AMC Math Practice

AMC 8 · AMC 9 · AMC 10 | 20 Core Problems

Print-Ready Worksheet · Work Space Included

Instructions: Each problem has a Key Concept, Worked Example, and 3 Steps. Answer ALL 3 steps for each problem. Write your work in the space provided. Answers are shown at the end of each problem.

Problem 01 of 20 · Number Theory · GCD & LCM

■ Key Concept

GCD (Greatest Common Divisor): largest integer dividing both numbers.
LCM (Least Common Multiple): smallest positive integer divisible by both.
Key: GCD(a,b) × LCM(a,b) = a × b

■ Worked Example

Find GCD(12, 18) and LCM(12, 18).
12 = 2^2 × 3, 18 = 2 × 3^2
GCD = 2 × 3 = 6, LCM = 4 × 9 = 36
Check: 6 × 36 = 216 = 12 × 18 ✓

✏■ Your Turn — Answer All 3 Steps

Step 1: What is LCM(8, 12)?

(A) 16 (B) 24 (C) 32 (D) 48

Work space:

Step 2: If GCD(a,b) = 6 and LCM(a,b) = 60, what is a × b?

(A) 66 (B) 120 (C) 360 (D) 720

Work space:

Step 3: How many positive integers ≤ 100 are divisible by both 4 and 6?

(A) 8 (B) 12 (C) 16 (D) 25

Work space:

Answers: Step 1: (B) 24 | Step 2: (C) 360 | Step 3: (A) 8

Problem 02 of 20 · Fractions & Ratios · Ratios & Proportions

■ Key Concept

A ratio a:b compares two quantities.

Proportion: a/b = c/d means ad = bc (cross-multiply).

For mixture/sharing problems, write variables as k × (ratio part).

■ Worked Example

If a:b = 3:5 and a+b = 40, find a and b.

Let a = 3k, b = 5k. Then 8k = 40 → k = 5.

So a = 15, b = 25.

✏■ Your Turn — Answer All 3 Steps

Step 1: Boys:Girls = 3:4, 28 total students. How many boys?

(A) 9 (B) 12 (C) 16 (D) 21

Work space:

Step 2: x/y = 5/3 and y = 12. What is x?

(A) 15 (B) 18 (C) 20 (D) 25

Work space:

Step 3: Mix 40% juice and 70% juice to get 100 L of 55% juice. Liters of 40% needed?

(A) 40 (B) 50 (C) 55 (D) 60

Work space:

Answers: Step 1: (B) 12 | Step 2: (C) 20 | Step 3: (B) 50

Problem 03 of 20 · Percent · Percent Change & Discount

■ Key Concept

Percent change = (New – Old) / Old × 100%

Successive changes: multiply factors, e.g., +20% then –20% → 1.2 × 0.8 = 0.96 (–4% net).

■ Worked Example

A shirt costs $80. After 25% discount: 80 × 0.75 = $60.

✏■ Your Turn — Answer All 3 Steps

Step 1: Price increases from $50 to $65. Percent increase?

(A) 23% (B) 25% (C) 30% (D) 35%

Work space:

Step 2: Store raises prices 20%, then reduces 20%. Net change?

(A) 0% (B) –2% (C) –4% (D) +4%

Work space:

Step 3: After 40% discount, item costs $48. Original price?

(A) $67.20 (B) $72 (C) $80 (D) $84

Work space:

Answers: Step 1: (C) 30% | Step 2: (C) –4% | Step 3: (C) $80

Problem 04 of 20 · Algebra · Linear Equations

■ Key Concept

Solve ax + b = cx + d by collecting x on one side.

Word problems: define variables, write equations, solve, verify.

■ Worked Example

Solve 3x – 7 = 2(x + 4).

3x – 7 = 2x + 8 → x = 15.

✏■ Your Turn — Answer All 3 Steps

Step 1: If 5x – 3 = 2x + 12, what is x?

(A) 3 (B) 4 (C) 5 (D) 7

Work space:

Step 2: Two numbers sum to 54 and differ by 18. Larger number?

