

Mathematics 8

A Problem-Centered Course

520 problems in 130 spiral sets

Problems first. Ideas built through conjecture, representation, discussion, and revision.

To the Student

This is not a textbook that explains a method and then asks you to imitate it. The problems are the course. Bring a serious first attempt, a diagram or representation when useful, and questions worth discussing. A complete solution communicates why an answer is reasonable, not only what the answer is.

Most class meetings use one four-problem set. Some problems are quick; others deserve an entire discussion or a return visit. When exact and approximate answers are both useful, give both. Include units, label graphs, and state assumptions. Calculators may support investigation, but they do not replace reasoning.

A productive routine

1. Read all four problems before choosing where to begin.
2. Record attempts, including approaches that do not finish the problem.
3. Compare representations: words, tables, graphs, equations, and diagrams.
4. Revise after discussion. Keep the original thinking visible.
5. When a problem asks you to create or critique, expect more than one valid response.

Course map

The sets spiral rather than isolate topics. Across the year you will repeatedly meet rational numbers, proportional and linear relationships, equations and systems, functions, exponents and roots, transformations, similarity, the Pythagorean Theorem, volume, statistics, probability, and mathematical modeling.

Phase 1: Reasoning with quantities

The ideas in this phase are intentionally mixed. Look for connections to earlier sets and be ready to reuse prior results.

Set 1

1. Store A sells 10 ounces for \$10.00; Store B sells 14 ounces for \$14.53. Which is the better buy? Quantify the difference per ounce.
2. Simplify $(5^2 \cdot 5^1)/5^1$ without a calculator. State the exponent rule used.
3. For $f(x) = 3x + 3$, find $f(-2)$, solve $f(x) = 12$, and interpret each result.
4. Compare $y = 2x + 1$ and $y = 3x - 1$. Find their intersection and interpret it as a break-even point.

Set 2

5. Write an equation for the line parallel to $y = -2x + 0$ through $(0, 4)$. How do you know the lines never meet?
6. A graph crosses the y -axis at -1 and rises 7 units for every 2 units right. Write its equation and give three points on the graph.
7. Simplify $(3^2 \cdot 3^1)/3^1$ without a calculator. State the exponent rule used.
8. A tank contains 120 liters and drains at 4 liters per minute. Write a function for the amount remaining and decide whether it is proportional.

Set 3

9. Tickets cost \$7.00 for adults and \$4.00 for students. A group buys 9 tickets for \$45.00. How many of each were bought?
10. Write an equation for the line parallel to $y = -3x + 3$ through $(0, 7)$. How do you know the lines never meet?
11. On a map, 6 cm represents 72 km. Two points are 6.5 cm apart. Find the actual distance and describe the proportional relationship.
12. Three consecutive integers have sum 21. Find them and write the equation you used.

Set 4

13. A square has area 144 square units. Find its exact side length and explain how square roots undo squaring.
14. A ladder 11 ft long reaches 6 ft up a wall. How far is its foot from the wall? Draw and label a model first.
15. Design a simulation for an event with probability $\frac{4}{10}$. State how many trials you would run and how you would judge whether results are reasonable.
16. A graph crosses the y -axis at -4 and rises 7 units for every 2 units right. Write its equation and give three points on the graph.

Set 5

17. The diagonal of a rectangle is 14 and one side is 4. Is a rectangle with these measurements possible? Justify using the Pythagorean Theorem.
18. The perimeter of a rectangle is 26 cm. Its sides are $x + 3$ and $x - 2$ cm. Find x and both side lengths.
19. Tickets cost \$7.00 for adults and \$4.00 for students. A group buys 12 tickets for \$57.00. How many of each were bought?
20. A bag has 4 red, 6 blue, and 4 green tiles. Two are drawn without replacement. Find the probability both are blue.

Set 6

21. A sample of 46 students includes 18 who prefer option A. Estimate how many of 460 students would prefer A, and state one source of sampling bias.
22. Create two different linear equations whose only common solution is (9, 6). Explain how your equations guarantee this.
23. Solve $2x + 1 = 15$. Check your solution by substitution.
24. A ladder 17 ft long reaches 12 ft up a wall. How far is its foot from the wall? Draw and label a model first.

Set 7

25. A graph crosses the y -axis at -5 and rises 7 units for every 2 units right. Write its equation and give three points on the graph.
26. A scatter plot appears to fall from left to right. Describe the association, give a plausible context, and explain why association does not prove causation.
27. The diagonal of a rectangle is 20 and one side is 10. Is a rectangle with these measurements possible? Justify using the Pythagorean Theorem.
28. A square has area 100 square units. Find its exact side length and explain how square roots undo squaring.

Set 8

- 29.** Solve $6(x - 4) = 18$. Then explain one step that preserves equality.
- 30.** A recipe uses 8 cups of broth for 7 servings. How much broth is needed for 12 servings? State the unit rate.
- 31.** Find the slope through $(3, -10)$ and $(6, -16)$. Write the equation of the line.
- 32.** Create two different linear equations whose only common solution is $(9, 9)$. Explain how your equations guarantee this.

Set 9

- 33.** A quantity rises from 120 to 140. Find the percent increase, then reverse the change and explain why the two percentages differ.
- 34.** Compare 2^3 and $2^p + 2^q$. Which is larger? Is your conclusion always true for positive p, q ?
- 35.** A graph crosses the y -axis at 3 and rises 7 units for every 2 units right. Write its equation and give three points on the graph.
- 36.** Find the slope through $(3, -10)$ and $(6, -19)$. Write the equation of the line.

Set 10

- 37.** Compare $y = 2x - 2$ and $y = 3x - 4$. Find their intersection and interpret it as a break-even point.
- 38.** Describe a real situation modeled by $y = 5x - 1$. Identify a sensible domain and explain whether all real numbers belong in it.
- 39.** Compare 2^3 and $2^p + 2^q$. Which is larger? Is your conclusion always true for positive p, q ? Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 40.** Store A sells 12 ounces for \$12.00; Store B sells 16 ounces for \$16.60. Which is the better buy? Quantify the difference per ounce.

Phase 2: Rates and linear patterns

The ideas in this phase are intentionally mixed. Look for connections to earlier sets and be ready to reuse prior results.

Set 11

- 41. Simplify $(4^4 \cdot 4^1)/4^1$ without a calculator. State the exponent rule used.
- 42. A line has slope -3 and passes through $(4, -9)$. Find its y -intercept and write an equation.
- 43. Compare $y = -1x + 4$ and $y = 0x + 2$. Find their intersection and interpret it as a break-even point.
- 44. Solve $6(x - 4) = 60$. Then explain one step that preserves equality.

Set 12

- 45. A ladder 19 ft long reaches 14 ft up a wall. How far is its foot from the wall? Draw and label a model first.
- 46. A cone and cylinder have the same radius 3 cm and height 8 cm. Compare their volumes and explain the factor of $\frac{1}{3}$.
- 47. For $f(x) = 3x + 5$, find $f(-2)$, solve $f(x) = 14$, and interpret each result.
- 48. Function A starts at -2 and increases by 4 per step. Function B is $y = 3x + 2$. Which is larger when $x = 10$, and when do they agree?

Set 13

- 49. Design a simulation for an event with probability $\frac{2}{10}$. State how many trials you would run and how you would judge whether results are reasonable.
- 50. A streaming plan costs \$7.00 plus \$1.50 per movie. Write and solve an equation for the number of movies when the bill is \$28.00.
- 51. Simplify $(5^4 \cdot 5^1)/5^1$ without a calculator. State the exponent rule used.
- 52. A bag has 3 red, 6 blue, and 5 green tiles. Two are drawn without replacement. Find the probability both are blue.

Set 14

- 53.** Describe a real situation modeled by $y = 5x - 3$. Identify a sensible domain and explain whether all real numbers belong in it.
- 54.** Solve the system $x + y = 12$ and $3x + 1y = 24$. Verify the ordered pair in both equations.
- 55.** A quantity rises from 80 to 90. Find the percent increase, then reverse the change and explain why the two percentages differ.
- 56.** A cone and cylinder have the same radius 9 cm and height 8 cm. Compare their volumes and explain the factor of $\frac{1}{3}$.

Set 15

- 57.** A streaming plan costs \$6.00 plus \$1.00 per movie. Write and solve an equation for the number of movies when the bill is \$14.00.
- 58.** A scatter plot appears to fall from left to right. Describe the association, give a plausible context, and explain why association does not prove causation. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 59.** A fair number cube is rolled twice. Find the probability that the sum is 9. Organize the sample space so no outcomes are missed.
- 60.** A culture begins with 200 cells and doubles every hour. Write a function and find the population after 5 hours. Is the function linear? Explain.

Set 16

- 61.** On a map, 8 cm represents 96 km. Two points are 3.5 cm apart. Find the actual distance and describe the proportional relationship.
- 62.** A quantity rises from 100 to 135. Find the percent increase, then reverse the change and explain why the two percentages differ.
- 63.** Create two different linear equations whose only common solution is $(9, 5)$. Explain how your equations guarantee this.
- 64.** Solve the system $x + y = 15$ and $3x + 1y = 27$. Verify the ordered pair in both equations.

