S & M WATER CONSULTANTS RECERTIFICATION PRACTICE EXAM

1. A water consumer/property owner in Colorado must maintain records of the test for_ year(s).
   a) 1
   b) 2
   c) 3
   d) 4

2. A Colorado cross-connection control technician shall provide a copy of a test report to the local water supplier within _ day(s).
   a) 1
   b) 3
   c) 4
   d) 5

3. Colorado regulations state that the has the explicit responsibility of preventing cross-connections from being installed into structures within its/their jurisdiction, through plans review and inspection.
   a) health agency
   b) water purveyor
   c) plumbing official
   d) treatment plant superintendent

4. Colorado Revised Statute Volume 8, Section 25-1-114, states that a conviction of
   maintaining a cross-connection could result in a jail sentence and a fine of $ _.
   a) 100
   b) 1,000
   c) 5,000
   d) 10,000

5. An enforcement order issued from the Colorado Department of Public Health and Environment will require the control of cross-connection within _ days.
   a) 1
   b) 3
   c) 5
   d) 10

6. A Colorado cross-connection control technician shall provide a written notification of a test failure to the water supplier within _ day(s).
   a) 1
   b) 2
   c) 3
   d) 5

7. "General" testers working in Colorado
   a) approve new devices
   b) shall be authorized to repair devices
   c) may test all types of devices
   d) all of the above

8. The water suppliers in Colorado shall keep records of backflow preventer tests for _ years.
   a) 1
   b) 3
   c) 4
   d) 5

9. The specifies the minimum frequency of routine testing and inspection of backflow prevention devices in Colorado.
   a) Colorado State Health Department
   b) federal government
   c) water purveyor
   d) device manufacturer

10. A technician working in the state of Colorado does not have the authority to:
    a) determine a hazard application
    b) discontinue water service
    c) repair a backflow preventer
    d) report assembly failures

11. A high hazard classification includes which of the following:
    a) Radioactive waste.
    b) Raw sewage.
    c) Caustic soda.
    d) All of the above.

12. Test cock number two (2) of a Reduced Pressure Principle Backflow Preventer (ASSE 1013) is located:
    a) Upstream of shut off valve number one
    b} downstream of check valve number one (1
    c) downstream of check valve number two (2).
    d) upstream of check valve number one (1).

13. Before installing a backflow preventer assembly you hould:

a) test the device.
b} flush the line.
c) take the device apart and clean it.
d) all of the above.

14. The federal law placing responsibility for the protection of the public water supply on the purveyor of water is the:

a) Occupational Safety & Health Administration Regulations.
b) Safe Drinking Water Act.
c) Food and Drug Administration Unicode.
d) Clean Water Act.

15. A Reduced Pressure Principle Backflow Preventer's (ASSE 1013) relief valve must open before the differential pressure across the inlet check valve reaches __ .

a) 1.0 psid
b) 2.0 psid
c) 2.5 psid
d) 3.0 psid

16. The required number of test cocks on a two (2) inch and smaller Pressure Vacuum Breaker Assembly (ASSE 1020) is:

a) none.
b) one (1).
c) two (2).
d) three (3).

17. A pressure of 75 psi would be equivalent to a head of water:

a) 37.5 feet
b) 75 feet
c) 150 feet
d) 173.5 feet

18. The required backflow prevention assembly for a fire suppression system containing chemicals is:

a) Reduced Pressure Detector Fire Protection Backflow Prevention Assembly (ASSE 1047) or Reduced Pressure Principle Assembly (ASSE1013)
b) Double Check Detector Fire Protection Backflow Prevention Assembly (ASSE 1048) or Double Check Backflow Prevention Assembly (ASSE 1015).
c) Pressure Vacuum Breaker Assembly (ASSE 1020).
d) Dual Check Valve Type Backflow Preventer (ASSE 1024).

19. Waterborne illness from a cross-connection can cause:
    a) typhoid
    b) cholera
    c) Giardiasis
    d) all of the above

20. The primary consideration in determining what type of backflow preventer to install is:
    a) cost.
    b) customer preference.
    c) degree of hazard.
    d) system temperature.

