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# Water Treatment

## Class III



1. The filter rate and backwash rate of each filter shall be determined and recorded once each
  - a. week.
  - b. month.
  - c. quarter.
  - d. year.
  
2. The culture media used in the presumptive test is of
  - a. agar.
  - b. a brilliant green lactose bile broth.
  - c. a lactose or lauryl tryptose broth.
  - d. a nutrient agar.
  
3. Fish eyes are
  - a. undissolved clumps in solution.
  - b. the primary cause of floc carryover.
  - c. spots of coagulant attaching to the sides of the basin.
  - d. an unavoidable operating problem associated with solution tanks.
  
4. Water may be aerated by several methods, almost all of which involve
  - a. covering the storage facilities.
  - b. exposing a large surface area to the atmosphere.
  - c. increasing the pressure.
  - d. reducing its temperature.
  
5. All chlorine cylinders are required to contain at least one fusible metal safety device (plug) designed to melt at between \_\_\_\_\_ °F.
  - a. 98-105
  - b. 120-150
  - c. 158-165
  - d. 200-212

6. What is the amount of chlorine required to treat 5 mil gal of water to provide a 0.8 ppm residual and satisfy 2.4 ppm chlorine demand?
  - a. 33.33 lb
  - b. 66.67 lb
  - c. 100.00 lb
  - d. 133.33 lb
  
7. The detention time usually required in a conventional straight-flow sedimentation basin is \_\_\_\_\_ h.
  - a. 0.5–1
  - b. 2–6
  - c. 10–12
  - d. 24
  
8. Air binding is a condition that may occur as a result of
  - a. filter-bed compaction.
  - b. gravel displacement.
  - c. negative head.
  - d. reaching terminal head loss.
  
9. A program for the control of algae should be instituted
  - a. on a routine, periodic schedule, but not to exceed two applications per year.
  - b. on a seasonal basis.
  - c. after trend information has been established and adequate monitoring is practiced.
  - d. during extended periods of warm water temperatures.
  
10. With the coming of winter, the water temperature drops. A likely operational problem at a filtration plant with coagulation is
  - a. floc carryover from the sedimentation system.
  - b. high alkalinity.
  - c. high chlorine residual.
  - d. odor.
  
11. A fluoride saturator
  - a. can only be used by large treatment facilities.
  - b. eliminates the need for a metering pump.
  - c. eliminates the need for chemical handling.
  - d. is suitable for small water systems.

12. The most desirable place to feed activated carbon in a lime-soda ash softening plant is
- after lime feed.
  - in the clearwell.
  - to raw water at earliest stage possible.
  - with lime feed.
13. Activated alumina is used effectively for the removal of
- certain inorganic elements.
  - herbicides and pesticides.
  - humic substances.
  - oxidized precipitates.
14. Four milligrams per litre of chlorine is added continuously to a water flow that averages 5 mgd. How much chlorine will be used in 30 days?
- 1500 lb
  - 3000 lb
  - 5000 lb
  - 15,000 lb
15. Harvesting, dewatering, dredging, shading, and lining are all methods for controlling rooted aquatic plants
- without much effort.
  - physically.
  - chemically.
  - biologically.
16. Sodium hydroxide (NaOH) is often used as the base in acid-base titrations. It has a molecular weight of 40 ( $23 + 16 + 1 = 40$ ). How many grams of NaOH are in 1 L of a 1N (normal) solution?
- 20
  - 40
  - 60
  - 80
17. When using the multiple-tube fermentation test method and coliform organisms occur in six out of ten of the 10-mL portions of a single standard sample, then
- customers should be told to boil their water.
  - the system must collect a set of repeat samples within 24 h.
  - the chlorine residual should be increased to 1.0 mg/L.
  - the water main should be flushed for 24 h.

