

EGLE B

WASTEWATER EXAM PREP

"The most comprehensive and effective guide available"

Michigan Class B Wastewater Operator — Study Edition

Prepared by: America's Municipal Water Operator Pipeline, LLC
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Disclaimer

While every effort has been made to ensure accuracy, regulatory requirements and examination standards may change. Users should always verify critical information with EGLE, 40 CFR Part 136, and other official regulatory sources.

This Book is intended as a supplemental study resource and should not be considered a substitute for hands-on operational training, formal coursework, or official state-issued exam materials.

Introduction

This Study Edition was created by a Michigan EGLE–certified Class B wastewater operator who has completed all major training courses available for exam preparation. Many existing study materials are outdated, incomplete, or inconsistent with current EGLE expectations. These gaps can add unnecessary difficulty to the licensing process.

The goal of this Study Edition is to provide a clearer, more accurate, and more comprehensive study guide for operators preparing for the Michigan Class B Wastewater Operator Exam. Content is organized to support a consistent, structured study routine and to help operators build the confidence needed to succeed.

Most operators benefit from a daily study plan lasting approximately six months. This book is designed to support that effort. The Math Workbook is accompanied by step-by-step instructional.

Instructions on the best way to navigate the Book for the most efficiency. Print out table of contents to help you navigate through -Book with efficiency. 1st read the chapter, 2nd do the practice exams = PE, 3rd Answer Key Appendix = AK, 4th Water Math Problems = WMP for that chapter, 5th Water Math Solutions = WMPS

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Chapter 1 — Laboratory Procedures

Topics Covered: - Sampling types and protocols

- Analytical methods (40 CFR Part 136)

- QA/QC principles

- Chemical formulas

- Laboratory math and conversions

- Practice problems

1. Sampling Techniques

Composite Samples

Composite samples represent wastewater characteristics over a period—commonly 24 hours.

Used for: - BOD

- Ammonia

- Total Phosphorus

- TSS

Grab Samples

Collected at a specific moment. Used for:

- pH

- Dissolved Oxygen (DO)

- Fecal coliform bacteria

Sampling Locations

Influent: Collected upstream of internal recycles.

Effluent: Collected after disinfection at permitted discharge.

Sampling Methods

1. Composite samples are used for: **BOD**, **Ammonia**, **Phosphorus**, **Suspended Solids**
2. Grab samples are used for: **pH**, **DO**, **Fecal Coliform**
3. The influent sample is collected where the wastewater **enters** the plant.
4. The effluent sample is collected after **disinfection**, just before **discharge**.

2. Analytical Method Requirements

All regulated laboratory analysis must follow **EPA-approved methods listed in 40 CFR Part 136**, unless an approved alternative has been authorized.

Method Selection Criteria: - Method appears on EPA approved list

- Hazardous waste generated

- Required detection limits

- Equipment availability

- Complexity of method

- Cost per analysis

3. Quality Assurance Components

A complete QA program verifies:

- **Accuracy** — closeness to true value
- **Recovery** — ability to measure known additions
- **Duplicates** — precision between repeat measurements
- **Control Charts** — tracking long-term performance

4. Common Chemical Formulas

- NO_3 — Nitrate
- NO_2 — Nitrite
- SO_4 — Sulfate
- PO_4 — Phosphate
- CO_2 — Carbon Dioxide
- CO — Carbon Monoxide
- CH_4 — Methane
- HCO_3 — Bicarbonate
- CO_3 — Carbonate

- NH_3 — Ammonia
- $FeCl_3$ — Ferric Chloride
- $Al_2(SO_4)_3 \cdot 14H_2O$ — Alum
- NaCl — Sodium Chloride
- NaOCl — Sodium Hypochlorite
- SO_2 — Sulfur Dioxide
- H_2S — Hydrogen Sulfide

5. Lab Math & Conversions

Mass:

- 1 g = 1,000 mg
- 1 mg = 1,000 µg

Volume:

- 1 L = 1,000 mL
- 1 mL = 1,000 µL

Standard Dilution Equation:

$C_1V_1 = C_2V_2$

Operational Checks

VA/Alk ratio should be less than **0.3**.

