

50 multiple-choice questions

Question 1 (Level 1) — *Simple linear pair*

Solve: $x + y = 5$ and $x - y = 1$.

- (A) $x = 3, y = 2$
- (B) $x = 2, y = 3$
- (C) $x = 4, y = 1$
- (D) $x = 1, y = 4$

Question 2 (Level 1) — *Substitution method*

Solve: $y = 2x$ and $x + y = 6$.

- (A) $x = 2, y = 4$
- (B) $x = 4, y = 2$
- (C) $x = 3, y = 3$
- (D) $x = 1, y = 5$

Question 3 (Level 1) — *Elimination method*

Solve: $2x + y = 7$ and $x + y = 4$.

- (A) $x = 3, y = 1$
- (B) $x = 1, y = 3$
- (C) $x = 2, y = 3$
- (D) $x = 4, y = -1$

Question 4 (Level 1) — *Word problem setup*

Two numbers add to 10 and differ by 4. What are the numbers?

- (A) 7 and 3
- (B) 8 and 2
- (C) 6 and 4
- (D) 9 and 1

Question 5 (Level 1) — *Solve with given y*

Solve: $x + 3y = 11$ and $y = 2$.

- (A) $x = 5, y = 2$
- (B) $x = 3, y = 2$
- (C) $x = 8, y = 2$

- (D) $x = 2, y = 5$

Question 6 (Level 1) — *Simple elimination*

Solve: $3x + y = 10$ and $3x - y = 8$.

- (A) $x = 3, y = 1$
(B) $x = 3, y = -1$
(C) $x = 1, y = 3$
(D) $x = 2, y = 4$

Question 7 (Level 1) — *Substitution with doubling*

Solve: $y = x + 1$ and $2x + y = 7$.

- (A) $x = 2, y = 3$
(B) $x = 3, y = 2$
(C) $x = 1, y = 5$
(D) $x = 3, y = 4$

Question 8 (Level 1) — *Negative solution*

Solve: $x + y = 2$ and $x - y = 6$.

- (A) $x = 4, y = -2$
(B) $x = -2, y = 4$
(C) $x = 3, y = -1$
(D) $x = 5, y = -3$

Question 9 (Level 1) — *Cost problem*

A pen costs \$2 more than a pencil. Together they cost \$8. Find the cost of each.

- (A) Pencil \$3, pen \$5
(B) Pencil \$4, pen \$4
(C) Pencil \$2, pen \$6
(D) Pencil \$1, pen \$7

Question 10 (Level 1) — *Both equations same form*

Solve: $2x + 3y = 12$ and $2x + y = 8$.

- (A) $x = 3, y = 2$
(B) $x = 2, y = 3$

- (C) $x = 4, y = 0$
- (D) $x = 1, y = 4$

Question 11 (Level 2) — *Elimination with multiplying*

Solve: $3x + 2y = 16$ and $x + y = 7$.

- (A) $x = 2, y = 5$
- (B) $x = 5, y = 2$
- (C) $x = 3, y = 4$
- (D) $x = 4, y = 3$

Question 12 (Level 2) — *Fractional answer*

Solve: $x + 2y = 5$ and $3x + y = 5$.

- (A) $x = 1, y = 2$
- (B) $x = 2, y = 1$
- (C) $x = 5, y = 0$
- (D) $x = 0, y = \frac{5}{2}$

Question 13 (Level 2) — *Both coefficients need multiplying*

Solve: $2x + 3y = 7$ and $3x + 2y = 8$.

- (A) $x = 2, y = 1$
- (B) $x = 1, y = 2$
- (C) $x = 3, y = \frac{1}{3}$
- (D) $x = \frac{7}{2}, y = 0$

Question 14 (Level 2) — *Infinite solutions*

How many solutions does the system $x + y = 3$ and $2x + 2y = 6$ have?

- (A) Infinitely many
- (B) Exactly one
- (C) No solutions
- (D) Exactly two

Question 15 (Level 2) — *No solution (parallel lines)*

How many solutions does the system $x + y = 3$ and $x + y = 5$ have?

- (A) No solutions
- (B) Infinitely many
- (C) Exactly one
- (D) Exactly two

Question 16 (Level 2) — *Negative coefficients*

Solve: $4x - 3y = 11$ and $2x + y = 5$.