Set 17

- 65.** Find the slope through $(1, -6)$ and $(4, -12)$. Write the equation of the line.
- 66.** Write 200 in scientific notation. Then multiply it by 3×10^{-2} .
- 67.** The perimeter of a rectangle is 50 cm. Its sides are $x + 7$ and $x - 2$ cm. Find x and both side lengths.

68. Make a table for $y = -3x - 1$ using four x -values of your choice. Graph the points and explain what the slope means.

Set 18

69. Create two different linear equations whose only common solution is $(5, 6)$. Explain how your equations guarantee this.
70. Is the relation $(1, 3), (2, 5), (3, 7), (1, 5)$ a function? Explain using inputs and outputs.
71. Triangle ABC has vertices $(0, 0), (7, 0), (0, 6)$. Reflect it across the y -axis and list the new coordinates. What measurements stay unchanged?
72. A recipe uses 5 cups of broth for 3 servings. How much broth is needed for 8 servings? State the unit rate.

Set 19

73. Compare 2^5 and $2^p + 2^q$. Which is larger? Is your conclusion always true for positive p, q ?
74. A line passes through $(4, 5)$ and has a perpendicular slope to $y = 1x + 7$. Write its equation.
75. Find the slope through $(1, 5)$ and $(4, 14)$. Write the equation of the line.
76. A streaming plan costs \$8.00 plus \$1.50 per movie. Write and solve an equation for the number of movies when the bill is \$15.50.

Set 20

77. A ladder 17 ft long reaches 12 ft up a wall. How far is its foot from the wall? Draw and label a model first. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
78. A cone and cylinder have the same radius 10 cm and height 8 cm. Compare their volumes and explain the factor of $\frac{1}{3}$.
79. A graph crosses the y -axis at 5 and rises 7 units for every 2 units right. Write its equation and give three points on the graph.
80. Is the relation $(1, 0), (2, 2), (3, 4), (1, 2)$ a function? Explain using inputs and outputs.

Phase 3: Equations in context

The ideas in this phase are intentionally mixed. Look for connections to earlier sets and be ready to reuse prior results.

Set 21

- 81. For $f(x) = 3x - 1$, find $f(-2)$, solve $f(x) = 8$, and interpret each result.
- 82. Solve $3x - 2 = 25$. Check your solution by substitution.
- 83. The angles of a triangle are $(2x + 6)^\circ$, $(3x - 10)^\circ$, and $(x + 7)^\circ$. Find x and all three angles.
- 84. A bag has 7 red, 6 blue, and 2 green tiles. Two are drawn without replacement. Find the probability both are blue.

Set 22

- 85. Three consecutive integers have sum 30. Find them and write the equation you used.
- 86. Tickets cost \$8.00 for adults and \$4.00 for students. A group buys 9 tickets for \$48.00. How many of each were bought?
- 87. Compare $y = -3x + 1$ and $y = -2x - 1$. Find their intersection and interpret it as a break-even point.
- 88. The angles of a triangle are $(2x + 9)^\circ$, $(3x - 10)^\circ$, and $(x + 11)^\circ$. Find x and all three angles.

Set 23

- 89. A recipe uses 10 cups of broth for 2 servings. How much broth is needed for 7 servings? State the unit rate.
- 90. A scatter plot appears to fall from left to right. Describe the association, give a plausible context, and explain why association does not prove causation. Then change one numerical condition by a factor of 3 and analyze how the solution changes.
- 91. For $f(x) = 3x - 4$, find $f(-2)$, solve $f(x) = 5$, and interpret each result.
- 92. A square has area 144 square units. Find its exact side length and explain how square roots undo squaring. Then change one numerical condition by a factor of 2 and analyze how the solution changes.

Set 24

- 93.** Write an equation for the line parallel to $y = 1x + 3$ through $(0, 7)$. How do you know the lines never meet?
- 94.** A tank contains 150 liters and drains at 8 liters per minute. Write a function for the amount remaining and decide whether it is proportional.
- 95.** Simplify $(2^2 \cdot 2^1)/2^1$ without a calculator. State the exponent rule used.
- 96.** Tickets cost \$8.00 for adults and \$4.00 for students. A group buys 12 tickets for \$60.00. How many of each were bought?

Set 25

- 97.** Tickets cost \$7.00 for adults and \$4.00 for students. A group buys 12 tickets for \$69.00. How many of each were bought?
- 98.** Compare 2^5 and $2^p + 2^q$. Which is larger? Is your conclusion always true for positive p, q ? Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 99.** Store A sells 14 ounces for \$14.00; Store B sells 18 ounces for \$18.68. Which is the better buy? Quantify the difference per ounce.
- 100.** Find the slope through $(1, -4)$ and $(4, -13)$. Write the equation of the line.

Set 26

- 101.** A square has area 100 square units. Find its exact side length and explain how square roots undo squaring. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 102.** Describe a real situation modeled by $y = 5x + 3$. Identify a sensible domain and explain whether all real numbers belong in it.
- 103.** A scatter plot appears to fall from left to right. Describe the association, give a plausible context, and explain why association does not prove causation. Then change one numerical condition by a factor of 4 and analyze how the solution changes.
- 104.** A quantity rises from 200 to 215. Find the percent increase, then reverse the change and explain why the two percentages differ.

Set 27

- 105.** The angles of a triangle are $(2x + 7)^\circ$, $(3x - 10)^\circ$, and $(x + 11)^\circ$. Find x and all three angles.
- 106.** Compare $y = 1x + 1$ and $y = 2x - 1$. Find their intersection and interpret it as a break-even point.
- 107.** Tickets cost \$7.00 for adults and \$4.00 for students. A group buys 15 tickets for \$81.00. How many of each were bought?

108. Solve $3x + 3 = 42$. Check your solution by substitution.

Set 28

109. Design a simulation for an event with probability $\frac{4}{10}$. State how many trials you would run and how you would judge whether results are reasonable. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
110. The angles of a triangle are $(2x + 10)^\circ$, $(3x - 10)^\circ$, and $(x + 8)^\circ$. Find x and all three angles.
111. Three consecutive integers have sum 42. Find them and write the equation you used.
112. Describe a real situation modeled by $y = 5x + 0$. Identify a sensible domain and explain whether all real numbers belong in it.

Set 29

113. A graph crosses the y -axis at -1 and rises 7 units for every 2 units right. Write its equation and give three points on the graph. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
114. Solve $7(x - 4) = 63$. Then explain one step that preserves equality.
115. The angles of a triangle are $(2x + 4)^\circ$, $(3x - 10)^\circ$, and $(x + 5)^\circ$. Find x and all three angles.
116. A scatter plot appears to fall from left to right. Describe the association, give a plausible context, and explain why association does not prove causation. Then change one numerical condition by a factor of 5 and analyze how the solution changes.

Set 30

117. The perimeter of a rectangle is 50 cm. Its sides are $x + 2$ and $x - 3$ cm. Find x and both side lengths.
118. Tickets cost \$9.00 for adults and \$4.00 for students. A group buys 10 tickets for \$55.00. How many of each were bought?
119. Find the slope through $(3, 2)$ and $(6, 5)$. Write the equation of the line.
120. The angles of a triangle are $(2x + 7)^\circ$, $(3x - 10)^\circ$, and $(x + 9)^\circ$. Find x and all three angles.

Phase 4: Geometry through coordinates

The ideas in this phase are intentionally mixed. Look for connections to earlier sets and be ready to reuse prior results.

Set 31

- 121. Compare $y = -3x + 1$ and $y = -2x - 1$. Find their intersection and interpret it as a break-even point. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 122. A scatter plot appears to fall from left to right. Describe the association, give a plausible context, and explain why association does not prove causation. Then change one numerical condition by a factor of 6 and analyze how the solution changes.
- 123. Solve $6(x - 4) = 48$. Then explain one step that preserves equality.
- 124. A culture begins with 100 cells and doubles every hour. Write a function and find the population after 7 hours. Is the function linear? Explain.

Set 32

- 125. Create two different linear equations whose only common solution is $(9, 4)$. Explain how your equations guarantee this.
- 126. On a map, 7 cm represents 84 km. Two points are 7.5 cm apart. Find the actual distance and describe the proportional relationship.
- 127. A ladder 11 ft long reaches 6 ft up a wall. How far is its foot from the wall? Draw and label a model first. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 128. Graph $y = 3x - 8$ and $y = -3x + 51$. Estimate their intersection, then solve algebraically.

Set 33

- 129. Simplify $(3^4 \cdot 3^1)/3^1$ without a calculator. State the exponent rule used.
- 130. Write 500000 in scientific notation. Then multiply it by 3×10^{-2} .
- 131. Compare $y = 2x - 2$ and $y = 3x - 4$. Find their intersection and interpret it as a break-even point. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 132. Make a table for $y = -3x - 1$ using four x -values of your choice. Graph the points and explain what the slope means. Then change one numerical condition by a factor of 2 and analyze how the solution changes.