6. Ion-Selective Electrode (ISE) Use

ISEs are commonly applied to measurements such as:

- Ammonia
- Nitrate
- Nitrite
- pH
- Chlorine residual

7. pH Measurement Guidelines

- Must be a **grab sample** analyzed within **15 minutes**
- pH measures concentration of hydrogen ions (H^+)
- Requires **two-point calibration** and **temperature compensation**
- 1 pH unit change = **tenfold** change in H^+ concentration

8. Fecal Coliform Procedures

- Count only clearly identifiable **blue colonies**.
- Incubation temperature: **44.5°C ± 0.2°C** for **24 hours**.
- Grab samples must be analyzed immediately—no more than **6 hours** after collection.
- Fecal coliforms serve as an indicator organism.
- Valid plates must contain **20 to 60** colonies.
- Report results as **colonies per 100 mL**.
- **Geometric mean** is required for weekly and monthly averages.

9. Chemical Hygiene Program Requirements

Facilities handling hazardous chemicals must maintain a documented Chemical Hygiene Plan, which includes:

- Appointment of a **Chemical Hygiene Officer**
- Employee **training and information** programs
- Medical evaluations or consultations when exposure occurs
- Adequate **engineering controls** (e.g., ventilation, fume hoods)
- Record retention for **employment duration + 30 years**
- An **annual review** of the program's effectiveness

Fill-in-the-Blank Test Review Laboratory

Use this section to assess your knowledge and recall.

1. Sampling Methods

1. Composite samples are used for: _____, _____, _____, _____
2. Grab samples are used for: _____, _____, _____
3. The influent sample is collected where the wastewater _____ the plant.
4. The effluent sample is collected after _____, just before _____.

---

2. Analytical Method Requirements

Analytical methods must follow _____ CFR Part _____ or be approved by _____.

List the criteria for choosing a method:
a. _____
b. _____
c. _____
d. _____
e. _____
f. _____

---

3. Quality Assurance Components

1. _____
2. _____
3. _____
4. _____

---

4. Lab Math — Conversions

Weight
• 1 gram = _____ milligrams (mg)
• 1 milligram = _____ micrograms (µg)

Volume
• 1 liter = _____ milliliters (mL)
• 1 milliliter = _____ microliters (µL)

5. Chemical Formula Identification

Provide the chemical name for each formula:

- NO_3 _____
- NO_2 _____
- SO_4 _____
- PO_4 _____
- CO_2 _____
- CO _____
- CH_4 _____
- HCO_3 _____
- CO_3 _____
- NH_3 _____
- $FeCl_3$ _____
- $(SO_4)_3 \cdot 14H_2O$ _____
- NaCl _____
- NaOCl _____
- SO_2 _____
- H_2S _____

---

6. pH Analysis

- pH must be analyzed within _____ minutes.
- pH measures the concentration of _____ _____.
- Effluent sampling for pH must be a _____ sample, analyzed immediately or within _____ minutes.
- Calibration requires _____ and temperature compensation.
- Each pH unit change represents a concentration change of _____ ×.

---

7. Fecal Coliform Testing

- Count blue colonies.
- Incubate at _____ °C ± 0.2 for _____ hours.
- Must be a _____ sample; analyze immediately or within _____ hours maximum.
- Indicator organism: not pathogenic, but its removal indicates pathogens have been _____.

8. Chemical Hygiene Plan

List the required components:

a. _____
b. _____
c. _____
d. _____
e. _____

f. _____

---

9. Operational Checks

• The VA/Alk ratio should be less than _____.

---

10. Dilution Equation

Fill in the formula:
_____ × _____ = _____ × _____

Self-Grading

Score: _____ / _____ = _____ %

Multiple Choice Test Review Laboratory

Multiple Wastewater Operator Certification – Multiple Choice Worksheet

Name: _____ Date: _____

Score: _____ / _____ = _____ %

1. Sampling Methods

1. Composite samples are typically used for:

A. pH, temperature, color, odor
B. BOD, TSS, Ammonia, Phosphorus
C. Grab-only parameters, chlorine residual, turbidity
D. Immediate-response tests, field screening, visual checks

2. Grab samples are typically used for:

A. BOD, TSS, nutrients
B. Flow-weighted averages, composite analysis, pH
C. pH, chlorine residual, temperature
D. Long-term monitoring, trend analysis, composite sampling

3. Influent samples are collected where wastewater:

A. exits the plant
B. enters the plant
C. bypasses the plant
D. is discharged to receiving waters

4. Effluent samples are collected after _____, just before _____:

A. screening; grit removal
B. primary treatment; secondary treatment
C. final disinfection; discharge
D. influent pumping; aeration

