

43. Which of these activities is NOT part of a 5S program?
   a. Sustain
   b. Synchronize
   c. Standardize
   d. Straighten
   **Answer:** b
   **Reference:** Characteristics of Lean Systems for Services and Manufacturing
   **Difficulty:** Moderate
   **Keywords:** 5S, Five S
44. Continuous improvement with lean systems:
   a. involves navigating a ship over treacherous rocks.
   b. requires periodically increasing lot sizes or workforce levels to uncover problems.
   c. entails systematically stressing the system and focusing on problem areas.
   d. focuses exclusively on internal operations because the logistics department addresses relationships with customers and suppliers.
   **Answer:** c
   **Reference:** Continuous Improvement Using a Lean Systems Approach
   **Difficulty:** Moderate
   **Keywords:** JIT, just, time, continuous, improvement,

45. Which one of the following statements regarding the Toyota lean system is TRUE?
   a. It is particularly well suited for making irregularly used parts and customized “specials.”
   b. It is a “push system,” with orders pushed out in anticipation of future requirements.
   c. Each container has either a withdrawal or production-ordering kanban.
   d. The single most important factor in shaping the environment is having reliable suppliers nearby.
   **Answer:** c
   **Reference:** Multiple sections
   **Difficulty:** Moderate
   **Keywords:** JIT, just, time, container, bin, kanban, lean, system

46. A kanban system is an important mechanism for lean system management. Which one of the following statements regarding the operation of a kanban system is TRUE?
   a. A typical kanban used in the JIT system includes information such as item number, unit price, competitor’s product name, and its price.
   b. A kanban can be used to set the order quantity but not the inventory level.
   c. A kanban and a container move as a pair once production begins at the fabrication process.
   d. An empty container can be exchanged for a full container at the storage location even though no kanban is on the full container.
   **Answer:** c
   **Reference:** The Kanban System
   **Difficulty:** Moderate
   **Keywords:** kanban, container, lean, system

47. An important mechanism for lean systems is a kanban system. Which one of the following statements correctly describes the behavior of a two-card kanban system?
   a. A withdrawal kanban is issued to authorize production in the fabrication process.
   b. A production-ordering kanban authorizes the assembly process to remove the materials from the storage location.
   c. The fabrication process produces certain units defined by the lot size and pushes them down to the assembly process.
   d. Containers must never be removed from the storage location without an authorizing withdrawal kanban.
   **Answer:** d
   **Reference:** The Kanban System
   **Difficulty:** Moderate
   **Keywords:** container, kanban, withdrawal, lean, system
48. Which one of the following statements is TRUE?
   a. Two operating rules for the kanban system are (1) the container size should be equal to at least seven days of supply and (2) each container must have a kanban card.
   b. The kanban system is more effective when the assembly schedule calls for small lots and does not fluctuate much from day to day.
   c. The number of kanban cards should be equal to the desired safety stock times alpha.
   d. Supplier performance is much more important in U.S. environments than such factors as lot sizes, scrap losses, and worker flexibility.
   **Answer:** b
   **Reference:** The Kanban System
   **Difficulty:** Moderate
   **Keywords:** kanban, lot, schedule

49. Use the information in Case 9.1. Using an policy variable of 5%, calculate the number of kanban containers needed for the fastener.
   a. Three or fewer
   b. Four or five
   c. Five or six
   d. Seven or more
   **Answer:** b
   **Reference:** The Kanban System
   **Difficulty:** Moderate
   **Keywords:** kanban, container, bin

50. Use the information in Case 9.1. How many kanban containers would be required if a 10% policy variable is used?
   a. Three or fewer
   b. Four or five
   c. Five or six
   d. Seven or more
   **Answer:** b
   **Reference:** The Kanban System
   **Difficulty:** Moderate
   **Keywords:** kanban, container, bin
Chapter 9: Lean Systems

Case 9.2
A manufacturer using a kanban system has had problems with high inventory levels of one of the component parts it makes. Daily demand for the part is 3000 units, average waiting time during production is 0.20 day, processing time is 0.10 day per container, and a container holds 150 pieces.

