MATH IN ACTION

GRADE 6

Real-World Problem Solving for Pre-Algebra Success

Ratios • Integers • Algebra • Geometry • Statistics

STUDENT EDITION

GLOBAL SOVEREIGN UNIVERSITY

"Building a Bridge to Freedom Through Education—Not Handouts"

Math in Action: Grade 6 Real-World Problem Solving

Student Edition

FREE EDUCATIONAL RESOURCE

This curriculum is provided at no cost to students and educators worldwide.

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Why This Book Is Different

Nobel Prize-Winning Research Proves We Need a New Approach

> "*Students who score 96% on classroom math tests succeed only 1% of the time when solving the same problems in real life.*"
>
> — Banerjee & Duflo, Nature, February 2025 **(2019 Nobel Prize in Economics)**

What the Research Found

Nobel Prize-winning economists Abhijit Banerjee and Esther Duflo conducted a landmark study with over 1,400 children. They discovered something shocking: the math skills students learn in school don't transfer to real life.

Students who aced their classroom tests couldn't solve the same math problems when presented in real-world situations. Meanwhile, children who worked in markets (with no formal education) solved practical problems with 96% accuracy.

The Missing Bridge

The researchers concluded: Schools need to build a bridge between math learned in the classroom and math encountered in real-life situations.

This book IS that bridge.

How This Book Works

In every chapter, you will become a professional who needs math to succeed:

- Chapter 1: You're a Nutritionist calculating ratios and proportions for meal plans
- Chapter 2: You're a Banker working with positive and negative transactions
- Chapter 3: You're an Architect designing 3D structures with surface area
- Chapter 4: You're a Recipe Developer scaling recipes by dividing fractions
- Chapter 5: You're a Data Journalist analyzing statistical distributions
- Chapter 6: You're a Map Maker using scale drawings and proportional reasoning
- Chapter 7: You're a Stock Trader writing algebraic expressions for market trends
- Chapter 8: You're an Event Planner calculating percentages and budgets
- Chapter 9: You're a Climate Scientist working with absolute value and data
- Chapter 10: You're an Entrepreneur running your own startup with ALL skills

Pre-Algebra Foundation

Grade 6 is the critical bridge to algebra. Throughout this book, you'll work with:

- Variables and algebraic expressions
- One-step equations and inequalities
- Negative numbers and the number line
- Ratios, rates, and proportional relationships

By the end of this book, you won't just know math—you'll think like someone who uses math every day.

A Note to Students

You might wonder: Why do I need to learn this?

Here's the truth: Every job worth having uses math. Doctors calculate dosages. Engineers design bridges. Business owners track profits. Scientists analyze data. Even artists use proportions and geometry.

The difference between people who succeed and people who struggle often comes down to one thing: Can they apply what they learned in school to real situations?

This book trains you to do exactly that.

Research Citation

Banerjee, A., Duflo, E., et al. (2025). Children's arithmetic skills do not transfer between applied and academic mathematics. Nature.

Let's build that bridge—together.

CHAPTER 1

The Nutritionist

Master ratios, rates, and proportions to create balanced nutrition plans

Section 1.1: Understanding Ratios

As a nutritionist, you help people eat better. You need to understand the ratios between different nutrients—how much protein compared to carbs, how many vegetables relative to grains.

What is a Ratio?

A ratio compares two quantities. If a meal has 30 grams of protein and 45 grams of carbohydrates, the ratio of protein to carbs is 30:45 or 30/45.

$$\text{Ratio of A to B} = A : B = A/B$$

Ratios can be simplified like fractions. 30:45 simplifies to 2:3 (divide both by 15).

WORKED EXAMPLE

A smoothie recipe calls for 2 cups of fruit and 3 cups of yogurt. What is the ratio of fruit to yogurt? Write it in simplest form.

Solution: The ratio is 2:3. Check if it simplifies: GCF of 2 and 3 is 1, so 2:3 is already in simplest form.

Answer: **2:3 (or 2/3)**

WORKED EXAMPLE

A patient's meal has 40g protein, 60g carbs, and 20g fat. What is the ratio of protein to carbs to fat?

Solution: Write all three: 40:60:20. Find GCF of all three: 20. Divide each by 20: 40÷20 = 2, 60÷20 = 3, 20÷20 = 1.

Answer: **2:3:1**

Practice Problems

1. A salad has 4 cups of lettuce and 2 cups of spinach. What is the ratio of lettuce to spinach in simplest form?

Work:

Answer: _____

2. A protein shake has 25g protein and 35g carbs. Write the ratio of protein to carbs in simplest form.

Work:

Answer: _____

3. A meal plan includes 6 servings of vegetables and 3 servings of fruit daily. What is the ratio of vegetables to fruit?

Work:

Answer: _____

4. A patient needs 2,400 calories daily: 600 from protein, 900 from carbs, 900 from fat. Write the ratio in simplest form.

Work:

Answer: _____

5. A soup recipe uses 3 cups of broth for every 1 cup of vegetables. Write this ratio two different ways.

Work:

Answer: _____

6. In a healthy diet, the ratio of omega-3 to omega-6 should be 1:4. If you consume 8g of omega-6, how much omega-3 should you have?

Work:

Answer: _____

7. A nutrition bar has 12g sugar and 18g fiber. What is the ratio of sugar to fiber in simplest form?

Work:

Answer: _____

8. A breakfast plate has 2 eggs, 3 strips of bacon, and 4 pieces of toast. What is the ratio of eggs to bacon to toast?

Work:

Answer: _____

9. The ratio of protein to total calories should be about 30:100. Simplify this ratio.

Work:

Answer: _____

10. A dietitian recommends a 3:1 ratio of water to juice. If you drink 9 cups of water, how many cups of juice?

Work:

Answer: _____

11. A meal has 45g carbs and 15g protein. Express this as a unit ratio (how many g carbs per 1g protein).

Work:

Answer: _____

12. Compare: Meal A has protein:carbs ratio of 2:5. Meal B has ratio of 3:8. Which has more protein relative to carbs?

Work:

Answer: _____

13. A client's weekly meal plan has 21 servings of protein and 28 servings of vegetables. Simplify this ratio.

Work:

Answer: _____

14. The USDA recommends 2.5 cups of vegetables and 2 cups of fruit daily. What is the ratio of vegetables to fruit?

Work:

Answer: _____

15. A nutrition label shows 8g fat and 24g carbs. Write the ratio of fat to carbs, then express how many g carbs per g fat.

Work:

Answer: _____

Section 1.2: Unit Rates

A unit rate tells you how much of something per ONE unit of something else. As a nutritionist, you constantly work with unit rates: calories per serving, grams of protein per ounce, cost per meal.

Unit Rate = Total Quantity ÷ Number of Units

Key phrase: 'per' always signals a rate—miles per hour, dollars per pound, calories per serving.

WORKED EXAMPLE

A 24-ounce protein powder contains 720 grams of protein. How many grams of protein per ounce?

Solution: Unit rate = 720 ÷ 24 = 30

Answer: **30 grams per ounce**

WORKED EXAMPLE

A client burns 450 calories in 30 minutes of exercise. What is the rate of calories burned per minute?

Solution: Unit rate = 450 ÷ 30 = 15

Answer: **15 calories per minute**

Practice Problems

1. A box of 12 protein bars costs $36. What is the cost per bar?

Work:

Answer: _____

2. A chicken breast weighs 6 ounces and has 42 grams of protein. How many grams of protein per ounce?

Work:

Answer: _____

3. A client walks 4.5 miles in 90 minutes. What is their speed in miles per minute? In miles per hour?

Work:

Answer: _____

4. A 16-ounce bottle of juice has 240 calories. How many calories per ounce?

Work:

Answer: _____

5. A meal delivery service provides 21 meals for $189. What is the cost per meal?

Work:

Answer: _____

6. An apple has 95 calories and weighs 182 grams. How many calories per gram (round to 2 decimal places)?

Work:

Answer: _____

7. A runner burns 2,400 calories during a 3-hour marathon. What is the rate of calories burned per hour?

Work:

Answer: _____

8. A nutrition coach sees 35 clients in 7 hours. What is the rate of clients per hour?

Work:

Answer: _____

9. A 32-oz smoothie has 64 grams of sugar. How many grams of sugar per ounce?

Work:

Answer: _____

10. Brand A: 20 vitamins for $15. Brand B: 50 vitamins for $35. Which is the better unit price?

Work:

Answer: _____

11. A client loses 12 pounds in 8 weeks. What is the rate of weight loss per week?

Work:

Answer: _____

12. A recipe serves 8 people and uses 2.5 cups of rice. How many cups of rice per person?

Work:

Answer: _____

13. A gym charges $360 for 12 months. What is the cost per month? Per week (52 weeks)?

Work:

Answer: _____

14. A food blog gets 15,000 views in 30 days. What is the rate of views per day?

Work:

Answer: _____

15. A diabetic patient's blood sugar dropped 45 points over 3 hours. What is the rate of decrease per hour?

Work:

Answer: _____

Section 1.3: Solving Proportions

A proportion states that two ratios are equal. This is incredibly useful for scaling recipes, converting measurements, and calculating doses.

```
If a/b = c/d, then a × d = b × c (Cross-Multiplication)
```

To solve for an unknown, set up a proportion and cross-multiply.

WORKED EXAMPLE

A recipe calls for 3 cups of oats for 4 servings. How many cups do you need for 10 servings?

Solution: Set up proportion: 3/4 = x/10. Cross-multiply: 3 × 10 = 4 × x → 30 = 4x → x = 30 ÷ 4 = 7.5

Answer: **7.5 cups of oats**

WORKED EXAMPLE

A medication dosage is 5mg per 20 pounds of body weight. How much should a 140-pound patient receive?

Solution: Set up proportion: 5/20 = x/140. Cross-multiply: 5 × 140 = 20 × x → 700 = 20x → x = 35

Answer: **35 mg**

Practice Problems

1. A smoothie recipe uses 2 bananas for 3 servings. How many bananas for 12 servings?

   Work:

   _____

   _____

   Answer: _____

2. If 4 ounces of chicken has 28g protein, how much protein in 10 ounces?

   Work:

   _____

   _____

   Answer: _____

3. A diet plan burns 500 calories in 45 minutes. How many calories in 90 minutes at the same rate?

   Work:

   _____

   _____

   Answer: _____

4. The ratio of water to rice is 2:1. How much water for 3.5 cups of rice?

Work:

Answer: _____

5. A nutritionist charges $80 for a 2-hour consultation. How much for a 3-hour session at the same rate?

Work:

Answer: _____

6. If 3 cups of flour makes 24 cookies, how many cups for 40 cookies?

Work:

Answer: _____

7. A vitamin C tablet provides 500mg per tablet. How many tablets for 1,250mg?

Work:

Answer: _____

8. A food scale shows 8 ounces = 225 grams. How many grams is 12 ounces?

Work:

Answer: _____

9. If 6 eggs cost $2.40, how much do 15 eggs cost?

Work:

Answer: _____

10. A meal plan uses a ratio of 4 proteins to 6 vegetables per day. With 9 vegetable servings, how many protein?

Work:

Answer: _____

11. A patient burns 3 calories per minute walking. How long to burn 225 calories?

Work:

Answer: _____

12. If 100 grams of pasta has 350 calories, how many calories in 175 grams?

Work:

Answer: _____

13. The recommended calcium is 1,000mg per day. If a glass of milk has 300mg, how many glasses to meet 100%?

Work:

Answer: _____

14. A recipe feeds 6 people with 1.5 lbs of meat. How much meat for 10 people?

Work:

Answer: _____

15. If your heart beats 72 times per minute, how many beats in 2.5 hours?

Work:

Answer: _____

Section 1.4: Action Report

Complete this report as the lead nutritionist at Healthy Living Clinic.

1. A client needs a protein:carb:fat ratio of 3:4:1 for their meal plan. If they consume 45g of protein, how many grams of carbs should they have?

Work:

Answer: _____

2. Using the same ratio (3:4:1), how many grams of fat should they consume?

Work:

Answer: _____

3. The client's meal plan costs $175 for 7 days. What is the daily cost?

Work:

Answer: _____

4. A protein powder costs $45 for 30 servings. A competitor charges $38 for 25 servings. Which is the better value per serving?