2. Analytical Method Requirements

5. Analytical methods must follow:

A. EPA 40 CFR Part 136 or be approved by the state
B. ASTM Part 100 or be approved by the lab
C. OSHA Part 1910 or be approved by the supervisor
D. NPDES Part 503 or be approved by the operator

6. Which is NOT a valid criterion for choosing a method?

A. Sensitivity
B. Cost
C. Regulatory acceptance
D. Personal preference

3. Quality Assurance Components

7. Which of the following is NOT a QA/QC component?

A. Calibration
B. Chain of custody
C. Sample preservation
D. Operator certification

4. Lab Math — Conversions

8. 1 gram =

A. 10 mg B) 100 mg C) 1000 mg D) 10,000 mg

9. 1 milligram =

A. 100 µg B) 1000 µg C) 10 µg D) 10,000 µg

10. 1 liter =

A. 100 mL B) 1000 mL C) 10 mL D) 10,000 mL

11. 1 milliliter =

A. 100 µL B) 1000 µL C) 10 µL D) 10,000 µL

5. Chemical Formula Identification

12. NO_3 =

A. Nitrite B) Nitrate C) Ammonia D) Nitrogen gas

13. SO_4 =

A. Sulfide B) Sulfate C) Sulfur dioxide D) Sulfuric acid

14. PO_4 =

A. Phosphorus B) Phosphate C) Phosphite D) Phosgene

15. NH_3 =

A. Ammonium B) Ammonia C) Nitrite D) Nitrate

6. pH Analysis

16. pH must be analyzed within:

A. 5 min B) 15 min C) 30 min D) 60 min

17. pH measures the concentration of:

A. Dissolved oxygen B) Hydrogen ions C) Chlorine residual D) Ammonia

18. Effluent pH sampling must be:

A. Composite; 24 hrs
B. Grab; within 15 min
C. Grab; within 2 hrs
D. Composite; within 1 hr

19. Calibration requires:

A. Buffer solutions and temp compensation
B. Distilled water and conductivity meter
C. Reagent blanks and titration
D. Colorimeter and standard curve

20. Each pH unit change =

A. 2× B) 5× C) 10× D) 100×

7. Fecal Coliform Testing

21. Incubation temp and time:

A. 35°C ± 0.2 for 24 hrs
B. 44.5°C ± 0.2 for 24 hrs
C. 37°C ± 0.2 for 18 hrs
D. 44.5°C ± 0.2 for 18 hrs

22. Sample type and holding time:

A. Composite; 6 hrs.
B. Grab; 6 hrs.
C. Grab; 8 hrs.
D. Composite; 8 hrs.

23. Fecal coliform is an indicator because:

A. It is pathogenic
B. Its removal indicates pathogens have been removed
C. It is used in disinfection
D. It is a nutrient

8. Chemical Hygiene Plan

24. Which is NOT a required component?

A. Employee training
B. Exposure monitoring
C. Emergency procedures
D. Personal opinions

9. Operational Checks

25. The VA/Alk ratio should be:

A. > 0.5 B) < 0.3 C) = 1.0 D) < 0.1

10. Dilution Equation

26. The correct dilution formula is:

A. $C_1 \times V_1 = C_2 \times V_2$
B. $V_1 \times V_2 = C_1 \times C_2$
C. $C_1 + V_1 = C_2 + V_2$
D. $V_1/C_1 = V_2/C_2$

Laboratory Answer Key by Question – Fill in Blank

Answer Key

Sampling Methods

1. BOD, TSS, Ammonia, Phosphorus
2. pH, chlorine residual, temperature
3. enters the plant
4. final disinfection; discharge

Analytical Method Requirements

EPA 40 CFR Part 136 or approved by EPA

a. EPA approved

b. Detection Limit

c. Difficulty

d. Hazardous Waste Generated

e. Cost

f. Equipment in house

3. Quality Assurance Components

1. Accuracy
2. Recovery
3. Duplicates
4. Control Charts

4. Lab Math - Conversions

1 gram = 1000 mg

1 milligram = 1000 µg

1 liter = 1000 mL

1 milliliter = 1000 µL

5. Chemical Formula Identification

NO3 =Nitrate

NO2 = Nitrite

SO4 = Sulfate

PO4 = Phosphate

CO2 = Carbon Dioxide

CO = Carbon Monoxide

CH4 = Methane

HCO3 = Bicarbonate

CO3 = Carbonate

NH3 = Ammonia

FeCl3 = Ferric Chloride

(SO4)314h2O = Aluminum Sulfate Alum

NaCl = Sodium Chloride

NaOCl = Sodium Hypochlorite

SO2 = Sulfur Dioxide

H2S = Hydrogen Sulfide

6. pH Analysis

- 15 minutes
- Hydrogen ions
- Grab; within 15 minutes
- 2 buffer solutions and temperature compensation
- 10×

