

RATIOS, RATES, AND PROPORTIONS FOR AMC 8

ANDY JO

CONTENTS

1. Ratios	2
1.1. Part-to-Part and Part-to-Whole Ratios	2
1.2. Three-Term Ratios	3
2. Proportions	4
2.1. Setting Up a Proportion	4
2.2. Scaling	6
3. Rates	7
3.1. Unit Rates	7
3.2. Unit Conversion	8
4. Problems	10

1. RATIOS

A **ratio** compares two quantities. If a class has 12 boys and 18 girls, the ratio of boys to girls is 12 to 18. A ratio can be written with a colon (12 : 18), as a fraction ($\frac{12}{18}$), or in words. Order matters: the ratio of girls to boys is 18 : 12.

Multiplying or dividing both terms of a ratio by the same positive number gives an **equivalent ratio**, which makes the same comparison. Dividing both terms of 12 : 18 by 6 gives 2 : 3, the ratio in **lowest terms**: the class has 2 boys for every 3 girls.

A ratio gives the relative sizes of two quantities, not the quantities themselves. A class with 2 boys for every 3 girls could have 2 boys and 3 girls, 4 boys and 6 girls, or 20 boys and 30 girls. In general, it has $2k$ boys and $3k$ girls for some positive number k . Think of the class as split into equal parts, 2 parts boys and 3 parts girls, with k students in each part. Most ratio problems come down to finding k .

Definition 1.1. For positive A, B, a, b , the quantities A and B are in the ratio $a : b$ if $\frac{A}{B} = \frac{a}{b}$. Equivalently, $A = ak$ and $B = bk$ for some positive number k , called the **size of one part**.

1.1. Part-to-Part and Part-to-Whole Ratios. A ratio can compare one part of a group with another part, a **part-to-part ratio**, or one part with the whole group, a **part-to-whole ratio**. Suppose a bag holds only red and blue marbles, in the ratio 3 : 2. This ratio of red marbles to blue marbles is part to part. The whole bag is $3 + 2 = 5$ parts, so the ratio of red marbles to all marbles is 3 : 5. This part-to-whole ratio is the fraction $\frac{3}{5}$: three fifths of the marbles are red, and two fifths are blue.

Proposition 1.1.1. Suppose a whole consists of two parts A and B in the ratio $a : b$. Then

$$A = \frac{a}{a+b} \times (\text{whole}) \quad \text{and} \quad B = \frac{b}{a+b} \times (\text{whole}).$$

If $b > a$, the difference $B - A$ is $b - a$ parts.

Proof. Write $A = ak$ and $B = bk$. The whole is $A + B = (a + b)k$, so k is the whole divided by $a + b$, and $A = ak$ and $B = bk$ give the two formulas. The difference is $B - A = (b - a)k$. $\square$

So when a problem gives the whole or the difference, divide it by the matching number of parts to find the size of one part, then multiply.

A part-to-whole ratio is a fraction of one particular whole. To combine two groups, such as the students of two schools, find the number in each part of each group and add those numbers. Adding or averaging the fractions themselves gives the wrong answer when the groups have different sizes.

Examples.

Problem 1.1.2 (1985 AJHSME, Problem #16). The ratio of boys to girls in Mr. Brown's math class is 2 : 3. If there are 30 students in the class, how many more girls than boys are in the class?

(A) 1 (B) 3 (C) 5 (D) 6 (E) 10

Strategy. The class is $2 + 3 = 5$ equal parts. Find the size of one part.

Solution. The 30 students make up 5 equal parts, so each part has $\frac{30}{5} = 6$ students. There are $2 \cdot 6 = 12$ boys and $3 \cdot 6 = 18$ girls, so there are $18 - 12 = 6$ more girls than boys. Directly, the difference is $3 - 2 = 1$ part, which is 6 students.

Answer: (D) 6. $\square$

Problem 1.1.3 (2011 AMC 8, Problem #14). There are 270 students at Colfax Middle School, where the ratio of boys to girls is $5 : 4$. There are 180 students at Winthrop Middle School, where the ratio of boys to girls is $4 : 5$. The two schools hold a dance and all students from both schools attend. What fraction of the students at the dance are girls?

