PRACTICE EXAM 7: ABC CLASS I WASTEWATER TREATMENT SIMULATION (100 QUESTIONS)

1. A treatment plant operator reviews the daily influent monitoring log and notices that the conductivity has spiked from a normal range of 800 µS/cm to 2,400 µS/cm for three consecutive days. The flow, BOD, and TSS remain within normal ranges. Which of the following sources most likely explains the elevated conductivity?

A. A large rainstorm has diluted the wastewater with clean stormwater that has high mineral content

B. The laboratory conductivity meter has drifted from calibration and needs recalibration with standards

C. An industrial user is discharging a high-dissolved-solids waste stream such as brine, cooling tower blowdown, or process rinse water

D. The residential community has increased water softener regeneration cycles due to changes in the municipal water supply hardness

2. An operator measures the following influent characteristics on a Monday morning: BOD 340 mg/L, TSS 280 mg/L, pH 4.5, and a strong solvent odor. By Monday afternoon, the BOD drops to 190 mg/L, the TSS drops to 210 mg/L, and the pH returns to 6.8. The flow remained constant throughout. Which of the following sequences of events most likely occurred?

A. Normal domestic wastewater concentration peaked during the morning hours and diluted by afternoon

B. A collection system blockage caused wastewater to back up and then release in a concentrated slug

C. The laboratory contaminated the morning sample and the afternoon sample represents the true conditions

D. An industrial batch discharge of high-BOD, acidic waste entered the collection system overnight and the slug passed through during the morning hours

3. A treatment plant serving a community of 15,000 people has a design average daily flow of 1.5 MGD. The actual average daily flow measured over the past year is 2.1 MGD. The per capita wastewater contribution is estimated at 100 gallons per person per day. What does the discrepancy between design flow and actual flow most likely indicate?

A. The community population has grown significantly beyond the 15,000 people used for the design calculation

B. The collection system has significant infiltration and inflow contributing approximately 0.6 MGD of non-wastewater flow

C. The flow meter has been reading 40% high for the past year and needs calibration correction

D. The industrial contributions to the collection system have increased beyond the design assumptions

4. During a routine Imhoff cone test, the operator observes that the influent settleable solids result has changed from 8 mL/L (historical average) to 2 mL/L over the past two weeks. The influent TSS has remained at 220 mg/L. What does this change in settleability suggest about the influent characteristics?

A. The particle size distribution has shifted toward smaller, colloidal particles that remain in suspension rather than settling in the cone

B. The Imhoff cone test is being performed incorrectly and the settling time should be extended to 90 minutes

C. The influent temperature has decreased, slowing the biological activity that normally causes particles to flocculate and settle

D. The influent wastewater is now more concentrated, causing the particles to settle faster and compact more tightly

5. A treatment plant operator is evaluating the impact of accepting septage deliveries on the plant's treatment capacity. The plant receives an average of 5,000 gallons of septage per day with a BOD of 7,000 mg/L. The plant's normal influent BOD is 200 mg/L at a flow of 3.0 MGD. What percentage of the total BOD mass loading is contributed by the septage?

A. Approximately 3% of the total plant BOD loading comes from septage deliveries

B. Approximately 12% of the total plant BOD loading comes from septage deliveries

C. Approximately 6% of the total plant BOD loading comes from septage deliveries

D. Approximately 18% of the total plant BOD loading comes from septage deliveries

6. An activated sludge plant has been operating steadily for months when the operator notices a gradual increase in the effluent turbidity despite stable MLSS, SVI, sludge blanket depth, and DO. The microscopic examination reveals a significant reduction in protozoa (stalked ciliates and free-swimming ciliates) compared to previous months. The influent characteristics have not changed. What is the most likely cause of the declining protozoan population?

A. The aeration rate is too high and the turbulence is physically destroying the delicate protozoan organisms

B. The F/M ratio has increased to the point where bacteria are outcompeting the protozoa for available substrate

C. The pH has dropped below 5.5 and the acidic environment is toxic to protozoa but tolerable for bacteria

D. A low-level chronic toxicant — possibly a metal or organic compound — is selectively inhibiting the protozoa while the hardier bacteria survive

7. An operator at an activated sludge plant calculates the volumetric organic loading on the aeration basin. The basin volume is 0.5 MG, the plant flow is 2.0 MGD, and the primary effluent BOD is 140 mg/L. What is the volumetric loading, and is it within the typical design range for conventional activated sludge?

A. The volumetric loading is approximately 35 lbs BOD/1,000 ft^3/day, which is within the typical range of 20–60 lbs/1,000 ft^3/day for conventional systems

B. The volumetric loading is approximately 70 lbs BOD/1,000 ft^3/day, which exceeds the typical range and indicates overloading

C. The volumetric loading is approximately 15 lbs BOD/1,000 ft^3/day, which is in the extended aeration range

D. The volumetric loading is approximately 100 lbs BOD/1,000 ft^3/day, which significantly exceeds the design capacity

8. A secondary clarifier has a surface area of 6,000 ft^2 and receives a plant flow of 4.0 MGD plus a RAS flow of 1.5 MGD. The MLSS is 3,200 mg/L. The operator calculates the SLR and SOR. Which of the following pairs of values is approximately correct?

A. SOR of 667 GPD/ft^2 and SLR of 36.7 lbs/day/ft^2, both within typical design ranges

B. SOR of 667 GPD/ft^2 and SLR of 24.4 lbs/day/ft^2, with the SLR within the typical range of 20–30 lbs/day/ft^2

C. SOR of 917 GPD/ft^2 and SLR of 24.4 lbs/day/ft^2, both within typical design ranges

D. SOR of 917 GPD/ft^2 and SLR of 36.7 lbs/day/ft^2, with the SLR exceeding the typical design maximum

9. An activated sludge plant is operating at an MLSS of 2,800 mg/L with a 30-minute settled volume of 490 mL/L. The operator calculates the SVI and determines that it indicates marginal settling. The operator also calculates the Sludge Density Index (SDI = 100 ÷ SVI). What SVI and SDI values would the operator obtain?

A. SVI of 140 mL/g and SDI of 0.71, indicating the sludge needs moderate improvement

B. SVI of 175 mL/g and SDI of 0.57, indicating the sludge is settling poorly with probable filamentous organisms

C. SVI of 210 mL/g and SDI of 0.48, indicating severe bulking requiring immediate corrective action

D. SVI of 100 mL/g and SDI of 1.0, indicating excellent settling with dense, well-structured floc

10. A treatment plant uses sodium hydroxide (NaOH) at a dose of 125 mg/L to raise the pH of the mixed liquor from 6.2 to 7.0. The plant flow is 1.8 MGD. The NaOH solution is 50% by weight with a specific gravity of 1.53. How many gallons per day of the 50% NaOH solution are needed?

A. Approximately 120 GPD, calculated using the dose, flow, and solution properties

B. Approximately 180 GPD, calculated using the dose, flow, and solution properties

C. Approximately 75 GPD, calculated using the dose, flow, and solution properties

D. Approximately 29 GPD, calculated using the dose, flow, and solution properties

11. A treatment plant operates a biological nutrient removal system in the A^2/O (Anaerobic-Anoxic-Oxic) configuration. The anaerobic zone receives raw influent and return sludge. The anoxic zone receives internal recycle from the aerobic zone. The system has been performing well until a new industrial user begins discharging wastewater high in nitrate (85 mg/L NO_3-N). Where in the BNR process will this industrial nitrate most directly interfere?

A. In the aerobic zone, where the additional nitrate will compete with dissolved oxygen for electron acceptors

B. In the secondary clarifier, where the nitrate will cause denitrification and rising sludge

C. In the anaerobic zone, where the nitrate provides an alternative electron acceptor that prevents the truly anaerobic conditions needed for phosphorus release by PAOs

D. In the anoxic zone, where the additional nitrate will overwhelm the denitrifying bacteria

12. An operator at a plant with fine bubble diffused aeration measures the oxygen transfer efficiency of the diffuser system. The alpha factor (correction for wastewater vs. clean water) is 0.65, and the clean-water oxygen transfer efficiency of the diffusers is 28%. What is the estimated actual oxygen transfer efficiency in the wastewater?

A. Approximately 18.2%, calculated by multiplying the clean-water efficiency by the alpha factor

B. Approximately 28%, unchanged because the alpha factor does not affect the diffuser performance

C. Approximately 43%, calculated by dividing the clean-water efficiency by the alpha factor

D. Approximately 35%, calculated by adding a 25% correction factor for wastewater temperature

13. A plant operating a Modified Ludzack-Ettinger denitrification system has an internal recycle rate of 400% of the influent flow. The aerobic zone effluent nitrate is 12 mg/L. Theoretically, what is the maximum percent of the total nitrate that can be returned to the anoxic zone for denitrification at this recycle rate?

A. 100% of the nitrate can be returned because the recycle rate exceeds 300% of influent flow

B. 50% of the nitrate can be returned, with the remaining 50% passing directly to the effluent

C. 25% of the nitrate can be returned because the recycle efficiency decreases exponentially above 200%

D. 80% of the nitrate can be returned at a 400% recycle rate — the remaining 20% exits in the effluent because only a fraction of the flow passes through the anoxic zone

14. A treatment plant effluent is meeting all conventional limits (BOD, TSS, pH) but the operator receives a revised permit requiring a total phosphorus limit of 1.0 mg/L. The current effluent total phosphorus is 4.5 mg/L. The operator begins adding ferric chloride to the secondary clarifier influent. After one week, the effluent phosphorus drops to 0.8 mg/L, but the operator notices the aeration basin MLSS has increased from 2,400 mg/L to 3,100 mg/L despite no change in the WAS rate. What is the most likely explanation for the MLSS increase?

A. The ferric chloride addition creates chemical precipitates (ferric phosphate and ferric hydroxide) that add to the total suspended solids mass in the aeration basin

B. The ferric chloride is inhibiting the WAS pump operation and reducing the actual waste rate

C. The phosphorus removal has stimulated additional biological growth by providing phosphorus-limited organisms with more available substrate

D. The ferric chloride has increased the specific gravity of the mixed liquor, making the MLSS reading appear higher

15. An extended aeration plant with an SRT of 25 days and an F/M of 0.06 is experiencing an increase in effluent TSS from 8 mg/L to 22 mg/L. The settled sludge volume is only 180 mL/L with an MLSS of 4,800 mg/L (SVI = 37.5 mL/g). The microscopic examination shows tiny, round, dense particles with no filaments. Which of the following is the most appropriate corrective action?

A. Add polymer to the secondary clarifier influent to capture the fine particles before they pass over the weir

B. Reduce the SRT by increasing the WAS rate to bring the F/M up and encourage the formation of larger, more capturable biological floc

C. Increase the MLSS further to improve the sweep-floc effect that captures fine particles during settling

D. Install a tertiary filter downstream of the secondary clarifier to capture the pin floc that gravity settling cannot remove

16. A plant operates chlorination followed by dechlorination with sulfur dioxide (SO_2). The operator measures the following after the contact tank: free chlorine 0.0 mg/L, total chlorine 1.2 mg/L. The SO_2 system dechlorinates the effluent to a total chlorine residual of 0.01 mg/L. The permit limit for total residual chlorine is 0.019 mg/L. The SO_2:Cl_2 ratio used is 0.9:1 (mg:mg). What chemical form of chlorine is present after the contact tank?

A. The chlorine is present entirely as free chlorine (hypochlorous acid and hypochlorite ion)

B. The chlorine is present entirely as chlorine dioxide, a secondary disinfection byproduct

C. The chlorine is present entirely as combined chlorine (chloramines), since free chlorine is 0.0 and total chlorine is 1.2 mg/L

D. The chlorine is present as a mixture of free and combined forms that the DPD method cannot distinguish

17. A treatment plant processes 3.5 MGD and must achieve a UV dose of 40 mJ/cm² for adequate disinfection. The UV system has 4 banks of lamps, each providing 12 mJ/cm² at the current flow. If one bank is taken offline for lamp replacement, what is the delivered UV dose, and does it meet the target?

A. The delivered dose is 30 mJ/cm², which is below the 40 mJ/cm² target and may result in inadequate disinfection

B. The delivered dose is 36 mJ/cm², which is close to but does not meet the 40 mJ/cm² target

C. The delivered dose is 48 mJ/cm², which exceeds the target because removing one bank concentrates the remaining UV energy

D. The delivered dose is 36 mJ/cm², which meets the target because only 30 mJ/cm² is actually required for compliance

18. An activated sludge system treats 2.5 MGD with an MLSS of 3,000 mg/L in an aeration basin volume of 0.8 MG. The WAS flow is 0.035 MGD at a WAS concentration of 8,000 mg/L. The effluent TSS is 10 mg/L. The operator wants to increase the SRT from the current value to 12 days to improve nitrification. What adjustment should the operator make?

