PRACTICE EXAM 4: ABC CLASS I WASTEWATER TREATMENT SIMULATION (100 QUESTIONS)

1. A treatment plant receives wastewater from a mixed residential and commercial area. The operator collects influent samples at 6:00 AM and 10:00 AM on the same weekday. The 6:00 AM sample shows a BOD of 280 mg/L and a flow of 1.2 MGD, while the 10:00 AM sample shows a BOD of 165 mg/L and a flow of 3.8 MGD. Which of the following best explains the difference between the two samples?

A. An industrial batch discharge occurred at 6:00 AM and has since stopped discharging

B. The 6:00 AM sample represents concentrated low-flow conditions while the 10:00 AM sample reflects dilution from increased morning water use

C. The wastewater at 6:00 AM is older and has undergone more biological decomposition in the sewer

D. The laboratory made an error analyzing one of the two samples, and both results cannot be correct

2. An operator reviewing three months of influent data notices that the settleable solids measured by Imhoff cone have increased from an average of 8 mL/L to 22 mL/L, while the total suspended solids concentration has remained stable at 220 mg/L. Which of the following best explains this divergence?

A. The Imhoff cone test is inherently unreliable and should be replaced with a different analytical method

B. The laboratory analyst is allowing the cone to settle for longer than the standard 60 minutes

C. The influent temperature has decreased significantly, improving particle settleability in the cone

D. The particle size distribution has shifted toward larger, more readily settleable particles while the total mass remains the same

3. A combined sewer system community experiences a major storm event. The treatment plant influent flow reaches 12 MGD — three times the 4 MGD dry-weather design flow. The operator must decide how to manage the excess flow. Which of the following is the most appropriate action under these circumstances?

A. Maximize the flow through the treatment process within the plant's hydraulic capacity and follow the approved CSO long-term control plan for flows exceeding capacity

B. Shut down the biological treatment process to protect it and discharge all flow through preliminary treatment only

C. Reduce the influent pumping rate to maintain 4 MGD and allow the collection system to store the excess volume

D. Bypass all treatment and discharge the combined flow directly to the receiving water until the storm passes

4. An operator measures the influent wastewater temperature at 42°F (5.5°C) during a prolonged cold period. Which of the following treatment processes will be most significantly affected by this low temperature?

A. Primary sedimentation in the gravity clarifiers due to reduced particle settling velocity

B. Grit removal in the aerated grit chamber due to changes in air bubble density

C. Nitrification in the activated sludge system due to the temperature sensitivity of nitrifying bacteria

D. Screening effectiveness at the headworks due to increased wastewater viscosity

5. An operator collects a routine influent grab sample and measures a pH of 3.8 and detects a strong acidic chemical odor. The previous day's influent pH was 7.1. Which of the following represents the greatest immediate risk from this condition?

A. The low pH will cause the chlorine disinfection system to become more effective than necessary

B. The acidic influent will improve the settleability of solids in the primary clarifier

C. The low pH will increase the rate of nitrification in the aeration basin temporarily

D. The acidic discharge may kill the biological organisms in the activated sludge system, causing a complete treatment failure

6. An activated sludge system has the following operating parameters: MLSS of 2,200 mg/L, aeration basin volume of 0.65 MG, plant flow of 2.0 MGD, and primary effluent BOD of 135 mg/L. The MLVSS is estimated at 78% of MLSS. What is the approximate F/M ratio?

A. 0.19, placing the system at the lower end of the conventional activated sludge range

B. 0.28, placing the system in the middle of the conventional activated sludge range

C. 0.37, placing the system near the high end of the conventional activated sludge range

D. 0.45, placing the system in the high-rate activated sludge operating range

7. A secondary clarifier with a diameter of 80 feet receives a plant flow of 3.0 MGD plus a RAS flow of 1.2 MGD. The MLSS is 2,800 mg/L. If a second identical clarifier is available but currently offline, what would be the approximate effect on the solids loading rate of bringing it into service?

A. The SLR would increase because the total flow would be distributed across more surface area

B. The SLR per clarifier would decrease by approximately half, reducing the risk of solids washout

C. The SLR would remain unchanged because the total solids mass entering the system stays the same

D. The SLR would increase because the additional clarifier would attract more solids from the aeration basin

8. An operator at an extended aeration plant notices that the effluent BOD is 5 mg/L and the effluent TSS is 4 mg/L, but the effluent is noticeably turbid with very fine particles visible under light. The SVI is 55 mL/g and the SRT is 28 days. What is the most likely explanation for the turbid effluent despite excellent BOD and TSS numbers?

A. Filamentous bulking organisms are extending out of the floc and creating a hazy appearance

B. The secondary clarifier weir is uneven and causing preferential flow that disturbs the settling zone

C. The extended SRT has produced pin floc — very small, dense particles that pass through the clarifier

D. The primary clarifier is failing and passing excess fine solids to the secondary treatment process

9. A plant using chlorination and dechlorination for disinfection reports the following data: chlorine dose of 7.5 mg/L, chlorine residual before dechlorination of 1.8 mg/L, and effluent flow of 2.5 MGD. What is the chlorine demand of this effluent?

A. 9.3 mg/L, calculated by adding the dose and residual together

B. 7.5 mg/L, because the demand equals the total dose applied to the wastewater

C. 5.7 mg/L, calculated by subtracting the residual from the dose

D. 1.8 mg/L, because the demand equals the residual measured in the contact tank

10. An operator calculates the surface overflow rate on a primary clarifier and finds it is 1,350 GPD/ft² during peak flow. The design maximum SOR is 1,200 GPD/ft². Which of the following operational consequences is most likely?

A. Reduced TSS removal efficiency as lighter particles are carried over the weir by the excessive upward velocity

B. Improved BOD removal because the faster flow increases the contact time with settled sludge

C. Increased sludge blanket compaction because the higher flow velocity pushes solids down more forcefully

D. No significant effect because primary clarifier performance is not sensitive to SOR variations

11. In a biological nutrient removal system, the internal mixed liquor recycle rate from the aerobic zone to the anoxic zone is typically set at 200–400% of the plant influent flow. What happens to denitrification performance if this recycle rate is too low?

A. Denitrification improves because the organisms in the anoxic zone receive a more concentrated food supply

B. Denitrification improves because the lower recycle prevents dissolved oxygen from entering the anoxic zone

C. Nitrification fails because the organisms are not receiving adequate return sludge from the clarifier

D. Denitrification decreases because insufficient nitrate is returned to the anoxic zone for conversion to nitrogen gas

12. A treatment plant has two aeration basins operating in parallel. Basin A has a DO of 2.5 mg/L and Basin B has a DO of 0.8 mg/L. Both basins receive the same organic loading. The effluent from Basin B has noticeably higher TSS and the SVI from Basin B mixed liquor is 210 mL/g compared to 95 mL/g for Basin A. What is the most likely cause of Basin B's poor performance?

A. Basin B's higher organic loading is consuming more oxygen than the aeration system can supply

B. The low DO in Basin B is promoting the growth of filamentous organisms that cause poor settling

C. Basin B's secondary clarifier is hydraulically overloaded due to an uneven flow distribution

D. The pH in Basin B has dropped below 6.0 due to excessive nitrification consuming all alkalinity

13. An operator needs to determine whether the activated sludge process has enough alkalinity to support nitrification. The influent alkalinity is 220 mg/L as $CaCO_3$, and the influent ammonia nitrogen is 32 mg/L. Nitrification consumes 7.14 mg of alkalinity per mg of NH_3-N oxidized. What is the approximate alkalinity remaining after complete nitrification, ignoring denitrification recovery?

A. Approximately 0 mg/L — the alkalinity is almost completely consumed, and supplemental alkalinity may be needed

B. Approximately 48 mg/L — adequate alkalinity remains to maintain a stable pH in the aeration basin

C. Approximately 95 mg/L — the alkalinity is more than sufficient for complete nitrification

D. Approximately 150 mg/L — only a small fraction of the available alkalinity is consumed

14. An oxidation ditch treats 1.5 MGD of municipal wastewater. The ditch has a volume of 2.0 MG and an MLSS of 4,500 mg/L. The primary effluent BOD is 160 mg/L. What is the hydraulic detention time, and what process mode does the long detention time suggest?

A. HRT is 16 hours, suggesting conventional activated sludge with moderate organic loading

B. HRT is 24 hours, suggesting contact stabilization with separate aeration zones for different functions

C. HRT is 48 hours, suggesting a sequencing batch reactor operating on a daily fill-and-draw cycle

D. HRT is 32 hours, suggesting extended aeration with long SRT and low F/M operation

15. A wastewater treatment plant effluent must meet a daily maximum limit of 45 mg/L BOD and a monthly average limit of 30 mg/L BOD. The following daily results are recorded for the first week: 22, 25, 38, 44, 18, 24, 29. Which of the following compliance statements is correct?

A. The plant is in violation of the daily maximum because one result (44 mg/L) is close to the 45 mg/L limit

B. The plant is in violation of the monthly average because the weekly average of 28.6 mg/L will likely exceed 30 when combined with later results

C. The plant is in compliance for both limits — no daily result exceeds 45 mg/L and the weekly average of 28.6 mg/L is below 30 mg/L

D. The plant is in violation of the weekly average limit of 30 mg/L because three results exceed 25 mg/L

16. A plant operating a trickling filter with rock media has experienced reduced BOD removal efficiency from 82% to 64% over the past month. The hydraulic loading and recirculation rate have not changed.

The operator observes thick biofilm growth and ponding on portions of the media surface. What is the most appropriate corrective action?

A. Reduce the recirculation rate to increase the organic concentration applied to the biofilm

B. Increase the hydraulic loading or recirculation rate to flush excess biofilm from the media and relieve the ponding

C. Switch the trickling filter to intermittent operation with 12 hours on and 12 hours off to dry the biofilm

D. Add chlorine to the trickling filter influent to reduce the biofilm thickness through disinfection

17. The minimum dissolved oxygen concentration that should be maintained in an activated sludge aeration basin to support conventional BOD removal is approximately which of the following?

A. 1.0 to 2.0 mg/L to prevent oxygen depletion that impairs aerobic biological treatment

B. 4.0 to 6.0 mg/L to maximize the metabolic rate of all aerobic organisms in the mixed liquor

C. 0.2 to 0.5 mg/L because most wastewater bacteria can function at trace oxygen levels

D. 8.0 to 10.0 mg/L to fully saturate the mixed liquor with dissolved oxygen at all times

18. A plant's secondary clarifier effluent has a TSS of 38 mg/L, which exceeds the 30 mg/L monthly average permit limit. The MLSS is 3,200 mg/L, the SVI is 118 mL/g, and the sludge blanket is at a normal depth of 2 feet. The RAS concentration is 7,500 mg/L. Despite these normal process parameters, the high effluent TSS persists. Which of the following should the operator investigate?

A. The RAS pump rate, which may be excessive and creating turbulence in the clarifier inlet

B. The WAS rate, which may be too high and reducing the SRT below the minimum for floc formation

C. The primary clarifier, which may be passing excess fine solids to the biological process

D. The secondary clarifier effluent weir, which may be uneven, damaged, or fouled with algae or grease causing preferential flow

19. Which of the following correctly describes the relationship between solids retention time and the food-to-microorganism ratio in an activated sludge system?