18. Fire fighting may cause low pressure in an area of a distribution system. The low pressure might lead to
- a. contamination of the system by backsiphonage.
  - b. ice formation in the pipes.
  - c. loss of chlorine residual.
  - d. muddy water.
19. Pinpoint floc is a condition associated with
- a. flash mixing.
  - b. low turbidity.
  - c. the type of chemical selected.
  - d. water temperature.
20. Sedimentation can be improved by
- a. lowering the water temperature after flocculation.
  - b. maintaining a uniform, horizontal, low-velocity flow across the basin.
  - c. maintaining a uniform sludge blanket.
  - d. reducing the detention time.
21. A carbon dosage of 20 mg/L is required for the removal of taste and odors. With a flow of 5560 gpm, how many pounds of carbon should be fed per hour?
- a. 27.8 lb
  - b. 49.9 lb
  - c. 55.6 lb
  - d. 668.0 lb
22. If a filter has been out of service and allowed to go dry, which filter control valve should be used to refill it with water?
- a. effluent valve
  - b. influent valve
  - c. rewash valve
  - d. backwash inlet valve
23. A liquid has a specific gravity of 1.16. How much would 300 gal of this liquid weigh?
- a. 158 lb
  - b. 348 lb
  - c. 2502 lb
  - d. 2899 lb

24. Polyelectrolytes are
- coagulants.
  - coagulant aids.
  - used for hardness reduction.
  - used for pH adjustment.
25. A tank 6 ft in overall length and 18 in. in diameter is in the shape of a cylinder with two hemispherical ends. Its capacity is \_\_\_\_\_ gal.
- 7.7
  - 72.7
  - 270
  - 1720
26. What is total hardness of water in mg/L  $\text{CaCO}_3$  when magnesium (Mg) is 10 mg/L and calcium (Ca) is 20 mg/L?
- 10 mg/L
  - 30 mg/L
  - 41 mg/L
  - 91 mg/L
27. One function of aeration is the removal of \_\_\_\_\_ from water prior to the lime-soda ash softening process.
- carbon dioxide
  - chlorine
  - inorganic material
  - oxygen
28. Calcium carbonate stability refers to
- a condition where calcium carbonate, pH, and alkalinity are in equilibrium.
  - a condition where water will neither dissolve nor deposit calcium carbonate.
  - a theoretical property of water.
  - water in equilibrium where the measured pH is equal to the Langelier Index.
29. A condition that tends to increase the corrosiveness of water on metals is
- high dissolved oxygen content.
  - high fluoride concentration.
  - low dissolved oxygen content.
  - low total dissolved solids.

30. Adsorption operates on the principle of
- adhesion.
  - chance collision.
  - gravity.
  - magnetic polarization.
31. When adding polyphosphate for sequestration to a well and also adding chlorine to the well, which should be fed first?
- chlorine
  - polyphosphate
  - both added simultaneously
  - either may be added first
32. Practicing breakpoint chlorination involves chlorine addition until
- taste and odor characteristics of a swimming pool have dissipated.
  - combined chlorine residual reaches its highest point of disinfection.
  - chloroorganics and chloramines have formed.
  - chloroorganics and chloramines are destroyed and free available chlorine residual is formed.
33. If a water supply exceeds a maximum contaminant level, whose responsibility is it to notify the consumer?
- EPA
  - laboratory
  - state
  - water supplier
34. Coagulation usually
- occurs in seconds.
  - occurs in minutes.
  - occurs in hours.
  - depends on coagulant and mixing rates.
35. Which chemical is considered most effective for removing or destroying the effect of phenols in water?
- activated carbon
  - $\text{Cl}_2$
  - $\text{ClO}_2$
  - $\text{KMnO}_4$

36. Treated water is always used for backwashing
- because of its availability.
  - because the use of untreated water is more costly.
  - to avoid contamination of the filter bed.
  - to lessen sludge disposal problems.
37. A water treatment plant produces 850,000 gpd. On one day 24,526 gal was used for backwashing the filters. What was the net production for this day?
- 406,740 gal
  - 604,740 gal
  - 476,604 gal
  - 825,474 gal
38. The nephelometric method of measuring turbidity is based on the
- transmission of light.
  - scattering of light.
  - passage of light.
  - adsorption of light.
39. A hydrofluosilicic acid ( $\text{H}_2\text{SiF}_6$ ) chemical feed pump is feeding a 30 percent by weight solution (specific gravity = 1.26) at the rate of .025 gpm in a plant operating at 12 mgd. The resulting fluoride dosage is \_\_\_\_\_ mg/L.
- 1.4
  - 1.1
  - 0.90
  - 0.71
40. How can the supervisor be certain that scheduled maintenance is completed?
- Ask the workers.
  - Hire someone to inspect completed work.
  - Supervisor inspects work.
  - Wait and see if there are any failures.
41. Hydrogen sulfide in water may be effectively controlled by
- aeration.
  - filtration.
  - fluoridation.
  - sedimentation.