21. For companies who utilize a contaminated auxiliary water supply for fire protection, the water service connection must be protected with a:
    a) Dual Check Valve Backflow Preventer (ASSE 1024).
    b) Double Check Backflow Prevention Assembly (ASSE 1015).
    c) Reduced Pressure Principle Backflow Preventer (ASSE 1013).
    d) Pressure Vacuum Breaker Assembly (ASSE 1020).

22. The type of backflow protection assembly required for the main water supply to a waste water treatment plant is a(n):
    a) Pressure Type Vacuum Breaker Assembly (ASSE 1020).
    b) Reduced Pressure Principle Assembly (ASSE 1013).
    c) Double Check Backflow Prevention Assembly (ASSE 1015)
    d) Atmospheric type Vacuum Breaker (ASSE1001)

23. Cross connections are the between potable and non potable systems.
    a) physical links
    b) physical separations
    c) hydraulics
    d) pressures

24. One general service procedure to follow after repair and upon re-assembly of a backflow prevention assembly is lubrication of some parts. Acceptable lubricants include:
    a) Petroleum based oil.
    b) Pipe dope.
    c) Water resistant lubricants complying with FDA requirements for use in potable water systems
    d) All of the above.

25. A small hole in the underground potable water distribution system may:
    a) reduce the incoming pressure significantly.
    b) allow contamination of the system from backsiphonage backflow (Venturi Effect).
    c) create backpressure backflow.
    d) increase the system pressure.

26. Which of the following conditions would be a factor in water contamination through a cross connection?
    a) The use of self closing lavatory faucets.
    b) Turning off service to a multi-story building & allowing the water supply to drain.
    c) A vacuum produced by closing a valve.
    d) The installation of water conserving fixtures.

27. Regarding an Atmospheric Type Vacuum Breaker (ASSE 1001). the following statement is correct.
    a) Includes a spring loaded check valve.
    b) Is used for low hazard protection only.
    c) Includes a spring loaded air inlet valve.
    d) Must be used for backsiphonage protection only.

28. The required type of protection between a potable water system and the building sewer is a(n):
    a) Double Check Backflow Prevention Assembly (ASSE 1015).
    b) Pressure Vacuum Breaker Assembly (ASSE 1020)
    c) Air gap separation
    d) Backwater valve

29. The weight of one (1) cubic foot of water at sea level is:
    a) 14.4 pounds.
    b) 23.5 pounds.
    c) 37.5 pounds.
    d) 62.4 pounds.

30. When Testing a Double Check Detector Fire Protection Backflow Preventer Assembly (ASSE 1048) what is the minimal acceptable pressure differential across the check valves?
    a) 0.5 psi
    b) 1.0 psi
    c) 2.0 psi
    d) 3.0 psi

31. The venturi principle states that when the water velocity within the pipe increases, the gauge pressure:
    a) increases.
    b) remains the same.
    c) compresses the water.
    d) decreases.

32. An air gap, to be considered affected by two (2) intersecting walls, must encroach upon or be within a zone defined as times the effective opening of the potable water outlet in width.
    a) One and one half (1 *1/2)*
    b) Two (2)
    c) Three (3)
    d) Four (4)

33. Atmospheric Type Vacuum Breakers (ASSE 1001) are installed to protect against:
    a) Backpressure low hazard conditions only.
    b) Backpressure high hazard conditions only.
    c) Backsiphonage low hazard conditions only.
    d) Backsiphonage high or low hazard conditions only.

34. Which of the following does not determine the type of test procedure to be used when testing Backflow Assemblies?
    a) Size of assembly
    b) Type of assembly (Reduced Pressure Principle Backflow Preventer (ASSE 1013), Double Check Backflow Prevention Assembly (ASSE 1015), Pressure Vacuum Breaker Assembly (ASSE 1020).
    c) Manufacture
    d) Both A and C

35. Which of the following conditions can cause backpressure?
    a) Auxiliary water supply connected to potable system.
    b) An etevated distribution system.
    c) Potable distribution system connected to a boiler.
    d) All of the above.

36. Before testing the number one (1) check valve of a Double Check Backflow Prevention Assembly (ASSE 1015), you must first:
    a) attach the high pressure hose to test cock number three (3).
    b) attach the low pressure hose to test cock number two (2).
    c) close shut off valve number one (1).
    d) flush all four (4) test cocks.