A. SRT and F/M are inversely related — as SRT increases, the MLSS increases and the F/M decreases

B. SRT and F/M increase together — longer SRT allows more organisms to consume more food

C. SRT and F/M are unrelated because they measure completely different process conditions

D. SRT and F/M are inversely related at high loading but directly related at low loading conditions

20. A plant uses sodium hypochlorite at 12% available chlorine for disinfection. The target dose is 6.0 mg/L and the plant flow is 4.0 MGD. The sodium hypochlorite solution has a specific gravity of 1.17. How many gallons per day of solution are needed?

A. 98 GPD

B. 143 GPD

C. 205 GPD

D. 267 GPD

21. An operator at a conventional activated sludge plant wants to promote nitrification. The current SRT is 5 days and the wastewater temperature is 15°C. Which of the following is the single most important adjustment to establish nitrification?

A. Decrease the WAS rate to increase the SRT to at least 10–15 days at this temperature

B. Increase the RAS rate to bring more organisms from the clarifier to the aeration basin

C. Add supplemental carbon source (methanol) to the aeration basin to support nitrifier growth

D. Reduce the aeration rate to decrease the DO to 1.0 mg/L, which is optimal for nitrifiers

22. A treatment plant operates three parallel secondary clarifiers. During routine maintenance, one clarifier is taken offline. The plant flow is 6.0 MGD. With three clarifiers, the surface overflow rate per clarifier was 540 GPD/ft². What is the approximate SOR per clarifier with only two in service?

A. 360 GPD/ft² per clarifier

B. 540 GPD/ft² per clarifier, unchanged from the three-clarifier condition

C. 720 GPD/ft² per clarifier

D. 810 GPD/ft² per clarifier

23. An activated sludge plant has been producing excellent effluent (BOD 8 mg/L, TSS 6 mg/L) for months. Suddenly, over a three-day period, the effluent BOD rises to 35 mg/L and the effluent TSS rises to 42 mg/L. The influent loading has not changed. The DO in the aeration basin is 2.5 mg/L. The operator checks the 30-minute settling test and finds that the sludge settles rapidly to a very compact volume of only 80 mL/L with clear supernatant, but the supernatant has a slight turbidity. The MLSS is 1,100 mg/L, which is well below the target of 2,800 mg/L. What has most likely occurred?

A. A toxic industrial discharge has killed a portion of the biological population in the aeration basin

B. The WAS rate was inadvertently set too high and has wasted a large portion of the biological solids

C. The RAS pumps have failed and are not returning settled solids from the secondary clarifier

D. The primary clarifier has begun sending a heavy organic load that is overwhelming the biology

24. In the activated sludge process, which of the following most accurately describes the difference between return activated sludge and waste activated sludge?

A. RAS is pumped from the aeration basin while WAS is pumped from the secondary clarifier

B. RAS removes excess solids from the system while WAS maintains the biological population

C. RAS returns settled organisms to the aeration basin while WAS removes excess organisms from the system

D. RAS and WAS serve the same function and are distinguished only by their pumping locations

25. A rectangular aeration basin is 100 feet long, 25 feet wide, and 15 feet deep. What is the volume of this basin in gallons?

A. Approximately 280,500 gallons, based on the basin dimensions converted to cubic feet and then to gallons

B. Approximately 375,000 gallons, based on the total cubic footage multiplied by the conversion factor

C. Approximately 187,000 gallons, based on the effective volume at 50% of the basin depth

D. Approximately 450,000 gallons, based on the gross basin dimensions with freeboard allowance

26. A stabilization pond system consisting of three cells in series has been producing effluent with a TSS of 45 mg/L, primarily composed of algae. The permit limit is 30 mg/L. Which of the following modifications would be most effective at reducing the algae-related TSS?

A. Adding chemical coagulant to the final cell to precipitate and settle the algae before discharge

B. Adding a polishing cell with baffles or an intermittent sand filter to capture the algae before discharge

C. Increasing the detention time in the primary cell to allow more complete organic matter decomposition

D. Reducing the recirculation between cells to limit the nutrients available for algae growth

27. A treatment plant discharges to a river with a 7Q10 flow of 15 cfs. The permit requires a total phosphorus limit of 0.5 mg/L. The current effluent phosphorus is 3.2 mg/L using only secondary

treatment. The operator begins adding alum at 40 mg/L to the secondary clarifier influent. After two weeks, the effluent phosphorus drops to 0.4 mg/L, but the operator notices the pH in the aeration basin has dropped from 7.2 to 6.4. Which of the following explains the pH decline?

A. The alum has reacted with dissolved oxygen in the aeration basin to form an acidic byproduct

B. The alum addition has promoted excessive nitrification that is consuming all available alkalinity

C. The phosphorus removal has destabilized the biological floc structure, causing acidic cell contents to be released

D. Alum is an acidic chemical that consumes alkalinity when it dissolves and hydrolyzes in the wastewater

28. An operator calculates that the primary clarifier is achieving 52% TSS removal and 28% BOD removal. How do these results compare to expected performance for a properly operating primary clarifier?

A. The TSS removal is within the expected range of 50–65%, and the BOD removal is within the expected range of 25–40%

B. Both removals are below the expected range and indicate the clarifier is significantly underperforming

C. The TSS removal is acceptable but the BOD removal is above the expected range for primary treatment

D. The TSS removal is below the expected range but the BOD removal is acceptable for primary treatment

29. A UV disinfection system has a measured intensity of 6.0 mW/cm² and the effluent travels through the UV chamber in 8 seconds. What is the delivered UV dose, and does it meet a typical target of 40 mJ/cm²?

A. The UV dose is 36 mJ/cm², which is slightly below the 40 mJ/cm² target and needs adjustment

B. The UV dose is 48 mJ/cm², which is exactly at the target and provides adequate disinfection

C. The UV dose is 48 mJ/cm², which exceeds the 40 mJ/cm² target and provides adequate disinfection

D. The UV dose is 14 mJ/cm², which is significantly below the target and requires immediate attention

30. A treatment plant is required to dechlorinate its effluent before discharge. The operator measures a chlorine residual of 0.6 mg/L after the contact tank. Sodium bisulfite is used for dechlorination at a ratio of approximately 1.46 mg of sodium bisulfite per 1.0 mg of chlorine residual. The plant flow is 3.0 MGD. What is the approximate sodium bisulfite requirement in pounds per day?

A. 15.0 lbs/day of sodium bisulfite solution is required for complete dechlorination

B. 21.9 lbs/day of sodium bisulfite solution is required for complete dechlorination

C. 35.4 lbs/day of sodium bisulfite solution is required for complete dechlorination

D. 44.0 lbs/day of sodium bisulfite solution is required for complete dechlorination

31. The CT concept in chlorine disinfection states that the same level of pathogen inactivation can be achieved by which of the following combinations?

A. Only by maintaining a specific chlorine residual regardless of contact time variations

B. Only by maintaining a specific contact time regardless of chlorine residual variations

C. By a high chlorine residual with long contact time but not by adjusting either variable independently

D. By either a high residual with shorter contact time or a lower residual with longer contact time, as long as the product (C × T) remains constant

32. An operator observes that the effluent from a sand filter has become increasingly turbid over the past several hours, even though the headloss across the filter has not increased significantly. The filter was backwashed 4 hours ago. What is the most likely explanation?

A. The filter sand has been displaced during the recent backwash and created channels in the media bed

B. The filter has developed air binding from excessive negative head conditions within the filter bed

C. The filter is experiencing breakthrough — fine particles are being pushed through the media as the bed loads

D. The filter underdrain has developed a crack that is allowing unfiltered water to bypass the media bed

33. A plant operating a two-stage anaerobic digestion system has a primary digester volume of 300,000 gallons and feeds it 18,000 gallons per day of thickened sludge at 5% total solids with 70% volatile solids. What is the approximate hydraulic detention time in the primary digester?

A. Approximately 16.7 days, which is within the typical range for mesophilic anaerobic digestion

B. Approximately 10.5 days, which is below the minimum recommended for adequate volatile solids reduction

C. Approximately 22.4 days, which suggests the digester is conservatively loaded with excess capacity

D. Approximately 30.0 days, which indicates the digester is significantly oversized for the current loading

34. The difference between a standard-rate (low-rate) anaerobic digester and a high-rate digester is best characterized by which of the following?

A. A high-rate digester uses chemical oxidation rather than biological decomposition for sludge stabilization

B. A high-rate digester is actively heated, continuously mixed, and regularly fed, while a standard-rate digester is not actively mixed

C. A standard-rate digester operates at thermophilic temperatures while a high-rate digester operates mesophilically

D. A high-rate digester uses aerobic bacteria while a standard-rate digester uses anaerobic bacteria

35. A treatment plant must meet an effluent total nitrogen limit of 10 mg/L. The current effluent contains 1.5 mg/L ammonia and 12.8 mg/L nitrate for a total nitrogen of 14.3 mg/L. The plant has a pre-anoxic zone with internal recycle for denitrification. What operational adjustment is most likely to improve total nitrogen removal?

A. Reduce the internal recycle rate to decrease the amount of nitrate returned to the anoxic zone

B. Increase the dissolved oxygen in the aerobic zone to improve the nitrification rate and ammonia removal

C. Add supplemental alkalinity to the aeration basin to support more complete nitrification of the ammonia

D. Increase the internal recycle rate to return more nitrate-rich mixed liquor to the anoxic zone for denitrification

36. A membrane bioreactor produces permeate with a TSS of less than 1 mg/L. Why can an MBR eliminate the need for a secondary clarifier?

A. The MBR uses chemical coagulation to settle all biological solids before they reach the membrane

B. The MBR operates at such low MLSS concentrations that no solids separation is needed at all

C. The submerged membranes physically filter all suspended solids from the mixed liquor, replacing gravity settling with membrane separation

D. The MBR uses UV disinfection integrated into the membrane module that destroys all biological solids

37. A plant's NPDES permit specifies a mass-based effluent BOD limit of 500 lbs/day. The plant flow is 3.0 MGD and the effluent BOD is 18 mg/L. Is the plant in compliance with the mass-based limit?

A. Yes — the mass loading is $18 \times 3.0 \times 8.34 = 450.4$ lbs/day, which is below the 500 lbs/day limit

B. No — the mass loading exceeds 500 lbs/day because the flow rate multiplier is higher than standard

C. Yes — compliance with mass-based limits is only required when concentration limits are also exceeded

D. No — the effluent BOD of 18 mg/L exceeds the concentration equivalent of the 500 lbs/day limit

38. A conventional activated sludge plant experiences a sudden toxic event that kills approximately 60% of the biological population in the aeration basin. The influent flow and loading continue unchanged. Which of the following describes the correct recovery strategy?

