

Algebra 2 & Geometry

Self-Study Workbook · 20 Core Problems · Common Traps & Memory Points

PART I — ALGEBRA 2

Word Problems · 10 Questions

Q01 · Algebra 2 · Quadratics · ★■ ■ ■

■ MEMORY POINT: vertex time = $-b/(2a)$; 'max height' = vertex

Q1. A ball is thrown upward with initial velocity 48 ft/s. Height: $h(t) = -16t^2 + 48t$. How long to reach maximum height?

Example: $h(t) = -16t^2 + 32t$: vertex at $t = -32/(2 \cdot -16) = 1$ sec. Same formula here.

- (A) 2 seconds
- (B) 1.5 seconds ✓
- (C) 3 seconds
- (D) 1 second

Q02 · Algebra 2 · Systems / Rates · ★★ ■

■ MEMORY POINT: combined rate = add fractions; NOT add times

Q2. Pipe A fills a tank in 4 hrs, Pipe B in 6 hrs. Both open together — how many hours to fill?

Example: Rate A = $1/4$, Rate B = $1/6$. Together: $1/4 + 1/6 = 5/12$. Time = $12/5 = 2.4$ hrs.

- (A) 5 hours
 - (B) 2 hours
 - (C) $12/5$ hours ✓
 - (D) 3 hours
-

Q03 · Algebra 2 · Exponentials · ★■

■ MEMORY POINT: doubling: $A=A_0 \times 2^{(t/\text{period})}$ — divide t by the period!

Q3. A bacteria culture starts at 500 and doubles every 3 hours. Which formula gives cells after t hours?

Example: $500 \cdot 2^t$ means doubling every 1 hr. Divide t by 3 for every-3-hr doubling.

- (A) $500 \cdot 2^t$
- (B) $500 \cdot 2^{(t/3)}$ ✓
- (C) $500 \cdot 3^{(t/2)}$
- (D) $500 \cdot 2^{(3t)}$

Q04 · Algebra 2 · Logarithms · ★★

■ MEMORY POINT: $\log_b(x)=y$ means $b^y=x$; the base 'goes down' and becomes the base of the power

Q4. An investment satisfies $\log(\text{base } 2)$ of $A = 5$. What is A ?

Example: $\log_2(A)=5 \rightarrow 2^5 = A$. Count: 2,4,8,16,32.

- (A) 10
- (B) 25
- (C) 32 ✓
- (D) 16

Q05 · Algebra 2 · Rational Equations · ★★

■ MEMORY POINT: ALWAYS check for extraneous solutions by plugging back in!

Q5. Solve: $x/(x-2) + 3/(x+2) = 8/(x^2-4)$. Note: $x^2-4 = (x-2)(x+2)$.

Example: Multiply both sides by LCD. Solve quadratic. Check: if solution makes denominator 0, reject it.

- (A) $x = 2$
- (B) $x = -2$
- (C) $x = 4$
- (D) No solution (extraneous) ✓

Q06 · Algebra 2 · Complex Numbers · ★★■**■ MEMORY POINT:** FOIL first, then replace i^2 with -1 at the very end**Q6. Simplify: $(3 + 2i)(1 - 4i)$** *Example: FOIL: $3-12i+2i-8i^2$. Now $-8i^2=-8(-1)=+8$. Real: $3+8=11$. Imag: $-10i$.*

- (A) $3 - 10i$
- (B) $11 - 10i$ ✓
- (C) $11 + 10i$
- (D) $3 - 8i$

Q07 · Algebra 2 · Sequences · ★■■■**■ MEMORY POINT:** $d = (\text{change in value}) \div (\text{number of steps between terms})$ **Q7. The 3rd term of an arithmetic sequence is 11 and the 7th term is 27. Find d .***Example: Steps from term 3 to 7 = 4. Value change = $27-11=16$. $d=16/4=4$.*

