



STUDY GUIDE

REGISTERED WATERPROOFING CONSULTANT EXAM

Prepared By

RWC Examination Development Committee

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RWC STUDY GUIDE

TABLE OF CONTENTS

<u>ITEM</u>	<u>PAGE</u>
INTRODUCTION	1
PART I	2
PART 2	5
PART 1: SAMPLE QUESTIONS	7
STUDY REVIEW	17
ANSWERS.....	18



STUDY GUIDE RWC EXAMINATION RCI, Inc.

INTRODUCTION

One early goal of RCI, Inc. was to develop a nationally recognized registration program. The Registered Waterproofing Consultant Program was developed in 2004. RCI is working toward national recognition of its Registration Program and hopes to achieve this goal in the future. The primary beneficiaries of this Registration Program will be the public, the waterproofing industry, and those individuals who become registered.

Registration is a two-part program based on verifiable minimum levels of education, training, experience, and satisfactory performance on a comprehensive written examination.

The application for registration allows RCI to verify certain aspects of your education and waterproofing experience. The written examination confirms minimum levels of education, training, and experience by testing your knowledge of below grade, plaza deck and green roof waterproofing and your ability to use this knowledge in practical applications.

This Study Guide outlines subjects that are addressed in the written examination; however, the Study Guide is not intended to be an inclusive listing of every topic addressed on the examination. This document is strictly a guide. However, when making purchases, RCI recommends that all applicants purchase the most recent version of all reference books.

Please understand that the examination is not tailored to any one particular area of below grade waterproofing or to the design and construction practices unique to your geographic area. The examination deals with waterproofing consulting in general as indicated by the references listed on the next page. It may include all phases of waterproofing consulting such as: evaluation, design, testing, construction, and all waterproofing systems.

In order to receive a passing score on the examination you must be thoroughly familiar with a broad spectrum of principles related to below grade, plaza deck and green roof waterproofing system design, testing and construction. This spectrum of knowledge includes waterproofing design parameters, specification development, project management, project administration, life cycle costing, conflict resolution, contracts and contract documents, construction materials, testing, and report preparation. Education and training in these areas are extremely important. However, practical application under the guidance of a qualified mentor may be even more important because it reinforces the formal education and training and provides a sound foundation over a broad spectrum. It pulls everything together. The weakness most often identified with exam failure is a narrow focus in the industry.

The registration examination is offered several times each year. The dates and locations can be obtained from RCI Headquarters or from the RCI website (rci-online.org). The examination is eight hours in length and consists of two parts; one three hour segment and one five hour segment.

The examination has a closed book format. Any required formulas, charts, or tables will be provided with the examination.

Each part of the examination carries equal weight and a passing score must be attained for each part. A standard psychometric process was used to determine that 218 points (300 maximum) are required to pass Part 1 and 272 points (400 maximum) are required for Part 2. Passing one part of the exam and failing another part of the exam requires only that the applicant retake the part for which a passing score was not attained.

PART 1

Part 1 of the examination consists of approximately 300 multiple choice questions.

Questions for Part 1 have been prepared based on the following documents:

1. 2000 International Building Code 1802.2.3, publishes by the International Code Council, Inc.
2. ACI(American Concrete Institute)
ACI 318
3. AIA Handbook of Professional Practice, published by John Wiley & Sons Inc., Copyright 2001 by AIA, Editor, Joseph Demkin.
AIA A101, "Standard Form of Agreement Between Owner and Contractor" published by American Institute of Architects, 1997
AIA 201, "General Conditions of the Contract or Construction" published by American Institute of Architects, 1997
4. APA Technical Topics Form TT-002, published by The Engineered Wood Association, May 2002.
5. ASCE 7 (American Society of Civil Engineers) "Minimum Design Loads for Building & Other Structures", published July, 2002 by ASCE Press
6. ASHRAE 1984 Fundamentals Handbook
7. ASTM Standards