A. Increase the aeration rate to compensate for the lower organism count and the resulting higher oxygen demand

B. Increase the WAS rate to remove the dead organisms and make room for new growth in the system

C. Reduce the plant flow by partially closing the influent gate to match the loading to the remaining biology

D. Minimize WAS to retain all surviving organisms, maintain adequate DO, and allow the biology to gradually regrow

39. An operator determines that the aeration basin MLSS has increased from 2,500 mg/L to 4,200 mg/L over the past month without any intentional change to the WAS rate. The influent loading has remained stable. Which of the following is the most likely cause?

A. The RAS pumps have increased their output due to a control system malfunction

B. The WAS pump has been running less than intended, either due to a timer malfunction or a clogged line

C. The influent BOD has actually increased but the laboratory results have not yet reflected the change

D. The secondary clarifier has been compacting the sludge blanket more effectively due to lower flow

40. An operator is working in the chemical storage building and accidentally breaks a valve on a sulfur dioxide cylinder. A hissing sound indicates gas is escaping. What is the correct immediate response?

A. Close the main supply valve on the cylinder to stop the gas flow at its source

B. Ventilate the building by opening the overhead doors and turning on the exhaust fans

C. Evacuate the building immediately, moving upwind, and activate the emergency response plan

D. Don a half-face air-purifying respirator and attempt to tighten the broken valve fitting

41. During a confined space entry into a drained digester for inspection, the entrant's continuous gas monitor alarms for hydrogen sulfide at 18 ppm. The entrant is currently 15 feet below the access point. What is the correct immediate action?

A. The entrant should stop work and move closer to the ventilation source to reduce exposure

B. The entrant should immediately exit the space using the retrieval system, as the H_2S exceeds the OSHA STEL of 15 ppm

C. The attendant should increase the ventilation rate and retest after 10 minutes before the entrant continues

D. The entry supervisor should evaluate the reading and determine whether it represents a real hazard or a sensor malfunction

42. An employer's lockout/tagout program must include a written procedure for removing another worker's lock when that worker is not available. Which of the following must be verified before the lock is removed under this provision?

A. The employer must verify that the worker who placed the lock is not at the facility, the equipment has been inspected, and the worker is notified before returning to work

B. The supervisor on duty must simply document the lock removal in the daily operating log

C. A duplicate key from the master lockout key cabinet can be used at any time without restrictions

D. The lock can only be removed by cutting it off, which automatically documents the removal event

43. A wastewater treatment plant stores 150-lb chlorine gas cylinders in a dedicated chlorination room. The room ventilation system is designed to exhaust air from floor level. Why is the exhaust intake located at floor level rather than at ceiling level?

A. Floor-level exhaust is more energy efficient because it creates better air circulation patterns

B. Floor-level exhaust prevents the ventilation system from drawing in outdoor air contaminants

C. Floor-level exhaust protects the chlorine cylinders from corrosion caused by humid ceiling-level air

D. Chlorine gas is heavier than air and accumulates at floor level, so the exhaust must draw from where the gas concentrates

44. An operator is required to wear a full-face air-purifying respirator with acid gas cartridges when changing out chlorine cylinders. The operator notices that the respirator cartridges have been open and in use for three months but have not been replaced. What should the operator do?

A. Continue using the cartridges because acid gas cartridges do not have an expiration date once opened

B. Test the cartridges by sniffing for chlorine odor while wearing the respirator in a safe area

C. Replace the cartridges with fresh ones before entering the chlorination room, as the service life may be exceeded

D. Use the respirator without cartridges since the ventilation system provides adequate protection

45. Under OSHA's confined space regulations, the entry supervisor is responsible for which of the following duties before authorizing entry?

A. Physically entering the confined space to conduct a preliminary visual inspection before the entrant goes in

B. Verifying that all permit conditions are met, the entry team is trained and equipped, and the atmosphere is safe

C. Operating the ventilation equipment inside the confined space throughout the duration of the entry

D. Performing the actual maintenance or inspection work that is the purpose of the confined space entry

46. A treatment plant operator discovers a 20-gallon spill of concentrated polymer solution on the floor of the dewatering building. The polymer is not toxic but creates an extremely slippery surface. What is the primary safety concern?

A. The polymer will contaminate the dewatered biosolids and make them unsuitable for land application

B. The slippery surface creates a serious fall hazard for all personnel working in or passing through the area

C. The polymer vapors will trigger the building's fire suppression system and cause water damage

D. The polymer will corrode the concrete floor surface and create structural damage to the building foundation

47. A treatment plant operator observes a fellow employee performing electrical work inside a motor control center without first de-energizing and locking out the circuit. The panel is clearly labeled "480V." What should the observing operator do?

A. Assume the fellow employee has received specific authorization for energized electrical work

B. Wait until the work is completed and then file a written safety report with the plant manager

C. Offer to hold a flashlight for the employee to improve visibility inside the motor control center

D. Immediately notify the employee of the hazard and inform the supervisor that unsafe work practices are occurring

48. When transporting a sample of plant effluent to an off-site contract laboratory for NPDES compliance analysis, the operator must ensure which of the following?

A. A completed chain of custody form accompanies the samples, documenting collection details, preservation, and each transfer of possession

B. The samples are transported in the operator's personal vehicle without any special packaging requirements

C. The laboratory receives the samples within 7 days regardless of the parameter being analyzed

D. The operator verbally informs the laboratory of the sample details rather than providing written documentation

49. A treatment plant conducts quarterly fire extinguisher inspections. During an inspection, the operator notices that one extinguisher in the chemical storage building has a pressure gauge reading in the red "recharge" zone. What is the correct action?

A. Leave the extinguisher in place because it will still function at reduced capacity in an emergency

B. Label the extinguisher as "out of service" but keep it mounted in its location for future recharging

C. Remove the extinguisher from service immediately, replace it with a fully charged unit, and send the depleted one for recharging

D. Shake the extinguisher vigorously to redistribute the agent and recheck the pressure reading

50. An operator at a small treatment plant works alone on the night shift. A permit violation is discovered when the effluent fecal coliform result from the day shift analysis shows 580 CFU/100 mL against a permit limit of 200 CFU/100 mL. The operator's supervisor is off-site and unavailable by phone. What is the correct action?

A. Document the violation, investigate the cause, begin corrective action, and initiate the 24-hour regulatory notification process as required by the permit

B. Wait until the supervisor is available to discuss the violation before taking any action

C. Resample the effluent immediately and report whichever result is more favorable on the DMR

D. Reduce the chlorine dose to prevent excessive disinfection that may be causing false positive results

51. Under OSHA regulations, an operator who witnesses a serious workplace injury (hospitalization, amputation, or loss of an eye) must ensure the employer reports the incident to OSHA within what timeframe?

A. Within 7 calendar days of the incident through a written report to the nearest OSHA area office

B. Within 30 days of the incident as part of the annual OSHA 300 log summary submission

C. No reporting is required unless the injured employee files a formal complaint with OSHA

D. Within 24 hours of the employer learning of the hospitalization, amputation, or loss of an eye

52. An operator reviewing the plant's Safety Data Sheet for sodium hypochlorite finds that the SDS lists the chemical as both an oxidizer and a corrosive. What does the "oxidizer" classification mean in terms of storage requirements?

A. The chemical must be stored in a fire-resistant cabinet rated for flammable material storage

B. The chemical must be stored at temperatures below 40°F to prevent spontaneous oxidation reactions

C. The chemical must be separated from fuels, organic materials, and reducing agents that could react with it

D. The chemical requires no special storage because all wastewater treatment chemicals are classified as oxidizers

53. A newly hired operator asks why the plant's gas detection system in the digester building includes both a hydrogen sulfide detector AND a combustible gas (methane) detector, since both gases come from the same digester. What is the correct explanation?

A. The two detectors serve the same function and one could be eliminated to reduce maintenance costs

B. The H_2S detector protects against toxic inhalation hazard while the combustible gas detector protects against explosion hazard — different hazards require different detection

C. The H_2S detector is required by the NPDES permit while the combustible gas detector is required by OSHA

D. The combustible gas detector also measures H_2S but at a different sensitivity range for calibration purposes

54. A DMR for the month of March shows the following effluent BOD results: weekly averages of 22, 28, 31, and 26 mg/L. The monthly average permit limit is 30 mg/L and the weekly average permit limit is 40 mg/L. What is the compliance status?

A. The plant is in compliance — the monthly average is 26.8 mg/L (below 30) and no weekly average exceeds 40 mg/L

B. The plant is in violation because the third week's average of 31 mg/L exceeds the monthly average limit

C. The plant is in violation because two of the four weekly averages exceed 25 mg/L

D. The plant is in compliance for the weekly limits but in violation of the monthly average

55. A centrifugal pump that has been in service for five years shows the following trends over the past six months: discharge pressure decreasing by 8%, motor amperage decreasing by 5%, and flow rate decreasing by 12%. Which of the following is the most likely diagnosis?

A. The pump suction strainer is progressively clogging, reducing flow to the pump over time

B. The pump motor is losing power due to degraded windings and is unable to drive the impeller

C. The pump discharge valve is gradually closing due to a faulty actuator or operator error

D. The pump impeller is wearing from abrasion, reducing its ability to develop head, flow, and power consumption

56. A positive displacement blower supplying air to the aeration basin suddenly trips on a high-pressure alarm. The discharge piping appears intact and the diffusers were recently cleaned. Which of the following should the operator check first?

A. The blower inlet air filter for excessive dirt loading that could restrict airflow into the blower

B. The aeration basin level to determine if the water depth has increased above the design level

C. The discharge piping valve positions to verify that no valves have been inadvertently closed or partially closed

D. The blower motor electrical connections for a loose wire that could cause intermittent power loss

57. An operator's daily inspection of pump station equipment reveals that the lead influent pump vibration levels have increased from 0.15 inches per second to 0.45 inches per second over the past two weeks. All other parameters are normal. What is the most appropriate action?

A. Schedule a vibration analysis and bearing inspection to diagnose the cause before the vibration leads to failure

B. Immediately shut down the pump and disassemble it to inspect the impeller and bearings

C. Increase the pump speed to compensate for any performance loss caused by the vibration

D. Continue monitoring the vibration weekly since the increase is within the acceptable operating range

58. Which of the following instruments would be used to measure the insulation resistance of a motor winding to detect deterioration that could lead to an electrical fault?

A. An ammeter measuring the motor's full-load current draw under normal operating conditions

B. A megohmmeter (megger) that applies high DC voltage to the winding and measures insulation resistance

C. A tachometer measuring the rotational speed of the motor shaft in revolutions per minute

D. A voltmeter measuring the line voltage supplied to the motor terminal box from the power panel

59. A plant SCADA system displays an alarm indicating that the wet well level in the influent pump station has risen above the high-high level setpoint. The lead pump is running but the lag pump has not

started. The operator checks the lag pump and finds the HOA (Hand-Off-Auto) switch in the "OFF" position. What corrective action should be taken immediately?

A. Reset the SCADA alarm and wait for the lead pump to draw the level down on its own

B. Call the maintenance team to investigate why the lag pump HOA switch was left in the OFF position

C. Shut down the lead pump to avoid overloading it while the lag pump issue is resolved

D. Switch the lag pump HOA to "AUTO" or "HAND" to start the pump and prevent a wet well overflow

60. An operator notices that the torque alarm on a circular secondary clarifier mechanism has been activating repeatedly over the past 24 hours. The sludge blanket depth is 4.5 feet, which is above the normal range of 1–3 feet. Which corrective action should the operator take first?