Work:

Answer: _____

5. The clinic recommends 64 ounces of water daily. If a client drinks 8-ounce glasses, how many glasses is that?

Work:

Answer: _____

6. A recipe makes 8 portions with 2 cups of quinoa. The client needs 20 portions for a party. How many cups of quinoa?

Work:

Answer: _____

7. The client burns 12 calories per minute jogging. They want to burn 540 calories. How many minutes should they jog?

Work:

Answer: _____

8. A supplement contains 25mg of zinc per tablet. The daily recommendation is 8mg. What fraction of the daily value is one tablet?

Work:

Answer: _____

9. The client's current weight is 180 lbs. Their goal is a ratio of 1 lb muscle gain per 2 lbs fat loss. If they lose 8 lbs of fat, how much muscle should they gain?

Work:

Answer: _____

10. Create a weekly meal prep budget: If groceries cost $4.50 per meal and the client eats 3 meals a day for 7 days, what is the weekly cost?

Work:

Answer: _____

CHAPTER 2

The Banker

Work with positive and negative numbers to track credits, debits, and account balances

Section 2.1: Understanding Integers

As a banker, you work with positive numbers (deposits, credits, gains) and negative numbers (withdrawals, debits, losses). Understanding integers is essential for accurate accounting.

The Number Line

Integers include positive whole numbers, negative whole numbers, and zero. On a number line, positive numbers go right, negative numbers go left.

```
... -5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5 ...
```

Key concepts:

- Positive numbers represent deposits, credits, profits, gains
- Negative numbers represent withdrawals, debits, losses, debt
- Zero represents a balanced account (no money, no debt)

WORKED EXAMPLE

A customer has $350 in their account. They withdraw $400. What is their new balance?

Solution: Start: +350. Subtract withdrawal: 350 - 400 = -50

Answer: **-$50 (overdrawn by $50)**

WORKED EXAMPLE

Order these account balances from least to greatest: $45, -$120, $0, -$30, $15

Solution: On a number line, further left = smaller. Order: -120, -30, 0, 15, 45

Answer: **-$120, -$30, $0, $15, $45**

Practice Problems

1. A checking account has $500. After a $675 purchase, what is the balance?

Work:

Answer: _____

2. Order from least to greatest: -45, 23, -12, 0, -50, 18

Work:

Answer: _____

3. A business had a profit of $2,500 in January and a loss of $1,800 in February. Represent each as an integer.

Work:

Answer: _____

4. A customer's balance is -$75. They deposit $100. What is the new balance?

Work:

Answer: _____

5. The temperature in the bank vault is -5°F. The lobby is 73°F. What is the difference?

Work:

Answer: _____

6. Place on a number line and identify which is greater: -25 or -30?

Work:

Answer: _____

7. A savings account earns $45 interest but has a $12 fee. What is the net change?

Work:

Answer: _____

8. Compare using < or >: -156 ___ -149

Work:

Answer: _____

9. A stock drops $8 per share on Monday, rises $12 on Tuesday, then drops $3 on Wednesday. What is the total change?

Work:

Answer: _____

10. An account shows: +$250, -$180, +$95, -$200. List these in order from smallest to largest.

Work:

Answer: _____

11. What integer represents: 'The account is overdrawn by $340'?

Work:

Answer: _____

12. The bank's basement is 15 feet below ground level. The roof is 48 feet above. What is the total height from basement to roof?

Work:

Answer: _____

13. Compare: Which is further from zero, -45 or 38?

Work:

Answer: _____

14. A loan balance is -$5,000. After a $750 payment, what is the new balance?

Work:

Answer: _____

15. List all integers between -4 and 3, inclusive.

Work:

Answer: _____

Section 2.2: Adding and Subtracting Integers

Adding and subtracting integers follows specific rules. Master these rules and you can track any financial transaction.

Adding Integers

Same signs: Add absolute values, keep the sign

Different signs: Subtract absolute values, use sign of larger absolute value

Subtracting Integers

Subtracting = Adding the opposite: a - b = a + (-b)

WORKED EXAMPLE

A customer has -$45 (overdrawn). They overdraw another $30. What is the balance?

Solution: Adding two negatives: (-45) + (-30) = -(45 + 30) = -75

Answer: **-$75**

WORKED EXAMPLE

An account balance is -$200. A deposit of $350 is made. What is the new balance?

Solution: Different signs: (-200) + (+350) → |350| - |200| = 150. Larger absolute value (350) is positive.

Answer: **+$150**

WORKED EXAMPLE

Calculate: 25 - (-40)

Solution: Subtracting a negative = adding a positive: 25 - (-40) = 25 + 40 = 65

Answer: **65**

Practice Problems

1. Calculate: (-35) + (-42)

   Work:

   Answer: _____

2. Calculate: (-18) + 45

Work:

Answer: _____

3. Calculate: 72 + (-95)

Work:

Answer: _____

4. Calculate: (-50) - (-25)

Work:

Answer: _____

5. Calculate: 33 - 78

Work:

Answer: _____

6. An account starts at $250. Transactions: -$80, +$125, -$200, +$50. What is the final balance?

Work:

Answer: _____

7. Calculate: (-15) + (-8) + 20 + (-12)

Work:

Answer: _____

8. Calculate: 100 - (-45) - 30

Work:

Answer: _____

9. A bank starts the day with $5,000 in the vault. Withdrawals total $8,500 and deposits total $4,200. End balance?

Work:

Answer: _____

10. Calculate: (-125) - (-125)

Work:

Answer: _____

11. Calculate: 0 - (-67)

Work:

Answer: _____

12. The temperature dropped from 5°F to -12°F. How many degrees did it drop?

Work:

Answer: _____

13. Calculate: (-45) + 45 + (-30) + 30

Work:

Answer: _____

14. An investor loses $2,400 in Q1 and loses $1,800 in Q2. What is the total change?

Work:

Answer: _____

15. Calculate: 500 - 250 - (-100) + (-175)

Work:

Answer: _____

Section 2.3: Multiplying and Dividing Integers

Multiplication and division of integers follow simple sign rules. These are essential for calculating interest, fees, and investment returns.

Sign Rules for Multiplication and Division

```
Positive × Positive = Positive    (+)(+) = +
Negative × Negative = Positive    (−)(−) = +
Positive × Negative = Negative    (+)(−) = −
Negative × Positive = Negative    (−)(+) = −
```

Same signs → Positive result. Different signs → Negative result.

WORKED EXAMPLE

A stock loses $12 per day for 5 days. What is the total loss?

Solution: Loss = -12 per day. Total = (-12) × 5 = -60

Answer: **-$60 (loss of $60)**

WORKED EXAMPLE

A debt of $840 is split equally among 4 partners. How much does each owe?

Solution: Debt = -840. Each share = (-840) ÷ 4 = -210

Answer: **-$210 each**

Practice Problems

1. Calculate: (-8) × (-9)

   Work:

   _____

   _____

   Answer: _____

2. Calculate: (-15) × 4

   Work:

   _____

   _____

   Answer: _____

3. Calculate: 6 × (-12)

   Work:

   _____

Answer: _____

4. Calculate: (-144) ÷ (-12)

Work:

Answer: _____

5. Calculate: 90 ÷ (-15)

Work:

Answer: _____

6. Calculate: (-100) ÷ 25

Work:

Answer: _____

7. A loan charges $25 interest per month. After 8 months, what is the total interest (as a negative)?

Work:

Answer: _____

8. Calculate: (-5) × (-5) × (-5)

Work:

Answer: _____

9. Calculate: (-72) ÷ 8 × (-3)

Work:

Answer: _____

10. An investment loses 3% of its $4,000 value. What is the dollar loss (express as negative)?

Work:

Answer: _____

11. Calculate: 12 × (-3) × (-2) × (-1)

Work:

Answer: _____

12. A temperature drops 4 degrees per hour. After 6 hours, what is the total change?

    Work:

    _____

    _____

    Answer: _____

13. Calculate: [(-48) ÷ (-6)] × (-4)

    Work:

    _____

    _____

    Answer: _____

14. Divide a loss of $1,200 among 6 investors. What is each person's share (as negative)?

    Work:

    _____

    _____

    Answer: _____

15. Calculate: $(-2)^4$ (that is: -2 × -2 × -2 × -2)

    Work:

    _____

    _____

    Answer: _____

Section 2.4: Action Report

Complete this report as a personal banker at First National Bank.

1. A new customer opens an account with $500. Their first month's transactions: +$1,200 (paycheck), -$450 (rent), -$85 (utilities), -$120 (groceries), +$50 (refund), -$75 (subscription). What is the ending balance?

Work:

Answer: _____

2. The customer above wants to know their average transaction amount. Calculate the mean of all 6 transactions (not including the opening deposit).

Work:

Answer: _____

3. A savings account starts at $2,000. It earns $15 interest but has a $4 monthly fee. What is the net gain?

Work:

Answer: _____

4. Compare two account options: Account A charges -$12/month but pays +$20 in rewards. Account B charges -$8/month with no rewards. Which is better and by how much?

Work:

Answer: _____

5. An investor's portfolio: Stock A lost $450, Stock B gained $680, Stock C lost $225. What is the net change?

Work:

Answer: _____

6. A customer is overdrawn by $125. What is the minimum deposit needed to bring the balance to exactly $0?

Work:

Answer: _____

7. A loan balance is -$15,000. Monthly payments of $450 are made. How many months until the balance reaches -$10,500?

Work:

Answer: _____

8. Calculate the total: Start at -$300, add $150, subtract $75, add -$100, subtract -$200

Work:

Answer: _____

9. Temperature in the bank vault: Monday -2°F, Tuesday 5°F, Wednesday -8°F, Thursday 3°F, Friday -5°F. What is the average temperature?

Work:

Answer: _____

10. A credit card has a -$2,400 balance. The customer pays $200/month. If no new charges occur, what will the balance be after 8 months?

Work:

Answer: _____

CHAPTER 3

The Architect

Calculate surface area and volume for 3D structures and understand nets

Section 3.1: Surface Area of Rectangular Prisms

As an architect, you need to know how much material covers the outside of a structure. This is surface area—the total area of all faces of a 3D shape.

Surface Area of a Rectangular Prism

A rectangular prism has 6 faces: top, bottom, front, back, left side, right side.

$$SA = 2lw + 2lh + 2wh$$

Where l = length, w = width, h = height. Each pair of opposite faces has the same area.

WORKED EXAMPLE

A storage building is 20 ft long, 15 ft wide, and 10 ft tall. What is the total surface area to paint (all 6 sides)?

Solution: SA = 2(20×15) + 2(20×10) + 2(15×10) = 2(300) + 2(200) + 2(150) = 600 + 400 + 300 = 1,300

Answer: **1,300 square feet**

WORKED EXAMPLE

A gift box is 8 in × 6 in × 4 in. How much wrapping paper is needed to cover it completely?

Solution: SA = 2(8×6) + 2(8×4) + 2(6×4) = 2(48) + 2(32) + 2(24) = 96 + 64 + 48 = 208

Answer: **208 square inches**

Practice Problems

1. Find the surface area of a cube with sides of 5 cm.

Work:

Answer: _____

2. A room is 12 ft × 10 ft × 8 ft. Find the surface area of all walls (4 sides only, not floor or ceiling).

Work:

Answer: _____

3. A shipping container is 40 ft × 8 ft × 8.5 ft. Calculate the total surface area.

Work:

Answer: _____

4. Find the surface area: l = 9 in, w = 6 in, h = 4 in.

Work:

Answer: _____

5. A rectangular pool is 30 ft × 15 ft × 6 ft. What is the surface area of the bottom and four sides (not the top)?

Work:

Answer: _____

6. How much cardboard is needed to make an open-top box that is 10 in × 8 in × 5 in?

Work:

Answer: _____

7. A cube has a surface area of 150 sq cm. What is the length of one side?

Work:

Answer: _____

8. Find the surface area: l = 2.5 m, w = 1.5 m, h = 2 m.

Work:

Answer: _____

9. An architect needs to cover a building with siding. The building is 60 ft × 40 ft × 25 ft. What is the area of all four walls?

