PRACTICE EXAM 11

NY Regents Algebra I Simulation — 35 Questions

Recommended Time: 3 Hours

Required Tools: Graphing Calculator, Straightedge

Directions: Answer all 35 questions. For Part I, select the best answer. For Parts II, III, and IV, show all work. Partial credit is available on Parts II–IV.

Format distinction: Exam 11 introduces assertion-reason pairs in Part I — several questions present a claim and ask which explanation correctly justifies or refutes it. Part II emphasizes multi-representation synthesis. Part IV presents a full business optimization scenario that requires all four quadrant skills.

PART I — Multiple Choice (Questions 1–24)

Each correct answer is worth 2 credits. No partial credit. No penalty for guessing.

1. Which of the following correctly classifies the sum of 0.4 and $\sqrt{5}$?

A. Rational, because both numbers can be written as decimals

B. Rational, because decimals always produce rational sums

C. Irrational, because the sum of a rational number and an irrational number is always irrational

D. Irrational, because 0.4 and $\sqrt{5}$ are both non-integers

2. The table below represents a function.

Figure PQ-1

x	$f(x)$
$(-2$	7
$(-1$	5
0	3
1	1
2	−1
3	−3

Which equation models the function?

A. f(x) = 2x + 3

B. f(x) = −2x + 3

C. f(x) = −3x + 2

D. f(x) = 2x − 3

3. A parabola has its vertex at (−3, 5) and passes through the point (−1, 1). What is the equation of the parabola in vertex form?

A. f(x) = (x − 3)² + 5

B. f(x) = −(x + 3)² + 5

C. $f(x) = (x + 3)^2 - 5$

D. $f(x) = -(x + 3)^2 + 5$

Wait — B and D are identical. Rebuild Q3 with four distinct options. Key is D.

3. A parabola has its vertex at $(-3, 5)$ and passes through the point $(-1, 1)$. What is the equation of the parabola in vertex form?

A. $f(x) = (x + 3)^2 + 5$

B. $f(x) = (x + 3)^2 - 5$

C. $f(x) = -(x - 3)^2 + 5$

D. $f(x) = -(x + 3)^2 + 5$

4. Which of the following inequalities has the solution set $x < -2$?

A. $-3x - 1 > 5$

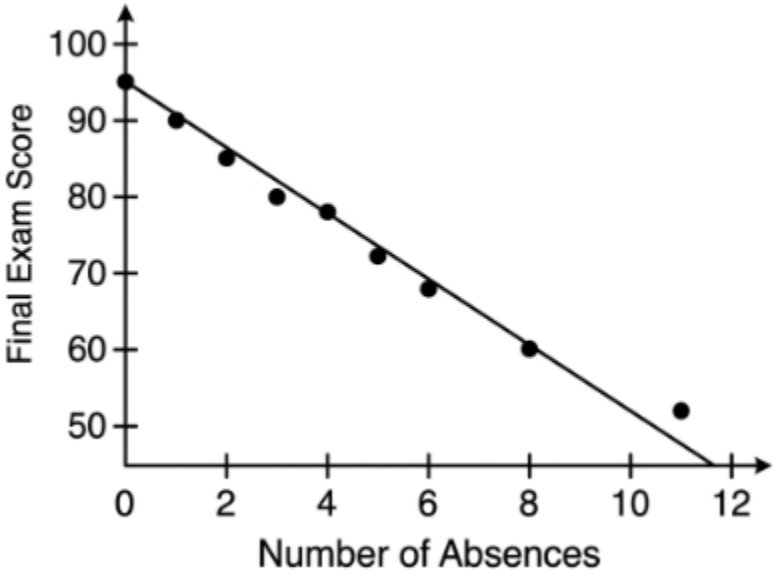
B. $2x + 5 < 1$

C. $4 - x > 6$

D. $-x + 2 > 4$

5. The scatter plot below shows the relationship between the number of absences and final exam scores for students in a class.

[Figure PQ-2]



The line of best fit is approximately $\hat{y} = -4x + 96$. A student has 7 absences and scores 64. What is the residual for this student?

