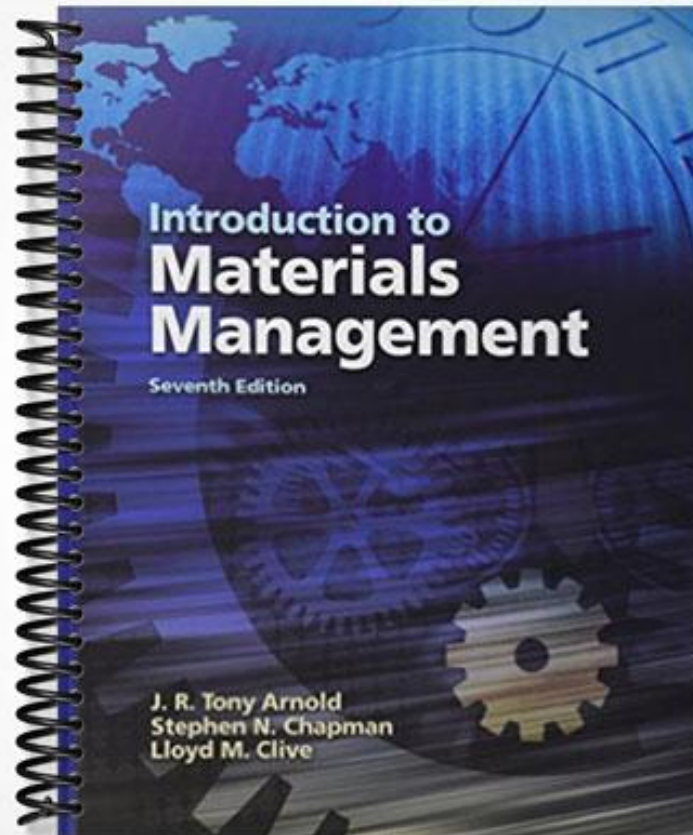


SOLUTIONS MANUAL



Introduction to Materials Management

Seventh Edition

J. R. Tony Arnold
Stephen N. Chapman
Lloyd M. Clive

 This work is protected by
US copyright laws and is for
instructors' use only.

**Online Instructor's Manual
to accompany**

Introduction to Materials Management

Seventh Edition

**Tony Arnold
Steve Chapman
Lloyd Clive**



Upper Saddle River, New Jersey
Columbus, Ohio



This work is protected by United States copyright laws and is provided solely for the use of instructors in teaching their courses and assessing student learning. Dissemination or sale of any part of this work (including on the World Wide Web) will destroy the integrity of the work and is not permitted. The work and materials from it should never be made available to students except by instructors using the accompanying text in their classes. All recipients of this work are expected to abide by these restrictions and to honor the intended pedagogical purposes and the needs of other instructors who rely on these materials.

Copyright © 2012 by Pearson Education, Inc., Upper Saddle River, New Jersey 07458. All rights reserved. Printed in the United States of America. This publication is protected by Copyright and permission should be obtained from the publisher prior to any prohibited reproduction, storage in a retrieval system, or transmission in any form or by any means, electronic, mechanical, photocopying, recording, or likewise. For information regarding permission(s), write to: Rights and Permissions Department.

Instructors of classes using Arnold, Chapman, and Clive's *Introduction to Materials Management, Seventh Edition*, may reproduce material from the instructor's manual for classroom use.



10 9 8 7 6 5 4 3 2 1

ISBN-13: 978-0-13-137671-7
ISBN-10: 0-13-137671-3

CONTENTS

Chapter 1: Introduction to Materials Management.....	1
Chapter 2: Production Planning System	9
Chapter 3: Master Scheduling.....	21
Chapter 4: Material Requirements Planning.....	31
Chapter 5: Capacity Management.....	57
Chapter 6: Production Activity Control.....	65
Chapter 7: Purchasing.....	83
Chapter 8: Forecasting.....	87
Chapter 9: Inventory Fundamentals.....	112
Chapter 10: Order Quantities.....	123
Chapter 11: Independent Demand Ordering Systems.....	136
Chapter 12: Physical Inventory and Warehouse Management.....	170
Chapter 13: Physical Distribution.....	181
Chapter 14: Products and Processes	192
Chapter 15: Lean Production	202
Chapter 16: Total Quality Management	210

INTRODUCTION TO MATERIALS MANAGEMENT

CHAPTER 1

ANSWERS TO PROBLEMS

1.1	Sales	100%		100%
	Cost of manufacturing	60%	50%	
	Other costs	<u>30%</u>	<u>90%</u>	<u>30%</u>
	Profit (percent of Sales)	10%		20%

Therefore a 10% reduction in the cost of manufacturing would produce a 100% increase in profit.