C 717	Standard Terminology of Building and Sealants
C 755	
C 794	Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants
C 898	Standard Guide for Use of High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane with Separate Wearing Course
C 920	Standard Specification for Elastomeric Sealants
C 981	Standard Guide for Design of Built-Up Butuminous Membrane
C 1193	Standard Guide for the use of Joint Sealers
D 312	Standard Specification for Asphalt Used in Roofing
D 2829	Sampling and Analysis of Built-up Roofs
D 3617	Sampling and Analysis of New Built-up Roofs
D 5295	Preparation of Concrete Surfaces for Adhered (Bonded) Membrane Waterproofing Systems
D 5385	Hydrostatic Pressure Resistance of Waterproofing Membranes
D 5843	Application of Fully Adhered Vulcanized Rubber Sheets Used in Waterproofing
D 5898	Standard Details for Adhered Sheet Waterproofing
D 5957	Flood Testing Horizontal Waterproofing Installations

D 6135	Application for Self-Adhered Modified Bituminous Waterproofing
D 6451	Application of Asphalt Based Protection Board
D 6506	Asphalt Based Protection Board for Below-Grade Waterproofing
D 6622	Application of Fully Adhered Hot-Applied Reinforced Waterproofing Systems
D 6769	Application of Fully Adhered, Cold-Applied, Prefabricated Reinforced Modified Bituminous Membrane Waterproofing Systems
E 84	Test Method for Surface Burning Characteristics of Building Materials
E 331	Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference
E 917	Measuring Life-Cycle Costs of Buildings and Building Systems
E 1105	Field Determination of Water Penetration of Installed Exterior Windows, Curtain Walls, and Doors by Uniform or Cyclic Static Air Pressure Difference
F 1869	Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

8. American Architectural Manufacturers Association

- AAMA 501.1
- AAMA 501.2.
- AAMA 501.3

9. Brick Institute of America - Technical Notes

10. CSI (Construction Specifications Institute), Project Resource Manual, published by CSI, 2004 edition.
Joint Sealers: CSI Monograph Series 12/991

11. Construction Waterproofing Handbook, published by McGraw-Hill, written by Michael T. Kubal, 2000

12. FM Global publications

13. Handbook of Accepted Roofing Knowledge (NRCA)

14. The Manual of Below-Grade Waterproofing Systems, Henshell, published by John Wiley & Sons

15. Moisture Analysis and Condensation Control in Building Envelopes by Heinz R. Trechsel, 2001

16. NRCA Roofing and Waterproofing Manual, 5th edition, published by National Roofing Contractors Association, 2001.

17. OSHA CFR 29 Part 1926 Subpart M

18. Proceedings from RCI Building Envelope Symposium, published by RCI, Inc., 1997-2004

19. Principles of Design and Installation for Plaza Waterproofing Systems by Ruggiero & Rutila, SGH

20. RCI Code of Ethics, adopted by RCI, Inc.

21. RCI Manual of Practice, Volume III, Published by RCI, Inc., 2003

22. RCI waterproofing Theory: educational course and manual

23. SMACNA, Sixth Edition, published by Sheet Metal & Air Conditions Contractors National Association, December 2003

24. SPRI (Sheet Membrane & Component Suppliers to the Commercial Roofing Industry)

ANSI-SPRI RP-4-2002 Wind Design Standard for Ballasted Single-ply Roofing Systems

25. Sealant Waterproofing Restoration Institute (SWRI)

Below-Grade Waterproofing Manual

Building Restoration and Maintenance Manual

Sealants: The Professionals Guide

26. Standard Handbook for Civil Engineering, Merrit, 1976 published by McGraw-Hill
27. UL Standards
 - UL 790 Tests for Fire Resistance of Roof Covering Materials
 - UL 580 Tests for Uplift Resistance of Roof Assemblies
28. Underground Waterproofing, published by Earth Integrated Technics, Inc., copyright 1983, by Brent Anderson
29. Understanding Dampness by Trotman, Sanders, & Harrison
30. Waterproofing the Building Envelope, Michael T. Kubal, McGraw-Hill, copyright 1983

PART 2

Part 2 of the examination tests your ability to apply waterproofing knowledge to solve problems; knowledge necessary for this test is acquired through reviewing the documents listed above in Part 1 and through practical experience.

A number of comprehensive word problems will be presented for solution. All will be mandatory and the point value for each problem will be identified in the examination booklet.

References used in preparing the problems are the same as those utilized in Part 1. Please understand that any charts or references required for the solution of problems will be provided in the examination booklet. However, if you have never worked a problem on a certain topic during your professional experience, there will probably not be sufficient time for you to both study the information and solve the problem.