Work:

Answer: _____

10. A rectangular prism has a surface area of 94 sq in. If l = 5 in and w = 3 in, find h.

Work:

Answer: _____

11. Compare: Box A is 4×4×4. Box B is 2×4×8. Which has greater surface area?

Work:

Answer: _____

12. Find the surface area of a rectangular prism with dimensions 7.5 ft × 4 ft × 3 ft.

Work:

Answer: _____

13. A jewelry box is 6 in × 4 in × 2 in. The outside will be covered with fabric. How much fabric is needed?

Work:

Answer: _____

14. A storage unit is 10 ft × 8 ft × 9 ft. Paint costs $0.50 per sq ft. What is the cost to paint all surfaces?

Work:

Answer: _____

15. Find the missing dimension: SA = 158 sq m, l = 7 m, w = 5 m, h = ?

Work:

Answer: _____

Section 3.2: Nets of 3D Figures

A net is a 2D pattern that folds into a 3D shape. Architects use nets to plan how materials will be cut and assembled.

Identifying Nets

A valid net for a cube has 6 squares that fold into a closed cube. A valid net for a rectangular prism has 6 rectangles (pairs of equal rectangles for opposite faces).

- Cube net: 6 equal squares in a cross or stair pattern
- Rectangular prism net: 3 pairs of equal rectangles
- Triangular prism net: 2 triangles + 3 rectangles
- Pyramid net: 1 base + triangular faces meeting at a point

WORKED EXAMPLE

Describe the net for a rectangular prism that is 4 in × 3 in × 2 in.

Solution: The net has 6 rectangles: Two 4×3 (top/bottom), Two 4×2 (front/back), Two 3×2 (sides).

Answer: **2 rectangles of 4×3, 2 rectangles of 4×2, 2 rectangles of 3×2**

Practice Problems

1. How many faces does a cube have? Describe the net.

Work:

Answer: _____

2. A net for a rectangular prism shows rectangles with areas: 24, 24, 18, 18, 12, 12 sq in. What are the prism's dimensions?

Work:

Answer: _____

3. Draw and label a net for a rectangular prism: 6 cm × 4 cm × 2 cm. List the dimensions of each rectangle.

Work:

Answer: _____

4. A triangular prism has triangular bases with area 10 sq cm each and three rectangular faces (6×5, 6×4, 6×3). Find total SA.

Work:

Answer: _____

5. Can a net with 5 squares form a cube? Explain.

Work:

Answer: _____

6. A net shows 6 equal squares, each with area 16 sq in. What is the side length of the cube it forms?

Work:

Answer: _____

7. Describe the net for a square pyramid (square base, 4 triangular sides).

Work:

Answer: _____

8. A net for a cereal box shows rectangles: 12×8, 12×8, 12×3, 12×3, 8×3, 8×3. What are the box dimensions?

Work:

Answer: _____

9. If you unfold a 5 cm × 5 cm × 5 cm cube, what is the total area of the net?

Work:

Answer: _____

10. A net has 2 triangles (base 6, height 4) and 3 rectangles (8×6, 8×5, 8×5). What shape does it form?

Work:

Answer: _____

11. Which uses less cardboard: one 8×6×4 box or two 4×4×4 boxes?

Work:

Answer: _____

12. A net for a rectangular prism uses 40 sq in of material. If two faces are 3×4, two are 3×5, what is the area of the last two faces?

Work:

Answer: _____

13. Can you make a closed rectangular prism from a net missing one face? Explain.

Work:

Answer: _____

14. A gift box net has rectangles 10×6, 10×6, 10×4, 10×4, 6×4, 6×4. Verify this is a valid net and find total area.

Work:

Answer: _____

15. An architect cuts a net from sheet metal. The prism is 12×8×6 ft. How many sq ft of metal is needed?

Work:

Answer: _____

Section 3.3: Volume with Fractional Edges

Real-world dimensions aren't always whole numbers. As an architect, you must calculate volume accurately even with fractional measurements.

```
Volume = length × width × height
```

When dimensions include fractions, convert to decimals or multiply fractions carefully.

WORKED EXAMPLE

A planter box is 4½ ft × 2 ft × 1½ ft. What is its volume?

Solution: V = 4.5 × 2 × 1.5 = 9 × 1.5 = 13.5 (or: 9/2 × 2 × 3/2 = 9 × 3/2 = 27/2 = 13.5)

Answer: **13.5 cubic feet**

WORKED EXAMPLE

A brick is 2¼ in × 3¾ in × 8 in. Find its volume.

Solution: V = 2.25 × 3.75 × 8 = 8.4375 × 8 = 67.5

Answer: **67.5 cubic inches**

Practice Problems

1. Find the volume: 3½ ft × 2 ft × 4 ft

   Work:

   Answer: _____

2. Find the volume: 5 in × 2½ in × 6 in

   Work:

   Answer: _____

3. A concrete slab is 10 ft × 8 ft × ½ ft. How many cubic feet of concrete is needed?

   Work:

   Answer: _____

4. Find the volume: 2¼ cm × 4 cm × 3½ cm

   Work:

Answer: _____

5. A foundation is 24 ft × 18 ft × ¾ ft. Calculate the volume.

Work:

Answer: _____

6. Find the volume: 6½ in × 4½ in × 2 in

Work:

Answer: _____

7. A room is 12.5 ft × 10 ft × 8.5 ft. What is the volume?

Work:

Answer: _____

8. A container holds 24 cubic feet. If it is 4 ft × 3 ft × h, find h.

Work:

Answer: _____

9. Find the volume: 1½ m × 2½ m × 3 m

Work:

Answer: _____

10. A pool is 20 ft × 10 ft × 4½ ft. How many cubic feet of water does it hold?

Work:

Answer: _____

11. Find the volume: 7.5 cm × 4 cm × 2.5 cm

Work:

Answer: _____

12. A garden bed is 6 ft × 2½ ft × ⅔ ft. What is the volume?

Work:

Answer: _____

13. A box has volume 45 cubic inches. If l = 5 in and w = 3 in, find h.

Work:

Answer: _____

14. Compare volumes: Box A is 4 × 3 × 2. Box B is 3½ × 3½ × 2. Which is larger?

Work:

Answer: _____

15. A shipping crate is 5½ ft × 4 ft × 3½ ft. Find the volume.

Work:

Answer: _____

Section 3.4: Action Report

Complete this report as the lead architect at Modern Design Studio.

1. A client wants a garden shed: 10 ft × 8 ft × 7 ft. Calculate the surface area of all 6 sides.

Work:

Answer: _____

2. The shed (above) needs exterior paint. If one gallon covers 350 sq ft, how many gallons are needed? (Round up)

Work:

Answer: _____

3. Describe the net for the shed. List dimensions of all 6 rectangles.

Work:

Answer: _____

4. The shed floor will be poured concrete, 4 inches (⅓ ft) thick. Calculate the volume of concrete needed.

Work:

Answer: _____

5. A skylight will be cut from the roof: 3 ft × 2 ft. What is the new roof surface area?

Work:

Answer: _____

6. Design a storage bench: 4 ft × 1½ ft × 1½ ft. Find the volume.

Work:

Answer: _____

7. The storage bench will be covered with cedar planks on all 6 sides. Find the total surface area.

Work:

Answer: _____

8. Compare two planter designs: Design A is 3 ft × 3 ft × 2 ft. Design B is 4 ft × 2 ft × 2.5 ft. Which has more volume?

Work:

Answer: _____

9. A brick wall uses bricks that are 8 in × 4 in × 2.5 in. What is the volume of one brick?

Work:

Answer: _____

10. If the wall needs 500 bricks, what is the total volume of all bricks in cubic inches? Convert to cubic feet.

Work:

Answer: _____

CHAPTER 4

The Recipe Developer

Master dividing fractions to scale recipes up and down with precision

Section 4.1: Dividing Fractions by Whole Numbers

As a recipe developer, you often need to divide ingredients. If a recipe serves 8 but you want 4 servings, you divide each ingredient by 2. But what about dividing ¾ cup by 2?

The Rule: Multiply by the Reciprocal

$$a/b \div c = a/b \times 1/c = a/(b \times c)$$

Dividing by a whole number is the same as multiplying by its reciprocal (1 over that number).

WORKED EXAMPLE

A recipe calls for ¾ cup of sugar for 6 servings. How much sugar per serving?

Solution: ¾ ÷ 6 = ¾ × ⅙ = 3/24 = 1/8

Answer: **⅛ cup per serving**

WORKED EXAMPLE

Divide 5/8 cup of flour among 4 portions.

Solution: 5/8 ÷ 4 = 5/8 × 1/4 = 5/32

Answer: **5/32 cup per portion**

Practice Problems

1. Calculate: ½ ÷ 4

   Work:

   _____

   _____

Answer: _____

2. Calculate: ⅔ ÷ 3

Work:

Answer: _____

3. Calculate: ¾ ÷ 2

Work:

Answer: _____

4. Calculate: 5/6 ÷ 5

Work:

Answer: _____

5. A recipe uses 2/3 cup of honey for 4 servings. How much per serving?

Work:

Answer: _____

6. Calculate: 7/8 ÷ 7

Work:

Answer: _____

7. Calculate: 3/4 ÷ 6

Work:

Answer: _____

8. Split 5/6 lb of butter among 10 recipes. How much per recipe?

Work:

Answer: _____

9. Calculate: 9/10 ÷ 3

Work:

Answer: _____

10. A 3/4 gallon of milk is split into 8 equal portions. How much each?

Work:

Answer: _____

11. Calculate: 4/5 ÷ 4

Work:

Answer: _____

12. Calculate: 11/12 ÷ 11

Work:

Answer: _____

13. A bag contains 7/8 lb of flour. If split into 2 batches, how much per batch?

Work:

Answer: _____

14. Calculate: 2/3 ÷ 8

Work:

Answer: _____

15. Calculate: 5/8 ÷ 10

Work:

Answer: _____

Section 4.2: Dividing Fractions by Fractions

Sometimes you need to know how many times one fraction fits into another. How many ¼ cup portions are in ¾ cup? This is fraction division.

a/b ÷ c/d = a/b × d/c (Multiply by the reciprocal)

To divide by a fraction, flip it (find the reciprocal) and multiply.

WORKED EXAMPLE

How many ¼ cup servings are in ¾ cup?

Solution: ¾ ÷ ¼ = ¾ × 4/1 = 12/4 = 3

Answer: **3 servings**

WORKED EXAMPLE

Divide: 5/6 ÷ 2/3

Solution: 5/6 ÷ 2/3 = 5/6 × 3/2 = 15/12 = 5/4 = 1¼

Answer: **1¼ (or 5/4)**

Practice Problems

1. Calculate: ½ ÷ ¼

   Work:

   Answer: _____

2. Calculate: ⅔ ÷ ⅓

   Work:

   Answer: _____

3. Calculate: ¾ ÷ ⅜

   Work:

   Answer: _____

4. Calculate: 5/8 ÷ ¼

   Work:

Answer: _____

5. How many ⅓ cup portions are in 2/3 cup?

Work:

Answer: _____

6. Calculate: 4/5 ÷ 2/5

Work:

Answer: _____

7. Calculate: 7/8 ÷ ½

Work:

Answer: _____

8. A recipe needs ¾ cup of oil. If each batch uses ⅛ cup, how many batches?

Work:

Answer: _____

9. Calculate: 9/10 ÷ 3/5

Work:

Answer: _____

10. Calculate: 5/6 ÷ 5/12

Work:

Answer: _____

11. Calculate: ⅔ ÷ 4/9

Work:

Answer: _____

12. How many ⅜ lb portions in 1½ lbs?

Work:

Answer: _____

13. Calculate: 11/12 ÷ 1/3

Work:

Answer: _____

14. Calculate: 3/4 ÷ 9/8

Work:

Answer: _____

15. A bag has ⅔ lb sugar. Each cookie needs 1/12 lb. How many cookies?

Work:

Answer: _____

Section 4.3: Dividing Mixed Numbers

Mixed numbers (like 2½) must be converted to improper fractions before dividing.