1.2 Profit = Sales – (direct costs + overhead)
 0.20 = Sales – (0.60 × Sales + 0.30)
 Sales = $\frac{0.5}{0.4} = 1.25 = 125\%$

To increase profits from 10% to 20% takes a 25% increase in sales but only a 10% decrease in costs. Good materials management can have a direct impact on profit. Note the cost of overhead has been left unchanged in this problem.

1.3 a. Weekly cost of goods sold = $\frac{\$15,000,000}{50} = \$300,000$
 Value of 10 weeks' WIP = $10 \times \$300,000 = \$3,000,000$
 b. Value of 7 weeks' WIP = $7 \times \$300,000 = \$2,100,000$
 Reduction in WIP = $\$900,000$
 Annual saving = $20\% \times \$900,000 = \$180,000$

1.4 a. Weekly cost of goods sold = $\frac{\$40,000,000}{50} = \$800,000$
 Value of 12 weeks' WIP = $12 \times \$800,000 = \$9,600,000$
 b. Value of 5 weeks' WIP = $5 \times \$800,000 = \$4,000,000$
 Reduction in WIP = $\$5,600,000$
 Annual saving = $20\% \times \$5,600,000 = \$1,120,000$

1.5 Using \$1 million as the units:

			<u>As a % of sales</u>	
Sales		\$10.0		100%
Direct material	\$3.5		35%	
Direct labor	2.5		25%	
Overhead	<u>3.5</u>	<u>9.5</u>	<u>35%</u>	<u>95%</u>
Profit		\$.5		5%

a. From the above we can say: (in millions or M\$)

$$\begin{aligned} \text{Sales} &= \text{direct material} + \text{direct labor} + \text{overhead} + \text{profit (now 1M\$)} \\ &= .35(\text{sales}) + .25(\text{sales}) + 3.5 \text{ M\$} + 1.0 \text{ M\$} \\ .40 (\text{Sales}) &= 4.5 \text{ M\$} \end{aligned}$$

$$\text{Sales} = 11.25 \text{ M\$} = 11.25 \times \$1,000,000 = \$11,250,000$$

Therefore there must be a \$1.25 million increase in sales.

b. To increase profit by \$500,000 there must be a \$500,000 reduction in cost. Therefore direct material must be reduced by \$500,000. It therefore takes 2 ½ times the sales dollars to obtain the profit that would be realized in material reductions.

c. As for b. Direct labor would have to be reduced by \$500,000.

MULTIPLE CHOICE QUESTIONS

1. Select the best answer to the following:
 - a. traditionally the supply-production-distribution functions have reported to different departments
 - b. the supply, production and distribution functions are part of a total system
 - c. materials flow into an organization, are processed in some way and distributed to the consumer
 - d. all the above are correct
 - e. none of the above is correct

2. Manufacturing is important to the economy because:
 - a. it generates wealth
 - b. it supports service industries
 - c. it adds value to products
 - d. all of the above
 - e. none of the above

3. Which of the following is the best statement about the operating environment in which operations management functions?
 - a. most organizations do not need to worry about competition
 - b. customers are more demanding
 - c. government regulation is not important for companies
 - d. price is more important than quality
 - e. none of the above is true

4. Which of the following statements is best regarding order winners?
 - a. they persuade a company's customers to choose its product
 - b. they are the same in every market
 - c. they are the same as order qualifiers, only better
 - d. they are present in every product
 - e. all the above are true

5. Which of the following strategies has the shortest delivery lead time and the least customer input?
 - a. engineer-to-order
 - b. make-to-order
 - c. assemble-to-order
 - d. make-to-stock

6. Which of the following statements is best?
 - a. the supply chain includes all activities and processes to provide a product or service to a customer.
 - b. material in the supply chain usually flows from producer to customer.
 - c. the supply chain contains only one supplier.
 - d. all of the above are true.
 - e. a and b only are true.

7. Companies A and B supply company C, which supplies customers D and E. Which of the following statements is best?
 - a. the supply chain for company A includes B, C, D, and E.
 - b. the supply chain for company B includes A, C, D and E.
 - c. the supply chain for company C includes A, B, D, and E.
 - d. all the above are true.

