

Mathematics 7

A Problem-Centered Course

520 problems in 130 spiral sets

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

Tower School

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 sustained discussion or a return visit. Include units, label representations, and state assumptions. Keep unfinished work: an organized attempt is valuable evidence of thinking.

A productive routine

1. Read all four problems before choosing where to begin.
2. Record attempts and useful mistakes.
3. Compare words, tables, graphs, equations, and diagrams.
4. Revise after discussion while keeping earlier thinking visible.
5. Expect more than one valid response when asked to create or critique.

How this book fits your course

Keep this compilation in your binder as a year-long source of problems. Your teacher may assign a complete set, select one problem for discussion, or invite you to explore it when time allows. Problem-Solving Labs are separate, longer investigations built around a carefully chosen mathematical arc.

Phase 1: Rational-number reasoning

Ideas are mixed intentionally. Look for connections and reuse earlier results.

Set 1

1. A population is 5700 after a 25% increase. Find the original population and check by forward calculation.
2. A scale factor of $\frac{3}{2}$ is applied to a rectangle 5 by 8. Compare the old and new perimeters and areas.
3. Choose one earlier result and solve it with a second representation. What became clearer?
4. An item priced \$58.00 is discounted 10% and then taxed 6%. Find the final price and explain the order of operations.

Set 2

5. Create a proportional comparison in which the option with the larger total price is the better deal.
6. Revise one earlier question so it has no solution or infinitely many solutions. Explain the change.
7. Solve $-6x + 5 > -64$ and graph the solution. Explain when the inequality sign reverses.
8. Find the GCF and LCM of 36 and 48. Explain a situation in which each would be useful.

Set 3

9. Solve $4(x - 4) = 20$. Explain why division is a useful first or last step.
10. A quantity grows from 71 to 86. Find the percent increase. Then find the percent decrease needed to return to 71.
11. Compute $\frac{9}{8} \div \frac{10}{10}$. Explain the reciprocal rule with a measurement context.
12. A scatter plot shows a strong positive association. Write one conclusion that is supported and one causal conclusion that is not.

Set 4

13. A prism has base area 63 cm^2 and height 7 cm. Find volume. Then design different base dimensions with the same volume.
14. Plot a triangle with vertices $(0, 0)$, $(8, 0)$, $(0, 5)$. Reflect it over the x -axis and then translate it right 3. List the final coordinates.
15. A transversal crosses parallel lines. One angle is $(4x + 9)^\circ$ and its alternate interior angle is $(6x - 10)^\circ$. Find all distinct angle measures.
16. Construct two triangles with side lengths 10, 6, and 15. Are they necessarily congruent? Explain.

Set 5

17. Find the slope through $(2, 4)$ and $(5, 10)$. Write the equation.
18. A pattern begins 2, 7, 12, 17. Write an explicit rule and explain how the graph reveals it.
19. A student says subtracting always makes a number smaller. Give two counterexamples and refine the statement.
20. A recipe ratio is 2:8. Change the total while keeping the ratio, then change one part without the other. Which situation remains proportional?

Set 6

21. A sample of 42 students has 27 who prefer a later start. Estimate the count in a school of 520, then critique the sample.
22. A population is 6100 after a 25% increase. Find the original population and check by forward calculation.
23. Compare $y = 5x + 0$ with $y = 6x - 3$. When do the outputs agree?
24. Compare $-\frac{2}{4}$ and $-\frac{3}{6}$. Explain without relying only on decimal approximations.

Set 7

25. A pattern begins 2, 7, 12, 17. Write an explicit rule and explain how the graph reveals it. Then create one related example in which 3 is a relevant value, and solve or analyze it.
26. Two angles form a linear pair and measure $(3x + 3)^\circ$ and $(2x + 11)^\circ$. Find x and both angles.
27. Write a percent problem whose answer is 58. Solve it two ways.
28. Make a conjecture about a percent, proportion, or angle pattern. Test it and decide what would count as proof.

Set 8

29. Find the GCF and LCM of 18 and 18. Explain a situation in which each would be useful.
30. Create a real situation modeled by $4x + 3 = 50$, then solve and interpret the answer.
31. Two tiles are selected without replacement from 5 red and 5 blue tiles. Find the probability both are red using a tree or organized fractions.
32. For $y = 2x + 3$, make a table, graph four points, and interpret slope and intercept.

Set 9

- 33.** A student says subtracting always makes a number smaller. Give two counterexamples and refine the statement. Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 34.** Write a percent problem whose answer is 51. Solve it two ways.
- 35.** The graph of a proportional relationship contains (7, 35). Find two more points and explain why the origin must be included.
- 36.** A number is 5 more than 5 times another number, and their sum is 59. Write equations and find both numbers.

Set 10

- 37.** A restaurant bill is \$100.00. Compare an 18% tip with rounding the bill up and taking 20%. Quantify the difference.
- 38.** A composite figure consists of a 6-by-8 rectangle and a semicircle with diameter 6. Find its area and perimeter.
- 39.** A pattern begins 2, 7, 12, 17. Write an explicit rule and explain how the graph reveals it. Then create one related example in which 4 is a relevant value, and solve or analyze it.
- 40.** Explain why increasing by 40% and decreasing by 40% do not cancel. Use a numerical example.

Phase 2: Rates and proportionality

Ideas are mixed intentionally. Look for connections and reuse earlier results.

Set 11

41. A number is 3 more than 5 times another number, and their sum is 33. Write equations and find both numbers.
42. Estimate and then calculate 9.7×6.1 . Explain whether the decimal placement is reasonable.
43. A prism has base area 49 cm^2 and height 3 cm. Find volume. Then design different base dimensions with the same volume.
44. Compute $-10 + 8 - (-12)$ and represent the steps on a number line.

Set 12

45. A composite figure consists of a 6-by-5 rectangle and a semicircle with diameter 6. Find its area and perimeter.
46. A recipe ratio is 6:8. Change the total while keeping the ratio, then change one part without the other. Which situation remains proportional?
47. Find a rational number halfway between -4 and $\frac{8}{2}$. Verify using distances.
48. Which does not belong: a table, graph, equation, and verbal rule you create for one relationship? Give two defensible answers.

Set 13

49. Compare $y = 1x - 4$ with $y = 2x - 7$. When do the outputs agree?
50. Find the slope through $(2, 13)$ and $(5, 31)$. Write the equation.
51. For $y = 5x - 3$, make a table, graph four points, and interpret slope and intercept.
52. A student thinks every straight-line graph is proportional. Give an example that disproves the claim and state the missing condition.

Set 14

53. Create two different data sets with the same mean 16 but different medians. Explain how you controlled each statistic.
54. Write 60000 in scientific notation and compare its magnitude with 9×10^3 .
55. A population is 9700 after a 25% increase. Find the original population and check by forward calculation.

- 56.** Solve $4(x - 1) = 28$. Explain why division is a useful first or last step.

Set 15

- 57.** Choose one earlier result and solve it with a second representation. What became clearer? Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 58.** Determine whether the pairs $(2, 18)$, $(5, 45)$, $(8, 72)$ form a proportional relationship. Give the constant and equation.
- 59.** A scatter plot shows a strong positive association. Write one conclusion that is supported and one causal conclusion that is not. Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 60.** Write a percent problem whose answer is 94. Solve it two ways.

Set 16

- 61.** Write 800000 in scientific notation and compare its magnitude with 10×10^4 .
- 62.** A tank begins with 136 liters and loses 4 liters per minute. Write and graph a function with a sensible domain.
- 63.** A scale drawing uses 3 cm for 18 m. A wall measures 5.5 cm. Find the actual length and state the scale factor.
- 64.** Write 0.28 as a fraction and percent. Place all three forms on a number line.

Set 17

- 65.** Compute $-7 + 3 - (-9)$ and represent the steps on a number line.
- 66.** Create an expression involving rational numbers whose value is exactly 3. Show two different evaluation paths.
- 67.** Revise one earlier question so it has no solution or infinitely many solutions. Explain the change. Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 68.** A sample of 55 students has 20 who prefer a later start. Estimate the count in a school of 450, then critique the sample.

Set 18

- 69.** A population is 8300 after a 25% increase. Find the original population and check by forward calculation.
- 70.** A scale drawing uses 4 cm for 24 m. A wall measures 5.5 cm. Find the actual length and state the scale factor.
- 71.** Simplify $3(2x - 4) + 3(x + 3)$. Use an area model or partial products to verify.
- 72.** A prism has base area 35 cm^2 and height 2 cm. Find volume. Then design different base dimensions with the same volume.

