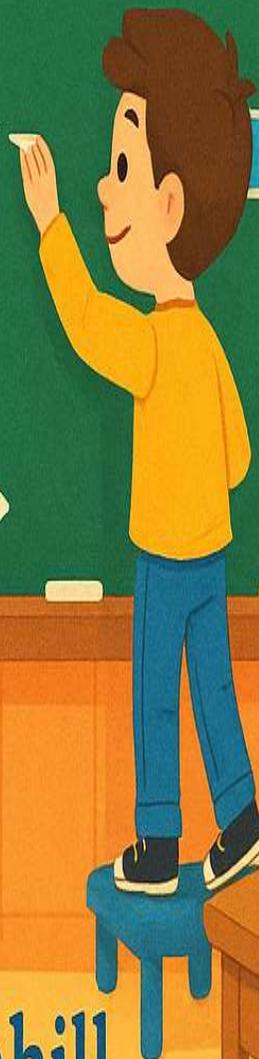
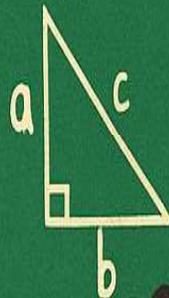


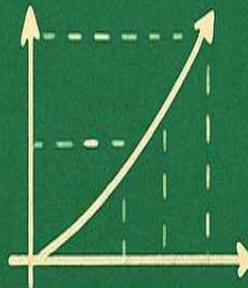
6TH GRADE MATH ADVENTURES



$$x^2 - 9 = 0$$



$$25 \div 5 = 5$$



Amanda Cahill

Preface

Mathematics is not only a subject but a gateway to understanding the world around us. As I embarked on the journey of writing 6th Grade Math Adventures, I wanted to create a resource that would make math accessible, exciting, and engaging for middle school students. The inspiration for this book came during my participation in the AI/ML Literacy and Training ML Models Using Web Browsers Camp. Under the mentorship of brilliant guides like Dr. Hu, Garrett Godwin, Ayodeji Williams, Tienna Freeman, Stevie Scott, and Erica Jones, I developed a deeper appreciation for problem-solving and logical thinking—skills that are at the heart of both mathematics and machine learning. Their guidance and encouragement fueled my passion for creating an educational tool that would inspire young learners to embrace the beauty of numbers, equations, and problem-solving.

I would also like to express my heartfelt gratitude to my parents and my boyfriend, Clint, for their unwavering support and belief in me throughout this journey. Their encouragement has been my strength in pursuing this project. To my grandmother, who has always been a source of wisdom and inspiration, thank you for instilling in me the value of education and perseverance. This book is as much a tribute to your love and guidance as it is a resource for young minds stepping into the fascinating world of math.

I hope this book serves as a stepping stone for students to build confidence in math, explore its wonders, and realize their potential to solve problems creatively and effectively. May it bring joy and clarity to your math-learning journey!

Sincerely Amanda Cahill



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The book is also available online at

<https://www.backupspirit.com/camp/2025/completion/AmandaCahill.html>

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Whole Numbers & Negative Numbers: Concepts, Examples, and Tests

Master basic math skills: place value, operations, negatives, coordinates, and more!

Concepts

Examples

Pre-Test

Q & A

Post-Test

Concepts Explained

1. Place Value

Each digit in a whole number has a value based on its position. For example, in 4,573:

- 4 is in the thousands place (4,000)
- 5 is in the hundreds place (500)
- 7 is in the tens place (70)
- 3 is in the ones place (3)

2. Adding & Subtracting Whole Numbers

Addition joins two or more numbers.

Subtraction finds the difference between two numbers.

3. Estimating Sums & Differences

Estimation makes calculations easier by rounding numbers. For example, $397 + 624$ can be estimated as $400 + 600 = 1,000$.

4. Multiplying Whole Numbers & Estimating Products

Multiplication is repeated addition. Estimation uses rounded numbers (e.g., $49 \times 21 \approx 50 \times 20 = 1,000$).

5. Dividing Whole Numbers & Estimating Quotients

Division splits a number into equal groups. Estimation helps check your answer (e.g., $198 \div 4 \approx 200 \div 4 = 50$).

6. Negative Numbers

Numbers less than zero (e.g., -5). Useful for temperatures, elevations, and finances.

7. Adding with Negative Numbers

When adding a negative, you move left on the number line. For example, $7 + (-3) = 4$.

8. Absolute Value

The distance a number is from zero. Always positive. E.g., $|-6| = 6$.

9. Plotting Ordered Pairs

Ordered pairs (x, y) show positions on a coordinate plane. $(3, 2)$ means 3 units right, 2 units up from the origin.

10. Distance

The straight-line length between two points. On a number line, it's the absolute difference. On a grid, use the Pythagorean theorem if needed.

Examples

- **Place Value:** In 5,204, the digit 2 is in the hundreds place (value: 200).
- **Addition:** $867 + 235 = 1,102$.
- **Subtraction:** $500 - 187 = 313$.
- **Estimating Sums:** $678 + 147 \approx 700 + 150 = 850$.
- **Multiplication:** $24 \times 6 = 144$.
- **Estimating Products:** $38 \times 19 \approx 40 \times 20 = 800$.
- **Division:** $96 \div 8 = 12$.
- **Estimating Quotients:** $205 \div 9 \approx 210 \div 10 = 21$.
- **Negative Numbers:** -7 is 7 units to the left of 0 on a number line.
- **Adding with Negatives:** $5 + (-9) = -4$.
- **Absolute Value:** $|-15| = 15$.
- **Plotting Ordered Pairs:** Plot $(-2, 3)$: move 2 units left and 3 units up from the origin.
- **Distance on a Number Line:** Between -3 and 4 : $|4 - (-3)| = |7| = 7$.

Pre-Test (40 Questions)

Q1. Which is NOT a negative number?

- -7
- -2
- 0
- -11

Q2. Divide: $144 \div 12 = ?$

- 12
- 14
- 10

13

Q3. What is the opposite of 9?

- 9
- 9
- 0
- 1

Q4. Estimate: $125 \div 4 \approx$

- 30
- 32
- 28
- 34

Q5. What is $574 + 219$?

- 783
- 793
- 813
- 800

Q6. Which is a negative number?

- 7
- 0
- 3
- 3

Q7. Multiply: $34 \times 3 = ?$

- 102
- 105
- 99
- 97

Q8. What is the distance between 10 and 4?

- 14
- 6

5

4

Q9. What is the absolute value of 7?

7

-7

0

14

Q10. In 8,392, what place is the 9 in?

Tens

Hundreds

Thousands

Ones

Q11. Estimate: $399 \div 8 \approx$

50

60

40

55

Q12. Subtract: $903 - 478 = ?$

425

435

415

423

Q13. What is $|-14|$?

14

-14

0

7

Q14. Estimate: $856 - 399 \approx$

400

- 500
- 450
- 600

Q15. Find the distance between -3 and 2 .

- 5
- 4
- 3
- 6

Q16. Estimate: $47 \times 19 \approx$

- 900
- 800
- 1,000
- 950

Q17. Estimate: $394 + 218 \approx$

- 600
- 700
- 500
- 800

Q18. Divide: $180 \div 9 = ?$

- 16
- 18
- 20
- 15

Q19. What is $1,200 - 689$?

- 511
- 521
- 501
- 411

Q20. What is the value of the 5 in 2,154?

- 50
- 5
- 500
- 5,000

Q21. What is the absolute value of 0?

- 0
- 1
- 1
- 10

Q22. What is $-4 + (-5)$?

- 9
- 9
- 1
- 1

Q23. Plot $(5, -2)$. What is the y-coordinate?

- 2
- 5
- 2
- 5

Q24. What is $6 + (-8)$?

- 14
- 14
- 2
- 2

Q25. What is 16×12 ?

- 172
- 192
- 182
- 196

Q26. What is 15×7 ?

- 105
- 115
- 120
- 95

Q27. Estimate: $32 \times 29 \approx$

- 900
- 800
- 1,000
- 950

Q28. Estimate: $250 \div 6 \approx$

- 40
- 42
- 45
- 50

Q29. In $(-2, 4)$, what is the x-coordinate?

- 2
- 4
- 2
- 4

Q30. Plot $(-3, 5)$. What is the y-coordinate?

- 3
- 5
- 3
- 5

Q31. What is $72 \div 6$?

- 11
- 10
- 12
- 13

Q32. What is $|-20|$?

- 20
- 20
- 0
- 10

Q33. What is the value of the 6 in 6,427?

- 6
- 600
- 6,000
- 60

Q34. Add: $379 + 618 = ?$

- 997
- 987
- 995
- 1007

Q35. Estimate: $202 \div 9 \approx$

- 20
- 22
- 18
- 19

Q36. Find the sum: $-7 + 9 = ?$

- 2
- 2
- 16
- 16

Q37. What is $144 \div 8$?

- 20
- 18
- 17
- 16

Q38. Multiply: $23 \times 5 = ?$

- 115
- 120
- 110
- 105

Q39. Find the distance between -8 and 3 .

- 5
- 10
- 11
- 8

Q40. Estimate: $387 + 614 \approx$

- 900
- 1,000
- 1,100
- 990

Submit

Questions & Answers from Your Pre-Test

Answer the Pre-Test to see questions and answers here!

Post-Test (40 Questions)

Q1. Multiply: $34 \times 3 = ?$

- 102
- 105
- 99
- 97

Q2. Add: $379 + 618 = ?$

- 997
- 987
- 995
- 1007

Q3. Estimate: $399 \div 8 \approx$

- 50
- 60
- 40
- 55

Q4. What is $8 + (-5)$?

- 13
- 3
- 3
- 5

Q5. What is the x-coordinate in $(4, -2)$?

- 2
- 4
- 2
- 0

Q6. Estimate: $387 + 614 \approx$

- 900
- 1,000
- 1,100
- 990

Q7. Plot $(5, -2)$. What is the y-coordinate?

- 2
- 5
- 2
- 5

Q8. Divide: $144 \div 12 = ?$

- 12
- 14
- 10

13

Q9. Divide: $180 \div 9 = ?$

16

18

20

15

Q10. Estimate: $202 \div 9 \approx$

20

22

18

19

Q11. What is $574 + 219$?

783

793

813

800

Q12. What is the opposite of 9?

-9

9

0

-1

Q13. Estimate: $250 \div 6 \approx$

40

42

45

50

Q14. What is the absolute value of 7?

7

-7

- 0
- 14

Q15. What is $1,200 - 689$?

- 511
- 521
- 501
- 411

Q16. What is the absolute value of 0?

- 0
- 1
- 1
- 10

Q17. Estimate: $78 \times 12 \approx$

- 900
- 1,000
- 800
- 950

Q18. Multiply: $23 \times 5 = ?$

- 115
- 120
- 110
- 105

Q19. What is $72 \div 6$?

- 11
- 10
- 12
- 13

Q20. Plot $(-3, 5)$. What is the y-coordinate?

- 3

- 5
- 3
- 5

Q21. What is the distance between 10 and 4?

- 14
- 6
- 5
- 4

Q22. Estimate: $856 - 399 \approx$

- 400
- 500
- 450
- 600

Q23. Subtract: $903 - 478 = ?$

- 425
- 435
- 415
- 423

Q24. What is $|-14|$?

- 14
- 14
- 0
- 7

Q25. What is $-4 + (-5)$?

- 9
- 9
- 1
- 1

Q26. What is $144 \div 8$?

- 20
- 18
- 17
- 16

Q27. In $(-2, 4)$, what is the x-coordinate?