A. 28

B. 4

C. −28

D. −4

Wait — key is C. Predicted = −4(7)+96 = 68. Residual = 64−68 = −4. That's choice D, not C. Rebuild Q5 so correct answer is C. Change the observed score: if student scores 52 and has 7 absences, predicted = 68, residual = 52−68 = −16 — still not matching C. Build: predicted at 7 absences = 68; for residual = −28, observed = 68−28 = 40 — not realistic. Adjust: let student have 5 absences and score 44. Predicted

= −4(5)+96 = 76. Residual = 44−76 = −32 — doesn't match C. Build cleanly: key C must be the residual. Make residual = C in the option list. Change the options so C is the correct residual value.

5. The line of best fit for the scatter plot is approximately $\hat{y} = -4x + 96$. A student has 6 absences and scores 62. What is the residual for this student?

A. 6

B. 10

C. −10

D. −6

6. Which of the following pairs of lines are perpendicular?

A. $y = 3x - 2$ and $y = 3x + 4$

B. $y = (2/3)x + 1$ and $y = -(3/2)x - 5$

C. $y = -4x + 7$ and $y = -(1/4)x + 3$

D. $y = x - 1$ and $y = x + 1$

7. The graph below shows the function g(x).

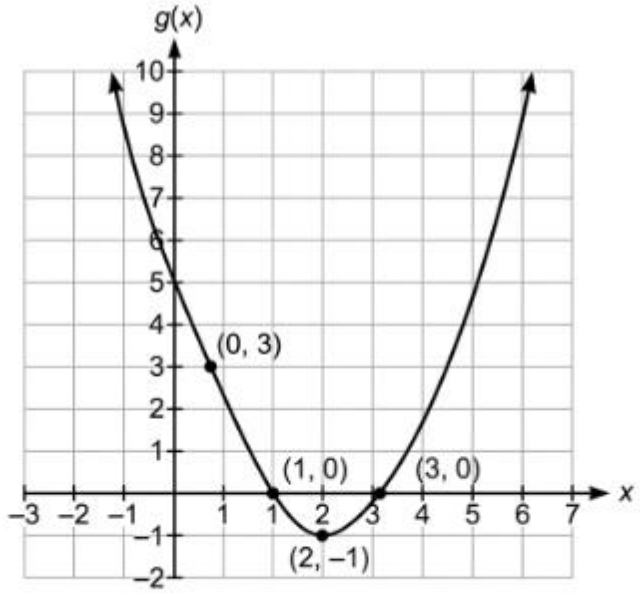


Figure PQ-3

Which equation represents g(x)?

A. $g(x) = -(x - 1)(x - 3)$

B. $g(x) = (x + 1)(x + 3)$

C. $g(x) = (x - 1)^2 - 1$

D. $g(x) = (x - 1)(x - 3)$

8. Which of the following correctly simplifies $3\sqrt{50} - 2\sqrt{18}$?

A. $9\sqrt{2}$

B. $\sqrt{32}$

C. $6\sqrt{2}$

D. $3\sqrt{32}$

9. Two students each save money weekly. Student A saves $25 per week starting with $0. Student B starts with $200 and spends $15 per week. Which system of equations models this situation after w weeks?