A. Replace the torque alarm sensor because repeated alarms suggest the sensor has drifted out of calibration

B. Reduce the influent flow to the clarifier to decrease the solids loading entering the tank

C. Increase the RAS pumping rate to draw down the excessive sludge blanket and reduce the load on the mechanism

D. Shut down the clarifier mechanism motor to prevent damage until a maintenance crew can inspect it

61. A magnetic flow meter on the plant effluent line requires which of the following conditions to provide accurate readings?

A. The pipe must be completely full of liquid at the measurement point with no air pockets

B. The flow velocity must exceed 10 feet per second to generate a measurable electromagnetic signal

C. The pipe must be made of metal to conduct the electromagnetic field through the pipe wall

D. The fluid must be heated above 60°F to ensure adequate electrical conductivity for measurement

62. A treatment plant has a standby generator rated at 500 kW. During the annual load bank test, the generator can only sustain 380 kW before the engine begins laboring and the voltage drops below acceptable limits. What does this result indicate?

A. The load bank test equipment is providing inaccurate readings and should be recalibrated before retesting

B. The generator is operating normally because generators are designed to sustain only 75% of their rated capacity

C. The generator cooling system is inadequate and is causing the engine to overheat under sustained load

D. The generator is not capable of producing its rated output, indicating a mechanical or electrical deficiency that must be diagnosed and corrected

63. An operator checking the daily instrument readings notices that the inline suspended solids analyzer on the RAS line has been reading a steady 8,200 mg/L for three days. A laboratory TSS analysis of a grab sample from the same location shows 5,600 mg/L. What should the operator do?

A. Report the laboratory result on all process control records since it is the more recently obtained value

B. Recalibrate the inline analyzer against laboratory-verified standards to restore accurate readings

C. Average the two readings and use the average for all process control calculations going forward

D. Adjust the WAS rate based on the higher inline reading to maintain a conservative process control approach

64. A wastewater treatment plant uses a Parshall flume for influent flow measurement. The operator notices that sediment has accumulated in the approach channel upstream of the flume. What effect will this sediment have on the flow measurement?

A. The sediment will have no effect on flow measurement because the flume is self-cleaning at normal flows

B. The sediment will improve accuracy by creating a more uniform velocity profile approaching the flume

C. The sediment may raise the water level upstream, causing the flow meter to read higher than actual flow

D. The sediment will cause the flume to measure lower flows because the restriction reduces velocity

65. Which of the following maintenance practices is most important for ensuring accurate readings from a dissolved oxygen probe installed in an aeration basin?

A. Regular cleaning of the probe membrane and periodic calibration against a known reference standard

B. Replacement of the entire probe assembly every 30 days regardless of the readings it produces

C. Installation of a protective guard around the probe to prevent contact with mixed liquor solids

D. Monthly verification of the probe reading against the BOD incubator temperature setting

66. A belt-driven blower has been operating at reduced airflow for the past week. The operator checks the blower and finds the drive belt is loose, with visible deflection of more than 1 inch when pressed. What maintenance action is required?

A. Apply belt dressing to increase the friction between the belt and the sheave surfaces

B. Replace the belt with a new one because excessive deflection indicates the belt has permanently stretched

C. Increase the motor speed to compensate for the belt slippage until the next scheduled maintenance

D. Adjust the belt tension to the manufacturer's specification to restore proper power transmission

67. An operator reviewing the maintenance history for a progressive cavity pump notes that the stator has been replaced twice in the past year. The pump handles primary sludge at 5% solids. Which of the following factors most likely contributes to the accelerated stator wear?

A. The sludge concentration is too low and the pump is running dry for portions of each cycle

B. Grit and abrasive particles in the primary sludge are wearing the elastomer stator material prematurely

C. The pump discharge pressure is too low and the rotor is spinning faster than designed

D. The polymer conditioning applied to the sludge is chemically attacking the stator elastomer material

68. A treatment plant has two RAS pumps, each rated for 1,500 GPM. Both pumps run simultaneously during peak flow periods. If one pump fails during peak flow, what is the most critical operational concern?

A. The aeration basin MLSS will immediately double because all solids are concentrated in half the volume

B. The secondary clarifier sludge blanket will rise because only half the settled sludge is being returned, potentially causing solids washout

C. The WAS rate will automatically increase to compensate for the reduced RAS capacity

D. The plant influent flow will decrease because the reduced RAS creates backpressure in the system

69. An operator is evaluating whether a pressure gauge on a chemical feed line is reading accurately. The gauge reads 35 psi, but the operator suspects it may be incorrect. Which of the following is the simplest field verification method?

A. Calculate the expected pressure using Bernoulli's equation and compare it to the gauge reading

B. Remove the gauge and send it to a calibration laboratory for certified testing and adjustment

C. Install a test gauge (a calibrated reference gauge) alongside the suspect gauge and compare the readings

D. Reduce the system pressure to zero and verify the gauge returns to exactly 0 psi before re-pressurizing

70. A SCADA trend shows that the plant influent flow has been reading exactly 2.000 MGD continuously for 72 hours with no variation whatsoever — no diurnal pattern, no peak, no minimum. What should the operator conclude?

A. The flow meter has likely failed or frozen and is providing a static false reading rather than actual flow data

B. The influent flow has genuinely stabilized at exactly 2.000 MGD due to consistent upstream conditions

C. The SCADA system is functioning correctly and the constant reading reflects actual steady-state conditions

D. The plant influent pumps have been set to a constant pumping rate that matches the displayed value

71. A gravity thickener receiving WAS has been producing thickened sludge at only 2.0% total solids instead of the target 3.5%. The supernatant is relatively clear. Which of the following operational changes would most likely improve the thickened sludge concentration?

A. Increase the WAS feed rate to apply more solids per unit area of the thickener surface

B. Reduce the sludge withdrawal rate to allow the sludge blanket more time to compact in the thickener

C. Increase the speed of the picket rake mechanism to release more entrapped gas from the sludge

D. Switch the thickener feed to primary sludge, which thickens more readily by gravity than WAS

72. A belt filter press operator observes that the dewatered cake is cracking and breaking apart as it discharges from the press, and the cake solids are 28%, which is higher than the typical 20% target. What is the most likely cause?

A. The sludge has not been adequately conditioned with polymer before entering the press

B. The belt speed is too slow, allowing excessive dewatering that produces an overly dry, brittle cake

C. The belt tension and roller pressure are set too high, over-compressing the sludge beyond optimal dryness

D. The sludge feed concentration is too low and the belt press is squeezing out all available water

73. A treatment plant is evaluating whether to use aerobic or anaerobic digestion for sludge stabilization. Which of the following is a significant advantage of anaerobic digestion over aerobic digestion?

A. Anaerobic digestion produces methane gas that can be used as fuel for heating, electricity generation, or other energy recovery

B. Anaerobic digestion requires less capital investment and is simpler to operate than aerobic digestion

C. Anaerobic digestion performs better at cold temperatures than aerobic digestion without supplemental heating

D. Anaerobic digestion eliminates the need for any downstream dewatering of the stabilized sludge

74. A centrifuge dewatering digested sludge is producing cake at 22% solids with clear centrate. The operator increases the sludge feed rate by 25% to process the day's production faster. What is the most likely effect on cake quality?

A. The cake solids will increase because the centrifuge processes thicker sludge at higher feed rates

B. The cake solids will decrease because the solids spend less time in the bowl for compaction and drainage

C. The cake quality will remain unchanged because the centrifuge automatically adjusts to match the feed rate

D. The centrate will become clearer because the higher feed rate improves the separation efficiency

75. A composting operation using the aerated static pile method maintains pile temperatures at 140°F for 5 consecutive days. Under Part 503 requirements for the ASP method, the pile must maintain temperatures above 131°F (55°C) for at least 3 days. Based on this information, which of the following is true?

A. The compost has not yet met the time requirement and must continue at elevated temperatures

B. The compost pile has achieved only vector attraction reduction but not pathogen reduction

C. The composting process needs to also demonstrate fecal coliform below 1,000 MPN/g for Class A

D. The time-temperature requirement has been met and the compost is automatically classified as Class A

76. Raw sludge entering an anaerobic digester has 74% volatile solids. Digested sludge leaving has 54% volatile solids. Using the Van Kleeck equation, what is the approximate percent volatile solids reduction?

A. 27% volatile solids reduction, indicating insufficient stabilization for Part 503 requirements

B. 40% volatile solids reduction, which does not meet the 38% minimum requirement

C. 59% volatile solids reduction, which exceeds the 38% minimum for vector attraction reduction

D. 74% volatile solids reduction, indicating nearly complete destruction of all volatile matter

77. A digester operator measures the following weekly gas composition data: Week 1: 63% CH_4, Week 2: 61% CH_4, Week 3: 56% CH_4, Week 4: 52% CH_4. The volatile acids have increased from 180 mg/L to 650 mg/L over the same period. What trend do these data indicate?

A. The digester is operating within normal parameters and the gas composition fluctuation is seasonal

B. The gas collection system has developed a leak that is diluting the methane with outside air

C. The digester gas is becoming enriched with carbon dioxide, indicating an overactive acid-forming bacterial population

D. The digester heating system is providing too much energy, causing the methanogens to over-produce

78. A dewatering centrifuge operator adjusts the scroll differential speed from 15 RPM to 8 RPM while all other operating parameters remain the same. What effect will this adjustment have on the dewatered cake?

A. The cake will become wetter because the slower scroll cannot convey solids out of the bowl fast enough

B. The cake will remain unchanged because scroll differential speed does not affect cake dryness

C. The cake will become drier because the solids remain in the bowl longer, allowing more water drainage on the beach

D. The cake will become drier because the lower scroll speed increases the centrifugal force applied to the solids

79. A treatment plant produces biosolids that meet Class B pathogen reduction standards and all pollutant concentrations are below the ceiling limits but above the Table 3 pollutant concentration limits. What additional requirement applies when these biosolids are land-applied?

A. The biosolids must be incinerated before land application to reduce the metal concentrations below limits

B. Cumulative pollutant loading rates must be tracked for each application site to ensure lifetime limits are not exceeded

C. The biosolids must undergo additional chemical treatment to reduce metal concentrations below Table 3 limits

D. The biosolids can only be land-applied at sites located more than 100 miles from any municipal water supply

80. Biosolids that are classified as Exceptional Quality under Part 503 may be distributed to the general public for unrestricted use. Which THREE criteria must the biosolids meet simultaneously to earn this designation?

A. Class B pathogen reduction, below ceiling concentration limits, and injection below the soil surface

B. A minimum volatile solids reduction of 50%, below Table 3 pollutant limits, and zero fecal coliform count

C. Class A pathogen reduction, below Table 3 pollutant concentration limits, and one of the vector attraction reduction options

D. Thermophilic digestion for 30 days, below ceiling concentration limits, and incorporation within 6 hours

81. An operator at a small plant uses sand drying beds for sludge dewatering. The operator applies a 10-inch layer of digested sludge to a freshly prepared bed. After 5 days, the surface has formed a dark crust but the underlying sludge is still liquid. What should the operator do to improve drying?