- 2
- 4
- 2
- 4

Q28. Estimate: $32 \times 29 \approx$

- 900
- 800
- 1,000
- 950

Q29. What is 15×7 ?

- 105
- 115
- 120
- 95

Q30. What is 16×12 ?

- 172
- 192
- 182
- 196

Q31. Find the distance between -8 and 3 .

- 5
- 10
- 11
- 8

Q32. Estimate: $61 \times 8 \approx$

- 480
- 500
- 490
- 520

Q33. Which digit is in the tens place of 4,978?

- 9
- 7
- 8
- 4

Q34. What is the distance between 2 and -5 on a number line?

- 7
- 3
- 5
- 2

Q35. Estimate: $741 - 298 \approx$

- 400
- 500
- 450
- 600

Q36. Estimate: $47 \times 19 \approx$

- 900
- 800
- 1,000
- 950

Q37. Which is NOT a negative number?

- -7
- -2
- 0
- -11

Q38. Estimate: $125 \div 4 \approx$

- 30
- 32
- 28
- 34

Q39. Which is a negative number?

- 7
- 0
- 3
- 3

Q40. What is the value of the 6 in 6,427?

- 6
- 600
- 6,000
- 60

Submit

Fractions, Ratios, Proportions, and Numbers: Study Guide

Master key concepts with examples, questions, and interactive quizzes!

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About Numbers

What is a Whole Number?

A whole number is a number without fractions or decimals. Whole numbers include 0, 1, 2, 3, 4, 5, etc. (no negatives, no fractions).

What is Place Value?

Place value is the value of a digit depending on its position in a number. For example, in 345, the 3 is in the "hundreds" place (so it's worth 300), the 4 is in the "tens" place (worth 40), and the 5 is in the "ones" place (worth 5).

What is Absolute Value?

The **absolute value** of a number is its distance from zero, ignoring sign. For example, the absolute value of -7 is 7; the absolute value of 5 is 5. It's always positive or zero.

What is Distance (on a Number Line)?

The **distance** between two numbers is how far apart they are, measured as the absolute value of their difference. For example, the distance between 3 and -4 is $|3 - (-4)| = |3 + 4| = 7$.

Fractions & Mixed Numbers

- **Changing Improper Fractions to Mixed Numbers:** Divide the numerator by the denominator. The quotient is the whole number part; the remainder is the new numerator.
- **Changing Mixed Numbers to Improper Fractions:** Multiply the whole number by the denominator, add the numerator, and place over the original denominator.

Example:

Convert **11/4** to a mixed number: $11 \div 4 = 2$ remainder 3, so $2 \frac{3}{4}$.

Convert **3 2/5** to an improper fraction: $3 \times 5 + 2 = 17$, so $17/5$.

Operations with Fractions

- **Adding Fractions with Like Denominators:** Add numerators, keep denominator.
- **Subtracting Fractions with Like Denominators:** Subtract numerators, keep denominator.
- **Adding or Subtracting Fractions with Unlike Denominators:** Find the least common denominator (LCD), make equivalent fractions, then add or subtract numerators.
- **Adding Mixed Numbers with Unlike Denominators:** Convert fractions to common denominators, add fractions, add whole numbers, simplify if needed.
- **Subtracting Mixed Numbers with Unlike Denominators:** Find LCD, subtract fractions and whole numbers; you may need to borrow.
- **Estimating Sums and Differences:** Round each mixed number or fraction to nearest whole or "easy" fraction, then add or subtract.

Example:

- $2/5 + 1/5 = (2+1)/5 = 3/5$
- $3/4 - 1/4 = (3-1)/4 = 2/4 = 1/2$
- $1/2 + 1/3 \rightarrow$ LCD is 6: $(3/6) + (2/6) = 5/6$

Multiplying Fractions

- **Multiplying Fractions and Whole Numbers:** Multiply the whole number by the numerator, keep the denominator.
- **Multiplying Fractions: Reciprocals:** The reciprocal of a/b is b/a . Multiplying a number by its reciprocal gives 1.

- **Multiplying Fractions and Mixed Numbers: Reducing:** Convert mixed numbers to improper fractions first. Cancel (reduce) any common factors before multiplying. Simplify the answer.

Example:

- $3 \times 2/7 = (3 \times 2)/7 = 6/7$
- Reciprocal of $3/5$ is $5/3$
- $1 \frac{1}{4} \times 2/3 \rightarrow 1 \frac{1}{4} = 5/4$, so $5/4 \times 2/3 = 10/12 = 5/6$

Dividing Fractions

- **Dividing Fractions by Whole Numbers:** Multiply the fraction by the reciprocal of the whole number.
- **Dividing Whole Numbers by Fractions:** Multiply the whole number by the reciprocal of the fraction.
- **Dividing Fractions by Fractions:** Multiply the first fraction by the reciprocal of the second.
- **Dividing Mixed Numbers:** Change mixed numbers to improper fractions, then proceed as above.

Example:

- $3/4 \div 2 = 3/4 \times 1/2 = 3/8$
- $5 \div 1/4 = 5 \times 4/1 = 20$
- $2/3 \div 5/7 = 2/3 \times 7/5 = 14/15$

Ratios, Proportions & Rates

- **Ratios:** A comparison of two quantities, expressed as a:b or a/b.
- **Proportions and Cross-Multiplying:** A proportion is an equation showing two ratios are equal. Cross-multiply to solve for unknowns.
- **Ratio Tables:** Tables showing how quantities increase or decrease in the same ratio.
- **Rates:** A ratio comparing two quantities with different units (e.g., miles/hour).
- **Problem-Solving with Proportions:** Use proportions and cross-multiplying to solve real-world problems.

Example:

- Ratio: 3 apples to 5 oranges = 3:5
- Proportion: $\frac{2}{3} = \frac{4}{6}$ (cross-multiplied: $2 \times 6 = 3 \times 4$)
- Rate: 120 miles in 2 hours = 60 miles/hour
- Ratio Table:

Apples	2	4	6
Oranges	3	6	9

Examples of the Topics

- **Improper Fraction to Mixed:** $\frac{15}{4} = 3 \frac{3}{4}$
- **Mixed to Improper:** $2 \frac{5}{6} = \frac{(2 \times 6 + 5)}{6} = \frac{17}{6}$
- **Add like denominators:** $\frac{1}{7} + \frac{3}{7} = \frac{4}{7}$
- **Subtract unlike denominators:** $\frac{5}{8} - \frac{1}{4} = \frac{5}{8} - \frac{2}{8} = \frac{3}{8}$
- **Add mixed numbers (unlike):** $1 \frac{2}{3} + 2 \frac{1}{4} = (1+2) + (\frac{8}{12} + \frac{3}{12}) = 3 + \frac{11}{12}$
- **Estimate:** $4 \frac{2}{3} + 1 \frac{3}{10} \approx 5 + 1 = 6$
- **Multiply:** $\frac{2}{5} \times \frac{5}{6} = \frac{10}{30} = \frac{1}{3}$
- **Divide:** $\frac{3}{5} \div \frac{2}{3} = \frac{3}{5} \times \frac{3}{2} = \frac{9}{10}$
- **Ratio:** 12 girls : 9 boys = 4:3
- **Proportion:** If $\frac{x}{12} = \frac{3}{4}$, then $x = 12 \times \frac{3}{4} = 9$

Pre-Test (40 Questions)

1. What is the distance between -7 and 5 on a number line?

- A. 12
 B. 2
 C. 3
 D. 7

2. $\frac{2}{3} - \frac{1}{6} = ?$

- A. $\frac{1}{2}$

B. $1/3$

C. $1/6$

D. $2/9$

3. $2/3 \div 4/7 = ?$

A. $7/6$

B. $8/21$

C. $14/12$

D. $2/7$

4. Estimate the difference: $8 \frac{5}{6} - 3 \frac{1}{3} \approx ?$

A. 6

B. 5

C. 4

D. 7

5. If $5/x = 10/30$, what is x ?

A. 15

B. 10

C. 20

D. 25

6. $1 \frac{1}{4} \div 1/2 = ?$

A. $2 \frac{1}{2}$

B. 3

C. $2 \frac{2}{3}$

D. $3 \frac{1}{2}$

7. What is the absolute value of -18?

A. 18

B. 0

C. -18

D. 1

8. $4/5 \times 5/8 = ?$

A. $1/2$

B. 1

C. $5/12$

D. $4/8$

9. $7/9 - 2/9 = ?$

A. $5/9$

B. $9/7$

C. $1/7$

D. $1/2$

10. A 12-ounce can of juice costs \$1.20. What is the unit price per ounce?

- A. \$0.10
- B. \$0.12
- C. \$0.20
- D. \$0.15

11. Estimate the sum: $3\frac{3}{8} + 2\frac{2}{5} \approx ?$

- A. 6
- B. 5
- C. 7
- D. 8

12. Which of the following is a proportion?

- A. $\frac{1}{2} = \frac{2}{4}$
- B. $\frac{2}{3} = \frac{3}{4}$
- C. $\frac{1}{4} = \frac{2}{3}$
- D. $\frac{3}{5} = \frac{2}{5}$

13. Write $4\frac{1}{3}$ as an improper fraction.

- A. $\frac{13}{3}$
- B. $\frac{12}{7}$
- C. $\frac{7}{4}$
- D. $\frac{10}{3}$

14. $1\frac{1}{2} \times \frac{2}{3} = ?$ (simplest form)