Set 34

- 133.** Triangle ABC has vertices $(0, 0)$, $(5, 0)$, $(0, 6)$. Reflect it across the y -axis and list the new coordinates. What measurements stay unchanged?
- 134.** Is the relation $(1, 7)$, $(2, 9)$, $(3, 11)$, $(1, 9)$ a function? Explain using inputs and outputs.
- 135.** For $f(x) = 3x - 2$, find $f(-2)$, solve $f(x) = 7$, and interpret each result.
- 136.** A tank contains 105 liters and drains at 5 liters per minute. Write a function for the amount remaining and decide whether it is proportional.

Set 35

- 137.** A scatter plot appears to fall from left to right. Describe the association, give a plausible context, and explain why association does not prove causation. Then change one numerical condition by a factor of 7 and analyze how the solution changes.
- 138.** A line passes through $(2, 3)$ and has a perpendicular slope to $y = 1x + 7$. Write its equation.
- 139.** Simplify $(4^4 \cdot 4^1)/4^1$ without a calculator. State the exponent rule used. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 140.** Three consecutive integers have sum 27. Find them and write the equation you used.

Set 36

- 141.** Describe a real situation modeled by $y = 5x + 1$. Identify a sensible domain and explain whether all real numbers belong in it.
- 142.** A right triangle has legs 10 cm and 4 cm. Find its hypotenuse exactly and approximately to the nearest tenth.
- 143.** A tank contains 120 liters and drains at 8 liters per minute. Write a function for the amount remaining and decide whether it is proportional.
- 144.** Is the relation $(1, 4)$, $(2, 6)$, $(3, 8)$, $(1, 6)$ a function? Explain using inputs and outputs.

Set 37

- 145.** Solve $5x + 4 = 74$. Check your solution by substitution.
- 146.** The perimeter of a rectangle is 38 cm. Its sides are $x + 7$ and $x - 4$ cm. Find x and both side lengths.
- 147.** For the data set 5, 10, 13, 11, 13, find the mean and median. Which better represents the center? Explain.
- 148.** A scatter plot appears to fall from left to right. Describe the association, give a plausible context, and explain why association does not prove causation. Then change one numerical condition by a factor of 8 and analyze how the solution changes.

Set 38

- 149.** Store A sells 8 ounces for \$4.00; Store B sells 12 ounces for \$6.45. Which is the better buy? Quantify the difference per ounce.
- 150.** Graph $y = 4x - 8$ and $y = -3x + 53$. Estimate their intersection, then solve algebraically.
- 151.** Create two different linear equations whose only common solution is $(5, 4)$. Explain how your equations guarantee this.
- 152.** A right triangle has legs 7 cm and 4 cm. Find its hypotenuse exactly and approximately to the nearest tenth.

Set 39

- 153.** Find the slope through $(1, 0)$ and $(4, 3)$. Write the equation of the line.
- 154.** Design a simulation for an event with probability $\frac{3}{10}$. State how many trials you would run and how you would judge whether results are reasonable.
- 155.** A streaming plan costs \$6.00 plus \$1.50 per movie. Write and solve an equation for the number of movies when the bill is \$10.50.
- 156.** Between which two consecutive integers does $\sqrt{28}$ lie? Defend your answer without using a decimal approximation.

Set 40

- 157.** Create two different linear equations whose only common solution is $(9, 5)$. Explain how your equations guarantee this. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 158.** A recipe uses 7 cups of broth for 8 servings. How much broth is needed for 13 servings? State the unit rate.
- 159.** A ladder 18 ft long reaches 13 ft up a wall. How far is its foot from the wall? Draw and label a model first.
- 160.** Graph $y = 4x - 8$ and $y = -3x + 41$. Estimate their intersection, then solve algebraically.

Phase 5: Exponents and magnitude

The ideas in this phase are intentionally mixed. Look for connections to earlier sets and be ready to reuse prior results.

Set 41

- 161.** The diagonal of a rectangle is 13 and one side is 3. Is a rectangle with these measurements possible? Justify using the Pythagorean Theorem.
- 162.** Compare 2^3 and $2^p + 2^q$. Which is larger? Is your conclusion always true for positive p, q ? Then change one numerical condition by a factor of 3 and analyze how the solution changes.
- 163.** Tickets cost \$9.00 for adults and \$4.00 for students. A group buys 9 tickets for \$51.00. How many of each were bought?
- 164.** Find the slope through $(3, -10)$ and $(6, -19)$. Write the equation of the line. Then change one numerical condition by a factor of 2 and analyze how the solution changes.

Set 42

- 165.** A bag has 4 red, 8 blue, and 4 green tiles. Two are drawn without replacement. Find the probability both are blue.
- 166.** Describe a real situation modeled by $y = 5x - 4$. Identify a sensible domain and explain whether all real numbers belong in it.
- 167.** Solve $4x + 0 = 60$. Check your solution by substitution.
- 168.** On a map, 4 cm represents 48 km. Two points are 3.5 cm apart. Find the actual distance and describe the proportional relationship.

Set 43

- 169.** For $f(x) = 3x + 3$, find $f(-2)$, solve $f(x) = 12$, and interpret each result. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 170.** Compare $y = 1x + 1$ and $y = 2x - 1$. Find their intersection and interpret it as a break-even point. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 171.** The diagonal of a rectangle is 19 and one side is 9. Is a rectangle with these measurements possible? Justify using the Pythagorean Theorem.
- 172.** Solve $3(x - 4) = -3$. Then explain one step that preserves equality.

Set 44

- 173.** Solve $8(x - 4) = 88$. Then explain one step that preserves equality.
- 174.** Triangle ABC has vertices $(0, 0)$, $(10, 0)$, $(0, 6)$. Reflect it across the y -axis and list the new coordinates. What measurements stay unchanged?
- 175.** Compare $y = 2x + 4$ and $y = 3x + 2$. Find their intersection and interpret it as a break-even point.
- 176.** Describe a real situation modeled by $y = 5x + 4$. Identify a sensible domain and explain whether all real numbers belong in it.

Set 45

- 177.** A quantity rises from 120 to 160. Find the percent increase, then reverse the change and explain why the two percentages differ.
- 178.** A streaming plan costs \$5.00 plus \$3.50 per movie. Write and solve an equation for the number of movies when the bill is \$15.50.
- 179.** For $f(x) = 3x + 0$, find $f(-2)$, solve $f(x) = 9$, and interpret each result.
- 180.** A scatter plot appears to fall from left to right. Describe the association, give a plausible context, and explain why association does not prove causation. Then change one numerical condition by a factor of 9 and analyze how the solution changes.

Set 46

- 181.** Write an equation for the line parallel to $y = -3x - 3$ through $(0, 1)$. How do you know the lines never meet?
- 182.** Create two different linear equations whose only common solution is $(5, 7)$. Explain how your equations guarantee this.
- 183.** Simplify $(6^2 \cdot 6^1)/6^1$ without a calculator. State the exponent rule used.
- 184.** Triangle ABC has vertices $(0, 0)$, $(7, 0)$, $(0, 6)$. Reflect it across the y -axis and list the new coordinates. What measurements stay unchanged? Then change one numerical condition by a factor of 2 and analyze how the solution changes.

Set 47

- 185.** Tickets cost \$7.00 for adults and \$4.00 for students. A group buys 7 tickets for \$37.00. How many of each were bought?
- 186.** Design a simulation for an event with probability $\frac{4}{10}$. State how many trials you would run and how you would judge whether results are reasonable. Then change one numerical condition by a factor of 3 and analyze how the solution changes.

- 187.** A recipe uses 6 cups of broth for 4 servings. How much broth is needed for 9 servings? State the unit rate.
- 188.** Simplify $(4^2 \cdot 4^1)/4^1$ without a calculator. State the exponent rule used.

Set 48

- 189.** A square has area 64 square units. Find its exact side length and explain how square roots undo squaring.
- 190.** A quantity rises from 80 to 120. Find the percent increase, then reverse the change and explain why the two percentages differ.
- 191.** A bag has 4 red, 6 blue, and 4 green tiles. Two are drawn without replacement. Find the probability both are blue. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 192.** Create two different linear equations whose only common solution is $(5, 3)$. Explain how your equations guarantee this.

Set 49

- 193.** The diagonal of a rectangle is 20 and one side is 10. Is a rectangle with these measurements possible? Justify using the Pythagorean Theorem. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 194.** A square has area 16 square units. Find its exact side length and explain how square roots undo squaring.
- 195.** Tickets cost \$7.00 for adults and \$4.00 for students. A group buys 10 tickets for \$49.00. How many of each were bought?
- 196.** Write an equation for the line parallel to $y = 1x - 3$ through $(0, 1)$. How do you know the lines never meet?

Set 50

- 197.** A scatter plot appears to fall from left to right. Describe the association, give a plausible context, and explain why association does not prove causation. Then change one numerical condition by a factor of 10 and analyze how the solution changes.
- 198.** For $f(x) = 3x - 4$, find $f(-2)$, solve $f(x) = 5$, and interpret each result. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 199.** Solve $8(x - 4) = 16$. Then explain one step that preserves equality.
- 200.** A recipe uses 4 cups of broth for 4 servings. How much broth is needed for 9 servings? State the unit rate.

Phase 6: Functions and representations

The ideas in this phase are intentionally mixed. Look for connections to earlier sets and be ready to reuse prior results.