Convert mixed to improper: 2½ = 5/2, then divide using reciprocals

WORKED EXAMPLE

Divide: 3½ ÷ ¾

Solution: Convert: 3½ = 7/2. Then: 7/2 ÷ 3/4 = 7/2 × 4/3 = 28/6 = 14/3 = 4⅔

Answer: 4⅔

WORKED EXAMPLE

Divide: 2¼ ÷ 1½

Solution: Convert: 2¼ = 9/4, 1½ = 3/2. Then: 9/4 ÷ 3/2 = 9/4 × 2/3 = 18/12 = 3/2 = 1½

Answer: 1½

Practice Problems

1. Calculate: 1½ ÷ ½

   Work:

   Answer: _____

2. Calculate: 2⅓ ÷ ⅔

   Work:

   Answer: _____

3. Calculate: 3¼ ÷ 1½

   Work:

   Answer: _____

4. Calculate: 4½ ÷ ¾

   Work:

   Answer: _____

5. A recipe uses 2¼ cups flour total. Each batch uses ¾ cup. How many batches?

Work:

Answer: _____

6. Calculate: 5⅓ ÷ 2⅔

Work:

Answer: _____

7. Calculate: 1⅞ ÷ ⅝

Work:

Answer: _____

8. A roast weighing 3½ lbs will be cut into ½ lb portions. How many portions?

Work:

Answer: _____

9. Calculate: 2½ ÷ 1¼

Work:

Answer: _____

10. Calculate: 4⅔ ÷ ⅓

Work:

Answer: _____

11. Calculate: 6¼ ÷ 2½

Work:

Answer: _____

12. A chef has 5½ lbs of potatoes. Each dish uses ¾ lb. How many dishes?

Work:

Answer: _____

13. Calculate: 3⅜ ÷ 1⅛

Work:

Answer: _____

14. Calculate: 7½ ÷ 2½

    Work:

    _____

    _____

    Answer: _____

15. A punch bowl holds 4¾ gallons. If each glass is ⅜ gallon, how many glasses?

    Work:

    _____

    _____

    Answer: _____

Section 4.4: Action Report

Complete this report as head recipe developer at Gourmet Test Kitchen.

1. A brownie recipe serves 16 and uses 1½ cups of cocoa. How much cocoa per serving?

   Work:

   Answer: _____

2. The same recipe uses ⅔ cup of butter for 16 servings. How much for 4 servings?

   Work:

   Answer: _____

3. You have 3¾ cups of flour. The recipe uses ¾ cup per batch. How many batches can you make?

   Work:

   Answer: _____

4. Scale down: Original uses 2⅔ cups sugar for 12 servings. How much for 3 servings?

   Work:

   Answer: _____

5. A cake recipe uses 1½ cups milk. You want to make ⅔ of the recipe. How much milk?

   Work:

   Answer: _____

6. You have 2½ lbs of ground beef. Each burger uses ⅓ lb. How many burgers?

   Work:

   Answer: _____

7. A pie recipe serves 8 with ¾ cup of berries. Scale to serve 2. How many cups of berries?

   Work:

   Answer: _____

8. A pasta recipe uses ⅝ lb of noodles for 5 servings. How much per serving?

   Work:

Answer: _____

9. You have 4⅓ cups of broth. Each portion uses ⅔ cup. How many full portions?

Work:

Answer: _____

10. Create a ratio: If ¾ cup of oil is needed for 6 muffins, express this as a unit rate (cups per muffin).

Work:

Answer: _____

CHAPTER 5

The Data Journalist

Analyze statistical distributions and communicate data stories using box plots and histograms

Section 5.1: Measures of Center and Spread

As a data journalist, you turn numbers into stories. Understanding how data is centered and spread helps you accurately report on trends and patterns.

Review: Mean, Median, Mode, Range

Mean = Sum of values ÷ Number of values

Median = Middle value when ordered

Mode = Most frequent value

Range = Maximum - Minimum

WORKED EXAMPLE

Test scores: 78, 85, 92, 85, 88, 95, 72. Find the mean, median, mode, and range.

Solution: Mean: (78+85+92+85+88+95+72) ÷ 7 = 595 ÷ 7 = 85. Ordered: 72, 78, 85, 85, 88, 92, 95. Median: 85 (middle). Mode: 85 (appears twice). Range: 95-72 = 23.

Answer: **Mean: 85, Median: 85, Mode: 85, Range: 23**

Practice Problems

1. Dataset: 12, 15, 18, 15, 22, 15, 20. Find mean, median, and mode.

Work:

Answer: _____

2. Salaries (in thousands): 45, 52, 48, 125, 50, 47, 51. Find mean and median. Which better represents typical salary?

Work:

Answer: _____

3. Temperature readings: 68, 72, 75, 71, 69, 73, 70. Find the range and mean.

Work:

Answer: _____

4. Test scores: 88, 92, 76, 88, 95, 88, 82. What is the mode? What does it tell you?

Work:

Answer: _____

5. Two datasets: A = {10, 20, 30} and B = {18, 20, 22}. Both have mean 20. Which has greater range?

Work:

Answer: _____

6. Add one number to {5, 10, 15, 20} so the mean becomes 12. What number?

Work:

Answer: _____

7. Dataset: 3, 7, 7, 9, 11, 15. Find the median.

Work:

Answer: _____

8. Home prices (in thousands): 250, 275, 280, 310, 975. Which measure is misleading and why?

Work:

Answer: _____

9. Rainfall (inches): 2.1, 3.4, 0.8, 5.2, 2.9, 1.6. Find mean rounded to nearest tenth.

Work:

Answer: _____

10. Dataset: 100, 105, 110, 115, 120. If you add 10 to each value, what happens to the mean? The range?

Work:

Answer: _____

11. Find the missing value: Mean of 8, 12, x, 18, 22 is 14. What is x?

Work:

Answer: _____

12. Which has less spread: {10, 30, 50} or {25, 30, 35}? Explain.

Work:

Answer: _____

13. Dataset: 5, 5, 5, 5, 5. Find mean, median, mode, and range.

Work:

Answer: _____

14. After removing an outlier of 200 from {20, 25, 30, 35, 200}, how do mean and median change?

Work:

Answer: _____

15. Create a dataset of 5 numbers with mean 10, median 8, and range 12.

Work:

Answer: _____

Section 5.2: Mean Absolute Deviation (MAD)

Range tells us the gap between extremes, but MAD tells us how spread out all values are from the center on average.

MAD = Sum of |each value - mean| ÷ Number of values

A smaller MAD means data is clustered near the mean. A larger MAD means data is spread out.

WORKED EXAMPLE

Find the MAD for: 2, 4, 6, 8, 10

Solution: Mean = 30 ÷ 5 = 6. Deviations: |2-6|=4, |4-6|=2, |6-6|=0, |8-6|=2, |10-6|=4. Sum = 12. MAD = 12 ÷ 5 = 2.4

Answer: **MAD = 2.4**

Practice Problems

1. Find MAD: 5, 5, 5, 5, 5 (Hint: what happens when all values equal the mean?)

   Work:

   Answer: _____

2. Find MAD: 10, 20, 30, 40, 50

   Work:

   Answer: _____

3. Find MAD: 8, 10, 10, 12, 10

   Work:

   Answer: _____

4. Dataset A: 20, 20, 20. Dataset B: 10, 20, 30. Find MAD for each. Which is more consistent?

   Work:

   Answer: _____

5. Find MAD: 3, 5, 7, 9, 11 (mean = 7)

   Work:

Answer: _____

6. Find MAD: 100, 102, 98, 104, 96

Work:

Answer: _____

7. Which has greater MAD without calculating: {1, 1, 1, 10} or {1, 3, 5, 7}? Explain.

Work:

Answer: _____

8. Find MAD: 15, 18, 12, 20, 15

Work:

Answer: _____

9. A journalist reports 'average commute is 25 min with MAD of 2 min.' What does this mean?

Work:

Answer: _____

10. Find MAD: 50, 60, 70, 80, 90

Work:

Answer: _____

11. If you add 10 to every value in a dataset, what happens to the MAD?

Work:

Answer: _____

12. Find MAD for test scores: 82, 88, 75, 95, 80

Work:

Answer: _____

13. Two stores have same mean sales ($500). Store A has MAD of $20, Store B has MAD of $150. Which is more predictable?

Work:

Answer: _____

14. Find MAD: 4, 8, 6, 8, 4

    Work:

    Answer: _____

15. Create a dataset of 4 numbers with mean = 10 and MAD = 0.

    Work:

    Answer: _____

Section 5.3: Box Plots and Quartiles

A box plot (box-and-whisker plot) shows the five-number summary: minimum, Q1, median, Q3, maximum.

Finding Quartiles

- Q1 (First Quartile): Median of lower half
- Q2 (Median): Middle of entire dataset
- Q3 (Third Quartile): Median of upper half
- IQR (Interquartile Range): Q3 - Q1

WORKED EXAMPLE

Find the five-number summary for: 12, 15, 18, 22, 25, 28, 30, 35, 40

Solution: Min = 12, Max = 40. Median (Q2) = 25 (5th value). Lower half: 12, 15, 18, 22 → Q1 = (15+18)/2 = 16.5. Upper half: 28, 30, 35, 40 → Q3 = (30+35)/2 = 32.5.

Answer: **Min: 12, Q1: 16.5, Median: 25, Q3: 32.5, Max: 40**

Practice Problems

1. Find the five-number summary: 5, 8, 12, 15, 18, 20, 25

   Work:

   Answer: _____

2. Find Q1, median, Q3 for: 10, 12, 14, 16, 18, 20, 22, 24, 26

   Work:

   Answer: _____

3. Find the IQR for: 3, 5, 7, 9, 11, 13, 15

   Work:

   Answer: _____

4. Dataset: 20, 25, 30, 35, 40, 45, 50, 55, 60. Find all quartiles and IQR.

   Work:

   Answer: _____

5. What percent of data falls between Q1 and Q3?

Work:

Answer: _____

6. Find five-number summary: 100, 105, 110, 115, 120, 125, 130, 135

Work:

Answer: _____

7. Two box plots have same median. Plot A has IQR of 10, Plot B has IQR of 30. Which shows more variability?

Work:

Answer: _____

8. Find Q1 and Q3: 2, 4, 6, 8, 10, 12

Work:

Answer: _____

9. Dataset: 50, 60, 70, 80, 90, 100. Find IQR.

Work:

Answer: _____

10. If Min=10, Q1=25, Median=40, Q3=55, Max=80, what is the IQR?

Work:

Answer: _____

11. Find five-number summary: 1, 1, 2, 3, 5, 8, 13, 21

Work:

Answer: _____

12. The 'box' in a box plot represents what portion of the data?

Work:

Answer: _____

13. Ages: 22, 25, 28, 30, 32, 35, 38, 42, 45. Find quartiles.

Work:

Answer: _____

14. Create a dataset of 7 numbers where Q1=10, Median=15, Q3=20.

    Work:

    Answer: _____

15. Find five-number summary: 65, 70, 72, 78, 80, 82, 85, 88, 92, 95

    Work:

    Answer: _____

Section 5.4: Action Report

Complete this report as a data journalist at Metro News.

1. City A temperatures (°F): 45, 52, 48, 55, 50, 47, 53. City B: 42, 58, 35, 62, 48, 55, 50. Find the mean for each city.

Work:

Answer: _____

2. Which city (above) has a larger range? What does this tell you about weather consistency?

Work:

Answer: _____

3. For City A (above), find the MAD. Is the weather consistent or variable?

Work:

Answer: _____

4. Home prices (thousands): 250, 275, 280, 295, 300, 310, 325, 350, 850. Find the median and mean. Which is a better headline?

Work:

Answer: _____

5. For the home prices above, find the five-number summary.

Work:

Answer: _____

6. Calculate the IQR for the home prices. What does this tell you about the middle 50% of prices?

Work:

Answer: _____

7. Is $850,000 an outlier? Use the rule: Outlier if beyond Q1 - 1.5(IQR) or Q3 + 1.5(IQR).

Work:

Answer: _____

8. Commute times (min): 15, 18, 20, 22, 25, 28, 30, 32, 35. Find Q1, median, and Q3.

Work:

Answer: _____

9. Write a headline summarizing the commute data: use median and IQR.

Work:

Answer: _____

10. Compare two schools' test scores: School A has median 78 with IQR 15. School B has median 80 with IQR 35. Which school would you send your child to? Explain.

Work:

Answer: _____

CHAPTER 6

The Map Maker

Use scale drawings and proportional reasoning to create accurate maps and blueprints

Section 6.1: Understanding Scale

As a cartographer (map maker), you must represent large real-world distances on small pieces of paper. A scale tells you the relationship between map distance and actual distance.

Reading Scales

A scale of 1 inch : 50 miles means 1 inch on the map represents 50 miles in real life.

$$\text{Actual Distance} = \text{Map Distance} \times \text{Scale Factor}$$

$$\text{Map Distance} = \text{Actual Distance} \div \text{Scale Factor}$$

WORKED EXAMPLE

On a map with scale 1 in : 25 mi, two cities are 3.5 inches apart. What is the actual distance?