- A. 1
- B. $\frac{1}{2}$
- C. 1
- D. 2

15. What is the place value of 4 in the number 3,482?

- A. Hundreds
- B. Units
- C. Tens
- D. Thousands

16. If 12 pencils cost \$3.00, what is the cost per pencil?

- A. \$0.25
- B. \$0.30
- C. \$0.20
- D. \$0.15

17. If 3 pencils cost \$0.90, how much does 1 pencil cost?

- A. \$0.03
- B. \$0.30
- C. \$0.90
- D. \$0.60

18. What is the reciprocal of $\frac{5}{7}$?

- A. $\frac{7}{5}$
- B. $\frac{2}{7}$
- C. $\frac{5}{2}$
- D. $\frac{1}{7}$

19. What is $\frac{2}{5} + \frac{1}{10}$?

- A. $\frac{1}{2}$
- B. $\frac{3}{10}$
- C. $\frac{1}{4}$
- D. $\frac{1}{5}$

20. $6 \div \frac{2}{5} = ?$

- A. 15
- B. 12
- C. 30
- D. $\frac{8}{5}$

21. What is the missing value in the proportion $\frac{9}{12} = \frac{?}{8}$

- A. 5
- B. 6
- C. 8
- D. 12

22. At a speed of 60 miles per hour, how far in 2.5 hours?

- A. 120
- B. 130
- C. 150
- D. 100

23. $\frac{2}{3} \times \frac{3}{5} = ?$

- A. $\frac{2}{5}$
- B. $\frac{1}{5}$
- C. $\frac{6}{15}$
- D. $\frac{3}{8}$

24. What is the ratio of 8 to 12 in simplest form?

- A. 2:3
- B. 3:2
- C. 4:7
- D. 4:6

25. If $4:7 = x:21$, what is x ?

- A. 8
- B. 10
- C. 12

D. 6

26. If 24 is 60% of a number, what is the number?

A. 36

B. 40

C. 30

D. 42

27. The ratio 2:5 is equivalent to which of the following?

A. 4:15

B. 4:10

C. 5:2

D. 2:10

28. $\frac{3}{4} \times 8 = ?$

A. 6

B. $\frac{8}{3}$

C. $\frac{3}{32}$

D. $\frac{9}{32}$

29. $1 \frac{1}{4} + 2 \frac{1}{2} = ?$

A. $3 \frac{3}{4}$

B. $3 \frac{2}{3}$

C. $4 \frac{1}{4}$

D. $2 \frac{1}{4}$

30. What is the missing value? $7:21 = ?:3$

A. 1

B. 2

C. 3

D. 4

31. The ratio of boys to girls is 4:5. There are 16 boys. How many girls?

A. 18

B. 20

C. 12

D. 24

32. What is the value of x in the proportion $\frac{6}{9} = \frac{x}{12}$?

A. 8

B. 7

C. 6

D. 9

33. What is the unit rate if you buy 5 books for \$20?

A. \$2

B. \$3

C. \$4

D. \$5

34. $1/4 + 1/2 = ?$

A. $2/4$

B. $3/4$

C. $2/6$

D. $1/3$

35. $2 \frac{2}{3} \div 1 \frac{1}{3} = ?$

A. 2

B. 4

C. 1

D. 3

36. If a car travels 150 miles in 3 hours, what is the rate in miles per hour?

A. 45

B. 50

C. 55

D. 60

37. $2 \frac{3}{5} - 1 \frac{1}{2} = ?$

A. $1 \frac{1}{10}$

B. $1 \frac{2}{5}$

C. $1 \frac{3}{5}$

D. $1 \frac{1}{5}$

38. What is the mixed number for $17/5$?

A. $2 \frac{2}{5}$

B. $3 \frac{2}{5}$

C. $3 \frac{3}{5}$

D. $2 \frac{3}{5}$

39. Complete the ratio table: Apples 4, 8, 12; Oranges 6, __, __

A. 12, 18

B. 8, 12

C. 9, 12

D. 10, 15

40. Solve for x: $4/x = 2/6$

A. 12

B. 8

C. 10

D. 6

Submit Answers

Questions & Answers

After you complete the pre-test above, you'll see step-by-step solutions here for any questions you answered incorrectly.

Post-Test (40 Questions)

1. What is $\frac{2}{5} + \frac{1}{10}$?

- A. $\frac{1}{2}$
- B. $\frac{3}{10}$
- C. $\frac{1}{4}$
- D. $\frac{1}{5}$

2. $\frac{3}{4} \times 8 = ?$

- A. 6
- B. $\frac{8}{3}$
- C. $\frac{3}{32}$
- D. $\frac{9}{32}$

3. $\frac{3}{8} + \frac{2}{8} = ?$

- A. $\frac{5}{8}$
- B. $\frac{1}{2}$
- C. $\frac{3}{16}$
- D. $\frac{3}{10}$

4. $1 \frac{1}{4} \div \frac{1}{2} = ?$

- A. $2 \frac{1}{2}$
- B. 3
- C. $2 \frac{2}{3}$
- D. $3 \frac{1}{2}$

5. A 12-ounce can of juice costs \$1.20. What is the unit price per ounce?

- A. \$0.10
- B. \$0.12

C. \$0.20

D. \$0.15

6. At a speed of 60 miles per hour, how far in 2.5 hours?

A. 120

B. 130

C. 150

D. 100

7. $3/4 \div 2 = ?$

A. $3/8$

B. $3/2$

C. $2/3$

D. $1/2$

8. Change $5 \frac{2}{3}$ to an improper fraction.

A. $17/3$

B. $15/3$

C. $16/3$

D. $12/3$

9. What is the mixed number for $17/5$?

A. $2 \frac{2}{5}$

B. $3 \frac{2}{5}$

C. $3 \frac{3}{5}$

D. $2 \frac{3}{5}$

10. If 3 pencils cost \$0.90, how much does 1 pencil cost?

A. \$0.03

B. \$0.30

C. \$0.90

D. \$0.60

11. What is the absolute value of -18?

A. 18

B. 0

C. -18

D. 1

12. What is the value of x in the proportion $6/9 = x/12$?

A. 8

B. 7

C. 6

D. 9

13. Solve for x: $4/x = 2/6$

A. 12

- B. 8
- C. 10
- D. 6

14. $2/3 - 1/6 = ?$

- A. $1/2$
- B. $1/3$
- C. $1/6$
- D. $2/9$

15. What is the distance between -7 and 5 on a number line?

- A. 12
- B. 2
- C. 3
- D. 7

16. $6 \div 2/5 = ?$

- A. 15
- B. 12
- C. 30
- D. $8/5$

17. $1 \frac{1}{4} + 2 \frac{1}{2} = ?$

- A. $3 \frac{3}{4}$
- B. $3 \frac{2}{3}$
- C. $4 \frac{1}{4}$
- D. $2 \frac{1}{4}$

18. $4/5 \times 5/8 = ?$

- A. $1/2$
- B. 1
- C. $5/12$
- D. $4/8$

19. $1/4 + 1/2 = ?$

- A. $2/4$
- B. $3/4$
- C. $2/6$
- D. $1/3$

20. $1 \frac{1}{2} \times 2/3 = ?$ (simplest form)

- A. 1
- B. $1/2$
- C. 1
- D. 2

21. What is the missing value? $7:21 = ?:3$

- A. 1
- B. 2
- C. 3
- D. 4

22. Which of the following is a proportion?

- A. $1/2 = 2/4$
- B. $2/3 = 3/4$
- C. $1/4 = 2/3$
- D. $3/5 = 2/5$

23. If $4:7 = x:21$, what is x ?

- A. 8
- B. 10
- C. 12
- D. 6

24. What is the reciprocal of $5/7$?

- A. $7/5$
- B. $2/7$
- C. $5/2$
- D. $1/7$

25. If $5/x = 10/30$, what is x ?

- A. 15
- B. 10
- C. 20
- D. 25

26. A recipe uses 2 cups of flour for every 3 cups of sugar. How much flour for 12 cups of sugar?

- A. 8
- B. 6
- C. 4
- D. 10

27. Complete the ratio table: Apples 4, 8, 12; Oranges 6, __, __

- A. 12, 18
- B. 8, 12
- C. 9, 12
- D. 10, 15

28. $2\frac{2}{3} \div 1\frac{1}{3} = ?$

- A. 2
- B. 4
- C. 1
- D. 3

29. Estimate the sum: $3\frac{3}{8} + 2\frac{2}{5} \approx ?$

- A. 6
- B. 5
- C. 7
- D. 8

30. $\frac{2}{3} \div \frac{4}{7} = ?$

- A. $\frac{7}{6}$
- B. $\frac{8}{21}$
- C. $\frac{14}{12}$
- D. $\frac{2}{7}$

31. The ratio of boys to girls is 4:5. There are 16 boys. How many girls?

- A. 18
- B. 20
- C. 12
- D. 24

32. If a car travels 150 miles in 3 hours, what is the rate in miles per hour?

- A. 45
- B. 50
- C. 55
- D. 60

33. What is the ratio of 8 to 12 in simplest form?

- A. 2:3
- B. 3:2
- C. 4:7
- D. 4:6

34. In the proportion $\frac{3}{4} = \frac{x}{8}$, what is x?

- A. 4
- B. 6
- C. 7
- D. 8

35. What is the unit rate if you buy 5 books for \$20?

- A. \$2
- B. \$3
- C. \$4
- D. \$5

36. What is the place value of 4 in the number 3,482?

- A. Hundreds
- B. Units
- C. Tens

D. Thousands

37. Estimate the difference: $8 \frac{5}{6} - 3 \frac{1}{3} \approx ?$

A. 6

B. 5

C. 4

D. 7

38. The ratio 2:5 is equivalent to which of the following?

A. 4:15

B. 4:10

C. 5:2

D. 2:10

39. What is the missing value in the proportion $9/12 = ?/8$

A. 5

B. 6

C. 8

D. 12

40. If 24 is 60% of a number, what is the number?

A. 36

B. 40

C. 30

D. 42

Submit Answers

Decimals, Fractions, and Percents: Concepts & Practice

Master the basics with explanations, examples, and practice!

Concepts

Examples

Pre-Test

Q & A

Post-Test

Chapter 1: Concepts Explained

1. Decimal Place Value and Rounding

- **Place Value:** Each digit in a decimal has a place value based on its position. Example: In 3.726, 7 is in the tenths place.
- **Rounding:** To round a decimal, look at the digit to the right of your place value. If it is 5 or greater, round up.

2. Changing Fractions to Decimals

- Divide the numerator by the denominator. For example, $3/4 = 0.75$.

3. Changing Decimals to Fractions

- Write the decimal as a fraction with a denominator of 10, 100, 1000, etc., then simplify. Example: $0.6 = 6/10 = 3/5$.

4. Comparing and Ordering Decimals

- Line up the decimals by the decimal point and compare digit by digit.

5. Adding & Subtracting Decimals

- Line up the decimal points vertically before adding or subtracting.

6. Adding & Subtracting Money

- Treat money as decimals (e.g., $\$4.25 + \$2.75 = \$7.00$).

7. Estimating Decimal Sums & Differences

- Round decimals to the nearest whole number or tenth before adding or subtracting.

8. Multiplying Decimals & Money

- Multiply as whole numbers, then count total decimal places for the answer.

9. Estimating Decimal Products

- Round numbers before multiplying for a quick estimate.

10. Dividing Decimals

- **By Whole Numbers:** Divide as usual, bring down decimal point.
By Decimals: Move decimal to make divisor a whole number, do the same to dividend, then divide.

11. Dividing Money

- Divide as with decimals, keep track of the decimal point.

12. Estimating Decimal Quotients

- Round numbers before dividing for a quick estimate.

13. Understanding Percent

- **Percent** means "per hundred." $25\% = 25$ out of $100 = 0.25$.

14. Percents and Fractions

- Write percent as a fraction over 100 and simplify. Example: $40\% = 40/100 = 2/5$.

15. Percents and Decimals

- Move decimal point two places left to change percent to decimal. Example: $8\% = 0.08$.

16. Multiplying Percents and Fractions

- Convert percent to decimal or fraction, then multiply.

Chapter 2: Worked Examples

Example 1: Round 4.678 to the nearest tenth.

Solution: The digit in the hundredths place is 7 (which is 5 or more), so round up. Answer: 4.7

Example 2: Change $\frac{7}{8}$ to a decimal.

Solution: $7 \div 8 = 0.875$

Example 3: Write 0.65 as a fraction in simplest form.

Solution: $0.65 = \frac{65}{100} = \frac{13}{20}$

Example 4: Add $0.23 + 0.7$

Solution: $0.23 + 0.70 = 0.93$

Example 5: Estimate 3.78×1.2

Solution: Round 3.78 to 4, 1.2 to 1. $4 \times 1 = 4$ (estimate)

Example 6: Divide \$12.48 by 4

Solution: $\$12.48 \div 4 = \3.12

Example 7: What is 36% as a decimal and fraction?