Set 19

- 73.** Create a proportional comparison in which the option with the larger total price is the better deal. Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 74.** Create a nonproportional linear relationship with slope 6. Give a context, table, and equation.
- 75.** Write 600 in scientific notation and compare its magnitude with 7×10^1 .
- 76.** Plan A costs \$11.00 per use. Plan B costs \$21.00 plus \$9.00 per use. When are the costs equal?

Set 20

- 77.** Solve $4(x - 4) = 4$. Explain why division is a useful first or last step.
- 78.** Write 0.14 as a fraction and percent. Place all three forms on a number line.
- 79.** Plot a triangle with vertices $(0, 0)$, $(8, 0)$, $(0, 7)$. Reflect it over the x -axis and then translate it right 3. List the final coordinates.
- 80.** A student says subtracting always makes a number smaller. Give two counterexamples and refine the statement. Then create one related example in which 4 is a relevant value, and solve or analyze it.

Phase 3: Percent and financial reasoning

Ideas are mixed intentionally. Look for connections and reuse earlier results.

Set 21

- 81. A tank begins with 103 liters and loses 7 liters per minute. Write and graph a function with a sensible domain.
- 82. Solve $4(x - 5) = -4$. Explain why division is a useful first or last step.
- 83. A quantity grows from 75 to 90. Find the percent increase. Then find the percent decrease needed to return to 75.
- 84. Compute $\frac{4}{9} \div \frac{5}{11}$. Explain the reciprocal rule with a measurement context.

Set 22

- 85. A scatter plot shows a strong positive association. Write one conclusion that is supported and one causal conclusion that is not. Then create one related example in which 4 is a relevant value, and solve or analyze it.
- 86. Create two different data sets with the same mean 8 but different medians. Explain how you controlled each statistic.
- 87. A sample of 52 students has 17 who prefer a later start. Estimate the count in a school of 420, then critique the sample.
- 88. Design a simulation for the probability of getting at least one head in three coin flips.

Set 23

- 89. Create a real situation modeled by $4x + 7 = 50$, then solve and interpret the answer.
- 90. Compare $-\frac{10}{9}$ and $-\frac{11}{11}$. Explain without relying only on decimal approximations.
- 91. Determine whether the pairs $(2, 18)$, $(5, 45)$, $(8, 72)$ form a proportional relationship. Give the constant and equation. Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 92. Two angles form a linear pair and measure $(3x + 3)^\circ$ and $(2x + 4)^\circ$. Find x and both angles.

Set 24

- 93.** Between which integers does $\sqrt{25}$ lie? Justify using perfect squares.
- 94.** Solve $-6x + 8 > -55$ and graph the solution. Explain when the inequality sign reverses.
- 95.** Which does not belong: a table, graph, equation, and verbal rule you create for one relationship? Give two defensible answers. Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 96.** A scale drawing uses 3 cm for 18 m. A wall measures 5.5 cm. Find the actual length and state the scale factor. Then create one related example in which 3 is a relevant value, and solve or analyze it.

Set 25

- 97.** Compare $-\frac{3}{10}$ and $-\frac{4}{12}$. Explain without relying only on decimal approximations.
- 98.** A bag has 3 red, 4 blue, and 2 green tiles. Find the probability of blue, then the probability of not blue.
- 99.** A student combines $3x + 4$ into $7x$. Diagnose the misconception using two possible values of x .
- 100.** Create three rational numbers with sum zero, none of which are opposites of another. Show the sum.

Set 26

- 101.** Store A offers 30% off; Store B offers buy 3, get 1 free. For equally priced items, which deal is better? Explain assumptions.
- 102.** Evaluate $(-7)(4) + 31$. Explain how the sign rules affect the result.
- 103.** Estimate and then calculate 3.1×5.4 . Explain whether the decimal placement is reasonable.
- 104.** Choose one earlier result and solve it with a second representation. What became clearer? Then create one related example in which 4 is a relevant value, and solve or analyze it.

Set 27

- 105.** Determine whether the pairs $(2, 6)$, $(5, 15)$, $(8, 24)$ form a proportional relationship. Give the constant and equation.
- 106.** A student combines $3x + 4$ into $7x$. Diagnose the misconception using two possible values of x . Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 107.** A composite figure consists of a 6-by-4 rectangle and a semicircle with diameter 6. Find its area and perimeter.
- 108.** A line passes through $(0, 1)$ and rises 6 for every 2 units right. Explain two ways to recognize its equation.

Set 28

- 109.** A number is 3 more than 5 times another number, and their sum is 63. Write equations and find both numbers.
- 110.** A spinner lands on A with probability 0.35. Predict results in 123 spins and describe reasonable experimental variation.
- 111.** Compare $-\frac{10}{7}$ and $-\frac{11}{9}$. Explain without relying only on decimal approximations.
- 112.** Solve $2x + 6 = 20$, check the solution, and name the inverse operations used.

Set 29

- 113.** A composite figure consists of a 6-by-10 rectangle and a semicircle with diameter 6. Find its area and perimeter.
- 114.** Create three rational numbers with sum zero, none of which are opposites of another. Show the sum. Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 115.** A line passes through $(0, 3)$ and rises 4 for every 2 units right. Explain two ways to recognize its equation.
- 116.** A population is 6900 after a 25% increase. Find the original population and check by forward calculation.

Set 30

- 117.** Compare $y = 3x + 1$ with $y = 4x - 2$. When do the outputs agree?
- 118.** Simplify $3(2x - 6) + 3(x + 3)$. Use an area model or partial products to verify.
- 119.** An item priced \$45.00 is discounted 10% and then taxed 6%. Find the final price and explain the order of operations.
- 120.** Create an expression involving rational numbers whose value is exactly 4. Show two different evaluation paths.

Phase 4: Expressions and equations

Ideas are mixed intentionally. Look for connections and reuse earlier results.

Set 31

- 121. Which does not belong: a table, graph, equation, and verbal rule you create for one relationship? Give two defensible answers. Then create one related example in which 4 is a relevant value, and solve or analyze it.
- 122. Create a real situation modeled by $4x + 7 = 50$, then solve and interpret the answer. Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 123. Choose one earlier result and solve it with a second representation. What became clearer? Then create one related example in which 5 is a relevant value, and solve or analyze it.
- 124. A pattern begins 2, 7, 12, 17. Write an explicit rule and explain how the graph reveals it. Then create one related example in which 5 is a relevant value, and solve or analyze it.

Set 32

- 125. Create an expression involving rational numbers whose value is exactly 9. Show two different evaluation paths.
- 126. Write a percent problem whose answer is 80. Solve it two ways.
- 127. Solve $-6x + 8 > -61$ and graph the solution. Explain when the inequality sign reverses.
- 128. A tank begins with 96 liters and loses 6 liters per minute. Write and graph a function with a sensible domain.

Set 33

- 129. A diver moves from -32 m to -9 m. Find and interpret the signed change and the distance traveled.
- 130. Construct two triangles with side lengths 10, 6, and 15. Are they necessarily congruent? Explain. Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 131. Compute $\frac{9}{3} \div \frac{10}{5}$. Explain the reciprocal rule with a measurement context.
- 132. A student combines $3x + 4$ into $7x$. Diagnose the misconception using two possible values of x . Then create one related example in which 4 is a relevant value, and solve or analyze it.

Set 34

- 133.** Write a percent problem whose answer is 73. Solve it two ways.
- 134.** Make a conjecture about a percent, proportion, or angle pattern. Test it and decide what would count as proof. Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 135.** A circle has diameter 8 cm. Find circumference and area exactly and approximately. Explain which uses linear units and which uses square units.
- 136.** A restaurant bill is \$86.00. Compare an 18% tip with rounding the bill up and taking 20%. Quantify the difference.

Set 35

- 137.** A car travels 36 miles in 4 hours. At the same rate, how far in 6.5 hours? Show a table and equation.
- 138.** An item priced \$70.00 is discounted 10% and then taxed 6%. Find the final price and explain the order of operations.
- 139.** A student says subtracting always makes a number smaller. Give two counterexamples and refine the statement. Then create one related example in which 5 is a relevant value, and solve or analyze it.
- 140.** Between which integers does $\sqrt{15}$ lie? Justify using perfect squares.