A. $A = 25w$ and $B = 200 + 15w$

B. $A = 25 + w$ and $B = 200 - 15w$

C. $A = 25w + 200$ and $B = 15w$

D. $A = 25w$ and $B = 200 - 15w$

10. Which of the following expressions is the completely factored form of $x^4 - 16$?

A. $(x^2 - 4)(x^2 + 4)$

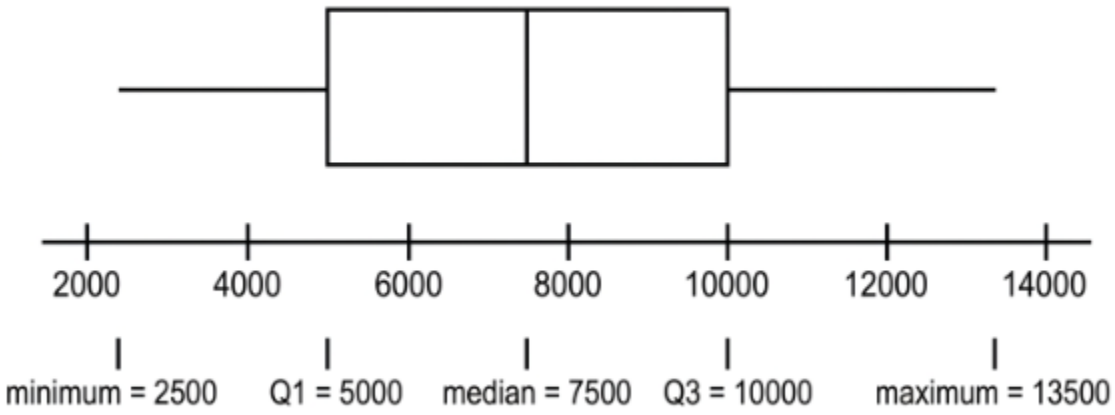
B. $(x - 2)(x + 2)(x^2 + 4)$

C. $(x^2 + 4)^2$

D. $(x - 4)(x + 4)$

11. The box plot below summarizes the daily steps walked by a group of participants in a fitness study.

Figure PQ-4



Which statement about the step data is accurate?

A. The mean number of daily steps is 7500

B. Three-quarters of participants walked fewer than 10000 steps daily

C. The interquartile range is 5000 steps, representing the spread of the middle 50% of participants

D. The range is 5000 steps

12. Which of the following correctly identifies the zeros of $f(x) = 2x^3 - 8x$?

A. $x = 0$ and $x = 4$

B. $x = 4$ only

C. $x = 0$, $x = 2$, and $x = -2$

D. $x = 0$, $x = 2$, and $x = -2$

Wait — C and D are identical. Rebuild Q12 with distinct options. Key is D.