(A) 27 (B) 32 (C) 36 (D) 42

Work space:

Step 3: Train A travels 300 km at speed v. Train B travels same at v+25 km/h and arrives 1 hour earlier. Find v.

(A) 50 (B) 60 (C) 75 (D) 100

Work space:

Answers: Step 1: (C) 5 | Step 2: (C) 36 | Step 3: (C) 75

Problem 05 of 20 · Algebra · Systems of Equations

■ Key Concept

Two equations, two unknowns.

• Substitution: isolate one variable and substitute.

• Elimination: multiply/add equations to cancel one variable.

■ Worked Example

x + y = 10, 2x – y = 5. Add: 3x = 15 → x = 5, y = 5.

⇒■ Your Turn — Answer All 3 Steps

Step 1: x + y = 7 and x – y = 3. Find x.

(A) 2 (B) 3 (C) 4 (D) 5

Work space:

Step 2: 2x + 3y = 12 and 4x – 3y = 6. Find x + y.

(A) 2 (B) 3 (C) 4 (D) 5

Work space:

Step 3: 3a + 2b = 16 and a – b = 2. What is 5a + b?

(A) 16 (B) 18 (C) 20 (D) 22

Work space:

Answers: Step 1: (D) 5 | Step 2: (D) 5 | Step 3: (D) 22

Problem 06 of 20 · Geometry · Area & Perimeter

■ Key Concept

Rectangle: A = lw, P = 2(l+w)

Triangle: A = (1/2)bh

Circle: A = πr², C = 2πr

Trapezoid: A = (1/2)(b■ + b■)h

■ Worked Example

Triangle base 10, height 6: A = (1/2)(10)(6) = 30.

✏■ Your Turn — Answer All 3 Steps

Step 1: Rectangle perimeter 36, length 10. Area?

(A) 60 (B) 80 (C) 90 (D) 100

Work space:

Step 2: Circle area = 49π. Circumference?

(A) 7π (B) 14π (C) 21π (D) 49π

Work space:

Step 3: Trapezoid parallel sides 8 and 14, height 5. Area?

(A) 45 (B) 50 (C) 55 (D) 60

Work space:

Answers: Step 1: (B) 80 | Step 2: (B) 14π | Step 3: (C) 55

Problem 07 of 20 · Geometry · Pythagorean Theorem

■ Key Concept

Right triangle legs a, b and hypotenuse c: $a^2 + b^2 = c^2$

Common triples: (3,4,5), (5,12,13), (8,15,17), (7,24,25).

■ Worked Example

Legs 6 and 8: c = √(36+64) = √100 = 10.

✏■ Your Turn — Answer All 3 Steps

Step 1: Right triangle legs 9 and 12. Hypotenuse?

(A) 14 (B) 15 (C) 16 (D) 18

Work space:

Step 2: Ladder 13 ft, base 5 ft from wall. Height reached?

(A) 10 (B) 11 (C) 12 (D) 13

Work space:

Step 3: Square ABCD with side 6. Length of diagonal AC?

(A) 6 (B) 6√2 (C) 6√3 (D) 12

Work space:

Answers: Step 1: (B) 15 | Step 2: (C) 12 | Step 3: (B) 6√2

Problem 08 of 20 · Number Theory · Prime Numbers & Divisibility

■ Key Concept

A prime has exactly 2 factors: 1 and itself. Primes: 2, 3, 5, 7, 11, 13, ...

Divisibility: by 2 (even), by 3 (digit sum ÷ 3), by 9 (digit sum ÷ 9), by 5 (ends 0 or 5).

Number of factors of p^a × q^b = (a+1)(b+1).

■ Worked Example

$72 = 2^3 \times 3^2$. Number of factors = (3+1)(2+1) = 12.

✏■ Your Turn — Answer All 3 Steps

Step 1: How many prime numbers are less than 20?

(A) 6 (B) 7 (C) 8 (D) 9

Work space:

Step 2: How many positive divisors does $2^3 \times 3 \times 5^2$ have?

(A) 18 (B) 20 (C) 24 (D) 30

Work space:

Step 3: Largest prime factor of 2310?