8. Which of the following statements is best?
 - a. the basic elements of a supply chain are supply, production, and distribution
 - b. the elements of a supply chain are interdependent
 - c. design information generally flows from customer to supplier
 - d. all the above are true

9. Which of the following is the best statement about the environment in which operations management functions?
 - a. most organizations do not need to worry about competition
 - b. world-wide competition is not significant for most companies
 - c. government regulation is not important for companies
 - d. customers are more demanding
 - e. none of the above is true

10. If a firm wishes to maximize profit, which of the following objectives are in conflict?
 - I. Maximize customer service.
 - II. Minimize production costs.
 - III. Minimize inventory costs.
 - IV. Minimize distribution costs.
 - a. all the above
 - b. none of the above
 - c. I and II only
 - d. I and III only
 - e. II and III only

11. Which of the following statements is best?
- I. The conflict between marketing, finance and production centers on customer service, disruption to production, and inventory levels.
 - II. Marketing's objectives can be met with higher inventories.
 - III. Finance's objectives can be met with higher inventories.
 - IV. Production's objectives can be met with higher inventories.
- a. all of the above are true
 - b. I and II only are true
 - c. I, II and III only are true
 - d. I, II and IV only are true
 - e. II, III and IV only are true
12. Which of the following is normally a major activity of materials management?
- I. Manufacturing planning and control.
 - II. Physical supply/distribution.
- a. both I and II
 - b. neither I nor II
 - c. I only
 - d. II only
13. The objective of materials management is to:
- I. Provide the required level of customer service.
 - II. Maximize the use of the firm's resources.
- a. I only
 - b. II only
 - c. I and II
 - d. neither I nor II
14. Which of the following is/are primary activities of manufacturing planning and control?
- I. Production planning.
 - II. Implementation and control.
 - III. Inventory management.
- a. I and II only
 - b. II and III only
 - c. I and III only
 - d. all the above are primary activities
15. Which of the following is (are) input(s) to manufacturing planning and control?
- a. product description
 - b. process description
 - c. available facilities
 - d. quantities to be produced
 - e. all the above are inputs

16. Which of the following is NOT an activity of physical supply/distribution?
- transportation
 - factory inventory
 - warehousing
 - packaging
 - materials handling
17. Materials management can be considered a balancing act because:
- There are trade-offs between customer service and the cost of providing the service.
 - Priority and capacity must be balanced.
- neither I nor II
 - I only
 - II only
 - I and II
18. If the cost of manufacturing (direct labor and materials) is 50% of sales and profit is 15% of sales, what would the profit percentage be if the direct costs of manufacturing was reduced from 50% to 47%?
- 3%
 - 6%
 - 12%
 - 15%
 - 18%
19. Which of the following are generally considered overall objectives of an organization?
- Providing good customer service.
 - Maintaining low levels of inventory investment.
 - Optimizing use of resources.
 - Providing sufficient return on investment.
- I and II only
 - I, II and III only
 - I, III and IV only
 - all the above

20. The purpose of the materials management concept is:
- I. To manage materials in a production operation.
 - II. To have purchasing support the needs of production.
 - III. To have production support the needs of purchasing.
 - a. II and III only
 - b. I and II only
 - c. I, II and III
 - d. I and III only
21. Making a pizza at a fast-food restaurant would be considered a form of:
- a. Engineer to order
 - b. Assemble to order
 - c. Make to stock
 - d. Make to order
 - e. None of the above
22. Metrics in a supply chain are:
- a. Governed by the International Metric Commission
 - b. Measurements of performance
 - c. A charge passed on to customers
 - d. Not used on transportation
 - e. Do not apply to the supply chain
23. Performance measures in a supply:
- a. Should be objective
 - b. Are viewed mostly by finance
 - c. Must be measurements of one parameter only
 - d. Concentrate on cost only
 - e. Are not used once a process is automated
24. Which statement is best?
- a. Performance standards are set by the supplier
 - b. Performance standards set the goal
 - c. Performance measurements show how well you did
 - d. Both b and c are correct
 - e. None of the above applies to the supply chain
25. Savings in the supply chain mostly are the result of:
- a. Members in the chain sharing information
 - b. Being able to ship in larger quantities
 - c. Members having clout with suppliers
 - d. Sticking with local competition
 - e. Cutting cost after the design phase
26. Postponement is best described as:
- a. Delaying payment to a supplier until the goods have been sold