- (A) $x = \frac{13}{5}$, $y = -\frac{1}{5}$
- (B) $x = 2$, $y = 1$
- (C) $x = 3$, $y = -1$
- (D) $x = \frac{11}{4}$, $y = 0$

Question 17 (Level 2) — *Ages problem*

Amy is 3 years older than Ben. The sum of their ages is 25. Find their ages.

- (A) Amy 14, Ben 11
- (B) Amy 13, Ben 12
- (C) Amy 15, Ben 10
- (D) Amy 12, Ben 13

Question 18 (Level 2) — *Three-step elimination*

Solve: $5x + 4y = 22$ and $3x + 4y = 14$.

- (A) $x = 4$, $y = \frac{1}{2}$
- (B) $x = 2$, $y = 3$
- (C) $x = 4$, $y = 2$
- (D) $x = 3$, $y = \frac{7}{4}$

Question 19 (Level 2) — *Ticket problem*

Adult tickets cost \$10 and child tickets \$6. 50 tickets sold for \$380. How many adult tickets?

- (A) 20
- (B) 30
- (C) 25
- (D) 15

Question 20 (Level 2) — *Geometric interpretation*

The lines $y = 2x + 1$ and $y = -x + 7$ intersect at which point?

- (A) (2, 5)
- (B) (3, 7)
- (C) (1, 3)
- (D) (2, 3)

Question 21 (Level 3) — *Linear and quadratic*

Solve: $y = x^2$ and $y = x + 2$.

- (A) (2, 4) and (-1, 1)
- (B) (2, 4) only
- (C) (1, 1) and (-2, 4)
- (D) (2, 2) and (-1, -1)

Question 22 (Level 3) — *Line tangent to parabola*

For what value of k is $y = 2x + k$ tangent to $y = x^2$?

- (A) $k = -1$
- (B) $k = 1$
- (C) $k = 0$
- (D) $k = -4$

Question 23 (Level 3) — *Non-linear substitution*

Solve: $x^2 + y^2 = 25$ and $y = x + 1$.

- (A) (3, 4) and (-4, -3)
- (B) (4, 3) and (-3, -4)
- (C) (3, 4) only
- (D) (5, 0) and (0, 5)

Question 24 (Level 3) — *Three unknowns (simple)*

Solve: $x + y + z = 6$, $x = 1$, $y = 2$.

- (A) $x = 1$, $y = 2$, $z = 3$
- (B) $x = 1$, $y = 2$, $z = 6$
- (C) $x = 1$, $y = 2$, $z = 4$
- (D) $x = 1$, $y = 2$, $z = 0$

Question 25 (Level 3) — *System with fractions*

Solve: $\frac{x}{2} + y = 4$ and $x - y = 2$.

(A) $x = 4, y = 2$

(B) $x = 2, y = 4$

(C) $x = 6, y = 1$

(D) $x = 3, y = 1$

Question 26 (Level 3) — *Parabola intersections*

Solve: $y = x^2 - 3x$ and $y = x - 3$.

(A) $(1, -2)$ and $(3, 0)$

(B) $(1, -2)$ only

(C) $(3, 0)$ only

(D) $(-1, -4)$ and $(3, 0)$

Question 27 (Level 3) — *Number of intersections*

How many points of intersection do $y = x^2$ and $y = -1$ have?

(A) 0

(B) 1

(C) 2

(D) Infinitely many

Question 28 (Level 3) — *Mixture problem*

A 20% acid solution is mixed with a 50% acid solution to make 300 mL of 30% acid. How much of each?

(A) 200 mL of 20% and 100 mL of 50%

(B) 150 mL of each

(C) 100 mL of 20% and 200 mL of 50%

(D) 250 mL of 20% and 50 mL of 50%

Question 29 (Level 3) — *System with product*

Solve: $xy = 6$ and $x + y = 5$.

(A) $(2, 3)$ and $(3, 2)$

(B) $(2, 3)$ only

(C) $(1, 6)$ and $(6, 1)$

- (D) No solution

Question 30 (Level 3) — *Distance-speed-time*

A boat travels 20 km upstream in 5 hours and 20 km downstream in 2 hours. Find the speed of the boat in still water and the current speed.