Solution: Actual = Map × Scale Factor = 3.5 × 25 = 87.5

Answer: **87.5 miles**

WORKED EXAMPLE

Two cities are 180 miles apart. Using scale 1 in : 30 mi, how far apart should they be on the map?

Solution: Map = Actual ÷ Scale = 180 ÷ 30 = 6

Answer: **6 inches**

Practice Problems

1. Scale: 1 in : 10 mi. Map distance is 4.5 in. Find actual distance.

   Work:

   Answer: _____

2. Scale: 1 cm : 25 km. Actual distance is 150 km. Find map distance.

   Work:

   Answer: _____

3. Scale: 1 in : 100 ft. A building is 450 ft tall. How tall on the drawing?

   Work:

   Answer: _____

4. Scale: 1:50,000. A road is 3 cm on the map. How long in reality (in meters)?

   Work:

   Answer: _____

5. Two points are 7 inches apart on a map with scale 1 in : 40 mi. Find actual distance.

   Work:

   Answer: _____

6. Scale: 1 cm : 5 m. A room is 8 m × 6 m. What are the dimensions on the blueprint?

   Work:

   Answer: _____

7. A 600-mile flight appears as 4 inches on a map. What is the scale?

   Work:

   Answer: _____

8. Scale: 1 in : 75 mi. How far apart should cities be if actual distance is 300 miles?

   Work:

   Answer: _____

9. Scale: 2 cm : 50 km. Map shows 7 cm. Find actual distance.

   Work:

Answer: _____

10. A football field (100 yards) is 5 inches on a drawing. Find the scale.

    Work:

    Answer: _____

11. Scale: 1:24. A model car is 8 inches long. How long is the real car (in feet)?

    Work:

    Answer: _____

12. Scale: 1 in : 20 ft. A house is 60 ft × 40 ft. Find blueprint dimensions.

    Work:

    Answer: _____

13. On a map, 2.5 inches = 125 miles. What does 1 inch represent?

    Work:

    Answer: _____

14. Scale: 1 cm : 15 km. Two cities are 120 km apart. Map distance?

    Work:

    Answer: _____

15. A state is 8 inches wide on a map (scale 1 in : 60 mi). How wide is the actual state?

    Work:

    Answer: _____

Section 6.2: Scale Factors and Similar Figures

When shapes are similar (same shape, different size), all corresponding lengths have the same scale factor.

Scale Factor = New Length ÷ Original Length

If scale factor is 2, the new figure is twice as big. If scale factor is 0.5, it's half the size.

WORKED EXAMPLE

A rectangle is 8 cm × 6 cm. A similar rectangle has length 12 cm. Find the width and scale factor.

Solution: Scale factor = 12 ÷ 8 = 1.5. Width = 6 × 1.5 = 9 cm.

Answer: **Width: 9 cm, Scale factor: 1.5**

Practice Problems

1. Original: 4 in × 6 in. Scale factor: 3. Find new dimensions.

   Work:

   Answer: _____

2. Original: 10 cm × 15 cm. New: 4 cm × ?. Find the missing dimension and scale factor.

   Work:

   Answer: _____

3. A model train is 1:87 scale. If the real engine is 52.2 ft, how long is the model (in inches)?

   Work:

   Answer: _____

4. Triangle sides: 3, 4, 5. Similar triangle has shortest side 9. Find other two sides.

   Work:

   Answer: _____

5. Photo: 4 in × 6 in. Enlarged to 10 in × ?. Find missing dimension.

   Work:

Answer: _____

6. Scale factor is 0.25. Original is 80 ft × 120 ft. Find new dimensions.

Work:

Answer: _____

7. Original rectangle: 12 cm × 8 cm. Reduced copy is 9 cm × ?. Find missing dimension.

Work:

Answer: _____

8. A 6-foot person appears 2 inches tall in a photo. What is the scale factor?

Work:

Answer: _____

9. Similar triangles: Triangle A has sides 5, 12, 13. Triangle B has longest side 39. Find all sides of B.

Work:

Answer: _____

10. Blueprint scale: 1 in : 4 ft. A room is 3.5 in × 4 in on paper. Find actual dimensions.

Work:

Answer: _____

11. Scale factor 2.5. If perimeter of original is 40 cm, what is perimeter of new figure?

Work:

Answer: _____

12. Map scale: 1:50,000. Two mountains are 4 cm apart on map. Actual distance in km?

Work:

Answer: _____

13. A mural is 12 ft × 8 ft. A postcard version is 6 in × ?. Find missing dimension.

Work:

Answer: _____

14. Original square: side 5 m. New square: side 7.5 m. Find scale factor.

Work:

Answer: _____

15. Scale factor is 1:4. Model building is 15 inches tall. How tall is actual building (in feet)?

Work:

Answer: _____

Section 6.3: Area and Scale

When you scale a figure, area changes differently than length!

If length scale factor = k, then Area scale factor = k^2

Double the length (k=2), and area quadruples (k^2=4).

WORKED EXAMPLE

A square has side 5 cm (area 25 sq cm). If you double each side, what is the new area?

Solution: New side = 10 cm. New area = 10^2 = 100 sq cm. Or: Area factor = 2^2 = 4, so 25 × 4 = 100.

Answer: **100 sq cm (4× the original)**

Practice Problems

1. Original: 4 cm × 6 cm = 24 sq cm. Scale factor: 3. Find new area.

   Work:

   Answer: _____

2. A rectangle's length and width are both tripled. By what factor does area increase?

   Work:

   Answer: _____

3. Original area: 50 sq in. Scale factor: 2. New area?

   Work:

   Answer: _____

4. A map uses scale 1 in : 100 ft. A park is 2 in × 3 in on the map. Find actual area in sq ft.

   Work:

   Answer: _____

5. Scale factor: 0.5. Original area: 400 sq cm. New area?

   Work:

   Answer: _____

6. A room is 12 ft × 10 ft. A model (scale 1:4) has what dimensions and area?

Work:

Answer: _____

7. Original square: 8 in side. New square: 4 in side. Scale factor? Area factor?

Work:

Answer: _____

8. Blueprint: 1 in : 5 ft. A room is 3 in × 4 in = 12 sq in on paper. Actual area?

Work:

Answer: _____

9. A poster is enlarged by factor 1.5. Original area: 200 sq in. New area?

Work:

Answer: _____

10. Two similar rectangles. Smaller: 6 cm × 4 cm. Larger has length 15 cm. Find larger area.

Work:

Answer: _____

11. If area increases by factor of 9, what is the linear scale factor?

Work:

Answer: _____

12. Scale: 1:50. Model floor is 0.5 m^2. Actual floor area?

Work:

Answer: _____

13. A tile design: 2 in × 2 in. Scaled up to 6 in × 6 in. Area multiplied by what factor?

Work:

Answer: _____

14. Original garden: 8 m × 5 m. Scaled version: 4 m × 2.5 m. Find scale factor and area ratio.

Work:

Answer: _____

15. If you reduce a figure by half (k=0.5), area becomes what fraction of original?

Work:

Answer: _____

Section 6.4: Action Report

Complete this report as a cartographer at Atlas Geographic.

1. Your state map uses scale 1 in : 40 mi. The state capital to the coast is 7.5 inches on the map. Actual distance?

Work:

Answer: _____

2. A nature reserve is 200 miles × 150 miles. Using scale 1 in : 50 mi, find map dimensions.

Work:

Answer: _____

3. Two cities are 280 miles apart. You want them 4 inches apart on your map. What scale should you use?

Work:

Answer: _____

4. Find the area of the nature reserve on the map (from problem 2). Then verify by calculating actual area and converting.

Work:

Answer: _____

5. Blueprint scale: 1 in : 8 ft. A room is 24 ft × 20 ft. Find blueprint dimensions.

Work:

Answer: _____

6. The room (above) has area 480 sq ft. What is its area on the blueprint (in sq in)?

Work:

Answer: _____

7. A model skyscraper is 1:500 scale. The model is 30 inches tall. How tall is the real building in feet?

Work:

Answer: _____

8. On your map, a lake measures 1.5 in × 2 in. Scale is 1 in : 10 mi. Find the actual area of the lake.

Work:

Answer: _____

9. You're reducing a 24 in × 36 in poster to fit in a 4 in × 6 in frame. What is the scale factor?

Work:

Answer: _____

10. The original poster has 864 sq in of art. How much art (in sq in) will fit in the frame?

Work:

Answer: _____

CHAPTER 7

The Stock Trader

Write, evaluate, and solve algebraic expressions and equations for market analysis

Section 7.1: Writing Algebraic Expressions

As a stock trader, you track investments using formulas with variables. A variable is a letter that represents an unknown or changing value.

Translating Words to Algebra

- Addition: sum, plus, increased by, more than, total
- Subtraction: difference, minus, decreased by, less than, fewer
- Multiplication: product, times, of, twice, double, triple
- Division: quotient, divided by, ratio, per, split

```
Let n = number of shares, p = price per share
Total Value = n × p  or  np
```

WORKED EXAMPLE

Write an expression: 'A stock's price increased by $5.'

Solution: Let p = original price. 'Increased by' means add. Expression: p + 5

Answer: **p + 5**

WORKED EXAMPLE

Write an expression: 'Three times the number of shares, minus 10.'

Solution: Let n = number of shares. Three times: 3n. Minus 10: 3n - 10

Answer: **3n - 10**

Practice Problems

1. Write an expression: 'A stock price plus $12'

   Work:

   Answer: _____

2. Write an expression: 'Double the number of shares'

   Work:

   Answer: _____

3. Write an expression: 'The price decreased by $8'

   Work:

   Answer: _____

4. Write an expression: 'The quotient of total profit and 4'

   Work:

   Answer: _____

5. Write an expression: '15 less than the stock price'

   Work:

   Answer: _____

6. Write an expression: 'The sum of two investments, x and y'

   Work:

   Answer: _____

7. Write an expression: '5 more than triple a number'

   Work:

   Answer: _____

8. Write an expression: 'A number divided by 6'

   Work:

   Answer: _____

9. Write an expression: 'The product of 7 and a number, decreased by 3'

   Work:

Answer: _____

10. Write an expression: 'Half of the total investment'

    Work:

    Answer: _____

11. Define variables and write: 'Total cost of buying n shares at p dollars each'

    Work:

    Answer: _____

12. Write an expression: 'The difference between selling price s and buying price b'

    Work:

    Answer: _____

13. Write an expression: '20% of the investment value v' (Hint: 20% = 0.20)

    Work:

    Answer: _____

14. Write an expression: 'Commission is $10 plus 2% of the sale amount'

    Work:

    Answer: _____

15. Write an expression using two variables: 'Total portfolio = stocks plus bonds'

    Work:

    Answer: _____

Section 7.2: Evaluating Expressions

Once you write an expression, you can evaluate it by substituting numbers for variables.

To evaluate: Replace each variable with its value, then calculate

WORKED EXAMPLE

Evaluate 3x + 7 when x = 5

Solution: Replace x with 5: 3(5) + 7 = 15 + 7 = 22

Answer: 22

WORKED EXAMPLE

Evaluate 2a - b when a = 8 and b = 3

Solution: Replace a with 8 and b with 3: 2(8) - 3 = 16 - 3 = 13

Answer: 13

Practice Problems

1. Evaluate 4x when x = 9

   Work:

   Answer: _____

2. Evaluate n + 15 when n = 27

   Work:

   Answer: _____

3. Evaluate 5y - 12 when y = 8

   Work:

   Answer: _____

4. Evaluate 2a + 3b when a = 4 and b = 5

   Work:

   Answer: _____

5. Evaluate 24 ÷ m when m = 6

Work:

Answer: _____

6. Evaluate $x^2 + 5$ when $x = 3$

Work:

Answer: _____

7. Evaluate $3(n - 4)$ when $n = 10$

Work:

Answer: _____

8. Evaluate $2p + q - 5$ when $p = 6$ and $q = 9$

Work:

Answer: _____

9. Evaluate $100 - 4x$ when $x = 15$

Work:

Answer: _____

10. A stock's value is $25n$ (n = shares). Find value when $n = 40$.

Work:

Answer: _____

11. Evaluate $(a + b) \div 2$ when $a = 18$ and $b = 22$

Work:

Answer: _____

12. Evaluate $0.08x$ (8% of x) when $x = 500$

Work:

Answer: _____

13. Evaluate $5x^2$ when $x = 4$

Work:

Answer: _____

14. Profit = Revenue - Cost = r - c. Find profit when r = 850 and c = 620.

Work:

Answer: _____

15. Evaluate 2(l + w) when l = 12 and w = 8

Work:

Answer: _____

Section 7.3: Solving One-Step Equations

An equation states that two expressions are equal. Solving means finding the value of the variable that makes the equation true.