Solution: $36\% = 0.36 = \frac{36}{100} = \frac{9}{25}$

Example 8: Multiply $60\% \times \frac{3}{5}$

Solution: $60\% = 0.6; 0.6 \times \frac{3}{5} = 0.6 \times 0.6 = 0.36$

Chapter 3: Pre-Test (40 Multiple Choice Questions)

1. Write the place value of the digit 4 in 3.456.

- Ones
- Tenths
- Hundredths

Thousandths

2. Round 5.283 to the nearest hundredth.

- 5.3
- 5.28
- 5.29
- 5.2

3. Change $\frac{2}{5}$ to a decimal.

- 0.25
- 0.2
- 0.5
- 0.4

4. Change 0.8 to a fraction in simplest form.

- $\frac{8}{10} = \frac{4}{5}$
- $\frac{8}{100} = \frac{2}{25}$
- $\frac{8}{1}$
- $\frac{8}{80} = \frac{1}{10}$

5. Order from least to greatest: 0.72, 0.6, 0.67

- 0.67, 0.6, 0.72
- 0.6, 0.67, 0.72
- 0.6, 0.72, 0.67
- 0.72, 0.67, 0.6

6. Add: $0.34 + 0.8$

- 1.14
- 0.42
- 0.84
- 1.05

7. Subtract: $2.5 - 1.17$

- 1.17
- 1.33
- 1.43
- 1.37

8. Add: $\$7.35 + \2.65

- \$10.10
- \$9.90
- \$9.00
- \$10.00

9. Estimate: $5.87 + 3.14$

- 8

- 9
- 10
- 7

10. 10. Multiply: 0.6×0.3

- 0.09
- 0.18
- 0.03
- 0.21

11. 11. Multiply: $\$4.75 \times 3$

- \$14.25
- \$13.25
- \$12.25
- \$15.25

12. 12. Estimate: 2.63×4.1

- 10
- 8
- 12
- 6

13. 13. Divide: $7.2 \div 3$

- 2.2
- 2.4
- 2.6
- 2.8

14. 14. Divide: $15 \div 0.5$

- 7.5
- 30
- 3
- 5

15. 15. Divide: $1.44 \div 0.12$

- 12
- 10
- 14
- 1.2

16. 16. Divide: $\$9.90 \div 3$

- \$3.70
- \$3.30
- \$3.11
- \$3.00

17. 17. Estimate: $5.1 \div 2.4$

- 2
- 1
- 3
- 4

18. 18. What does 40% mean?

- 40 out of 100
- 40 out of 1000
- 4 out of 100
- 400 out of 100

19. 19. Write 25% as a fraction.

- $25/100 = 1/4$
- $25/10 = 5/2$
- $25/1000 = 1/40$
- $25/25 = 1$

20. 20. Write 0.45 as a percent.

- 0.45%
- 4.5%
- 45%
- 450%

21. 21. Multiply: $20\% \times 1/4$

- 0.2
- 0.05
- 0.8
- 0.1

22. 22. Write the place value of 7 in 5.782.

- Ones
- Tenths
- Hundredths
- Thousandths

23. 23. Round 8.499 to the nearest tenth.

- 8.4
- 8.5
- 8.49
- 8.50

24. 24. Change $3/8$ to a decimal.

- 0.38
- 0.25
- 0.375

0.83

25. 25. Change 0.32 to a fraction.

$32/100 = 8/25$

$32/10 = 16/5$

$32/1000 = 4/125$

$32/32 = 1$

26. 26. Order from greatest to least: 0.25, 0.8, 0.55

0.8, 0.55, 0.25

0.25, 0.8, 0.55

0.8, 0.25, 0.55

0.25, 0.55, 0.8

27. 27. Add: $1.5 + 0.8$

2.3

2.4

3.3

2.7

28. 28. Subtract: $9.21 - 6.77$

2.54

1.44

3.44

1.34

29. 29. Add: $\$5.45 + \3.22

$\$8.67$

$\$7.67$

$\$8.57$

$\$7.57$

30. 30. Estimate: $10.7 + 4.4$

14

16

12

18

31. 31. Multiply: 0.9×0.6

0.54

0.64

0.06

0.45

32. 32. Multiply: $\$8.25 \times 2$

$\$16.50$

- \$15.50
- \$16.25
- \$16.20

33. 33. Estimate: 7.6×2.3

- 18
- 16
- 14
- 20

34. 34. Divide: $4.5 \div 5$

- 0.9
- 1.9
- 0.7
- 1.1

35. 35. Divide: $12 \div 0.3$

- 4
- 40
- 36
- 3

36. 36. Divide: $2.16 \div 0.18$

- 12
- 10
- 14
- 1.2

37. 37. Divide: $\$6.40 \div 4$

- \$1.60
- \$1.40
- \$1.50
- \$1.20

38. 38. Estimate: $9.8 \div 3.1$

- 3
- 2
- 4
- 5

39. 39. What does 15% mean?

- 15 out of 100
- 15 out of 1000
- 1.5 out of 100
- 150 out of 100

40. Write 60% as a fraction.

- $60/100 = 3/5$
- $60/10 = 6$
- $60/1000 = 3/50$
- $60/60 = 1$

Submit Pre-Test

Chapter 4: Questions & Answers

No missed questions yet. Complete the Pre-Test to see Q&A for any you missed.

Chapter 5: Post-Test (40 Multiple Choice Questions)

1. Write the place value of the digit 6 in 9.654.

- Tenths
- Hundredths
- Thousandths
- Ones

2. Round 2.497 to the nearest hundredth.

- 2.50
- 2.49
- 2.48
- 2.5

3. Change $3/8$ to a decimal.

- 0.38
- 0.375
- 0.83
- 0.3

4. Change 0.7 to a fraction in simplest form.

- $7/10$

- 70/100
- 7/100
- 1/7

5. 5. Order from least to greatest: 0.37, 0.49, 0.41

- 0.41, 0.37, 0.49
- 0.37, 0.41, 0.49
- 0.49, 0.41, 0.37
- 0.37, 0.49, 0.41

6. 6. Add: $0.51 + 0.8$

- 1.31
- 1.29
- 1.21
- 1.41

7. 7. Subtract: $4.6 - 2.18$

- 2.38
- 2.42
- 2.48
- 2.52

8. 8. Add: $\$8.90 + \3.20

- \$12.10
- \$12.00
- \$11.90
- \$13.10

9. 9. Estimate: $6.89 + 2.12$

- 9
- 8
- 7
- 10

10. 10. Multiply: 0.4×0.5

- 0.2
- 0.25
- 0.1
- 0.05

11. 11. Multiply: $\$6.25 \times 4$

- \$24.00
- \$25.00
- \$24.50
- \$26.00

12. 12. Estimate: 3.27×5.1

- 15
- 16
- 20
- 10

13. 13. Divide: $8.4 \div 2$

- 4.2
- 4.1
- 4.5
- 4.4

14. 14. Divide: $18 \div 0.6$

- 30
- 3
- 36
- 6

15. 15. Divide: $2.52 \div 0.21$

- 12
- 10
- 11
- 9

16. 16. Divide: $\$10.80 \div 6$

- \$1.80
- \$2.80
- \$1.70
- \$2.70

17. 17. Estimate: $7.5 \div 2.4$

- 3
- 4
- 2
- 5

18. 18. What does 55% mean?

- 55 out of 10
- 55 out of 100
- 5.5 out of 100
- 55 out of 1000

19. 19. Write 10% as a fraction.

- $1/10$
- $1/100$
- $10/100 = 1/10$

10/1

20. 20. Write 0.23 as a percent.

2.3%

23%

0.23%

230%

21. 21. Multiply: $15\% \times 1/5$

0.03

0.75

0.05

0.15

22. 22. Write the place value of 2 in 8.213.

Hundredths

Tenths

Thousandths

Ones

23. 23. Round 9.995 to the nearest tenth.

10.0

9.9

10

9.99

24. 24. Change $5/8$ to a decimal.

0.625

0.58

0.8

0.85

25. 25. Change 0.56 to a fraction.

$56/100 = 14/25$

$56/10 = 28/5$

$56/1000 = 7/125$

$56/56 = 1$

26. 26. Order from greatest to least: 0.91, 0.45, 0.67

0.91, 0.67, 0.45

0.45, 0.67, 0.91

0.67, 0.91, 0.45

0.91, 0.45, 0.67

27. 27. Add: $2.3 + 0.9$

3.1

- 3.2
- 3.3
- 3.4

28. 28. Subtract: $7.66 - 4.35$

- 3.31
- 3.41
- 3.21
- 3.51

29. 29. Add: $\$4.67 + \3.33

- \$7.00
- \$8.00
- \$8.10
- \$8.20

30. 30. Estimate: $8.3 + 5.5$

- 13
- 14
- 12
- 15

31. 31. Multiply: 0.7×0.8

- 0.56
- 0.64
- 0.14
- 0.7

32. 32. Multiply: $\$7.50 \times 2$

- \$15.00
- \$14.00
- \$13.50
- \$16.00

33. 33. Estimate: 6.4×1.9

- 12
- 10
- 11
- 13

34. 34. Divide: $3.6 \div 6$

- 0.6
- 0.7
- 0.5
- 0.8

35. 35. Divide: $14 \div 0.2$

- 70
- 7
- 14
- 0.7

36. 36. Divide: $1.98 \div 0.11$

- 18
- 17
- 19
- 20

37. 37. Divide: $\$5.50 \div 5$

- \$1.10
- \$1.20
- \$1.00
- \$1.50

38. 38. Estimate: $10.2 \div 2.5$

- 4
- 5
- 3
- 2

39. 39. What does 20% mean?

- 20 out of 100
- 2 out of 100
- 20 out of 10
- 200 out of 100

40. 40. Write 90% as a fraction.

- $9/10$
- $1/9$
- $9/100$
- $10/9$

Submit Post-Test

Algebra Concepts: Exponents, Scientific Notation, and More

Comprehensive Guide with Pre/Post Tests and Practice

Concepts

Examples

Pre-Test

Review Pre-Test

Post-Test

Chapter 1: Concepts Explained

- Exponents:** An exponent tells how many times to multiply a number (the base) by itself. Example:
 $2^3 = 2 \times 2 \times 2 = 8$.
- Scientific Notation:** A way to write very large or very small numbers using powers of 10. Example:
 $3,000 = 3 \times 10^3$.
- Order of Operations:** The rule for the order to solve parts of a math problem: Parentheses, Exponents, Multiplication/Division, Addition/Subtraction (PEMDAS).
- Commutative and Associative Properties:**
 - Commutative:** Changing the order of addition or multiplication does not change the result ($a + b = b + a$; $ab = ba$).
 - Associative:** Changing grouping does not affect the sum or product ($(a+b)+c = a+(b+c)$).
- Distributive Property and Identity:**
 - Distributive:** $a(b + c) = ab + ac$.
 - Identity:** Adding 0 or multiplying by 1 keeps the number the same ($a+0=a$; $a \times 1=a$).
- Zero Property, Equality Properties:**
 - Zero Property:** Any number times 0 is 0 ($a \times 0 = 0$).
 - Equality Properties:** Rules that allow you to solve equations, such as adding/subtracting/multiplying/dividing both sides by the same number.
- Factors and Multiples:**
 - Factor:** A number that divides another without a remainder.
 - Multiple:** The result of multiplying a number by an integer.
- Understanding Variable Expressions:** An expression that includes variables, numbers, and operations (e.g., $3x + 2$).

9. **Solving Equations by Addition and Subtraction:** Isolate the variable by adding or subtracting the same value on both sides.
10. **Solving Equations by Multiplication and Division:** Isolate the variable by multiplying or dividing both sides by the same number.
11. **Inequalities:** Math sentences using $>$, $<$, \geq , or \leq . They show relationships where values are not equal.
12. **Solving Equations and Inequalities by Substitution:** Replace a variable with a number or expression to solve.