Set 51

- 201.** A streaming plan costs \$5.00 plus \$2.00 per movie. Write and solve an equation for the number of movies when the bill is \$11.00.
- 202.** A line passes through $(4, 5)$ and has a perpendicular slope to $y = 1x + 7$. Write its equation. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 203.** Design a simulation for an event with probability $\frac{2}{10}$. State how many trials you would run and how you would judge whether results are reasonable. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 204.** The perimeter of a rectangle is 56 cm. Its sides are $x + 3$ and $x + 3$ cm. Find x and both side lengths.

Set 52

- 205.** On a map, 8 cm represents 96 km. Two points are 7.5 cm apart. Find the actual distance and describe the proportional relationship.
- 206.** A cylinder has radius 5 cm and height 8 cm. Find its volume in terms of π , then approximate using 3.14.
- 207.** Create two different linear equations whose only common solution is $(9, 9)$. Explain how your equations guarantee this. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 208.** Is the relation $(1, -3), (2, -1), (3, 1), (1, -1)$ a function? Explain using inputs and outputs.

Set 53

- 209.** Compare $y = 2x + 4$ and $y = 3x + 2$. Find their intersection and interpret it as a break-even point. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 210.** Solve $7x - 4 = 73$. Check your solution by substitution.
- 211.** The perimeter of a rectangle is 18 cm. Its sides are $x + 2$ and $x - 3$ cm. Find x and both side lengths.
- 212.** A scatter plot appears to fall from left to right. Describe the association, give a plausible context, and explain why association does not prove causation. Then change one numerical condition by a factor of 11 and analyze how the solution changes.

Set 54

- 213.** Create two different linear equations whose only common solution is $(5, 3)$. Explain how your equations guarantee this. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 214.** Solve the system $x + y = 9$ and $4x + 1y = 15$. Verify the ordered pair in both equations.
- 215.** Triangle ABC has vertices $(0, 0)$, $(6, 0)$, $(0, 6)$. Reflect it across the y -axis and list the new coordinates. What measurements stay unchanged?
- 216.** A cylinder has radius 3.5 cm and height 8 cm. Find its volume in terms of π , then approximate using 3.14.

Set 55

- 217.** Simplify $(2^4 \cdot 2^1)/2^1$ without a calculator. State the exponent rule used.
- 218.** Design a simulation for an event with probability $\frac{5}{10}$. State how many trials you would run and how you would judge whether results are reasonable.
- 219.** Compare $y = -2x + 1$ and $y = -1x - 1$. Find their intersection and interpret it as a break-even point.
- 220.** Between which two consecutive integers does $\sqrt{12}$ lie? Defend your answer without using a decimal approximation.

Set 56

- 221.** A ladder 16 ft long reaches 11 ft up a wall. How far is its foot from the wall? Draw and label a model first.
- 222.** A tank contains 135 liters and drains at 3 liters per minute. Write a function for the amount remaining and decide whether it is proportional.
- 223.** For $f(x) = 3x + 2$, find $f(-2)$, solve $f(x) = 11$, and interpret each result.
- 224.** Solve the system $x + y = 5$ and $4x + 1y = 11$. Verify the ordered pair in both equations.

Set 57

- 225.** A bag has 5 red, 6 blue, and 2 green tiles. Two are drawn without replacement. Find the probability both are blue.
- 226.** A culture begins with 300 cells and doubles every hour. Write a function and find the population after 5 hours. Is the function linear? Explain.
- 227.** Simplify $(3^4 \cdot 3^1)/3^1$ without a calculator. State the exponent rule used. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 228.** A line has slope 1 and passes through $(4, 1)$. Find its y -intercept and write an equation.

Set 58

- 229.** Describe a real situation modeled by $y = 5x + 5$. Identify a sensible domain and explain whether all real numbers belong in it.
- 230.** A sequence begins -2, 4, 10, 16. Write a recursive rule and an explicit rule for term n .
- 231.** On a map, 4 cm represents 48 km. Two points are 7.5 cm apart. Find the actual distance and describe the proportional relationship.
- 232.** A quantity rises from 180 to 200. Find the percent increase, then reverse the change and explain why the two percentages differ.

Set 59

- 233.** Three consecutive integers have sum 24. Find them and write the equation you used.
- 234.** Make a table for $y = -2x - 1$ using four x -values of your choice. Graph the points and explain what the slope means.
- 235.** A sample of 68 students includes 25 who prefer option A. Estimate how many of 680 students would prefer A, and state one source of sampling bias.
- 236.** Solve $7x + 1 = 106$. Check your solution by substitution.

Set 60

- 237.** A recipe uses 8 cups of broth for 8 servings. How much broth is needed for 13 servings? State the unit rate.
- 238.** A cylinder has radius 4 cm and height 8 cm. Find its volume in terms of π , then approximate using 3.14.
- 239.** Create two different linear equations whose only common solution is $(9, 3)$. Explain how your equations guarantee this.
- 240.** A sequence begins -5, 1, 7, 13. Write a recursive rule and an explicit rule for term n .

Phase 7: Transformations and similarity

The ideas in this phase are intentionally mixed. Look for connections to earlier sets and be ready to reuse prior results.

Set 61

- 241.** Tickets cost \$9.00 for adults and \$4.00 for students. A group buys 16 tickets for \$99.00. How many of each were bought?
- 242.** Three consecutive integers have sum 21. Find them and write the equation you used. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 243.** Store A sells 14 ounces for \$7.00; Store B sells 18 ounces for \$9.67. Which is the better buy? Quantify the difference per ounce.
- 244.** A scatter plot appears to fall from left to right. Describe the association, give a plausible context, and explain why association does not prove causation. Then change one numerical condition by a factor of 12 and analyze how the solution changes.

Set 62

- 245.** Compare 2^3 and $2^p + 2^q$. Which is larger? Is your conclusion always true for positive p, q ? Then change one numerical condition by a factor of 4 and analyze how the solution changes.
- 246.** Tickets cost \$9.00 for adults and \$4.00 for students. A group buys 14 tickets for \$91.00. How many of each were bought?
- 247.** A fair number cube is rolled twice. Find the probability that the sum is 9. Organize the sample space so no outcomes are missed. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 248.** The diagonal of a rectangle is 17 and one side is 7. Is a rectangle with these measurements possible? Justify using the Pythagorean Theorem.

Set 63

- 249.** The angles of a triangle are $(2x + 6)^\circ$, $(3x - 10)^\circ$, and $(x + 10)^\circ$. Find x and all three angles.
- 250.** Design a simulation for an event with probability $\frac{2}{10}$. State how many trials you would run and how you would judge whether results are reasonable. Then change one numerical condition by a factor of 3 and analyze how the solution changes.
- 251.** Tickets cost \$9.00 for adults and \$4.00 for students. A group buys 12 tickets for \$83.00. How many of each were bought?
- 252.** Simplify $(2^4 \cdot 2^1)/2^1$ without a calculator. State the exponent rule used. Then change one numerical condition by a factor of 2 and analyze how the solution changes.

Set 64

- 253.** Create a set of six integers with mean 13, median 10, and no mode. Show that it meets all three conditions.
- 254.** On a map, 6 cm represents 72 km. Two points are 8.5 cm apart. Find the actual distance and describe the proportional relationship.
- 255.** Three consecutive integers have sum 27. Find them and write the equation you used. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 256.** Tickets cost \$9.00 for adults and \$4.00 for students. A group buys 10 tickets for \$75.00. How many of each were bought?

Set 65

- 257.** For $f(x) = 3x - 4$, find $f(-2)$, solve $f(x) = 5$, and interpret each result. Then change one numerical condition by a factor of 3 and analyze how the solution changes.
- 258.** A square has area 400 square units. Find its exact side length and explain how square roots undo squaring.
- 259.** The angles of a triangle are $(2x + 3)^\circ$, $(3x - 10)^\circ$, and $(x + 11)^\circ$. Find x and all three angles.
- 260.** Write an equation for the line parallel to $y = 1x - 3$ through $(0, 1)$. How do you know the lines never meet? Then change one numerical condition by a factor of 2 and analyze how the solution changes.

Set 66

- 261.** The perimeter of a rectangle is 32 cm. Its sides are $x + 4$ and $x - 4$ cm. Find x and both side lengths.
- 262.** For $f(x) = 3x + 0$, find $f(-2)$, solve $f(x) = 9$, and interpret each result. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 263.** Compare $y = 3x - 2$ and $y = 4x - 4$. Find their intersection and interpret it as a break-even point.
- 264.** A tank contains 90 liters and drains at 6 liters per minute. Write a function for the amount remaining and decide whether it is proportional.

Set 67

- 265.** A tank contains 150 liters and drains at 8 liters per minute. Write a function for the amount remaining and decide whether it is proportional. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 266.** Find the slope through $(1, -3)$ and $(4, -9)$. Write the equation of the line.
- 267.** For $f(x) = 3x + 4$, find $f(-2)$, solve $f(x) = 13$, and interpret each result.
- 268.** Three consecutive integers have sum 33. Find them and write the equation you used.