Some problems may involve making mathematical computations requiring familiarity with basic algebra, geometry and trigonometry.

Examples of the kinds of problems that may be included on Part 2 are:

1. Identification of the responsibilities of a Waterproofing Consultant, Architect, Owner, and QA observer
2. Review and processing of applications for payment, calculating retainage amounts, alternate bid pricing, proper amounts for unit price work, etc.
3. Development of change order forms including calculation of new Contract Sum, and Contract Time.
4. Determination of coating dry film thickness based on wet film thickness, material quantities, etc.
5. Determination of the size and appropriate type of plaza drain assemblies. Calculating drain capacities and tributary areas.
6. Design of plaza tapered topping systems for drainage, calculating tapered topping slopes and elevations
7. Calculation of dead loads of plaza assemblies and overburden material
8. Calculation of total R-Value of plaza assemblies
9. Knowledge of energy codes and determining required insulation values for plaza deck assemblies
10. Knowledge of sealant joint selection, and design of sealant joint width and depth
11. Calculation of moisture and thermal movement of building components
12. General knowledge of failure analysis and leak detection, including water testing methods
13. Knowledge of plaza systems and material
14. Knowledge of AIA standard conditions of contract, agreement forms, and contract administration forms
15. Knowledge of CSI specification formats and CSI contract administration forms
16. Knowledge of subsurface drainage systems
17. Knowledge of test methods for substrate moisture emission, and calculating test results

RCI REGISTRATION (RWC) Program

Following are names and numbers for reference material cited in the RWC Study Guide

American Architectural Manufacturers Association Schaumburg, Illinois	847-303-5664
American Society of Civil Engineers Reston, VA	800-548-2723
ASTM West Conshohocken, PA	610-832-9585
Construction Specification Institute (CSI) Alexandria, VA	800-689-2900
FM Global Norwood, MA	781-255-6681
National Roofing Contractors Association (NRCA) Rosemont, IL	800-323-9545
RCI, Inc. Raleigh, NC	800-828-1902
Sealant, Waterproofing, & Restoration Institute Kansas City, MO	816-472-7974
Sheet Metal and Air Conditioning Contractors National Assn. Chantilly, VA	703-803-2980
Sheet Membrane & Component Suppliers to Commercial Roofing Ind. Waltham, MA	781-647-7026
Underwriters Laboratories, Inc. North Brook, IL	877-854-3577

PART 1

SAMPLE QUESTIONS

Several questions are provided for some of the categories of the examination. Each is an actual question taken from previous examinations.

Domain # I Condition Assessment

1. Which of the following are documents for construction projects for limited scopes and small projects?
 - A. B 801/901
 - B. AIA A101/201
 - C. AIA G702/703
 - D. AIA B151/155

2. What are “As-Built” drawings?
 - A. Drawings provided by the manufacturer, attached to the warranty.
 - B. Drawings provided during the submittal phase reflecting the proposed construction.
 - C. Drawings maintained by the Owner reflecting all changes and modifications after construction.
 - D. Drawings provided by the Contractor during contract close-out phase reflecting the actual construction.

3. The majority of waterproofing leaks are attributable to causes other than material or system failures. What is the cause of the remaining waterproofing leaks?
 1. Wrong system being specified for in-place service requirements
 2. Inadequate preparatory work
 3. Incompatible materials being transitioned together
 - A. 1 only
 - B. 1 & 2 only
 - C. 2 & 3 only
 - D. 1, 2, & 3

4. What product would most likely be installed on the top surface of the ramp area of a concrete parking deck?
 - A. siloxane
 - B. epoxy resin
 - C. polyurethane
 - D. hot rubberized asphalt

5. What are the three basic ingredients in concrete?
 - A. Portland cement, lime, and water siloxane
 - B. Portland cement, aggregate, and water
 - C. Portland cement, aggregate, and add mixture
 - D. Portland cement, additive for curing and water

6. The water table level must be determined by accurate soil borings and results corrected for seasonal variations. In which of the following months should the designer be aware that soil borings taken may not be accurate?
 - A. April, October & January
 - B. July, August & December
 - C. January, February & March
 - D. October, November & December

7. Which of the following construction assemblies is the most suited to be tested for moisture with the use of a capacitance meter?
 - A. metal clad wall panels
 - B. precast concrete parking deck
 - C. paver/pedestal plaza assembly
 - D. below-grade CMU wall with gypsum sheathing