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Chapter 2: Examples

- **Exponents:** $5^2 = 25$, $10^3 = 1,000$
- **Scientific Notation:** $0.00057 = 5.7 \times 10^{-4}$
- **Order of Operations:** $2 + 3 \times 4^2 = 2 + 3 \times 16 = 2 + 48 = 50$
- **Commutative Property:** $7 + 4 = 4 + 7$
- **Associative Property:** $(2 + 3) + 4 = 2 + (3 + 4)$
- **Distributive Property:** $3(x + 2) = 3x + 6$
- **Identity Property:** $9 \times 1 = 9$, $9 + 0 = 9$
- **Zero Property:** $13 \times 0 = 0$
- **Equality Property:** If $a = b$, then $a + c = b + c$
- **Factors:** Factors of 12 are 1, 2, 3, 4, 6, 12
- **Multiples:** Multiples of 4 are 4, 8, 12, 16, ...
- **Variable Expressions:** If $x = 2$, then $3x + 5 = 3(2) + 5 = 11$
- **Solving by Addition/Subtraction:** $x - 7 = 10 \rightarrow x = 17$
- **Solving by Multiplication/Division:** $4y = 20 \rightarrow y = 5$
- **Inequality:** $x + 6 > 10 \rightarrow x > 4$
- **Substitution:** If $y = 3$, then $2y + 1 = 7$

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Chapter 3: Pre-Test (40 Multiple Choice Questions)

1. What is 2^4 ?

- 6
- 8
- 16
- 24

2. Express 4,500 in scientific notation.

- 4.5×10^3
- 4.5×10^2
- 45×10^2
- 0.45×10^4

3. Simplify: $3 + 2 \times 5$

- 25
- 16
- 13
- 11

4. What is the commutative property of addition?

- $a + b = b + a$
- $(a + b) + c = a + (b + c)$
- $a \times (b + c) = ab + ac$
- $a + 0 = a$

5. What is the associative property of multiplication?

- $(a \times b) \times c = a \times (b \times c)$
- $a \times b = b \times a$
- $a \times 1 = a$
- $a \times 0 = 0$

6. Simplify: $2(x + 3)$

- $2x + 3$
- $2x + 6$
- $x + 6$
- $2x + 9$

7. What is the identity property of multiplication?

- $a \times 1 = a$
- $a \times 0 = 0$
- $a + 0 = a$
- $(a \times b) \times c = a \times (b \times c)$

8. What is 0×7 ?

- 0
- 7
- 1
- 7×0

9. Which is NOT a factor of 18?

- 2
- 3
- 9
- 5

10. Find the first 3 multiples of 6.

- 6, 12, 18
- 1, 2, 3
- 3, 6, 9

- 12, 18, 24

11. Evaluate $3y + 2$ when $y = 4$.

- 10
- 12
- 14
- 11

12. Solve for x : $x + 5 = 12$

- $x = 7$
- $x = 17$
- $x = 5$
- $x = 12$

13. Solve for x : $7x = 35$

- $x = 5$
- $x = 42$
- $x = 28$
- $x = 7$

14. What is an inequality?

- A math sentence using $=$
- A math sentence using $>$, $<$, \geq , or \leq
- A math sentence using only numbers
- A math sentence using \times

15. Solve: $x - 3 > 5$

- $x > 2$
- $x < 8$

$x > 8$

$x < 2$

16. Substitute $a = 2$ in $5a + 1$.

6

11

10

7

17. What is 10^0 ?

1

0

10

Undefined

18. Express 0.007 in scientific notation.

7×10^{-3}

7×10^{-2}

0.7×10^{-2}

7×10^3

19. Simplify: $(4 + 2) \times 3$

24

18

12

6

20. What is the distributive property?

$a(b + c) = ab + ac$

- $a + b = b + a$
- $a \times 0 = 0$
- $(a + b) + c = a + (b + c)$

21. What is the zero property of multiplication?

- $a \times 0 = 0$
- $a \times 1 = a$
- $a + 0 = a$
- $a \times a = a^2$

22. Is 15 a factor of 45?

- Yes
- No
- Only if 45 is even
- Only if 15 is odd

23. Is 24 a multiple of 8?

- Yes
- No
- Only if 8 is even
- Only if 24 is odd

24. Write a variable expression for "twice a number plus 3".

- $2x + 3$
- $x^2 + 3$
- $2 + 3x$
- $3x + 2$

25. Solve for x: $x - 8 = 3$

$x = 11$

$x = 5$

$x = 3$

$x = -5$

26. Solve for y: $5y = 25$

$y = 5$

$y = 20$

$y = 125$

$y = 0$

27. What is the solution to $z + 6 < 10$?

$z > 4$

$z < 16$

$z < 4$

$z > 16$

28. Substitute $m = 5$ in $2m - 4$.

6

10

4

5

29. What is 4^2 ?

16

8

12

4

30. Express 920,000 in scientific notation.

- 9.2×10^5
- 9.2×10^4
- 92×10^5
- 0.92×10^6

31. Simplify: $12 \div (2 + 2)$

- 3
- 2
- 4
- 6

32. What is the commutative property of multiplication?

- $a \times b = b \times a$
- $a \times 0 = 0$
- $a(b + c) = ab + ac$
- $a \times 1 = a$

33. What is the identity property of addition?

- $a + 0 = a$
- $a \times 1 = a$
- $a \times 0 = 0$
- $a + 1 = a$

34. Which is NOT a factor of 20?

- 2
- 4
- 10

7

35. Find the first 4 multiples of 3.

3, 6, 9, 12

2, 4, 6, 8

1, 2, 3, 4

3, 6, 12, 15

36. Evaluate $x^2 + 2x$ when $x = 3$.

15

12

9

11

37. Solve for a: $a + 7 = 15$

$a = 7$

$a = 8$

$a = 22$

$a = 15$

38. Solve for b: $3b = 21$

$b = 7$

$b = 18$

$b = 24$

$b = 6$

39. What does it mean if $x \leq 9$?

x is less than or equal to 9

x is greater than or equal to 9

- x is less than 9
- x is greater than 9

40. Substitute $x = 2$ in $x^2 + x$.

- 6
- 4
- 5
- 2

Grade My Test

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Chapter 4: Review Pre-Test Mistakes

Take the Pre-Test in Chapter 3 and grade it to review your mistakes here.

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Chapter 5: Post-Test (40 Multiple Choice Questions)

1. What is 3^2 ?

- 6
- 9
- 12
- 3

2. Express 8,200 in scientific notation.

- 8.2×10^3

- 8.2×10^2
- 82×10^2
- 0.82×10^4

3. Simplify: $4 + 3 \times 6$

- 42
- 22
- 18
- 24

4. What does the commutative property say about multiplication?

- $a \times b = b \times a$
- $(a \times b) \times c = a \times (b \times c)$
- $a \times 1 = a$
- $a + 0 = a$

5. What does the associative property say about addition?

- $(a + b) + c = a + (b + c)$
- $a + b = b + a$
- $a \times (b + c) = ab + ac$
- $a + 0 = a$

6. Expand: $5(x + 2)$

- $5x + 2$
- $5x + 10$
- $x + 10$
- $5x + 7$

7. What is the identity property of addition?

$a + 0 = a$

$a \times 1 = a$

$a \times 0 = 0$

$a + 1 = a$

8. What is 0×12 ?

0

12

1

12×0

9. List all factors of 24.

1, 2, 3, 4, 6, 8, 12, 24

2, 3, 4, 6, 8, 24

1, 2, 4, 6, 8, 24

2, 4, 8, 12, 24

10. Find the first 3 multiples of 7.

7, 14, 21

14, 21, 28

1, 2, 3

7, 21, 28

11. Evaluate $4y + 1$ when $y = 3$.

12

11

13

15

12. Solve for x: $x - 4 = 9$

- $x = 5$
- $x = 13$
- $x = 9$
- $x = 4$

13. Solve for x: $6x = 18$

- $x = 3$
- $x = 12$
- $x = 24$
- $x = 6$

14. What is an inequality?

- A math sentence using $=$
- A math sentence using $>$, $<$, \geq , or \leq
- A math sentence using only numbers
- A math sentence using \times

15. Solve: $x + 2 > 7$

- $x > 5$
- $x < 9$
- $x > 9$
- $x < 5$

16. Substitute $a = 3$ in $4a + 2$.

- 12
- 10
- 14

20

17. What is 2^5 ?

10

25

32

12

18. Express 0.00081 in scientific notation.

8.1×10^{-4}

8.1×10^{-3}

0.81×10^{-3}

0.81×10^{-4}

19. Simplify: $(3 + 5) \times 2$

16

13

8

12

20. What is the distributive property?

$a(b + c) = ab + ac$

$a + b = b + a$

$a \times 0 = 0$

$(a + b) + c = a + (b + c)$

21. What is the zero property of multiplication?

$a \times 0 = 0$

$a \times 1 = a$

$a + 0 = a$

$a \times a = a^2$

22. Is 10 a factor of 40?

Yes

No

Only if 40 is even

Only if 10 is odd

23. Is 36 a multiple of 9?

Yes

No

Only if 9 is even

Only if 36 is odd

24. Write a variable expression for "four times a number minus 1".

$4x - 1$

$x^2 - 1$

$4 - x$

$x - 4$

25. Solve for x: $x - 2 = 8$

$x = 10$

$x = 6$

$x = 8$

$x = -6$

26. Solve for y: $2y = 18$

$y = 9$

$y = 16$

$y = 20$

$y = 36$

27. What is the solution to $b + 3 < 7$?

$b < 4$

$b > 4$

$b < 10$

$b > 10$

28. Substitute $m = 6$ in $3m - 5$.

13

18

11

15

29. What is 6^2 ?

36

12

18

6

30. Express 540,000 in scientific notation.

5.4×10^5

5.4×10^4

54×10^5

0.54×10^6

31. Simplify: $18 \div (3 + 3)$

- 3
- 2
- 4
- 6

32. What is the commutative property of addition?

- $a + b = b + a$
- $a + 0 = a$
- $a \times (b + c) = ab + ac$
- $(a + b) + c = a + (b + c)$

33. What is the identity property of multiplication?

- $a \times 1 = a$
- $a \times 0 = 0$
- $a + 0 = a$
- $a \times a = a^2$

34. Find all factors of 30.

- 1, 2, 3, 5, 6, 10, 15, 30
- 2, 3, 5, 6, 10, 30
- 1, 2, 3, 5, 6, 10, 30
- 2, 3, 5, 6, 10, 15

35. Find the first 4 multiples of 5.

- 5, 10, 15, 20
- 10, 15, 20, 25
- 1, 2, 3, 4
- 5, 15, 20, 25

36. Evaluate $y^2 + 3y$ when $y = 2$.

- 10
- 12
- 8
- 6

37. Solve for a: $a + 6 = 13$

- $a = 7$
- $a = 6$
- $a = 19$
- $a = 13$

38. Solve for b: $4b = 32$

- $b = 8$
- $b = 16$
- $b = 12$
- $b = 4$

39. What does it mean if $y \geq 8$?

- y is greater than or equal to 8
- y is less than or equal to 8
- y is greater than 8
- y is less than 8

40. Substitute $x = 3$ in $x^2 + 2x$.

- 15
- 12
- 9

Grade My Post-Test

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Concepts

Concepts

Examples

Pre-Test

Q & A

Post-Test

1. Customary Units of Length

- Inch (in), Foot (ft), Yard (yd), Mile (mi)
- $1 \text{ ft} = 12 \text{ in}$, $1 \text{ yd} = 3 \text{ ft} = 36 \text{ in}$, $1 \text{ mi} = 1,760 \text{ yd} = 5,280 \text{ ft}$

2. Customary Units of Liquid Volume

- Cup (c), Pint (pt), Quart (qt), Gallon (gal)
- $1 \text{ pt} = 2 \text{ c}$, $1 \text{ qt} = 2 \text{ pt} = 4 \text{ c}$, $1 \text{ gal} = 4 \text{ qt} = 8 \text{ pt} = 16 \text{ c}$