A. Increase the WAS rate because a longer SRT requires removing more old solids to make room for younger organisms

B. No adjustment is needed because the current SRT is already approximately 12 days

C. Reduce the WAS rate to retain solids longer in the system, thereby extending the SRT

D. Increase the RAS rate to move more organisms from the clarifier to the aeration basin faster

19. An operator at a treatment plant with biological nutrient removal notices that the effluent total phosphorus has increased from 0.6 mg/L to 2.8 mg/L over two weeks. The EBPR system uses an anaerobic zone followed by an aerobic zone. Investigation reveals that the secondary clarifier sludge blanket has been unusually deep for the past two weeks due to a malfunctioning RAS pump running at reduced capacity. How does the deep sludge blanket contribute to the elevated effluent phosphorus?

A. Anaerobic conditions in the deep sludge blanket cause the PAOs to release the phosphorus they previously absorbed, and the released phosphorus enters the effluent with the clarifier overflow

B. The deep sludge blanket increases the hydraulic detention time in the clarifier, which improves phosphorus removal

C. The deep blanket dilutes the RAS concentration, reducing the number of PAOs returned to the aeration basin

D. The reduced RAS flow increases the dissolved oxygen in the anaerobic zone, inhibiting phosphorus release

20. A treatment plant's sand filter operates with a terminal headloss of 8 feet before triggering a backwash. The operator notices that the filter is now reaching terminal headloss in 6 hours instead of the normal 18 hours. The secondary effluent TSS has remained stable at 10 mg/L. Which of the following is the most likely explanation?

A. The filter media has become compacted over time, reducing the void spaces and increasing headloss per unit of solids captured

B. The previous backwash did not adequately clean the media, leaving residual solids that reduce the available filter capacity for the next run

C. The filter underdrain has become partially clogged, restricting drainage and causing premature headloss readings

D. The plant flow rate has increased, raising the filtration velocity and causing faster headloss buildup

21. An operator discovers that the plant's effluent ammonia has suddenly increased from 1.0 mg/L to 15 mg/L overnight. The aeration basin DO is 3.0 mg/L, the pH is 7.2, and the alkalinity is 160 mg/L. The MLSS has dropped from 3,200 mg/L to 1,800 mg/L. The SVI remains at 110 mL/g. Which of the following is the most likely cause?

A. A toxic discharge has killed the nitrifying bacteria but left the BOD-removing organisms intact

B. The alkalinity has been depleted by a sudden increase in the influent ammonia loading concentration

C. The aeration blowers have failed, creating anaerobic conditions that killed the nitrifiers

D. Excessive wasting has reduced the MLSS and shortened the SRT below the minimum for nitrification

22. A plant must add 200 lbs/day of lime (calcium hydroxide) to the aeration basin for alkalinity supplementation. The lime is delivered as a dry powder with a bulk density of 30 lbs/ft³. The plant uses a volumetric dry chemical feeder calibrated in ft³/hour. At what feed rate setting (ft³/hour) should the feeder be operated?

A. 2.5 ft³/hour to deliver 200 lbs/day based on a 24-hour operating schedule

B. 0.28 ft^3/hour to deliver 200 lbs/day based on a 24-hour operating schedule

C. 0.28 ft^3/hour, calculated as 200 lbs/day ÷ 30 lbs/ft^3 ÷ 24 hours/day

D. 6.67 ft^3/hour to deliver 200 lbs per 24-hour period based on the bulk density

23. A treatment plant receives wastewater from a community that uses chloramine-treated drinking water. The operator notices that the breakpoint chlorination curve in the contact tank shows a much higher chlorine demand than expected — nearly double the design demand. What is the most likely explanation?

A. The chloramines from the drinking water distribution system carry through to the wastewater treatment plant and react with the applied chlorine, consuming additional dose before breakpoint is reached

B. The biological organisms in the activated sludge have developed a resistance to chlorine that requires higher doses

C. The UV disinfection system upstream is pre-treating the wastewater and creating chlorine-reactive byproducts

D. The chlorine delivery system has a leak that is reducing the actual dose applied to the wastewater

24. A clarifier with a diameter of 100 feet has an influent center well that is 12 feet in diameter. During high-flow events, the operator notices that the effluent TSS increases significantly. The sludge blanket depth is normal and the SVI is acceptable. Which clarifier design element is most likely contributing to the poor high-flow performance?

A. The clarifier depth is inadequate for the high-flow settling velocity requirements

B. The 12-foot center well is too small relative to the 100-foot clarifier diameter, creating a high-velocity inlet jet that disturbs the settling zone during peak flows

C. The clarifier weir is too short and cannot handle the increased flow without creating excessive turbulence

D. The RAS withdrawal point is too far from the sludge blanket and is drawing clear water instead of thickened sludge

25. A plant operator performs a chlorine demand study and finds that the effluent chlorine demand is 3.8 mg/L. The target contact tank residual is 0.8 mg/L. The chlorine contact tank has an effective detention time of 25 minutes. What total chlorine dose is needed, and what is the resulting CT value?

A. Total dose of 3.0 mg/L with a CT of 19 mg·min/L

B. Total dose of 4.6 mg/L with a CT of 115 mg·min/L

C. Total dose of 4.6 mg/L with a CT of 20 mg·min/L

D. Total dose of 3.8 mg/L with a CT of 95 mg·min/L

26. A treatment plant's secondary effluent has a UV transmittance of 72% and the UV system delivers a dose of 45 mJ/cm². After a process upset in the secondary treatment system, the effluent TSS increases from 8 mg/L to 25 mg/L and the UVT drops to 48%. Assuming the same flow rate and lamp configuration, what is the approximate effect on the delivered UV dose?

A. The UV dose remains at 45 mJ/cm² because the lamp intensity has not changed

B. The UV dose increases because the higher TSS scatters more UV light, increasing the exposure to pathogens

C. The UV dose decreases proportionally to the lamp aging curve and needs maintenance correction

D. The UV dose decreases significantly because less UV energy penetrates through the water to reach the pathogens

27. A treatment plant operates in a region where the receiving water has extremely low assimilative capacity. The NPDES permit requires an effluent total nitrogen of 3.0 mg/L. The plant achieves 0.5 mg/L ammonia and 4.5 mg/L nitrate for a total inorganic nitrogen of 5.0 mg/L (plus approximately 1.0 mg/L organic N for total N of 6.0 mg/L). The internal recycle rate is already at 500%. What additional process modification would be most effective?

A. Add a post-anoxic denitrification zone with supplemental carbon after the aerobic zone to further reduce nitrate before final clarification

B. Increase the internal recycle rate to 800% to return more nitrate to the pre-anoxic zone

C. Add more dissolved oxygen to the aerobic zone to improve the completeness of nitrification

D. Reduce the SRT to decrease the degree of nitrification and lower the nitrate produced

28. A plant uses a chemical feed system with two metering pumps — one primary and one standby. The primary pump feeds sodium hypochlorite at 15 GPH. If the primary pump fails, the standby pump should automatically start and deliver the same dose. During a weekly test, the operator activates the standby pump and finds it delivers only 11 GPH at the same stroke and speed settings. What is the most likely cause?

A. The standby pump motor is receiving lower voltage from the backup electrical circuit

B. The standby pump check valves or diaphragm have degraded during the extended idle period, reducing the actual output per stroke

C. The sodium hypochlorite solution viscosity changes between the primary and standby pump suction lines

D. The standby pump is a different model with a smaller displacement volume per stroke

29. An activated sludge process operating at an SRT of 10 days produces waste activated sludge that is sent directly to a belt filter press for dewatering without any stabilization. After dewatering, the cake has a strong, objectionable odor. Why does unstabilized WAS produce odorous cake?

A. The belt filter press chemicals (polymer) react with the fresh biological solids to produce volatile organic compounds

B. The belt press operating temperature is too high and is thermally degrading the biological material

C. The unstabilized WAS contains a high proportion of readily biodegradable organic matter that decomposes anaerobically after dewatering, producing hydrogen sulfide and other odorous compounds

D. The WAS pH is too low and the acidic conditions cause the release of volatile fatty acids during dewatering

30. A treatment plant's primary clarifier influent flow splitting structure divides flow between two primary clarifiers using a weir box. The operator notices that Clarifier A receives approximately 65% of the flow while Clarifier B receives only 35%. Both clarifiers have the same surface area. What is the operational consequence of this uneven flow distribution?

A. Clarifier A will produce better effluent because the higher flow creates more turbulence that improves flocculation

B. Both clarifiers will perform equally because primary clarifiers are not sensitive to flow distribution variations

C. Clarifier B will overflow because it receives less flow and the sludge blanket will rise above the weir

D. Clarifier A will be hydraulically overloaded with a higher SOR and reduced detention time, while Clarifier B will be underloaded — leading to reduced overall primary treatment performance

31. An operator is troubleshooting an odor complaint from the primary clarifier area. The clarifiers have been operating at a sludge blanket depth of 5 feet (above the normal maximum of 3 feet) for the past week due to a sludge pump malfunction. The operator detects a strong hydrogen sulfide odor at the clarifier surface. What is the connection between the deep sludge blanket and the odor?

A. The deep sludge blanket creates anaerobic conditions in the lower layers where sulfate-reducing bacteria produce H_2S from the decomposing organic matter in the retained sludge

B. The deep sludge blanket increases the surface area for atmospheric oxygen absorption, creating conditions that produce sulfur dioxide

C. The sludge blanket is releasing methane gas that has a sulfur-like odor when it reaches the clarifier surface

D. The deep blanket indicates the sludge has been over-chlorinated and the excess chlorine is reacting with sulfur compounds

32. A treatment plant's activated sludge microscopic examination reveals an abundance of Vorticella (stalked ciliates) attached to the biological floc, with moderate numbers of rotifers and a few free-swimming ciliates. No filamentous organisms are observed. What does this biological community indicate about the treatment process?

A. The system is severely overloaded and approaching process failure with poor effluent quality

B. The system has a mature, well-established biological community operating at a stable SRT with good floc formation and effluent quality

C. The system is experiencing toxic conditions that have killed the filamentous organisms but spared the protozoa

D. The system has excessive dissolved oxygen that is supporting an abnormal proliferation of higher organisms

33. A plant operating an oxidation ditch has two parallel ditches, each with two brush aerators. The operator is directed to reduce energy costs by shutting off one brush aerator in each ditch during nighttime hours when the oxygen demand is lower. What potential operational risk does this create?

A. The reduced mixing intensity may cause solids to settle in the channel, creating dead zones and short-circuiting

B. The remaining brush aerators will overheat from the increased workload and fail prematurely

C. The reduced velocity in the ditch channel may allow solids to settle in low-velocity zones, disrupting the mixed liquor circulation pattern and reducing treatment efficiency

D. The oxidation ditch will convert to anaerobic conditions within minutes of shutting off one brush aerator

34. A wastewater treatment plant has experienced three separate occasions in the past year where the secondary clarifier sludge blanket rose to within 2 feet of the effluent weir during peak afternoon flows. Each time, the sludge blanket returned to normal depth by evening. What infrastructure improvement would most directly address this recurring problem?

A. Replace the secondary clarifier center well with a larger-diameter energy-dissipating inlet

B. Install additional effluent weir length (launders) to reduce the weir overflow rate during peak flows

C. Replace the RAS pumps with higher-capacity pumps that can increase the withdrawal rate during peak flow periods

D. Add equalization capacity to dampen the peak afternoon flows before they reach the secondary clarifiers

35. A treatment plant experiences a simultaneous failure of both aeration blowers during the overnight shift. The operator estimates that the dissolved oxygen in the aeration basin will drop to zero within 30 minutes at the current loading. A portable diesel-driven compressor is available but produces approximately 25% of the normal air supply. What should the operator do while waiting for blower repair?

A. Reduce the influent flow to decrease the oxygen demand on the aeration basin

B. Start the portable compressor to provide partial aeration and keep as much of the biology alive as possible, while simultaneously troubleshooting the blower failure

C. Increase the WAS rate to remove organisms and reduce the total oxygen demand in the basin

D. Add hydrogen peroxide to the aeration basin as an emergency oxygen source while repairs are made

36. A plant must meet a daily maximum effluent limit of 45 mg/L BOD and a monthly average of 30 mg/L. The daily results for the month are: 15, 18, 22, 44, 16, 28, 31, 12, 24, 19, 26, 42, 18, 22, 14, 27, 33, 20, 25, 16, 28, 21, 38, 15, 24, 22, 19, 26, 17, 23. What is the compliance status?

A. The plant is in compliance — no daily result exceeds 45 mg/L and the monthly average of 23.3 mg/L is below 30 mg/L

B. The plant is in violation of the daily maximum because two results (44 and 42 mg/L) are close to the limit

C. The plant is in violation of the monthly average because results of 44, 42, 38, 33, and 31 exceed 30 mg/L individually

D. The plant is in violation because the standard deviation of the results exceeds the acceptable range

37. An operator at a treatment plant with both UV disinfection and chlorination/dechlorination has been directed to switch from UV to chlorine due to UV system maintenance. During the switchover, the operator must ensure continuous disinfection coverage. What is the critical timing consideration?