8. A consultant notices a leak below the junction of a building/plaza intersection, looking up from the garage level below. What action would be the first step in identifying the source of the leak?
 - A. flood testing the area
 - B. visually inspecting the location
 - C. reviewing applicable contract drawings
 - D. locating the leak location on the plaza level

9. During the design phase, what is the best method for addressing costs associated with repairs with unknown quantity?
 - A. issuing change orders
 - B. including a lump sum allowance amount in bid
 - C. including unit costs and quantity allowances in bid
 - D. negotiating with the Contractor once the repair quantity is known

10. When preparing a condition assessment report, what information would be included in the “background section” of the report?
1. building description/location
 2. cost estimate
 3. name of building design professional
 4. waterproofing system components
- A. 1 only
B. 1 & 2 only
C. 1, 2, & 4 only
D. 2, 3, & 4 only

Domain # 2 Design

11. What effect does an Owner Controlled Insurance Program (OCIP) generally have on the Waterproofing Consultant’s insurance coverage?
- A. reduces the Consultant's design liability
B. increases the Consultant's design liability
C. provides primary coverage for the Consultants design liability
D. reduces the basis for calculating the Consultant's general liability premium
12. When installing one part urethane sealant, what type of backer rod is typically specified?
1. open cell backer rod
 2. close cell backer rod
 3. neoprene rubber backer rod
- A. 2 only
B. 3 only
C. 1,& 2 only
D. 1, 2,& 3
13. Under what Division of the CSI Masterformat Manual would epoxy grout injection be specified?
- A. Division 3
B. Division 5
C. Division 7
D. Division 9

14. Which of the following below grade waterproofing systems require back filling immediately after installation?
- A. hydro clay systems
 - B. fluid applied systems
 - C. cementitious systems
 - D. thermoplastic sheet membrane systems
15. What division of the CSI specifications includes concrete placement and finishing?
- A. Division 2
 - B. Division 3
 - C. Division 5
 - D. Division 7
16. Below grade waterproofing does all of the following except?
- 1. Protection of structural/foundation
 - 2. Control of drainage of both surface and groundwater
 - 3. Protection of the interior equipment and finishes below grade
 - 4. Protection from environment wind driven rain, ultraviolet weathering and acid rain
- A. 2 & 3 only
 - B. 1, 2, & 3 only
 - C. 1, 3, & 4 only
 - D. 1,2,3, & 4
17. What manual provides information regarding building code requirements?
- A. IBC
 - B. ASTM
 - C. SWRI
 - D. SMACNA
18. For removing and existing waterproofing membrane, which of the following division of CSA specification specifies the demolition means & methods?
- A. Division 1
 - B. Division 2
 - C. Division 7
 - D. None, the demolition means & methods should not be specified by the Architect/Engineer/Consultant
19. On earth-covered slabs, where should drainage courses be located?
- A. below the soil
 - B. below the insulation
 - C. above the insulation
 - D. above and below the insulation

20. Consider the following equation: what is it used to calculate?

$$T_v = \left[T_i - \frac{R}{\sum R} (T_i - T_o) \right]$$

- A. Long term thermal resistance of insulation board
- B. Transpermeance of a vapor barrier membrane
- C. Temperature at the vapor retarder membrane
- D. Water vapor transmission rate

21. Which of the following are advantages of fully adhered waterproofing membranes over loose laid waterproofing?

1. less probability of slippage during backfilling
2. ease of locating leaks
3. isolation from dynamic joint movement
4. not as critical of substrate finish

- A. 1 & 2 only
- B. 1 & 4 only
- C. 2 & 4 only
- D. 3 & 4 only

22. Who usually designs the below grade, under slab drainage system?

- A. Owner
- B. Architect
- C. Civil Engineer
- D. Waterproofing Consultant

23. What methods are utilized to improve the wind resistance of concrete pavers in a ballasted system?

1. install pavers in straight line fashion
2. install clips and adhesive between pavers
3. install stone ballast around penetrations
4. utilize edge attachment mechanisms at perimeters