51. Use the information in Case 9.2. How many kanban containers would be required if a 5% policy variable is used?
   a. Three or fewer
   b. Four or five
   c. Six or seven
   d. Eight or more
   Answer: c
   Reference: The Kanban System
   Difficulty: Moderate
   Keywords: kanban, container, bin

52. Use the information in Case 9.2. How many kanban containers would be required if a 10% policy variable is used?
   a. Three or fewer
   b. Four or five
   c. Five or six
   d. Six or seven
   Answer: d
   Reference: The Kanban System
   Difficulty: Moderate
   Keywords: kanban, container, bin

Case 9.3
A company uses a kanban system. The demand for part A over an eight-hour production day is 1000 units. The average waiting time for a container of parts is 45 minutes. The processing time for a container of part A is 2 hours, and a container holds 70 units.

53. Use the information in Case 9.3. How many kanban containers would be required if a 5% policy variable is used?
   a. Fewer than 2
   b. 5 or 6
   c. 50 to 650
   d. 700 or more
   Answer: b
   Reference: The Kanban System
   Difficulty: Moderate
   Keywords: kanban, bin, container
54. Use the information in Case 9.3. How many kanban containers would be required if a 15% policy variable is used?
   a. 6 or fewer
   b. 7 or 8
   c. 15 to 20
   d. 20 or more
   Answer: a
   Reference: The Kanban System
   Difficulty: Moderate
   Keywords: kanban, container, bin

55. Use the information in Case 9.3. How many kanban containers would be required if the containers held only 15 pieces and a 5% policy variable is declared?
   a. 10 or fewer
   b. 11 to 20
   c. 21 to 30
   d. 31 or more
   Answer: c
   Reference: The Kanban System
   Difficulty: Moderate
   Keywords: kanban, container, bin

56. Which of the following actions would increase the number of containers in use in a kanban system?
   a. Larger containers that can hold more parts than before
   b. Less demand for the part held by the container
   c. Increased waiting time for the container
   d. Faster processing times for the part held by the container
   Answer: c
   Reference: The Kanban System
   Difficulty: Moderate
   Keywords: kanban, container, bin

57. Which of the following actions would decrease the number of containers in use in a kanban system?
   a. Smaller containers that can hold fewer parts than before
   b. Higher demand for the part held by the container
   c. Reduced waiting time for the container
   d. Slower processing times for the part held by the container
   Answer: c
   Reference: The Kanban System
   Difficulty: Moderate
   Keywords: kanban, container, bin
58. Which of the following maps is NOT a part of value stream mapping analysis?
   a. Steady state
   b. Current state
   c. Future state
   d. Work plan and implementation
   **Answer:** a
   **Reference:** Value Stream Mapping
   **Difficulty:** Moderate
   **Keywords:** VSM, value, stream, mapping

59. A supplier to a company using JIT II:
   a. will incur increased invoicing and payment costs but will get higher prices.
   b. will be able to sell directly to the engineering department of the customer.
   c. must be very flexible to incur the dramatic swings in requirements from the customer.
   d. enjoys a savings in personnel costs because the in-plant representative is employed by the customer.
   **Answer:** b
   **Reference:** JIT II
   **Difficulty:** Moderate
   **Keywords:** supplier, JIT II

60. In a JIT II system:
   a. the in-plant representative replaces the buyer, salesperson, and sometimes the materials planner.
   b. the customer need not have close interaction with the supplier.
   c. the customer is brought into the plant as an active member of the purchasing department of the supplier.
   d. the sales effort of the supplier increases, but the cost of materials to the customer decreases.
   **Answer:** a
   **Reference:** JIT II
   **Difficulty:** Moderate
   **Keywords:** JIT II, plant, representative