Set 68

- 269.** Write an equation for the line parallel to $y = 2x + 0$ through $(0, 4)$. How do you know the lines never meet?
- 270.** The diagonal of a rectangle is 18 and one side is 8. Is a rectangle with these measurements possible? Justify using the Pythagorean Theorem.
- 271.** Simplify $(5^2 \cdot 5^1)/5^1$ without a calculator. State the exponent rule used. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 272.** For $f(x) = 3x - 3$, find $f(-2)$, solve $f(x) = 6$, and interpret each result.

Set 69

- 273.** Tickets cost \$7.00 for adults and \$4.00 for students. A group buys 10 tickets for \$61.00. How many of each were bought?
- 274.** The perimeter of a rectangle is 54 cm. Its sides are $x + 4$ and $x + 3$ cm. Find x and both side lengths.
- 275.** A quantity rises from 200 to 215. Find the percent increase, then reverse the change and explain why the two percentages differ. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 276.** Design a simulation for an event with probability $\frac{2}{10}$. State how many trials you would run and how you would judge whether results are reasonable. Then change one numerical condition by a factor of 4 and analyze how the solution changes.

Set 70

- 277.** A square has area 36 square units. Find its exact side length and explain how square roots undo squaring.
- 278.** Tickets cost \$7.00 for adults and \$4.00 for students. A group buys 15 tickets for \$81.00. How many of each were bought? Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 279.** Create a set of six integers with mean 9, median 10, and no mode. Show that it meets all three conditions.
- 280.** The diagonal of a rectangle is 15 and one side is 5. Is a rectangle with these measurements possible? Justify using the Pythagorean Theorem.

Phase 8: Systems and comparisons

The ideas in this phase are intentionally mixed. Look for connections to earlier sets and be ready to reuse prior results.

Set 71

- 281.** A fair number cube is rolled twice. Find the probability that the sum is 9. Organize the sample space so no outcomes are missed. Then change one numerical condition by a factor of 3 and analyze how the solution changes.
- 282.** Design a simulation for an event with probability $\frac{3}{10}$. State how many trials you would run and how you would judge whether results are reasonable. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 283.** A square has area 256 square units. Find its exact side length and explain how square roots undo squaring.
- 284.** Between which two consecutive integers does $\sqrt{39}$ lie? Defend your answer without using a decimal approximation.

Set 72

- 285.** A graph crosses the y -axis at -2 and rises 7 units for every 2 units right. Write its equation and give three points on the graph.
- 286.** Store A sells 7 ounces for \$2.62; Store B sells 11 ounces for \$4.54. Which is the better buy? Quantify the difference per ounce.
- 287.** A tank contains 120 liters and drains at 4 liters per minute. Write a function for the amount remaining and decide whether it is proportional. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 288.** Graph $y = 4x - 4$ and $y = -3x + 25$. Estimate their intersection, then solve algebraically.

Set 73

- 289.** Solve $7x + 3 = 66$. Check your solution by substitution.
- 290.** A culture begins with 200 cells and doubles every hour. Write a function and find the population after 7 hours. Is the function linear? Explain.
- 291.** A scatter plot appears to fall from left to right. Describe the association, give a plausible context, and explain why association does not prove causation. Then change one numerical condition by a factor of 13 and analyze how the solution changes.
- 292.** A line has slope 1 and passes through $(2, -1)$. Find its y -intercept and write an equation.

Set 74

- 293.** Store A sells 8 ounces for \$6.00; Store B sells 12 ounces for \$9.45. Which is the better buy? Quantify the difference per ounce.
- 294.** A sequence begins 2, 8, 14, 20. Write a recursive rule and an explicit rule for term n .
- 295.** Create two different linear equations whose only common solution is $(5, 8)$. Explain how your equations guarantee this.
- 296.** On a map, 3 cm represents 36 km. Two points are 4.5 cm apart. Find the actual distance and describe the proportional relationship.

Set 75

- 297.** Compare $y = 3x - 2$ and $y = 4x - 4$. Find their intersection and interpret it as a break-even point. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 298.** Make a table for $y = -2x - 1$ using four x -values of your choice. Graph the points and explain what the slope means. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 299.** A streaming plan costs \$5.00 plus \$2.50 per movie. Write and solve an equation for the number of movies when the bill is \$32.50.
- 300.** Solve $7(x - 4) = 7$. Then explain one step that preserves equality.

Set 76

- 301.** Create two different linear equations whose only common solution is $(9, 9)$. Explain how your equations guarantee this. Then change one numerical condition by a factor of 3 and analyze how the solution changes.
- 302.** A dilation centered at the origin sends $(8, 4)$ to $(16, 8)$. Find the scale factor and the image of $(-6, 8)$.
- 303.** A ladder 17 ft long reaches 12 ft up a wall. How far is its foot from the wall? Draw and label a model first. Then change one numerical condition by a factor of 3 and analyze how the solution changes.
- 304.** A sequence begins -1, 5, 11, 17. Write a recursive rule and an explicit rule for term n .

Set 77

- 305.** Simplify $(6^4 \cdot 6^1)/6^1$ without a calculator. State the exponent rule used.
- 306.** A streaming plan costs \$8.00 plus \$2.00 per movie. Write and solve an equation for the number of movies when the bill is \$18.00.
- 307.** Compare $y = 1x + 4$ and $y = 2x + 2$. Find their intersection and interpret it as a break-even point.
- 308.** Design a simulation for an event with probability $\frac{3}{10}$. State how many trials you would run and how you would judge whether results are reasonable. Then change one numerical condition by a factor of 3 and analyze how the solution changes.

Set 78

- 309.** Triangle ABC has vertices $(0, 0)$, $(11, 0)$, $(0, 6)$. Reflect it across the y -axis and list the new coordinates. What measurements stay unchanged?
- 310.** Graph $y = 2x - 4$ and $y = -3x + 32$. Estimate their intersection, then solve algebraically.
- 311.** For $f(x) = 3x - 5$, find $f(-2)$, solve $f(x) = 4$, and interpret each result.
- 312.** A dilation centered at the origin sends $(5, 4)$ to $(10, 8)$. Find the scale factor and the image of $(-7, 5)$.

Set 79

- 313.** Create a set of six integers with mean 9, median 10, and no mode. Show that it meets all three conditions. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 314.** A sample of 63 students includes 20 who prefer option A. Estimate how many of 630 students would prefer A, and state one source of sampling bias.
- 315.** Simplify $(2^4 \cdot 2^1)/2^1$ without a calculator. State the exponent rule used. Then change one numerical condition by a factor of 3 and analyze how the solution changes.
- 316.** Write 40000 in scientific notation. Then multiply it by 3×10^{-2} .

Set 80

- 317.** Describe a real situation modeled by $y = 5x - 2$. Identify a sensible domain and explain whether all real numbers belong in it.
- 318.** A quantity rises from 60 to 70. Find the percent increase, then reverse the change and explain why the two percentages differ.
- 319.** Store A sells 12 ounces for \$12.00; Store B sells 16 ounces for \$16.60. Which is the better buy? Quantify the difference per ounce. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 320.** Graph $y = 2x - 4$ and $y = -3x + 20$. Estimate their intersection, then solve algebraically.

Phase 9: Statistics and probability

The ideas in this phase are intentionally mixed. Look for connections to earlier sets and be ready to reuse prior results.

Set 81

- 321.** A quantity rises from 120 to 145. Find the percent increase, then reverse the change and explain why the two percentages differ.
- 322.** A square has area 36 square units. Find its exact side length and explain how square roots undo squaring. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 323.** Describe a real situation modeled by $y = 5x - 3$. Identify a sensible domain and explain whether all real numbers belong in it. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 324.** Write an equation for the line parallel to $y = 1x - 3$ through $(0, 1)$. How do you know the lines never meet? Then change one numerical condition by a factor of 3 and analyze how the solution changes.

Set 82

- 325.** Find the slope through $(3, -7)$ and $(6, -10)$. Write the equation of the line.
- 326.** For $f(x) = 3x + 4$, find $f(-2)$, solve $f(x) = 13$, and interpret each result. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 327.** A square has area 144 square units. Find its exact side length and explain how square roots undo squaring. Then change one numerical condition by a factor of 3 and analyze how the solution changes.
- 328.** Store A sells 12 ounces for \$9.00; Store B sells 16 ounces for \$12.60. Which is the better buy? Quantify the difference per ounce.

Set 83

- 329.** Tickets cost \$9.00 for adults and \$4.00 for students. A group buys 11 tickets for \$59.00. How many of each were bought?
- 330.** Find the slope through $(3, -7)$ and $(6, -13)$. Write the equation of the line.
- 331.** A recipe uses 6 cups of broth for 8 servings. How much broth is needed for 13 servings? State the unit rate.
- 332.** The perimeter of a rectangle is 68 cm. Its sides are $x + 7$ and $x + 1$ cm. Find x and both side lengths.

Set 84

- 333.** Compare 2^3 and $2^p + 2^q$. Which is larger? Is your conclusion always true for positive p, q ? Then change one numerical condition by a factor of 5 and analyze how the solution changes.
- 334.** A ladder 16 ft long reaches 11 ft up a wall. How far is its foot from the wall? Draw and label a model first. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 335.** For the data set 7, 9, 9, 11, 19, find the mean and median. Which better represents the center? Explain.
- 336.** For $f(x) = 3x + 1$, find $f(-2)$, solve $f(x) = 10$, and interpret each result.