3. Customary Units of Weight

- Ounce (oz), Pound (lb), Ton (T)
- $1 \text{ lb} = 16 \text{ oz}$, $1 \text{ T} = 2,000 \text{ lb}$

4. Perimeter

- Distance around a shape. For rectangles: $P = 2(l + w)$

5. Area

- Space inside a shape. For rectangles: $A = l \times w$

6. Volume of a Solid

- Space inside a 3D object. For rectangular prisms: $V = l \times w \times h$

7. Time

- Seconds (s), Minutes (min), Hours (h), Days (d), Weeks, Months, Years
- $1 \text{ min} = 60 \text{ s}$, $1 \text{ h} = 60 \text{ min}$, $1 \text{ d} = 24 \text{ h}$, $1 \text{ wk} = 7 \text{ d}$

8. Temperature

- Measured in degrees Fahrenheit ($^{\circ}\text{F}$) in customary system, Celsius ($^{\circ}\text{C}$) in metric

9. Metric Units of Length

- Millimeter (mm), Centimeter (cm), Meter (m), Kilometer (km)
- $1 \text{ m} = 100 \text{ cm} = 1,000 \text{ mm}$, $1 \text{ km} = 1,000 \text{ m}$

10. Metric Units of Liquid Volume

- Milliliter (mL), Liter (L)
- $1 \text{ L} = 1,000 \text{ mL}$

11. Metric Units of Mass

- Milligram (mg), Gram (g), Kilogram (kg)
- $1 \text{ g} = 1,000 \text{ mg}$, $1 \text{ kg} = 1,000 \text{ g}$

12. Perimeter, Area, and Volume (Metric)

- Formulas are the same. Units: meters (m), square meters (m^2), cubic meters (m^3)

13. Changing from Customary Units to Metric Units

- Length: $1 \text{ in} \approx 2.54 \text{ cm}$, $1 \text{ ft} \approx 30.48 \text{ cm}$, $1 \text{ mi} \approx 1.609 \text{ km}$
- Volume: $1 \text{ gal} \approx 3.785 \text{ L}$
- Weight: $1 \text{ lb} \approx 0.454 \text{ kg}$
- Temperature: $^{\circ}\text{C} = (^{\circ}\text{F} - 32) \times 5/9$

14. Changing from Metric Units to Customary Units

- Length: $1 \text{ cm} \approx 0.394 \text{ in}$, $1 \text{ m} \approx 3.281 \text{ ft}$, $1 \text{ km} \approx 0.621 \text{ mi}$
- Volume: $1 \text{ L} \approx 0.264 \text{ gal}$
- Weight: $1 \text{ kg} \approx 2.205 \text{ lb}$
- Temperature: $^{\circ}\text{F} = (^{\circ}\text{C} \times 9/5) + 32$

Examples

Example 1: Customary Length

How many inches are in 4 feet?

Solution: $1 \text{ ft} = 12 \text{ in}$, so $4 \text{ ft} = 4 \times 12 = \mathbf{48 \text{ in}}$.

Example 2: Metric Mass

Convert 2,500 grams to kilograms.

Solution: $1 \text{ kg} = 1,000 \text{ g}$, so $2,500 \text{ g} = 2,500 \div 1,000 = \mathbf{2.5 \text{ kg}}$.

Example 3: Area

What is the area of a rectangle with length 8 cm and width 6 cm?

Solution: $\text{Area} = 8 \times 6 = \mathbf{48 \text{ cm}^2}$.

Example 4: Convert Gallons to Liters

Convert 3 gallons to liters ($1 \text{ gal} \approx 3.785 \text{ L}$).

Solution: $3 \times 3.785 = \mathbf{11.355 \text{ L}}$.

Example 5: Temperature Conversion

Convert 68°F to Celsius.

Solution: $(68-32) \times 5/9 = 36 \times 5/9 = \mathbf{20^\circ\text{C}}$.

Pre-Test

Q1. How many inches are in a foot?

- 10
- 12
- 14
- 16

Q2. How many feet are in a yard?

- 2
- 3
- 4
- 5

Q3. How many yards are in a mile?

- 880
- 1,760
- 5,280
- 3,600

Q4. How many cups are in a quart?

- 2
- 3
- 4
- 6

Q5. How many quarts are in a gallon?

- 2
- 3
- 4
- 8

Q6. How many ounces are in a pound?

- 8
- 10
- 12
- 16

Q7. How many pounds are in a ton?

- 500
- 1,000
- 2,000
- 5,000

Q8. Perimeter of a rectangle formula?

- $l \times w$
- $2(l + w)$
- $l + w + h$
- $4l$

Q9. Area of a rectangle formula?

- $l \times w$
- $2(l + w)$
- $l + w + h$
- $l \div w$

Q10. Volume of a rectangular prism?

- $l + w + h$
- $l \times w \times h$
- $l \times w$
- $2(l + w)$

Q11. How many minutes in an hour?

- 30
- 45
- 60
- 90

Q12. How many hours in a day?

- 12
- 18
- 24
- 48

Q13. How many days in a week?

- 5
- 6
- 7
- 8

Q14. Which is not a customary length unit?

- Foot
- Inch
- Meter
- Yard

Q15. Which is a metric unit of length?

- Inch
- Centimeter
- Foot
- Mile

Q16. How many centimeters in a meter?

- 10
- 100
- 1,000
- 10,000

Q17. How many milliliters in a liter?

- 10
- 100
- 1,000
- 10,000

Q18. How many grams in a kilogram?

- 10
- 100
- 500
- 1,000

Q19. What is the metric unit for mass?

- Pound
- Ounce
- Gram
- Ton

Q20. What is 1 meter in centimeters?

- 10
- 100
- 1,000
- 1

Q21. What is the freezing point of water in Celsius?

- 0°C
- 32°C
- 100°C
- 10°C

Q22. What is the boiling point of water in Celsius?

- 0°C
- 32°C
- 100°C
- 212°C

Q23. What is 1 gallon in liters (approx)?

- 1.5
- 2.5
- 3.8
- 4.5

Q24. What is 1 inch in centimeters?

- 1.54
- 2.54
- 3.54
- 5.4

Q25. What is 1 kilogram in pounds (approx)?

- 1.1
- 2.2
- 3.3
- 4.4

Q26. What is 1 kilometer in miles (approx)?

- 0.62
- 1.61
- 1.8
- 2.2

Q27. Which is larger: 1 quart or 1 liter?

- 1 quart
- 1 liter
- Same
- Cannot compare

Q28. Which is larger: 1 mile or 1 kilometer?

- 1 mile
- 1 kilometer
- Same
- Cannot compare

Q29. Convert 500 mL to L.

- 0.05
- 0.5
- 5
- 50

Q30. How many millimeters in a centimeter?

- 1
- 10
- 100
- 1,000

Q31. How many feet in a mile?

- 1,760
- 3,280
- 5,280
- 10,560

Q32. What is the formula to convert Celsius to Fahrenheit?

- $^{\circ}\text{F} = (^{\circ}\text{C} \times 9/5) + 32$
- $^{\circ}\text{F} = (^{\circ}\text{C} \times 5/9) + 32$
- $^{\circ}\text{F} = (^{\circ}\text{C} - 32) \times 5/9$
- $^{\circ}\text{F} = (^{\circ}\text{C} + 32) \times 9/5$

Q33. What is 1 liter in milliliters?

- 10
- 100
- 1,000
- 10,000

Q34. How many seconds in one minute?

- 30
- 45
- 60
- 90

Q35. What is the area of a rectangle: $l = 5\text{cm}$, $w = 3\text{cm}$?

- 8 cm^2
- 15 cm^2
- 25 cm^2
- 18 cm^2

Q36. What is 2.5 kilometers in meters?

- 25
- 250
- 2,500
- 25,000

Q37. How many pints in a gallon?

- 2
- 4
- 8
- 16

Q38. How many cups in a pint?

- 1
- 2
- 4
- 8

Q39. What is 1 foot in centimeters (approx)?

- 12
- 20
- 30
- 50

Q40. How many centimeters in a kilometer?

- 1,000
- 10,000
- 100,000
- 1,000,000

Submit Pre-Test

Questions & Answers

Post-Test

Q1. How many inches are in a foot?

- 10
- 12
- 14
- 16

Q2. How many feet are in a yard?

- 2
- 3
- 4
- 5

Q3. How many yards are in a mile?

- 880
- 1,760

- 5,280
- 3,600

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- 2
- 3
- 4
- 6

Q5. How many quarts are in a gallon?

- 2
- 3
- 4
- 8

Q6. How many ounces are in a pound?

- 8
- 10
- 12
- 16

Q7. How many pounds are in a ton?

- 500
- 1,000
- 2,000
- 5,000

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- $l \times w$

- $2(l + w)$
- $l + w + h$
- $l \div w$

Q10. Volume of a rectangular prism?

- $l + w + h$
- $l \times w \times h$
- $l \times w$
- $2(l + w)$

Q11. How many minutes in an hour?

- 30
- 45
- 60
- 90

Q12. How many hours in a day?

- 12
- 18
- 24
- 48

Q13. How many days in a week?

- 5
- 6
- 7
- 8

Q14. Which is not a customary length unit?

- Foot
- Inch
- Meter
- Yard

Q15. Which is a metric unit of length?

- Inch
- Centimeter
- Foot
- Mile

Q16. How many centimeters in a meter?

- 10
- 100
- 1,000
- 10,000

Q17. How many milliliters in a liter?

- 10
- 100
- 1,000
- 10,000

Q18. How many grams in a kilogram?

- 10
- 100
- 500
- 1,000

Q19. What is the metric unit for mass?

- Pound
- Ounce
- Gram
- Ton

Q20. What is 1 meter in centimeters?

- 10
- 100
- 1,000
- 1

Q21. What is the freezing point of water in Celsius?

- 0°C
- 32°C
- 100°C
- 10°C

Q22. What is the boiling point of water in Celsius?

- 0°C
- 32°C
- 100°C
- 212°C

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- 1.5
- 2.5
- 3.8
- 4.5

Q24. What is 1 inch in centimeters?

- 1.54
- 2.54
- 3.54
- 5.4

Q25. What is 1 kilogram in pounds (approx)?

- 1.1
- 2.2
- 3.3
- 4.4

Q26. What is 1 kilometer in miles (approx)?

- 0.62
- 1.61
- 1.8
- 2.2

Q27. Which is larger: 1 quart or 1 liter?

- 1 quart
- 1 liter
- Same
- Cannot compare

Q28. Which is larger: 1 mile or 1 kilometer?

- 1 mile
- 1 kilometer
- Same
- Cannot compare

Q29. Convert 500 mL to L.

- 0.05
- 0.5
- 5
- 50

Q30. How many millimeters in a centimeter?

- 1
- 10
- 100
- 1,000

Q31. How many feet in a mile?

- 1,760
- 3,280
- 5,280
- 10,560

Q32. What is the formula to convert Celsius to Fahrenheit?

- $^{\circ}\text{F} = (^{\circ}\text{C} \times 9/5) + 32$
- $^{\circ}\text{F} = (^{\circ}\text{C} \times 5/9) + 32$
- $^{\circ}\text{F} = (^{\circ}\text{C} - 32) \times 5/9$
- $^{\circ}\text{F} = (^{\circ}\text{C} + 32) \times 9/5$

Q33. What is 1 liter in milliliters?

- 10
- 100
- 1,000
- 10,000

Q34. How many seconds in one minute?

- 30
- 45
- 60
- 90

Q35. What is the area of a rectangle: $l = 5\text{cm}$, $w = 3\text{cm}$?