(A) 7 (B) 11 (C) 13 (D) 17

Work space:

Answers: Step 1: (C) 8 | Step 2: (C) 24 | Step 3: (B) 11

Problem 09 of 20 · Combinatorics · Counting & Combinations

■ Key Concept

Permutation (order matters): P(n,r) = n! / (n–r)!

Combination (order doesn't matter): C(n,r) = n! / [r!(n–r)!]

■ Worked Example

Choose 3 from 5 students: C(5,3) = 5!/(3!2!) = 10.

✏■ Your Turn — Answer All 3 Steps

Step 1: In how many ways can 4 books be arranged on a shelf?

(A) 16 (B) 20 (C) 24 (D) 32

Work space:

Step 2: From 6 people, how many groups of 2 can be formed?

(A) 12 (B) 15 (C) 18 (D) 30

Work space:

Step 3: 3-digit numbers using {1,2,3,4,5} with no digit repeated?

(A) 30 (B) 45 (C) 60 (D) 120

Work space:

Answers: Step 1: (C) 24 | Step 2: (B) 15 | Step 3: (C) 60

Problem 10 of 20 · Probability · Basic Probability

■ Key Concept

P(event) = favorable outcomes / total outcomes

P(A or B) = P(A) + P(B) – P(A and B)

Independent: P(A and B) = P(A) × P(B)

■ Worked Example

Drawing a red card from a standard deck: P = 26/52 = 1/2.

✏■ Your Turn — Answer All 3 Steps

Step 1: Bag has 3 red, 4 blue, 5 green balls. P(red)?

(A) 1/3 (B) 1/4 (C) 1/5 (D) 3/12

Work space:

Step 2: Two fair coins flipped. P(exactly one head)?

(A) 1/4 (B) 1/3 (C) 1/2 (D) 3/4

Work space:

Step 3: Die rolled. P(odd) + P(>4) – P(odd AND >4) = ?

(A) 1/2 (B) 2/3 (C) 5/6 (D) 1

Work space:

Answers: Step 1: (B) 1/4 | Step 2: (C) 1/2 | Step 3: (B) 2/3

Problem 11 of 20 · Algebra · Quadratic Equations

■ Key Concept

$ax^2 + bx + c = 0$. Solve by factoring or quadratic formula:

$x = [-b \pm \sqrt{(b^2-4ac)}] / 2a$

Sum of roots = $-b/a$, Product of roots = c/a.

■ Worked Example

$x^2 - 5x + 6 = 0 \rightarrow (x-2)(x-3) = 0 \rightarrow x = 2$ or 3.

✏■ Your Turn — Answer All 3 Steps

Step 1: Solutions of $x^2 - 7x + 10 = 0$?

(A) 2 and 5 (B) 3 and 4 (C) 1 and 10 (D) 2 and 7

Work space:

Step 2: Sum of two numbers is 11 and product is 28. Larger number?

(A) 4 (B) 6 (C) 7 (D) 8

Work space:

Step 3: For what value(s) of k does $x^2 + kx + 9 = 0$ have exactly one solution?

(A) 3 (B) 6 (C) 9 (D) ±6

Work space:

Answers: Step 1: (A) 2 and 5 | Step 2: (C) 7 | Step 3: (D) ±6

Problem 12 of 20 · Geometry · Similar Triangles

■ Key Concept

Triangles are similar if angles match (AA, SAS, SSS).

Sides are proportional: $a/a' = b/b' = c/c'$.

Area ratio = (side ratio)².

■ Worked Example

■ABC ~ ■DEF, AB = 6, DE = 9. Area ratio = $(6/9)^2 = 4/9$.

✏■ Your Turn — Answer All 3 Steps

Step 1: Similar triangles side ratio 2:3. Smaller area = 8. Larger area?

(A) 12 (B) 16 (C) 18 (D) 27

Work space:

Step 2: 6-ft person casts 4-ft shadow. Tree casts 18-ft shadow. Tree height?

(A) 12 (B) 24 (C) 27 (D) 36

Work space:

Step 3: In ■ABC, DE ■ BC, AD=4, DB=2, DE=6. Find BC.