- A. 1 & 2 only
- B. 2 & 3 only
- C. 2 & 4 only
- D. 3 & 4 only

24. What is the common UL test for fire endurance of specific waterproofing materials?
- A. UL-263
 - B. UL-580
 - C. ASTM D-93
 - D. ASTM E-669
25. Which of the following are typically not included in warranties provided by waterproofing manufacturers?
- A. removal of overburden or components
 - B. repair of leakage due to defective materials
 - C. repair of leakage due to defective workmanship
 - D. limitations of total cost exposing under warranty
26. In which division of CSI Masterformat are Addenda placed?
- A. bid form
 - B. Division 0
 - C. Division 1
 - D. None - Addenda are not placed in any divisions
27. During a pre-bid conference, which of the following are Contractors allowed to do?
- A. submit product substitutions
 - B. determine time and date of bid
 - C. request information on means and methods
 - D. ask questions regarding the relationship between the specifications and drawings
28. Which of the following statements is accurate regarding Addenda?
- A. Addenda cannot be used to modify the invitation to bid.
 - B. Addenda can be only issued during the bidding phase of the project, and not after the contract is signed.
 - C. Addenda generally modify contract documents and can be issued during bidding or construction phase of the project.
 - D. It is not necessary that an addendum indicates it supersedes and supplements all portions of the bidding documents which change conflicts.

Domain # 3 Contract Administration & Quality Assurance

29. What is the primary purpose of value engineering?
- A. to reduce overall cost of the project
 - B. to validate overall design commissioning of the project
 - C. to improve the quality of products incorporated into the project
 - D. to balance cost between quality and functionality of the project

30. Who sets the criteria for Contractor qualifications?
1. Waterproofing Consultant
 2. Manufacturer
 3. Owner
 4. Contractor
- A. 1 & 3 only
B. 2 & 3 only
C. 1, 2 & 3 only
D. 1, 2, & 4 only
31. What is the difference between an “Addendum” and an “Amendment”?
- A. Amendments change the bid dates.
B. Amendments can only be issued by the Owner.
C. The Amendment changes the contract documents prior to the bid.
D. The Addendum modifies the contract documents prior to award contract.
32. What is the purpose of reviewing the Schedule of Values?
- A. to determine the time for payments
B. to verify costs for specific work items
C. to determine overhead of SubContractors
D. to determine profits due to General Contractors
33. Which of the following are addressed to the pre-construction conference?
1. site requirements
 2. administrative requirements
 3. safety requirements and regulations
 4. submittals
- A. 1, 2 & 3 only
B. 1, 2 & 4 only
C. 2, 3 & 4 only
D. 2, 3 & 4 only
34. What is the difference between a construction change directive and a change order?
- A. A change order comes at the end of the job, and the construction change directive comes during the job.
B. A change order includes dollar amounts, a construction change directive is issued for minor changes that do not impact cost or contract time.
C. A change order is signed by the Owner, Architect, and Contractor. The construction change is only signed by the Owner and Architect only.
D. None, they are essentially the same.
35. Which of the following asphalt based materials can be applied to uncured/curing concrete?
- A. coal tar
B. emulsions
C. solvent based
D. polymeric asphalt

36. What AIA documents are most commonly used for Contractor submission progress billing?
1. AIA Doc 709
 2. AIA Doc 202
 3. AIA Doc 702
 4. AIA Doc 703
- A. 2 & 3 only
B. 3 & 4 only
C. 1, 3 & 4 only
D. 1, 2, 3 & 4 only
37. In what phase of the project are partial lien waivers from the Contractor submitted?
- A. with substantial completion
B. with final application for payment
C. at the start of project with submittals
D. with monthly application for payment
38. The design professional is asked to perform an inspection to establish a date for substantial completion. What is required of the Contractor to initiate this process?
- A. Waiting for the work to be 98% complete.
B. Submitting the final application for payment with all releases.
C. A notification that no leaks exist and all materials and systems are protected.
D. A notification of substantial completion with the list of incomplete items as provided by the Contractor.
39. Which of the following needs verification prior to processing the Contractor's final payment application?
- A. All punch list items have been completed.
B. Contractor certification that contract requirements are complete.
C. General Contractor final payments from the Owner has been received.
D. Confirmation that all contract requirements have been completed according to the contract documents.
40. Which of the following should be included in the project close-out documentation?
- A. Q/A documents, pictures and release from Owner
B. warranties, maintenance manuals, as built drawings
C. letter from Contractor verifying work has been completed
D. stamped documents confirming work is completed and final application for payment