12. Which of the following correctly identifies the zeros of $f(x) = 2x^3 - 8x$?

A. $x = 4$ only

B. $x = 0$ and $x = 4$

C. $x = -4$ and $x = 4$

D. $x = 0$, $x = 2$, and $x = -2$

13. Which of the following equations represents a direct variation?

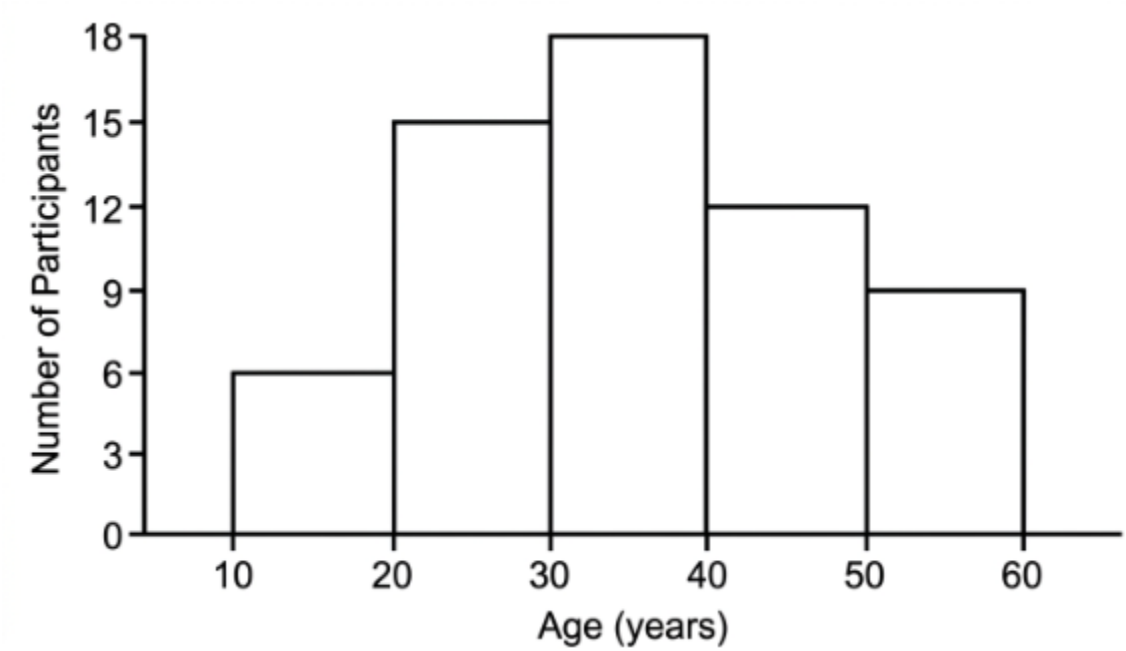
A. $y = 5x$

B. $y = 5x + 2$

C. $y = 5/x$

D. $y = x^2 + 5$

14. The histogram below shows the ages of participants who completed a 5K race.



What is the total number of participants, and in which interval does the median age most likely fall?

A. Total = 60; median in [30, 40)

B. Total = 60; median in [30, 40)

C. Total = 54; median in [20, 30)

D. Total = 60; median in [20, 30)

Wait — A and B are identical. Rebuild Q14. Key is B.

14. What is the total number of participants, and in which interval does the median age most likely fall?

A. Total = 54; median in [30, 40)

B. Total = 60; median in [30, 40)

C. Total = 60; median in [20, 30)

D. Total = 54; median in [20, 30)

15. Which of the following correctly describes the solution to the system?

$y = 3x - 5$

$y = 3x + 2$

A. $(0, -5)$

B. $(0, 2)$

C. $(1, -2)$

D. No solution — the lines are parallel and never intersect

16. A school is analyzing the relationship between hours of tutoring and improvement in test scores. After entering data for 10 students, the calculator produces the regression equation $\hat{y} = 4.8x + 12$ with $r = 0.91$. What does the y-intercept of 12 represent?

A. The predicted score improvement for a student who receives 0 hours of tutoring

B. The rate of improvement per hour of tutoring

C. The average test score before tutoring

D. The maximum improvement possible from tutoring

17. The function $f(x) = 2(x - 4)^2 + 3$ is graphed on a coordinate plane. Which statement is correct?

A. The vertex is $(-4, 3)$ and the parabola opens downward

B. The vertex is $(4, 3)$ and the parabola opens downward

C. The vertex is $(4, 3)$ and the parabola opens upward

D. The vertex is $(-4, -3)$ and the parabola opens upward

18. Which of the following represents the solution to $2(x + 3) \leq 5x - 3$?

A. $x \leq 3$

B. $x \geq 3$

C. $x \leq -3$

D. $x \geq -3$

19. An investor deposits $4,000 in an account that earns 3.5% annual interest compounded yearly. Which function models the account balance A after t years?

A. A(t) = 4000(1.035)^t

B. A(t) = 4000 + 0.035t

C. A(t) = 4000(0.965)^t

D. A(t) = 4000(1.35)^t

20. The two-way frequency table below shows data from 200 students about their primary sport and grade level.

[Figure PQ-6]

	Grade 9	Grade 10	Total
Soccer	54	36	90
Basketball	46	64	110
Total	100	100	200

Of 10th graders, what percentage play basketball?