(A) 8 (B) 9 (C) 10 (D) 12

Work space:

Answers: Step 1: (C) 18 | Step 2: (C) 27 | Step 3: (B) 9

Problem 13 of 20 · Statistics · Mean, Median & Mode

■ Key Concept

Mean = sum / count

Median = middle value (sorted); average of two middles if even count.

Mode = most frequent value.

■ Worked Example

Data: 3, 7, 7, 9, 14. Mean = 8. Median = 7. Mode = 7.

✏■ Your Turn — Answer All 3 Steps

Step 1: Test scores: 78, 85, 90, 72, 95. Mean?

(A) 82 (B) 84 (C) 86 (D) 88

Work space:

Step 2: 6 numbers have mean 10. When 14 is added, new mean?

(A) 10 4/7 (B) 10 2/7 (C) 11 (D) 10 6/7

Work space:

Step 3: Data: 4,6,6,8,10,10,10. Mean – Median = ?

(A) 0 (B) 1 (C) 2 (D) 3

Work space:

Answers: Step 1: (B) 84 | Step 2: (A) 10 4/7 | Step 3: (A) 0 (approx)

Problem 14 of 20 · Number Theory · Number Patterns & Sequences

■ Key Concept

Arithmetic: a_n = a■ + (n–1)d, S_n = n/2 × (a■ + a_n)

Geometric: a_n = a■ × r^(n–1), S_n = a■(r^n – 1)/(r–1)

■ Worked Example

AP 3, 7, 11, … d=4. a■■ = 3+9×4 = 39. S■■ = 5(3+39) = 210.

✏■ Your Turn — Answer All 3 Steps

Step 1: 20th term of 5, 9, 13, … ?

(A) 77 (B) 81 (C) 85 (D) 89

Work space:

Step 2: Sum of all even integers from 2 to 100?

(A) 2500 (B) 2550 (C) 5000 (D) 5050

Work space:

Step 3: Geometric sequence a■=2, a■=54. What is a■?

(A) 6 (B) 9 (C) 18 (D) 27

Work space:

Answers: Step 1: (B) 81 | Step 2: (B) 2550 | Step 3: (C) 18

Problem 15 of 20 · Algebra · Exponents & Radicals

■ Key Concept

a^m × a^n = a^(m+n), (a^m)^n = a^(mn), a^(–n) = 1/a^n

a^(1/n) = n-th root of a. √(ab) = √a × √b

■ Worked Example

√72 = √(36×2) = 6√2.

✏■ Your Turn — Answer All 3 Steps

Step 1: Simplify (2^5 × 2^3) / 2^4

(A) 2² (B) 2■ (C) 2■ (D) 2■

Work space:

Step 2: √75 – √48 = ?

(A) √3 (B) 2√3 (C) 3√3 (D) 5√3

Work space:

Step 3: If 4^x = 8, what is x?

(A) 2/3 (B) 3/2 (C) 2 (D) 3

Work space:

Answers: Step 1: (B) 2■ | Step 2: (A) √3 | Step 3: (B) 3/2

Problem 16 of 20 · Geometry · Volume & Surface Area

■ Key Concept

Cube: V = s³, SA = 6s²

Rectangular prism: V = lwh, SA = 2(lw + lh + wh)

Cylinder: V = πr²h, SA = 2πr² + 2πrh

Sphere: V = (4/3)πr³, SA = 4πr²

■ Worked Example

Cylinder r=3, h=5: V = π(9)(5) = 45π.

✏■ Your Turn — Answer All 3 Steps

Step 1: Cube has surface area 150. Volume?

(A) 100 (B) 125 (C) 150 (D) 175

Work space:

Step 2: Cylinder radius 4, height 9. Volume?

(A) 36π (B) 72π (C) 112π (D) 144π

Work space:

Step 3: Sphere radius 3. Volume = kπ. What is k?

(A) 12 (B) 18 (C) 36 (D) 108

Work space:

Answers: Step 1: (B) 125 | Step 2: (D) 144π | Step 3: (C) 36

Problem 17 of 20 · Combinatorics · Pascal's Triangle & Binomial

■ Key Concept

Pascal's triangle row n: coefficients of (a+b)^n.