- b. Delaying the removal of inventory until the last possible moment
 - c. Reducing inventory from RM when the parent item is produced
 - d. Changing the BOM after the old components have been used up
27. Postponement is best used with items that:
- a. Have a long lead time and many product configurations
 - b. Are standardized and have short lead times
 - c. Experience a yield that you won't know until the product is complete
 - d. Suppliers with poor delivery performance
28. A channel master in a supply chain
- a. Initiates integration of a supply chain
 - b. Is the final customer in a supply chain
 - c. Is the largest member of a supply chain
 - d. Controls the raw material supplies in a supply chain
29. The term that describes eliminating waste throughout a company is:
- a. Kaizen
 - b. Lean Production
 - c. Theory of Constraints
 - d. Process Control
30. If the manufacturing lead time of an item is reduced by 50% the work in process inventory:
- a. Does not change
 - b. Is reduced by approximately 70%
 - c. Is reduced by approximately 50%
 - d. More information is needed for this problem

Answers.

- | | | | | | | | | |
|------|------|------|------|------|------|------|------|------|
| 1 d | 2 d | 3 b | 4 a | 5 d | 6 e | 7 c | 8 d | 9 e |
| 10 a | 11 d | 12 a | 13 c | 14 d | 15 e | 16 b | 17 d | 18 e |
| 19 d | 20 b | 21 b | 22 b | 23 a | 24 d | 25 a | 26 c | 27 b |
| 28 a | 29 b | 30 c | | | | | | |

PRODUCTION PLANNING SYSTEM
CHAPTER 2

ANSWERS TO PROBLEMS

2.1 Ending inventory = opening inventory + production – demand
= 400 + 700 – 900 = 200 units

2.2 Total working days = 19 + 20 + 21 = 60
Average daily production = 500 ÷ 60 = 8.3 units

2.3 Total working days = 22 + 21 + 20 = 63
Average daily production = 25,000 ÷ 63 = 396.8 units

2.4 Month 1 production = 19 × 8.3 = 157.7 units
Month 2 production = 20 × 8.3 = 166 units
Month 3 production = 21 × 8.3 = 1174.3 units

2.5 Month 1 production = 22 × 396.8 = 8729.6 units
Month 2 production = 21 × 396.8 = 8332.8 units
Month 3 production = 20 × 396.8 = 7936 units

2.6

Period		1	2	3	4	5	6
Forecast		750	700	1050	1600	1000	850
Planned production		1000	1000	1000	1000	1000	1000
Planned inventory	600	850	1150	1100	500	500	650

2.7

Period		1	2	3	4	5	6	Total
Forecast demand		100	120	125	130	115	110	700
Planned production		125	125	125	125	125	125	750
Planned inventory	100	125	130	130	125	135	150	

Total production = 700 + 100 – 150 = 750 units
Period production = 750 ÷ 6 = 125 units

2.8

Period		1	2	3	4	5	6	Total
Forecast demand		1300	1200	800	600	800	900	5600
Planned production		892	892	892	892	892	892	5500
Planned inventory	450	42	-266	-174	118	210	202	

$$\text{Total production} = 5600 + 200 - 450 = 5350 \text{ units}$$

$$\text{Period production} = 5350 \div 6 = 892 \text{ units}$$

2.9

Period		1	2	3	4	Total
Forecast demand		9	5	9	9	32
Planned production		8	8	8	8	32
Planned inventory	0	-1	2	1	0	

- a. 8 units
- b. period 1, minus 1
- c. 9 units, ending inventory = 4 units

2.10 a. There is a stockout of 1 unit in period one.

The cost will be:

$$\text{Stockout cost: } 1 \times \$500 = \$500$$

$$\text{Carrying cost: } 3 \times \$50 = \underline{150}$$

$$\text{Total cost:} = \$650$$

- c. Total period inventory = $0 + 5 + 3 + 4 = 12$ units

$$\text{The cost will be} = \$50 \times 12 = \$600$$

Since there are no stockouts this will be the total cost of the plan.

- 2.11 a. Total production = $530 + 130 - 100 = 560$
 b. Daily production = $560/70 = 8$ units
 c. The monthly production for May = 168 units
 d. The ending inventory for May = 153 units

Month	May	Jun	Jul	Aug	Total
Working days	21	19	20	10	70
Forecast demand	115	125	140	150	530
Planned production	168	152	160	80	560
Planned inventory	100	153	180	200	130

2.12

Month	Jan	Feb	Mar	Apr	May	Jun	Total
Working days	20	22	20	20	18	19	119
Forecast demand	1300	1200	800	700	700	900	5600
Planned production	874	961	874	874	787	830	5200
Planned inventory	500	74	-165	-91	83	170	100

Total production = $5600 + 100 - 500 = 5200$

Daily production = $5200 \div 119 = 43.7$ units per day

There will be a stockout of 165 units in February and 91 units in March.