Set 36

- 141.** Solve $-6x + 2 > -37$ and graph the solution. Explain when the inequality sign reverses.
- 142.** A scale factor of $\frac{3}{2}$ is applied to a rectangle 5 by 12. Compare the old and new perimeters and areas.
- 143.** Compare $y = 2x + 0$ with $y = 3x - 3$. When do the outputs agree?
- 144.** Two tiles are selected without replacement from 3 red and 5 blue tiles. Find the probability both are red using a tree or organized fractions.

Set 37

- 145.** A scale factor of $\frac{3}{2}$ is applied to a rectangle 5 by 6. Compare the old and new perimeters and areas.
- 146.** Write a problem connecting two course strands, such as probability and percent or geometry and proportion. Solve it fully.
- 147.** Write a percent problem whose answer is 84. Solve it two ways.
- 148.** Plot a triangle with vertices $(0, 0)$, $(8, 0)$, $(0, 12)$. Reflect it over the x -axis and then translate it right 3. List the final coordinates.

Set 38

- 149.** A tank begins with 135 liters and loses 3 liters per minute. Write and graph a function with a sensible domain.
- 150.** A restaurant bill is \$72.00. Compare an 18% tip with rounding the bill up and taking 20%. Quantify the difference.
- 151.** Two tiles are selected without replacement from 8 red and 5 blue tiles. Find the probability both are red using a tree or organized fractions.
- 152.** Determine whether the pairs $(2, 16)$, $(5, 40)$, $(8, 64)$ form a proportional relationship. Give the constant and equation.

Set 39

- 153.** A scatter plot shows a strong positive association. Write one conclusion that is supported and one causal conclusion that is not. Then create one related example in which 5 is a relevant value, and solve or analyze it.
- 154.** Plot a triangle with vertices $(0, 0)$, $(8, 0)$, $(0, 9)$. Reflect it over the x -axis and then translate it right 3. List the final coordinates.
- 155.** The graph of a proportional relationship contains $(7, 56)$. Find two more points and explain why the origin must be included.
- 156.** Evaluate $(-8)(10) + 83$. Explain how the sign rules affect the result.

Set 40

- 157.** Create a real situation modeled by $4x + 7 = 50$, then solve and interpret the answer. Then create one related example in which 4 is a relevant value, and solve or analyze it.
- 158.** Choose one earlier result and solve it with a second representation. What became clearer? Then create one related example in which 6 is a relevant value, and solve or analyze it.
- 159.** A pattern begins 2, 7, 12, 17. Write an explicit rule and explain how the graph reveals it. Then create one related example in which 6 is a relevant value, and solve or analyze it.
- 160.** Write a problem connecting two course strands, such as probability and percent or geometry and proportion. Solve it fully. Then create one related example in which 3 is a relevant value, and solve or analyze it.

Phase 5: Inequalities and constraints

Ideas are mixed intentionally. Look for connections and reuse earlier results.

Set 41

- 161. Evaluate $(-4)(8) + 35$. Explain how the sign rules affect the result.
- 162. A scale drawing uses 8 cm for 48 m. A wall measures 5.5 cm. Find the actual length and state the scale factor.
- 163. Construct two triangles with side lengths 10, 7, and 16. Are they necessarily congruent? Explain.
- 164. A bag has 5 red, 4 blue, and 2 green tiles. Find the probability of blue, then the probability of not blue.

Set 42

- 165. Explain why increasing by 40% and decreasing by 40% do not cancel. Use a numerical example. Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 166. Create a nonproportional linear relationship with slope 4. Give a context, table, and equation.
- 167. Find a rational number halfway between -4 and $\frac{3}{2}$. Verify using distances.
- 168. A circle has diameter 8 cm. Find circumference and area exactly and approximately. Explain which uses linear units and which uses square units. Then create one related example in which 3 is a relevant value, and solve or analyze it.

Set 43

- 169. A scale drawing uses 9 cm for 54 m. A wall measures 5.5 cm. Find the actual length and state the scale factor.
- 170. Write 0.74 as a fraction and percent. Place all three forms on a number line.
- 171. For $y = 2x - 3$, make a table, graph four points, and interpret slope and intercept.
- 172. Create a proportional comparison in which the option with the larger total price is the better deal. Then create one related example in which 4 is a relevant value, and solve or analyze it.

Set 44

- 173. Write two different equations with solution $x = 11$. One must include parentheses.
- 174. The graph of a proportional relationship contains $(7, 21)$. Find two more points and explain why the origin must be included.
- 175. A population is 6200 after a 25% increase. Find the original population and check by forward calculation.

- 176.** A diver moves from -28 m to -6 m. Find and interpret the signed change and the distance traveled.

Set 45

- 177.** A circle has diameter 8 cm. Find circumference and area exactly and approximately. Explain which uses linear units and which uses square units. Then create one related example in which 4 is a relevant value, and solve or analyze it.
- 178.** For $y = 1x - 1$, make a table, graph four points, and interpret slope and intercept.
- 179.** A scatter plot shows a strong positive association. Write one conclusion that is supported and one causal conclusion that is not. Then create one related example in which 6 is a relevant value, and solve or analyze it.
- 180.** Revise one earlier question so it has no solution or infinitely many solutions. Explain the change. Then create one related example in which 4 is a relevant value, and solve or analyze it.

Set 46

- 181.** A line passes through $(0, 2)$ and rises 2 for every 2 units right. Explain two ways to recognize its equation.
- 182.** Find the GCF and LCM of 24 and 36. Explain a situation in which each would be useful.
- 183.** A scale drawing uses 6 cm for 36 m. A wall measures 5.5 cm. Find the actual length and state the scale factor.
- 184.** Find the slope through $(4, 15)$ and $(7, 27)$. Write the equation.

Set 47

- 185.** A bag has 8 red, 4 blue, and 5 green tiles. Find the probability of blue, then the probability of not blue.
- 186.** Create a proportional comparison in which the option with the larger total price is the better deal. Then create one related example in which 5 is a relevant value, and solve or analyze it.
- 187.** Revise one earlier question so it has no solution or infinitely many solutions. Explain the change. Then create one related example in which 5 is a relevant value, and solve or analyze it.
- 188.** Solve $-6x + 7 > -26$ and graph the solution. Explain when the inequality sign reverses.

Set 48

- 189.** Which does not belong: a table, graph, equation, and verbal rule you create for one relationship? Give two defensible answers. Then create one related example in which 5 is a relevant value, and solve or analyze it.
- 190.** Compare $y = 4x - 4$ with $y = 5x - 7$. When do the outputs agree?

- 191.** Simplify $3(2x - 7) + 3(x + 3)$. Use an area model or partial products to verify.
- 192.** An item priced \$49.00 is discounted 10% and then taxed 6%. Find the final price and explain the order of operations.

Set 49

- 193.** Create an expression involving rational numbers whose value is exactly 5. Show two different evaluation paths.
- 194.** Between which integers does $\sqrt{109}$ lie? Justify using perfect squares.
- 195.** Write 600000 in scientific notation and compare its magnitude with 10×10^4 .
- 196.** Find the GCF and LCM of 12 and 18. Explain a situation in which each would be useful.

Set 50

- 197.** A diver moves from -16 m to -9 m. Find and interpret the signed change and the distance traveled.
- 198.** A car travels 162 miles in 4 hours. At the same rate, how far in 6.5 hours? Show a table and equation.
- 199.** Two angles form a linear pair and measure $(3x + 3)^\circ$ and $(2x + 7)^\circ$. Find x and both angles.
- 200.** A scatter plot shows a strong positive association. Write one conclusion that is supported and one causal conclusion that is not. Then create one related example in which 7 is a relevant value, and solve or analyze it.

Phase 6: Geometry and angle relationships

Ideas are mixed intentionally. Look for connections and reuse earlier results.

Set 51

- 201.** Plan A costs \$12.00 per use. Plan B costs \$21.00 plus \$10.00 per use. When are the costs equal?
- 202.** A spinner lands on A with probability 0.35. Predict results in 123 spins and describe reasonable experimental variation. Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 203.** A quantity grows from 40 to 55. Find the percent increase. Then find the percent decrease needed to return to 40.
- 204.** For $y = 6x - 2$, make a table, graph four points, and interpret slope and intercept.

Set 52

- 205.** A student combines $3x + 4$ into $7x$. Diagnose the misconception using two possible values of x . Then create one related example in which 5 is a relevant value, and solve or analyze it.
- 206.** Create three rational numbers with sum zero, none of which are opposites of another. Show the sum. Then create one related example in which 4 is a relevant value, and solve or analyze it.
- 207.** A sample of 46 students has 26 who prefer a later start. Estimate the count in a school of 510, then critique the sample.
- 208.** A number is 3 more than 5 times another number, and their sum is 27. Write equations and find both numbers.