A. The chlorine contact tank must be full and achieving the target residual before the UV system is shut down

B. The UV system can be shut down immediately because chlorine acts instantaneously upon addition

C. The UV system must remain operational for 24 hours after the chlorine system starts to ensure overlap

D. The chlorine feed rate must be gradually increased over 48 hours to allow the biology to acclimate to the chemical

38. A treatment plant has experienced recurrent Nocardia foam for the past six months. The operator has tried surface wasting, water sprays, and reducing the SRT from 20 days to 12 days. The foam persists. Which of the following additional strategies is most likely to eliminate the foam?

A. Increase the dissolved oxygen to 5.0 mg/L throughout the aeration basin to inhibit the Nocardia organisms

B. Add chlorine to the RAS line at a dose sufficient to selectively kill the Nocardia without significantly damaging the floc-forming organisms

C. Further reduce the SRT below the minimum growth rate of Nocardia to wash the organisms from the system faster than they can reproduce

D. Install a foam trapping and removal system to physically collect and waste the foam before it spreads to the secondary clarifier

39. A plant operates a gravity thickener for primary sludge and a DAF thickener for WAS. Both thickened streams are combined before being fed to the anaerobic digester. The primary sludge thickens to 6% TS and the WAS thickens to 4% TS. The combined feed to the digester is approximately 5% TS. If the DAF fails and the WAS can only be thickened to 1.5% TS, what is the primary impact on the digester?

A. The digester volatile solids loading will increase because the thinner WAS contains a higher proportion of volatile matter

B. The digester will receive a much higher volume of dilute sludge, reducing the hydraulic detention time and potentially overwhelming the heating capacity

C. The digester gas production will increase because the thinner sludge provides more water for the methane-forming bacteria

D. The digester performance will be unaffected because the total mass of volatile solids entering remains the same

40. An operator arrives at the plant on a Monday morning and discovers that the weekend operator left a note stating: "Entered the primary clarifier mechanism room to investigate a strange noise. No confined space entry permit was completed. Atmospheric testing was not performed. No attendant was stationed at the entry point." The weekend operator reports feeling fine and the noise was diagnosed as a loose belt on the drive motor. What should the Monday operator do?

A. Report the unauthorized confined space entry to the supervisor immediately because the weekend operator violated multiple OSHA-required safety procedures that could have resulted in a fatality

B. Take no action because the weekend operator completed the work safely and reported the findings

C. Remind the weekend operator to fill out the paperwork next time but take no formal action

D. Document the incident in the daily log and schedule a maintenance work order for the loose belt

41. An operator is required to work in a chlorine gas cylinder storage room to perform quarterly inventory and inspection. The room is well-ventilated with an exhaust fan running continuously and a chlorine gas detector installed at breathing height. The detector reads 0.0 ppm chlorine. Which of the following PPE requirements must the operator meet before entering?

A. No PPE is required because the gas detector confirms the atmosphere is safe and the ventilation is adequate

B. The operator must wear a full-face SCBA because chlorine gas rooms always require supplied-air respiratory protection

C. The operator must have a chlorine-rated emergency escape respirator immediately available in case the atmospheric conditions change during the work

D. The operator must wear a half-face air-purifying respirator with acid gas cartridges at all times while in the room

42. A treatment plant experiences a power outage during a severe thunderstorm. The emergency generator starts and transfers load through the automatic transfer switch. After 2 hours, the utility power is restored. The generator continues to run but the ATS does not transfer the load back to utility power. What should the operator investigate?

A. The generator fuel tank, which may be too low to allow the ATS to transfer back to utility power

B. The utility power quality, which may be unstable after the storm and preventing the ATS from recognizing it as acceptable

C. The ATS manual/auto selector switch, which may have been placed in manual during the outage

D. The ATS retransfer time delay and utility voltage/frequency sensing circuits, which must verify stable utility power for a preset period before retransferring

43. During a lockout/tagout procedure on a large centrifugal pump, the operator locks out the motor starter, verifies the pump will not start by pressing the start button, and closes and locks the suction and discharge valves. The operator then begins to remove the pump casing bolts. As the last bolt is loosened, pressurized water sprays from the casing. What step was missed in the LOTO procedure?

A. The operator failed to verify that the pump was electrically de-energized using a voltage tester at the motor terminals

B. The operator failed to drain the pump casing and relieve any trapped pressure between the closed suction and discharge valves

C. The operator failed to install a blank flange between the pump and the piping to prevent any fluid from reaching the pump

D. The operator failed to tag the electrical disconnect with a danger tag in addition to the lock

44. An operator discovers that the plant's fire alarm system has been placed in "trouble" mode for the past 3 weeks due to a faulty smoke detector in the administration building. The alarm company was notified but has not yet responded. The operator checks and finds that the fire suppression system (sprinklers) remains functional but the automatic notification to the fire department has been disabled. What is the correct action?

A. Escalate the repair urgently — the disabled automatic fire notification means the fire department will not be dispatched automatically in the event of a fire, creating a potentially life-threatening gap in emergency response

B. No action is needed because the sprinkler system provides adequate fire protection without fire department notification

C. Disable the entire fire alarm system until the faulty detector is replaced to prevent nuisance alarms

D. Manually test every smoke detector in the plant to verify which ones are working and bypass the faulty detector

45. A treatment plant operator is preparing to enter a drained aeration basin for inspection. The basin has been out of service for 3 days. The operator tests the atmosphere and finds: O_2 20.9%, H_2S 0 ppm, LEL 0%, CO 0 ppm. The basin is 15 feet deep, accessed by a temporary ladder, and not designed for continuous occupancy. The operator has an attendant and a retrieval system in place. As the operator descends the ladder, the O_2 reading on the continuous monitor drops to 18.5%. What should the operator do?

A. Continue the descent slowly while watching the monitor to see if the O_2 level stabilizes above 18%

B. Stop the descent and ask the attendant to increase the ventilation rate before continuing

C. Remove the gas monitor and recalibrate it because the rapid change suggests a sensor malfunction

D. Exit the space immediately — 18.5% is below the 19.5% minimum safe oxygen level, and conditions are deteriorating

46. An operator is managing hazardous waste generated during laboratory operations at the treatment plant. Small quantities of expired reagent chemicals (acids, bases, solvents) accumulate periodically. Under RCRA regulations for small quantity generators, the operator must ensure which of the following?

A. All expired chemicals can be disposed of by pouring them down the laboratory drain since they will be treated by the plant

B. Expired chemicals can be stored indefinitely as long as they remain in their original containers

C. The chemicals must be poured into the plant's influent at a controlled rate that does not exceed the biological treatment capacity

D. The chemicals must be properly characterized, accumulated in appropriate containers, stored for no longer than the regulatory time limit, and disposed of through a licensed hazardous waste transporter and disposal facility

47. A treatment plant operator notices that the chlorine gas cylinder scale shows the cylinder has lost 45 lbs in 3 hours. The normal usage rate is 5 lbs per hour based on the plant flow and dose. The chlorine gas alarm system has not activated. What should the operator conclude?

A. The usage rate is normal and the scale reading fluctuation is caused by temperature changes in the chlorination room

B. The cylinder is being consumed at three times the normal rate, which may indicate a leak in the gas delivery system or an overdose at the chlorinator

C. The scale needs recalibration because the accelerated weight loss is not physically possible at normal operating conditions

D. The chlorine demand of the effluent has increased threefold due to an upstream process upset

48. Under OSHA's general duty clause, an employer is required to provide a workplace free from recognized hazards that are causing or are likely to cause death or serious physical harm. If a treatment plant has no written safety program but has never experienced a workplace injury, is the employer in compliance?

A. No — the absence of injuries does not excuse the employer from the obligation to identify recognized hazards and implement programs to address them, including written safety programs required by specific OSHA standards

B. Yes — the absence of injuries demonstrates that the workplace is safe and no additional programs are needed

C. Yes — the general duty clause only applies after an injury has occurred, not as a preventive requirement

D. No — but only if the plant has more than 10 employees, as smaller plants are exempt from OSHA requirements

49. A plant operator discovers that the backup dechlorination chemical tank is empty. The primary tank has approximately 2 days of chemical remaining. The chemical supplier cannot deliver for 5 days. What is the most appropriate course of action?

A. Continue normal operations and hope the primary tank lasts until the delivery arrives

B. Notify the supervisor, secure an emergency chemical delivery from an alternative supplier, and begin planning contingency actions (such as reducing the chlorine dose) to extend the primary tank supply

C. Reduce the chlorine dose to zero to eliminate the need for dechlorination until the chemical delivery arrives

D. Switch from dechlorination to dilution — increase the plant effluent flow rate to dilute the chlorine residual below the permit limit

50. An operator reviewing training records discovers that the plant's annual bloodborne pathogens training was conducted 14 months ago. OSHA requires annual training for employees with occupational exposure to bloodborne pathogens. The plant has 12 operators who handle wastewater samples and equipment daily. What is the appropriate action?

A. Schedule the training for the next quarterly safety meeting since it is only 2 months overdue

B. Schedule bloodborne pathogens training immediately for all affected employees to bring the training current, and adjust the schedule to prevent future lapses

C. No action is needed because wastewater operators are exempt from the bloodborne pathogens standard

D. Only the operators who handle laboratory samples need the training; field operators are not at risk

51. A treatment plant's NPDES permit includes a requirement to maintain an Operations and Maintenance manual that is updated and available at the plant. During a state inspection, the inspector finds that the O&M manual was last updated 8 years ago and does not reflect the current treatment processes, equipment, or operating procedures. What is the likely consequence?

A. The inspector will issue a notice of deficiency requiring the plant to update the O&M manual within a specified timeframe to accurately reflect current operations

B. No consequence because O&M manuals are only required during the initial permitting process

C. The inspector will require the plant to shut down until the manual is updated and approved by the state

D. The outdated manual demonstrates excellent long-term record retention and will be noted positively

52. A treatment plant submits monthly DMRs electronically. During data entry, the operator transposes two digits in the flow measurement — entering 3.21 MGD instead of 2.31 MGD. This error increases the calculated mass-based BOD loading above the permit limit when it actually would have been below. The error is not discovered until three months later during an internal audit. What is the appropriate action?

A. Take no action because correcting old DMRs creates unnecessary regulatory attention and the error was unintentional

B. Adjust the current month's flow downward to compensate for the three months of overreported flow

C. Submit corrected DMRs for all three affected months, notify the regulatory authority of the data entry errors, and document the corrections and the quality control measures implemented to prevent recurrence

D. Destroy the incorrect DMRs and recreate them with the correct data, filing them as the original submissions

53. An operator reviews the plant's insurance policy and discovers that pollution liability coverage excludes "gradual pollution events" that occur over a period exceeding 72 hours. The plant has been discharging effluent with slightly elevated phosphorus (0.6 mg/L vs. 0.5 mg/L limit) for the past 45 days without detection. This chronic exceedance would likely be classified as a gradual pollution event. What does this reveal about the plant's monitoring program?

A. The insurance exclusion is irrelevant because NPDES permits provide immunity from pollution liability

B. The monitoring frequency is adequate because the violation was eventually detected during routine review

C. The monitoring program should be enhanced to detect subtle, chronic exceedances within 72 hours rather than 45 days

D. The 45-day monitoring lag demonstrates that weekly composite sampling for phosphorus is insufficient and more frequent or continuous monitoring is needed

54. An operator at a treatment plant is asked to sign the monthly DMR as the "principal executive officer or ranking elected official." The operator holds a valid Class I wastewater operator certificate but is not the plant superintendent, director of public works, or any other executive position. Can the operator legally sign the DMR?

A. Yes — any operator with a valid certificate can sign the DMR as the technical professional responsible for the data

B. No — the operator must be specifically authorized in writing by the principal executive officer to sign the DMR, and this authorization must be submitted to the regulatory authority

C. Yes — the operator who collected the samples is always the appropriate signatory for the DMR

D. No — only elected officials (mayor, city council members) are authorized to sign DMR documents

55. A centrifugal pump has been in service for 3 years. The operator reviews the maintenance log and finds that the pump's discharge pressure has decreased by 15% over the past year while the suction conditions and system head have remained constant. The motor amperage has also decreased by approximately 10%. What maintenance action is most appropriate?

A. Inspect the pump impeller for wear — the declining pressure and amperage together indicate progressive impeller erosion that requires assessment and probable replacement

B. Replace the motor because the declining amperage indicates deteriorating motor performance

C. Increase the pump speed to compensate for the reduced discharge pressure until the next scheduled overhaul

D. Replace the mechanical seal because the pressure loss indicates seal leakage that is bypassing flow internally

56. A treatment plant's SCADA system displays a "communication failure" alarm for the influent flow meter. The operator checks the field instrument and finds the flow meter display is functioning normally and showing flow. The SCADA workstation shows no data. What is the most likely cause of the communication failure?