- (A) Boat 7 km/h, current 3 km/h
(B) Boat 10 km/h, current 4 km/h
(C) Boat 5 km/h, current 1 km/h
(D) Boat 8 km/h, current 2 km/h

Question 31 (Level 4) — *Exponential and linear*

Solve: $e^x = 2x + 1$ at $x = 0$. Verify this is a solution.

- (A) Yes, $(0, 1)$ is a solution
(B) No, $e^0 = 0$ so it fails
(C) Yes, $(0, 0)$ is a solution
(D) No, $2(0) + 1 = 2$

Question 32 (Level 4) — *Log and linear system*

Solve $\log_e(x) = 2 - x$ using CAS. How many solutions are there?

- (A) Exactly one solution
(B) No solutions
(C) Exactly two solutions
(D) Infinitely many solutions

Question 33 (Level 4) — *Circle and line*

Find the points of intersection of $x^2 + y^2 = 10$ and $y = 3x$.

- (A) $(1, 3)$ and $(-1, -3)$
(B) $(1, 3)$ only
(C) $(3, 1)$ and $(-3, -1)$
(D) $(\sqrt{10}, 0)$ and $(0, \sqrt{10})$

Question 34 (Level 4) — *Two parabolas*

Find the intersection points of $y = x^2$ and $y = 2x^2 - 3$.

- (A) $(\sqrt{3}, 3)$ and $(-\sqrt{3}, 3)$
(B) $(3, 9)$ and $(-3, 9)$

(C) $(\sqrt{3}, \sqrt{3})$ and $(-\sqrt{3}, -\sqrt{3})$

(D) No intersection

Question 35 (Level 4) — *Trig system*

Solve $\sin(x) = \cos(x)$ for $x \in [0, 2\pi]$.

(A) $x = \frac{\pi}{4}, \frac{5\pi}{4}$

(B) $x = \frac{\pi}{4}$ only

(C) $x = \frac{\pi}{4}, \frac{3\pi}{4}$

(D) $x = 0, \pi$

Question 36 (Level 4) — *Exponential system*

Solve: $2^x = 8^y$ and $x + y = 4$.

(A) $x = 3, y = 1$

(B) $x = 1, y = 3$

(C) $x = 2, y = 2$

(D) $x = 4, y = 0$

Question 37 (Level 4) — *Finding parameters*

The line $y = mx + c$ passes through $(1, 5)$ and $(3, 11)$. Find m and c .

(A) $m = 3, c = 2$

(B) $m = 2, c = 3$

(C) $m = 4, c = 1$

(D) $m = 3, c = -1$

Question 38 (Level 4) — *Hyperbola and line*

Find the intersections of $y = \frac{4}{x}$ and $y = x + 3$.

(A) $(1, 4)$ and $(-4, -1)$

(B) $(4, 1)$ and $(-1, -4)$

(C) $(1, 4)$ only

(D) $(2, 2)$ and $(-2, -2)$

Question 39 (Level 4) — *Investment problem*

Jane invests \$10,000 in two accounts earning 5% and 8% annually. Total interest is \$680.

How much in each?

- (A) \$4,000 at 5% and \$6,000 at 8%
- (B) \$5,000 at each
- (C) \$6,000 at 5% and \$4,000 at 8%
- (D) \$3,000 at 5% and \$7,000 at 8%

Question 40 (Level 4) — *Discriminant analysis*

For what values of m does the line $y = mx$ intersect $y = x^2 + 1$ at exactly one point?

- (A) $m = 2$ or $m = -2$
- (B) $m = 2$ only
- (C) $m = 4$ or $m = -4$
- (D) $m = 1$ or $m = -1$

Question 41 (Level 5) — *Exponential-linear intersection count*

How many solutions does $e^x = kx$ have when $k = e$?

- (A) Exactly one (tangent at $x = 1$)
- (B) Exactly two
- (C) No solutions
- (D) Infinitely many

Question 42 (Level 5) — *Non-linear system*

Solve: $x^2 + y^2 = 13$ and $x^2 - y = 1$.

- (A) $(2, 3)$ and $(-2, 3)$
- (B) $(2, 3), (-2, 3), (\sqrt{3}, -4), (-\sqrt{3}, -4)$
- (C) $(3, 2)$ and $(-3, 2)$
- (D) $(2, 3)$ only

Question 43 (Level 5) — *System with log*

Solve: $\log_2(x) + \log_2(y) = 5$ and $\log_2(x) - \log_2(y) = 1$.