A. Score or crack the surface crust with a rake to allow moisture beneath the crust to evaporate

B. Apply an additional 6-inch layer of sludge on top of the crust to weigh it down and compress moisture out

C. Flood the bed surface with clean water to dissolve the crust and allow it to drain through the sand

D. Remove the crust entirely and dispose of it, then allow the remaining liquid sludge to drain separately

82. A treatment plant's incinerator ash must be tested for metals before it can be disposed of in a landfill. If the ash test shows elevated concentrations of a regulated metal, what is the proper disposal method?

A. The ash can be disposed of in any municipal solid waste landfill regardless of the metals content

B. The ash can be returned to the digester for further processing to reduce the metal concentrations

C. The ash should be blended with clean soil to dilute the metal concentrations before disposal

D. The ash may require disposal in a specialized landfill or facility permitted to accept waste with elevated metals

83. An anaerobic digester has been operating at a VA/Alk ratio of 0.08 for the past year. A new industrial discharge of food processing waste is accepted, and the sludge feed to the digester increases by 30%. Two weeks later, the VA/Alk ratio has risen to 0.28. What is the most appropriate response?

A. Continue monitoring because a VA/Alk ratio of 0.28 is approaching but has not yet reached the 0.35 critical threshold

B. Reduce the sludge feed rate back to the pre-industrial level to allow the methanogens to stabilize before gradually increasing the feed

C. Increase the digester temperature by 10°F to accelerate the methane-forming bacteria and reduce the volatile acids

D. Add lime to the digester to neutralize the excess volatile acids and restore the alkalinity ratio

84. A gravity belt thickener processing WAS uses a cationic polymer for conditioning. The operator notices that the polymer solution has been stored at ambient temperature for 45 days. The polymer manufacturer recommends a maximum storage life of 30 days for the diluted solution. What should the operator do?

A. Continue using the polymer solution because the 30-day recommendation is conservative and the product is likely still effective

B. Test the polymer effectiveness using a jar test, and if performance has degraded, prepare a fresh batch

C. Discard the solution immediately regardless of performance because expired polymer could damage the equipment

D. Double the polymer dose to compensate for any degradation that may have occurred during the extended storage

85. In a two-stage anaerobic digestion system, what is the primary function of the secondary (second-stage) digester?

A. Providing unheated, unmixed storage for the digested sludge, allowing supernatant separation and additional thickening

B. Performing a second round of active heated digestion to further reduce volatile solids beyond what the primary achieved

C. Providing aeration to convert the digested sludge from anaerobic to aerobic conditions before dewatering

D. Serving as a surge tank for the raw sludge feed when the primary digester is temporarily taken offline

86. An operator determines that the plant's biosolids have a fecal coliform concentration of 1.8×10^6 MPN/g after mesophilic anaerobic digestion. This level qualifies for which Part 503 pathogen classification?

A. Class A, because the concentration is below the 2×10^6 threshold

B. Neither Class A nor Class B, because the fecal coliform exceeds all regulatory limits

C. Class A with Exceptional Quality designation if all metal limits are also met

D. Class B, because the fecal coliform geometric mean is below 2×10^6 MPN/g of total solids

87. A plant operating a gravity belt thickener for WAS produces thickened sludge at 4.5% total solids. The operator needs to calculate the solids mass in pounds per day being sent to the digester. The thickened sludge flow is 15,000 gallons per day. What is the approximate mass of total solids?

A. 3,753 lbs/day based on the volume and concentration of the thickened sludge

B. 5,630 lbs/day based on the volume and concentration of the thickened sludge

C. 5,629 lbs/day, calculated as 15,000 GPD × 8.34 lbs/gal × 0.045

D. 7,506 lbs/day based on the assumption that the specific gravity of sludge is 1.2

88. An operator needs to collect a sample for dissolved oxygen analysis at the aeration basin. The sample location is accessible by lowering a collection device from a walkway 6 feet above the basin surface. Which of the following sample collection techniques will produce the most accurate result?

A. Lower a bucket into the basin, haul it up, and pour the water into a sample bottle on the walkway

B. Use a portable DO meter with a probe on a cable, lowering the probe directly into the basin and allowing it to equilibrate before reading

C. Collect a grab sample in a BOD bottle by lowering it into the basin on a weighted line, filling it completely, and analyzing immediately

D. Pump a continuous stream of mixed liquor to the walkway through a hose and measure DO from the flowing stream

89. An operator's weekly laboratory results show the following effluent ammonia trend: Week 1: 0.8 mg/L, Week 2: 1.4 mg/L, Week 3: 3.2 mg/L, Week 4: 7.1 mg/L. The NPDES permit limit is 5.0 mg/L. What should the operator conclude from this trend?

A. Nitrification performance is deteriorating progressively, and the operator should investigate the cause immediately to prevent continued permit violations

B. The ammonia results are within normal analytical variability and do not indicate a process problem

C. The laboratory is producing erroneous results and the ammonia analysis method should be changed

D. The trend is caused by increasing influent ammonia loading and cannot be corrected by process adjustments

90. A composite sampler has been collecting aliquots at equal time intervals (every 30 minutes) over a 24-hour period. The plant flow varies significantly throughout the day following a normal diurnal pattern. What type of composite does this collection method produce, and is it the preferred method for NPDES compliance?

A. A flow-proportional composite that is preferred for NPDES compliance monitoring

B. A grab composite that is only acceptable for parameters requiring instantaneous measurement

C. A depth-integrated composite that captures samples at multiple depths simultaneously

D. A time-proportional composite, which is acceptable but flow-proportional compositing is generally preferred for NPDES compliance

91. A laboratory analyst performs a TSS analysis on a secondary effluent sample. The filter weight before filtration is 1.5312 g and the filter weight after drying is 1.5340 g. The sample volume filtered is 500 mL. What is the TSS concentration?

A. 2.8 mg/L

B. 5.6 mg/L

C. 14.0 mg/L

D. 28.0 mg/L

92. An operator measures a chlorine residual of 2.4 mg/L in the contact tank effluent. The dechlorination system then reduces the residual to 0.02 mg/L before discharge. The plant flow is 2.0 MGD. How many pounds of chlorine residual per day are being removed by the dechlorination system?

A. 0.33 lbs/day of chlorine residual removed by the dechlorination process

B. 20.0 lbs/day of chlorine residual removed by the dechlorination process

C. 39.7 lbs/day of chlorine residual removed by the dechlorination process

D. 60.0 lbs/day of chlorine residual removed by the dechlorination process

93. An operator collects an influent composite sample and a primary effluent composite sample on the same day. The influent BOD is 205 mg/L and the primary effluent BOD is 138 mg/L. What is the primary clarifier BOD removal efficiency?

A. 48.6% removal, which is above the expected range for a primary clarifier

B. 32.7% removal, which is within the expected range for a primary clarifier

C. 67.3% removal, which is above the expected range for a primary clarifier

D. 32.7% removal, which confirms the primary clarifier BOD removal is within the typical 25–40% range

94. An operator performing daily process control monitoring measures the following in the aeration basin: MLSS of 2,800 mg/L by the inline TSS analyzer, DO of 2.2 mg/L by the online probe, pH of 7.1 by the online analyzer, and temperature of 19°C by the inline sensor. A laboratory grab sample confirms

the DO at 2.1 mg/L and the pH at 7.0. Based on the close agreement between online and laboratory readings, what should the operator conclude?

A. The online instruments are well-calibrated and producing reliable data for process control decisions

B. The online instruments should still be recalibrated because any deviation from the laboratory indicates drift

C. The MLSS analyzer is the only instrument that cannot be verified and should be taken out of service

D. All process control decisions should be based exclusively on laboratory results regardless of online agreement

95. A plant operator submits an NPDES compliance sample to a contract laboratory. The laboratory reports a fecal coliform result of 150 CFU/100 mL. The permit limit is 200 CFU/100 mL. However, the operator notices the chain of custody form shows the sample was received at 12°C instead of the required 4°C. Should this result be considered valid for compliance purposes?

A. Yes, because the result is below the permit limit and temperature during transport does not affect fecal coliform analysis

B. Yes, because the 12°C temperature is within the acceptable range for bacteriological sample transport

C. No — the sample temperature exceeds the preservation requirement, and the result should be flagged as potentially compromised

D. No — the sample must be discarded entirely and no result can be reported for this monitoring period

96. When performing the BOD_5 analysis, the analyst prepares seeded dilution water by adding a small amount of settled wastewater or commercial seed to the dilution water. What is the purpose of adding seed organisms?

A. The seed provides indicator organisms for comparison with the sample's indigenous bacterial population

B. The seed organisms provide the microbial population needed to biologically decompose the organic matter during the five-day incubation

C. The seed acidifies the dilution water to the optimal pH range for the BOD_5 incubation period

D. The seed introduces a known concentration of organic matter that serves as an internal standard

97. An operator performs a settleability test on the aeration basin mixed liquor and records the following data: 5 minutes: 650 mL/L, 10 minutes: 480 mL/L, 15 minutes: 380 mL/L, 20 minutes: 340 mL/L, 25 minutes: 320 mL/L, 30 minutes: 310 mL/L. The MLSS is 2,600 mg/L. What is the SVI, and what does the settling pattern indicate?

A. SVI is 119 mL/g with smooth, progressive settling indicating healthy, well-structured biological floc

B. SVI is 250 mL/g with erratic settling indicating probable filamentous growth in the sludge

C. SVI is 85 mL/g with rapid compaction indicating the sludge is over-aged and approaching pin floc

D. SVI is 190 mL/g with slow initial settling indicating the floc is dispersed and poorly structured

98. When calibrating a laboratory pH meter, the analyst notes that the electrode response time — the time for the reading to stabilize after immersing the electrode in the buffer solution — has increased from 10 seconds to over 60 seconds. What does this suggest?

A. The pH meter electronics are failing and the entire instrument should be replaced immediately

B. The buffer solutions have expired and new buffers should be prepared for the calibration procedure

C. The pH electrode is aging or fouled, and may need cleaning, reconditioning, or replacement

D. The meter is functioning normally and the extended response time is a result of temperature differences

99. An operator reviews the plant's monthly compliance data and finds the following effluent TSS results: 14, 18, 22, 16, 28, 12, 19, 24, 15, 20, 17, 22 mg/L. The monthly average permit limit is 30 mg/L. The daily maximum limit is 45 mg/L. What is the compliance status?

A. In violation because several individual results approach the monthly average limit

B. In compliance — the monthly average of 18.9 mg/L is below 30 mg/L and no daily result exceeds 45 mg/L

C. In violation because the range of results (12 to 28) suggests inconsistent treatment plant performance

D. In compliance for the monthly average but in violation of the daily maximum due to the 28 mg/L result

100. A treatment plant operator discovers that a composite sampler was programmed to collect aliquots from the plant influent when the permit requires effluent monitoring for TSS compliance. The 24-hour composite has been completed and the sample is available, but it is from the wrong location. What is the correct action?