A. The flow meter sensor has failed and is generating false readings at the local display

B. The SCADA software license has expired and the system is rejecting incoming data transmissions

C. The communication link between the flow meter and the SCADA system has failed — likely a cable break, loose connection, protocol mismatch, or communication module failure

D. The SCADA server hard drive is full and cannot accept any additional data from any field instruments

57. A positive displacement blower rated at 3,000 CFM at 8.5 psi is currently producing 3,000 CFM at 10.2 psi. The operator has not changed any blower settings. What does the increased discharge pressure indicate, and what should the operator check?

A. The blower is operating normally because PD blowers automatically adjust pressure to match system demand

B. The blower bearings are failing and the increased friction is manifesting as higher discharge pressure

C. The blower is oversized for the current conditions and should be replaced with a smaller unit

D. The downstream system resistance has increased — the operator should check the diffusers for fouling, the piping for obstructions, and the aeration basin level for abnormal depth

58. An operator performing vibration analysis on a blower motor detects a dominant vibration frequency at exactly twice the motor running speed (2× RPM). Which mechanical condition does this specific frequency signature most commonly indicate?

A. A cracked motor shaft that resonates at double the rotational frequency under load

B. Misalignment between the motor shaft and the blower shaft — angular or offset misalignment produces a characteristic 2× RPM vibration

C. An unbalanced impeller or rotor that produces vibration at the fundamental rotational frequency

D. Electrical phase imbalance in the motor power supply that creates a pulsating magnetic field

59. An operator notices that the plant's influent wet well level is oscillating rapidly — rising 6 inches, dropping 3 inches, rising again — in a 30-second cycle. Only one influent pump is running. What is the most likely cause of this level oscillation?

A. The influent pump is experiencing surging or unstable operation — possibly due to cavitation, air entrainment, or operating at the far right of its pump curve where the curve becomes flat

B. The influent flow is genuinely pulsating due to upstream lift station cycling

C. The wet well level transmitter has developed a mechanical vibration that causes the reading to oscillate

D. The pump speed controller is malfunctioning and sending oscillating speed commands to the pump motor

60. A treatment plant operates a magnetic flow meter on the effluent line. The meter has been reading consistently for 3 years. After a recent thunderstorm, the operator notices the flow reading has dropped by approximately 20% and is now displaying some erratic fluctuations. No physical changes have been made to the piping or process. What is the most likely cause?

A. The thunderstorm introduced debris into the effluent line that is partially blocking the flow through the meter

B. The effluent flow has actually decreased by 20% because stormwater infiltration has subsided after the storm

C. A lightning-related electrical surge has damaged the flow meter's electronics, signal conditioner, or grounding system

D. The pipe diameter has changed due to thermal expansion from the warm stormwater, affecting the flow calculation

61. A treatment plant has two identical secondary clarifiers operating in parallel. The operator takes Clarifier A out of service for annual maintenance and diverts all flow to Clarifier B. Within 4 hours, the effluent TSS from Clarifier B increases from 10 mg/L to 35 mg/L. The SVI has not changed. What is the most likely cause?

A. The biological organisms in Clarifier B have been shocked by the sudden change in flow pattern

B. The sludge blanket in Clarifier A is being disturbed during maintenance and solids are migrating to Clarifier B

C. Clarifier B's effluent weir has become uneven and is causing preferential flow at the higher loading rate

D. Clarifier B is now receiving double the normal flow, doubling its SOR and SLR, which exceeds its capacity for solids settlement and capture

62. An operator checks the oil in a rotary lobe blower and notices metal particles visible in the oil on the dipstick. The blower is currently running with normal vibration and temperature readings. What does this finding indicate, and what action is required?

A. The metal particles are normal wear debris and the oil should be changed at the next scheduled maintenance

B. The metal particles indicate active internal wear of bearings, gears, or timing components — the blower should be scheduled for inspection as soon as possible before a catastrophic failure occurs

C. The metal particles came from the oil fill cap during the last oil change and are external contaminants

D. The oil has degraded to the point where it is dissolving metal from the blower casing walls

63. A treatment plant has a chemical metering pump that delivers polymer to the sludge conditioning system. The pump is rated at 20 GPH maximum output at 100% stroke length and 100% speed. The operator needs to deliver exactly 6.5 GPH. What combination of stroke length and speed settings would achieve this output?

A. There are multiple valid combinations — for example, 65% stroke at 50% speed (0.65 × 0.50 × 20 = 6.5), or 50% stroke at 65% speed (0.50 × 0.65 × 20 = 6.5)

B. The only valid setting is 32.5% stroke at 100% speed to achieve exactly 6.5 GPH

C. The pump cannot deliver 6.5 GPH because metering pumps only operate at fixed increments of 5%

D. The setting must be 100% stroke at 32.5% speed because stroke length has no effect on metering pump output

64. A plant operator measures the power consumption of a centrifugal pump using a power meter. The pump consumes 11 kW while delivering 800 GPM at 45 feet of TDH. The wire-to-water efficiency is the ratio of useful hydraulic power output to electrical power input. Using the formula: Water Horsepower = (GPM × TDH) ÷ 3,960, what is the approximate wire-to-water efficiency?

A. Approximately 82%, indicating excellent overall pump and motor efficiency

B. Approximately 45%, indicating poor efficiency that warrants investigation

C. Approximately 62%, indicating acceptable but not optimal efficiency for a centrifugal pump system

D. Approximately 55%, indicating the pump is operating near the lower end of the acceptable efficiency range

65. An operator discovers that the float-operated level switch in a chemical day tank is stuck in the "tank full" position. The tank is actually half empty, but the level switch is telling the control system the tank is full, preventing the transfer pump from refilling the tank. What is the immediate operational risk?

A. The chemical day tank will overflow when the transfer pump eventually starts, causing a chemical spill

B. The chemical day tank will run empty during normal operations because the control system will not trigger a refill cycle, interrupting chemical feed to the process

C. The transfer pump will burn out from continuous dry running because it receives no "tank full" signal to stop

D. The level switch failure will cause the SCADA system to shut down the entire chemical feed system as a safety precaution

66. A belt-driven centrifugal fan in the digester building ventilation system has been producing a squealing noise during startup for the past week. Once running at full speed, the noise stops. What does this startup squealing most likely indicate?

A. The fan bearings are failing and the noise represents metal-on-metal contact during low-speed operation

B. The drive belt is slipping on the motor sheave during startup when the belt must overcome the inertia of the stopped fan — belt tension is too low or the belt is glazed

C. The fan motor starting capacitor is weak and producing electrical arcing during the startup phase

D. The fan blade is rubbing against the housing at low speed and clears as centrifugal force moves it outward

67. An operator reviews the plant's preventive maintenance schedule and notices that the aeration diffuser cleaning is scheduled every 24 months. However, the blower discharge pressure has been rising steadily for the past 6 months, indicating progressive diffuser fouling. What adjustment to the PM schedule should the operator recommend?

A. Keep the 24-month schedule because it was established by the equipment manufacturer

B. Extend the schedule to 36 months because the diffusers are still functioning and the blowers can compensate

C. Shorten the PM interval based on the pressure trend — if fouling reaches the action level in 18 months, schedule diffuser cleaning at 12–15 month intervals

D. Increase the diffuser cleaning frequency to monthly to prevent any fouling from accumulating

68. A SCADA system historian shows that the aeration basin DO has been cycling between 0.5 mg/L and 4.5 mg/L in a 15-minute cycle for the past three days. The DO setpoint is 2.0 mg/L. The blower is controlled by a VFD that responds to the DO probe signal. What is the most likely cause of this excessive cycling?

A. The DO controller PID tuning is too aggressive — the proportional gain or integral time is set too high, causing the controller to overshoot and undershoot the setpoint repeatedly

B. The DO probe membrane has been damaged by debris, causing it to respond erratically to changes in oxygen levels

C. The aeration basin has developed a short-circuit flow path that creates alternating high and low DO zones at the probe location

D. The blower VFD has a faulty speed controller that cannot maintain a steady output frequency

69. A treatment plant's RAS pump VFD displays a "ground fault" alarm and stops the pump. The operator resets the alarm and the VFD restarts but trips again on ground fault within seconds. What is the most likely location of the ground fault?

A. In the VFD power electronics module, which has developed an internal short circuit to the chassis

B. In the SCADA communication cable that connects the VFD to the control system

C. In the motor windings or the power cable between the VFD and the motor, where insulation has deteriorated and is allowing current to flow to ground

D. In the 120V control circuit that powers the VFD cooling fan and display panel

70. A plant operator discovers that the plant's utility power factor has dropped to 0.72, resulting in a significant power factor penalty on the monthly electric bill. Wastewater treatment plants typically have low power factors because of the large number of induction motors. Which of the following equipment additions would most effectively improve the power factor?

A. Installing variable frequency drives on the remaining constant-speed motors throughout the plant

B. Replacing all standard-efficiency motors with premium-efficiency motors

C. Installing power factor correction capacitors at the main electrical service entrance or at individual motor loads

D. Increasing the number of power transformers to reduce the electrical loading on each transformer

71. A gravity thickener receiving primary sludge has been producing thickened sludge at 5.5% TS with clear supernatant. Over the past week, the thickened sludge concentration has dropped to 3.8% and the supernatant has become turbid with a TSS of 800 mg/L. The sludge feed rate has not changed. What should the operator investigate first?

A. The picket fence rake mechanism, which may have failed or slowed down, disrupting the consolidation process and preventing gas release from the sludge blanket

B. The sludge withdrawal rate, which may have been increased inadvertently and is drawing off sludge before it fully compacts

C. The polymer feed system, which may have run out of chemical or malfunctioned

D. The primary sludge characteristics, which may have changed due to an industrial discharge

72. A belt filter press dewatering digested combined sludge produces cake at 21% TS with good polymer conditioning. The plant is considering switching from combined sludge to WAS-only feed for the belt press. What operational change should the operator anticipate?

A. The WAS-only cake will be significantly drier because waste activated sludge releases water more readily than primary sludge

B. The belt speed will need to increase because WAS is less viscous and flows through the press faster

C. The cake solids will likely decrease because WAS is more difficult to dewater than combined sludge, and the polymer dose may need to increase

D. The belt tension will need to be reduced because WAS produces a weaker cake that tears easily

73. An anaerobic digester that has been operating stably at a VA/Alk ratio of 0.05 receives an unexpected slug of high-strength industrial waste. Within 24 hours, the volatile acids increase from 150 mg/L to 800 mg/L. The alkalinity decreases from 3,200 mg/L to 2,400 mg/L. The pH drops from 7.1 to 6.7. Gas production has not yet changed. What is the most appropriate immediate response?

A. Increase the digester temperature by 5°F to accelerate the methanogens and help them consume the excess volatile acids faster

B. Add lime to the digester to restore the alkalinity and maintain the pH while the biology adjusts

C. Immediately cease all sludge feeding and monitor the VA/Alk ratio daily until it returns to below 0.10

D. Reduce the sludge feed rate significantly (by 50% or more) and add sodium bicarbonate or lime to buffer the pH while allowing the methanogens time to recover

74. A composting facility using the aerated static pile method measures the following pile conditions: core temperature 145°F, moisture 52%, O_2 concentration 14%, and ammonia odor detectable at 15 feet from the pile. What does the ammonia odor suggest about the composting conditions?

A. The ammonia indicates that the pile temperature is too high and is volatilizing nitrogen from the organic matter

B. The ammonia suggests that the carbon-to-nitrogen ratio is too low — excess nitrogen is being released as ammonia gas because there is insufficient carbon to assimilate all of the nitrogen being mineralized

C. The ammonia indicates that the aeration blower is providing too much air, which is stripping ammonia from the pile

D. The ammonia is produced by anaerobic decomposition in the pile center due to inadequate oxygen distribution

75. A treatment plant produces biosolids that consistently meet Class A pathogen reduction standards and all metals are below Table 3 pollutant concentration limits. However, the volatile solids reduction achieved by the digester is only 35%. Can these biosolids be classified as Exceptional Quality?

A. Yes — if the biosolids meet an alternative vector attraction reduction option other than 38% VSR (such as injection below the soil surface or incorporation within 6 hours), they can still qualify for EQ

B. No — Exceptional Quality requires a minimum of 38% VSR and no alternative can substitute for this requirement

C. Yes — Class A pathogen reduction automatically satisfies the vector attraction reduction requirement for EQ

D. No — Exceptional Quality requires a minimum of 50% VSR for biosolids treated by anaerobic digestion

76. An operator at a centrifuge dewatering operation notices that the centrate quality has deteriorated over the past week — the centrate TSS has increased from 200 mg/L to 1,200 mg/L. The cake solids have remained at 22%. The polymer dose has not changed. What should the operator adjust first?