- (A) $x = 8, y = 4$
- (B) $x = 4, y = 8$
- (C) $x = 16, y = 2$
- (D) $x = 32, y = 1$

Question 44 (Level 5) — *Cubic and linear*

Find all intersections of $y = x^3 - 4x$ and $y = 0$.

- (A) $(0, 0), (2, 0), (-2, 0)$
- (B) $(0, 0)$ and $(4, 0)$
- (C) $(0, 0)$ and $(2, 0)$
- (D) $(2, 0)$ and $(-2, 0)$ only

Question 45 (Level 5) — *Parameter for no intersection*

For what values of k does $y = x^2 + k$ and $y = 2x - 1$ have no intersection?

- (A) $k > 0$
- (B) $k < 0$
- (C) $k > 1$
- (D) $k = 0$

Question 46 (Level 5) — *Exponential system*

Solve: $2^x \cdot 4^y = 32$ and $2^x \div 2^y = 4$.

- (A) $x = 3, y = 1$
- (B) $x = 5, y = 0$
- (C) $x = 1, y = 2$
- (D) $x = 4, y = \frac{1}{2}$

Question 47 (Level 5) — *System with trig*

Solve $2 \sin(x) = 1$ and $\cos(x) > 0$ for $x \in [0, 2\pi]$.

- (A) $x = \frac{\pi}{6}$
- (B) $x = \frac{\pi}{6}$ and $x = \frac{5\pi}{6}$
- (C) $x = \frac{\pi}{3}$
- (D) $x = \frac{5\pi}{6}$

Question 48 (Level 5) — *CAS-style problem*

The curves $y = e^x$ and $y = 4 - x^2$ intersect. Use technology to find the positive x -value correct to 3 decimal places.

- (A) $x \approx 1.058$
- (B) $x \approx 1.386$
- (C) $x \approx 0.693$

- (D) $x \approx 1.500$

Question 49 (Level 5) — *Three-variable system*

Solve: $x + y + z = 6$, $2x - y + z = 3$, $x + 2y - z = 3$.

(A) $x = \frac{9}{7}$, $y = \frac{15}{7}$, $z = \frac{18}{7}$

(B) $x = 1$, $y = 2$, $z = 3$

(C) $x = 2$, $y = 1$, $z = 3$

(D) $x = \frac{3}{2}$, $y = 2$, $z = \frac{5}{2}$

Question 50 (Level 5) — *Finding equation of a parabola*

A parabola $y = ax^2 + bx + c$ passes through $(0, 1)$, $(1, 4)$, and $(-1, 2)$. Find a , b , and c .

(A) $a = 2$, $b = 1$, $c = 1$

(B) $a = 1$, $b = 2$, $c = 1$

(C) $a = 2$, $b = -1$, $c = 1$

(D) $a = 3$, $b = 0$, $c = 1$

Solutions

Q1: (A)

Adding: $2x = 6 \Rightarrow x = 3$. Substituting: $3 + y = 5 \Rightarrow y = 2$.

Q2: (A)

$x + 2x = 6 \Rightarrow 3x = 6 \Rightarrow x = 2$. Then $y = 2(2) = 4$.

Q3: (A)

Subtracting: $x = 3$. Then $3 + y = 4 \Rightarrow y = 1$.

Q4: (A)

$x + y = 10$ and $x - y = 4$. Adding: $2x = 14 \Rightarrow x = 7$, $y = 3$.

Q5: (A)

$x + 3(2) = 11 \Rightarrow x + 6 = 11 \Rightarrow x = 5$.

Q6: (A)

Adding: $6x = 18 \Rightarrow x = 3$. Then $9 + y = 10 \Rightarrow y = 1$.

Q7: (A)

$2x + (x + 1) = 7 \Rightarrow 3x = 6 \Rightarrow x = 2$, $y = 3$.

Q8: (A)

Adding: $2x = 8 \Rightarrow x = 4$. Then $4 + y = 2 \Rightarrow y = -2$.

Q9: (A)

$x + (x + 2) = 8 \Rightarrow 2x = 6 \Rightarrow x = 3$. Pencil = \$3, pen = \$5.