7. Fecal Coliform Testing

- Count blue colonies
- 44.5°C ± 0.2 for 24 hours
- Grab; 6 hours
- Its removal indicates pathogens have been removed

8. Chemical Hygiene Plan

a. A written plan for hazardous chemicals in house

b. Chemical Hygiene Officer

c. Employment records: Keep years employment + 30 years

d. Medical consultation and medical exams

e. Information and training

f. Annual Review

9. Operational Checks

The VA/Alk ratio should be less than < 0.3 — Stable, healthy digestion

10. Dilution Equation

$$C_1 \times V_1 = C_2 \times V_2$$

Answer Key for the "Laboratory – Multiple Wastewater Operator Certification – Multiple Choice Worksheet":

Answer Key

1. B
2. C
3. B
4. C
5. A
6. D
7. D
8. C
9. B
10. B
11. B
12. B
13. B
14. B
15. B
16. B
17. B
18. B
19. A
20. C
21. B
22. B
23. B
24. D
25. B
26. A

LABORATORY WATER MATH PRACTICE PROBLEMS

Clean, Organized, Step-by-Step Solutions

Problems 1-9

Laboratory Calculations, Dilutions, Solids, CBOD, and Bacteriological Analysis

PROBLEM 1

Standard Deviation Example

Given Information	Value / Detail
Data set	88, 101, 68.5, 105, 104
Number of values	n = 5
Required results	Mean, population standard deviation, and sample standard deviation

Step-by-Step Solution

STEP 1 **Calculate the mean**	Mean = Σx / n Mean = (88 + 101 + 68.5 + 105 + 104) / 5 Mean = 466.5 / 5 = 93.3
STEP 2 **Calculate deviations**	88 - 93.3 = -5.3 101 - 93.3 = 7.7 68.5 - 93.3 = -24.8 105 - 93.3 = 11.7 104 - 93.3 = 10.7
STEP 3 **Square and sum deviations**	$(-5.3)^2 + (7.7)^2 + (-24.8)^2 + (11.7)^2 + (10.7)^2$ = 28.09 + 59.29 + 615.04 + 136.89 + 114.49 $\Sigma(x - \bar{x})^2 = 953.80$
STEP 4 **Population standard deviation**	$\sigma^2 = 953.80 / 5 = 190.76$ $\sigma = \sqrt{190.76} = 13.8116 \approx 13.812$
STEP 5 **Sample standard deviation**	$s^2 = 953.80 / (5 - 1) = 238.45$ $s = \sqrt{238.45} = 15.4418 \approx 15.442$

Final Answer

Mean = 93.3
Population standard deviation = 13.812
Sample standard deviation = 15.442

PROBLEM 2

Chloride Standard Dilution

Given Information	Value / Detail
Stock concentration, C_1	1,000 mg/L
Final concentration, C_2	25 mg/L
Final solution volume, V_2	250 mL
Required result	Volume of stock solution, V_1, and dilution procedure

Step-by-Step Solution

STEP 1 **Write the dilution equation**	$C_1V_1 = C_2V_2$
STEP 2 **Rearrange for V_1**	$V_1 = (C_2 \times V_2) / C_1$
STEP 3 **Insert the values**	V_1 = (25 mg/L × 250 mL) / 1,000 mg/L
STEP 4 **Calculate**	V_1 = 6,250 / 1,000 = 6.25 mL
STEP 5 **Prepare the dilution**	Pipette 6.25 mL of stock into a 250-mL volumetric flask. Add dilution water to the 250-mL mark and mix thoroughly.

Final Answer

Use 6.25 mL of the 1,000 mg/L stock solution.
Dilute to a final total volume of 250 mL.