- (A) $\frac{7}{18}$ (B) $\frac{7}{15}$ (C) $\frac{22}{45}$ (D) $\frac{1}{2}$ (E) $\frac{23}{45}$

Strategy. The two schools have different numbers of students, so their ratios cannot be combined directly. Count the girls at each school.

Solution. At Colfax, the 270 students make up $5 + 4 = 9$ parts of $\frac{270}{9} = 30$ students each, so there are $4 \cdot 30 = 120$ girls. At Winthrop, the 180 students make up $4 + 5 = 9$ parts of $\frac{180}{9} = 20$ students each, so there are $5 \cdot 20 = 100$ girls. The dance has $120 + 100 = 220$ girls out of $270 + 180 = 450$ students, so the fraction of girls is

$$\frac{220}{450} = \frac{22}{45}.$$

Averaging the fractions of girls at the two schools, $\frac{4}{9}$ and $\frac{5}{9}$, would give $\frac{1}{2}$. That is wrong because Colfax, the school with the smaller fraction of girls, also has more students.

Answer: (C) $\frac{22}{45}$. □

1.2. Three-Term Ratios. A ratio can compare three or more quantities. If the numbers of red, white, and blue beads in a jar are in the ratio $2 : 3 : 5$, then for some positive number k the jar holds $2k$ red, $3k$ white, and $5k$ blue beads. The whole is $2 + 3 + 5 = 10$ parts, so $\frac{2}{10} = \frac{1}{5}$ of the beads are red, $\frac{3}{10}$ are white, and $\frac{5}{10} = \frac{1}{2}$ are blue. Any two of the quantities, or one quantity and the whole, also form a ratio: red to blue is $2 : 5$, and white to all beads is $3 : 10$.

Some problems give two ratios with a quantity in common and ask about all three quantities. Suppose $A : B = 2 : 3$ and $B : C = 4 : 5$. Here B is 3 parts in the first ratio and 4 parts in the second, so the parts of the two ratios have different sizes, and the ratios cannot be joined yet. Scale both so that B has the same number of parts in each, using the least common multiple of 3 and 4, which is 12:

$$A : B = (2 \cdot 4) : (3 \cdot 4) = 8 : 12, \quad B : C = (4 \cdot 3) : (5 \cdot 3) = 12 : 15.$$

Now all the parts have the same size, so $A : B : C = 8 : 12 : 15$. In particular, $A : C = 8 : 15$.

Examples.

Problem 1.2.1 (2003 AMC 12A, Problem #10). Al, Bert, and Carl are the winners of a school drawing for a pile of Halloween candy, which they are to divide in a ratio of $3 : 2 : 1$, respectively. Due to some confusion they come at different times to claim their prizes, and each assumes he is the first to arrive. If each takes what he believes to be his correct share of candy, what fraction of the candy goes unclaimed?

- (A) $\frac{1}{18}$ (B) $\frac{1}{6}$ (C) $\frac{2}{9}$ (D) $\frac{5}{18}$ (E) $\frac{5}{12}$

Strategy. Write each share as a fraction of the whole pile. Each winner takes that fraction of the candy he finds, not of the original pile.

Solution. The ratio $3 : 2 : 1$ splits the candy into $3 + 2 + 1 = 6$ equal parts, so the correct shares are $\frac{3}{6} = \frac{1}{2}$ of the pile for Al, $\frac{2}{6} = \frac{1}{3}$ for Bert, and $\frac{1}{6}$ for Carl. Each winner takes his fraction of the

candy that is there when he arrives. Taking $\frac{1}{2}$ of a pile leaves $\frac{1}{2}$ of it, taking $\frac{1}{3}$ leaves $\frac{2}{3}$ of it, and taking $\frac{1}{6}$ leaves $\frac{5}{6}$ of it. In whatever order they arrive, the candy left at the end is

$$\frac{1}{2} \cdot \frac{2}{3} \cdot \frac{5}{6} = \frac{10}{36} = \frac{5}{18}$$

of the original pile. For example, in the order Al, Bert, Carl, Al takes $\frac{1}{2}$ of the pile, Bert takes $\frac{1}{3} \cdot \frac{1}{2} = \frac{1}{6}$, and Carl takes $\frac{1}{6} \cdot \frac{1}{3} = \frac{1}{18}$, which leaves $1 - \frac{1}{2} - \frac{1}{6} - \frac{1}{18} = \frac{5}{18}$.