42. In general, a properly operated presedimentation facility should remove
- 90 percent of all suspended matter.
  - at least 60 percent of the settleable matter.
  - all the algae and floating debris.
  - none of the above.
43. Trihalomethanes are formed when
- the water contains organic chemicals.
  - the water contains large concentrations of inorganic chemicals.
  - the filters are backwashed.
  - chlorine reacts with humic and fulvic acids in water.
44. The most severe symptom of fluorosis is teeth that
- show signs of pitting.
  - darken, turning shades of gray to black.
  - are mottled in appearance.
  - are less susceptible to cavities and erosion.
45. To ensure that operating parameters are effectively monitored during aeration, surface water should be sampled and tested
- daily, at a minimum.
  - more frequently as seasonal temperatures rise and less frequently when temperatures drop.
  - only as needed since monitoring is not as critical with aeration as with other treatment processes.
  - to the extent required to detect and evaluate all significant changes in water quality.
46. In-plant sampling points following filtration are normally selected to monitor for
- turbidity removal.
  - reduction in turbidity, taste and odor, and bacteria.
  - reduction in sediment load and bacteria.
  - bacteria and turbidity removal.
47. The chemical formula for ferric oxide is
- FO.
  - FeO.
  - FeO<sub>2</sub>.
  - Fe<sub>2</sub>O<sub>3</sub>.



48. Sedimentation is improved by
- a sludge blanket.
  - reducing the detention period in the basin.
  - short circuiting.
  - uniform, horizontal, low-velocity flow across the basin.
49. When calculating carbonate hardness, the following would be included:
- calcium chloride.
  - calcium sulfate.
  - magnesium bicarbonate.
  - magnesium chloride.
50. An important reason for analyzing raw-water samples for color is
- to improve customer relations.
  - to comply with the Secondary Drinking Water Regulations.
  - because the test data is a good baseline indicator for treatment plant efficiency.
  - because it may indicate high levels of organic compounds, which may produce trihalomethanes upon contact with chlorine.
51. Objectives for a preventive maintenance program include
- eliminate parts inventory.
  - get organized to unstop overflowing manholes quickly.
  - increase use of standby equipment.
  - reduce emergency repairs and maintenance.
52. Treatment plant operators should
- obtain reports of school dental-health surveys to better determine whether local fluoridation is necessary or effective.
  - insist on oral fluoridation treatments if their community does not fluoridate.
  - have some knowledge of the health effects associated with fluoridation.
  - none of the above.
53. Baffles are installed downstream of the basin inlet to
- reduce velocity.
  - induce turbulence.
  - collect settled water as it leaves the basin.
  - channel the water.

54. Two chemical contaminants with maximum contaminant levels that are regulated in both community and noncommunity systems are nitrate and
- turbidity.
  - sodium.
  - hardness.
  - chloride.
55. If static pressure in a water system is too high, the remedy is to
- install a booster pump.
  - install pressure-reducing valves.
  - throttle the suction valve on the well pump.
  - none of the above.
56. The main purpose of flocculation is to
- allow chemicals to mix thoroughly.
  - bring together microfloc particles.
  - filter out suspended particles.
  - settle out suspended particles.
57. If your treatment plant treats 36 mgd and alum is fed at the rate of 25 mg/L, how many pounds per hour must the chemical feeder dispense to meet these requirements?
- 8.34 lb/h
  - 31.3 lb/h
  - 36 lb/h
  - 313 lb/h
58. Solids-contact basins and sludge-blanket clarifiers are also called
- peripheral-feed settling tanks.
  - shallow-depth sedimentation basins.
  - tube-settling tanks.
  - upflow clarifiers.
59. Two operating problems commonly associated with screening facilities are
- clogging and corrosion.
  - clogging and frequent replacement of the shear pin.
  - frequent inspection and frequent removal of debris.
  - intensive recordkeeping and intensive maintenance.