61. Management at Pepman has decided to switch from a push system to a pull system of manufacturing. They are a large repetitive manufacturer of bicycles. Which one of the following is most likely to occur?
   a. The cycle time will increase, resulting in higher inventory levels.
   b. The space required will increase due to the increase in the number of units that require rework.
   c. The decrease in WIP inventory levels will reduce the space requirements.
   d. The workers at any given process will produce units before they are needed by the subsequent process.
   **Answer:** c
   **Reference:** Operational Benefits and Implementation Issues
   **Difficulty:** Moderate
   **Keywords:** WIP, inventory, push, pull
62. The final assembly schedule in a lean system:
   a. should be developed for each product independent of the process requirements for the other products.
   b. strives to create a uniform flow at the work centers in the plant.
   c. avoids the use of small lot sizes because they create many production orders and cause confusion.
   d. allows daily changes in demand levels, regardless of size, to be incorporated immediately into the work center schedules.
   **Answer:** b
   **Reference:** Operational Benefits and Implementation Issues
   **Difficulty:** Moderate
   **Keywords:** assembly, schedule, flow, lean, system

63. Which one of the following is an advantage of lean systems?
   a. Lean systems reduce equipment needs by using larger lot sizes.
   b. Lean systems can be implemented in any production environment.
   c. Lean systems result in a decrease in safety stock and work-in-process inventory.
   d. Lean systems result in an increase in manufacturing lead times.
   **Answer:** c
   **Reference:** Operational Benefits and Implementation Issues
   **Difficulty:** Moderate
   **Keywords:** JIT, just, time, WIP, inventory, safety, lean, system

64. Implementing a lean system:
   a. has the advantage that workers have less stress because of the routine, repetitive work they perform.
   b. typically relieves the workers and first-line supervisors from activities such as scheduling, expediting, and productivity improvements.
   c. requires an examination of the reward system to make sure it is consistent with the JIT philosophy.
   d. involves the reorganization of material flows to that of a flexible flow.
   **Answer:** c
   **Reference:** Operational Benefits and Implementation Issues
   **Difficulty:** Moderate
   **Keywords:** JIT, just, time, reward, lean, system
65. Which of the following is a process consideration in the implementation of a lean system?
   a. Firms might have to change existing layouts.
   b. Workstations typically will be moved farther apart.
   c. A contract with strict job classifications will be adopted.
   d. Plant access by rail will be necessary.
   **Answer:** a
   **Reference:** Operational Benefits and Implementation Issues
   **Difficulty:** Moderate
   **Keywords:** implementation, lean, layout

66. Which of the following is NOT a typical concern for inventory and scheduling when implementing a lean system?
   a. Frequent, small shipment must be arranged with suppliers.
   b. Changeover times must be reduced.
   c. Production schedules must be stabilized.
   d. Companies can increase setup times because deliveries are frequent.
   **Answer:** d
   **Reference:** Operational Benefits and Implementation Issues
   **Difficulty:** Moderate
   **Keywords:** implementation, lean, setup

67. Which of the following is NOT a typical concern for the organization when implementing a lean system?
   a. Workers usually feel as if they have gained autonomy.
   b. Workers can feel increased stress and pressure due to specified cycle times.
   c. Organizational relationships must be reoriented to build close cooperation and trust.
   d. The reward system might require tweaking.
   **Answer:** a
   **Reference:** Operational Benefits and Implementation Issues
   **Difficulty:** Moderate
   **Keywords:** implementation, lean, worker, autonomy

68. When implementing a lean system:
   a. managers can mitigate some of the effects of worker stress by judiciously using safety stocks and emphasizing material flows rather than worker pace.
   b. management should base the reward system on production volume.
   c. the plant layout is the only environmental characteristic that need not be analyzed.
   d. it is critical to develop a master production schedule that changes frequently as forecasts change.
   **Answer:** a
   **Reference:** Operational Benefits and Implementation Issues
   **Difficulty:** Moderate
   **Keywords:** JIT, just, time, inventory, safety, stock, lean, system
FILL IN THE BLANK