Set 85

- 337.** The diagonal of a rectangle is 19 and one side is 9. Is a rectangle with these measurements possible? Justify using the Pythagorean Theorem. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 338.** Solve $4x + 3 = 55$. Check your solution by substitution.
- 339.** Tickets cost \$9.00 for adults and \$4.00 for students. A group buys 7 tickets for \$43.00. How many of each were bought?
- 340.** Design a simulation for an event with probability $\frac{4}{10}$. State how many trials you would run and how you would judge whether results are reasonable. Then change one numerical condition by a factor of 4 and analyze how the solution changes.

Set 86

- 341.** A fair number cube is rolled twice. Find the probability that the sum is 9. Organize the sample space so no outcomes are missed. Then change one numerical condition by a factor of 4 and analyze how the solution changes.
- 342.** Create two different linear equations whose only common solution is $(9, 8)$. Explain how your equations guarantee this.
- 343.** Solve $3(x - 4) = 30$. Then explain one step that preserves equality.
- 344.** A ladder 13 ft long reaches 8 ft up a wall. How far is its foot from the wall? Draw and label a model first.

Set 87

- 345.** For $f(x) = 3x + 0$, find $f(-2)$, solve $f(x) = 9$, and interpret each result. Then change one numerical condition by a factor of 3 and analyze how the solution changes.
- 346.** A sample of 42 students includes 14 who prefer option A. Estimate how many of 420 students would prefer A, and state one source of sampling bias.
- 347.** The diagonal of a rectangle is 16 and one side is 6. Is a rectangle with these measurements possible? Justify using the Pythagorean Theorem.

- 348.** Compare 2^3 and $2^p + 2^q$. Which is larger? Is your conclusion always true for positive p, q ? Then change one numerical condition by a factor of 6 and analyze how the solution changes.

Set 88

- 349.** A streaming plan costs \$8.00 plus \$3.50 per movie. Write and solve an equation for the number of movies when the bill is \$57.00.
- 350.** A tank contains 120 liters and drains at 4 liters per minute. Write a function for the amount remaining and decide whether it is proportional. Then change one numerical condition by a factor of 3 and analyze how the solution changes.
- 351.** Compare $y = -1x + 1$ and $y = 0x - 1$. Find their intersection and interpret it as a break-even point.
- 352.** Create two different linear equations whose only common solution is $(9, 4)$. Explain how your equations guarantee this. Then change one numerical condition by a factor of 2 and analyze how the solution changes.

Set 89

- 353.** On a map, 6 cm represents 72 km. Two points are 6.5 cm apart. Find the actual distance and describe the proportional relationship. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 354.** Simplify $(6^2 \cdot 6^1)/6^1$ without a calculator. State the exponent rule used. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 355.** For $f(x) = 3x - 3$, find $f(-2)$, solve $f(x) = 6$, and interpret each result. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 356.** Compare $y = -2x + 4$ and $y = -1x + 2$. Find their intersection and interpret it as a break-even point.

Set 90

- 357.** Write an equation for the line parallel to $y = 3x + 3$ through $(0, 7)$. How do you know the lines never meet?
- 358.** A graph crosses the y -axis at 4 and rises 7 units for every 2 units right. Write its equation and give three points on the graph.
- 359.** Simplify $(4^2 \cdot 4^1)/4^1$ without a calculator. State the exponent rule used. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 360.** A quantity rises from 160 to 185. Find the percent increase, then reverse the change and explain why the two percentages differ.

Phase 10: Connecting algebra and geometry

The ideas in this phase are intentionally mixed. Look for connections to earlier sets and be ready to reuse prior results.

Set 91

- 361.** A square has area 64 square units. Find its exact side length and explain how square roots undo squaring. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 362.** Make a table for $y = -2x - 1$ using four x -values of your choice. Graph the points and explain what the slope means. Then change one numerical condition by a factor of 3 and analyze how the solution changes.
- 363.** Write an equation for the line parallel to $y = 2x + 0$ through $(0, 4)$. How do you know the lines never meet? Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 364.** A streaming plan costs \$6.00 plus \$3.50 per movie. Write and solve an equation for the number of movies when the bill is \$34.00.

Set 92

- 365.** A ladder 15 ft long reaches 10 ft up a wall. How far is its foot from the wall? Draw and label a model first.
- 366.** A cone and cylinder have the same radius 8 cm and height 8 cm. Compare their volumes and explain the factor of $\frac{1}{3}$.
- 367.** Describe a real situation modeled by $y = 5x - 1$. Identify a sensible domain and explain whether all real numbers belong in it. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 368.** A sequence begins 3, 9, 15, 21. Write a recursive rule and an explicit rule for term n .

Set 93

- 369.** For the data set 5, 11, 9, 11, 17, find the mean and median. Which better represents the center? Explain.
- 370.** Three consecutive integers have sum 27. Find them and write the equation you used. Then change one numerical condition by a factor of 3 and analyze how the solution changes.
- 371.** A square has area 144 square units. Find its exact side length and explain how square roots undo squaring. Then change one numerical condition by a factor of 4 and analyze how the solution changes.
- 372.** Design a simulation for an event with probability $\frac{5}{10}$. State how many trials you would run and how you would judge whether results are reasonable. Then change one numerical condition by a factor of 2 and analyze how the solution changes.

Set 94

- 373.** A graph crosses the y -axis at 2 and rises 7 units for every 2 units right. Write its equation and give three points on the graph.
- 374.** Solve the system $x + y = 14$ and $2x + 1y = 20$. Verify the ordered pair in both equations.
- 375.** On a map, 4 cm represents 48 km. Two points are 4.5 cm apart. Find the actual distance and describe the proportional relationship.
- 376.** A cone and cylinder have the same radius 5 cm and height 8 cm. Compare their volumes and explain the factor of $\frac{1}{3}$.

Set 95

- 377.** Three consecutive integers have sum 48. Find them and write the equation you used.
- 378.** A sample of 51 students includes 23 who prefer option A. Estimate how many of 510 students would prefer A, and state one source of sampling bias.
- 379.** A bag has 6 red, 4 blue, and 2 green tiles. Two are drawn without replacement. Find the probability both are blue.
- 380.** Write 200 in scientific notation. Then multiply it by 3×10^{-2} . Then change one numerical condition by a factor of 2 and analyze how the solution changes.

Set 96

- 381.** A recipe uses 8 cups of broth for 5 servings. How much broth is needed for 10 servings? State the unit rate.
- 382.** On a map, 5 cm represents 60 km. Two points are 2.5 cm apart. Find the actual distance and describe the proportional relationship.
- 383.** Create two different linear equations whose only common solution is $(9, 7)$. Explain how your equations guarantee this.
- 384.** Solve the system $x + y = 10$ and $2x + 1y = 16$. Verify the ordered pair in both equations.

Set 97

- 385.** Compare $y = -1x + 1$ and $y = 0x - 1$. Find their intersection and interpret it as a break-even point. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 386.** Between which two consecutive integers does $\sqrt{28}$ lie? Defend your answer without using a decimal approximation. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 387.** Solve $8x + 3 = 35$. Check your solution by substitution.

- 388.** A line passes through $(4, -4)$ and has a perpendicular slope to $y = -2x + 7$. Write its equation.

Set 98

- 389.** Create two different linear equations whose only common solution is $(5, 8)$. Explain how your equations guarantee this. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 390.** Function A starts at -5 and increases by 4 per step. Function B is $y = 3x - 1$. Which is larger when $x = 10$, and when do they agree?
- 391.** Triangle ABC has vertices $(0, 0)$, $(3, 0)$, $(0, 6)$. Reflect it across the y -axis and list the new coordinates. What measurements stay unchanged?
- 392.** A tank contains 75 liters and drains at 7 liters per minute. Write a function for the amount remaining and decide whether it is proportional.

Set 99

- 393.** Simplify $(5^4 \cdot 5^1)/5^1$ without a calculator. State the exponent rule used. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 394.** A line has slope 2 and passes through $(4, 5)$. Find its y -intercept and write an equation.
- 395.** Compare $y = -3x - 2$ and $y = -2x - 4$. Find their intersection and interpret it as a break-even point.
- 396.** Three consecutive integers have sum 39. Find them and write the equation you used.

Set 100

- 397.** A ladder 13 ft long reaches 8 ft up a wall. How far is its foot from the wall? Draw and label a model first. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 398.** A cone and cylinder have the same radius 6 cm and height 8 cm. Compare their volumes and explain the factor of $\frac{1}{3}$.
- 399.** For $f(x) = 3x - 1$, find $f(-2)$, solve $f(x) = 8$, and interpret each result. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 400.** Function A starts at 3 and increases by 4 per step. Function B is $y = 3x + 7$. Which is larger when $x = 10$, and when do they agree?

Phase 11: Modeling and critique

The ideas in this phase are intentionally mixed. Look for connections to earlier sets and be ready to reuse prior results.