60. The purpose of the completed test using the multiple-tube fermentation method is to
- verify the presence of pathogens.
  - verify the presence of coliform bacteria.
  - verify that bacterial contamination was not caused by laboratory error.
  - determine if suspected coliform bacteria meets all the criteria of an indicator organism.
61. A portion of cast-iron pipe after five years of use shows a white-colored scale  $\frac{1}{2}$ -in. thick on the inside pipe walls. This means that
- the water has been corrosive.
  - the water is chemically unstable and is depositing calcium carbonate.
  - the *C* factor should increase due to the lining effect.
  - red water will soon become a problem.
62. If the pH is being raised slightly beyond the saturation point to prevent corrosion in the distribution system, then chlorination dosages may need to be
- increased.
  - decreased.
  - kept the same.
  - closely monitored to determine changes in chlorine demand.
63. The type of aerator most effective in removing dissolved gases is the
- cascade.
  - diffuser.
  - draft.
  - slat and coke tray.
64. The term volatile can best be defined as
- a precipitate.
  - capable of being easily attacked.
  - highly explosive.
  - turning to vapor easily.
65. A total of 3060 h was worked by 15 employees of a water treatment plant. What was the average number of hours worked by each employee?
- 420 h
  - 402 h
  - 240 h
  - 204 h

66. Problems with pinpoint floc can often be corrected by
  - a. adding a weighting agent.
  - b. altering the point of chemical application.
  - c. increasing the detention time during flocculation.
  - d. increasing the mixing energy during flocculation.
  
67. The purpose of the confirmed test using the multiple-tube fermentation method is to
  - a. determine the cause of contamination.
  - b. increase the certainty that coliform bacteria are present.
  - c. verify the presence of bacteria.
  - d. verify the presence of pathogenic organisms.
  
68. One characteristic of activated carbon that enhances its use in the adsorption process is its
  - a. atomic weight.
  - b. large pore structure.
  - c. molecular structure.
  - d. stickiness.
  
69. What metallic element should be monitored for when using caustic soda for corrosion control?
  - a. copper
  - b. iron
  - c. sodium
  - d. zinc
  
70. A rectangular reservoir 110 ft × 60 ft × 12 ft is filled with water. How many pounds of a chemical must be added to produce a dosage of 80 mg/L?
  - a. 125 lb
  - b. 250 lb
  - c. 310 lb
  - d. 395 lb
  
71. When operating a surface-water treatment plant, which of the following laboratory tests is of most significance for establishing chemical dosages for coagulating water?
  - a. calcium and magnesium
  - b. pH and alkalinity
  - c. sulfates
  - d. total hardness

72. An example of a chemical element is
- alum.
  - ammonia.
  - carbon.
  - water.
73. The process of adjusting pH just above the saturation point of calcium carbonate will
- accelerate the corrosion process.
  - form a protective coating on the surface of the pipes.
  - prevent the precipitation of iron compounds.
  - sequester scale-forming ions.
74. An operator is caught in a room where chlorine gas is leaking. If the operator does not have a mask, what should the operator do?
- keep mouth closed, keep head as high as possible, and quickly walk out of the room, holding breath if possible.
  - lay down on the floor and quickly crawl out of the room
  - pull shirt over mouth and face and quickly walk out of the room.
  - walk out of the room quickly.
75. Fluoride chemicals, like many chemicals used in water treatment, constitute a variety of potential health hazards, but the hazard most common in handling and feeding dry fluoride compounds is
- asphyxiation.
  - bodily contact.
  - ingestion.
  - inhalation.
76. The purpose of adding carbon dioxide to water after a chemical precipitation softening process is to
- combine with any excess alum present.
  - increase the pH of the water.
  - reduce the amount of lime required.
  - restore the carbonate balance.
77. Both alum and ferric sulfate are affected by
- alkalinity.
  - filter media selection.
  - other coagulants.
  - sunlight.

78. *Anabaena* can cause what undesirable characteristic in water?
- color and decomposition
  - evaporation and contamination
  - hardness and "blue babies"
  - taste and odor
79. If maintaining pressure in a fluoride feed system is not necessary, backflow can best be prevented by
- installing an atmospheric loop.
  - installing a vacuum breaker.
  - installing an antisiphoning device.
  - providing an air gap.
80. The annual operating cost is  
Salaries = \$5970  
Chemicals = \$2540  
Power = \$3251  
Miscellaneous = \$269
- What is the cost per 1000 gal if 2 mil gal of water are pumped each month?
- \$6.02
  - \$2.99
  - \$0.50
  - cannot be determined
81. How many pounds of hypochlorite, at 65 percent available chlorine, are required to equal 90 lb of pure chlorine?
- 243.6 lb
  - 170.39 lb
  - 138.5 lb
  - 109.57 lb
82. The SPADNS method can be used to determine the concentration of
- coliform bacteria.
  - dissolved oxygen.
  - fluoride.
  - iron.
83. Flow measurements for plant operations are usually taken
- at a point before the water enters the intake structure.
  - somewhere near the point where the water enters the treatment plant.
  - weekly.
  - within the intake structure.