A. Analyze the influent composite and calculate the expected effluent TSS using the plant's historical removal rate

B. Report the influent result on the DMR with a footnote explaining the sampling location error

C. Report no data for this monitoring period and explain the sampling error in the DMR remarks section

D. Immediately recollect a new 24-hour composite from the correct effluent location and analyze within the holding time; document the error and missed monitoring event on the DMR

Practice Exam 4: Answer Key and Explanations

1. B — At 6:00 AM, the community is mostly asleep with minimal water use, so the wastewater flow is low and concentrated (high BOD, low flow). By 10:00 AM, morning activities (showers, toilets, laundry, dishwashing) have dramatically increased the water volume flowing into the sewer, diluting the BOD concentration. This is the normal diurnal flow pattern — concentrated low flow overnight, diluted high flow during the morning peak.

2. D — Settleable solids (measured by Imhoff cone) reflect particle size and density, while TSS measures total mass of suspended material. An increase in settleable solids at constant TSS means the same mass of solids now includes a greater proportion of larger, denser particles that settle readily in the cone. This shift in particle size distribution can result from changes in industrial contributions, seasonal variations, or collection system conditions.

3. A — During extreme wet-weather events in combined sewer communities, the correct approach is to treat as much flow as possible through the full treatment process and manage flows exceeding plant capacity according to the approved CSO long-term control plan. Shutting down biological treatment or bypassing all treatment entirely are not acceptable options under the Clean Water Act unless specifically authorized.

4. C — Nitrification is the process most severely affected by cold temperatures because nitrifying bacteria (Nitrosomonas and Nitrobacter) grow much more slowly than heterotrophic bacteria. At 5.5°C, nitrifier growth rates are dramatically reduced, and the SRT must be extended significantly (potentially to 20+ days) to maintain a viable nitrifying population. BOD-removing heterotrophs are more temperature-tolerant.

5. D — A pH of 3.8 is severely acidic and represents an immediately dangerous condition for the biological treatment process. The microorganisms in the activated sludge system function optimally between pH 6.5 and 8.5, and exposure to pH 3.8 can kill a large portion of the biological population within hours, causing complete treatment failure and potentially weeks of recovery time.

6. A — MLVSS = 2,200 × 0.78 = 1,716 mg/L. MLVSS (lbs) = 1,716 × 0.65 × 8.34 = 9,301 lbs. BOD Loading = 135 × 2.0 × 8.34 = 2,252 lbs/day. F/M = 2,252 ÷ 9,301 = 0.24, approximately 0.19–0.24 depending on rounding. This places the system at the lower end of the conventional activated sludge range (0.2–0.5).

7. B — Bringing a second identical clarifier into service doubles the total clarifier surface area. Since the total solids mass entering the system remains the same, dividing it across twice the area cuts the solids loading rate per clarifier approximately in half. This reduces the risk of solids washout by giving each clarifier more capacity to settle and compact the biological solids.

8. C — An SRT of 28 days with an SVI of 55 mL/g places the system deep in the endogenous respiration phase. The organisms are consuming their own cell mass, producing very dense but extremely small particles (pin floc) that pass through the clarifier despite their density. The effluent BOD and TSS remain low because the particles are tiny, but they cause visible turbidity.

9. C — Chlorine demand = Dose – Residual = 7.5 – 1.8 = 5.7 mg/L. The demand represents the chlorine consumed by reactions with organic matter, ammonia, and other substances in the wastewater before any residual is established. This is the foundational equation for chlorine disinfection process control: Dose = Demand + Residual.

10. A — An SOR of 1,350 GPD/ft² exceeds the design maximum of 1,200 GPD/ft², meaning the upward velocity of water in the clarifier is higher than the settling velocity of some particles. Lighter particles that would normally settle under design conditions are carried upward and over the effluent weir, reducing TSS removal efficiency and potentially causing permit exceedances.

11. D — The internal recycle returns nitrate-rich mixed liquor from the aerobic zone (where nitrification produces nitrate) to the anoxic zone (where denitrification converts nitrate to nitrogen gas). If the recycle rate is too low, insufficient nitrate reaches the anoxic zone, and denitrification is limited by nitrate availability rather than carbon or anoxic conditions.

12. B — Low dissolved oxygen (0.8 mg/L) in Basin B creates conditions that favor filamentous organisms over floc-forming bacteria. Filamentous bacteria can thrive at low DO levels where normal floc-formers are stressed, and their proliferation produces the elevated SVI of 210 mL/g — the hallmark of filamentous bulking. Correcting the DO to 1.5–3.0 mg/L is the primary remedy.

13. A — Alkalinity consumed = 32 mg/L NH_3-N × 7.14 mg alk/mg NH_3-N = 228.5 mg/L. Remaining alkalinity = 220 – 228.5 = –8.5 mg/L. The alkalinity is essentially completely consumed, leaving no buffer capacity. Without supplemental alkalinity, the pH will crash as nitrification proceeds, inhibiting both nitrification and general biological treatment.

14. D — HRT = Volume ÷ Flow = 2.0 MG ÷ 1.5 MGD = 1.33 days = 32 hours. A 32-hour detention time is characteristic of extended aeration — far longer than conventional activated sludge (4–8 hours). Oxidation ditches are designed as extended aeration systems with long SRTs, low F/M ratios, and operation in the endogenous respiration phase.

15. C — No individual daily result exceeds the 45 mg/L daily maximum (the highest is 44 mg/L). The weekly average = (22+25+38+44+18+24+29) ÷ 7 = 28.6 mg/L, which is below the 30 mg/L monthly average limit. The plant is currently in compliance for both limits, though the 44 mg/L result warrants monitoring for any upward trend.

16. B — Ponding is caused by excessive biofilm growth clogging the void spaces in the media. Increasing the hydraulic loading or recirculation rate increases the volume and velocity of water flowing over the media, which physically shears off excess biofilm and flushes it through the underdrain system. This restores the void spaces and eliminates the ponding.

17. A — The minimum DO for conventional aerobic BOD removal is approximately 1.0–2.0 mg/L. Below this level, the aerobic bacteria that consume organic matter become oxygen-limited, treatment efficiency decreases, and conditions may favor filamentous organisms that cause settling problems. For nitrification, higher DO (≥2.0 mg/L) is needed.

18. D — With normal MLSS, acceptable SVI, normal sludge blanket depth, and adequate RAS concentration, the most likely cause of persistent high effluent TSS is a physical problem with the clarifier effluent system. An uneven, damaged, or algae-fouled weir creates preferential flow paths that draw solids upward and over the weir at specific points, even when the bulk settling process is functioning well.

19. B — SRT and F/M have an inverse relationship. When SRT increases (WAS is reduced), more solids accumulate in the system, MLSS and MLVSS increase, and the same food supply is divided among more organisms — the F/M ratio decreases. Conversely, when SRT decreases (WAS is increased), solids are removed, MLVSS decreases, and each organism receives more food — F/M increases.

20. C — lbs Cl_2/day = 6.0 × 4.0 × 8.34 = 200.2 lbs/day. lbs NaOCl solution = 200.2 ÷ 0.12 = 1,668 lbs/day. Weight per gallon = 1.17 × 8.34 = 9.76 lbs/gal. Volume = 1,668 ÷ 9.76 = 170.9, approximately 170–205 GPD depending on rounding and actual solution strength. The calculation demonstrates the three-step conversion from dose to pounds to solution volume.

21. A — Establishing nitrification requires an SRT long enough for the slow-growing nitrifying bacteria to reproduce faster than they are wasted from the system. At 15°C, a minimum SRT of 10–15 days is needed. The current 5-day SRT is far too short. Decreasing the WAS rate retains more solids, extending the SRT to the minimum required for nitrifiers to establish and maintain their population.

22. D — With three clarifiers, total flow per clarifier = 6.0 ÷ 3 = 2.0 MGD, producing an SOR of 540 GPD/ft². With two clarifiers, flow per clarifier = 6.0 ÷ 2 = 3.0 MGD. SOR increases by 50%: 540 × 1.5 = 810 GPD/ft². This significant increase may push the clarifiers toward their hydraulic design limit.

23. B — The key diagnostic clues are: MLSS has dropped dramatically (from 2,800 to 1,100 mg/L), the remaining sludge settles well (compact at 80 mL/L with clear supernatant), and the process upset was sudden (three days). This pattern — rapid loss of solids with the remaining biology functioning normally — indicates excessive wasting, not toxicity (which would show poor settling and dead organisms) or equipment failure.

24. C — RAS returns settled biological solids from the secondary clarifier to the aeration basin, maintaining the microbial population that performs treatment. WAS removes excess biological solids from the system to control the MLSS and SRT. RAS maintains the biology; WAS controls the biology. Together they regulate the total mass and age of the biological population.

25. A — Volume = 100 × 25 × 15 = 37,500 ft^3. Volume in gallons = 37,500 × 7.48 = 280,500 gallons (0.2805 MG). This is a straightforward volume calculation using the rectangular tank formula (L × W × D) converted to gallons using the 7.48 gal/ft^3 conversion factor.

26. B — Adding a polishing cell or intermittent sand filter downstream of the final facultative pond captures the algae that pass through the main pond system. Since algae-related TSS is the specific compliance challenge, physical removal of the algae before discharge is the most direct and effective solution. Chemical addition in a pond is less practical and harder to control.

27. D — Aluminum sulfate is an acidic coagulant that consumes alkalinity when it dissolves and hydrolyzes in water. Each mg/L of alum consumes approximately 0.5 mg of alkalinity as $CaCO_3$. At a dose of 40 mg/L, the alkalinity consumption is significant. Combined with the alkalinity consumption from nitrification, the total demand exceeds the available alkalinity, causing the pH to drop.

28. A — Primary clarifier TSS removal of 52% falls within the expected range of 50–65%. BOD removal of 28% falls within the expected range of 25–40%. Both values indicate normal primary clarifier performance — the gravity sedimentation process is removing settleable solids and the associated particulate BOD at typical rates.

29. C — UV dose = Intensity × Time = 6.0 mW/cm^2 × 8 seconds = 48 mJ/cm^2. Since 48 mJ/cm^2 exceeds the 40 mJ/cm^2 target, the UV system is delivering an adequate disinfection dose. The margin above the target provides a safety factor that accounts for lamp aging, quartz sleeve fouling, and variations in effluent quality.

30. B — $NaHSO_3$ needed = 0.6 mg/L Cl_2 × 1.46 mg $NaHSO_3$/mg Cl_2 = 0.876 mg/L. lbs/day = 0.876 × 3.0 × 8.34 = 21.9 lbs/day. The 1.46:1 ratio converts chlorine residual to the equivalent sodium bisulfite dose needed for complete dechlorination. Slight overdosing is common to ensure no chlorine reaches the receiving water.

31. D — The CT concept states that disinfection effectiveness depends on the product of residual concentration and contact time. The same CT value — and therefore the same degree of pathogen

inactivation — can be achieved by either increasing C and decreasing T, or decreasing C and increasing T, as long as the product remains at or above the required minimum.

32. C — Breakthrough occurs when particles that have accumulated within the filter media bed are pushed through by the increasing hydraulic pressure as the filter loads. Unlike headloss buildup (which indicates particles being captured), turbidity breakthrough indicates particles are being released from the lower layers of the bed into the filtrate. This signals the filter should be backwashed promptly.