Set 101

- 401.** Describe a real situation modeled by $y = 5x + 4$. Identify a sensible domain and explain whether all real numbers belong in it. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 402.** Solve $4(x - 4) = -4$. Then explain one step that preserves equality.
- 403.** The angles of a triangle are $(2x + 11)^\circ$, $(3x - 10)^\circ$, and $(x + 10)^\circ$. Find x and all three angles.
- 404.** Design a simulation for an event with probability $\frac{2}{10}$. State how many trials you would run and how you would judge whether results are reasonable. Then change one numerical condition by a factor of 5 and analyze how the solution changes.

Set 102

- 405.** The perimeter of a rectangle is 32 cm. Its sides are $x + 6$ and $x + 4$ cm. Find x and both side lengths.
- 406.** Tickets cost \$7.00 for adults and \$4.00 for students. A group buys 11 tickets for \$53.00. How many of each were bought?
- 407.** Write an equation for the line parallel to $y = -2x - 3$ through $(0, 1)$. How do you know the lines never meet?
- 408.** The angles of a triangle are $(2x + 5)^\circ$, $(3x - 10)^\circ$, and $(x + 7)^\circ$. Find x and all three angles.

Set 103

- 409.** A tank contains 150 liters and drains at 4 liters per minute. Write a function for the amount remaining and decide whether it is proportional.
- 410.** A sample of 60 students includes 17 who prefer option A. Estimate how many of 600 students would prefer A, and state one source of sampling bias.
- 411.** Describe a real situation modeled by $y = 5x + 1$. Identify a sensible domain and explain whether all real numbers belong in it. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 412.** Compare 2^5 and $2^p + 2^q$. Which is larger? Is your conclusion always true for positive p, q ? Then change one numerical condition by a factor of 3 and analyze how the solution changes.

Set 104

- 413.** Find the slope through $(3, 5)$ and $(6, 11)$. Write the equation of the line.
- 414.** Store A sells 14 ounces for \$7.00; Store B sells 18 ounces for \$9.67. Which is the better buy? Quantify the difference per ounce. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 415.** A square has area 100 square units. Find its exact side length and explain how square roots undo squaring. Then change one numerical condition by a factor of 3 and analyze how the solution changes.
- 416.** Tickets cost \$7.00 for adults and \$4.00 for students. A group buys 7 tickets for \$37.00. How many of each were bought? Then change one numerical condition by a factor of 2 and analyze how the solution changes.

Set 105

- 417.** Tickets cost \$9.00 for adults and \$4.00 for students. A group buys 14 tickets for \$91.00. How many of each were bought? Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 418.** Simplify $(4^4 \cdot 4^1)/4^1$ without a calculator. State the exponent rule used. Then change one numerical condition by a factor of 3 and analyze how the solution changes.
- 419.** A quantity rises from 200 to 235. Find the percent increase, then reverse the change and explain why the two percentages differ.
- 420.** Compare $y = -2x + 4$ and $y = -1x + 2$. Find their intersection and interpret it as a break-even point. Then change one numerical condition by a factor of 2 and analyze how the solution changes.

Set 106

- 421.** Compare 2^3 and $2^p + 2^q$. Which is larger? Is your conclusion always true for positive p, q ? Then change one numerical condition by a factor of 7 and analyze how the solution changes.
- 422.** A graph crosses the y -axis at -3 and rises 7 units for every 2 units right. Write its equation and give three points on the graph.
- 423.** A sample of 40 students includes 12 who prefer option A. Estimate how many of 400 students would prefer A, and state one source of sampling bias.
- 424.** On a map, 10 cm represents 120 km. Two points are 5.5 cm apart. Find the actual distance and describe the proportional relationship.

Set 107

- 425.** The angles of a triangle are $(2x + 3)^\circ$, $(3x - 10)^\circ$, and $(x + 7)^\circ$. Find x and all three angles.
- 426.** Write an equation for the line parallel to $y = 2x - 3$ through $(0, 1)$. How do you know the lines never meet?
- 427.** Tickets cost \$9.00 for adults and \$4.00 for students. A group buys 10 tickets for \$75.00. How many of each were bought? Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 428.** Solve $4(x - 4) = 12$. Then explain one step that preserves equality.

Set 108

- 429.** For the data set 7, 8, 11, 11, 19, find the mean and median. Which better represents the center? Explain.
- 430.** The angles of a triangle are $(2x + 6)^\circ$, $(3x - 10)^\circ$, and $(x + 11)^\circ$. Find x and all three angles.
- 431.** The perimeter of a rectangle is 40 cm. Its sides are $x + 6$ and $x + 0$ cm. Find x and both side lengths.
- 432.** A graph crosses the y -axis at 5 and rises 7 units for every 2 units right. Write its equation and give three points on the graph. Then change one numerical condition by a factor of 2 and analyze how the solution changes.

Set 109

- 433.** For $f(x) = 3x + 4$, find $f(-2)$, solve $f(x) = 13$, and interpret each result. Then change one numerical condition by a factor of 3 and analyze how the solution changes.
- 434.** A streaming plan costs \$6.00 plus \$4.00 per movie. Write and solve an equation for the number of movies when the bill is \$34.00.
- 435.** The angles of a triangle are $(2x + 9)^\circ$, $(3x - 10)^\circ$, and $(x + 8)^\circ$. Find x and all three angles.
- 436.** A sample of 50 students includes 22 who prefer option A. Estimate how many of 500 students would prefer A, and state one source of sampling bias.

Set 110

- 437.** Solve $3x + 2 = 23$. Check your solution by substitution.
- 438.** Tickets cost \$8.00 for adults and \$4.00 for students. A group buys 12 tickets for \$60.00. How many of each were bought? Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 439.** Compare $y = 2x + 4$ and $y = 3x + 2$. Find their intersection and interpret it as a break-even point. Then change one numerical condition by a factor of 3 and analyze how the solution changes.
- 440.** The angles of a triangle are $(2x + 3)^\circ$, $(3x - 10)^\circ$, and $(x + 5)^\circ$. Find x and all three angles.

Phase 12: Multi-step investigations

The ideas in this phase are intentionally mixed. Look for connections to earlier sets and be ready to reuse prior results.

Set 111

- 441. Write an equation for the line parallel to $y = -2x - 3$ through $(0, 1)$. How do you know the lines never meet? Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 442. A sample of 69 students includes 26 who prefer option A. Estimate how many of 690 students would prefer A, and state one source of sampling bias.
- 443. A streaming plan costs \$8.00 plus \$3.50 per movie. Write and solve an equation for the number of movies when the bill is \$29.00.
- 444. Write 500000 in scientific notation. Then multiply it by 3×10^{-2} . Then change one numerical condition by a factor of 2 and analyze how the solution changes.

Set 112

- 445. Create two different linear equations whose only common solution is $(9, 6)$. Explain how your equations guarantee this. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 446. A recipe uses 7 cups of broth for 2 servings. How much broth is needed for 7 servings? State the unit rate.
- 447. A ladder 16 ft long reaches 11 ft up a wall. How far is its foot from the wall? Draw and label a model first. Then change one numerical condition by a factor of 3 and analyze how the solution changes.
- 448. Graph $y = 2x - 8$ and $y = -3x + 28$. Estimate their intersection, then solve algebraically.

Set 113

- 449. A square has area 576 square units. Find its exact side length and explain how square roots undo squaring.
- 450. Between which two consecutive integers does $\sqrt{12}$ lie? Defend your answer without using a decimal approximation. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 451. Write an equation for the line parallel to $y = 3x + 3$ through $(0, 7)$. How do you know the lines never meet? Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 452. A line passes through $(2, 0)$ and has a perpendicular slope to $y = -2x + 7$. Write its equation.

Set 114

- 453.** Triangle ABC has vertices $(0, 0)$, $(10, 0)$, $(0, 6)$. Reflect it across the y -axis and list the new coordinates. What measurements stay unchanged? Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 454.** Function A starts at -1 and increases by 4 per step. Function B is $y = 3x + 3$. Which is larger when $x = 10$, and when do they agree?
- 455.** Describe a real situation modeled by $y = 5x + 3$. Identify a sensible domain and explain whether all real numbers belong in it. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 456.** Store A sells 11 ounces for \$9.62; Store B sells 15 ounces for \$13.69. Which is the better buy? Quantify the difference per ounce.

Set 115

- 457.** A sample of 46 students includes 18 who prefer option A. Estimate how many of 460 students would prefer A, and state one source of sampling bias. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 458.** A line has slope 2 and passes through $(2, 1)$. Find its y -intercept and write an equation.
- 459.** A square has area 64 square units. Find its exact side length and explain how square roots undo squaring. Then change one numerical condition by a factor of 3 and analyze how the solution changes.
- 460.** The perimeter of a rectangle is 66 cm. Its sides are $x + 4$ and $x - 1$ cm. Find x and both side lengths.

Set 116

- 461.** A graph crosses the y -axis at -5 and rises 7 units for every 2 units right. Write its equation and give three points on the graph. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 462.** A right triangle has legs 6 cm and 4 cm. Find its hypotenuse exactly and approximately to the nearest tenth.
- 463.** Store A sells 12 ounces for \$6.00; Store B sells 16 ounces for \$8.60. Which is the better buy? Quantify the difference per ounce.
- 464.** Function A starts at -4 and increases by 4 per step. Function B is $y = 3x + 0$. Which is larger when $x = 10$, and when do they agree?