Answer: (D) $\frac{5}{18}$. □

Problem 1.2.2 (2013 AMC 8, Problem #16). A number of students from Fibonacci Middle School are taking part in a community service project. The ratio of 8th-graders to 6th-graders is $5 : 3$, and the ratio of 8th-graders to 7th-graders is $8 : 5$. What is the smallest number of students that could be participating in the project?

(A) 16 (B) 40 (C) 55 (D) 79 (E) 89

Strategy. Both ratios involve the 8th-graders. Scale the ratios so that the 8th-graders have the same number of parts in each, then combine them into one three-term ratio.

Solution. The 8th-graders are 5 parts in the first ratio and 8 parts in the second. The least common multiple of 5 and 8 is 40, so

$$5 : 3 = 40 : 24 \quad \text{and} \quad 8 : 5 = 40 : 25,$$

and the ratio of 8th-graders to 6th-graders to 7th-graders is $40 : 24 : 25$.

With k students in each part, there are $40k$ eighth-graders, $24k$ sixth-graders, and $25k$ seventh-graders, or $89k$ students in all. The number of 7th-graders minus the number of 6th-graders is $25k - 24k = k$, so k is a whole number, and $k \geq 1$. The smallest possible number of students is therefore 89, with 40 eighth-graders, 24 sixth-graders, and 25 seventh-graders.

Answer: (E) 89. □

2. PROPORTIONS

2.1. Setting Up a Proportion. A **proportion** is an equation stating that two ratios are equal, such as $\frac{a}{b} = \frac{c}{d}$. When three of the four numbers are known, the proportion determines the fourth.

Proposition 2.1.1 (Cross-Multiplication). If b and d are not zero, then $\frac{a}{b} = \frac{c}{d}$ exactly when $ad = bc$.

Proof. Multiplying both sides of $\frac{a}{b} = \frac{c}{d}$ by bd gives $ad = bc$, and dividing both sides of $ad = bc$ by bd gives the proportion back. □

To set up a proportion, write both ratios in the same order, with matching quantities in matching places. For example, suppose the ratio of students to teachers at a school is 20 to 1, and the school has 300 students and t teachers. Both fractions below are students over teachers:

$$\frac{20}{1} = \frac{300}{t} \quad \Rightarrow \quad 20t = 300 \quad \Rightarrow \quad t = 15.$$

The equation $\frac{20}{1} = \frac{t}{300}$ is not a correct proportion here, because its left side is students over teachers and its right side is teachers over students.

A proportion also handles a ratio that changes. Write the starting amounts in terms of the size of one part k , apply the change, and set the new ratio equal to the given one. The second example below does this.

Examples.

Problem 2.1.2 (2009 AMC 8, Problem #2). On average, for every 4 sports cars sold at the local car dealership, 7 sedans are sold. The dealership predicts that it will sell 28 sports cars next month. How many sedans does it expect to sell?

- (A) 7 (B) 32 (C) 35 (D) 49 (E) 112

Strategy. Set the ratio of sports cars to sedans next month equal to 4 : 7.

Solution. Let s be the number of sedans. Both fractions below are sports cars over sedans:

$$\frac{4}{7} = \frac{28}{s} \quad \Rightarrow \quad 4s = 7 \cdot 28 = 196 \quad \Rightarrow \quad s = 49.$$

Alternatively, 28 sports cars are $\frac{28}{4} = 7$ groups of 4, and each group comes with 7 sedans, so the dealership expects to sell $7 \cdot 7 = 49$ sedans.

Answer: (D) 49. □

Problem 2.1.3. The ratio of boys to girls in a club is 5 : 3. Then 2 boys leave the club and 3 girls join it, and the ratio of boys to girls becomes 4 : 3. How many students were in the club at the start?

Strategy. Write the starting numbers as $5k$ boys and $3k$ girls, apply the changes, and set the new ratio equal to 4 : 3.

Solution. At the start there are $5k$ boys and $3k$ girls. After the changes there are $5k - 2$ boys and $3k + 3$ girls, so

$$\frac{5k - 2}{3k + 3} = \frac{4}{3} \quad \Rightarrow \quad 3(5k - 2) = 4(3k + 3) \quad \Rightarrow \quad 15k - 6 = 12k + 12 \quad \Rightarrow \quad k = 6,$$

where the first step is cross-multiplication. The club had $5k + 3k = 8k = 48$ students at the start. To check, 30 boys and 18 girls become 28 boys and 21 girls, and $28 : 21 = 4 : 3$.