Inverse Operations

Addition ↔ Subtraction (undo each other)

Multiplication ↔ Division (undo each other)

Whatever you do to one side, do to the other side to keep the equation balanced.

WORKED EXAMPLE

Solve: x + 15 = 42

Solution: Subtract 15 from both sides: x + 15 - 15 = 42 - 15 → x = 27. Check: 27 + 15 = 42 ✓

Answer: **x = 27**

WORKED EXAMPLE

Solve: 5n = 85

Solution: Divide both sides by 5: 5n ÷ 5 = 85 ÷ 5 → n = 17. Check: 5(17) = 85 ✓

Answer: **n = 17**

WORKED EXAMPLE

Solve: y - 23 = 41

Solution: Add 23 to both sides: y - 23 + 23 = 41 + 23 → y = 64. Check: 64 - 23 = 41 ✓

Answer: **y = 64**

Practice Problems

1. Solve: x + 8 = 25

   Work:

   Answer: _____

2. Solve: n - 14 = 36

   Work:

Answer: _____

3. Solve: 4y = 48

Work:

Answer: _____

4. Solve: m ÷ 5 = 12

Work:

Answer: _____

5. Solve: 15 + a = 52

Work:

Answer: _____

6. Solve: b - 27 = 45

Work:

Answer: _____

7. Solve: 9x = 108

Work:

Answer: _____

8. Solve: p ÷ 8 = 7

Work:

Answer: _____

9. Solve: 35 = c + 18

Work:

Answer: _____

10. Solve: 72 = 6n

Work:

Answer: _____

11. Solve: z - 100 = 250

Work:

Answer: _____

12. Solve: w ÷ 4 = 25

Work:

Answer: _____

13. A stock gained $x and is now worth $156. It started at $120. Solve: 120 + x = 156

Work:

Answer: _____

14. You split $y equally among 5 accounts, putting $45 in each. Solve: y ÷ 5 = 45

Work:

Answer: _____

15. After losing $38, your portfolio is worth $412. Solve: p - 38 = 412

Work:

Answer: _____

Section 7.4: Writing and Solving Inequalities

Sometimes you need to express 'at least,' 'at most,' 'more than,' or 'less than.' These use inequalities.

Inequality Symbols

- < means 'less than'
- > means 'greater than'
- ≤ means 'less than or equal to' (at most)
- ≥ means 'greater than or equal to' (at least)

WORKED EXAMPLE

Write and solve: 'A number plus 5 is greater than 12'

Solution: Inequality: x + 5 > 12. Solve: x > 12 - 5 → x > 7. Any number greater than 7 works.

Answer: **x > 7**

WORKED EXAMPLE

Write and solve: 'To avoid fees, you need at least $500. You have $350. How much more do you need?'

Solution: Let x = additional amount. 350 + x ≥ 500. Solve: x ≥ 150.

Answer: **x ≥ $150**

Practice Problems

1. Write as inequality: 'x is greater than 10'

   Work:

   Answer: _____

2. Write as inequality: 'The price p is at most $50'

   Work:

   Answer: _____

3. Write as inequality: 'You need at least 100 shares'

   Work:

   Answer: _____

4. Solve: $x + 7 > 15$

Work:

Answer: _____

5. Solve: $n - 4 \leq 20$

Work:

Answer: _____

6. Solve: $3y < 27$

Work:

Answer: _____

7. Solve: $m \div 2 \geq 8$

Work:

Answer: _____

8. Write and solve: 'Five more than a number is less than 30'

Work:

Answer: _____

9. Write and solve: 'A number divided by 3 is at least 9'

Work:

Answer: _____

10. You have $x in savings. You want more than $1,000. Write and interpret the inequality.

Work:

Answer: _____

11. Solve: $25 + p > 40$

Work:

Answer: _____

12. Solve: $6n \leq 54$

Work:

Answer: _____

13. A broker requires at least $2,500 to open an account. You have $1,800. How much more? Write and solve.

Work:

Answer: _____

14. Solve: $z - 15 \geq 45$

Work:

Answer: _____

15. Stock must be above $75 to sell. Current: $60. How much must it rise? Write inequality.

Work:

Answer: _____

Section 7.5: Action Report

Complete this report as a junior analyst at Summit Trading.

1. Write an expression for total investment: n shares at p dollars per share.

Work:

Answer: _____

2. Evaluate your expression from #1 when n = 50 shares and p = $32 per share.

Work:

Answer: _____

3. Write an expression: 'Profit equals selling price minus buying price, times number of shares.'

Work:

Answer: _____

4. A stock rose $x and is now at $78. It started at $65. Write and solve an equation to find x.

Work:

Answer: _____

5. You want to buy shares at $25 each with $400. Write and solve: 25n ≤ 400. How many shares can you buy?

Work:

Answer: _____

6. Commission is 2% of sale value plus $10. Write the expression using variable s for sale value.

Work:

Answer: _____

7. Evaluate your commission expression when s = $5,000.

Work:

Answer: _____

8. Write and solve: Your portfolio needs to grow by at least $2,000 this year. After 6 months, you've gained $1,350. How much more do you need? Use inequality.

Work:

Answer: _____

9. A stock dropped from $92 to an unknown price p after losing $17. Write and solve the equation.

Work:

Answer: _____

10. Challenge: Write an expression for net profit after buying n shares at $40 each, selling them at $52 each, and paying a $25 commission.

Work:

Answer: _____

CHAPTER 8

The Event Planner

Apply percent calculations to budgets, markups, discounts, and tips

Section 8.1: Percent of a Number

As an event planner, you calculate deposits (often 25%), tips (15-20%), taxes (varies), and markups. Mastering percents is essential.

Percent of a Number = Percent × Number

Convert percent to decimal: move decimal 2 places left (25% = 0.25)

WORKED EXAMPLE

Find 35% of $240

Solution: Convert: 35% = 0.35. Calculate: 0.35 × 240 = 84

Answer: **$84**

WORKED EXAMPLE

A venue requires a 20% deposit on $4,500. How much is the deposit?

Solution: 20% = 0.20. Deposit = 0.20 × 4,500 = 900

Answer: **$900**

Practice Problems

1. Find 15% of 80

   Work:

   _____

   _____

   Answer: _____

2. Find 40% of $350

Work:

Answer: _____

3. Find 8.5% of $1,200

Work:

Answer: _____

4. A caterer charges 18% gratuity on $2,400. How much is the tip?

Work:

Answer: _____

5. Find 125% of 60 (percents can be over 100%!)

Work:

Answer: _____

6. Find 6% sales tax on a $850 rental

Work:

Answer: _____

7. Find 33⅓% of 270 (hint: 33⅓% = ⅓)

Work:

Answer: _____

8. A DJ requires 50% upfront on a $600 fee. How much is due now?

Work:

Answer: _____

9. Find 2.5% of $8,000

Work:

Answer: _____

10. Find 75% of 48

Work:

Answer: _____

11. A venue offers 15% off a $3,200 rental. What is the discount amount?

Work:

Answer: _____

12. Find 110% of 200

Work:

Answer: _____

13. Insurance costs 4% of the total budget of $12,500. How much?

Work:

Answer: _____

14. Find 66⅔% of 90

Work:

Answer: _____

15. A florist adds 12% for delivery on a $425 order. What is the delivery fee?

Work:

Answer: _____

Section 8.2: Finding the Whole from a Percent

Sometimes you know the part and the percent, but need to find the whole.

If Part = Percent × Whole, then Whole = Part ÷ Percent

WORKED EXAMPLE

A 25% deposit is $600. What is the total cost?

Solution: Whole = Part ÷ Percent = 600 ÷ 0.25 = 2,400

Answer: **$2,400**

WORKED EXAMPLE

If 15% of the guests are vegetarian and that's 12 people, how many total guests?

Solution: Total = 12 ÷ 0.15 = 80

Answer: **80 guests**

Practice Problems

1. 20% of a number is 45. Find the number.

   Work:

   Answer: _____

2. A $180 deposit is 30% of the total. Find the total.

   Work:

   Answer: _____

3. If 40% of attendees arrived early (that's 28 people), how many total attendees?

   Work:

   Answer: _____

4. A 15% tip was $22.50. What was the bill before tip?

   Work:

   Answer: _____

5. 8% of a budget is $640. What is the total budget?

   Work:

Answer: _____

6. A 25% discount saved you $75. What was the original price?

Work:

Answer: _____

7. 12 vegetarian meals are 15% of the order. How many total meals?

Work:

Answer: _____

8. Sales tax of 7% added $56 to a rental. What was the rental before tax?

Work:

Answer: _____

9. A 5% deposit is $250. Find the total contract value.

Work:

Answer: _____

10. If 60% of tickets are sold (that's 360 tickets), how many total tickets?

Work:

Answer: _____

11. A $90 gratuity was 18% of the catering bill. Find the bill.

Work:

Answer: _____

12. 10% of the flowers are roses (that's 45 roses). How many total flowers?

Work:

Answer: _____

13. A 35% markup added $140 to the cost. What was the original cost?

Work:

Answer: _____

14. Insurance at 3% costs $450. What is the total event budget?

Work:

Answer: _____

15. If 80% capacity is 240 people, what is 100% capacity?

Work:

Answer: _____

Section 8.3: Percent Change

When prices increase or decrease, you often express the change as a percent.

Percent Change = (New - Original) ÷ Original × 100

Positive result = increase. Negative result = decrease.

WORKED EXAMPLE

A venue raised prices from $2,000 to $2,400. What is the percent increase?

Solution: Change = 2,400 - 2,000 = 400. Percent = 400 ÷ 2,000 × 100 = 20%

Answer: **20% increase**

WORKED EXAMPLE

An early-bird price dropped from $80 to $60. What is the percent decrease?

Solution: Change = 60 - 80 = -20. Percent = -20 ÷ 80 × 100 = -25%

Answer: **25% decrease**

Practice Problems

1. Original: $50. New: $65. Find percent change.

   Work:

   _____

   _____

   Answer: _____

2. Original: $200. New: $150. Find percent change.

   Work:

   _____

   _____

   Answer: _____

3. A caterer raised prices from $25/person to $30/person. Percent increase?

   Work:

   _____

   _____

   Answer: _____

4. Attendance went from 120 to 180. Find percent change.

   Work:

   _____

   _____

   Answer: _____

5. Original price: $400. After discount: $340. Percent discount?

Work:

Answer: _____

6. A venue that charged $1,500 now charges $1,800. Percent increase?

Work:

Answer: _____

7. Budget was $5,000, now $4,500. Find percent change.

Work:

Answer: _____

8. Guest count went from 80 to 100. Percent increase?

Work:

Answer: _____

9. A photographer dropped rates from $500 to $400. Percent decrease?

Work:

Answer: _____

10. Last year's cost: $3,200. This year: $3,520. Percent change?

Work:

Answer: _____

11. Original quote: $750. Final price: $600. Percent saved?

Work:

Answer: _____

12. Ticket sales went from 200 to 320. Find percent change.

Work:

Answer: _____

13. A DJ raised fee from $400 to $450. Percent increase?

Work:

Answer: _____

14. Food cost dropped from $40/plate to $35/plate. Percent decrease?

    Work:

    Answer: _____

15. Event budget grew from $8,000 to $10,000. Percent increase?

    Work:

    Answer: _____

Section 8.4: Action Report

Complete this report as lead planner at Celebrations Unlimited.