Set 117

- 465.** Solve $6(x - 4) = 24$. Then explain one step that preserves equality.
- 466.** Solve $8x + 1 = 121$. Check your solution by substitution.
- 467.** Create a set of six integers with mean 14, median 10, and no mode. Show that it meets all three conditions.
- 468.** A sample of 59 students includes 16 who prefer option A. Estimate how many of 590 students would prefer A, and state one source of sampling bias.

Set 118

- 469.** A quantity rises from 80 to 100. Find the percent increase, then reverse the change and explain why the two percentages differ.
- 470.** Graph $y = 3x - 8$ and $y = -3x + 51$. Estimate their intersection, then solve algebraically. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 471.** Create two different linear equations whose only common solution is $(5, 6)$. Explain how your equations guarantee this. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 472.** A right triangle has legs 3 cm and 4 cm. Find its hypotenuse exactly and approximately to the nearest tenth.

Set 119

- 473.** Compare $y = 2x + 4$ and $y = 3x + 2$. Find their intersection and interpret it as a break-even point. Then change one numerical condition by a factor of 4 and analyze how the solution changes.
- 474.** For the data set 6, 11, 12, 11, 14, find the mean and median. Which better represents the center? Explain.
- 475.** Three consecutive integers have sum 33. Find them and write the equation you used. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 476.** A culture begins with 150 cells and doubles every hour. Write a function and find the population after 7 hours. Is the function linear? Explain.

Set 120

- 477.** Create two different linear equations whose only common solution is $(9, 7)$. Explain how your equations guarantee this. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 478.** A tank contains 105 liters and drains at 5 liters per minute. Write a function for the amount remaining and decide whether it is proportional. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 479.** A ladder 14 ft long reaches 9 ft up a wall. How far is its foot from the wall? Draw and label a model first.
- 480.** Graph $y = 3x - 8$ and $y = -3x + 39$. Estimate their intersection, then solve algebraically.

Phase 13: Synthesis and creation

The ideas in this phase are intentionally mixed. Look for connections to earlier sets and be ready to reuse prior results.

Set 121

- 481.** The diagonal of a rectangle is 18 and one side is 8. Is a rectangle with these measurements possible? Justify using the Pythagorean Theorem. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 482.** Simplify $(2^2 \cdot 2^1)/2^1$ without a calculator. State the exponent rule used. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 483.** Tickets cost \$8.00 for adults and \$4.00 for students. A group buys 11 tickets for \$56.00. How many of each were bought?
- 484.** Compare $y = -2x + 4$ and $y = -1x + 2$. Find their intersection and interpret it as a break-even point. Then change one numerical condition by a factor of 3 and analyze how the solution changes.

Set 122

- 485.** Design a simulation for an event with probability $\frac{4}{10}$. State how many trials you would run and how you would judge whether results are reasonable. Then change one numerical condition by a factor of 5 and analyze how the solution changes.
- 486.** A graph crosses the y -axis at 1 and rises 7 units for every 2 units right. Write its equation and give three points on the graph.
- 487.** Solve $5(x - 4) = 25$. Then explain one step that preserves equality.
- 488.** A recipe uses 4 cups of broth for 5 servings. How much broth is needed for 10 servings? State the unit rate.

Set 123

- 489.** Describe a real situation modeled by $y = 5x - 3$. Identify a sensible domain and explain whether all real numbers belong in it. Then change one numerical condition by a factor of 3 and analyze how the solution changes.
- 490.** Write an equation for the line parallel to $y = 2x - 3$ through $(0, 1)$. How do you know the lines never meet? Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 491.** The diagonal of a rectangle is 15 and one side is 5. Is a rectangle with these measurements possible? Justify using the Pythagorean Theorem. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 492.** A streaming plan costs \$8.00 plus \$2.00 per movie. Write and solve an equation for the number of movies when the bill is \$28.00.

Set 124

- 493.** A streaming plan costs \$7.00 plus \$1.00 per movie. Write and solve an equation for the number of movies when the bill is \$16.00.
- 494.** Triangle ABC has vertices $(0,0)$, $(6,0)$, $(0,6)$. Reflect it across the y -axis and list the new coordinates. What measurements stay unchanged? Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 495.** Write an equation for the line parallel to $y = 1x + 0$ through $(0,4)$. How do you know the lines never meet?
- 496.** A graph crosses the y -axis at -2 and rises 7 units for every 2 units right. Write its equation and give three points on the graph. Then change one numerical condition by a factor of 2 and analyze how the solution changes.

Set 125

- 497.** On a map, 6 cm represents 72 km. Two points are 3.5 cm apart. Find the actual distance and describe the proportional relationship.
- 498.** Three consecutive integers have sum 33. Find them and write the equation you used. Then change one numerical condition by a factor of 3 and analyze how the solution changes.
- 499.** Describe a real situation modeled by $y = 5x + 5$. Identify a sensible domain and explain whether all real numbers belong in it. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 500.** A sample of 68 students includes 25 who prefer option A. Estimate how many of 680 students would prefer A, and state one source of sampling bias. Then change one numerical condition by a factor of 2 and analyze how the solution changes.

Set 126

- 501.** Find the slope through $(3, -4)$ and $(6, -10)$. Write the equation of the line.
- 502.** Create two different linear equations whose only common solution is $(5, 9)$. Explain how your equations guarantee this.
- 503.** A square has area 64 square units. Find its exact side length and explain how square roots undo squaring. Then change one numerical condition by a factor of 4 and analyze how the solution changes.
- 504.** Triangle ABC has vertices $(0,0)$, $(3,0)$, $(0,6)$. Reflect it across the y -axis and list the new coordinates. What measurements stay unchanged? Then change one numerical condition by a factor of 2 and analyze how the solution changes.

Set 127

- 505.** Tickets cost \$9.00 for adults and \$4.00 for students. A group buys 9 tickets for \$51.00. How many of each were bought? Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 506.** For the data set 7, 9, 9, 11, 19, find the mean and median. Which better represents the center? Explain. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 507.** A tank contains 90 liters and drains at 4 liters per minute. Write a function for the amount remaining and decide whether it is proportional.
- 508.** A square has area 16 square units. Find its exact side length and explain how square roots undo squaring. Then change one numerical condition by a factor of 2 and analyze how the solution changes.

Set 128

- 509.** Compare 2^3 and $2^p + 2^q$. Which is larger? Is your conclusion always true for positive p, q ? Then change one numerical condition by a factor of 8 and analyze how the solution changes.
- 510.** On a map, 4 cm represents 48 km. Two points are 3.5 cm apart. Find the actual distance and describe the proportional relationship. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 511.** Design a simulation for an event with probability $\frac{4}{10}$. State how many trials you would run and how you would judge whether results are reasonable. Then change one numerical condition by a factor of 6 and analyze how the solution changes.
- 512.** Create two different linear equations whose only common solution is (5, 5). Explain how your equations guarantee this.

Set 129

- 513.** The diagonal of a rectangle is 16 and one side is 6. Is a rectangle with these measurements possible? Justify using the Pythagorean Theorem. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 514.** Compare 2^3 and $2^p + 2^q$. Which is larger? Is your conclusion always true for positive p, q ? Then change one numerical condition by a factor of 9 and analyze how the solution changes.
- 515.** Tickets cost \$9.00 for adults and \$4.00 for students. A group buys 12 tickets for \$63.00. How many of each were bought?
- 516.** Find the slope through (3, 8) and (6, 14). Write the equation of the line.

Set 130

- 517.** A sample of 42 students includes 14 who prefer option A. Estimate how many of 420 students would prefer A, and state one source of sampling bias. Then change one numerical condition by a factor of 2 and analyze how the solution changes.
- 518.** Describe a real situation modeled by $y = 5x + 1$. Identify a sensible domain and explain whether all real numbers belong in it. Then change one numerical condition by a factor of 3 and analyze how the solution changes.
- 519.** A streaming plan costs \$8.00 plus \$1.00 per movie. Write and solve an equation for the number of movies when the bill is \$21.00.
- 520.** A tank contains 60 liters and drains at 8 liters per minute. Write a function for the amount remaining and decide whether it is proportional.

Capstone Invitations

Return to selected problems and develop one of the following into a polished investigation.

1. Choose one situation that can be represented by a table, graph, and equation. Explain what each representation reveals and hides.
2. Find a claim from an earlier set that was true for the given numbers. Decide whether it is always, sometimes, or never true; prove your conclusion or give counterexamples.
3. Create a pair of problems that look different but have the same mathematical structure. Solve both and explain the connection.
4. Collect or locate a small data set. Ask a statistical question, choose appropriate displays and summaries, and discuss limitations of the data.
5. Design a geometry problem whose solution requires both a transformation and the Pythagorean Theorem. Include a diagram and a complete solution.

Inspired by the problem-centered tradition described by Phillips Exeter Academy. This compilation is an original Grade 8 resource and is not an Exeter problem set.