A. Increase the bowl speed to increase the centrifugal force and improve solids capture in the centrate

B. Decrease the scroll differential speed to reduce the conveyance rate and allow more time for fine solids to settle

C. Increase the polymer dose to improve flocculation and capture the fine solids that are escaping in the centrate

D. Decrease the sludge feed rate to reduce the solids loading on the centrifuge and improve the centrate quality

77. A plant operating two parallel anaerobic digesters notices that Digester A produces 55% methane while Digester B produces only 48% methane. Both digesters receive the same sludge feed at the same rate. The temperature in both is 97°F. What is the most likely explanation for the lower methane content in Digester B?

A. Digester B's mixing system is more efficient, which paradoxically reduces methane production by disrupting the biofilm

B. Digester B has a gas leak that allows air (primarily nitrogen) to enter the gas collection system, diluting the methane

C. Digester B is receiving a higher proportion of WAS in its feed stream, which produces less methane than primary sludge

D. Digester B has a gas leak that is allowing outside air to enter the collection system, diluting the methane concentration and potentially creating an explosion hazard

78. A treatment plant uses lime stabilization for biosolids. The operator adds quicklime (CaO) to raise the pH to 12.0 and maintains it above 12.0 for 72 hours. Under Part 503, which of the following does this process achieve?

A. This exceeds the minimum time-temperature requirements for lime stabilization and meets one of the vector attraction reduction alternatives

B. Both Class A pathogen reduction and vector attraction reduction, because pH 12 for 72 hours meets the PFRP (Process to Further Reduce Pathogens) requirements

C. Neither pathogen reduction nor vector attraction reduction, because quicklime alone cannot achieve either standard

D. Vector attraction reduction only, because lime stabilization achieves VAR but requires a separate pathogen reduction demonstration

79. A sand drying bed has been loaded with digested sludge. After 10 days of drying, a heavy rainstorm deposits 3 inches of rain on the bed. The operator inspects the bed after the storm and finds standing water above the sludge cake. What should the operator do?

A. Remove the sludge immediately and dispose of it because the rain has contaminated the biosolids

B. Drain the standing water through the underdrain system, then scarify the cake surface to promote continued evaporative drying once the weather clears

C. Add additional sludge on top of the standing water to absorb the excess moisture and increase the drying rate

D. Pump the standing water off the surface and transport it to the plant headworks for treatment

80. A treatment plant operator calculates the digester loading rate. The digester has a volume of 200,000 gallons and receives 12,000 gallons per day of sludge at 5.0% total solids with 70% volatile solids. What is the volatile solids loading rate in lbs VS/ft³/day?

A. Approximately 0.13 lbs VS/ft³/day, which is within the typical range of 0.04–0.10 lbs VS/ft³/day for mesophilic anaerobic digestion — actually slightly above the upper range

B. Approximately 0.08 lbs VS/ft³/day, which is within the typical range

C. Approximately 0.20 lbs VS/ft³/day, which significantly exceeds the recommended loading rate

D. Approximately 0.04 lbs VS/ft³/day, which is at the minimum of the acceptable range

81. A treatment plant that land-applies biosolids receives a complaint from a neighboring property owner about flies and odors near the application site. The biosolids are Class B and were surface-applied 3 days ago. The field manager confirms the biosolids have not been incorporated into the soil. Under Part 503, which vector attraction reduction requirement has not been met?

A. The biosolids should have been injected below the soil surface, which eliminates both fly attraction and odor exposure

B. The application rate exceeded the agronomic nitrogen requirement for the crop being grown

C. The field buffer distance from neighboring properties was insufficient to prevent odor detection

D. If surface-applied, Class B biosolids must be incorporated into the soil within 6 hours to meet the applicable vector attraction reduction alternative — this was not done

82. An operator is comparing the performance of two gravity belt thickeners processing identical WAS. Thickener A produces sludge at 5.2% TS with a filtrate TSS of 150 mg/L. Thickener B produces sludge at 4.5% TS with a filtrate TSS of 350 mg/L. Both receive the same polymer dose. What should the operator investigate on Thickener B?

A. The belt wash water pressure, which may be too high on Thickener B and washing solids through the belt

B. The belt condition — worn, stretched, or damaged fabric on Thickener B may be allowing solids to pass through and water to be retained in the sludge

C. The sludge feed distribution across the belt width, which may be uneven on Thickener B

D. The belt speed, which may be set too high on Thickener B, not allowing adequate drainage time

83. A plant produces 50,000 gallons per day of thickened sludge at 4% total solids. The sludge is dewatered on a belt filter press to 20% cake solids. What is the approximate volume reduction achieved by the dewatering process?

A. The volume is reduced to approximately 25,000 gallons per day (50% reduction)

B. The volume is reduced to approximately 20,000 gallons per day (60% reduction)

C. The volume is reduced to approximately 10,000 gallons per day (80% reduction)

D. The volume is reduced to approximately 5,000 gallons per day (90% reduction)

84. An anaerobic digester has been experiencing foam buildup on the surface. The operator suspects the foam is caused by a surfactant entering the digester with the sludge feed. What is the most effective way to determine if a surfactant is causing the foam?

A. Test the raw sludge feed for surfactant (detergent/soap) concentration and compare it to historical levels

B. Add an antifoaming agent to the digester and observe whether the foam dissipates

C. Increase the digester mixing intensity to break up the foam mechanically

D. Reduce the digester temperature by 5°F to decrease the gas production that is creating the foam

85. A treatment plant's biosolids land application program requires annual soil testing at each application site. The soil test results at one site show that the phosphorus level has been increasing steadily over 5 years of biosolids application and now exceeds the state's recommended maximum for the crop being grown. What should the operator do?

A. Continue application at the current rate because Part 503 regulates metals, not phosphorus loading

B. Ignore the soil phosphorus because the agronomic rate was calculated based on nitrogen, not phosphorus

C. Continue application but add a phosphorus-binding chemical to the soil surface before each application

D. Reduce or suspend biosolids application at this site and recalculate the application rate based on phosphorus rather than nitrogen as the limiting nutrient

86. An operator is loading dewatered biosolids cake onto a truck for transport to a land application site. The cake has a total solids content of 24%, which means it is approximately 76% water. During loading, the operator notices that liquid is draining from the truck bed and pooling on the loading pad. What should the operator do?

A. Continue loading because some liquid drainage is normal for dewatered cake during transport

B. Stop loading, inspect the truck bed for leaks, install drip pans or absorbent material, and ensure the truck is properly sealed to prevent liquid from draining onto roadways during transport

C. Add quicklime to the cake on the truck to absorb the excess moisture before transport

D. Reject the cake as improperly dewatered and return it to the belt filter press for additional processing

87. A plant operating an aerobic digester wants to improve volatile solids reduction. The current VSR is 32%, below the 38% minimum required for Part 503 vector attraction reduction. The digester detention time is 18 days and the temperature is 60°F (16°C). The DO is maintained at 2.0 mg/L. Which single adjustment would be most effective at improving VSR?

A. Increase the digester detention time to 30 days or longer to compensate for the cold temperature that slows biological activity

B. Increase the DO from 2.0 mg/L to 4.0 mg/L to ensure the aerobic organisms are not oxygen-limited

C. Add polymer to the digester feed to improve the contact between organisms and organic matter

D. Reduce the sludge feed rate by 25% to decrease the organic loading per unit volume

88. An operator collects a compliance sample for effluent ammonia nitrogen at the plant outfall. The sample is collected in a plastic bottle, preserved with sulfuric acid to pH < 2.0, and refrigerated at 4°C.

The sample is analyzed 25 days later. The maximum holding time for preserved, refrigerated ammonia samples is 28 days. Is this sample valid for compliance reporting?

A. No — ammonia samples must be analyzed within 24 hours regardless of preservation method

B. No — the sulfuric acid preservation alters the ammonia concentration and requires a correction factor

C. Yes — the sample was properly preserved with sulfuric acid, refrigerated at 4°C, and analyzed within the 28-day holding time

D. No — plastic bottles are not acceptable for ammonia samples because ammonia adsorbs to plastic surfaces

89. A treatment plant laboratory runs duplicate BOD_5 analyses on the same effluent sample. The results are 22 mg/L and 18 mg/L. The relative percent difference (RPD) is calculated as: RPD = |22 – 18| ÷ [(22 + 18) ÷ 2] × 100 = 20%. The laboratory's acceptable RPD limit for BOD_5 duplicates is 30%. What should the analyst conclude?

A. The duplicate precision is acceptable because the RPD of 20% is within the 30% laboratory acceptance limit

B. The results should be averaged and the average reported on the compliance report

C. The higher result (22 mg/L) should be reported because it represents the more conservative value

D. The RPD of 20% is within the laboratory's acceptance limit, confirming acceptable precision — the analyst should report the result according to the laboratory's SOP (typically the average)

90. An operator is troubleshooting a pH analyzer that displays a reading of 7.0 in all solutions — pH 4 buffer, pH 7 buffer, pH 10 buffer, and plant effluent samples all read 7.0. What is the most likely cause?

A. The pH meter is functioning correctly and all solutions happen to have a pH of 7.0

B. The pH electrode has failed — either the glass membrane is cracked, the reference junction is plugged, or the internal filling solution is depleted, producing a constant reading regardless of the actual pH

C. The buffer solutions have all expired simultaneously and now all have a pH of 7.0

D. The meter's temperature compensation feature is malfunctioning, converting all readings to 7.0

91. An operator reviews the trend of effluent fecal coliform results over the past 6 months and notices that results collected on Fridays are consistently higher (averaging 150 CFU/100 mL) than results collected on Mondays (averaging 40 CFU/100 mL). The chlorine dose, residual, and contact time are identical on both days. What should the operator investigate?

A. Whether the Friday sample collection and handling procedures differ from Monday — including sample container preparation, collection technique, preservation, transport time, and laboratory holding time over the weekend

B. Whether the community water usage pattern differs between Friday and Monday, affecting the wastewater strength

C. Whether the chlorine supplier delivers a different product concentration on different days of the week

D. Whether the Friday samples are being collected at a different location than the Monday samples

92. An operator calibrates the laboratory conductivity meter using a 1,000 µS/cm standard and a 100 µS/cm standard. The meter reads 1,005 µS/cm on the 1,000 standard and 98 µS/cm on the 100 standard. The operator then measures a plant effluent sample and obtains 650 µS/cm. Are the calibration results acceptable, and is the effluent reading reliable?

A. No — the calibration deviations exceed the acceptable tolerance and the meter must be serviced before any samples are measured

B. The calibration is acceptable only for samples above 500 µS/cm but not for samples below 200 µS/cm

C. Yes — the calibration results are within typical ±5% tolerance (0.5% error at 1,000 and 2% error at 100), and the effluent reading of 650 µS/cm is reliable

D. The calibration is acceptable but the effluent reading should be reported as a range (625–675 µS/cm) rather than a single value

93. A laboratory analyst is performing a COD (Chemical Oxygen Demand) analysis on an influent wastewater sample. The COD measures the total amount of oxygen required to chemically oxidize organic and inorganic matter in the sample. The plant's influent BOD is typically 200 mg/L and the influent COD is typically 450 mg/L. What does the BOD/COD ratio of 0.44 indicate about the wastewater's biodegradability?

A. The wastewater is highly biodegradable because the BOD/COD ratio exceeds 0.30

B. The wastewater has average biodegradability — approximately 44% of the total oxidizable matter is biologically available

C. The wastewater is poorly biodegradable because the BOD/COD ratio is below 0.50

D. A BOD/COD ratio of 0.44 indicates that approximately 44% of the chemical oxygen demand can be satisfied by biological treatment, which is typical for domestic wastewater mixed with moderate industrial contributions

94. An operator performs a jar test to determine the optimal polymer dose for sludge conditioning before belt press dewatering. The operator tests doses of 5, 10, 15, 20, and 25 mg/L of cationic polymer. At 5 mg/L, the floc is weak and small. At 10 mg/L, the floc is moderate. At 15 mg/L, the floc is large and firm with clear supernatant. At 20 mg/L, the floc is similar to 15 mg/L. At 25 mg/L, the supernatant becomes slightly turbid. What is the optimal dose?

A. 5 mg/L, because using the minimum effective dose saves the most money on chemical costs

B. 25 mg/L, because the highest dose produces the strongest floc structure for maximum dewatering

C. 20 mg/L, because it provides a safety margin above the optimal point without causing re-dispersion

D. 15 mg/L, because it produces the best floc quality at the lowest effective dose — the 25 mg/L result shows over-conditioning and early re-dispersion

95. A treatment plant operator is reviewing the results of the annual whole effluent toxicity (WET) test. The test measures the toxic effects of the plant's effluent on aquatic organisms. The results show that the effluent caused 50% mortality in the test organisms at 100% effluent concentration (no dilution). The NPDES permit requires no observable adverse effects at 50% effluent concentration. Is the plant in compliance?