Answer: 48. □

Problem 2.1.4 (2018 AMC 8, Problem #12). The clock in Sri's car, which is not accurate, gains time at a constant rate. One day as he begins shopping he notes that his car clock and his watch (which is accurate) both say 12:00 noon. When he is done shopping, his watch says 12:30 and his car clock says 12:35. Later that day, Sri loses his watch. He looks at his car clock and it says 7:00. What is the actual time?

- (A) 5:50 (B) 6:00 (C) 6:30 (D) 6:55 (E) 8:10

Strategy. The clock gains time at a constant rate, so the time that actually passes and the time the car clock shows passing, both counted from noon, are always in the same ratio.

Solution. While 30 minutes actually pass, the car clock moves ahead 35 minutes, so

$$\text{actual time passed} : \text{car clock time passed} = 30 : 35 = 6 : 7.$$

When the car clock says 7:00, it has moved ahead 7 hours since noon. If t hours have actually passed, then

$$\frac{t}{7} = \frac{6}{7} \quad \Rightarrow \quad t = 6.$$

Six hours after noon, the actual time is 6:00.

Answer: (B) 6:00. □

2.2. Scaling. To scale a group of quantities is to multiply all of them by the same positive number, called the **scale factor**. Scaling does not change any ratio among the quantities, because both terms of each ratio are multiplied by the same number. Scaling comes up in three common settings.

- *Recipes.* A recipe for m servings becomes a recipe for n servings when every ingredient is multiplied by $\frac{n}{m}$. For example, a recipe for 4 servings that uses 6 eggs needs $6 \cdot \frac{10}{4} = 15$ eggs for 10 servings.
- *Scale models and drawings.* A model built at a scale of $1 : 20$ has every length equal to $\frac{1}{20}$ of the real length. The scale factor is $\frac{1}{20}$ from the real object to the model, and 20 from the model to the real object.
- *Maps.* A map scale such as “1 centimeter represents 6 kilometers” means that each centimeter on the map stands for 6 kilometers, so a 5-centimeter line on the map stands for $5 \cdot 6 = 30$ kilometers.

A recipe can be scaled up only as far as the ingredients on hand allow.

Proposition 2.2.1 (Limiting Ingredient). For each ingredient, divide the amount on hand by the amount one batch uses. The smallest of these quotients is the largest number of batches that can be made, allowing part of a batch, and its ingredient is the first to run out.

Proof. Making s batches uses s times the amount of each ingredient in one batch. This is possible exactly when s is at most the quotient for every ingredient, so the largest possible s is the smallest quotient. $\square$

Examples.

Problem 2.2.2 (2018 AMC 8, Problem #1). An amusement park has a collection of scale models, with a ratio of $1 : 20$, of buildings and other sights from around the country. The height of the United States Capitol is 289 feet. What is the height in feet of its replica at this park, rounded to the nearest whole number?

- (A) 14 (B) 15 (C) 16 (D) 18 (E) 20

Strategy. A scale of $1 : 20$ means that each length on the model is $\frac{1}{20}$ of the real length.

Solution. The replica is $\frac{289}{20} = 14.45$ feet tall, which rounds to 14 feet.

Answer: (A) 14. $\square$

Problem 2.2.3 (2009 AMC 8, Problem #15). A recipe that makes 5 servings of hot chocolate requires 2 squares of chocolate, $\frac{1}{4}$ cup sugar, 1 cup water and 4 cups milk. Jordan has 5 squares of chocolate, 2 cups of sugar, lots of water, and 7 cups of milk. If she maintains the same ratio of ingredients, what is the greatest number of servings of hot chocolate she can make?

- (A) $5\frac{1}{8}$ (B) $6\frac{1}{4}$ (C) $7\frac{1}{2}$ (D) $8\frac{3}{4}$ (E) $9\frac{7}{8}$

Strategy. Find how many batches of the recipe each ingredient allows. The smallest number decides.