Q10: (A)

Subtracting: $2y = 4 \Rightarrow y = 2$. Then $2x + 2 = 8 \Rightarrow x = 3$.

Q11: (A)

Multiply eq2 by 2: $2x + 2y = 14$. Subtract from eq1: $x = 2$. Then $2 + y = 7 \Rightarrow y = 5$.

Q12: (A)

From eq1: $x = 5 - 2y$. Sub into eq2: $3(5 - 2y) + y = 5 \Rightarrow 15 - 5y = 5 \Rightarrow y = 2$, $x = 1$.

Q13: (A)

$6x + 9y = 21$ and $6x + 4y = 16$. Subtracting: $5y = 5 \Rightarrow y = 1$. Then $2x + 3 = 7 \Rightarrow x = 2$.

Q14: (A)

$2x + 2y = 6$ simplifies to $x + y = 3$, same as eq1. Infinitely many solutions.

Q15: (A)

The lines $x + y = 3$ and $x + y = 5$ are parallel. No solutions.

Q16: (A)

$4x - 3(5 - 2x) = 11 \Rightarrow 4x - 15 + 6x = 11 \Rightarrow 10x = 26 \Rightarrow x = \frac{13}{5}$. Then $y = 5 - \frac{26}{5} = -\frac{1}{5}$.

Q17: (A)

$b + (b + 3) = 25 \Rightarrow 2b = 22 \Rightarrow b = 11$. Ben is 11, Amy is 14.

Q18: (A)

Subtracting: $2x = 8 \Rightarrow x = 4$. Then $20 + 4y = 22 \Rightarrow y = \frac{1}{2}$.

Q19: (A)

$10a + 6(50 - a) = 380 \Rightarrow 10a + 300 - 6a = 380 \Rightarrow 4a = 80 \Rightarrow a = 20$.

Q20: (A)

$2x + 1 = -x + 7 \Rightarrow 3x = 6 \Rightarrow x = 2$, $y = 5$.

Q21: (A)

$x^2 = x + 2 \Rightarrow x^2 - x - 2 = 0 \Rightarrow (x - 2)(x + 1) = 0$. So $x = 2$, $y = 4$ or $x = -1$, $y = 1$.

Q22: (A)

$x^2 - 2x - k = 0$. Discriminant = $4 + 4k = 0 \Rightarrow k = -1$.

Q23: (A)

$x^2 + (x + 1)^2 = 25 \Rightarrow 2x^2 + 2x - 24 = 0 \Rightarrow x^2 + x - 12 = 0 \Rightarrow (x + 4)(x - 3) = 0$. So $(3, 4)$ and $(-4, -3)$.

Q24: (A)

$$1 + 2 + z = 6 \Rightarrow z = 3.$$

Q25: (A)

$$\frac{y+2}{2} + y = 4 \Rightarrow \frac{y+2+2y}{2} = 4 \Rightarrow 3y + 2 = 8 \Rightarrow y = 2, x = 4.$$

Q26: (A)

$$x^2 - 4x + 3 = 0 \Rightarrow (x - 1)(x - 3) = 0. x = 1, y = -2 \text{ or } x = 3, y = 0.$$

Q27: (A)

$x^2 = -1$ has no real solutions. Zero points of intersection.

Q28: (A)

$$x + y = 300 \text{ and } 0.2x + 0.5y = 90. \text{ From eq1: } x = 300 - y. 0.2(300 - y) + 0.5y = 90 \Rightarrow 60 + 0.3y = 90 \Rightarrow y = 100, x = 200.$$

Q29: (A)

$$x(5 - x) = 6 \Rightarrow x^2 - 5x + 6 = 0 \Rightarrow (x - 2)(x - 3) = 0. (x, y) = (2, 3) \text{ or } (3, 2).$$

Q30: (A)

$$b - c = 4 \text{ and } b + c = 10. \text{ Adding: } 2b = 14 \Rightarrow b = 7, c = 3.$$

Q31: (A)

At $x = 0$: $e^0 = 1$ and $2(0) + 1 = 1$. Both equal 1, so $x = 0$ is a solution. The point is $(0, 1)$.