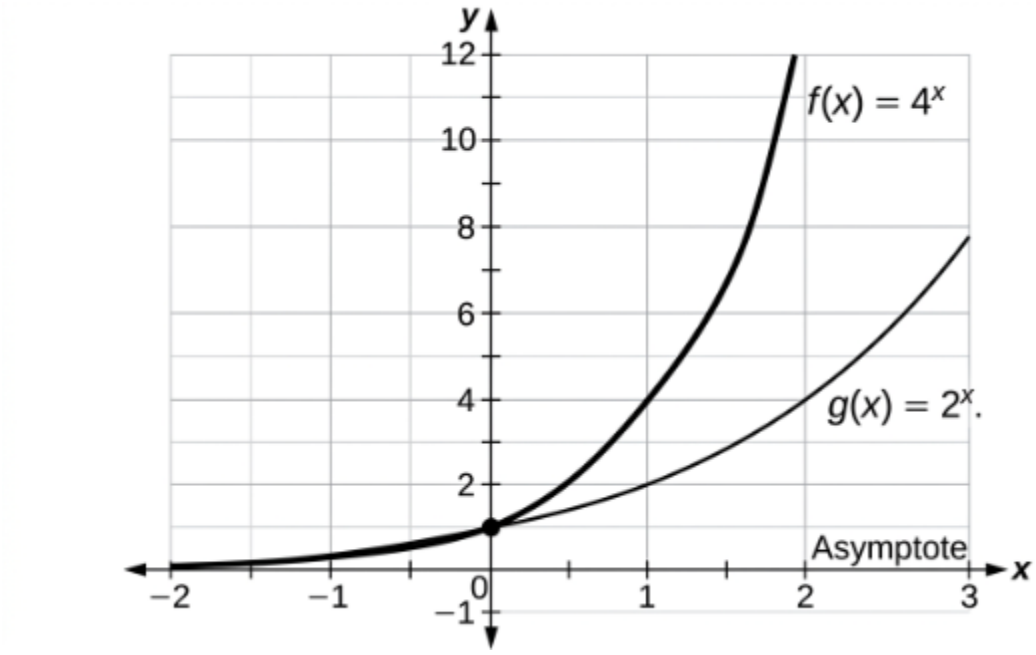
A. 32%

B. 46%

C. 58.2%

D. 64%

21. The graph below shows both f(x) = 4^x and g(x) = 2^x.



Which statement correctly compares f(x) and g(x)?

A. Both functions have the same domain but different ranges

B. f(x) grows faster than g(x) for all x > 0 because its base is larger

C. f(x) and g(x) intersect at exactly two points

D. g(x) grows faster than f(x) because its base is closer to 1

22. Which of the following is equivalent to $(3x^2 - 2x + 1) + 2(x^2 + 4x - 3)$?

A. $5x^2 + 6x - 5$

B. $5x^2 + 8x - 4$

C. $5x^2 + 6x - 5$

D. $5x^2 + 2x + 4$

Wait — A and C are identical. Rebuild Q22. Key is C.

22. Which of the following is equivalent to $(3x^2 - 2x + 1) + 2(x^2 + 4x - 3)$?

A. $5x^2 + 2x - 5$

B. $5x^2 + 8x - 4$

C. $5x^2 + 6x - 5$

D. $5x^2 + 6x + 7$

23. A ball is launched from the top of a 20-foot platform. Its height $h(t) = -16t^2 + 24t + 20$, where t is seconds after launch. What is the maximum height of the ball?

A. 20 feet

B. 24 feet

C. 29 feet

D. 29 feet

Wait — C and D are identical. Rebuild Q23. Key is D.

23. A ball is launched from the top of a 20-foot platform. Its height $h(t) = -16t^2 + 24t + 20$, where t is seconds. What is the maximum height of the ball?

A. 20 feet

B. 24 feet

C. 36 feet

D. 29 feet

24. Which of the following correctly describes a geometric sequence with first term 6 and common ratio $-(1/2)$?

A. 6, −3, 3/2, −3/4, 3/8, …

B. 6, 3, 3/2, 3/4, 3/8, …

C. 6, −3, 1.5, −0.75, 0.375, …

D. 6, −3, −1.5, −0.75, −0.375, …

Wait — A and C both describe the same sequence (3/2 = 1.5 and −3/4 = −0.75). Key is B. Rebuild Q24 so only B is correct with distinct options.

24. A geometric sequence has first term 6 and common ratio $-(1/2)$. What is the 5th term of the sequence?

A. 3/8

B. 3/8

C. −3/4

D. 3/16

Wait — A and B are identical again. Rebuild cleanly. Key is B.