84. The chlorine demand of a certain water is 3 mg/L. The operator treats 250,000 gal of water with 10 lb of chlorine gas. What will the chlorine residual be?
- 1.8 mg/L
  - 3.0 mg/L
  - 4.8 mg/L
  - 6.0 mg/L
85. A commonly used test to monitor the influent and effluent water of a presedimentation basin is
- algal count.
  - bacteriological count.
  - solids test.
  - total dissolved solids test.
86. The Langelier Index is an indicator used to measure
- whether water is likely to dissolve or precipitate  $\text{CaCO}_3$ .
  - the theoretical pH.
  - the rate of corrosion.
  - scale-forming potential.
87. Effectiveness of the coagulation/flocculation process is best measured
- against a coagulant performance curve.
  - by titration to an end point.
  - by visual observation.
  - using a nephelometric turbidimeter.
88. The removal of organic materials using activated carbon depends on
- adsorption.
  - filtration.
  - oxidation.
  - recarbonation.
89. The efficiency of the aeration process is primarily determined by the
- velocity of air flow.
  - surface contact between air and water.
  - number of splash areas.
  - mixing patterns.
90. The maximum safe dosage of copper sulfate depends in part on
- the toxic effect on fish.
  - solubility constant for copper.
  - how much the boat can carry.
  - how much algae is present.

91. One method to detect short-circuiting problems is to
  - a. change coagulants and coagulant aids.
  - b. conduct tracer studies.
  - c. increase detention time.
  - d. install perforated baffles.
92. A common operating problem with fluoridation is
  - a. extremely high feed rates.
  - b. corrosion in the distribution system.
  - c. fluoride concentrations below the optimum due to inadequate feed rates.
  - d. tastes and odors.
93. An important operating reason for adding powdered activated carbon ahead of normal coagulation/flocculation and filtration is that
  - a. the coagulant dosage can be reduced.
  - b. taste and odor removal is ineffective following filtration.
  - c. detention time can be more easily controlled.
  - d. carbon treatment should not be allowed to interfere with disinfection.
94. The amount of time a sample can be stored depends on
  - a. the laboratory procedure being used.
  - b. the stability of the constituent to be tested and whether the sample can be preserved.
  - c. the temperature.
  - d. whether the sample contains raw or treated water.
95. If excessive media loss occurs consistently, one should
  - a. check the rate-of-flow controller for malfunctioning.
  - b. discontinue using surface washers.
  - c. investigate all backwashing procedures.
  - d. probe the filter bed.
96. Sodium thiosulfate crystals are placed in bacteriological sample bottles to
  - a. hold pH at a constant value.
  - b. kill any pathogens that may be present in the sample.
  - c. neutralize any chlorine present in the sample.
  - d. preserve the sample.
97. Ferric hydroxide is
  - a. a strong solution for purging bacterial growths.
  - b. common rust.
  - c. formed at the cathode.
  - d. used for dissolving tubercules.



98. "Black water" complaints are the result of
- alum entering the distribution system.
  - high threshold odor numbers in the treated water.
  - high trihalomethanes.
  - powdered activated carbon entering the distribution system.
99. If a fuse continues to blow, you should
- inspect the affected equipment to determine the cause.
  - provide a jumper in the box.
  - replace it with a fuse of lower capacity.
  - replace it with a higher capacity fuse.
100. Solids-contact basins are designed with baffles to
- intensify agitation during flash mixing.
  - reduce velocity and produce a nonturbulent flow.
  - separate the influent and effluent zones.
  - separate the mixing and settling processes.
101. If phosphate is used to sequester (suspend) iron, the phosphate should be injected
- after chlorination.
  - before chlorination.
  - in the well.
  - with alum.
102. What type of treatment should be given when a well produces red water?
- pH adjustment, aeration, and filtration
  - sedimentation
  - softening
  - taste and odor control
103. Operational control of flash mixing is best achieved by
- altering the rate of flow.
  - a baffled chamber.
  - installing in-line mechanical mixers.
  - the pump and conduit-type of flash mixer.
104. Dissolved oxygen, pH, and temperature can best be related to the aeration process as
- basic control tests.
  - factors contributing to clogged diffusers.
  - factors that principally influence the selection of an aerator.
  - troublesome constituents.