Set 53

- 209.** Two angles form a linear pair and measure $(3x + 3)^\circ$ and $(2x + 7)^\circ$. Find x and both angles. Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 210.** Simplify $3(2x - 2) + 3(x + 3)$. Use an area model or partial products to verify.
- 211.** Determine whether the pairs $(2, 8)$, $(5, 20)$, $(8, 32)$ form a proportional relationship. Give the constant and equation.
- 212.** Explain why increasing by 40% and decreasing by 40% do not cancel. Use a numerical example. Then create one related example in which 4 is a relevant value, and solve or analyze it.

Set 54

- 213.** Create a nonproportional linear relationship with slope 6. Give a context, table, and equation. Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 214.** A sample of 64 students has 19 who prefer a later start. Estimate the count in a school of 440, then critique the sample.
- 215.** Which does not belong: a table, graph, equation, and verbal rule you create for one relationship? Give two defensible answers. Then create one related example in which 6 is a relevant value, and solve or analyze it.
- 216.** Estimate and then calculate 10.8×7.2 . Explain whether the decimal placement is reasonable.

Set 55

- 217.** Two tiles are selected without replacement from 7 red and 5 blue tiles. Find the probability both are red using a tree or organized fractions.
- 218.** Compute $-8 + 6 - (-10)$ and represent the steps on a number line.
- 219.** A student combines $3x + 4$ into $7x$. Diagnose the misconception using two possible values of x . Then create one related example in which 6 is a relevant value, and solve or analyze it.
- 220.** Create two different data sets with the same mean 15 but different medians. Explain how you controlled each statistic.

Set 56

- 221.** Make a conjecture about a percent, proportion, or angle pattern. Test it and decide what would count as proof. Then create one related example in which 4 is a relevant value, and solve or analyze it.
- 222.** A number is 5 more than 5 times another number, and their sum is 53. Write equations and find both numbers.
- 223.** Estimate and then calculate 3.1×8.4 . Explain whether the decimal placement is reasonable.
- 224.** A transversal crosses parallel lines. One angle is $(4x + 9)^\circ$ and its alternate interior angle is $(6x - 10)^\circ$. Find all distinct angle measures. Then create one related example in which 3 is a relevant value, and solve or analyze it.

Set 57

- 225.** Compute $\frac{10}{7} \div \frac{11}{9}$. Explain the reciprocal rule with a measurement context.
- 226.** A scatter plot shows a strong positive association. Write one conclusion that is supported and one causal conclusion that is not. Then create one related example in which 8 is a relevant value, and solve or analyze it.

- 227.** A transversal crosses parallel lines. One angle is $(4x + 9)^\circ$ and its alternate interior angle is $(6x - 4)^\circ$. Find all distinct angle measures.
- 228.** The graph of a proportional relationship contains $(7, 63)$. Find two more points and explain why the origin must be included.

Set 58

- 229.** Evaluate $(-9)(8) + 75$. Explain how the sign rules affect the result.
- 230.** A diver moves from -20 m to -9 m. Find and interpret the signed change and the distance traveled.
- 231.** Compare $-\frac{10}{10}$ and $-\frac{11}{12}$. Explain without relying only on decimal approximations.
- 232.** Compute $-6 + 3 - (-8)$ and represent the steps on a number line.

Set 59

- 233.** Explain why increasing by 40% and decreasing by 40% do not cancel. Use a numerical example. Then create one related example in which 5 is a relevant value, and solve or analyze it.
- 234.** Write two different equations with solution $x = 5$. One must include parentheses.
- 235.** A line passes through $(0, 3)$ and rises 10 for every 2 units right. Explain two ways to recognize its equation.
- 236.** Which does not belong: a table, graph, equation, and verbal rule you create for one relationship? Give two defensible answers. Then create one related example in which 7 is a relevant value, and solve or analyze it.

Set 60

- 237.** A scale drawing uses 9 cm for 54 m. A wall measures 5.5 cm. Find the actual length and state the scale factor. Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 238.** Two tiles are selected without replacement from 7 red and 5 blue tiles. Find the probability both are red using a tree or organized fractions. Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 239.** An item priced \$71.00 is discounted 10% and then taxed 6%. Find the final price and explain the order of operations.
- 240.** A student thinks every straight-line graph is proportional. Give an example that disproves the claim and state the missing condition. Then create one related example in which 3 is a relevant value, and solve or analyze it.

Phase 7: Scale drawings and similarity

Ideas are mixed intentionally. Look for connections and reuse earlier results.

Set 61

- 241.** Construct two triangles with side lengths 10, 12, and 21. Are they necessarily congruent? Explain.
- 242.** A restaurant bill is \$101.00. Compare an 18% tip with rounding the bill up and taking 20%. Quantify the difference.
- 243.** Choose one earlier result and solve it with a second representation. What became clearer? Then create one related example in which 7 is a relevant value, and solve or analyze it.
- 244.** A scale factor of $\frac{3}{2}$ is applied to a rectangle 5 by 9. Compare the old and new perimeters and areas.

Set 62

- 245.** A student thinks every straight-line graph is proportional. Give an example that disproves the claim and state the missing condition. Then create one related example in which 4 is a relevant value, and solve or analyze it.
- 246.** A circle has diameter 8 cm. Find circumference and area exactly and approximately. Explain which uses linear units and which uses square units. Then create one related example in which 5 is a relevant value, and solve or analyze it.
- 247.** Solve $-6x + 3 > -66$ and graph the solution. Explain when the inequality sign reverses.
- 248.** Plan A costs \$9.00 per use. Plan B costs \$21.00 plus \$7.00 per use. When are the costs equal?

Set 63

- 249.** A spinner lands on A with probability 0.35. Predict results in 189 spins and describe reasonable experimental variation.
- 250.** Choose one earlier result and solve it with a second representation. What became clearer? Then create one related example in which 8 is a relevant value, and solve or analyze it.
- 251.** Compute $\frac{9}{6} \div \frac{10}{8}$. Explain the reciprocal rule with a measurement context.
- 252.** A student says subtracting always makes a number smaller. Give two counterexamples and refine the statement. Then create one related example in which 6 is a relevant value, and solve or analyze it.

Set 64

- 253.** Revise one earlier question so it has no solution or infinitely many solutions. Explain the change. Then create one related example in which 6 is a relevant value, and solve or analyze it.
- 254.** Store A offers 30% off; Store B offers buy 3, get 1 free. For equally priced items, which deal is better? Explain assumptions. Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 255.** A prism has base area 70 cm^2 and height 5 cm. Find volume. Then design different base dimensions with the same volume.
- 256.** Create a real situation modeled by $4x + 7 = 50$, then solve and interpret the answer. Then create one related example in which 5 is a relevant value, and solve or analyze it.

Set 65

- 257.** Write 0.53 as a fraction and percent. Place all three forms on a number line.
- 258.** A prism has base area 28 cm^2 and height 2 cm. Find volume. Then design different base dimensions with the same volume.
- 259.** A student says subtracting always makes a number smaller. Give two counterexamples and refine the statement. Then create one related example in which 7 is a relevant value, and solve or analyze it.
- 260.** Create a nonproportional linear relationship with slope 5. Give a context, table, and equation.

Set 66

- 261.** Find a rational number halfway between -5 and $\frac{7}{2}$. Verify using distances.
- 262.** Which does not belong: a table, graph, equation, and verbal rule you create for one relationship? Give two defensible answers. Then create one related example in which 8 is a relevant value, and solve or analyze it.
- 263.** Compare $y = 5x + 0$ with $y = 6x - 3$. When do the outputs agree? Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 264.** Simplify $3(2x - 8) + 3(x + 3)$. Use an area model or partial products to verify.

Set 67

- 265.** An item priced \$89.00 is discounted 10% and then taxed 6%. Find the final price and explain the order of operations.
- 266.** Explain why increasing by 40% and decreasing by 40% do not cancel. Use a numerical example. Then create one related example in which 6 is a relevant value, and solve or analyze it.
- 267.** Write a percent problem whose answer is 49. Solve it two ways.

- 268.** Store A offers 30% off; Store B offers buy 3, get 1 free. For equally priced items, which deal is better? Explain assumptions. Then create one related example in which 4 is a relevant value, and solve or analyze it.