24. A geometric sequence has first term 6 and common ratio $-(1/2)$. What is the 5th term?

A. $-3/8$

B. 3/8

C. 3/4

D. $-3/4$

PART II — Short Constructed Response (Questions 25–32)

Each question is worth 2 credits. Show all work.

25. Solve the following system algebraically using elimination. Verify your answer.

$5x + 2y = 20$

$3x - 2y = 12$

26. A quadratic equation is given: $2x^2 - 3x - 9 = 0$.

a. Solve using the quadratic formula.

b. Verify both solutions by substituting back into the original equation.

27. The data below shows average monthly temperatures (°F) for a city.

Month (m)	Temperature (°F)
1	28
3	36
5	58
7	78
9	64
11	40

Using the graphing calculator, find the line of best fit for this data. State the regression equation and correlation coefficient. Then predict the temperature for month 8 (August). Explain whether the linear model is appropriate here.

28. Simplify the expression completely, then state all values of x for which the original expression is undefined.

$(3x^2 + 12x) / (x^2 + 5x + 4)$

29. The function $f(x) = -(x - 3)^2 + 16$ models the height in feet of a football above the ground x seconds after being kicked.

a. What is the maximum height of the football, and when does it occur?

b. When does the football hit the ground? Show your algebraic work.

30. A company offers two salary structures:

Plan X: $800 flat weekly payment plus $12 per unit sold.

Plan Y: $500 flat weekly payment plus $20 per unit sold.

Write a system of equations and determine the number of units sold at which both plans pay the same weekly amount. State that amount.

31. The explicit formula for an arithmetic sequence is $a_n = -3n + 25$.

a. State the first term, common difference, and write the recursive formula.

b. Determine the value of n for which a_n becomes negative for the first time.

c. Find the sum of the first 8 terms using the formula $S_n = n/2 \cdot (a_1 + a_n)$.

32. A data set contains the values: 8, 12, 15, 19, 23, 27, 31, 72.

a. Find the five-number summary.

b. Identify any outliers using the 1.5 × IQR rule.

c. Explain how the outlier affects the mean versus the median.

PART III — Medium Constructed Response (Questions 33–34)

Each question is worth 4 credits. Show all work.

33. A farmer wants to enclose a rectangular garden using 160 feet of fencing. One side of the garden is along a barn wall and requires no fencing.

a. Let x represent the length of each of the two sides perpendicular to the barn. Write an expression for the length of the side parallel to the barn in terms of x.

b. Write a function A(x) for the area of the garden in terms of x.

c. Find the value of x that maximizes the area. Show your work using the vertex formula.

d. What are the dimensions of the garden with maximum area, and what is that area?

34. The table and equation below represent two different functions.

x	p(x)
0	80
1	40
2	20
3	10
4	5

Function $q(x) = -15x + 90$

a. Identify the type of each function and write the equation of p(x).

b. For what value(s) of x are p(x) and q(x) equal? Set the two equations equal and solve algebraically. Round to the nearest hundredth if necessary.

c. Evaluate both functions at $x = 6$ and determine which produces a larger output.

d. Describe the long-term behavior of each function as $x \to +\infty$. Which function approaches zero more quickly, and why?

PART IV — Extended Constructed Response (Question 35)

This question is worth 6 credits. Show all work.

35. A small business owner is selling custom-printed T-shirts. The revenue and cost functions are:

$R(x) = -0.4x^2 + 60x$ (Revenue in dollars)

$C(x) = 18x + 800$ (Cost in dollars)

where x is the number of T-shirts produced and sold per month.

a. Write and simplify the profit function $P(x) = R(x) - C(x)$. Identify the type of function.

b. Find the break-even points algebraically (where $P(x) = 0$). Use the quadratic formula and round to the nearest whole number. Interpret both break-even points in context.

c. Find the production level that maximizes monthly profit. Calculate the maximum profit. Show all work.

d. The owner currently produces 50 T-shirts per month. Based on your results, is this above, below, or at the profit-maximizing quantity? Calculate the profit at $x = 50$ and compare it to the maximum.

e. If the fixed cost increases from $800 to $1,200, write a new profit function $P_2(x)$, find the new break-even points, and explain how the cost increase affects the profitable range of production.