Q32: (A)

$y = \ln(x)$ is increasing (concave down) and $y = 2 - x$ is decreasing. They intersect exactly once (around $x \approx 1.557$).

Q33: (A)

$$x^2 + 9x^2 = 10 \Rightarrow 10x^2 = 10 \Rightarrow x = \pm 1. \text{ Points: } (1, 3) \text{ and } (-1, -3).$$

Q34: (A)

$$x^2 = 2x^2 - 3 \Rightarrow x^2 = 3 \Rightarrow x = \pm\sqrt{3}. \text{ Points: } (\sqrt{3}, 3) \text{ and } (-\sqrt{3}, 3).$$

Q35: (A)

$$\tan(x) = 1 \Rightarrow x = \frac{\pi}{4} \text{ or } x = \frac{5\pi}{4}.$$

Q36: (A)

$$2^x = 2^{3y} \Rightarrow x = 3y. \text{ With } x + y = 4: 3y + y = 4 \Rightarrow y = 1, x = 3.$$

Q37: (A)

$$m + c = 5 \text{ and } 3m + c = 11. \text{ Subtracting: } 2m = 6 \Rightarrow m = 3, c = 2.$$

Q38: (A)

$$\frac{4}{x} = x + 3 \Rightarrow 4 = x^2 + 3x \Rightarrow x^2 + 3x - 4 = 0 \Rightarrow (x + 4)(x - 1) = 0. \text{ Points: } (1, 4) \text{ and } (-4, -1).$$

Q39: (A)

$$0.05(10000 - y) + 0.08y = 680 \Rightarrow 500 + 0.03y = 680 \Rightarrow y = 6000, x = 4000.$$

Q40: (A)

$$x^2 - mx + 1 = 0. \Delta = m^2 - 4 = 0 \Rightarrow m = \pm 2.$$

Q41: (A)

Let $f(x) = e^x - ex$. $f'(x) = e^x - e = 0 \Rightarrow x = 1$. $f(1) = e - e = 0$, so the curves are tangent at $x = 1$. Exactly one solution.

Q42: (A)

$$(y + 1) + y^2 = 13 \Rightarrow y^2 + y - 12 = 0 \Rightarrow (y + 4)(y - 3) = 0. y = 3: x^2 = 4, x = \pm 2. y = -4: x^2 = -3 \text{ (no real). Solutions: } (2, 3) \text{ and } (-2, 3).$$

Q43: (A)

$$u + v = 5 \text{ and } u - v = 1. \text{ Adding: } 2u = 6 \Rightarrow u = 3, v = 2. \text{ So } x = 2^3 = 8, y = 2^2 = 4.$$

Q44: (A)

$$x(x - 2)(x + 2) = 0 \Rightarrow x = 0, 2, -2. \text{ Points: } (0, 0), (2, 0), (-2, 0).$$

Q45: (A)

$$x^2 - 2x + (k + 1) = 0. \Delta = 4 - 4(k + 1) = -4k < 0 \Rightarrow k > 0.$$

Q46: (A)

$x + 2y = 5$ and $x - y = 2$. Subtracting: $3y = 3 \Rightarrow y = 1$, $x = 3$.

Q47: (A)

$\sin(x) = \frac{1}{2} \Rightarrow x = \frac{\pi}{6}$ or $x = \frac{5\pi}{6}$. $\cos\left(\frac{\pi}{6}\right) > 0 \checkmark$, $\cos\left(\frac{5\pi}{6}\right) < 0$. So $x = \frac{\pi}{6}$.

Q48: (A)

Solving $e^x = 4 - x^2$ numerically: $x \approx 1.058$ (positive root).

Q49: (A)

Eq1 + eq3: $2x + 3y = 9$. Eq2 + eq3: $3x + y = 6 \Rightarrow y = 6 - 3x$. Sub: $2x + 3(6 - 3x) = 9 \Rightarrow -7x = -9 \Rightarrow x = \frac{9}{7}$, $y = \frac{15}{7}$, $z = \frac{18}{7}$.

Q50: (A)

(0, 1): $c = 1$. (1, 4): $a + b + 1 = 4 \Rightarrow a + b = 3$. (-1, 2): $a - b + 1 = 2 \Rightarrow a - b = 1$. Adding: $2a = 4 \Rightarrow a = 2$, $b = 1$.