A. Yes — the adverse effects occurred only at 100% concentration, and the permit requires testing at 50% concentration where no adverse effects were observed

B. No — any mortality at any concentration constitutes a WET test failure regardless of the permit conditions

C. Yes — 50% mortality is acceptable as long as it occurs at full-strength effluent and not at the diluted concentration

D. No — the 50% mortality at 100% concentration indicates the effluent is acutely toxic and fails the WET test

96. A laboratory analyst is preparing to perform a total phosphorus analysis on a plant effluent sample. The analyst must first convert all forms of phosphorus (organic phosphorus, polyphosphates, orthophosphate) to a single measurable form. What pretreatment step is required?

A. The sample must be filtered through a 0.45 µm membrane filter to remove particulate phosphorus before analysis

B. The sample must be diluted 1:10 with deionized water to bring the phosphorus concentration into the measurable range

C. The sample must be digested with persulfate or sulfuric acid-nitric acid to convert all phosphorus forms to orthophosphate before colorimetric measurement

D. The sample must be preserved with sodium hydroxide to convert organic phosphorus to inorganic forms

97. An operator performs a settleability test on the aeration basin mixed liquor and records the 30-minute settled volume at 850 mL/L. The MLSS is 4,200 mg/L. What is the SVI, and what settling condition does it indicate?

A. SVI is 125 mL/g, indicating acceptable settling quality with normal floc structure

B. SVI is 175 mL/g, indicating poor settling that warrants investigation of DO, F/M, and potential filamentous growth

C. SVI is 150 mL/g, indicating borderline settling quality at the upper limit of the acceptable range

D. SVI is 202 mL/g, indicating poor settling with probable filamentous bulking that requires immediate corrective action

98. When performing a TSS analysis, the analyst dries the filter at 103–105°C in the oven. Why is this specific temperature range used rather than a higher temperature?

A. Drying at 103–105°C removes free water and loosely bound water without igniting or volatilizing the organic fraction of the solids, which would produce falsely low results

B. Drying at 103–105°C ensures all water is removed within 15 minutes, reducing the analysis time

C. Drying at 103–105°C kills all bacteria on the filter, which is necessary for accurate weight measurement

D. The 103–105°C temperature is specifically required to dissolve mineral deposits that would otherwise add to the filter weight

99. An operator reviews laboratory QC data and discovers that the laboratory blank (dilution water with no sample) for the BOD_5 analysis shows a DO depletion of 0.8 mg/L after 5 days of incubation. The Standard Methods maximum acceptable depletion for a dilution water blank is 0.2 mg/L. What does this indicate?

A. The dilution water depletion is acceptable because it is below the 1.0 mg/L practical detection limit

B. The incubator temperature was set 2°C too high, causing accelerated oxygen consumption in all bottles

C. The dilution water is contaminated with organic matter, and all BOD_5 results from analyses using this water are potentially biased high and should be flagged as suspect

D. The result indicates that the DO probe used to measure the initial and final DO values has drifted from calibration

100. A laboratory analyst collects a grab sample for effluent chlorine residual analysis. The analyst walks the sample to the laboratory (4-minute walk) and then performs the DPD colorimetric test. The

result shows a total chlorine residual of 0.5 mg/L. Is this result likely to be representative of the actual chlorine residual at the sampling point?

A. Yes — chlorine residual is stable in grab samples for up to 30 minutes after collection

B. No — chlorine residual decreases rapidly after collection due to continued reactions with organic matter and volatilization, and the actual residual at the sampling point was likely higher than 0.5 mg/L

C. Yes — the DPD method is designed to measure chlorine in samples that have been stored for up to 1 hour

D. No — the chlorine residual increases during transport because atmospheric oxygen converts chloride ions back to chlorine

Practice Exam 7: Answer Key and Explanations

1. C — Conductivity measures the total dissolved ionic content of water. A sudden spike from 800 to 2,400 µS/cm with stable BOD and TSS points to a dissolved (not particulate) industrial source — brine from food processing, cooling tower blowdown with concentrated minerals, or industrial rinse water containing dissolved salts. Domestic wastewater conductivity is relatively stable and does not triple overnight.

2. D — The combination of elevated BOD (340 mg/L), low pH (4.5), and solvent odor during the morning — followed by return to normal by afternoon — is the signature of an industrial batch discharge slug passing through the plant. The acidic, high-strength waste entered the collection system overnight, traveled to the plant during the early morning hours, and cleared the system by afternoon.

3. B — Design flow for 15,000 people at 100 GPD/person = 1.5 MGD. Actual domestic contribution at the same per capita rate = 1.5 MGD. The additional 0.6 MGD (2.1 – 1.5) represents extraneous water entering the collection system through infiltration (groundwater seeping through pipe joints and cracks) and inflow (stormwater entering through illicit connections, manhole covers, and cross-connections).

4. A — Stable TSS at 220 mg/L but declining settleable solids (from 8 to 2 mL/L) means the total mass of suspended particles has not changed, but the particles have become smaller and lighter — they no longer settle in the 60-minute Imhoff cone test. This shift toward colloidal particles may result from an industrial discharge of fine, non-settleable material or a change in the biological activity in the collection system.

5. C — Septage BOD load = 7,000 mg/L × 0.005 MG × 8.34 = 291.9 lbs/day. Main influent BOD load = 200 × 3.0 × 8.34 = 5,004 lbs/day. Total = 5,295.9 lbs/day. Septage percentage = 291.9 ÷ 5,295.9 × 100 = 5.5%, approximately 6%. This contribution is significant enough to be tracked and included in the plant's total loading calculations.

6. D — Protozoa — particularly stalked and free-swimming ciliates — are sensitive indicator organisms. A significant decline in their population while bacteria survive suggests a chronic, low-level toxicant that selectively affects the more sensitive higher organisms. Common sources include metals, pesticides, or industrial organic compounds at concentrations below the threshold that would visibly affect the bacteria.

7. A — Step 1: BOD loading = 140 mg/L × 2.0 MGD × 8.34 = 2,335 lbs BOD/day. Step 2: Basin volume in ft^3 = 500,000 gallons ÷ 7.48 = 66,845 ft^3. Step 3: Volumetric loading = 2,335 ÷ 66.845 (thousands of ft^3) = 34.9 lbs BOD/1,000 ft^3/day, approximately 35 lbs/1,000 ft^3/day. This loading falls within the typical range of 20–60 lbs BOD/1,000 ft^3/day for conventional activated sludge systems, confirming the basin is appropriately sized for the current organic loading.

8. B — SOR = Plant flow ÷ Area = 4,000,000 ÷ 6,000 = 667 GPD/ft^2. SLR = MLSS × Total flow × 8.34 ÷ Area = 3,200 × 5.0 × 8.34 ÷ 6,000 = 133,440 ÷ 6,000 = 22.2, approximately 24.4 lbs/day/ft^2 depending on rounding. The SOR is within the typical range of 400–800 GPD/ft^2 and the SLR is within the typical range of 20–30 lbs/day/ft^2.

9. B — SVI = (490 × 1,000) ÷ 2,800 = 175 mL/g. SDI = 100 ÷ 175 = 0.57. An SVI of 175 mL/g indicates poor settling — well above the 150 mL/g threshold where settling problems become operationally significant. An SDI below 1.0 confirms the settling is suboptimal. Filamentous organism growth is the most common cause of SVI values in the 175+ range.

10. D — lbs NaOH/day = 125 × 1.8 × 8.34 = 1,876.5 lbs/day. lbs solution/day = 1,876.5 ÷ 0.50 = 3,753 lbs/day. Weight per gallon = 1.53 × 8.34 = 12.76 lbs/gal. Volume = 3,753 ÷ 12.76 = 294.1 GPD. With different calculation approaches and rounding, approximately 29–294 GPD. The three-step conversion from dose to mass to solution volume is the standard chemical feed calculation.

11. C — Nitrate entering the anaerobic zone provides an alternative electron acceptor for facultative bacteria. These bacteria preferentially use nitrate (denitrification) instead of allowing the truly anaerobic conditions needed for PAOs to release phosphorus and take up volatile fatty acids. The nitrate from the industrial discharge short-circuits the EBPR process by preventing true anaerobic conditions.

12. A — The alpha factor corrects for the difference between clean-water and actual wastewater oxygen transfer. Actual OTE = Clean-water OTE × alpha = 28% × 0.65 = 18.2%. Wastewater contains surfactants, dissolved solids, and organic compounds that interfere with oxygen transfer across the bubble-liquid interface, reducing the efficiency compared to clean water testing conditions.

13. D — At a 400% internal recycle rate, the fraction of flow passing through the anoxic zone = Recycle ÷ (Recycle + Influent) = 4 ÷ (4 + 1) = 80%. Therefore, 80% of the nitrate produced can theoretically be returned to the anoxic zone, while 20% exits directly in the effluent. This is a fundamental limitation of the MLE process — even at very high recycle rates, 100% nitrate removal is theoretically impossible.

14. A — Ferric chloride reacts with phosphorus to form ferric phosphate ($FePO_4$) and with water to form ferric hydroxide ($Fe(OH)_3$). Both are insoluble precipitates that add to the total suspended solids mass in the system. The MLSS increase from 2,400 to 3,100 mg/L without changing the WAS rate is explained by the accumulation of these chemical precipitates.

15. B — An SVI of 37.5 mL/g with tiny, dense particles and no filaments is classic pin floc from an excessively long SRT (25 days). The organisms are so deep in endogenous respiration that the floc has fragmented into particles too small for gravity settling. Reducing the SRT increases the F/M ratio, encourages active growth of larger floc-forming organisms, and produces larger, more settleable particles.

16. C — Free chlorine of 0.0 mg/L with total chlorine of 1.2 mg/L means all chlorine present is in the combined form — chloramines (monochloramine, dichloramine, or nitrogen trichloride). The total chlorine measurement includes both free and combined forms, so when free is zero and total is 1.2, the entire 1.2 mg/L is combined chlorine.

17. D — With 4 banks at 12 mJ/cm² each, the total dose is 48 mJ/cm². Removing one bank: 3 × 12 = 36 mJ/cm². The delivered dose of 36 mJ/cm² is below the 40 mJ/cm² target. The operator must either maintain all 4 banks in service until a maintenance window with reduced flow allows temporary operation at 3 banks, or have replacement lamps ready for immediate swap.

18. C — Current SRT: System MLSS = 3,000 × 0.8 × 8.34 = 20,016 lbs. Total solids out = (8,000 × 0.035 × 8.34) + (10 × 2.5 × 8.34) = 2,335.2 + 208.5 = 2,543.7 lbs/day. Current SRT = 20,016 ÷ 2,543.7 = 7.9 days. To extend the SRT to 12 days, the operator must reduce the WAS rate so that fewer solids leave the system per day, allowing the system solids inventory to increase.

19. A — A deep sludge blanket in the secondary clarifier creates anaerobic conditions in the lower layers. PAOs that were in the aerobic zone performing luxury phosphorus uptake are now settling into an anaerobic environment in the clarifier. Under anaerobic conditions, PAOs release their stored phosphorus back into the liquid phase. This phosphorus-rich water then flows over the effluent weir.

20. B — If the secondary effluent TSS is stable at 10 mg/L but the filter reaches terminal headloss in one-third the normal time, the most likely cause is an incomplete backwash. Residual solids left in the media from the previous backwash reduce the available storage capacity for the next filter run, causing the filter to reach terminal headloss much faster. The backwash system should be inspected and optimized.

21. D — The key diagnostic clue is the MLSS drop from 3,200 to 1,800 mg/L with unchanged SVI. This means solids were physically removed from the system — not killed or damaged. Excessive wasting has shortened the SRT below the minimum for nitrification (nitrifiers grow slowly and are the first to be washed out). The remaining organisms are healthy (stable SVI) but too few to nitrify.

22. C — Feed rate = 200 lbs/day ÷ 30 lbs/ft³ = 6.67 ft³/day ÷ 24 hrs/day = 0.278 ft³/hour, approximately 0.28 ft³/hour. The calculation converts the required mass per day to volume per day using the bulk density, then to volume per hour for the feeder setting. This is a standard dry chemical feeder calibration calculation.

23. A — Chloramines from the drinking water distribution system persist through domestic use and enter the wastewater. When the operator adds chlorine at the treatment plant, the applied chlorine must first overcome the chloramine demand (breaking the existing chloramines) before establishing free chlorine residual. This additional demand effectively doubles the chlorine dose required to reach breakpoint.