Set 68

- 269.** Plan A costs \$12.00 per use. Plan B costs \$21.00 plus \$10.00 per use. When are the costs equal? Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 270.** Construct two triangles with side lengths 10, 10, and 19. Are they necessarily congruent? Explain.
- 271.** Two tiles are selected without replacement from 5 red and 5 blue tiles. Find the probability both are red using a tree or organized fractions. Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 272.** Compute $\frac{9}{4} \div \frac{10}{6}$. Explain the reciprocal rule with a measurement context.

Set 69

- 273.** A student combines $3x + 4$ into $7x$. Diagnose the misconception using two possible values of x . Then create one related example in which 7 is a relevant value, and solve or analyze it.
- 274.** Revise one earlier question so it has no solution or infinitely many solutions. Explain the change. Then create one related example in which 7 is a relevant value, and solve or analyze it.
- 275.** The graph of a proportional relationship contains (7, 21). Find two more points and explain why the origin must be included. Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 276.** Design a simulation for the probability of getting at least one head in three coin flips. Then create one related example in which 3 is a relevant value, and solve or analyze it.

Set 70

- 277.** Two angles form a linear pair and measure $(3x + 3)^\circ$ and $(2x + 12)^\circ$. Find x and both angles.
- 278.** A quantity grows from 59 to 74. Find the percent increase. Then find the percent decrease needed to return to 59.
- 279.** A pattern begins 2, 7, 12, 17. Write an explicit rule and explain how the graph reveals it. Then create one related example in which 7 is a relevant value, and solve or analyze it.
- 280.** A composite figure consists of a 6-by-9 rectangle and a semicircle with diameter 6. Find its area and perimeter.

Phase 8: Linear relationships

Ideas are mixed intentionally. Look for connections and reuse earlier results.

Set 71

- 281.** Design a simulation for the probability of getting at least one head in three coin flips. Then create one related example in which 4 is a relevant value, and solve or analyze it.
- 282.** Compare $y = 2x + 3$ with $y = 3x + 0$. When do the outputs agree?
- 283.** A scale factor of $\frac{3}{2}$ is applied to a rectangle 5 by 7. Compare the old and new perimeters and areas.
- 284.** Solve $2x + 4 = 26$, check the solution, and name the inverse operations used.

Set 72

- 285.** Write a problem connecting two course strands, such as probability and percent or geometry and proportion. Solve it fully. Then create one related example in which 4 is a relevant value, and solve or analyze it.
- 286.** Between which integers does $\sqrt{69}$ lie? Justify using perfect squares.
- 287.** Find a rational number halfway between -4 and $\frac{6}{2}$. Verify using distances.
- 288.** A population is 9500 after a 25% increase. Find the original population and check by forward calculation.

Set 73

- 289.** Estimate and then calculate 2.0×5.3 . Explain whether the decimal placement is reasonable.
- 290.** A car travels 90 miles in 4 hours. At the same rate, how far in 6.5 hours? Show a table and equation.
- 291.** For $y = 5x - 3$, make a table, graph four points, and interpret slope and intercept. Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 292.** Create an expression involving rational numbers whose value is exactly 8. Show two different evaluation paths.

Set 74

- 293.** Create three rational numbers with sum zero, none of which are opposites of another. Show the sum. Then create one related example in which 5 is a relevant value, and solve or analyze it.
- 294.** A line passes through $(0, 0)$ and rises 10 for every 2 units right. Explain two ways to recognize its equation.
- 295.** A population is 8800 after a 25% increase. Find the original population and check by forward calculation.

- 296.** A spinner lands on A with probability 0.35. Predict results in 102 spins and describe reasonable experimental variation.

Set 75

- 297.** A quantity grows from 84 to 99. Find the percent increase. Then find the percent decrease needed to return to 84.
- 298.** Compute $\frac{5}{8} \div \frac{6}{10}$. Explain the reciprocal rule with a measurement context.
- 299.** A scatter plot shows a strong positive association. Write one conclusion that is supported and one causal conclusion that is not. Then create one related example in which 9 is a relevant value, and solve or analyze it.
- 300.** Construct two triangles with side lengths 10, 8, and 17. Are they necessarily congruent? Explain.

Set 76

- 301.** The graph of a proportional relationship contains (7, 49). Find two more points and explain why the origin must be included.
- 302.** Plan A costs \$12.00 per use. Plan B costs \$21.00 plus \$10.00 per use. When are the costs equal? Then create one related example in which 4 is a relevant value, and solve or analyze it.
- 303.** A scale drawing uses 9 cm for 54 m. A wall measures 5.5 cm. Find the actual length and state the scale factor. Then create one related example in which 4 is a relevant value, and solve or analyze it.
- 304.** A car travels 36 miles in 4 hours. At the same rate, how far in 6.5 hours? Show a table and equation. Then create one related example in which 3 is a relevant value, and solve or analyze it.

Set 77

- 305.** Solve $2x + 7 = 23$, check the solution, and name the inverse operations used.
- 306.** A student thinks every straight-line graph is proportional. Give an example that disproves the claim and state the missing condition. Then create one related example in which 5 is a relevant value, and solve or analyze it.
- 307.** Revise one earlier question so it has no solution or infinitely many solutions. Explain the change. Then create one related example in which 8 is a relevant value, and solve or analyze it.
- 308.** Find a rational number halfway between -4 and $\frac{4}{2}$. Verify using distances.

Set 78

- 309.** Construct two triangles with side lengths 10, 8, and 17. Are they necessarily congruent? Explain. Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 310.** Estimate and then calculate 2.0×3.3 . Explain whether the decimal placement is reasonable.
- 311.** Simplify $3(2x - 2) + 3(x + 3)$. Use an area model or partial products to verify. Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 312.** A pattern begins 2, 7, 12, 17. Write an explicit rule and explain how the graph reveals it. Then create one related example in which 8 is a relevant value, and solve or analyze it.

Set 79

- 313.** A student thinks every straight-line graph is proportional. Give an example that disproves the claim and state the missing condition. Then create one related example in which 6 is a relevant value, and solve or analyze it.
- 314.** A recipe ratio is 3:8. Change the total while keeping the ratio, then change one part without the other. Which situation remains proportional?
- 315.** Write 60000 in scientific notation and compare its magnitude with 5×10^3 .
- 316.** A tank begins with 107 liters and loses 5 liters per minute. Write and graph a function with a sensible domain.

Set 80

- 317.** A spinner lands on A with probability 0.35. Predict results in 181 spins and describe reasonable experimental variation.
- 318.** Find the slope through (4, 23) and (7, 38). Write the equation.
- 319.** A composite figure consists of a 6-by-7 rectangle and a semicircle with diameter 6. Find its area and perimeter.
- 320.** A student combines $3x + 4$ into $7x$. Diagnose the misconception using two possible values of x . Then create one related example in which 8 is a relevant value, and solve or analyze it.

Phase 9: Probability and sampling

Ideas are mixed intentionally. Look for connections and reuse earlier results.

Set 81

- 321.** Find the GCF and LCM of 42 and 24. Explain a situation in which each would be useful.
- 322.** A diver moves from -12 m to -5 m. Find and interpret the signed change and the distance traveled.
- 323.** A quantity grows from 66 to 81. Find the percent increase. Then find the percent decrease needed to return to 66.
- 324.** Determine whether the pairs $(2, 12)$, $(5, 30)$, $(8, 48)$ form a proportional relationship. Give the constant and equation.

Set 82

- 325.** A student says subtracting always makes a number smaller. Give two counterexamples and refine the statement. Then create one related example in which 8 is a relevant value, and solve or analyze it.
- 326.** Write two different equations with solution $x = 3$. One must include parentheses.
- 327.** A sample of 40 students has 20 who prefer a later start. Estimate the count in a school of 600, then critique the sample.
- 328.** Evaluate $(-3)(8) + 27$. Explain how the sign rules affect the result.

Set 83

- 329.** A restaurant bill is \$91.00. Compare an 18% tip with rounding the bill up and taking 20%. Quantify the difference.
- 330.** Two tiles are selected without replacement from 5 red and 5 blue tiles. Find the probability both are red using a tree or organized fractions. Then create one related example in which 4 is a relevant value, and solve or analyze it.
- 331.** Determine whether the pairs $(2, 14)$, $(5, 35)$, $(8, 56)$ form a proportional relationship. Give the constant and equation.
- 332.** Write a problem connecting two course strands, such as probability and percent or geometry and proportion. Solve it fully. Then create one related example in which 5 is a relevant value, and solve or analyze it.