37. It is recommended that a Double Check Backflow Prevention Assembly (ASSE 1015) be installed with its critical level a minimum of:
    a) six (6) inches from a wall.
    b) twelve (12) inches above the highest point of use.
    c) twelve (12) inches above the surrounding ground or floor.
    d) thirty (30) inches above the surrounding ground or floor.

38. For containment protection in a low hazard situation, the minimum protection required shall be:
    a) Reduced Pressure Principle Backflow Preventer (ASSE 1013)
    b) two (2) single check valves in series
    c) Double Check Backflow Prevention Assembly(ASSE 1015)
    d) Atmospheric Type Vacuum Breaker (ASSE 1001)

39. As you increase elevation above sea level, atmospheric pressure:
    a) increases.
    b) decreases.
    c) fluctuates.
    d) stays the same.

40. A Double Check Backflow Prevention Assembly (ASSE 1015) test and maintenance report shall include all of the following information except the:
    a) address of the installation.
    b) serial number of the assembly.
    c) test results of check valve number one (1).
    d) differential pressure relief valve discharge reading.

41. The term air-gap separation refers to:
    a) a hole in the supply piping.
    b) a gap in the air line to a receiving vessel.
    c) a physical break between the water supply line and the flood level rim of the receiving vessel.
    d) a mechanical type backflow prevention device.

42. The maximum time in a 24 hour period a Pressure Vacuum Breaker Assembly (ASSE 1020) may be under pressure is:
    a) 10 hours
    b) 12 hours
    c) 18 hours

The springs on the two (2) check valves of a Reduced Pressure Principle Backflow Preventer (ASSE 1013) are:
    a) located outside the body of the assembly.
    b) externally loaded.
    c) not interchangeable.
    d) interchangeable.

44. What problem could occur if a hydronic system is connected to a domestic water system without protection?
    a) A cross-connection
    b) Backpressure
    c) Backsiphonage
    d) All of the above

45. Static pressure is:
    a) produced by a fluid in motion.
    b) the force exerted by a fluid at rest.
    c) exerts a pressure of .433 PSI at the lowest point.
    d) none of the above.

46. To a single family home, the minimum backflow protection required for the service line is a:
    a) Pressure Vacuum Breaker Assembly (ASSE 1020).
    b) Double Check Backflow PreventionAssembly (ASSE 1015).
    c) Reduced Pressure Principle Backflow Preventer Assembly (ASSE 1013).
    d) according to local jurisdiction.

47. When performing a directional flow test on the number 2 check valve of a Reduced Pressure Principle Assembly (ASSE 1013) the minimum differential reading shall be:
    a) 1 psid
    b) 2 psid
    c) 5 psid
    d) none of the above

48. Which of the following is <u>not</u> a cause of backpressure?
    a) Elevated plumbing.
    b) Thermal expansion.
    c) Pumps.
    d) Aspiration.

49. Which of the following should be considered when installing a cross connection control device?
    a) Sidewall clearances.
    b) Degree of hazard
    c) Distance of backflow device from the floor level.
    d) All of the above.

50. A pressure gauge reading of 50 PSI at the base of a column of water would indicate that the column was approximately feet high.
    a) 21.5
    b) 43.3
    c) 50
    d) 115.5

51. The suggested minimum vertical distance between the relief valve discharge port of a Reduced Pressure Principle Backflow Preventer (ASSE 1013) assembly and the flood level of the surrounding area ia:
    a) six (6) inches.
    b) twelve (12) inches.
    c) eighteen (18) inches.
    d) twenty four (24) inches.

52. A primary cause of reversal of flow of water in a piping system is
    a) the length of the piping system.
    b) low flow conditions
    c) the size of the pipe.
    d) the loss of pressure in the system.

53. Dynamic pressure is
    a) the force exerted by a fluid in motion.
    b) the force exerted by a fluid atrest.
    c) a force which always exerts a pressure equivalent to one atmosphere.
    d) none of the above.

54. A Double Check Backflow Prevention Assembly (ASSE 1015) with 50 psi greater pressure on the downstream side of check valve #2 than on the upstream side of check valve #1 has:
    a) a failed 1 st check.
    b) a failed 2nd check.
    c) a faulty #2 shut off valve.
    d) nothing wrong with it.

55. Differential pressure:
    a) is pressure caused by the weight of atmosphere.
    b) is a condition when upstream pressure is applied continuously to a device or assembly.
    c) may be described as the difference in pressure between two points in a system.
    d) is equal to gauge pressure plus atmospheric pressure.