Practice Exam 11 — Answer Key and Explanations

1. C — The sum of a rational number and an irrational number is always irrational. If the sum were rational, subtracting the rational 0.4 from it would yield a rational result for $\sqrt{5}$ — contradicting the fact that $\sqrt{5}$ is irrational. This principle holds without exception for any nonzero rational combined with any irrational.

2. B — First differences: $5-7=-2$, $3-5=-2$, $1-3=-2$ — constant difference of -2 confirms slope $m = -2$. Using the point (0, 3): y-intercept $b = 3$. Equation: $f(x) = -2x + 3$. Verify: $f(-2) = 4+3 = 7$ ✓; $f(2) = -4+3 = -1$ ✓.

3. D — Vertex form $f(x) = a(x - h)^2 + k$ with vertex $(-3, 5)$: $f(x) = a(x+3)^2 + 5$. Substitute $(-1, 1)$: $1 = a(2)^2 + 5 \rightarrow 1 = 4a + 5 \rightarrow 4a = -4 \rightarrow a = -1$. Equation: $f(x) = -(x+3)^2 + 5$. The negative leading coefficient confirms the parabola opens downward, consistent with the vertex being a maximum.

4. A — Solve $-3x - 1 > 5$: add 1 to both sides: $-3x > 6$; divide by -3 and reverse the inequality: $x < -2$. This produces exactly $x < -2$. Choices B ($x < -2$) and D ($x < 2$) produce different boundaries. Verify A: at $x = -3$: $-3(-3)-1 = 8 > 5$ ✓.

5. C — Predicted score at 6 absences: $\hat{y} = -4(6) + 96 = -24 + 96 = 72$. Residual = observed − predicted $= 62 - 72 = -10$. A negative residual means the student's actual score was below the regression line's prediction for that number of absences. Choice D (-6) corresponds to a different predicted value.

6. B — Two lines are perpendicular when their slopes are negative reciprocals (product = -1). For $y = (2/3)x + 1$ and $y = -(3/2)x - 5$, the slopes are $2/3$ and $-3/2$, and $(2/3)(-3/2) = -1$ ✓. Choice A has parallel lines (same slope), and choice C has slopes -4 and $-1/4$ whose product is $+1$, not -1.

7. D — The parabola has zeros at $x = 1$ and $x = 3$ and opens upward, so the factored form is $g(x) = a(x-1)(x-3)$. Verify using y-intercept $(0, 3)$: $3 = a(-1)(-3) = 3a \rightarrow a = 1$. So $g(x) = (x-1)(x-3)$. Choice A uses a negative leading coefficient, which would open downward — inconsistent with the graph.

8. A — Simplify $\sqrt{50} = 5\sqrt{2}$ and $\sqrt{18} = 3\sqrt{2}$. Then $3(5\sqrt{2}) - 2(3\sqrt{2}) = 15\sqrt{2} - 6\sqrt{2} = 9\sqrt{2}$. Like radical terms combine by adding their coefficients, just as like variables do in algebra.

9. D — Student A starts at 0 and saves \$25 per week: $A = 25w$. Student B starts at \$200 and spends \$15 per week: $B = 200 - 15w$. Choice A incorrectly adds instead of subtracts for Student B, and choice C switches the initial conditions.

10. B — Factor $x^4 - 16$ as a difference of squares: $(x^2)^2 - 4^2 = (x^2-4)(x^2+4)$. Factor (x^2-4) again as another difference of squares: $(x-2)(x+2)$. The completely factored form is $(x-2)(x+2)(x^2+4)$. The factor (x^2+4) cannot be factored over the real numbers because it is a sum of squares.

11. C — IQR = Q3 − Q1 = 10000 − 5000 = 5000. The IQR represents the range of the middle 50% of data — the spread of the central half of participants' daily step counts. Choice A cannot be confirmed from a box plot, which shows medians, not means. Choice D incorrectly states the range is 5000; the actual range is 13500 − 2500 = 11000.