33. A — HRT = 300,000 gal ÷ 18,000 gal/day = 16.7 days. This detention time is within the typical range of 15–30 days for mesophilic anaerobic digestion, providing adequate time for the three-stage biological process to substantially reduce volatile solids and produce a well-stabilized product.

34. B — The key distinction is operational intensity. A high-rate digester is actively heated to maintain optimal temperature (95–100°F mesophilic), continuously mixed to prevent stratification and maintain contact between organisms and substrate, and fed on a regular schedule. A standard-rate digester is not actively mixed, may not be heated, and is fed intermittently — relying on natural stratification and gas mixing.

35. D — The plant is nitrifying well (1.5 mg/L ammonia) but not denitrifying adequately (12.8 mg/L nitrate). With total nitrogen at 14.3 mg/L versus a 10 mg/L limit, more nitrate must be converted to nitrogen gas. Increasing the internal recycle rate returns more nitrate-rich mixed liquor to the anoxic zone, providing more substrate for denitrifying bacteria to convert to harmless N_2 gas.

36. C — An MBR uses submerged membrane modules (microfiltration or ultrafiltration) to physically filter the mixed liquor, producing a permeate with virtually zero suspended solids. This membrane separation replaces the gravity settling function of a secondary clarifier, eliminating the need for a separate clarification tank. The membranes retain all biological solids in the reactor.

37. A — Mass loading = 18 × 3.0 × 8.34 = 450.4 lbs/day. Since 450.4 lbs/day is below the 500 lbs/day permit limit, the plant is in compliance with the mass-based limit. This calculation demonstrates the pounds formula and the importance of checking both concentration-based and mass-based limits independently for each reporting period.

38. D — After a toxic event that kills 60% of the biology, the priority is to protect and nurture the surviving 40%. Minimizing WAS retains every surviving organism in the system. Maintaining adequate

DO supports the survivors' recovery. The biology will gradually regrow through normal cell division, but this takes days to weeks. Increasing WAS would remove surviving organisms and delay recovery.

39. B — MLSS increasing without intentional changes to WAS rate or influent loading strongly suggests the WAS system is not removing solids as intended. A timer malfunction, clogged WAS line, failed WAS pump, or incorrectly positioned valve could reduce or stop waste sludge removal, allowing solids to accumulate in the system and causing MLSS to rise progressively.

40. C — Sulfur dioxide is a toxic gas — heavier than air, corrosive, and immediately dangerous to health at concentrations above 100 ppm. A broken cylinder valve releasing SO_2 creates an IDLH atmosphere that the operator cannot safely address without SCBA. The correct immediate response is to evacuate upwind and activate the emergency response plan, including notifying the hazmat team.

41. B — H_2S at 18 ppm exceeds the OSHA short-term exposure limit of 15 ppm. The entrant must immediately exit the space using the retrieval system. There is no safe option to continue working at this concentration. The source of the H_2S must be identified (disturbed residual sludge, ventilation failure, gas intrusion) and the conditions corrected before re-entry is permitted.

42. A — OSHA's LOTO standard includes a provision for removing another worker's lock under specific, documented circumstances. The employer must verify the worker is not at the facility, the equipment has been inspected and cleared of hazards, and the worker is notified that the lock was removed before the worker returns to work. This is the only authorized procedure — cutting locks without this verification is prohibited.

43. D — Chlorine gas has a molecular weight of 71 (compared to air at 29), making it approximately 2.5 times heavier than air. When released, chlorine gas sinks to the floor and accumulates in low-lying areas. The ventilation exhaust intake is placed at floor level to draw the gas from where it concentrates, removing it from the breathing zone of personnel in the room.

44. C — Air-purifying respirator cartridges have a limited service life that decreases once the cartridge is opened and exposed to ambient air — even when not actively in use. After three months, the acid gas sorbent may be saturated or degraded. The operator should replace the cartridges with fresh ones before entering the chlorination room to ensure adequate respiratory protection.

45. B — The entry supervisor's role is to authorize and oversee the entry — verifying that all permit conditions are met (atmospheric testing complete and acceptable, rescue provisions in place,

communication established, PPE available), that the entry team is properly trained and equipped, and that conditions remain safe throughout the entry. The supervisor does not enter the space or perform the work.

46. B — Polymer solution on a floor creates one of the most slippery surfaces found in an industrial setting — significantly more slippery than water alone. Falls are the leading cause of injury at wastewater treatment plants, and a polymer spill dramatically increases the risk of serious slip-and-fall injuries. The area should be barricaded, cleaned immediately with absorbent material and water, and the surface verified as non-slippery before reopening.

47. D — Working inside an energized 480V motor control center without LOTO is an immediately life-threatening situation — 480V arc flash can produce temperatures exceeding 35,000°F and a blast wave capable of causing fatal burns and injuries. The observing operator has a duty to immediately intervene, alert the worker to the danger, and notify the supervisor.

48. A — A completed chain of custody form must accompany all compliance samples during transport to a contract laboratory. The COC documents who collected the sample, when, where, how it was preserved, and every person who handled it during transport. Without a COC, the laboratory results lack the legal defensibility required for NPDES compliance reporting.

49. C — A fire extinguisher with a pressure gauge in the red "recharge" zone may not function properly in an emergency — the propellant pressure may be insufficient to discharge the extinguishing agent effectively. The depleted unit must be removed immediately and replaced with a fully charged extinguisher so the chemical storage area is never left without functional fire suppression capability.

50. A — The NPDES permit requires 24-hour notification to the regulatory authority for permit violations regardless of whether the supervisor is available. The operator has the training, authority, and obligation to document the violation, investigate the cause (check chlorine residual, contact time, UV intensity), begin corrective action, and initiate the regulatory notification process independently.

51. D — OSHA requires employers to report work-related in-patient hospitalizations, amputations, and losses of an eye within 24 hours of learning of the event. Fatalities must be reported within 8 hours. These reporting requirements exist to enable OSHA to investigate serious incidents promptly and identify workplace hazards that may endanger other workers.

52. C — An oxidizer classification means the chemical promotes combustion and can intensify fires when in contact with combustible materials. Sodium hypochlorite must be stored separately from fuels, organic materials, reducing agents, and other chemicals that could undergo dangerous oxidation reactions. Physical separation with dedicated secondary containment prevents accidental contact.

53. B — The H_2S detector and combustible gas detector protect against two completely different hazards. H_2S is a toxic gas that can kill through inhalation at concentrations as low as 100 ppm — the detector warns workers before exposure reaches dangerous levels. The combustible gas (methane) detector warns of explosion risk when methane concentrations approach the lower explosive limit. Both hazards exist independently and require separate detection.

54. A — Monthly average = (22 + 28 + 31 + 26) ÷ 4 = 26.75 mg/L, which is below the 30 mg/L monthly average limit. No individual weekly average exceeds the 40 mg/L weekly limit (the highest is 31 mg/L). The plant is in compliance with both limits. The third week's result of 31 mg/L exceeds the monthly limit value but is compared against the weekly limit (40 mg/L), not the monthly limit.

55. D — The pattern of simultaneously decreasing discharge pressure, flow, and amperage indicates a worn impeller. 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 wear.

56. C — A PD blower delivers a constant volume of air per revolution. If the discharge pressure rises above the high-pressure alarm setpoint, the blower trips to protect itself from overload. A closed or partially closed discharge valve is the most common cause of sudden high discharge pressure — it creates a downstream restriction that the blower cannot overcome without exceeding its pressure rating.

57. A — A threefold increase in vibration (0.15 to 0.45 in/sec) over two weeks is a significant trend that indicates a developing mechanical problem — likely bearing wear, misalignment, imbalance, or a loose component. Scheduling a vibration analysis provides a detailed diagnosis of the specific fault pattern, allowing targeted maintenance before the condition progresses to catastrophic failure.

58. B — A megohmmeter (megger) applies a high DC voltage (typically 500V or 1,000V) across the motor winding insulation and measures the resistance. Healthy insulation shows high resistance (megohms). Deteriorating insulation shows declining resistance over time, and critically low readings indicate imminent failure risk. Periodic megger testing is the standard predictive maintenance technique for detecting insulation degradation.

59. D — With the wet well at the high-high alarm level and rising, overflow is imminent. The lag pump's HOA switch in "OFF" is the direct cause of the failure to auto-start. Switching it to "AUTO" (for automatic control) or "HAND" (for immediate manual start) will start the pump and begin drawing down the wet well level. This is the most urgent corrective action — investigation of why the switch was left in OFF can follow.

60. C — Elevated torque combined with a high sludge blanket (4.5 feet versus 1–3 feet normal) indicates the clarifier mechanism is dragging through an excessive accumulation of settled sludge. Increasing the RAS pumping rate removes more sludge from the clarifier bottom, reduces the blanket depth, decreases the resistance on the rotating mechanism, and resolves the torque alarm condition.

61. A — Magnetic flow meters operate on Faraday's law of electromagnetic induction, which requires the pipe to be completely full of conductive liquid. Air pockets, partially full pipes, or entrained air disrupt the electromagnetic field and produce erratic or inaccurate readings. The meter should be installed in a location where the pipe is always full — typically on a rising section of pipe.

62. D — A generator that cannot sustain its rated output during a load bank test has a deficiency that must be identified and corrected. Possible causes include engine mechanical problems (fuel system, turbocharger, cylinder compression), generator electrical problems (exciter, voltage regulator, windings), or auxiliary system issues (cooling, air filtration). Operating at 76% of rated capacity means the generator cannot power the plant's full critical load.

63. B — A 2,600 mg/L discrepancy between the inline analyzer (8,200) and the laboratory (5,600) indicates the inline instrument has drifted significantly from accuracy. The correct action is to recalibrate the inline analyzer using laboratory-verified standards so that online readings align with laboratory measurements. Process control decisions based on an uncalibrated instrument are unreliable.

64. C — Sediment accumulation in the approach channel raises the water level upstream of the Parshall flume. Since the flume calculates flow based on the measured head (water depth), a falsely elevated head produces a falsely elevated flow reading. The approach channel must be kept clean and free of sediment for accurate flow measurement. Regular inspection and cleaning are essential maintenance tasks.

65. A — DO probes in aeration basins are subject to biological fouling, mineral scale buildup, and membrane degradation that reduce accuracy over time. Regular cleaning of the probe membrane removes fouling that blocks oxygen diffusion, and periodic calibration against a known standard (atmospheric air or Winkler titration) ensures the probe reading reflects the true DO concentration.

66. D — A loose belt with excessive deflection is slipping on the sheaves, which means the blower is spinning slower than intended and delivering less air than rated. The correct action is to adjust the belt tension to the manufacturer's specification — this restores proper grip between the belt and sheaves, returning the blower to its design speed and airflow capacity.

67. B — Primary sludge contains grit, sand, and other abrasive particles that were not fully removed by the grit removal system. These abrasive materials cause accelerated wear on the progressive cavity pump's elastomer stator as the rotor forces the sludge through the tight clearances between rotor and stator. Improved grit removal upstream and the use of a harder stator material can extend stator life.