56. During a static condition a fouled #2 check valve shall cause a Reduced Pressure Principle Backflow Assembly (ASSE1 013) to :
    a) Dump from the intermediate vent.
    b) Do nothing.
    c) Improperly flow.
    d) Spit intermittently.

57. Thermal expansion:
    a) is the pressure increase which occurs in a piping system every time a water heater comes on to recover the temperature lost through the usage of hot water
    b) occurs in any hot water system when water is heated or recovered during periods on non-use
    c) can cause a dangerous increase in pressure
    d) all of the above

58. The responsibility for maintaining the quality of water to the last free flowing tap belongs to:
    a) the plumber.
    b) the tester.
    c) the water purveyor.
    d) the Health Department.

59. Before installation of a Reduced Pressure Principle Backflow Assembly (ASSE 1013), consideration should be made concerning:
    a) Brand of the assembly (ASSE 1013).
    b) Drainage of the relief valve.
    c) Keeping the assembly at least 18 inches above the surrounding floor.
    d) Bonding to prevent damage from lightening.

60. The normal path of water flow through an assembly, as stated by the manufacturer's design is called:
    a) direction of flow
    b) differential pressure
    c) head pressure
    d) pressure loss

61. Which assembly provides the highest backflow protection?
    a) Dual Check Backflow Preventer (ASSE 1024)
    b) Backflow Preventer with Intermediate Atmospheric Vent (ASSE 1012)
    c) Double Check Detector Fire Protection Backflow Preventer Assembly (ASSE 1048)
    d) Reduced Pressure Principle Backflow Assembly (ASSE 1013)

62. A/an is considered a device not an assembly.
    a) Atmospheric Type Vacuum Breaker (ASSE1001)
    b) Pressure Vacuum Breaker Assembly (ASSE 1020)
    c) Reduced Pressure Principle Assembly (ASSE 1013)
    d) Double Check Backflow Prevention Assembly (ASSE

63. The unintentional reversal of flow in a potable water system which may result in contamination or pollution of the system.
    a) Toxic
    b) Backflow
    c) Non-potable water
    d) Containment

64. When testing a Reduced Pressure Principle Backflow Assembly (ASSE 1013), the valve that must be closed tightly is the:
    a) number one (1) shut off valve.
    b) service connection shut off valve.
    c) flow control regulating shut -off valve.
    d) number two (2) shut off valve.

65. The crest of a siphon cannot be higher than above the highest liquid level since atmosphere cannot support a column of water greater than this height.
    a) 14.7 feet
    b) 21 feet.
    c) 29 feet
    d) 33.9 feet

66. Constant discharge from the relief valve of a Reduced Pressure Principle Assembly (ASSE 1013) usually indicates:
    a) a fluctuation in incoming pressure.
    b) a leaking number one (1) check valve.
    c) a fluctuation in the downstream pressure.
    d) excessive downstream pressure.

67. A Double Check Detector Fire Protection Backflow Prevention Assembly (ASSE 1048) contains one:
    a) air inlet valve.
    b) strainer.
    c) flow meter/indicator.
    d) pressure regulating valve.

68. The number of standard test cocks on a Double Check Backflow Prevention Assembly (ASSE 1015) is:
    a) two (2)
    b) four (4)
    c) six (6)
    d) eight (8)

69. A Double Check Backflow Prevention Assembly (ASSE 1015) that has equal pressure between a check's inlet and outlet suggests that the:
    a) check is closed.
    b) check is working properly.
    c) check has failed
    d) checks is under static conditions

70. A Hose Connection Vacuum Breaker (ASSE 1011) can be subject to:
    a) Continuous backpressure
    b) High hazard
    c) Low hazard only
    d) Containment

71. Which backflow prevention method should be used whenever possible?
    a) Atmospheric Vacuum Breaker
    b) Fixed Proper Air Gap
    c) Reduced pressure principal device
    d) Double check valve assembly

72. Which one is a backflow prevention device?
    a) Atmospheric Type Vacuum Breakers (ASSE 1001)
    b) Air gap
    c) Pressure Vacuum Breaker Assembly (ASSE 1020)
    d) All of the above

73. A water closet flushometer valve vacuum breaker shall be installed on the discharge side of the valve with the critical level at least above the top of the fixture.
    a) 4 inches
    b) 6inches
    c) 8inches
    d) 10inches