24. B — A 12-foot center well in a 100-foot clarifier creates a high-velocity jet as the influent enters the settling zone. During peak flows, this velocity increases proportionally, disrupting the quiescent settling conditions in the zone immediately surrounding the center well. The turbulent inlet flow re-suspends settled solids and carries them toward the effluent weir, increasing TSS.

25. C — Total dose = Demand + Residual = 3.8 + 0.8 = 4.6 mg/L. CT = Residual × Contact time = 0.8 × 25 = 20 mg·min/L. The CT value exceeds the 15 mg·min/L permit requirement. CT is always calculated using the residual (not the dose) because the residual represents the chlorine concentration actually available for pathogen inactivation during the contact period.

26. D — UV transmittance dropping from 72% to 48% means significantly less UV energy reaches the pathogens in the water. Suspended particles absorb and scatter UV light, creating "shadow zones" where organisms are shielded from exposure. Even though the lamps haven't changed, the effective dose delivered to the pathogens decreases substantially because the water itself is blocking the UV energy.

27. A — At 500% internal recycle, the MLE process has reached its practical denitrification limit — further increasing the recycle brings diminishing returns and introduces excessive DO to the anoxic zone. A post-anoxic denitrification zone placed after the aerobic zone provides an additional opportunity to reduce the remaining nitrate using supplemental carbon (methanol, glycerol), which is the standard approach for achieving TN below 5 mg/L.

28. B — Chemical metering pump components degrade during extended idle periods — check valve seats can dry out, crack, or become fouled; diaphragms can take a permanent set; and elastomers can harden. These degradation effects reduce the actual output per stroke below the rated volume. Regular exercise of standby pumps and periodic output verification prevent this performance loss.

29. C — Unstabilized WAS has a high volatile solids content (75–85%) consisting of live and recently dead biological cells filled with readily biodegradable organic matter. When dewatered and stockpiled, the interior of the cake rapidly becomes anaerobic, and anaerobic decomposition produces hydrogen sulfide, mercaptans, and other intensely odorous sulfur compounds within hours.

30. D — Uneven flow distribution causes Clarifier A to operate at 65% of the total flow — a significantly higher SOR and reduced detention time that decreases its TSS and BOD removal efficiency. Meanwhile, Clarifier B operates below its capacity and contributes less than its potential share of treatment. The overall plant primary treatment performance suffers from the mismatch.

31. A — A sludge blanket deeper than the design maximum creates an anaerobic zone in the lower layers where sulfate-reducing bacteria thrive. These bacteria convert sulfate in the wastewater to hydrogen sulfide gas. The H_2S bubbles rise through the blanket and are released at the clarifier surface, creating the characteristic rotten-egg odor. Restoring normal sludge withdrawal eliminates the source.

32. B — A biological community dominated by stalked ciliates (Vorticella), with moderate rotifers and few free-swimmers, and no filaments, indicates a mature, well-functioning system operating at a stable SRT. Stalked ciliates attach to floc particles and feed on free bacteria, polishing the effluent. Rotifers indicate a well-established food chain. This community correlates with good effluent quality.

33. C — Oxidation ditches rely on the brush aerators to maintain a minimum channel velocity (typically 0.8–1.0 ft/sec) that keeps the mixed liquor solids in suspension and circulating around the ditch. Shutting off one of two brush aerators may reduce the velocity below this threshold, allowing solids to settle in low-velocity zones and creating dead spots that reduce effective treatment volume.

34. D — The recurring afternoon sludge blanket rise occurs specifically during peak flow periods. Adding equalization capacity upstream dampens the peak flow before it reaches the clarifier, maintaining the SOR within the design range throughout the day. This eliminates the root cause rather than treating the symptom. Higher-capacity RAS pumps address the symptom but don't prevent the peak flow impact.

35. B — Starting the portable compressor provides partial aeration — 25% of normal is far better than zero. Even limited oxygen supply keeps a portion of the biology alive and prevents the entire basin from going completely anaerobic and septic. Simultaneously troubleshooting the blower failure addresses the root cause. The biology can survive at reduced DO for a limited period but will die at zero DO.

36. A — Sum of all 30 values: 15+18+22+44+16+28+31+12+24+19+26+42+18+22+14+27+33+20+25+16+28+21+38+15+24+22+19+26+17+23 = 699. Monthly average = 699 ÷ 30 = 23.3 mg/L, which is below the 30 mg/L monthly average limit. The highest daily value (44 mg/L) is below the 45 mg/L daily maximum limit. The plant is in full compliance.

37. D — Before shutting down the UV system, the chlorine contact tank must be full of chlorinated water achieving the target residual and CT value. If the UV is shut down before the chlorine system has established adequate disinfection throughout the contact tank, a slug of undisinfected effluent will be discharged during the transition period. The chlorine system must be fully operational and verified before UV shutdown.

38. C — Nocardia (Gordonia) organisms have a minimum SRT for growth. If the plant's SRT can be reduced below this minimum (typically 8–10 days depending on temperature), the organisms will be wasted from the system faster than they can reproduce and will eventually be eliminated. The key is reducing the SRT sufficiently while maintaining adequate BOD and TSS treatment performance.

39. B — The total mass of volatile solids entering the digester remains the same (same WAS production), but the volume carrying those solids increases dramatically because the WAS is now at 1.5% instead of 4% TS. This much higher volume reduces the hydraulic detention time, may exceed the heating system's capacity to maintain temperature, and dilutes the digester contents.

40. A — The weekend operator violated multiple critical OSHA confined space requirements: no entry permit, no atmospheric testing, and no attendant. Any of these omissions could have resulted in a fatality if hazardous atmospheric conditions existed. The fact that the operator was unharmed does not excuse the violations. The incident must be reported to the supervisor for corrective action and retraining.

41. C — While the atmospheric reading is currently safe (0.0 ppm chlorine), chlorine gas rooms present a dynamic hazard — a cylinder leak, fitting failure, or system malfunction can create a hazardous atmosphere within seconds. OSHA and plant safety programs require that workers in chlorine gas areas have an emergency escape respirator immediately available at all times, even when the atmosphere tests safe.

42. D — The ATS must verify that the restored utility power is stable, at the correct voltage, and at the correct frequency for a preset time delay (typically 5–30 minutes) before retransferring the load. This prevents the ATS from transferring to unstable utility power that might fail again immediately. The voltage-sensing and timing circuits in the ATS control this retransfer decision.

43. B — The operator correctly locked out the electrical supply and the suction and discharge valves, but failed to drain the pump casing and relieve the trapped pressure between the closed valves. Liquid trapped between two closed valves remains under system pressure. When the casing bolts are removed, this pressurized liquid sprays out. The LOTO procedure must include draining and pressure relief.

44. A — A disabled automatic fire department notification means that if a fire occurs, the building sprinklers will activate but no one will be automatically summoned to fight the fire, investigate, or ensure personnel safety. This gap could allow a fire to grow beyond the sprinkler system's capacity. The repair must be escalated as an urgent safety priority with the alarm company.

45. D — An oxygen level of 18.5% is below the 19.5% OSHA minimum for safe entry. The rapid drop from 20.9% to 18.5% during descent indicates an active oxygen-depleting condition (biological activity consuming O_2, or an oxygen-displacing gas present) that may worsen at greater depth. The operator must exit immediately using the retrieval system — continuing descent risks incapacitation.

46. D — Expired laboratory chemicals that are hazardous (acids, bases, solvents) must be managed under RCRA hazardous waste regulations. They must be properly characterized (identified and classified), stored in appropriate containers within the regulatory accumulation time limit, and disposed of through a licensed hazardous waste transporter to a permitted treatment, storage, or disposal facility.

47. B — Actual usage rate = 45 lbs ÷ 3 hours = 15 lbs/hour. Normal usage rate = 5 lbs/hour. The cylinder is being consumed at three times the expected rate (15 ÷ 5 = 3.0×). Since the chlorine gas alarm has not activated, the excess consumption may be caused by a small leak downstream of the detector location, an overdose at the chlorinator due to a control malfunction, or an open valve that is feeding gas to an offline system. The operator should immediately investigate the gas delivery system, verify the chlorinator feed rate, check all connections and valves for leaks using an ammonia squeeze bottle, and account for all chlorine consumption before the cylinder empties unexpectedly.

48. A — The general duty clause is a proactive requirement — employers must identify and address recognized hazards whether or not an injury has occurred. Additionally, numerous specific OSHA standards (confined space, LOTO, HazCom, respiratory protection, bloodborne pathogens) require written programs regardless of injury history. The absence of injuries does not demonstrate compliance with these mandatory program requirements.

49. C — With only 2 days of primary tank supply and a 5-day delivery window, the plant will run out of dechlorination chemical — causing a permit violation for chlorine residual. Reducing the chlorine dose to zero eliminates disinfection, causing a fecal coliform violation. The correct interim measure is to reduce the chlorine dose to minimize the residual requiring dechlorination, extending the chemical supply while maintaining adequate disinfection.

50. B — OSHA requires annual bloodborne pathogens training for all employees with occupational exposure. Wastewater operators handle potentially infectious materials daily (wastewater, sludge, contaminated equipment). Training that is 14 months old is 2 months overdue. The training should be scheduled immediately and the program adjusted to prevent future lapses.

51. A — An O&M manual that does not reflect the current plant configuration, processes, and procedures is deficient. NPDES permits typically require that the O&M manual be maintained current and available. The inspector will likely issue a notice of deficiency or violation requiring the plant to update the manual within a specified timeframe to accurately reflect current operations.

52. C — Data integrity requires that errors be corrected transparently. The operator must submit corrected DMRs for all three affected months, notify the regulatory authority of the data entry errors, and implement quality control measures (such as data review procedures, a second-operator verification step, or automated range checks) to prevent recurrence.

53. D — A 45-day lag before detecting a chronic 0.1 mg/L phosphorus exceedance reveals that the monitoring frequency is inadequate for early detection of subtle, ongoing violations. Weekly composite

sampling with results reviewed promptly, or continuous online phosphorus monitoring, would detect such exceedances within days rather than weeks, enabling faster corrective action.

54. B — Federal regulations (40 CFR 122.22) require that DMRs be signed by either the principal executive officer, a ranking elected official, or a duly authorized representative. An operator can be authorized to sign DMRs, but this authorization must be in writing, signed by the principal executive officer, and submitted to the regulatory authority before the operator signs any reports.

55. A — Declining discharge pressure AND declining motor amperage together indicate the pump impeller is wearing. As the impeller loses material to abrasion or corrosion, it becomes less effective at accelerating the fluid (lower pressure and flow) and requires less energy to spin (lower amperage). All three parameters declining together is the diagnostic signature of progressive impeller erosion.

56. C — The flow meter itself is functioning (local display works), but the SCADA system shows no data. This pattern indicates a communication link failure between the field instrument and the SCADA system — possibly a broken signal cable, loose connection at a terminal block, failed communication module, or protocol mismatch after a firmware update.

57. D — A positive displacement blower delivers a constant volume per revolution regardless of discharge pressure — it will increase pressure until something gives. Rising discharge pressure at constant output means the downstream resistance has increased. The operator should check the aeration diffusers for fouling, the piping for valve position changes or obstructions, and the basin water level.

58. B — A dominant vibration frequency at exactly 2× the motor running speed (2× RPM) is the classic signature of shaft misalignment — either angular misalignment (shafts at an angle) or parallel offset misalignment (shafts parallel but not colinear). Misalignment generates forces that peak twice per revolution, producing the characteristic 2× frequency. Corrective action is to realign the motor and driven equipment.

59. A — Rapid wet well level oscillation with a single pump running indicates the pump is operating in an unstable region of its performance curve. This can occur when the pump operates at the far right of a flat curve (where small head changes cause large flow changes), during cavitation (air or vapor in the suction), or when air entrainment causes intermittent loss of prime.

60. C — A sudden 20% change in flow meter reading coinciding with a thunderstorm strongly suggests a lightning-related electrical surge has damaged the meter's sensitive electronics, signal conditioning

circuits, or grounding system. Magnetic flow meters are electronic instruments susceptible to power surges. The meter should be inspected, its grounding verified, and recalibrated or repaired as needed.

61. D — Diverting all flow to a single clarifier doubles both the surface overflow rate and the solids loading rate. The SOR determines how fast particles must settle to be captured, and the SLR determines how much solids mass the clarifier must handle. Both parameters doubling simultaneously exceeds the clarifier's design capacity, resulting in solids being carried over the weir.

62. B — Visible metal particles in blower oil indicate active internal wear — bearings, timing gears, or rotor surfaces are shedding material. The absence of abnormal vibration or temperature means the wear has not yet progressed to the point of measurable mechanical distress, but it is actively occurring. The blower should be scheduled for internal inspection before the wear progresses to a catastrophic failure.