- 8 cm^2
- 15 cm^2
- 25 cm^2
- 18 cm^2

Q36. What is 2.5 kilometers in meters?

- 25
- 250
- 2,500
- 25,000

Q37. How many pints in a gallon?

- 2
- 4
- 8
- 16

Q38. How many cups in a pint?

- 1
- 2
- 4
- 8

Q39. What is 1 foot in centimeters (approx)?

- 12
- 20
- 30
- 50

Q40. How many centimeters in a kilometer?

- 1,000
- 10,000
- 100,000
- 1,000,000

Submit Post-Test

Concepts

Concepts

Examples

Pre-Test

Q & A

Post-Test

1. Points and Lines

- **Point:** An exact location in space, usually labelled with a capital letter (e.g., A).
- **Line:** Extends forever in both directions; made up of infinite points.

2. Line Segments and Rays

- **Line Segment:** Part of a line with two endpoints.
- **Ray:** Part of a line that starts at one point and extends forever in one direction.

3. Measuring Angles

- Measured in degrees ($^{\circ}$).
- Angles are formed when two rays share a common endpoint (vertex).

4. Types of Angles

- **Acute:** Less than 90°
- **Right:** Exactly 90°
- **Obtuse:** Greater than 90° but less than 180°
- **Straight:** Exactly 180°
- **Reflex:** Greater than 180° but less than 360°

5. Triangles

- 3 sides, 3 angles. Types: equilateral, isosceles, scalene, right, acute, obtuse.
- Sum of angles: 180°

6. Quadrilaterals

- 4 sides. Types: square, rectangle, parallelogram, rhombus, trapezoid, kite.
- Sum of angles: 360°

7. Polygons

- Closed shapes with 3 or more straight sides.
- Regular: all sides and angles equal. Irregular: not all sides/angles equal.

8. Circles

- Set of all points equidistant from the center.
- Parts: center, radius, diameter, chord, arc, sector, circumference.
- **Circumference:** $(C = 2\pi r)$
- **Area:** $(A = \pi r^2)$

9. Solid Figures

- 3D objects: cube, rectangular prism, sphere, cylinder, cone, pyramid.

10. Surface Area

- The total area of all faces of a solid figure.
- Cube: $(6a^2)$; Rectangular prism: $(2(lw + lh + wh))$

11. Graphing Figures

- Placing points, lines, and shapes on a coordinate plane (x, y axes).
- Each point is an ordered pair (x, y).

Examples

Example 1: Naming a Ray

Question: Name the ray that starts at point A and passes through B.

Solution: Ray AB (**not** BA).

Example 2: Measuring an Angle

Question: What is the measure of a right angle?

Solution: 90°

Example 3: Types of Triangles

Question: A triangle has angles 90° , 45° , and 45° . What type is it?

Solution: Right isosceles triangle

Example 4: Area of a Circle

Question: What is the area of a circle with $(r=3)$?

Solution: $(A = \pi r^2 = \pi \times 9 \approx 28.27)$

Example 5: Surface Area of a Cube

Question: If a cube has edge 2 units, what is its surface area?

Solution: $(6 \times 2^2 = 24)$ square units

Pre-Test

Q1. A location in space is called a:

- Line
- Ray
- Point
- Angle

Q2. A part of a line with two endpoints is called a:

- Line
- Ray
- Line Segment
- Chord

Q3. A line that starts at one end and extends forever in one direction is a:

- Ray
- Line
- Chord
- Angle

Q4. What unit is used to measure angles?

- Meters
- Degrees
- Inches
- Radians

Q5. An angle measuring exactly 90° is a:

- Acute
- Obtuse
- Right
- Straight

Q6. An angle less than 90° is:

- Acute
- Obtuse
- Straight
- Right

Q7. An angle between 90° and 180° is:

- Acute
- Obtuse
- Reflex
- Right

Q8. How many degrees in a straight angle?

- 90
- 180
- 270
- 360

Q9. A triangle with all equal sides is:

- Scalene
- Isosceles
- Equilateral
- Right

Q10. A triangle with a 90° angle is called:

- Acute
- Obtuse
- Equilateral
- Right

Q11. Sum of interior angles in a triangle:

- 90°
- 180°
- 270°
- 360°

Q12. How many sides does a quadrilateral have?

- 3
- 4
- 5
- 6

Q13. Sum of interior angles in a quadrilateral:

- 180°
- 270°
- 360°
- 540°

Q14. A square is a:

- Triangle
- Polygon
- Circle
- Ray

Q15. A polygon with 5 sides is called a:

- Hexagon
- Pentagon
- Heptagon
- Octagon

Q16. A polygon with all equal sides and angles is:

- Irregular
- Regular
- Scalene
- Obtuse

Q17. A circle is defined as:

- All points same distance from center
- Four straight sides
- Three points
- A line

Q18. A line passing through the center of a circle is called:

- Radius
- Diameter
- Chord
- Tangent

Q19. The distance from the center to any point on the circle is:

- Chord
- Arc
- Radius
- Diameter

Q20. Formula for circumference of a circle:

- $2\pi r$
- πr^2
- πd^2
- r^2

Q21. Formula for area of a circle:

- $2\pi r$
- πr^2
- πd
- r^2

Q22. Which is not a solid figure?

- Sphere
- Cube
- Rectangle
- Cylinder

Q23. A cube has how many faces?

- 4
- 6
- 8
- 12

Q24. A rectangular prism has how many edges?

- 6
- 8
- 10
- 12

Q25. The total area of all faces of a solid is called:

- Surface Area
- Volume
- Perimeter
- Circumference

Q26. Surface area of a cube with side 'a' is:

- a^2
- $4a^2$
- $6a^2$
- $12a$

Q27. The area of a rectangle is:

- $l + w$
- $2l + 2w$
- $l \times w$
- $l \div w$

Q28. A 3D figure with a circular base and one vertex is called:

- Cube
- Cylinder
- Cone
- Pyramid

Q29. On a coordinate plane, a point is written as:

- x,y
- y,x
- (x, y)
- $[y, x]$

Q30. A polygon with 8 sides is called:

- Hexagon
- Octagon
- Heptagon
- Nonagon

Q31. A triangle with all different side lengths is:

- Equilateral
- Isosceles
- Scalene
- Acute

Q32. A rectangle always has:

- All equal sides
- All equal angles (90°)
- No parallel sides
- One right angle

Q33. A kite and a rhombus both have:

- Two pairs of equal-length sides
- Four right angles
- No equal sides
- No parallel sides

Q34. How many vertices does a pentagon have?

- 3
- 4
- 5
- 6

Q35. Which figure has only one curved face?

- Cube
- Sphere
- Cylinder
- Pyramid

Q36. What is the surface area of a rectangular prism with $l=2$, $w=3$, $h=4$?

- 24
- 52
- 48
- 36

Q37. What is the name for a closed figure with all sides the same length and all angles equal?

- Regular Polygon
- Irregular Polygon
- Circle
- Quadrilateral

Q38. The diameter of a circle is always:

- Half the radius
- Twice the radius
- Same as radius

None

Q39. A parallelogram is a quadrilateral with:

- All sides equal
- Opposite sides parallel
- All right angles
- No parallel sides

Q40. Which figure always has all sides equal and all angles 90° ?

- Rectangle
- Parallelogram
- Square
- Rhombus

Submit Pre-Test

Questions & Answers

Post-Test

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- Line
- Ray
- Point
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Q40. Which figure always has all sides equal and all angles 90° ?

- Rectangle
- Parallelogram
- Square
- Rhombus

Submit Post-Test

Single Neuron Linear Regression Trainer

Chapter 1: Introduction - What is Linear Regression?

Linear regression is one of the simplest and most widely used algorithms in machine learning. The goal is to model the relationship between a scalar dependent variable y and an independent variable x . The relationship is assumed to be linear, and can be expressed as:

$$y = wx + b$$

Here, w is the weight (slope), and b is the bias (intercept). The algorithm finds the best line that fits the training data by adjusting w and b .

What Does a Single Neuron Look Like?

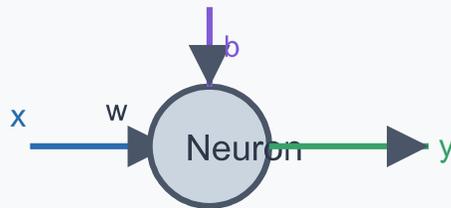


Diagram: A single neuron receives input x , multiplies it by weight w , adds bias b , and outputs y .

Easy Example

Imagine we have the following single neuron:

- Weight (w) = 2
- Bias (b) = 1
- Input (x) = 3

How does the neuron compute the output?

$$\begin{aligned} y &= w * x + b \\ &= 2 * 3 + 1 \\ &= 6 + 1 \\ &= 7 \end{aligned}$$

So, when we provide the input $x=3$, the neuron outputs $y=7$.

This is how a single neuron performs linear regression: it learns the values for w and b that best fit the data.

Chapter 4: Libraries for Model Definition, Training, and Visualization

Model Definition and Training Libraries

In JavaScript, especially for browser-based machine learning, several libraries are available for defining and training models:

- **TensorFlow.js (Early Version: 0.x and 1.x)**

<https://cdn.jsdelivr.net/npm/@tensorflow/tfjs@1.0.0/dist/tf.min.js>

TensorFlow.js is the main library for building and training neural networks in JavaScript. Early versions provided basic layers, optimizers, and tensor operations for training models directly in the browser or Node.js.

- **Synaptic.js**

<https://cdn.jsdelivr.net/npm/synaptic@1.1.4/dist/synaptic.js>

Synaptic is one of the earliest general-purpose neural network libraries for JavaScript, supporting perceptrons, LSTM, and more. It provides a simple API for defining and training neural networks in the browser.

Visualization Libraries for the Web Browser

To visualize data, training progress, or model predictions in the browser, popular early libraries include:

- **Chart.js (Early Version: 1.x)**

<https://cdn.jsdelivr.net/npm/chart.js@1.1.1/Chart.min.js>

Chart.js is a simple and flexible JavaScript charting library. Early versions supported basic line, bar, and scatter charts, making it useful for visualizing training losses and predictions.

- **D3.js (Early Version: 3.x)**

<https://cdn.jsdelivr.net/npm/d3@3.5.17/d3.min.js>

D3.js is a powerful library for creating complex, interactive data visualizations using web standards. Early versions enabled custom plotting of training data and model output.

Example: Including Early Libraries

```
<!-- TensorFlow.js v1.x -->
<script src="https://cdn.jsdelivr.net/npm/@tensorflow/tfjs@1.0.0/dist/tf.min.js"></script>

<!-- Synaptic.js v1.1.4 -->
<script src="https://cdn.jsdelivr.net/npm/synaptic@1.1.4/dist/synaptic.js"></script>

<!-- Chart.js v1.x -->
<script src="https://cdn.jsdelivr.net/npm/chart.js@1.1.1/Chart.min.js"></script>

<!-- D3.js v3.x -->
<script src="https://cdn.jsdelivr.net/npm/d3@3.5.17/d3.min.js"></script>
```

Using these early libraries, developers could build, train, and visualize machine learning models directly in the browser, paving the way for today's more advanced web-based ML solutions.

Run

Explore the Cars Dataset

The [Cars Dataset](#) includes information about various car models. Each entry contains details such as:

- **Miles per Gallon (MPG)**
- **Horsepower**
- **Weight**
- **Acceleration**
- **Year**
- **Origin**

This dataset is useful for exploring how car features relate to each other, such as how horsepower might affect fuel efficiency.

Why Clean the Data?

Sometimes the dataset includes missing or invalid values. Cleaning the data helps remove these records so analysis and visualizations are more accurate.