74. An Atmospheric Type Vacuum Breaker (ASSE 1001) will usually be installed in a:
    a) boiler system make up water line.
    b) service connection to a residence.
    c) service connection to a car wash.
    d) None of the above

75. The following are backflow prevention methods except:
    a) Air gap.
    b) Double Check Backflow Prevention Assembly (ASSE 1015)
    c) Reduced Pressure Principle Backflow Assembly (ASSE 1013)
    d) Swing Connection

76. A differential pressure gauge is used in the testing of:
    a) Dual Check Valve Type Backflow Preventer (ASSE 1024).
    b) Reduced Pressure Principle Backflow Preventer (ASSE 1013).
    c) Pipe Applied Atmospheric Type Vacuum Breaker (ASSE 1001).
    d) Backflow Preventer with Intermediate Atmospheric Vent (ASSE 1012).

77. An air gap separation is determined from the outlet piping's diameter
    a) outside diameter
    b) effective opening
    c) nominal pipe size
    d) greatest velocity

78. Which of the following is **not** a source of backpressure?
    a) Elevated pumping
    b) Thermal expansion
    c) Pumps
    d) Aspiration

79. A two (2) inch Atmospheric Type Vacuum Breaker (ASSE 1001), installed ona two (2) inch water supply to a tank must be at least above the flood rim of the tank:
    a) two (2) inches.
    b) four (4) inches.
    c) six (6) inches.
    d) eight (8) inches.

80. An assembly consisting of two internally loaded check valves.
    a) Air gap
    b) Pressure Vacuum Breaker Assembly (ASSE 1020)
    c) Double Check Backflow Prevention Assembly (ASSE 1015)
    d) Reduced Pressure Detector Fire Protection Backflow Prevention Assembly 1047)

81. A Reduced Pressure Principle Backflow Preventer's (ASSE 1013) relief valve operates from the inlet water pressure and the water pressure at the:
    a) number two (2) shut off valve.
    b) atmospheric vent.
    c) number four (4) test cock.
    d) intermediate zone pressure.

82. When working on a Pressure Vacuum Breaker Assembly (ASSE 1020) what would be the cause of the air inlet valve failing to open at 1 psig minimum?
    a) Weak spring load.
    b) Air inlet valve seal adhering to bonnet.
    c) Debris restricting free operation.
    d) All of the above.

83. An unprotected submerged hose bibb, with no hose connected to it, is what type of cross connection?
    a) Actual
    b) Potential
    c) Permanent
    d) None of the above

84. What causes a Pressure Vacuum Breaker Assembly (ASSE 1020) to chatter during a flow condition?
    a) Undersized assembly.
    b) Air trapped in the top of the device.
    c) Isolation valve #1 partially closed.
    d) Damaged poppet seal.

85. A barometric loop is effective against:
    a) Back siphonage.
    b) Back pressure.
    c) Both types of backflow.
    d) None of the above.

86. T F Containment devices should be installed at the service connection in high hazard facilities.

87. T F Discharge of water from the relief valve of a Reduced Pressure Principle Backflow Preventer Assembly (ASSE 1013) usually indicates either a malfunction in the first check or in the relief valve or both, or backflow occurring through a leaking second check valve.

88. T F A backflow preventer check valve must close tight when subject to any backflow conditions

89. T F A containment device is installed at the meter of a facility to protect the individuals within the facility.

90. T F Test cock #1 on a Double Check Backflow Prevention Assembly (ASSE 1015) is not normally used when testing the device.

91. The pressure measured in a system under a "no flow connection".

92. A device installed in a water supply at the meter or curbstop to protect the public potable water distribution system.

93. The maximum height a container can hold water or other liquids during a flooding condition before overflowing.

94. A condition induced by negative (sub atmospheric) pressure that causes backsiphonage to occur.

95. Does not constitute an actual health hazard although the quality of the water is impaired with respect to taste, odor, or utility.