2.13 Total production = $300 + 1080 - 200 = 1180$ units
 Number of weeks available for production = 5.5
 Average weekly level production = $\frac{1180}{5.5} = 214.5$ units

The nearest quantity that can be produced is 200 units on two shifts. In the second week there is a shutdown so production in that week that will be only 100 units.

Total production so far = $5 \times 200 + 100 = 1100$ units

The balance of 80 units can be made in week four when extra help is available.

Opening inventory = 200 units

Week		1	2	3	4	5	6	Total
Forecast demand		120	160	240	240	160	160	1080
Planned production		200	100	200	280	200	200	1180
Planned inventory	200	280	220	180	220	260	300	

2.14 Ending backlog = demand + opening backlog – production
 = $700 + 500 - 800 = 400$ units

2.15 Total production = demand + opening backlog – ending backlog
 = $3800 + 900 - 200 = 4500$ units
 Weekly production = $4500 \div 6 = 750$ units

Week		1	2	3	4	5	6	Total
Forecast demand		750	700	550	700	600	500	3800
Planned production		750	750	750	750	750	750	4500
Planned backlog	800	800	750	550	500	350	100	

2.16 Desired ending backlog = 1200

Note: All weekly production amounts determined using standard rounding rules.

$$\begin{aligned} \text{Total production} &= \text{demand} + \text{opening backlog} - \text{ending backlog} \\ &= 6800 + 1100 - 1200 = 6700 \text{ units} \\ \text{Weekly production} &= 6700 \div 6 = 1117 \text{ units} \end{aligned}$$

Week	1	2	3	4	5	6	Total
Forecast demand	1200	1100	1200	1200	1100	1000	7300
Planned production	1117	1117	1117	1117	1117	1117	7200
Planned backlog	1100	1183	1166	1249	1332	1315	1198

2.17 Total production = 112,500 + 9000 – 11,250 = 110,250 units

Daily production = 110,000 ÷ 75 = 1470 units

Number of workers required = 1470/15 = 98

Actual daily production = 98 × 15 = 1470 units

Month	1	2	3	4	Total
Working days	20	24	12	19	75
Forecast demand	28000	27500	28500	28500	112500
Planned production	29400	35280	17640	27930	110250
Planned inventory	11250	12650	20430	9750	9180

2.18 Total production = 17900 + 800 - 1000 = 17700
 Daily production = 17700/117 = 151.28 units
 Number of workers required = 151.28/9 = 16.81 → 17 workers
 Actual daily production = 17 × 9 = 153 units

Month		1	2	3	4	5	6	Total
Working days		20	24	12	22	20	19	117
Forecast demand		2800	3000	2700	3300	2900	3200	17900
Planned production		3060	3672	1836	3366	3060	2907	17901
Planned inventory	1000	1260	1932	1068	1134	1294	1001	

It is not possible to meet the ending inventory target because of the extra fraction of a worker needed. The only way to do it would be to reduce the number of workers to 16 at some point.

MULTIPLE CHOICE QUESTIONS

1. The ability of manufacturing to produce goods and services is called:
 - a. scheduling
 - b. production planning
 - c. capacity
 - d. routing
 - e. none of the above

2. Priority in production planning relates to:
 - a. what should come first
 - b. how much of what is needed and when
 - c. capacity
 - d. an objective of the firm
 - e. none of the above

3. Which of the following is an input to the production plan?
 - a. strategic business plan
 - b. financial plan
 - c. market plan
 - d. engineering plan
 - e. all of the above are inputs

4. Which of the following plans has the longest planning horizon and the least level of detail?
 - a. strategic business plan
 - b. production plan
 - c. master production schedule
 - d. all of the above have the same level of detail
 - e. none of the above

5. In terms of INCREASING level of detail, which is the best sequence of activities?
 - I. Material requirements planning.
 - II. Master production scheduling.
 - III. Production planning.
 - a. I, II and III
 - b. I, III, and II
 - c. II, III, and I
 - d. II, I, and III
 - e. III, II, and I

6. Over the time span of the production plan, which of the following can usually be varied to change capacity?
 - a. work force
 - b. inventories
 - c. plant and equipment
 - d. all of the above
 - e. a and b above

7. Which of the following is a characteristic of a production plan?
 - a. time horizons are five years
 - b. the production plan is for individual items
 - c. the only objective is to have an efficient plant
 - d. all of the above are characteristics of a production plan
 - e. none of the above is characteristic of a production plan