105. The carrying capacity of water mains is often reduced by
- high pressures.
  - looping.
  - tuberculation.
  - vacuum breakers.
106. Automation of a water system would provide
- constant pressure.
  - cross-connection control.
  - prevention of corrosion.
  - prevention of main breaks.
107. If short filter runs are occurring because of high head loss, it would be advisable to
- use the variable declining-rate filtration method.
  - reduce filter aid dosage.
  - increase the flow rate.
  - increase coagulant dosage.
108. In a 1-mil-gal reservoir, how many pounds of HTH (65 percent available chlorine) are required to produce a residual of 1.0 mg/L (assume water has zero chlorine demand)?
- 5.4 lb
  - 8.3 lb
  - 12.8 lb
  - 16.6 lb
109. The fluoridation monitoring practice that is most highly recommended involves
- ensuring that all chemical feed equipment is calibrated for proper dosage rates.
  - reporting daily test results to the state or EPA.
  - routinely determining the fluoride concentration in the raw and treated water.
  - sampling and testing representative points within the treatment plant.
110. Usually the most desirable point of application to add powdered activated carbon is
- during coagulation.
  - immediately following prechlorination.
  - in the raw-water intake line.
  - just ahead of the filter.

111. To test if a 110-V/AC outlet is hot, set volt-ohm meter for
- 100 A.
  - 250 A.
  - 100 V/AC.
  - 250 V/AC.
112. Iron that remains in the ferrous state will
- be removed by the filters.
  - pass through the filters.
  - precipitate in the reaction tank.
  - settle out.
113. A sample in the presumptive test for total coliform is positive if
- colonies with green metallic sheen are formed.
  - gas is produced within 48 h.
  - no gas is produced.
  - the presence of coliform bacteria is suspected.

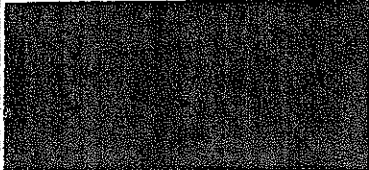


# ANSWERS



## Water Treatment Class III

- |       |       |       |
|-------|-------|-------|
| 1. b  | 19. a | 37. d |
| 2. c  | 20. b | 38. b |
| 3. a  | 21. c | 39. c |
| 4. b  | 22. d | 40. c |
| 5. c  | 23. d | 41. a |
| 6. d  | 24. b | 42. b |
| 7. b  | 25. b | 43. d |
| 8. c  | 26. d | 44. a |
| 9. c  | 27. a | 45. d |
| 10. a | 28. b | 46. d |
| 11. d | 29. a | 47. d |
| 12. c | 30. a | 48. d |
| 13. a | 31. b | 49. c |
| 14. c | 32. d | 50. d |
| 15. b | 33. d | 51. d |
| 16. b | 34. a | 52. c |
| 17. b | 35. c | 53. a |
| 18. a | 36. c | 54. a |

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- |       |       |        |
|-------|-------|--------|
| 55. b | 75. d | 95. c  |
| 56. b | 76. d | 96. c  |
| 57. d | 77. a | 97. b  |
| 58. d | 78. d | 98. d  |
| 59. a | 79. d | 99. a  |
| 60. b | 80. c | 100. d |
| 61. b | 81. c | 101. b |
| 62. a | 82. c | 102. a |
| 63. c | 83. b | 103. c |
| 64. d | 84. a | 104. a |
| 65. d | 85. b | 105. c |
| 66. a | 86. a | 106. a |
| 67. b | 87. d | 107. b |
| 68. b | 88. a | 108. c |
| 69. c | 89. b | 109. c |
| 70. d | 90. a | 110. c |
| 71. b | 91. b | 111. d |
| 72. c | 92. c | 112. b |
| 73. b | 93. d | 113. b |
| 74. a | 94. b |        |