PROBLEM 3

Sludge Thickening

Given Information	Value / Detail
Initial sludge volume, V_1	100,000 gal
Initial solids concentration, C_1	6% = 0.06
Final solids concentration, C_2	15% = 0.15
Required result	Final thickened-sludge volume, V_2

Step-by-Step Solution

STEP 1 **Write the solids balance**	$V_1C_1 = V_2C_2$ The amount of solids remains constant; only water is removed.
STEP 2 **Rearrange for final volume**	$V_2 = (V_1 \times C_1) / C_2$
STEP 3 **Insert the values**	$V_2 = (100{,}000 \text{ gal} \times 0.06) / 0.15$
STEP 4 **Calculate**	$V_2 = 6{,}000 / 0.15 = 40{,}000$ gal

Final Answer

40,000 gallons of thickened sludge

PROBLEM 4

Mercury Dilution

Given Information	Value / Detail
Industrial wastewater flow	50,000 gal/day = 0.050 MGD
Industrial mercury concentration	4.8 µg/L
Treatment plant flow	15.5 MGD
Required result	Resulting plant-discharge concentration in ng/L

Step-by-Step Solution

STEP 1 **Use the dilution mass balance**	$C_2 = (C_1 \times Q_1) / Q_2$
STEP 2 **Insert the flow and concentration**	$C_2 = (4.8\ \mu g/L \times 0.050\ MGD) / 15.5\ MGD$
STEP 3 **Calculate in µg/L**	$C_2 = 0.240 / 15.5 = 0.0154839\ \mu g/L$
STEP 4 **Convert µg/L to ng/L**	1 µg/L = 1,000 ng/L 0.0154839 × 1,000 = 15.4839 ng/L

Final Answer

Resulting mercury concentration ≈ 15.5 ng/L

PROBLEM 5

Titration and NaOH Dilution

Given Information	Value / Detail
HCl volume	30.0 mL
HCl normality	0.040 N
NaOH volume at endpoint	22.8 mL
NaOH volume to dilute	820 mL
Target NaOH normality	0.030 N

Step-by-Step Solution

STEP 1 **Write the titration equation**	$N_1V_1 = N_2V_2$
STEP 2 **Solve for NaOH normality**	NNaOH = (0.040 N × 30.0 mL) / 22.8 mL NNaOH = 1.200 / 22.8 = 0.0526316 N ≈ 0.0526 N
STEP 3 **Write the dilution equation**	$N_1V_1 = N_2V_2$ $V_2 = (N_1 \times V_1) / N_2$
STEP 4 **Calculate final volume**	V_2 = (0.0526316 N × 820 mL) / 0.030 N V_2 = 1,438.60 mL
STEP 5 **Calculate water to add**	Water added = final volume - initial volume Water added = 1,438.60 - 820 = 618.60 mL

Final Answer

a. NaOH normality = 0.0526 N
b. Water to add ≈ 619 mL

PROBLEM 6

NaOH Dilution Calculation

Given Information	Value / Detail
Initial NaOH volume, V_1	820 mL
Initial normality, N_1	0.05263 N
Target normality, N_2	0.030 N
Required results	Final total volume and volume of water to add

Step-by-Step Solution

STEP 1 **Write the dilution equation**	$N_1V_1 = N_2V_2$
STEP 2 **Rearrange for V_2**	$V_2 = (N_1 \times V_1) / N_2$
STEP 3 **Insert the values**	$V_2 = (0.05263\ N \times 820\ mL) / 0.030\ N$
STEP 4 **Calculate final total volume**	$V_2 = 43.1566 / 0.030 = 1{,}438.55\ mL \approx 1{,}439\ mL$
STEP 5 **Calculate water to add**	Water added = 1,438.55 - 820 = 618.55 mL ≈ 619 mL

Final Answer

Final total volume ≈ 1,439 mL
Water to add ≈ 619 mL

PROBLEM 7

Convert Nickel from µg/L Wet to mg/kg Dry

Given Information	Value / Detail
Measured nickel concentration	44 µg/L, wet basis
Wet sludge assumption	1 L ≈ 1 kg wet sludge
Percent solids	3.6% = 0.036 kg dry solids/kg wet sludge
Required result	Nickel concentration in mg/kg, dry basis

Step-by-Step Solution

STEP 1 **Express concentration per kg wet**	44 µg/L × 1 L/kg wet = 44 µg/kg wet

STEP 2 **Convert to a dry-weight basis**	44 µg/kg wet ÷ 0.036 kg dry/kg wet = 1,222.22 µg/kg dry