- (A) $d = 2$
- (B) $d = 8$
- (C) $d = 4$ ✓
- (D) $d = 16$

Q08 · Algebra 2 · Polynomials · ★★★**■ MEMORY POINT:** Remainder Theorem: remainder of $f(x) \div (x-c) = f(c)$ **Q8. What is the remainder when $f(x) = x^3 - 2x^2 + 5x - 6$ is divided by $(x - 2)$?***Example: $f(2) = 8 - 8 + 10 - 6 = 4$.*

- (A) -6
- (B) 4 ✓
- (C) 0
- (D) -32

Q09 · Algebra 2 · Conic Sections · ★★■**■ MEMORY POINT:** $(x+h)^2$ means center $x = -h$ — the sign FLIPS!**Q9. Find the center of the circle $(x+3)^2 + (y-5)^2 = 49$.***Example: $(x+3)^2=(x-(-3))^2$ so $h=-3$. $(y-5)^2$ so $k=+5$. Center: $(-3, 5)$.*

- (A) $(3, 5)$
- (B) $(-3, 5)$ ✓
- (C) $(-3, -5)$
- (D) $(3, -5)$

Q10 · Algebra 2 · Probability · ★★

■ MEMORY POINT: $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$; subtract the overlap once

Q10. Of 30 students: 18 play soccer, 12 play basketball, 5 play both. P(at least one sport)?

Example: Inclusion-Exclusion: $18 + 12 - 5 = 25$ students. $P = 25/30 = 5/6$.

- (A) $30/30 = 1$
- (B) $30/30$ (double-count error)
- (C) $25/30 = 5/6$ ✓
- (D) $20/30 = 2/3$

PART II — GEOMETRY

Word Problems · 10 Questions

Q11 · Geometry · Triangles · ★

■ MEMORY POINT: $a^2 + b^2 = c^2$; c is always the HYPOTENUSE (longest side)

Q11. A 13 ft ladder leans against a wall, its base 5 ft from the wall. How high up the wall does it reach?

Example: Hyp=13, leg=5. $b^2 = 13^2 - 5^2 = 169 - 25 = 144$. $b = 12$.

- (A) 8 ft
- (B) 12 ft ✓
- (C) $\sqrt{194}$ ft
- (D) 10 ft

Q12 · Geometry · Circles · ★

■ MEMORY POINT: Arc length = $(\theta/360) \times 2\pi r$; don't forget the $(\theta/360)$ fraction!

Q12. Circle with radius 10 cm, central angle 72° . Find the arc length.

Example: $(72/360) \times (2\pi \times 10) = (1/5) \times 20\pi = 4\pi$ cm.

- (A) 4π cm ✓
- (B) 20π cm
- (C) 4π cm ✓
- (D) 2π cm

Q13 - Geometry - Similar Triangles - ★★■

■ **MEMORY POINT:** set up a proportion: person height/shadow = tree height/shadow

Q13. A 6 ft person casts a 4 ft shadow. Simultaneously, a tree casts a 22 ft shadow. How tall is the tree?

Example: $6/4 = h/22 \rightarrow 4h=132 \rightarrow h=33$ ft.

- (A) 20 ft
- (B) 24 ft
- (C) 33 ft ✓
- (D) 44 ft

Q14 - Geometry - Volume - ★★■

■ **MEMORY POINT:** cone = $(1/3)\pi r^2 h$ — the 1/3 is most often forgotten!

Q14. Cone with radius 3 cm and height 7 cm. Find the exact volume.

Example: $V=(1/3)\pi(3^2)(7)=(1/3)\pi(9)(7)=21\pi$ cm³.

- (A) 63π cm³
- (B) 21π cm³ ✓
- (C) 7π cm³
- (D) 14π cm³

Q15 - Geometry - Angles - ★■

■ **MEMORY POINT:** parallel lines + transversal → alternate interior angles = EQUAL (not supplementary)

Q15. Parallel lines cut by transversal. Angles: $(3x+15)^\circ$ and $(5x-25)^\circ$. Find x.