Set 84

- 333.** A recipe ratio is 6:8. Change the total while keeping the ratio, then change one part without the other. Which situation remains proportional? Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 334.** Find a rational number halfway between -9 and $\frac{8}{2}$. Verify using distances.
- 335.** Which does not belong: a table, graph, equation, and verbal rule you create for one relationship? Give two defensible answers. Then create one related example in which 9 is a relevant value, and solve or analyze it.
- 336.** Compare $y = 6x + 4$ with $y = 7x + 1$. When do the outputs agree?

Set 85

- 337.** Simplify $3(2x - 6) + 3(x + 3)$. Use an area model or partial products to verify. Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 338.** Solve $2x + 7 = 25$, check the solution, and name the inverse operations used.
- 339.** A student combines $3x + 4$ into $7x$. Diagnose the misconception using two possible values of x . Then create one related example in which 9 is a relevant value, and solve or analyze it.
- 340.** Write two different equations with solution $x = 10$. One must include parentheses.

Set 86

- 341.** A transversal crosses parallel lines. One angle is $(4x + 9)^\circ$ and its alternate interior angle is $(6x - 4)^\circ$. Find all distinct angle measures. Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 342.** Design a simulation for the probability of getting at least one head in three coin flips. Then create one related example in which 5 is a relevant value, and solve or analyze it.
- 343.** Estimate and then calculate 3.1×3.4 . Explain whether the decimal placement is reasonable.
- 344.** A quantity grows from 70 to 85. Find the percent increase. Then find the percent decrease needed to return to 70.

Set 87

- 345.** For $y = 6x + 4$, make a table, graph four points, and interpret slope and intercept.
- 346.** A student says subtracting always makes a number smaller. Give two counterexamples and refine the statement. Then create one related example in which 9 is a relevant value, and solve or analyze it.
- 347.** A circle has diameter 8 cm. Find circumference and area exactly and approximately. Explain which uses linear units and which uses square units. Then create one related example in which 6 is a relevant value, and solve or analyze it.

- 348.** Write 70000 in scientific notation and compare its magnitude with 5×10^3 .

Set 88

- 349.** Design a simulation for the probability of getting at least one head in three coin flips. Then create one related example in which 6 is a relevant value, and solve or analyze it.
- 350.** Solve $4(x - 2) = 16$. Explain why division is a useful first or last step.
- 351.** Compare $-\frac{10}{5}$ and $-\frac{11}{7}$. Explain without relying only on decimal approximations.
- 352.** A bag has 4 red, 4 blue, and 5 green tiles. Find the probability of blue, then the probability of not blue.

Set 89

- 353.** Write a problem connecting two course strands, such as probability and percent or geometry and proportion. Solve it fully. Then create one related example in which 6 is a relevant value, and solve or analyze it.
- 354.** Create two different data sets with the same mean 10 but different medians. Explain how you controlled each statistic.
- 355.** A line passes through $(0, 3)$ and rises 4 for every 2 units right. Explain two ways to recognize its equation. Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 356.** A prism has base area 49 cm^2 and height 5 cm. Find volume. Then design different base dimensions with the same volume.

Set 90

- 357.** Estimate and then calculate 7.5×5.8 . Explain whether the decimal placement is reasonable.
- 358.** Compare $-\frac{3}{6}$ and $-\frac{4}{8}$. Explain without relying only on decimal approximations.
- 359.** An item priced \$97.00 is discounted 10% and then taxed 6%. Find the final price and explain the order of operations.
- 360.** Create a proportional comparison in which the option with the larger total price is the better deal. Then create one related example in which 6 is a relevant value, and solve or analyze it.

Phase 10: Statistics and inference

Ideas are mixed intentionally. Look for connections and reuse earlier results.

Set 91

- 361.** A population is 7400 after a 25% increase. Find the original population and check by forward calculation.
- 362.** A composite figure consists of a 6-by-8 rectangle and a semicircle with diameter 6. Find its area and perimeter. Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 363.** Choose one earlier result and solve it with a second representation. What became clearer? Then create one related example in which 9 is a relevant value, and solve or analyze it.
- 364.** An item priced \$75.00 is discounted 10% and then taxed 6%. Find the final price and explain the order of operations.

Set 92

- 365.** Create a proportional comparison in which the option with the larger total price is the better deal. Then create one related example in which 7 is a relevant value, and solve or analyze it.
- 366.** Revise one earlier question so it has no solution or infinitely many solutions. Explain the change. Then create one related example in which 9 is a relevant value, and solve or analyze it.
- 367.** Solve $-6x + 6 > -63$ and graph the solution. Explain when the inequality sign reverses.
- 368.** Find the GCF and LCM of 36 and 54. Explain a situation in which each would be useful.

Set 93

- 369.** Solve $4(x - 5) = 16$. Explain why division is a useful first or last step.
- 370.** A quantity grows from 88 to 103. Find the percent increase. Then find the percent decrease needed to return to 88.
- 371.** Compute $\frac{9}{9} \div \frac{10}{11}$. Explain the reciprocal rule with a measurement context.
- 372.** A scatter plot shows a strong positive association. Write one conclusion that is supported and one causal conclusion that is not. Then create one related example in which 10 is a relevant value, and solve or analyze it.

Set 94

- 373.** Plot a triangle with vertices $(0, 0)$, $(8, 0)$, $(0, 9)$. Reflect it over the x -axis and then translate it right 3. List the final coordinates. Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 374.** A transversal crosses parallel lines. One angle is $(4x + 9)^\circ$ and its alternate interior angle is $(6x - 5)^\circ$. Find all distinct angle measures.
- 375.** Construct two triangles with side lengths 10, 10, and 19. Are they necessarily congruent? Explain. Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 376.** Two angles form a linear pair and measure $(3x + 3)^\circ$ and $(2x + 6)^\circ$. Find x and both angles.

Set 95

- 377.** Find the slope through $(4, 20)$ and $(7, 35)$. Write the equation.
- 378.** A pattern begins 2, 7, 12, 17. Write an explicit rule and explain how the graph reveals it. Then create one related example in which 9 is a relevant value, and solve or analyze it.
- 379.** A student says subtracting always makes a number smaller. Give two counterexamples and refine the statement. Then create one related example in which 10 is a relevant value, and solve or analyze it.
- 380.** A recipe ratio is 3:8. Change the total while keeping the ratio, then change one part without the other. Which situation remains proportional? Then create one related example in which 3 is a relevant value, and solve or analyze it.

Set 96

- 381.** A sample of 49 students has 24 who prefer a later start. Estimate the count in a school of 490, then critique the sample.
- 382.** A population is 7800 after a 25% increase. Find the original population and check by forward calculation.
- 383.** Compare $y = 2x + 0$ with $y = 3x - 3$. When do the outputs agree? Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 384.** Compare $-\frac{2}{5}$ and $-\frac{3}{7}$. Explain without relying only on decimal approximations.

Set 97

- 385.** A pattern begins 2, 7, 12, 17. Write an explicit rule and explain how the graph reveals it. Then create one related example in which 10 is a relevant value, and solve or analyze it.
- 386.** A circle has diameter 8 cm. Find circumference and area exactly and approximately. Explain which uses linear units and which uses square units. Then create one related example in which 7 is a relevant value, and solve or analyze it.

- 387.** Write a percent problem whose answer is 75. Solve it two ways.
- 388.** Make a conjecture about a percent, proportion, or angle pattern. Test it and decide what would count as proof. Then create one related example in which 5 is a relevant value, and solve or analyze it.

Set 98

- 389.** Find the GCF and LCM of 18 and 24. Explain a situation in which each would be useful.
- 390.** Create a real situation modeled by $4x + 4 = 50$, then solve and interpret the answer.
- 391.** Two tiles are selected without replacement from 8 red and 5 blue tiles. Find the probability both are red using a tree or organized fractions. Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 392.** For $y = 5x + 3$, make a table, graph four points, and interpret slope and intercept.

Set 99

- 393.** A student says subtracting always makes a number smaller. Give two counterexamples and refine the statement. Then create one related example in which 11 is a relevant value, and solve or analyze it.
- 394.** Write a percent problem whose answer is 68. Solve it two ways.
- 395.** The graph of a proportional relationship contains $(7, 42)$. Find two more points and explain why the origin must be included.
- 396.** A number is 6 more than 5 times another number, and their sum is 60. Write equations and find both numbers.