Load and Clean the Dataset

Click the button below to load and clean the dataset. Only cars with both MPG and horsepower values are kept. The cleaned data is saved as a variable called `cleanedData` for use later.

Load Cars Dataset

Visualize the Dataset

Let's visualize the relationship between **Horsepower** and **Miles per Gallon (MPG)** using a scatter plot. This helps us understand how these two features relate, and why they are a good choice for model training.

- **X-Axis:** Horsepower
- **Y-Axis:** Miles per Gallon (MPG)

We will use these two features for training our model.

Show Visualization

Splitting the Dataset

Before training a machine learning model, it's common to split your data into two parts:

- **Training set:** Used to train the model.
- **Testing set:** Used to evaluate model performance on unseen data.

A popular approach is to use about 80% of the data for training and 20% for testing. This helps ensure your model can generalize well to new data.

Split the dataset

Define and Inspect a Neural Network Model

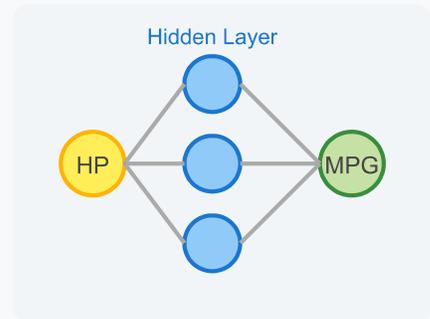
Let's build a simple artificial neural network model. When you click the button below, a model will be defined in JavaScript using TensorFlow.js. The structure (layers) of the model will be displayed.

Define Neural Network Model

About the Model

The model is a simple feedforward neural network (also called a "Dense Neural Network") that predicts a car's fuel efficiency (**MPG**) from its **Horsepower**. It consists of:

- One input node (for horsepower)
- One hidden layer with a few neurons (for learning complex relationships)
- One output node (for predicted MPG)



This model will be trained on the **training set** defined above.

Illustration: Input (Horsepower) → Hidden Layer → Output (MPG)

Train the Model

To make accurate predictions, the neural network model must be trained using data. During training, the model adjusts its internal parameters, learning how horsepower relates to MPG. When you click "Train Model", the model will use the **cleanedData** and update its weights to minimize prediction error.

- **Input:** Horsepower values
- **Target:** Actual MPG values

Train Model

Evaluate the Trained Model

After training, it is important to check how well the model performs on new, unseen data. We use the test set (the part of **cleanedData** that was kept aside) to measure the model's accuracy. When you click the button below, the model will make predictions on the test set, and you can compare them to the actual values.

Evaluate the model

Understanding the Confusion Matrix

A **confusion matrix** is a table that helps you visualize the performance of a classification model. It shows how many predictions were correctly or incorrectly classified into each category.

In this example, we will categorize MPG into three classes (Low, Medium, High efficiency) and display the confusion matrix to show how well the model predicts each class.

Show confusion matrix

Training a Convolutional Neural Network (CNN) in the Browser

1. Introduction to Convolutional Neural Networks

Convolutional Neural Networks (CNNs) are a specialized type of deep neural network designed to process structured grid data, such as images. CNNs are highly effective for image and video recognition, classification, and many other visual tasks.

- **Convolutional layers** automatically and adaptively learn spatial hierarchies of features from input images by applying filters across the image.
- **Pooling layers** reduce the spatial dimensions, making the network computationally efficient and helping prevent overfitting.
- **Fully connected layers** at the end of the network help in classifying the learned features into specific categories.

CNNs work by sliding small filters (kernels) over the input image to produce feature maps. These maps highlight important features like edges, textures, and shapes. The network learns which filters are most useful during training.

2. How to Train a CNN

Training a CNN involves multiple steps:

1. **Prepare the dataset:** Images are labeled and divided into training and testing sets.
2. **Build the CNN model:** Stack convolutional, pooling, and dense layers.
3. **Compile the model:** Specify the optimizer (e.g., SGD, Adam), loss function (e.g., categorical crossentropy), and evaluation metrics (e.g., accuracy).
4. **Train the model:** Run the learning process for several epochs, where the model adjusts its weights based on the loss.
5. **Evaluate the model:** Test the trained model on unseen data to measure its performance.

Example: CNN Model Structure in TensorFlow.js

```
const model = tf.sequential({
  layers: [
    tf.layers.conv2d({
      kernelSize: 3,
      filters: 16,
      inputShape: [28, 28, 3],
      useBias: true
    }),
    tf.layers.maxPooling2d({
      poolSize: [2, 2]
    }),
    tf.layers.conv2d({
      kernelSize: 3,
      filters: 16,
      useBias: true
    }),
    tf.layers.maxPooling2d({
      poolSize: [2, 2]
    }),
    tf.layers.conv2d({
      kernelSize: 3,
      filters: 16,
      useBias: true
    }),
    tf.layers.conv2d({
      kernelSize: 3,
      filters: 16,
      useBias: true
    }),
    tf.layers.flatten({}),
    tf.layers.dense({
      units: 100
    }),
    tf.layers.dense({
      units: 100
    }),
    tf.layers.dense({
      units: 10
    })
  ]
});
```

3. Using TensorFlow.js for Building and Training CNNs

[TensorFlow.js](#) is a JavaScript library for training and deploying machine learning models directly in the browser or in Node.js. It enables running computations on the client side, utilizing WebGL for fast parallel processing.

- **Model Creation:** Use `tf.sequential()` or `tf.model()` to construct models.
- **Layer Support:** TensorFlow.js provides layers for `conv2d`, `maxPooling2d`, `flatten`, `dense`, and more, making it suitable for CNNs.
- **Data Handling:** Load and process image data using `tf.data` and `tf.tensor` utilities.
- **Model Training:** Train models with `model.fit()`, specifying epochs, batch size, and callbacks for monitoring.
- **Deployment:** You can save models to files or IndexedDB, and run them instantly in the browser without server-side computation.

Example: Compiling and Training the Model

```
const model = tf.sequential({
  layers: [
    tf.layers.conv2d({
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    }),
    tf.layers.flatten({}),
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      units: 100
    }),
    tf.layers.dense({
      units: 100
    }),
    tf.layers.dense({
      units: 10
    })
  ]
});
```



4. Simple TensorFlow.js CNN Demo

Below is a demonstration code block. For a complete example, you need to supply appropriate `trainImages` and `trainLabels` tensors in the correct shape.



2. How to Train a CNN

Training a CNN involves multiple steps:

1. **Prepare the dataset:** Images are labeled and divided into training and testing sets.
2. **Build the CNN model:** Stack convolutional, pooling, and dense layers.
3. **Compile the model:** Specify the optimizer (e.g., SGD, Adam), loss function (e.g., categorical crossentropy), and evaluation metrics (e.g., accuracy).
4. **Train the model:** Run the learning process for several epochs, where the model adjusts its weights based on the loss.
5. **Evaluate the model:** Test the trained model on unseen data to measure its performance.

2.1 Visual Representation of a Simple CNN

5. Essential Libraries for Deep Learning and Visualization in the Browser

To define and train neural network models directly in the browser, as well as to visualize results and model structure, the following libraries are commonly used:

- [TensorFlow.js](#): A JavaScript library for building and training machine learning models in the browser and on Node.js.
- [tfjs-vis](#): A simple JavaScript library to help visualize TensorFlow.js models, training metrics, and data in the browser.

These libraries enable you to build, train, and visualize deep learning models interactively and entirely client-side.

Run

6. Discussion: The MNIST Image Dataset and Labels

The MNIST dataset is a classic benchmark in machine learning, consisting of images of handwritten digits (0–9) and their corresponding labels. Each image is a 28x28 grayscale pixel grid, making it ideal for training and evaluating image classification models such as convolutional neural networks (CNNs).

- **Images:** [mnist_images.png](#) contains all digit images, packed sequentially.
- **Labels:** [mnist_labels_uint8](#) contains the digit labels (0–9) for each image, stored as unsigned 8-bit integers.

The dataset is widely used to evaluate computer vision algorithms' ability to recognize handwritten numbers. Each image is associated with a single label, indicating which digit it represents.

Load Dataset

7. Visualization of the Cleaned MNIST Dataset

Visualizing the data is an important step for understanding the structure and variety of the MNIST dataset. Below, a selection of digit images and their labels from `cleanedData` is displayed as a grid. This helps verify that the data has loaded correctly and gives a sense for the input your models will see.

Show Sample Images

8. Splitting the Dataset into Training and Testing Sets

In machine learning, it is important to split your dataset into a **training set** and a **testing set**. The training set is used to train your model, while the testing set is used to evaluate how well your model performs on unseen data. A typical split is 80% for training and 20% for testing.

- **Training set:** Used to learn and fit the model parameters.
- **Testing set:** Used to evaluate the model's generalization to new, unseen data.

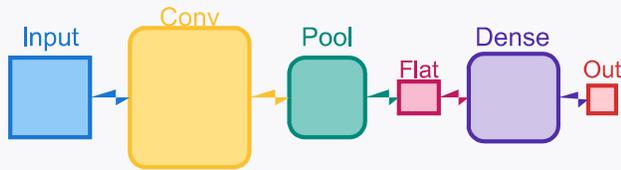
Split the dataset

9. Define a Convolutional Neural Network (CNN) Model

Convolutional Neural Networks (CNNs) are a popular architecture for image classification tasks, such as recognizing handwritten digits in the MNIST dataset.

Define CNN Model

What is a CNN?



How does a CNN work?

A CNN processes image data through several layers:

- **Input:** Receives the raw pixel values of the image.
- **Convolutional layers:** Learn local features (like edges, corners) by sliding small filters across the image.
- **Pooling layers:** Reduce spatial size, helping the model focus on the most important features.
- **Flattening:** Converts the 2D data to a 1D vector.
- **Dense (Fully Connected) layers:** Combine features to predict the final class label.

This layered approach allows the network to learn increasingly complex patterns, making CNNs highly effective for image recognition.

10. Training the CNN Model

After defining the CNN model, the next step is to train it using the training set. This process teaches the model to recognize patterns in the data by repeatedly adjusting its parameters to

minimize prediction errors.

- **Epoch:** One full pass through the entire training dataset.
- **Loss:** A measure of how far the model's predictions are from the correct answers.
- **Accuracy:** The percentage of correct predictions.

Train Model

How the training works

During training, the model uses the images and labels from the training set to learn. It repeatedly makes predictions and compares them to the actual labels, adjusting itself each time to improve. Over multiple epochs, the loss should decrease and the accuracy should increase, indicating that the model is learning to recognize the images.

11. Testing (Evaluation) of the CNN Model

After training, it's important to evaluate the model on a separate **test set**. This helps us understand how well the model generalizes to new, unseen data.

- **Test Loss:** Indicates how well (or poorly) the model performs on the test data.
- **Test Accuracy:** The percentage of correct predictions on the test set.

Test Model

What does evaluation show?

Testing the model on new data that it has never seen before gives a realistic sense of its performance in real-world scenarios. High test accuracy suggests that the model has learned to generalize well, not just remember the training data.

12. Understanding the Confusion Matrix

A **confusion matrix** is a table used to evaluate the performance of a classification model. It shows how many predictions were correct and where mistakes were made for each class.

- **Rows:** Actual (true) labels from the test set.
- **Columns:** Predicted labels from the model.
- Each cell $[i, j]$ shows how many times class **i** was predicted as class **j**.

Confusion Matrix

How to interpret

The diagonal cells show correct predictions. Off-diagonal cells show misclassifications. A perfect model has nonzero values only on the diagonal.