Solution. One batch makes 5 servings. The ingredients on hand allow

$$\text{chocolate: } \frac{5}{2} = 2\frac{1}{2}, \quad \text{sugar: } \frac{2}{1/4} = 8, \quad \text{milk: } \frac{7}{4} = 1\frac{3}{4}$$

batches, and the water allows any number. The milk runs out first, so Jordan can make $1\frac{3}{4}$ batches, which is $\frac{7}{4} \times 5 = \frac{35}{4} = 8\frac{3}{4}$ servings.

Answer: (D) $8\frac{3}{4}$. $\square$

3. RATES

3.1. Unit Rates. A **rate** is a ratio of two quantities measured in different units, such as 150 miles in 3 hours, or \$5 for 4 boxes. A **unit rate** gives the amount for one unit of the second quantity, and it is found by dividing: 150 miles in 3 hours is $\frac{150}{3} = 50$ miles per hour. The word “per” means “for each.” A speed is a unit rate, so 50 miles per hour means 50 miles in each hour.

Proposition 3.1.1. If a rate stays the same, then

$$\text{amount} = \text{unit rate} \times \text{number of units}, \quad \text{so} \quad \text{number of units} = \frac{\text{amount}}{\text{unit rate}}.$$

For example, at 50 miles per hour a car travels $50 \cdot 4 = 200$ miles in 4 hours, and it needs $\frac{300}{50} = 6$ hours to travel 300 miles. A unit rate is the scale factor from one quantity to the other.

Every rate gives two unit rates, each the reciprocal of the other. The rate \$5 for 4 boxes is $\frac{5}{4} = \$1.25$ per box, and also $\frac{4}{5} = 0.8$ box per dollar. Use the one whose units fit the question: dollars per box to find the cost of 6 boxes ($6 \cdot 1.25 = \$7.50$), and boxes per dollar to find how many boxes \$20 buys ($20 \cdot 0.8 = 16$). In the same way, a speed of 10 miles per hour is also $\frac{60}{10} = 6$ minutes per mile.

Unit rates compare two rates directly. A 12-ounce box of cereal for \$3.00 costs $\frac{300}{12} = 25$ cents per ounce, while an 18-ounce box for \$4.32 costs $\frac{432}{18} = 24$ cents per ounce, so the larger box is the better buy.

Two more facts follow from the meaning of a unit rate.

Remark 3.1.2. If one rate is k times another, then in the same time it produces k times as much, and it needs only $\frac{1}{k}$ of the time to produce the same amount. A cyclist who rides three times as fast as a friend walks covers three times the distance in any given time, and covers any given distance in one third of the time.

Remark 3.1.3. When several workers or machines work at the same time, the amounts they finish in each unit of time add up, so their rates add. Two hoses that each supply 3 gallons per minute together supply 6 gallons per minute.

Examples.

Problem 3.1.4 (2006 AMC 8, Problem #3). Elisa swims laps in the pool. When she first started, she completed 10 laps in 25 minutes. Now, she can finish 12 laps in 24 minutes. By how many minutes has she improved her lap time?

- (A) $\frac{1}{2}$ (B) $\frac{3}{4}$ (C) 1 (D) 2 (E) 3

Strategy. Her lap time is a unit rate in minutes per lap. Compute it before and after.

Solution. At first her lap time was $\frac{25}{10} = 2\frac{1}{2}$ minutes per lap. Now it is $\frac{24}{12} = 2$ minutes per lap. She has improved her lap time by $2\frac{1}{2} - 2 = \frac{1}{2}$ minute.

Answer: (A) $\frac{1}{2}$. □

Problem 3.1.5 (2018 AMC 8, Problem #6). On a trip to the beach, Anh traveled 50 miles on the highway and 10 miles on a coastal access road. He drove three times as fast on the highway as on the coastal road. If Anh spent 30 minutes driving on the coastal road, how many minutes did his entire trip take?

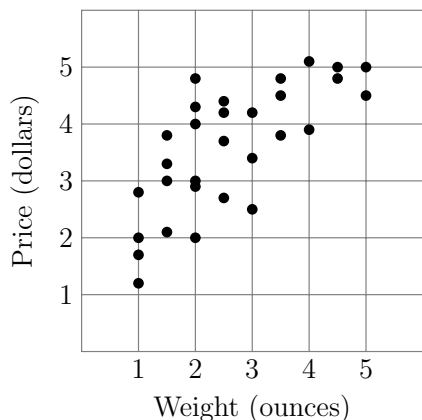
- (A) 50 (B) 70 (C) 80 (D) 90 (E) 100

Strategy. Find his speed on the coastal road as a unit rate in minutes per mile. On the highway, each mile takes one third as long.