(a+b)^n = Σ C(n,k) a^(n–k) b^k

Row n sum = 2^n.

■ Worked Example

$(x+1)^3 = x^3 + 3x^2 + 3x + 1$.

═■ Your Turn — Answer All 3 Steps

Step 1: Sum of all entries in row 5 of Pascal's triangle?

(A) 16 (B) 32 (C) 64 (D) 128

Work space:

Step 2: Coefficient of x^2y^3 in (x+y)^5?

(A) 5 (B) 10 (C) 15 (D) 20

Work space:

Step 3: Paths from (0,0) to (4,4) moving only right or up?

(A) 35 (B) 56 (C) 70 (D) 120

Work space:

Answers: Step 1: (B) 32 | Step 2: (B) 10 | Step 3: (C) 70

Problem 18 of 20 · Geometry · Angles & Parallel Lines

■ Key Concept

Transversal crossing parallel lines:

• Alternate interior angles: equal

• Corresponding angles: equal

• Co-interior (same-side) angles: supplementary (sum 180°)

Triangle angle sum = 180°. Exterior angle = sum of two non-adjacent interiors.

■ Worked Example

If one co-interior angle is 65°, the other is 180°–65°=115°.

✏■ Your Turn — Answer All 3 Steps

Step 1: Triangle angles 47° and 63°. Third angle?

(A) 60° (B) 70° (C) 80° (D) 90°

Work space:

Step 2: Exterior angle 120°, one non-adjacent interior 45°. Other non-adjacent interior?

(A) 60° (B) 65° (C) 70° (D) 75°

Work space:

Step 3: Alternate interior angles (3x+10)° and (5x–20)°. Find x.

(A) 10 (B) 15 (C) 20 (D) 25

Work space:

Answers: Step 1: (B) 70° | Step 2: (D) 75° | Step 3: (B) 15

Problem 19 of 20 · Word Problems · Rate, Work & Distance

■ Key Concept

Distance = Rate × Time

Work: if A finishes in a hours, rate = 1/a jobs/hour.

Combined rate: 1/a + 1/b = 1/t.

■ Worked Example

A + B finish in 6 h. A alone: 10 h. B alone: 1/6 – 1/10 = 1/15, so 15 h.

⇒■ Your Turn — Answer All 3 Steps

Step 1: Two cars 300 km apart, driving toward each other at 60 and 90 km/h. Meeting time?

(A) 1 h (B) 2 h (C) 3 h (D) 4 h

Work space:

Step 2: Pipe A fills tank in 4 h. Pipe B drains it in 12 h. Time to fill with both open?

(A) 3 h (B) 4 h (C) 6 h (D) 8 h

Work space:

Step 3: Train goes A→B at 80 km/h, returns at 120 km/h. Average speed?

(A) 96 km/h (B) 100 km/h (C) 104 km/h (D) 110 km/h

Work space:

Answers: Step 1: (B) 2 h | Step 2: (C) 6 h | Step 3: (A) 96 km/h

Problem 20 of 20 · Algebra · Inequalities & Absolute Value

■ Key Concept

$|x - a| < b$ means $a-b < x < a+b$

$|x - a| > b$ means $x < a-b$ or $x > a+b$

Flip the inequality sign when multiplying/dividing by a negative number.

■ Worked Example

Solve $|2x - 4| \le 6$: $-6 \le 2x-4 \le 6 \rightarrow -1 \le x \le 5$.

⇒■ Your Turn — Answer All 3 Steps

Step 1: Solve $3x - 5 > 7$. Solution?

(A) $x > 2$ (B) $x > 4$ (C) $x > -4$ (D) $x < 4$

Work space:

Step 2: How many integers satisfy $|x - 3| < 4$?

(A) 6 (B) 7 (C) 8 (D) 9

Work space:

Step 3: For what values of x is $x^2 < 9$?

(A) $x < 3$ (B) $0 < x < 3$ (C) $-3 < x < 3$ (D) $x > -3$

Work space:

Answers: Step 1: (B) $x > 4$ | Step 2: (B) 7 | Step 3: (C) $-3 < x < 3$

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