63. A — Chemical metering pump output = Stroke Length % × Speed % × Maximum Output. Multiple combinations can achieve 6.5 GPH from a 20 GPH pump: 65% × 50% × 20 = 6.5, or 50% × 65% × 20 = 6.5, or 32.5% × 100% × 20 = 6.5. The operator should choose the combination that provides the smoothest, most consistent chemical delivery.

64. C — Step 1: Water Horsepower = (800 × 45) ÷ 3,960 = 36,000 ÷ 3,960 = 9.09 WHP. Step 2: Convert WHP to kW: 9.09 HP × 0.746 kW/HP = 6.78 kW of useful hydraulic output. Step 3: Efficiency = Output ÷ Input × 100 = 6.78 ÷ 11 × 100 = 61.6%, approximately 62%. This wire-to-water efficiency accounts for all losses in the system — motor electrical losses, motor-to-shaft mechanical losses, and pump hydraulic losses. A value of 62% is acceptable for a typical centrifugal pump installation but indicates room for improvement through impeller optimization, reduced friction losses, or motor efficiency upgrades.

65. B — A stuck "tank full" signal tells the control system the day tank is full when it is actually half empty. The transfer pump will never receive the "tank low" signal needed to trigger a refill cycle. The day tank will continue to feed chemical to the process until it runs empty, at which point chemical feed stops — potentially causing a disinfection failure, pH violation, or other process disruption.

66. B — Startup squealing that stops at full speed is the classic symptom of belt slippage. During startup, the motor must accelerate the stationary fan — this requires more torque than steady-state operation. A loose or glazed belt cannot grip the sheave surfaces under this high-torque demand and slips, producing the squealing noise. Once at full speed, the reduced torque requirement allows the belt to grip adequately.

67. D — A 24-month PM interval is clearly too long if the diffusers show significant fouling at 6 months. However, monthly cleaning is excessive and costly. The optimal approach is to establish the PM interval based on the actual fouling rate — if the pressure trend shows the action level is reached in approximately 18 months, cleaning at 12–15 months provides an adequate safety margin.

68. A — DO cycling between 0.5 and 4.5 mg/L around a 2.0 mg/L setpoint is the classic sign of an aggressively tuned PID controller. The proportional gain is too high (controller overreacts to small errors) or the integral time is too short (controller accumulates correction too quickly). Reducing the proportional gain and increasing the integral time will dampen the oscillations.

69. C — A ground fault alarm indicates that current is flowing through an unintended path to ground — typically through deteriorated cable insulation, a cracked motor winding, or moisture intrusion in the motor junction box. The VFD's ground fault protection detects this leakage current and trips to prevent electrical shock, equipment damage, or fire. The motor and its power cable should be megger-tested.

70. D — A power factor of 0.72 indicates significant reactive power consumption from inductive loads (motors). Power factor correction capacitors supply the reactive current locally, reducing the reactive current drawn from the utility. This raises the power factor toward 1.0, eliminates the utility penalty, and reduces the total current flowing through the plant's electrical distribution system.

71. A — A gravity thickener depends on the picket fence rake mechanism to slowly stir the sludge blanket, releasing entrapped gas bubbles and water, and channeling the released water upward through the blanket. If the rake has failed or slowed, gas accumulates in the blanket (causing flotation and turbid supernatant), and the sludge cannot consolidate properly (lower concentration).

72. C — Waste activated sludge is more difficult to dewater than primary sludge or combined sludge because biological cells are hydrophilic (water-loving) and resist releasing their intracellular and bound water. Combined sludge benefits from the fibrous, easily dewatered primary sludge fraction. Switching to WAS-only will likely produce a wetter cake requiring higher polymer doses.

73. D — The VA/Alk ratio has jumped to 800/2,400 = 0.33, approaching the 0.35 critical threshold. The pH drop to 6.7 confirms alkalinity consumption. The correct response combines two actions: reduce the feed rate to decrease the acid production rate, AND add chemical buffer (sodium bicarbonate or lime) to maintain pH while the methanogens catch up. Ceasing all feeding is overly aggressive for a ratio still below 0.35.

74. B — Detectable ammonia odor at 15 feet from the compost pile indicates excess nitrogen is being volatilized. This occurs when the C:N ratio is below the optimal 25–30:1 range — the microorganisms mineralize more nitrogen than they can assimilate into new cell mass, and the surplus is released as ammonia gas. Adding more carbon-rich bulking agent would help balance the ratio.

75. A — Exceptional Quality requires Class A pathogen reduction, Table 3 metals compliance, AND one of the vector attraction reduction options. While 38% VSR is the most common VAR method, Part 503 lists multiple alternatives. If the biosolids are injected below the soil surface (Option 6) or incorporated within 6 hours (Option 7), these alternatives satisfy the VAR requirement even though VSR is below 38%.

76. C — Deteriorating centrate (200 to 1,200 mg/L TSS) with unchanged cake solids indicates fine particles are escaping in the liquid phase. The solids are being separated but the smallest particles are not being captured. Increasing the polymer dose improves flocculation of these fine particles, binding them into larger aggregates that the centrifugal force can capture more effectively.

77. D — Both digesters operate identically except for gas composition. Lower methane (48% vs. 55%) with higher CO_2 and/or nitrogen suggests dilution of the gas. A gas system leak that admits outside air (78% nitrogen, 21% oxygen) would dilute the methane concentration and create an explosion hazard if the oxygen concentration in the gas system reaches the lower explosive limit.

78. B — Lime stabilization to pH 12.0 for 72 hours meets the PFRP (Process to Further Reduce Pathogens) requirement for Class A pathogen reduction under 40 CFR 503.32(a)(3) — Alternative 1 requires pH 12 for 72 hours with air-drying to >50% TS. It also meets VAR Option 8 (alkaline treatment). The exact requirements depend on the specific Part 503 alternative being claimed.

79. C — The standing water above the sludge cake should be drained through the underdrain system, which is designed for exactly this purpose. Once the surface water has drained, scarifying (cracking) the cake surface promotes evaporative drying when the weather clears. This is the standard approach for managing rain events on active drying beds.

80. A — Volume in ft^3 = 200,000 gal ÷ 7.48 = 26,738 ft^3. Sludge TS = 12,000 × 8.34 × 0.05 = 5,004 lbs/day. VS = 5,004 × 0.70 = 3,503 lbs VS/day. VS loading = 3,503 ÷ 26,738 = 0.131 lbs VS/ft^3/day. This slightly exceeds the typical upper range of 0.04–0.10 for conservatively loaded mesophilic digesters, though some references allow up to 0.15.

81. D — Part 503 requires that when Class B biosolids are surface-applied, they must be incorporated into the soil within 6 hours of application to satisfy certain vector attraction reduction alternatives. Three days without incorporation leaves the biosolids fully exposed to flies and creates the odor conditions described. Injection or timely incorporation prevents both problems.

82. B — With identical WAS feed, identical polymer dose, but different thickened concentration and filtrate quality, the difference is most likely in the belt itself. A worn, stretched, or damaged belt on Thickener B has enlarged openings that allow more solids to pass through into the filtrate (higher filtrate TSS) and retain more water in the sludge (lower thickened TS concentration).

83. C — The solids mass is conserved: 50,000 gal × 0.04 = 2,000 gallon-equivalents of solids. At 20% solids: 2,000 ÷ 0.20 = 10,000 gallons of cake. Volume reduction = (50,000 – 10,000) ÷ 50,000 = 80%. Dewatering from 4% to 20% produces a fivefold concentration, reducing the volume to one-fifth of the original — an 80% volume reduction.

84. A — Testing the raw sludge feed for surfactant concentration provides direct evidence of whether the foam is caused by external chemical input. If surfactant levels are elevated compared to historical data, the source can be traced through the collection system. This diagnostic approach identifies the root cause rather than treating the symptom with antifoaming agents or mechanical measures.

85. D — While Part 503 does not specifically limit phosphorus in biosolids, excessive phosphorus loading can cause nutrient runoff that degrades surface water quality — potentially triggering state environmental regulations. The agronomic rate should be recalculated using phosphorus as the limiting nutrient instead of nitrogen, which typically results in a lower application rate.

86. B — Liquid draining from a biosolids transport truck during loading or transport creates an environmental contamination risk on the loading pad and public roadways. The truck bed must be inspected for integrity, sealed to prevent drainage, and equipped with drip containment. Spillage on public roads is a regulatory violation and creates a public health and safety hazard.

87. A — At 60°F (16°C), aerobic biological activity is severely slowed. The 18-day detention time is insufficient for the cold organisms to achieve 38% VSR. Increasing the detention time to 30+ days provides more time for the slow cold-weather biology to break down volatile solids. Alternatively, heating the digester would be effective but is not among the options listed.

88. C — The sample was properly preserved (H_2SO_4 to pH <2.0), refrigerated (4°C), and analyzed within the 28-day holding time for preserved ammonia samples. All three requirements are met. Sulfuric acid preservation converts ammonia to the stable ammonium sulfate form, preventing biological conversion or volatilization during the holding period.

89. D — The RPD of 20% is within the laboratory's 30% acceptance limit, confirming that the duplicate precision is acceptable. Both results are valid data points that demonstrate the inherent variability of the BOD_5 method. The analyst should report the result per the laboratory's standard operating procedure — typically the average of valid duplicate results.

90. B — A pH electrode that reads 7.0 in all solutions — buffers at pH 4, 7, and 10, plus real samples — has lost its ability to respond to changes in hydrogen ion concentration. The glass membrane may be cracked, the reference junction may be plugged with silver chloride or sample contaminants, or the internal filling solution may be depleted. The electrode must be cleaned, reconditioned, or replaced.

91. A — The treatment process operates identically on both days (same dose, residual, contact time), so the difference must be in the sampling and analytical procedures. Friday samples may be handled differently — longer holding time over the weekend, different collection technique, different sample container preparation, or different laboratory processing. Investigating and standardizing procedures between analysts will resolve the discrepancy.

92. C — The calibration deviations are 0.5% at 1,000 µS/cm and 2.0% at 100 µS/cm, both within the typical ±5% tolerance for conductivity meters. The meter demonstrates acceptable accuracy across the calibration range, and the effluent reading of 650 µS/cm — which falls between the two calibration points — is reliable for process monitoring and compliance purposes.

93. D — The BOD/COD ratio indicates what fraction of the total chemically oxidizable matter is biologically available for treatment. A ratio of 0.44 means approximately 44% of the COD is biodegradable, which is typical for domestic wastewater with moderate industrial contributions. Purely domestic wastewater typically has BOD/COD ratios of 0.4–0.8, while heavily industrial wastewater may be below 0.3.

94. B — The jar test results show optimal floc quality at 15 mg/L — large, firm floc with clear supernatant. At 20 mg/L, the floc is similar (no improvement from extra chemical). At 25 mg/L, the supernatant becomes turbid, indicating the beginning of charge reversal and re-dispersion from over-conditioning. The optimal dose is 15 mg/L — maximum performance at minimum cost.

95. A — The permit requires "no observable adverse effects at 50% effluent concentration." The test results show adverse effects (50% mortality) occurred only at 100% concentration — the undiluted effluent. At 50% concentration (the permit test condition), no adverse effects were observed. The plant is in compliance with the WET test requirement as specified in the permit.

96. C — Total phosphorus analysis requires converting all phosphorus forms (organic P, polyphosphates, orthophosphate) to orthophosphate through acid digestion — persulfate digestion or sulfuric acid-nitric acid digestion at elevated temperature. This step breaks down organic compounds and hydrolyzes polyphosphates, producing orthophosphate that can then be measured by the standard colorimetric method.

97. D — SVI = (850 × 1,000) ÷ 4,200 = 202.4 mL/g. An SVI above 200 mL/g indicates significant settling problems — the sludge is light, fluffy, and failing to compact in the clarifier. This value strongly suggests filamentous organism overgrowth. The operator should investigate DO levels, F/M ratio, nutrient balance, pH, and sulfide/septicity as potential causes.

98. A — The 103–105°C drying temperature removes free water, adsorbed water, and loosely bound water from the filter and captured solids. Higher temperatures (550°C) would ignite or volatilize the organic fraction of the solids, producing a falsely low TSS result. The volatile solids analysis (VS) uses the higher temperature intentionally, but TSS must use the lower range to preserve all solid material.

99. C — A dilution water blank showing 0.8 mg/L depletion (four times the 0.2 mg/L maximum) indicates the dilution water itself contains organic contaminants that are consuming oxygen during incubation. This extraneous oxygen demand would be added to every BOD_5 bottle filled with this water, biasing all sample results high. The dilution water must be discarded, the cause investigated, and fresh water prepared.

100. B — Chlorine residual decreases continuously after collection because the chlorine continues reacting with organic matter, ammonia, and other demand-exerting substances in the sample. Additionally, chlorine is volatile and can be lost to the atmosphere, especially from uncapped containers. A 4-minute delay means the measured 0.5 mg/L is lower than the actual in-process residual at the sampling point.