Solution. On the coastal road, Anh drove 10 miles in 30 minutes, which is $\frac{30}{10} = 3$ minutes per mile. On the highway he drove three times as fast, so each mile took one third as long, 1 minute. The 50 highway miles took $50 \cdot 1 = 50$ minutes, and the whole trip took $30 + 50 = 80$ minutes.

Answer: (C) 80. □

Problem 3.1.6 (2022 AMC 8, Problem #15). Laszlo went online to shop for black pepper and found thirty different black pepper options varying in weight and price, shown in the scatter plot below. In ounces, what is the weight of the pepper that offers the lowest price per ounce?



- (A) 1 (B) 2 (C) 3 (D) 4 (E) 5

Strategy. At a fixed weight, the cheapest option has the lowest price per ounce, so only the lowest point above each weight matters. Compare the unit prices of those points.

Solution. The lowest points above the whole-number weights give these unit prices:

Weight (ounces)	1	2	3	4	5
Lowest price (dollars)	1.20	2.00	2.50	3.90	4.50
Price per ounce (cents)	120	100	$83\frac{1}{3}$	$97\frac{1}{2}$	90

Every option at $1\frac{1}{2}$, $2\frac{1}{2}$, $3\frac{1}{2}$, or $4\frac{1}{2}$ ounces costs more dollars than its weight in ounces, so it costs more than 100 cents per ounce. The lowest price per ounce, about 83 cents, belongs to the 3-ounce option that costs \$2.50.

Answer: (C) 3. □

3.2. Unit Conversion. A rate is often given in one unit and needed in another, such as additions per second and additions per hour. Since 1 hour is 60 minutes, the fraction $\frac{60 \text{ minutes}}{1 \text{ hour}}$ equals 1, and multiplying by it changes the units without changing the amount. Such a fraction is called a **conversion factor**. Choose each conversion factor so that the unit to be removed appears once on top and once on the bottom, where it cancels. For example,

$$30 \frac{\text{feet}}{\text{second}} \times \frac{60 \text{ seconds}}{1 \text{ minute}} = 1800 \frac{\text{feet}}{\text{minute}}.$$

Several conversion factors can be used one after another. The ones needed most often are

$$\begin{array}{lll} 1 \text{ minute} = 60 \text{ seconds}, & 1 \text{ hour} = 60 \text{ minutes}, & 1 \text{ day} = 24 \text{ hours}, \\ 1 \text{ foot} = 12 \text{ inches}, & 1 \text{ yard} = 3 \text{ feet}, & 1 \text{ mile} = 5280 \text{ feet}. \end{array}$$

Examples.

Problem 3.2.1 (1987 AJHSME, Problem #14). A computer can do 10,000 additions per second. How many additions can it do in one hour?

(A) 6 million (B) 36 million (C) 60 million (D) 216 million (E) 360 million

Strategy. Convert the rate from additions per second to additions per hour.

Solution. One hour is $60 \cdot 60 = 3600$ seconds, so

$$10,000 \frac{\text{additions}}{\text{second}} \times \frac{3600 \text{ seconds}}{1 \text{ hour}} = 36,000,000 \frac{\text{additions}}{\text{hour}}.$$

The computer can do 36 million additions in one hour.

Answer: (B) 36 million. □

Problem 3.2.2 (2009 AMC 8, Problem #6). Steve's empty swimming pool will hold 24,000 gallons of water when full. It will be filled by 4 hoses, each of which supplies 2.5 gallons of water per minute. How many hours will it take to fill Steve's pool?

(A) 40 (B) 42 (C) 44 (D) 46 (E) 48

Strategy. The rates of the four hoses add. Convert the total rate to gallons per hour.

Solution. Together the hoses supply $4 \cdot 2.5 = 10$ gallons per minute, which is

$$10 \frac{\text{gallons}}{\text{minute}} \times \frac{60 \text{ minutes}}{1 \text{ hour}} = 600 \frac{\text{gallons}}{\text{hour}}.$$

Filling 24,000 gallons at 600 gallons per hour takes $\frac{24,000}{600} = 40$ hours.

