Digital SAT Math Complete Series

Advanced Math — Free Sample

6 Questions · Easy to Very Hard · Full Solutions · Mistake-Pattern Analysis

Question 1 [EASY]

Which expression is equivalent to 3x(x + 4) minus 2(x + 4)?

A) (3x minus 2)(x + 4)

B) (3x + 2)(x + 4)

C) 3x squared + 10x minus 8

D) 3x squared minus 10x + 8

Algebraic: Factor out (x + 4): (x + 4)(3x minus 2).

Desmos: Expand both and compare. Desmos can verify but factoring is instant.

Faster path: Algebraic. Recognising the common factor (x + 4) in both terms gives the answer in one step.

Mistake: Overcomplication: student expands all terms first, getting 3x squared + 12x minus 2x minus 8 = 3x squared + 10x minus 8, and then cannot match it to the factored form in the answer choices.

Question 2 [EASY]

Which expression is equivalent to (x + 3) squared minus (x minus 3) squared?

A) 12x

B) 2x squared + 18

C) 12

D) 36

Algebraic: Difference of squares: (a squared minus b squared) = (a+b)(a minus b). Here a = x+3, b = x minus 3. Product = (2x)(6) = 12x.

Desmos: Expand both squares and subtract. Desmos can confirm.

Faster path: Algebraic. Recognising the difference-of-squares pattern gives the answer in five seconds.

Mistake: Concept gap: student expands both squares fully and subtracts term by term instead of applying the difference-of-squares identity directly.

Question 3 [MEDIUM]

How many solutions does the system y = x squared minus 2x minus 3 and y = 2x + 1 have?

A) Zero

B) One

C) Two

D) Infinitely many

Algebraic: Substitute: x squared minus 2x minus 3 = 2x + 1. Rearrange: x squared minus 4x minus 4 = 0. Discriminant: 16 + 16 = 32. Positive discriminant means two solutions.

Desmos: Graph both and count intersections.

Faster path: Algebraic with discriminant check. Computing only the sign of b squared minus 4ac is faster than graphing and counting.

Mistake: Pacing error: student sets up the combined equation correctly but solves fully for both roots before realising the question only asked for the count.

Question 4 [MEDIUM]

A parabola has vertex (3, minus 4) and passes through the point (5, 4). What is the value of a in f(x) = a(x minus 3) squared minus 4?

(Student-produced response)

Algebraic: Substitute (5, 4): 4 = a(5 minus 3) squared minus 4. 4 = 4a minus 4. 8 = 4a. a = 2.

Desmos: Not faster. Direct substitution of the given point solves for a in two lines.

Faster path: Algebraic. The vertex form is already given, so substituting the second point is a direct one-unknown solve.

Mistake: Concept gap: student substitutes the vertex coordinates instead of the non-vertex point, producing 0 = 0 and concluding a cannot be found.

Question 5 [HARD]

What is the sum of the solutions to 2x squared minus 7x + 3 = 0?

(Student-produced response)

Shortcut: Vieta's Formulas: sum of roots = negative b over a = negative (minus 7) over 2 = 3.5.

Solution: Using Vieta's formulas, sum = minus b over a = minus(minus 7) over 2 = 7/2 = 3.5.

Mistake: Overcomplication: student applies the full quadratic formula, finds both roots separately, and then adds them, spending two minutes on a five-second calculation.

Question 6 [VERY HARD]

For what positive value of k does the equation x squared + kx + 25 = 0 have exactly one real solution?

(Student-produced response)

Shortcut: Discriminant = 0: set b squared minus 4ac = 0. k squared minus 100 = 0. k = 10.

Solution: For exactly one real solution, the discriminant equals zero: k squared minus 4(1)(25) = 0. k squared = 100. k = 10 (taking the positive value).

Mistake: Concept gap: student tries to factor x squared + kx + 25 as (x + 5) squared = x squared + 10x + 25 and gets k = 10 by pattern-matching, but cannot explain why or generalise the method.