96. The reversal of normal flow in a system due to a negative pressure (vacuum or partial vacuum) in the supply pipe.

97. An organization that is engaged in production and/or distribution of potable water for domestic use.

98. The total pressure, gauge pressure plus atmospheric pressure.

99. The expanding of a volume of water in a system due to an increase in the temperature of the water.

100. Any water supply on or available to the premise other than the public water supply.

a) Static Pressure

b) Vacuum

c) Containment Backflow

d) Auxiliary water supply

e) Absolute Pressure

f) Backsiphonage Backflow

g) Water Purveyor

h) Pollution

i) Thermal Expansion

j) Flood Level

1. c
2. d
3. c
4. b
5. d
6. c
7. b
8. b
9. a
10. b
11. d
12. d
13. b
14. b
15. b
16. c
17. d
18. a
19. d
20. c
21. c
22. b
23. a
24. c
25. b
26. b
27. d
28. c
29. d
30. b
31. d
32. c
33. d
34. d
35. d
36. d
37. c
38. c
39. b
40. d
41. c
42. d
43. c
44. d
45. b
46. d
47. a
48. d
49. d
50. a
51. b
52. d
53. a
54. c
55. c
56. b
57. d
58. c
59. b
60. a
61. d
62. a
63. b
64. d
65. d
66. b
67. c
68. b
69. c
70. b
71. b
72. c
73. b
74. d
75. d
76. b
77. b
78. d
79. c
80. c
81. d
82. d
83. a
84. c
85. a
86. T
87. T
88. T
89. F
90. T
91. a
92. c
93. j
94. b
95. h
96. f
97. g
98. c
99. i
100. d

S & M Water Consultants Practice exam questions

1. Water suppliers in Colorado must notify the Colorado Department of Public Health and Environment of a cross-connection's discovery within — calendar days.
   a) 1
   b) 3
   c) 5
   d)10

2 . An enforcement order issued from the Colorado Department of Public Health and Environment will require the control of cross-connection within — days.
   a) 1
   b) 3
   c) 5
   d 10

3. Colorado Revised Statute Volume 8, Section 25-1-114, states that a conviction of maintaining a cross-connection could result in a jail sentence and a fine of $ —.
   a) 100
   b 1,000
   c) 5,000
   d) 10,000

4. The Colorado Primary Drinking Water Regulations require the water suppliers in Colorado to:
   a) adopt the Cross-Connection Control Manual
   b) adopt the Uniform Plumbing Code
   c) install backflow preventers
   d) identify potential hazards

5. The water suppliers in Colorado shall keep records of backflow preventer tests for — years.
   a) 1
   b) 3
   c) 4
   d) 5

6. A technician working in the state of Colorado does not have the authority to:
   a) determine a hazard application
   b) discontinue water service
   c) repair a backflow preventer
   d) report assembly failures

7. A Colorado cross-connection control technician shall verbally report test failures that cannot be repaired immediately to the local water supplier within — day(s).
   a) I
   b) 2
   c) 3
   d) 5

8. A Colorado cross-connection control technician shall provide a copy of a test report to the local water supplier within — day(s).
   a) 1
   b) 3
   c) 4
   d) 5

9. A Colorado cross-connection control technician must maintain records of an assembly test for — year(s).
   a) 1
   b) 2
   c) 3
   d) 4

10. A Colorado cross-connection control technician shall provide a written notification of a test failure to the water supplier within — day(s).
    a) 1
    b) 2
    c) 3
    d) 5

11. A water consumer/property owner in Colorado must maintain records of the test for year(s).
    a) 1
    b) 2
    c) 3
    d) 4

12. “General” testers working in Colorado _____.
    a) Approve new devices
    b) shall be authorized to repair devices
    c) may test all types of devices
    d) all of the above

13. The Colorado Primary Drinking Water Regulations specifically state: “No supplier shall maintain a hazardous cross-connection. The cross-connection shall be corrected within working days of the state’s knowledge”.
    a) 1
    b) 3
    c) 5
    d) 10

14. The _____ specifies the minimum frequency of routine testing and inspection of backflow prevention devices in Colorado.
    a) Colorado State Health Department
    b) federal government
    c) water purveyor
    d) device manufacturer

15. Colorado regulations state that the _____ has the explicit responsibility of preventing cross-connections from being installed into structures within its/their jurisdiction, through plans review and inspection.
    a) Health agency
    b) water purveyor
    c) plumbing official
    d) treatment plant superintendent

Key sheet

1. d
2. d
3. b
4. d
5. b
6. b
7. a
8. d
9. c
10. c
11. c
12. c
13. d
14. c
15. c