Answer: (A) 40. □

4. PROBLEMS

Beginner.

1. (2004 AMC 8, Problem #1) On a map, a 12-centimeter length represents 72 kilometers. How many kilometers does a 17-centimeter length represent?
(A) 6 (B) 102 (C) 204 (D) 864 (E) 1224
2. (2014 AMC 8, Problem #5) Margie's car can go 32 miles on a gallon of gas, and gas currently costs \$4 per gallon. How many miles can Margie drive on \$20 worth of gas?
(A) 64 (B) 128 (C) 160 (D) 320 (E) 640
3. (2004 AMC 8, Problem #3) Twelve friends met for dinner at Oscar's Overstuffed Oyster House, and each ordered one meal. The portions were so large, there was enough food for 18 people. If they shared, how many meals should they have ordered to have just enough food for the 12 of them?
(A) 8 (B) 9 (C) 10 (D) 15 (E) 18
4. (2020 AMC 8, Problem #3) Carrie has a rectangular garden that measures 6 feet by 8 feet. She plants the entire garden with strawberry plants. Carrie is able to plant 4 strawberry plants per square foot, and she harvests an average of 10 strawberries per plant. How many strawberries can she expect to harvest?
(A) 560 (B) 960 (C) 1120 (D) 1920 (E) 3840

Intermediate.

5. (2014 AMC 8, Problem #7) There are four more girls than boys in Ms. Raub's class of 28 students. What is the ratio of the number of girls to the number of boys in her class?
(A) 3 : 4 (B) 4 : 3 (C) 3 : 2 (D) 7 : 4 (E) 2 : 1
6. (2013 AMC 8, Problem #7) Trey and his mom stopped at a railroad crossing to let a train pass. As the train began to pass, Trey counted 6 cars in the first 10 seconds. It took the train 2 minutes and 45 seconds to clear the crossing at a constant speed. Which of the following was the most likely number of cars in the train?
(A) 60 (B) 80 (C) 100 (D) 120 (E) 140
7. (2022 AMC 8, Problem #7) When the World Wide Web first became popular in the 1990s, download speeds reached a maximum of about 56 kilobits per second. Approximately how many minutes would the download of a 4.2-megabyte song have taken at that speed? (Note that there are 8000 kilobits in a megabyte.)
(A) 0.6 (B) 10 (C) 1800 (D) 7200 (E) 36000
8. (2016 AMC 8, Problem #12) Jefferson Middle School has the same number of boys and girls. Three-fourths of the girls and two-thirds of the boys went on a field trip. What fraction of the students on the field trip were girls?
(A) $\frac{1}{2}$ (B) $\frac{9}{17}$ (C) $\frac{7}{13}$ (D) $\frac{2}{3}$ (E) $\frac{14}{15}$

Advanced.

9. (2018 AMC 8, Problem #17) Bella begins to walk from her house toward her friend Ella's house. At the same time, Ella begins to ride her bicycle toward Bella's house. They each maintain a constant speed, and Ella rides 5 times as fast as Bella walks. The distance between their houses is 2 miles, which is 10,560 feet, and Bella covers $2\frac{1}{2}$ feet with each step. How many steps will Bella take by the time she meets Ella?
(A) 704 (B) 845 (C) 1056 (D) 1760 (E) 3520
10. (1999 AMC 8, Problem #22) In a far-off land three fish can be traded for two loaves of bread and a loaf of bread can be traded for four bags of rice. How many bags of rice is one fish worth?
(A) $\frac{3}{8}$ (B) $\frac{1}{2}$ (C) $\frac{3}{4}$ (D) $2\frac{2}{3}$ (E) $3\frac{1}{3}$
11. (2001 AMC 8, Problem #15) Homer began peeling a pile of 44 potatoes at the rate of 3 potatoes per minute. Four minutes later Christen joined him and peeled at the rate of 5 potatoes per minute. When they finished, how many potatoes had Christen peeled?
(A) 20 (B) 24 (C) 32 (D) 33 (E) 40
12. (2008 AMC 8, Problem #20) The students in Mr. Neatkin's class took a penmanship test. Two-thirds of the boys and $\frac{3}{4}$ of the girls passed the test, and an equal number of boys and girls passed the test. What is the minimum possible number of students in the class?
(A) 12 (B) 17 (C) 24 (D) 27 (E) 36