69. ____________ are operating systems that maximize the value added of each of their activities by paring unnecessary resources and delays from them.
   Answer: Lean systems
   Reference: Introduction
   Difficulty: Easy
   Keywords: lean, value, added

70. ____________ is the philosophy that waste can be eliminated by cutting unnecessary inventory and removing non-value-adding activities in operations.
   Answer: Just-in-time, JIT
   Reference: Introduction
   Difficulty: Easy
   Keywords: JIT, just, time, value, added, inventory

71. The ____________ method produces the item in advance of customer need.
   Answer: push
   Reference: Characteristics of Lean Systems for Services and Manufacturing
   Difficulty: Moderate
   Keywords: push, production, pull

72. A(n) ____________ is a group of activities needed to readjust a process between successive lots of items.
   Answer: setup or changeover
   Reference: Characteristics of Lean Systems for Services and Manufacturing
   Difficulty: Moderate
   Keywords: setup, changeover, lots

73. ____________ refers to the goal of having a setup time of fewer than 10 minutes.
   Answer: Single-digit setup
   Reference: Characteristics of Lean Systems for Services and Manufacturing
   Difficulty: Moderate
   Keywords: setup, single, digit

74. A(n) ____________ assembly line produces a mix of models in smaller lots.
   Answer: mixed-model
   Reference: Characteristics of Lean Systems for Services and Manufacturing
   Difficulty: Moderate
   Keywords: mixed, model, lot

75. A(n) ____________ is a card used to control the flow of production through a factory.
   Answer: kanban
   Reference: The Kanban System
   Difficulty: Easy
   Keywords: kanban, card, signal
76. In a(n) __________ system, an empty bin signals a need to fill it.
   Answer: container
   Reference: The Kanban System
   Difficulty: moderate
   Keywords: container, kanban, bin

77. A supplier is brought into the plant to be an active member of the purchasing office of the customer in a(n) ____________ system.
   Answer: JIT II
   Reference: JIT II
   Difficulty: Easy
   Keywords: supplier, customer, JIT II, just, time

78. If the inventory advantages of a lean system are to be realized, small lot sizes must be used; in order to use small lot sizes, manufacturers must significantly reduce ) ____________ .
   Answer: setup times
   Reference: Operational Benefits and Implementation Issues
   Difficulty: moderate
   Keywords: setup, time, lot, size, lean, system

**SHORT ANSWERS**

79. What are the four underlying principles of the Toyota Production System?
   Answer: The four underlying principles are: (1) all work must be completely specified as to content, sequence, timing and outcome; (2) every customer–supplier connection must be direct, unambiguously specifying the people involved, the form and quantity of goods and services, the way requests are made by customers, and the expected time in which the requests will be met; (3) the pathway for every product and service must be simple and direct; and (4) any improvement to the system must be made in accordance with the scientific method, under the guidance of a teacher, and at the lowest possible level.
   Reference: Introduction
   Difficulty: Moderate
   Keywords: TPS, Toyota, production, system

80. What is the difference between the “push” and “pull” methods of material flow? Which does lean systems use?
   Answer: With the pull method, customer demand (an order) activates the production of the goods or services. The production system does not anticipate the need for more product. The push method begins with a production schedule and customer demand is assumed (or hoped for). Lean system processes use the pull method of production.
   Reference: Characteristics of Lean Systems for Services and Manufacturing
   Difficulty: Moderate
   Keywords: push, pull, production, lean, system

81. With respect to lean systems, what is the advantage of standardized components?
   Answer: Standardization tends to increase the repeatability of tasks, which enables a higher degree of efficiency in production.
   Reference: Characteristics of Lean Systems for Services and Manufacturing
   Difficulty: Moderate
82. Explain how a line-flow strategy can be used to reduce or eliminate setups.
   **Answer:** Line flows can reduce setups, especially if used with group technology, or if the volume is high enough, a product layout can be used eliminating setup entirely. Another tactic, the one-worker–multiple–machines (OWMM) approach, also can be used to reduce or eliminate setups.
   **Reference:** Characteristics of Lean Systems for Services and Manufacturing
   **Difficulty:** Moderate
   **Keywords:** line, flow, strategy