STEP 3 **Convert µg to mg**	1,222.22 µg/kg ÷ 1,000 µg/mg = 1.22222 mg/kg dry

STEP 4 **Round appropriately**	1.22222 mg/kg ≈ 1.22 mg/kg

Final Answer

Nickel concentration ≈ 1.22 mg/kg on a dry-weight basis

PROBLEM 8

CBOD Seeded BOD Calculation

Given Information	Value / Detail
Seed control	Initial DO 9.10 mg/L; final DO 3.00 mg/L; seed volume 9.0 mL
Sample bottle	Initial DO 8.90 mg/L; final DO 3.40 mg/L; seed added 2.0 mL
Bottle and sample volumes	Bottle 300 mL; sample aliquot 6.0 mL
Required result	Seed-corrected CBOD concentration in mg/L

Step-by-Step Solution

STEP 1 **Seed control DO depletion**	9.10 - 3.00 = 6.10 mg/L
STEP 2 **Seed correction per mL**	6.10 mg/L ÷ 9.0 mL = 0.677778 mg/L per mL seed
STEP 3 **Seed correction for sample**	0.677778 × 2.0 mL = 1.355556 mg/L
STEP 4 **Raw sample DO depletion**	8.90 - 3.40 = 5.50 mg/L
STEP 5 **Net DO removal**	5.50 - 1.355556 = 4.144444 mg/L
STEP 6 **Calculate dilution factor**	300 mL ÷ 6.0 mL = 50
STEP 7 **Calculate final CBOD**	CBOD = 4.144444 mg/L × 50 = 207.2222 mg/L

Final Answer

Final CBOD concentration ≈ 207 mg/L

PROBLEM 9

Bacteriological Analysis — Daily CFU/100 mL

Given Information	Value / Detail
Acceptable plate range	20-60 colonies
Reporting formula	CFU/100 mL = colonies counted × (100 ÷ volume filtered)
Two acceptable plates	Calculate each CFU/100 mL value, then average the two values
TNTC	Too numerous to count; do not use

Step-by-Step Solution

STEP 1 **Day One**	Accept: 1 mL plate with 28 colonies. Reject: 10 mL and 100 mL plates (TNTC). 28 × (100 ÷ 1) = 2,800 CFU/100 mL
STEP 2 **Day Two**	Accept: 10 mL plate with 47 colonies. Reject: 1 mL plate (3) and 100 mL plate (7), both below 20. 47 × (100 ÷ 10) = 470 CFU/100 mL
STEP 3 **Day Three — first plate**	Accept: 50 mL plate with 24 colonies. 24 × (100 ÷ 50) = 48 CFU/100 mL
STEP 4 **Day Three — second plate**	Accept: 100 mL plate with 58 colonies. Reject: 10 mL plate with 12 colonies. 58 × (100 ÷ 100) = 58 CFU/100 mL
STEP 5 **Day Three — average**	Average = (48 + 58) ÷ 2 = 53 CFU/100 mL
STEP 6 **Day Four**	Accept: 30 mL plate with 33 colonies. Reject: 1 mL plate (0) and 90 mL plate (67). 33 × (100 ÷ 30) = 110 CFU/100 mL

Final Answer

Day One = 2,800 | Day Two = 470
Day Three = 53 | Day Four = 110 CFU/100 mL

PROBLEM 9 — CONTINUED

Bacteriological Analysis — Geometric Mean

Given Information	Value / Detail
Reported daily values	2,800; 470; 53; 110 CFU/100 mL
Number of values	n = 4
Log method	GM = 10^[Σlog₁₀(x) / n]
Required result	Geometric mean CFU/100 mL

Step-by-Step Solution

STEP 1 **Take the base-10 logs**	$\log_{10}(2{,}800) = 3.447158$ $\log_{10}(470) = 2.672098$ $\log_{10}(53) = 1.724276$ $\log_{10}(110) = 2.041393$
STEP 2 **Add the logarithms**	3.447158 + 2.672098 + 1.724276 + 2.041393 = 9.884925
STEP 3 **Average the logarithms**	Average log = 9.884925 ÷ 4 = 2.471231
STEP 4 **Take the antilog**	GM = 10^2.471231 = 295.9587 CFU/100 mL
STEP 5 **Round for reporting**	295.9587 ≈ 296 CFU/100 mL

Final Answer

Geometric mean = 296 CFU/100 mL