Set 100

- 397.** A restaurant bill is \$56.00. Compare an 18% tip with rounding the bill up and taking 20%. Quantify the difference.
- 398.** A prism has base area 56 cm^2 and height 3 cm. Find volume. Then design different base dimensions with the same volume.
- 399.** A pattern begins 2, 7, 12, 17. Write an explicit rule and explain how the graph reveals it. Then create one related example in which 11 is a relevant value, and solve or analyze it.
- 400.** Explain why increasing by 40% and decreasing by 40% do not cancel. Use a numerical example. Then create one related example in which 7 is a relevant value, and solve or analyze it.

Phase 11: Modeling and critique

Ideas are mixed intentionally. Look for connections and reuse earlier results.

Set 101

- 401. A number is 4 more than 5 times another number, and their sum is 34. Write equations and find both numbers.
- 402. Estimate and then calculate 9.7×7.1 . Explain whether the decimal placement is reasonable.
- 403. Plot a triangle with vertices $(0,0)$, $(8,0)$, $(0,7)$. Reflect it over the x -axis and then translate it right 3. List the final coordinates. Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 404. Compute $-10 + 9 - (-12)$ and represent the steps on a number line.

Set 102

- 405. A prism has base area 35 cm^2 and height 8 cm. Find volume. Then design different base dimensions with the same volume.
- 406. A recipe ratio is 7:8. Change the total while keeping the ratio, then change one part without the other. Which situation remains proportional?
- 407. Find a rational number halfway between -4 and $\frac{9}{2}$. Verify using distances.
- 408. Which does not belong: a table, graph, equation, and verbal rule you create for one relationship? Give two defensible answers. Then create one related example in which 10 is a relevant value, and solve or analyze it.

Set 103

- 409. Compare $y = 4x - 4$ with $y = 5x - 7$. When do the outputs agree? Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 410. Find the slope through $(4,13)$ and $(7,22)$. Write the equation.
- 411. For $y = 2x - 3$, make a table, graph four points, and interpret slope and intercept. Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 412. A student thinks every straight-line graph is proportional. Give an example that disproves the claim and state the missing condition. Then create one related example in which 7 is a relevant value, and solve or analyze it.

Set 104

- 413.** Create two different data sets with the same mean 16 but different medians. Explain how you controlled each statistic. Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 414.** Write 600000 in scientific notation and compare its magnitude with 10×10^4 . Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 415.** A population is 5300 after a 25% increase. Find the original population and check by forward calculation.
- 416.** Solve $4(x - 2) = 24$. Explain why division is a useful first or last step.

Set 105

- 417.** Choose one earlier result and solve it with a second representation. What became clearer? Then create one related example in which 10 is a relevant value, and solve or analyze it.
- 418.** Determine whether the pairs (2, 4), (5, 10), (8, 16) form a proportional relationship. Give the constant and equation.
- 419.** A scatter plot shows a strong positive association. Write one conclusion that is supported and one causal conclusion that is not. Then create one related example in which 11 is a relevant value, and solve or analyze it.
- 420.** Write a percent problem whose answer is 50. Solve it two ways.

Set 106

- 421.** Write 800 in scientific notation and compare its magnitude with 3×10^1 .
- 422.** A tank begins with 133 liters and loses 7 liters per minute. Write and graph a function with a sensible domain.
- 423.** A scale drawing uses 4 cm for 24 m. A wall measures 5.5 cm. Find the actual length and state the scale factor. Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 424.** Write 0.85 as a fraction and percent. Place all three forms on a number line.

Set 107

- 425.** Compute $-7 + 4 - (-9)$ and represent the steps on a number line.
- 426.** Create an expression involving rational numbers whose value is exactly 3. Show two different evaluation paths. Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 427.** Revise one earlier question so it has no solution or infinitely many solutions. Explain the change. Then create one related example in which 10 is a relevant value, and solve or analyze it.
- 428.** A sample of 62 students has 17 who prefer a later start. Estimate the count in a school of 420, then critique the sample.

Set 108

- 429.** A population is 10000 after a 25% increase. Find the original population and check by forward calculation.
- 430.** A scale drawing uses 5 cm for 30 m. A wall measures 5.5 cm. Find the actual length and state the scale factor.
- 431.** Simplify $3(2x - 5) + 3(x + 3)$. Use an area model or partial products to verify.
- 432.** Plot a triangle with vertices $(0, 0)$, $(8, 0)$, $(0, 5)$. Reflect it over the x -axis and then translate it right 3. List the final coordinates. Then create one related example in which 3 is a relevant value, and solve or analyze it.

Set 109

- 433.** Create a proportional comparison in which the option with the larger total price is the better deal. Then create one related example in which 8 is a relevant value, and solve or analyze it.
- 434.** Create a nonproportional linear relationship with slope 3. Give a context, table, and equation.
- 435.** Write 6000 in scientific notation and compare its magnitude with 8×10^2 .
- 436.** Plan A costs \$12.00 per use. Plan B costs \$21.00 plus \$10.00 per use. When are the costs equal? Then create one related example in which 5 is a relevant value, and solve or analyze it.

Set 110

- 437.** Solve $4(x - 5) = 0$. Explain why division is a useful first or last step.
- 438.** Write 0.71 as a fraction and percent. Place all three forms on a number line.
- 439.** A transversal crosses parallel lines. One angle is $(4x + 9)^\circ$ and its alternate interior angle is $(6x - 7)^\circ$. Find all distinct angle measures.
- 440.** A student says subtracting always makes a number smaller. Give two counterexamples and refine the statement. Then create one related example in which 12 is a relevant value, and solve or analyze it.

Phase 12: Multi-step investigations

Ideas are mixed intentionally. Look for connections and reuse earlier results.

Set 111

- 441.** A tank begins with 100 liters and loses 4 liters per minute. Write and graph a function with a sensible domain.
- 442.** Solve $4(x - 6) = -8$. Explain why division is a useful first or last step.
- 443.** A quantity grows from 92 to 107. Find the percent increase. Then find the percent decrease needed to return to 92.
- 444.** Compute $\frac{4}{10} \div \frac{5}{12}$. Explain the reciprocal rule with a measurement context.

Set 112

- 445.** A scatter plot shows a strong positive association. Write one conclusion that is supported and one causal conclusion that is not. Then create one related example in which 12 is a relevant value, and solve or analyze it.
- 446.** Create two different data sets with the same mean 8 but different medians. Explain how you controlled each statistic. Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 447.** A sample of 59 students has 29 who prefer a later start. Estimate the count in a school of 690, then critique the sample.
- 448.** Design a simulation for the probability of getting at least one head in three coin flips. Then create one related example in which 7 is a relevant value, and solve or analyze it.

Set 113

- 449.** Create a real situation modeled by $4x + 8 = 50$, then solve and interpret the answer.
- 450.** Compare $-\frac{10}{10}$ and $-\frac{11}{12}$. Explain without relying only on decimal approximations. Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 451.** Determine whether the pairs $(2, 4)$, $(5, 10)$, $(8, 16)$ form a proportional relationship. Give the constant and equation. Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 452.** A circle has diameter 8 cm. Find circumference and area exactly and approximately. Explain which uses linear units and which uses square units. Then create one related example in which 8 is a relevant value, and solve or analyze it.

Set 114

- 453.** Between which integers does $\sqrt{26}$ lie? Justify using perfect squares.
- 454.** Solve $-6x + 1 > -62$ and graph the solution. Explain when the inequality sign reverses.
- 455.** Which does not belong: a table, graph, equation, and verbal rule you create for one relationship? Give two defensible answers. Then create one related example in which 11 is a relevant value, and solve or analyze it.
- 456.** A scale drawing uses 4 cm for 24 m. A wall measures 5.5 cm. Find the actual length and state the scale factor. Then create one related example in which 4 is a relevant value, and solve or analyze it.

Set 115

- 457.** Compare $-\frac{3}{3}$ and $-\frac{4}{5}$. Explain without relying only on decimal approximations.
- 458.** A bag has 6 red, 4 blue, and 3 green tiles. Find the probability of blue, then the probability of not blue.
- 459.** A student combines $3x + 4$ into $7x$. Diagnose the misconception using two possible values of x . Then create one related example in which 10 is a relevant value, and solve or analyze it.
- 460.** Create three rational numbers with sum zero, none of which are opposites of another. Show the sum. Then create one related example in which 6 is a relevant value, and solve or analyze it.