Example: Set equal: $3x+15=5x-25 \rightarrow 40=2x \rightarrow x=20$. Check: $75^\circ=75^\circ$. ✓

- (A) $x = 10$
- (B) $x = 20$ ✓
- (C) $x = 5$
- (D) $x = 15$

Q16 - Geometry - Surface Area - ★★■

■ **MEMORY POINT:** cylinder SA = $2\pi r^2 + 2\pi rh$ (two bases + lateral); don't forget the bases!

Q16. Cylinder with radius 4 cm, height 10 cm. Find total surface area.

Example: $2\pi r^2 + 2\pi rh = 2\pi(16) + 2\pi(4)(10) = 32\pi + 80\pi = 112\pi \text{ cm}^2$.

- (A) $80\pi \text{ cm}^2$
- (B) $112\pi \text{ cm}^2$ ✓
- (C) $96\pi \text{ cm}^2$
- (D) $160\pi \text{ cm}^2$

Q17 - Geometry - Coordinate Geometry - ★■

■ **MEMORY POINT:** midpoint = average the x's AND average the y's

Q17. Segment AB: A(-3, 4) and B(7, -2). Find the midpoint.

Example: x: $(-3+7)/2=2$. y: $(4+(-2))/2=1$. Midpoint=(2,1).

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

Q18 - Geometry - Polygons - ★★■

■ **MEMORY POINT:** sum of interior angles = $(n-2)\times 180^\circ$; each angle (regular) = $\text{sum} \div n$

Q18. What is the measure of each interior angle of a regular octagon?

Example: $(8-2)\times 180=1080^\circ$. Each angle= $1080 \div 8=135^\circ$.

- (A) 120°
- (B) 135° ✓
- (C) 140°
- (D) 160°

Q19 - Geometry - Trigonometry - ★★■

■ **MEMORY POINT:** SOH-CAH-TOA: $\sin = \text{Opp}/\text{Hyp}$, $\cos = \text{Adj}/\text{Hyp}$, $\tan = \text{Opp}/\text{Adj}$

Q19. Right triangle, angle A=30°, hypotenuse=20. Find the side opposite angle A.

Example: $\sin(30^\circ) = \text{opp}/\text{hyp} \rightarrow 0.5 = BC/20 \rightarrow BC=10$.

- (A) $10\sqrt{3}$
- (B) 10 ✓
- (C) $20\sqrt{3}$
- (D) $20/\sqrt{3}$

Q20 - Geometry - Congruence - ★★★

■ MEMORY POINT: SAS=two sides + INCLUDED angle; SSA is NOT valid!

Q20. Two triangles: two pairs of sides equal, and the INCLUDED angle is equal. Which congruence postulate?

Example: Included = between the two known sides. Two sides + included angle = SAS.

- (A) SSS
- (B) SAS ✓
- (C) ASA
- (D) SSA (invalid!)

ANSWER KEY

| # | Ans | Value | # | Ans | Value |
|-----|----------|-----------------------|-----|------------|--------------------------|
| Q01 | B | 1.5 sec | Q11 | B | 12 ft |
| Q02 | C | 12/5 hrs | Q12 | A/C | 4π cm |
| Q03 | B | $500 \cdot 2^{(t/3)}$ | Q13 | C | 33 ft |
| Q04 | C | 32 | Q14 | B | 21π cm ³ |
| Q05 | D | No solution | Q15 | B | $x=20$ |
| Q06 | B | $11-10i$ | Q16 | B | 112π cm ² |
| Q07 | C | $d=4$ | Q17 | A | (2,1) |
| Q08 | B | 4 | Q18 | B | 135° |
| Q09 | B | (-3,5) | Q19 | B | 10 |
| Q10 | C | 5/6 | Q20 | B | SAS |

★ Easy · ★★ Medium · ★★★ Hard · ✓ = correct answer