83. Discuss the impact of alpha, the policy variable, on the total amount of inventory in the system. If alpha is set equal to zero, is system inventory zero? What would be required to achieve a system-wide inventory of zero?
   **Answer:** The policy variable alpha adds safety stock to cover for unexpected circumstances, for example, a quality issue or delays in supply. Even if alpha is zero, there is still inventory in the system as dictated by the average demand during lead time as calculated by the daily demand for parts multiplied by the sum of the average container travel time plus the average container process time. One unappealing way for system-wide inventory of zero would be for demand to drop to zero. Another way for system-wide inventory to be zero would be for a manufacturer to have infinite capacity and processing (work and replenishment) times equal to zero. Such capacity and speed would be prohibitively expensive for processing tangible goods.
   **Reference:** The Kanban System
   **Difficulty:** Moderate
   **Keywords:** kanban, system

84. Choose a simple, common process and create a value stream map containing the current state, plus a realistic future state, and implementation plan.
   **Answer:** Answers will vary.
   **Reference:** Value Stream Mapping
   **Difficulty:** Moderate
   **Keywords:** VSM, value, stream, mapping, current, future, state, implementation

85. How does JIT II differ in practice from JIT?
   **Answer:** JIT II incorporates an in-plant representative of the supplier. This person has the authority to issue purchase orders, work with the customer’s product design engineers, and coordinate schedules of the supplier and other subcontractors.
   **Reference:** JIT II
   **Difficulty:** Moderate
   **Keywords:** JIT, JIT II, just, time

86. What are the organizational issues companies must address before implementing a lean system?
   **Answer:** The organizational issues faced by companies include the human cost of lean systems (tends to create stress in worker), cooperation and trust (change activities of workers and the relationships between them), and changing reward systems and labor classification.
   **Reference:** Operational Benefits and Implementation Issues
   **Difficulty:** Moderate
   **Keywords:** JIT, just, time, implementation, lean, system
Chapter 9  Lean Systems

PROBLEMS

87. A company uses a kanban system. The daily demand for part A is 100 units. The average waiting time for a container of parts is 0.2 day. The processing time for a container of part A is 0.1 day, and a container holds 5 units. If the company wishes to use a 10% policy variable, how many containers are needed?

Answer:

\[ k = \frac{d(w + p)(1 + \alpha)}{c} = \frac{100(0.2 + 1)(1 + 0.1)}{5} = 6.6 \rightarrow 7 \text{ containers} \]

Reference: The Kanban System
Difficulty: Moderate
Keywords: container, kanban

88. A company uses a kanban system. The daily demand for the most critical part, the smylie, is 400 units over an eight-hour production period. The average waiting time for a container of smylies is 30 minutes. The processing time for a bin filled with smylies is 6 minutes, and a container holds 5 units. If the company wishes to use a 5% policy variable, how many containers are needed?

Answer:

\[ k = \frac{d(w + p)(1 + \alpha)}{c} = \frac{400(0.0625 + 0.0125)(1 + 0.05)}{5} = 6.3 \rightarrow 7 \text{ containers} \]

Reference: The Kanban System
Difficulty: Moderate
Keywords: container, kanban

89. A company uses a kanban system. The daily demand for part A is 300 units. The average waiting time for a container of parts is 0.25 day. The processing time for a container of part A is 0.1 day, and a container holds 10 units. If the company wishes to use a 10% policy variable, how many containers are needed?

Answer:

\[ k = \frac{d(w + p)(1 + \alpha)}{c} = \frac{300(0.25 + 0.1)(1 + 0.05)}{10} = 11.025 \rightarrow 12 \text{ containers} \]

Reference: The Kanban System
Difficulty: Moderate
Keywords: container, kanban