Set 116

- 461.** Store A offers 30% off; Store B offers buy 3, get 1 free. For equally priced items, which deal is better? Explain assumptions. Then create one related example in which 5 is a relevant value, and solve or analyze it.
- 462.** Evaluate $(-7)(5) + 38$. Explain how the sign rules affect the result.
- 463.** Estimate and then calculate 3.1×6.4 . Explain whether the decimal placement is reasonable.
- 464.** Choose one earlier result and solve it with a second representation. What became clearer? Then create one related example in which 11 is a relevant value, and solve or analyze it.

Set 117

- 465.** Determine whether the pairs $(2, 8)$, $(5, 20)$, $(8, 32)$ form a proportional relationship. Give the constant and equation. Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 466.** A student combines $3x + 4$ into $7x$. Diagnose the misconception using two possible values of x . Then create one related example in which 11 is a relevant value, and solve or analyze it.
- 467.** A prism has base area 28 cm^2 and height 7 cm. Find volume. Then design different base dimensions with the same volume.

- 468.** A line passes through $(0, 1)$ and rises 12 for every 2 units right. Explain two ways to recognize its equation.

Set 118

- 469.** A number is 4 more than 5 times another number, and their sum is 64. Write equations and find both numbers.
- 470.** A spinner lands on A with probability 0.35. Predict results in 180 spins and describe reasonable experimental variation.
- 471.** Compare $-\frac{10}{8}$ and $-\frac{11}{10}$. Explain without relying only on decimal approximations.
- 472.** Solve $2x + 7 = 21$, check the solution, and name the inverse operations used.

Set 119

- 473.** A prism has base area 70 cm^2 and height 8 cm. Find volume. Then design different base dimensions with the same volume.
- 474.** Create three rational numbers with sum zero, none of which are opposites of another. Show the sum. Then create one related example in which 7 is a relevant value, and solve or analyze it.
- 475.** A line passes through $(0, 3)$ and rises 10 for every 2 units right. Explain two ways to recognize its equation. Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 476.** A population is 8600 after a 25% increase. Find the original population and check by forward calculation.

Set 120

- 477.** Compare $y = 6x + 1$ with $y = 7x - 2$. When do the outputs agree?
- 478.** Simplify $3(2x - 7) + 3(x + 3)$. Use an area model or partial products to verify. Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 479.** An item priced \$62.00 is discounted 10% and then taxed 6%. Find the final price and explain the order of operations.
- 480.** Create an expression involving rational numbers whose value is exactly 4. Show two different evaluation paths. Then create one related example in which 3 is a relevant value, and solve or analyze it.

Phase 13: Synthesis and creation

Ideas are mixed intentionally. Look for connections and reuse earlier results.

Set 121

- 481. Which does not belong: a table, graph, equation, and verbal rule you create for one relationship? Give two defensible answers. Then create one related example in which 12 is a relevant value, and solve or analyze it.
- 482. Create a real situation modeled by $4x + 8 = 50$, then solve and interpret the answer. Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 483. Choose one earlier result and solve it with a second representation. What became clearer? Then create one related example in which 12 is a relevant value, and solve or analyze it.
- 484. A pattern begins 2, 7, 12, 17. Write an explicit rule and explain how the graph reveals it. Then create one related example in which 12 is a relevant value, and solve or analyze it.

Set 122

- 485. Create an expression involving rational numbers whose value is exactly 9. Show two different evaluation paths. Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 486. Write a percent problem whose answer is 97. Solve it two ways.
- 487. Solve $-6x + 1 > -68$ and graph the solution. Explain when the inequality sign reverses.
- 488. A tank begins with 93 liters and loses 3 liters per minute. Write and graph a function with a sensible domain.

Set 123

- 489. A diver moves from -32 m to -10 m. Find and interpret the signed change and the distance traveled.
- 490. Two angles form a linear pair and measure $(3x + 3)^\circ$ and $(2x + 6)^\circ$. Find x and both angles. Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 491. Compute $\frac{9}{4} \div \frac{10}{6}$. Explain the reciprocal rule with a measurement context. Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 492. A student combines $3x + 4$ into $7x$. Diagnose the misconception using two possible values of x . Then create one related example in which 12 is a relevant value, and solve or analyze it.

Set 124

- 493.** Write a percent problem whose answer is 90. Solve it two ways.
- 494.** Make a conjecture about a percent, proportion, or angle pattern. Test it and decide what would count as proof. Then create one related example in which 6 is a relevant value, and solve or analyze it.
- 495.** A scale factor of $\frac{3}{2}$ is applied to a rectangle 5 by 10. Compare the old and new perimeters and areas.
- 496.** A restaurant bill is \$103.00. Compare an 18% tip with rounding the bill up and taking 20%. Quantify the difference.

Set 125

- 497.** A car travels 54 miles in 4 hours. At the same rate, how far in 6.5 hours? Show a table and equation.
- 498.** An item priced \$87.00 is discounted 10% and then taxed 6%. Find the final price and explain the order of operations.
- 499.** A student says subtracting always makes a number smaller. Give two counterexamples and refine the statement. Then create one related example in which 13 is a relevant value, and solve or analyze it.
- 500.** Between which integers does $\sqrt{16}$ lie? Justify using perfect squares.

Set 126

- 501.** Solve $-6x + 3 > -36$ and graph the solution. Explain when the inequality sign reverses.
- 502.** A composite figure consists of a 6-by-12 rectangle and a semicircle with diameter 6. Find its area and perimeter.
- 503.** Compare $y = 5x + 0$ with $y = 6x - 3$. When do the outputs agree? Then create one related example in which 4 is a relevant value, and solve or analyze it.
- 504.** Two tiles are selected without replacement from 6 red and 5 blue tiles. Find the probability both are red using a tree or organized fractions.

Set 127

- 505.** A composite figure consists of a 6-by-6 rectangle and a semicircle with diameter 6. Find its area and perimeter.
- 506.** Write a problem connecting two course strands, such as probability and percent or geometry and proportion. Solve it fully. Then create one related example in which 7 is a relevant value, and solve or analyze it.
- 507.** Write a percent problem whose answer is 40. Solve it two ways.
- 508.** A transversal crosses parallel lines. One angle is $(4x + 9)^\circ$ and its alternate interior angle is $(6x - 12)^\circ$. Find all distinct angle measures.

Set 128

- 509.** A tank begins with 132 liters and loses 6 liters per minute. Write and graph a function with a sensible domain.
- 510.** A restaurant bill is \$89.00. Compare an 18% tip with rounding the bill up and taking 20%. Quantify the difference.
- 511.** Two tiles are selected without replacement from 5 red and 5 blue tiles. Find the probability both are red using a tree or organized fractions. Then create one related example in which 5 is a relevant value, and solve or analyze it.
- 512.** Determine whether the pairs $(2, 18)$, $(5, 45)$, $(8, 72)$ form a proportional relationship. Give the constant and equation. Then create one related example in which 4 is a relevant value, and solve or analyze it.

Set 129

- 513.** A scatter plot shows a strong positive association. Write one conclusion that is supported and one causal conclusion that is not. Then create one related example in which 13 is a relevant value, and solve or analyze it.
- 514.** A transversal crosses parallel lines. One angle is $(4x + 9)^\circ$ and its alternate interior angle is $(6x - 9)^\circ$. Find all distinct angle measures.
- 515.** The graph of a proportional relationship contains $(7, 63)$. Find two more points and explain why the origin must be included. Then create one related example in which 3 is a relevant value, and solve or analyze it.
- 516.** Evaluate $(-8)(3) + 27$. Explain how the sign rules affect the result.

Set 130

- 517.** Create a real situation modeled by $4x + 8 = 50$, then solve and interpret the answer. Then create one related example in which 4 is a relevant value, and solve or analyze it.
- 518.** Choose one earlier result and solve it with a second representation. What became clearer? Then create one related example in which 13 is a relevant value, and solve or analyze it.
- 519.** A pattern begins 2, 7, 12, 17. Write an explicit rule and explain how the graph reveals it. Then create one related example in which 13 is a relevant value, and solve or analyze it.
- 520.** Write a problem connecting two course strands, such as probability and percent or geometry and proportion. Solve it fully. Then create one related example in which 8 is a relevant value, and solve or analyze it.

Capstone Invitations

1. Connect one problem to a table, graph, equation, or diagram and explain what each representation contributes.
2. Choose a claim suggested by an earlier problem. Decide whether it is always, sometimes, or never true.
3. Create two problems with the same mathematical structure but different stories.
4. Revise an earlier solution into a polished explanation for a classmate.
5. Design and solve a problem that connects at least two major course ideas.

An original Tower School resource inspired by the problem-centered tradition described by Phillips Exeter Academy. This is not an Exeter problem set.