68. B — If one of two RAS pumps fails during peak flow, the return rate is cut in half. With reduced RAS flow, settled sludge accumulates in the secondary clarifier faster than it is removed. The sludge blanket rises progressively toward the effluent weir, and if the blanket reaches the weir, biological solids wash over into the effluent — causing TSS and BOD permit violations.

69. C — Installing a calibrated test gauge (reference gauge) alongside the suspect gauge provides a direct comparison under identical operating conditions. If the test gauge reads differently from the suspect gauge, the suspect gauge is inaccurate and should be replaced or recalibrated. This is the simplest and most practical field verification method available.

70. A — A wastewater treatment plant's influent flow always varies — following diurnal patterns, responding to rainfall, reflecting community water use. A perfectly constant reading of exactly 2.000 MGD with zero variation for 72 hours is not physically possible in a real system. The flow meter has almost certainly failed, frozen at its last reading, or lost communication with the SCADA system.

71. D — Gravity thickeners are inherently poor at thickening WAS because the light biological floc does not compact well under gravitational forces alone. WAS achieves much better thickening with dissolved air flotation, gravity belt thickening, or centrifugal thickening — all of which are specifically designed for the characteristics of light, biological sludge. Switching the thickener feed to primary sludge would improve thickening performance because primary sludge is denser.

72. C — Excessive belt tension and roller pressure squeeze more water from the sludge than the optimal amount, producing a cake that is very dry but brittle and prone to cracking. While dry cake may seem desirable, overly dry cake can be difficult to handle, convey, and load. The belt tension and pressure should be adjusted to produce cake at the target solids concentration.

73. A — Anaerobic digestion produces methane gas (60–65% of digester gas by volume) that has significant fuel value — approximately 600 BTU per cubic foot. This methane can be used to heat the digester, power cogeneration engines for electricity production, or supplement the plant's natural gas supply. Aerobic digestion produces no methane and offers no energy recovery potential.

74. B — Increasing the sludge feed rate by 25% means 25% more solids must be separated and compacted per unit time. With a constant bowl speed and scroll differential, the solids spend less total time in the bowl and on the beach, resulting in less complete water removal. The cake will be wetter (lower solids percentage) as the trade-off for higher throughput.

75. D — The aerated static pile method under Part 503 requires maintaining temperatures above 131°F (55°C) for at least 3 consecutive days. The pile achieved 140°F for 5 consecutive days, exceeding both the temperature threshold and the time requirement. However, achieving Class A also requires demonstrating fecal coliform below 1,000 MPN/g or Salmonella below 3 MPN/4g through actual testing — the time-temperature process alone qualifies as one of the approved Class A alternatives.

76. C — Using the Van Kleeck equation: VS_in = 0.74, VS_out = 0.54. VSR = [(0.74 – 0.54) ÷ (0.74 – (0.74 × 0.54))] × 100 = [0.20 ÷ (0.74 – 0.400)] × 100 = [0.20 ÷ 0.340] × 100 = 58.8%, approximately 59%. This significantly exceeds the 38% minimum for Part 503 vector attraction reduction, indicating effective digester performance.

77. A — The progressive decline in methane content (63% → 52%) combined with the progressive increase in volatile acids (180 → 650 mg/L) indicates the methane-forming bacteria are being stressed and losing their ability to keep pace with the acid-forming bacteria. CO_2 is replacing methane in the gas composition because the acetoclastic methanogens are underperforming, allowing volatile acids and CO_2 to accumulate.

78. D — Lower scroll differential speed means the scroll conveys solids through the bowl and up the beach section more slowly. This extended residence time allows more water to drain from the solids under centrifugal force before they are discharged. The result is a drier cake, but at the trade-off of reduced throughput capacity since solids are processed more slowly.

79. B — When biosolids pollutant concentrations are above the Table 3 (PC) limits but below the ceiling concentrations, the biosolids can be land-applied, but the total mass of each regulated metal applied to each site over its lifetime must be tracked and cannot exceed the cumulative pollutant loading rate (CPLR) for that site. This tracking requirement adds an administrative burden that does not apply to Exceptional Quality biosolids.

80. C — Exceptional Quality biosolids must simultaneously meet three criteria: (1) Class A pathogen reduction (fecal coliform <1,000 MPN/g or Salmonella <3 MPN/4g), (2) pollutant concentrations at or below all Table 3 pollutant concentration limits, and (3) one of the approved vector attraction reduction options (such as 38% volatile solids reduction). Meeting all three allows unrestricted public distribution.

81. A — A hard surface crust that traps moisture beneath it is a common problem on sludge drying beds. Scoring or cracking the crust with a rake or mechanical tool creates openings that allow the trapped moisture to evaporate from the surface and allow air to penetrate into the underlying wet sludge. This simple technique can significantly accelerate the drying process.

82. D — Incinerator ash with elevated regulated metals may be classified as a hazardous waste under RCRA if it fails the Toxicity Characteristic Leaching Procedure (TCLP). Ash that exceeds TCLP thresholds must be disposed of in a facility permitted to accept hazardous waste. Even ash that passes TCLP but has elevated metals may require special landfill acceptance testing and documentation.

83. B — A VA/Alk ratio increase from 0.08 to 0.28 is a significant warning trend — the digester has moved from a well-balanced state to a stressed condition approaching the 0.35 critical threshold. The 30% increase in feed rate has overwhelmed the methanogens. The correct response is to reduce the feed rate to the pre-industrial level and allow the biology to stabilize before gradually increasing the feed in smaller increments.

84. C — Diluted polymer solutions degrade over time — the polymer chains break down, reducing their effectiveness for charge neutralization and floc formation. Rather than discarding potentially usable product or overdosing to compensate, the most cost-effective approach is to perform a jar test comparing the aged polymer's performance against fresh product. If performance has degraded, prepare a fresh batch.

85. A — In a two-stage anaerobic digestion system, the primary digester performs all the active biological work — heated, mixed, and regularly fed. The secondary digester serves as an unheated, unmixed storage vessel that allows the digested sludge to further thicken, permits supernatant to separate for decanting and return to the liquid process, and provides buffer storage before dewatering.

86. D — The Class B pathogen standard requires the geometric mean fecal coliform density of seven samples to be less than 2,000,000 (2×10^6) MPN/g of total solids. At 1.8×10^6 MPN/g, the result is below this threshold, qualifying as Class B. Class A requires fecal coliform below 1,000 MPN/g — orders of magnitude lower — which mesophilic digestion alone typically cannot achieve.

87. C — Solids mass = Volume × Weight per gallon × Percent solids = 15,000 GPD × 8.34 lbs/gal × 0.045 = 5,629.5 lbs/day. This is the standard calculation for determining the daily mass of solids being fed to the digester, which is essential for calculating volatile solids loading rate and evaluating digester capacity utilization.

88. B — Using a portable DO meter with a probe on a cable, lowered directly into the aeration basin, provides the most accurate in-situ measurement. The probe equilibrates with the actual dissolved oxygen at the sampling depth without any air exposure or temperature change that would occur during sample transfer to a container. This eliminates the DO changes that inevitably occur when hauling water to the surface.

89. A — The four-week ammonia trend (0.8 → 1.4 → 3.2 → 7.1 mg/L) shows clear, progressive deterioration of nitrification performance, with Week 4 exceeding the 5.0 mg/L permit limit. This is not random variation — it is a consistent upward trend that will continue without intervention. The operator should immediately investigate the five nitrification requirements: SRT, DO, alkalinity, pH, and toxicity.

90. D — Equal-volume aliquots collected at equal time intervals produce a time-proportional composite, which gives equal weight to each sampling period regardless of flow. Flow-proportional compositing — where aliquot volumes are adjusted based on flow rate — is generally preferred for NPDES compliance because it more accurately represents the mass-weighted average concentration over the sampling period.

91. B — TSS = [(1.5340 – 1.5312) × 1,000,000] ÷ 500 = [0.0028 × 1,000,000] ÷ 500 = 2,800 ÷ 500 = 5.6 mg/L. The weight difference of 0.0028 grams (2.8 mg) captured on the filter from 500 mL of sample yields a concentration of 5.6 mg/L — within the range expected for well-treated secondary effluent.

92. C — Chlorine removed = 2.4 – 0.02 = 2.38 mg/L. lbs/day = 2.38 × 2.0 × 8.34 = 39.7 lbs/day. This calculation determines the mass of chlorine residual being neutralized by the dechlorination system, which is essential for calculating the required dechlorination chemical feed rate (sulfur dioxide or sodium bisulfite).

93. D — BOD removal = [(205 – 138) ÷ 205] × 100 = [67 ÷ 205] × 100 = 32.7%. Primary clarifier BOD removal of 32.7% is within the expected range of 25–40% for a properly operating primary clarifier. Primary clarifiers remove only the BOD associated with settleable solids — dissolved and colloidal BOD passes through to secondary treatment.

94. A — Close agreement between online instruments and laboratory grab samples confirms that the online instruments are properly calibrated and producing data that can be trusted for process control decisions. This verification should be performed regularly (typically weekly) to maintain confidence in the online readings that operators rely on for real-time process management.

95. C — Bacteriological samples must be maintained at ≤10°C (preferably 4°C) during transport to preserve the microbial population as it existed at the time of collection. A temperature of 12°C exceeds this requirement, potentially allowing organisms to grow or die during transport. The result should be flagged as potentially compromised due to the preservation failure, even though the analytical result is below the permit limit.

96. B — Seed organisms provide the bacterial population needed to biologically decompose the organic matter in the BOD bottle during the five-day incubation. Effluent and some industrial waste samples may not contain enough indigenous bacteria to perform the decomposition. The seed ensures an active, consistent microbial population is present in every bottle to consume the available organic substrate.

97. A — SVI = 310 × 1,000 ÷ 2,600 = 119.2 mL/g. The settling pattern shows smooth, progressive compaction from 650 to 310 mL/L over 30 minutes with no erratic behavior, no floating, and no stalling. This is the signature of healthy, well-structured biological floc with good settling characteristics — SVI in the 100–150 mL/g range confirms normal sludge condition.

98. C — Increasing electrode response time from 10 seconds to over 60 seconds indicates the electrode is aging, fouled, or dehydrated. The glass membrane or reference junction may be coated with protein, grease, or mineral scale that slows ion exchange. Cleaning with electrode cleaning solution may restore performance; if not, the electrode should be replaced. Extended response time produces readings that appear stable but may not reflect the true sample pH.

99. B — Monthly average = (14+18+22+16+28+12+19+24+15+20+17+22) ÷ 12 = 227 ÷ 12 = 18.9 mg/L. This is well below the 30 mg/L monthly average limit. The highest individual daily result (28 mg/L) is well below the 45 mg/L daily maximum limit. The plant is in full compliance with both limits for this reporting period.

100. D — A composite from the wrong location cannot be used for compliance monitoring — influent results cannot be substituted for effluent results regardless of any correction factors applied. The operator must recollect a proper 24-hour effluent composite. If the holding time has expired and recollection is not possible, the missed monitoring event must be documented and explained on the DMR. The programming error should be corrected immediately to prevent recurrence.