Domain # 4 Testing

41. Which ASTM Committee has jurisdiction of waterproofing and dampproofing system?
- A. C15
B. C24
C. D04
D. D08

42. Which of the following is the most appropriate test when determining suitability of concrete substrate for waterproofing application?
- A. chemical testing
 - B. compressive strength
 - C. Schmit Hammer testing
 - D. petrographic examination
43. Why is proper coating thickness important in a fluid applied waterproofing application under a concrete topping slab?
- A. reduce impact damage
 - B. improve wear resistance
 - C. allow membrane to bridge hairline cracks
 - D. reduce chalking and premature aging of membrane
44. Which of the following non-destructive methods can be used to most accurately locate reinforcing steel in concrete?
- A. stud finder
 - B. impact echo
 - C. hammer sounding
 - D. R-Meter/Pachometer
45. Which of the following principals does an R-meter/Pachometer use?
- A. magnetism
 - B. conductivity
 - C. sound waves
 - D. thermal resistance
46. Which of the following best defines water table?
- A. The depth in the soil where water is present during fall.
 - B. The elevation with the soil where water is flowing freely.
 - C. The depth in the soil where water is present during spring.
 - D. The elevation at which the soil is at atmospheric pressure.
47. A structural slab has been designed for a maximum deflection of $L/600$. The spacing between the beams running North-South are 60 feet -6 inches. The beams running East-West are spaced 40 feet apart. The slab is 6 inches thick. What is the maximum slab deflection?
- A. 0.067 inch
 - B. 0.1 inch
 - C. 0.8 inch
 - D. 1.21 inches

Domain # 5 Professional Responsibility

48. Which of the following activities according to OSHA regulations is applicable to below-grade waterproofing?
- A. proper storage of excavated dirt
 - B. length of breaks to prevent fatigue
 - C. the maximum depth of excavation for worker safety
 - D. the support of earthen walls during excavation and application
49. You are replacing a plaza waterproofing system that does not have a tapered topping slab. The existing plaza waterproofing system and topping slab weigh 30 PSF. The new waterproofing system will have tapered topping slab. At the drains (the shallowest areas), the waterproofing system, tapered topping and the topping slab weigh only 15 PSF. At the thickest area, the total system weight will be 35 PSF. The average system weight will be 25 PSF. Your client is an Architect who is serving as the prime consultant for the project. What actions, if any should you take?
- A. Inform the Owner
 - B. Inform the Architect
 - C. Inform the Structural Engineer who is another sub-consultant to the Architect
 - D. Since the average weight of the system is less than the original system, you are not obligated to inform anyone.
50. Continuing education is a vital part of maintaining your current knowledge & understanding of the waterproofing industry. Which of the following means would be acceptable for maintaining CEU requirements?
- 1. attending conventions presented by RCI, NRCA, etc.
 - 2. attending Manufacturer's product seminars
 - 3. participating in community based service programs
 - 4. on-line learning programs
- A. 1, 2 & 4 only
 - B. 1, 3 & 4 only
 - C. 2, 3 & 4 only
 - D. 1, 2, 3, & 4 only

STUDY REVIEW

Answers are provided on the following page. Note your errors. Review the appropriate document (s) in those areas to better understand the rationale behind the indicated error. Take advantage of the programs provided by RCI, including courses on the national and regional levels.

PART 1
ANSWERS FOR THE SAMPLE QUESTIONS

I. Condition Assessment

- 1. D
- 2. D
- 3. D
- 4. C
- 5. B
- 6. B
- 7. D
- 8. D
- 9. C
- 10. A

III. Contract Administration and Quality Assurance

- 11. D
- 12. A
- 13. A
- 14. A
- 15. B
- 16. D
- 17. A
- 18. D
- 19. D
- 20. C
- 21. A
- 22. C
- 23. C
- 24. A
- 25. A
- 26. B
- 27. D
- 28. B

II. Design

- 29. D
- 30. C
- 31. D
- 32. B
- 33. A
- 34. C
- 35. B
- 36. B
- 37. D
- 38. D
- 39. D
- 40. B

IV. Testing

- 41. D
- 42. D
- 43. C
- 44. D
- 45. A
- 46. D
- 47. D
- 48. D
- 49. B
- 50. A