1. A wedding venue costs $8,500. The 25% deposit is due now. How much?

   Work:

   Answer: _____

2. Catering is $45 per person for 120 guests. Add 20% gratuity and 8% tax (on food only). Total?

   Work:

   Answer: _____

3. A florist's original quote was $800. They offered 15% off. What is the new price?

   Work:

   Answer: _____

4. A DJ charges $650. Last year the same DJ charged $500. Percent increase?

   Work:

   Answer: _____

5. Photography is $1,200. A 30% deposit ($360) was paid. How much remains?

   Work:

   Answer: _____

6. The venue increased capacity from 150 to 200 guests. What is the percent increase?

   Work:

   Answer: _____

7. A client's budget is $15,000. They've spent $10,500. What percent remains?

   Work:

   Answer: _____

8. A 6% sales tax on decorations is $42. What was the decoration cost before tax?

   Work:

Answer: _____

9. Compare two caterers: Caterer A is $50/person. Caterer B is $45/person but adds 22% service charge. For 100 guests, which is cheaper?

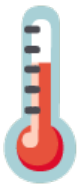
Work:

Answer: _____

10. Final budget breakdown: Venue 35%, Catering 40%, Photography 15%, Other 10%. If total is $20,000, find the dollar amount for each category.

Work:

Answer: _____



CHAPTER 9

The Climate Scientist

Apply absolute value and analyze data with positive and negative values

Section 9.1: Absolute Value

As a climate scientist, you work with temperatures above and below zero, elevations above and below sea level, and measurements that can be positive or negative. Absolute value helps you find distance from zero regardless of direction.

```
|x| = distance from x to 0 on the number line
```

Absolute value is always positive (or zero). It measures magnitude without direction.

WORKED EXAMPLE

Find: |-15| and |15|

Solution: Both -15 and 15 are 15 units from zero.

Answer: **|-15| = 15 and |15| = 15**

WORKED EXAMPLE

The temperature dropped from 0°F to -23°F. How many degrees did it drop?

Solution: Distance from 0 to -23 is |-23| = 23 degrees.

Answer: **23 degrees**

Practice Problems

1. Find: |8|

   Work:

   Answer: _____

2. Find: |-25|

Work:

Answer: _____

3. Find: |0|

Work:

Answer: _____

4. Compare: |-12| and |10|. Which is greater?

Work:

Answer: _____

5. Find: |-3| + |7|

Work:

Answer: _____

6. Find: |5 - 12|

Work:

Answer: _____

7. Find: |-8| × |-4|

Work:

Answer: _____

8. A submarine is at -450 feet. How far below sea level is it?

Work:

Answer: _____

9. Order from least to greatest absolute value: -3, 7, -10, 2, -5

Work:

Answer: _____

10. Find: |−20| − |15|

Work:

Answer: _____

11. The Dead Sea is at -430 meters. Mt. Everest is at +8,849 meters. Which has the greater absolute value for elevation?

Work:

Answer: _____

12. Find: $|-6|^2$

Work:

Answer: _____

13. If $|x| = 9$, what are the possible values of x?

Work:

Answer: _____

14. Find: $|4 - 10| + |10 - 4|$

Work:

Answer: _____

15. A temperature of -40°C equals -40°F. What is $|-40|$?

Work:

Answer: _____

Section 9.2: Comparing and Ordering Rational Numbers

Climate data includes decimals, fractions, and negative numbers. You must compare and order these rational numbers accurately.

Comparing Rational Numbers

- On a number line, numbers increase from left to right
- Any positive number > any negative number
- For negatives: further from zero = smaller value

WORKED EXAMPLE

Order from least to greatest: -2.5, 1.3, -0.8, 0, 2.1

Solution: Arrange on number line: -2.5 is furthest left, then -0.8, then 0, then 1.3, then 2.1.

Answer: **-2.5, -0.8, 0, 1.3, 2.1**

Practice Problems

1. Compare using < or >: -5 ___ -8

   Work:

   Answer: _____

2. Compare: 3.2 ___ -3.2

   Work:

   Answer: _____

3. Compare: -0.5 ___ -0.25

   Work:

   Answer: _____

4. Order from least to greatest: 4, -7, 2, -3, 0

   Work:

   Answer: _____

5. Compare: -⅔ ___ -¾ (Hint: convert to decimals)

   Work:

Answer: _____

6. Order: 1.5, -2.5, 0.5, -0.5, -1.5

Work:

Answer: _____

7. Which is colder: -15°C or -12°C?

Work:

Answer: _____

8. Order temperatures: 32°F, 0°F, -10°F, 45°F, -5°F

Work:

Answer: _____

9. Compare: |-4| ___ |3|

Work:

Answer: _____

10. Compare: -1.25 ___ -1.3

Work:

Answer: _____

11. Order elevations: -50m, 120m, -200m, 0m, 80m

Work:

Answer: _____

12. Compare: -⅝ ___ -½

Work:

Answer: _____

13. Find two numbers between -3 and -2.

Work:

Answer: _____

14. Order: 2.75, -2.75, 2.5, -2.5, 0

Work:

Answer: _____

15. Which depth is deeper: -85 feet or -90 feet?

Work:

Answer: _____

Section 9.3: Graphing on the Coordinate Plane

Climate scientists plot data using the coordinate plane. Both x and y can be positive or negative, creating four quadrants.

The Four Quadrants

- Quadrant I: (+, +) — upper right
- Quadrant II: (-, +) — upper left
- Quadrant III: (-, -) — lower left
- Quadrant IV: (+, -) — lower right

WORKED EXAMPLE

In which quadrant is the point (-3, 5)?

Solution: x is negative, y is positive: Quadrant II (upper left).

Answer: **Quadrant II**

Practice Problems

1. Name the quadrant: (4, 7)

   Work:

   Answer: _____

2. Name the quadrant: (-2, -6)

   Work:

   Answer: _____

3. Name the quadrant: (5, -3)

   Work:

   Answer: _____

4. Name the quadrant: (-8, 4)

   Work:

   Answer: _____

5. What quadrant is (0, 5) in? (Trick question!)

   Work:

Answer: _____

6. Plot and identify quadrant: (-4, -2)

Work:

Answer: _____

7. If a point is in Quadrant III, what are the signs of x and y?

Work:

Answer: _____

8. Give the coordinates of a point in Quadrant IV.

Work:

Answer: _____

9. Where is (-6, 0) located?

Work:

Answer: _____

10. Reflect (3, -4) over the x-axis. New coordinates?

Work:

Answer: _____

11. Reflect (-2, 5) over the y-axis. New coordinates?

Work:

Answer: _____

12. Distance from (0, 0) to (3, 0)? From (0, 0) to (0, -5)?

Work:

Answer: _____

13. A temperature sensor is at position (-5, 8). Which quadrant?

Work:

Answer: _____

14. Move (2, 3) left 5 units and down 7 units. New position?

Work:

Answer: _____

15. If a point moves from Quadrant I to Quadrant III, what must change?

Work:

Answer: _____

Section 9.4: Action Report

Complete this report as a researcher at the Global Climate Institute.

1. Arctic temperatures: -35°C, -28°C, -42°C, -31°C, -38°C. Find the mean temperature.

Work:

Answer: _____

2. Which temperature (above) has the greatest absolute value? What does this represent?

Work:

Answer: _____

3. Find the range of the Arctic temperatures.

Work:

Answer: _____

4. Ocean depths at research sites (meters): -120, -85, -200, -150, -95. Order from shallowest to deepest.

Work:

Answer: _____

5. A weather balloon rises from -50 meters (underground launch) to +12,000 meters. What is the total change in elevation?

Work:

Answer: _____

6. Temperature change from midnight to noon: -8°C to +15°C. Calculate the change.

Work:

Answer: _____

7. Plot these data points: Day 1: (1, -5°C), Day 2: (2, -2°C), Day 3: (3, 4°C), Day 4: (4, 1°C). What quadrants are used?

Work:

Answer: _____

8. Find |−42| − |−28| from the Arctic data. What does this represent?

Work:

Answer: _____

9. A glacier elevation changed from -15 meters (below sea level) to +22 meters (above). What is the absolute change?

Work:

Answer: _____

10. Compare two measurement errors: Site A had error of +3.5°C. Site B had error of -4.2°C. Which had greater absolute error?

Work:

Answer: _____

CHAPTER 10

The Entrepreneur

Apply ALL Grade 6 skills to launch and run your own startup business

Welcome, Entrepreneur!

This is your capstone project. You will apply every skill from Grade 6 to plan, launch, and analyze a business. No single-skill problems here—this is the real world, where problems combine multiple concepts.

YOUR BUSINESS: You are launching a mobile food cart selling gourmet tacos.

Part 1: Market Research (Ratios & Proportions)

1. You survey 120 people. The ratio of those who would buy tacos to those who wouldn't is 5:3. How many would buy?

Work:

Answer: _____

2. Of those who would buy, 60% prefer chicken, 25% prefer beef, 15% prefer veggie. How many prefer each?

Work:

Answer: _____

3. Your competitor sells 450 tacos in 6 hours. At what rate (tacos per hour)?

Work:

Answer: _____

4. You project selling at 80% of that rate. How many tacos would you sell in 8 hours?

Work:

Answer: _____

5. If ingredients cost $1.80 per taco and you charge $5, what is your profit ratio per taco?

Work:

Answer: _____

Part 2: Startup Budget (Integers & Percents)

6. Startup costs: Cart $3,500, Equipment $1,200, Permits $450, Initial inventory $800, Marketing $350. Calculate total startup costs.

Work:

Answer: _____

7. You have $4,000 saved. You borrow the rest from family (interest-free). Express your debt as a negative integer.

Work:

Answer: _____

8. A grant covers 15% of startup costs. How much do you receive?

Work:

Answer: _____

9. After the grant, recalculate your debt.

Work:

Answer: _____

10. If you repay $500/month, write and solve an equation to find when debt = 0.

Work:

Answer: _____

Part 3: Pricing Strategy (Algebra)

11. Write an expression for daily revenue: Let t = number of tacos sold at $5 each.

Work:

Answer: _____

12. Write an expression for daily profit: Revenue minus ingredient cost ($1.80 per taco) minus daily fixed costs ($75).

Work:

Answer: _____

13. Simplify your profit expression from #12.

Work:

Answer: _____

14. Evaluate daily profit if you sell 150 tacos.

Work:

Answer: _____

15. You want daily profit of at least $300. Write and solve an inequality: profit ≥ 300.

Work:

Answer: _____

Part 4: Cart Design (Geometry)

16. Your cart is 8 ft × 4 ft × 6 ft tall. Find the volume.

Work:

Answer: _____

17. You need to wrap the cart in weather-resistant vinyl (all 6 sides). Find the surface area.

Work:

Answer: _____

18. Vinyl costs $2.50 per square foot. What is the total cost?

Work:

Answer: _____

19. You want a refrigerator inside: 2.5 ft × 2 ft × 3 ft. What percent of cart volume does it occupy?

Work:

Answer: _____

20. A scale model of your cart is 1:8. What are the model's dimensions?

Work:

Answer: _____

Part 5: First Month Analysis (Statistics)

21. Daily sales (Week 1): 85, 120, 95, 140, 180, 210, 195. Find mean, median, range.

Work:

Answer: _____

22. Calculate the MAD for Week 1 sales. Is your business consistent?

Work:

Answer: _____

23. Week 2 sales: 105, 145, 130, 155, 190, 225, 200. Find the percent change in mean sales from Week 1 to Week 2.

Work:

Answer: _____

24. Combine all 14 days. Find Q1, median, Q3, and IQR.

Work:

Answer: _____

25. Create a summary: Based on your statistics, write a sentence describing your business's first two weeks.

Work:

Answer: _____

Part 6: Expansion Planning (Scale & Proportions)

26. You want to add a second cart. If one cart serves a 3-mile radius, what area does it cover? ($A = \pi r^2$, use $\pi \approx 3.14$)

Work:

Answer: _____

27. Two carts together cover twice the area. What is the total coverage?

Work:

Answer: _____

28. A city map uses scale 1 inch : 2 miles. How big is your 3-mile service radius on the map?

Work:

Answer: _____

29. You're designing a logo. Original is 4 in × 3 in. You need it 10 inches wide. What's the new height?

Work:

Answer: _____

30. The enlarged logo uses how many times more ink (by area)?

Work:

Answer: _____

Part 7: Final Business Report

Synthesize your work into a final summary.

31. Calculate your first month's total revenue (use Week 1 + Week 2 daily sales × $5 per taco).

Work:

Answer: _____

32. Calculate first month's total profit using your expression from Part 3. (Remember to multiply daily fixed costs by number of days.)