8. Determining the need for labor, machines, physical resources to meet the production objectives of the firm is called:
 - a. production control
 - b. production planning
 - c. capacity planning
 - d. all of the above
 - e. none of the above

9. The function of setting the limits or levels of manufacturing operations based on the market plan and resource availability is called:
 - a. production planning
 - b. production activity level
 - c. capacity planning
 - d. all of the above
 - e. none of the above

10. A statement of a schedule of requirements for individual end items is called:
 - a. a master production schedule
 - b. a material requirements plan
 - c. a production plan
 - d. a capacity plan
 - e. none of the above

11. Which of the following statements is most appropriate regarding production planning?
 - a. a high level of detail is not needed
 - b. a translation must be made from product demand to capacity demand
 - c. product groups based on similarity of manufacturing process should be used in planning
 - d. all of the above are true
 - e. none of the above is true

12. Which of the following statements is best about sales and operations planning?
- it provides an means of updating the material requirements plan
 - it includes only the marketing and production plans
 - it is usually updated on a monthly basis
 - it has no effect on inventory levels
13. Which of the following are characteristics of an MRPII system?
- It incorporates the plans of marketing, production and finance.
 - It is a fully integrated planning and control system.
 - It has feedback from the bottom up.
- I only
 - II only
 - III only
 - I, II and III
14. For the purposes of production planning, product groups should be established on the basis of:
- market segments
 - similarity of manufacturing process
 - the availability of materials
 - the availability of machinery
 - all of the above
15. Which of the following is a basic strategy in developing a production plan?
- hybrid strategy
 - production leveling
 - chase strategy
 - a and b above
 - b and c above
16. A production planning strategy which turns away extra demand is called:
- production leveling
 - demand matching
 - hybrid strategy
 - all of the above
 - none of the above
17. Which basic production planning strategy will build inventory and avoid the costs of excess capacity?
- demand matching (chase)
 - production leveling
 - subcontracting
 - all the above
 - none of the above

18. Which basic production planning strategy avoids hiring and layoff costs and the costs of excess capacity?
- demand matching
 - operation smoothing
 - subcontracting
 - all the above
 - none of the above
19. If the opening inventory is 100 units, the sales are 500 units and the ending inventory is 200 units, then manufacturing must produce:
- 300 units
 - 400 units
 - 500 units
 - 600 units
 - none of the above
20. Over a 10-week period the cumulative sales are forecast at 10,000 units, the opening inventory is 200 units and the closing inventory is to be 100 units. What should be the weekly planned production for level production?
- 990
 - 1000
 - 1010
 - 1030
 - none of the above
21. Firms will generally make-to-stock when:
- demand is unpredictable
 - there are many product options
 - delivery lead times are long
 - all of the above
 - none of the above
22. Firms will generally make-to-order when:
- products are produced to customer specifications
 - there are many product options
 - product is expensive to make and store
 - all of the above
 - none of the above

23. Which of the following information is needed to develop a make-to-stock production plan?
- I. Forecast by time period for the production plan.
 - II. Opening inventory.
 - III. Opening backlog of customer orders.
 - IV. Desired ending inventory.
- a. I, II and III
 - b. I, II and IV
 - c. I, III and IV
 - d. II, III and IV
 - e. none of the above
24. If the old backlog was 200 units, the forecast for the next period is 500 units, and production for the next period is 600 units, what will be the backlog at the end of the next period?
- a. 100 units
 - b. 200 units
 - c. 300 units
 - d. 700 units
 - e. 800 units
25. _____ is concerned with long-term planning of manufacturing activity:
- a. Sales and operations planning
 - b. Master production scheduling
 - c. MRP
 - d. Production activity control
 - e. Master planning
26. Which of the following is NOT a rule of Sales and Operations Planning?
- a. Product Groups need not be decided
 - b. Planning units of measure need to be decided
 - c. A planning horizon must include new product development time
 - d. Performance review periods to be compared should be decided
27. Which of the following is a complete closed loop planning system that develops plans for all materials and operations?
- a. Capacity requirements planning
 - b. Enterprise resource planning
 - c. Supply chain management
 - d. Material requirements planning

Answers.

1 c	2 b	3 e	4 a	5 e	6 e	7 e	8 c	9 a
10 a	11 d	12 c	13 d	14 b	15 e	16 e	17 b	18 c
19 d	20 a	21 e	22 d	23 b	24 a	25 a	26 a	27 b