Work:

Answer: _____

33. What percent of startup costs have you recovered after Month 1?

Work:

Answer: _____

34. At this profit rate, how many months until you pay off your family loan (from Part 2)?

Work:

Answer: _____

35. Write a one-paragraph business summary using at least 5 statistics from your analysis.

Work:

Answer: _____

Congratulations! You have completed the Grade 6 capstone project.

Extra Practice

Additional problems organized by chapter for targeted review

Chapter 1: Ratios, Rates, and Proportions

1. Simplify the ratio 48:64.

   Answer: _____

2. A recipe uses 5 cups of flour for 20 cookies. Write the unit rate.

   Answer: _____

3. Solve the proportion: 4/7 = x/35

   Answer: _____

4. If 3 apples cost $2.25, how much do 8 apples cost?

   Answer: _____

5. A car travels 280 miles on 8 gallons. Find miles per gallon.

   Answer: _____

6. The ratio of boys to girls is 5:7. If there are 35 boys, how many girls?

   Answer: _____

7. Solve: 9/12 = 15/x

   Answer: _____

8. Which is the better buy: 6 oz for $4.50 or 10 oz for $7.00?

   Answer: _____

9. A map scale is 1 in : 30 mi. Two cities are 4.5 inches apart. Find actual distance.

   Answer: _____

10. The ratio of protein to carbs in a meal is 2:5. If there are 30g of carbs, how much protein?

    Answer: _____

Chapter 2: Integers and Operations

1. Calculate: (-15) + (-23)

   Answer: _____

2. Calculate: 45 + (-67)

   Answer: _____

3. Calculate: (-8) - (-12)

   Answer: _____

4. Calculate: 25 - 38

   Answer: _____

5. Calculate: (-6) × 9

   Answer: _____

6. Calculate: (-72) ÷ (-8)

   Answer: _____

7. Order from least to greatest: -12, 5, -3, 0, -8, 7

   Answer: _____

8. A bank account: Start $200, withdraw $350, deposit $100. Final balance?

   Answer: _____

9. Calculate: (-4) × (-5) × (-2)

   Answer: _____

10. Evaluate: -15 + 8 - (-3) + (-10)

    Answer: _____

Chapter 3: Surface Area and Volume

1. Find surface area of a cube with side 7 cm.

   Answer: _____

2. Find surface area: l=10, w=6, h=4 inches.

   Answer: _____

3. A box is 5 ft × 3 ft × 2 ft. How much cardboard for all 6 sides?

   Answer: _____

4. Find volume: 8 in × 5 in × 3 in.

   Answer: _____

5. Find volume: 2.5 m × 4 m × 3 m.

   Answer: _____

6. A rectangular prism has SA = 148 sq cm. If l=6 and w=4, find h.

   Answer: _____

7. Find volume: 3½ ft × 2 ft × 4 ft.

   Answer: _____

8. Describe the net for a cube: how many squares and what size?

   Answer: _____

9. A pool is 25 ft × 12 ft × 5 ft. Find volume in cubic feet.

   Answer: _____

10. Find surface area of the four walls only: 12 ft × 10 ft × 8 ft room.

    Answer: _____

Chapter 4: Dividing Fractions

1. Calculate: ¾ ÷ 2

   Answer: _____

2. Calculate: ⅔ ÷ ½

   Answer: _____

3. Calculate: 5/8 ÷ ¼

   Answer: _____

4. Calculate: 2½ ÷ ½

   Answer: _____

5. Calculate: 4⅓ ÷ ⅔

   Answer: _____

6. How many ¼ cup servings in 3 cups?

   Answer: _____

7. Calculate: 7/8 ÷ 7/16

   Answer: _____

8. A recipe uses ⅔ cup sugar. You have 4 cups. How many batches?

   Answer: _____

9. Calculate: 3¾ ÷ 1½

   Answer: _____

10. Calculate: 5/6 ÷ 5/12

    Answer: _____

Chapter 5: Statistics

1. Find mean: 12, 18, 15, 21, 14.

   Answer: _____

2. Find median: 8, 3, 12, 7, 15, 9, 11.

   Answer: _____

3. Find range: 45, 52, 38, 67, 41.

   Answer: _____

4. Find MAD for: 10, 12, 14, 16, 18 (mean = 14).

   Answer: _____

5. Find Q1 and Q3: 5, 8, 12, 15, 18, 22, 25.

   Answer: _____

6. Calculate IQR from the dataset above.

   Answer: _____

7. Dataset: 20, 25, 25, 30, 35, 40. Find mode and median.

   Answer: _____

8. Find five-number summary: 10, 15, 20, 25, 30, 35, 40.

   Answer: _____

9. Which measure is affected most by outliers: mean or median?

   Answer: _____

10. Find MAD: 5, 5, 10, 15, 15 (mean = 10).

    Answer: _____

Chapter 6: Scale Drawings

1. Scale 1 in : 50 mi. Map distance 3.5 in. Find actual distance.

   Answer: _____

2. Actual distance 240 miles. Scale 1 in : 40 mi. Find map distance.

   Answer: _____

3. Original: 6 cm × 8 cm. Scale factor 2.5. Find new dimensions.

   Answer: _____

4. Similar rectangles: small is 4 × 6, large has length 10. Find large width.

   Answer: _____

5. Scale factor is 3. Original area is 20 sq cm. New area?

   Answer: _____

6. Blueprint: 1 in : 8 ft. Room is 2.5 in × 3 in on paper. Actual dimensions?

   Answer: _____

7. A model car is 1:24 scale. Real car is 12 ft. Model length in inches?

   Answer: _____

8. If area scale factor is 9, what is the linear scale factor?

   Answer: _____

9. Scale 1:100. Model is 15 cm tall. Actual height in meters?

   Answer: _____

10. Photo: 4 × 6 inches. Enlarged with factor 1.5. New area?

    Answer: _____

Chapter 7: Algebraic Expressions and Equations

1. Write expression: 'A number increased by 12'

   Answer: _____

2. Write expression: 'The product of 8 and a number, minus 5'

   Answer: _____

3. Evaluate $4x + 7$ when $x = 6$.

   Answer: _____

4. Evaluate $3a - 2b$ when $a = 5$ and $b = 4$.

   Answer: _____

5. Solve: $x + 18 = 45$

   Answer: _____

6. Solve: $n - 27 = 53$

   Answer: _____

7. Solve: $7y = 91$

   Answer: _____

8. Solve: $m \div 6 = 12$

   Answer: _____

9. Write and solve: 'A number plus 15 is greater than 40'

   Answer: _____

10. Solve: $5x \leq 75$

    Answer: _____

Chapter 8: Percent Applications

1. Find 45% of 80.

   Answer: _____

2. Find 8% of $650.

   Answer: _____

3. 20% of what number is 36?

   Answer: _____

4. What percent of 80 is 20?

   Answer: _____

5. A $120 item is discounted 25%. New price?

   Answer: _____

6. A price increased from $50 to $65. Percent increase?

   Answer: _____

7. Sales tax is 6.5% on a $240 purchase. Total cost?

   Answer: _____

8. 15% tip on a $84 bill. How much?

   Answer: _____

9. A 30% deposit is $450. What is the total?

   Answer: _____

10. Original: $80. Final: $60. Percent decrease?

    Answer: _____

Chapter 9: Absolute Value and Coordinate Plane

1. Find: |-18|

   Answer: _____

2. Find: |7| + |-12|

   Answer: _____

3. Compare: |-15| ___ |12|

   Answer: _____

4. Order: -8, 3, -5, 0, -2, 6 from least to greatest.

   Answer: _____

5. If |x| = 11, what are possible values of x?

   Answer: _____

6. Name quadrant: (-4, 7)

   Answer: _____

7. Name quadrant: (5, -2)

   Answer: _____

8. Reflect (3, -5) over x-axis. New point?

   Answer: _____

9. Find: |-9| × |-4|

   Answer: _____

10. Point is in Quadrant III. What are signs of (x, y)?

    Answer: _____

Challenge Problems

Advanced multi-step problems for students ready to go deeper

Challenge Set A: Mixed Operations

1. A store buys shirts at $15 each, marks them up 60%, then offers 20% off the marked price. What is the final price and profit per shirt?

Answer: _____

2. You have 3¾ cups of flour. Recipe A uses ½ cup per batch. Recipe B uses ⅔ cup per batch. How many more batches of A can you make than B?

Answer: _____

3. Temperature dropped from 8°C to -15°C over 5 hours. What was the average change per hour?

Answer: _____

4. A rectangular garden is 12 ft × 8 ft. You want to triple the area by increasing both dimensions by the same amount. What is the new length?

Answer: _____

5. Data set: 15, 18, 21, x, 27. If the mean is 20, find x. Then find the MAD.

Answer: _____

Challenge Set B: Multi-Step Applications

1. A pool is 20 ft × 15 ft × 6 ft. Water costs $0.004 per gallon. One cubic foot = 7.48 gallons. How much to fill the pool?

Answer: _____

2. Investment A earns 5% annually. Investment B loses 3% annually. If you put $1,000 in each, what is the combined value after one year?

Answer: _____

3. Map scale is 1:250,000. Two cities are 8 cm apart on the map. If you drive 60 km/h, how long is the trip?

Answer: _____

4. A recipe serves 6 and uses 2¼ cups flour, ¾ cup sugar, ½ cup butter. Scale to serve 10. Give all ingredient amounts.

Answer: _____

5. Stock A: -$5, +$12, -$3, +$8. Stock B: +$4, -$2, +$7, -$6. Which had better total performance and by how much?

Answer: _____

Challenge Set C: Pre-Algebra Preview

1. Solve the two-step equation: 3x + 7 = 22

   Answer: _____

2. Solve: 2(n - 4) = 14

   Answer: _____

3. The perimeter of a rectangle is 38 cm. The length is 3 more than the width. Find both dimensions. (Hint: P = 2l + 2w)

   Answer: _____

4. Solve: 5x - 12 > 28

   Answer: _____

5. A cell phone plan costs $25/month plus $0.10 per text. Write an expression for monthly cost with t texts. If you spent $43, how many texts?

   Answer: _____

6. Solve for x: x/4 + 5 = 12

   Answer: _____

7. Two numbers add to 45. One is 9 more than the other. Find both numbers.

   Answer: _____

8. Solve: 4(x + 2) - 3 = 25

   Answer: _____

9. A triangle has angles in ratio 1:2:3. Find all three angles. (Hint: angles sum to 180°)

   Answer: _____

10. If 2x + 3y = 21 and y = 3, find x.

    Answer: _____

Final Mastery Check

Comprehensive review covering all Grade 6 standards

1. Simplify: 36:48

   Answer: _____

2. Solve the proportion: 5/8 = 30/x

   Answer: _____

3. Calculate: (-24) + 15 - (-8)

   Answer: _____

4. Calculate: (-6) × (-7) × 2

   Answer: _____

5. Find surface area: l=9, w=5, h=3 cm

   Answer: _____

6. Find volume: 4½ ft × 3 ft × 2 ft

   Answer: _____

7. Calculate: 5/6 ÷ 2/3

   Answer: _____

8. Calculate: 3¼ ÷ 1½

   Answer: _____

9. Find mean and median: 12, 18, 15, 22, 18, 25

   Answer: _____

10. Find MAD for: 6, 8, 10, 12, 14 (mean = 10)

    Answer: _____

11. Scale 1 in : 25 mi. Actual distance 175 miles. Map distance?

    Answer: _____

12. Scale factor 4. Original area 15 sq in. New area?

    Answer: _____

13. Evaluate 5x - 2y when x = 4 and y = 3

    Answer: _____

14. Solve: n + 34 = 81

    Answer: _____

15. Solve: 6y = 78

    Answer: _____

16. Solve: x - 15 > 42

    Answer: _____

17. Find 35% of $180

Answer: _____

18. A price increased from $40 to $52. Percent increase?
    Answer: _____
19. 20% of a number is 45. Find the number.
    Answer: _____
20. Find: |-23| + |8|
    Answer: _____
21. Order: -7, 4, -2, 0, -9, 5 (least to greatest)
    Answer: _____
22. Name quadrant: (-5, -8)
    Answer: _____
23. A box is 12 in × 8 in × 6 in. You wrap it completely. How much paper?
    Answer: _____
24. Unit rate: 450 miles in 9 hours. Miles per hour?
    Answer: _____
25. Write expression: 'Triple a number, decreased by 7'
    Answer: _____

About Global Sovereign University

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