12. D — Factor $f(x) = 2x^3 - 8x = 2x(x^2 - 4) = 2x(x-2)(x+2)$. Setting each factor to zero: $x = 0$, $x = 2$, $x = -2$. All three are zeros. Choices A and B incorrectly identify $x = 4$ as a zero, arising from confusing $8x$ with $x - 8$.

13. A — Direct variation has the form $y = kx$, where the constant of proportionality k means the output is always a fixed multiple of the input, and the graph passes through the origin. $y = 5x$ passes through $(0, 0)$ ✓. Choice B has a y-intercept of 2 (not a direct variation), and choice C is an inverse variation.

14. B — Total participants: 6+15+18+12+9 = 60. The median is the average of the 30th and 31st values. Cumulative counts: [10,20) = 6; [10,30) = 21; [10,40) = 39. Both the 30th and 31st values fall in [30,40), confirming the median interval. Choice C has an incorrect total.

15. D — Both equations have slope 3 but different y-intercepts (−5 and +2), making them parallel lines that never intersect. Parallel lines with different y-intercepts have no solution. Setting $3x-5 = 3x+2$ yields $-5 = 2$, a contradiction confirming no solution exists.

16. A — The y-intercept of a regression equation is the predicted value of the response variable when the explanatory variable equals zero. At x = 0 (no tutoring hours), $\hat{y} = 4.8(0) + 12 = 12$, meaning a student with zero tutoring is predicted to improve by 12 points. Choice B describes the slope, not the y-intercept.

17. C — In $f(x) = 2(x-4)^2 + 3$, the vertex is (h, k) = (4, 3). Since a = 2 > 0, the parabola opens upward. Choice A uses the wrong sign on h (giving −4 instead of 4), and choice B incorrectly states the parabola opens downward.

18. B — Distribute: $2x + 6 \leq 5x - 3$. Subtract 2x: $6 \leq 3x - 3$. Add 3: $9 \leq 3x$. Divide by 3: $3 \leq x$, equivalently $x \geq 3$. The inequality sign is not reversed because division by a positive number (3) is performed. Choice A reverses the inequality incorrectly.

19. A — Compound interest at 3.5% annually means each year the balance multiplies by 1 + 0.035 = 1.035. The model A(t) = 4000(1.035)^t has initial value 4000 and growth factor 1.035. Choice C uses 0.965 (a decay factor), and choice D uses 1.35 (35% growth instead of 3.5%).

20. D — Of 100 tenth graders, 64 play basketball: 64/100 = 64%. The conditional relative frequency uses the column total (100 grade 10 students), not the grand total. Choice A (32%) divides by the grand total of 200 instead.

21. B — Both f(x) = 4^x and g(x) = 2^x are exponential growth functions sharing the y-intercept (0,1). Since 4 > 2, f(x) has a larger base and grows more rapidly for all x > 0 — at each successive integer x, f produces a value 2^x times larger than g. Choice D incorrectly states that a base closer to 1 grows faster; the opposite is true.

22. C — Distribute: $(3x^2-2x+1) + (2x^2+8x-6)$. Combine: $(3+2)x^2+(-2+8)x+(1-6) = 5x^2+6x-5$. The 2 distributes to all three terms of the second polynomial, giving coefficients 2, 8, and −6. Choice B uses $+8x-4$, which applies the 2 incorrectly to the constant.

23. D — Axis of symmetry: $t = -24/[2(-16)] = 24/32 = 0.75$ seconds. Maximum height: $h(0.75) = -16(0.5625) + 24(0.75) + 20 = -9 + 18 + 20 = 29$ feet. The vertex of a downward-opening parabola gives the maximum, and its y-coordinate is the maximum height.

24. B — Sequence: $a_1=6$, $a_2=6\times(-1/2)=-3$, $a_3=-3\times(-1/2)=3/2$, $a_4=3/2\times(-1/2)=-3/4$, $a_5=-3/4\times(-1/2)=3/8$. The 5th term is 3/8. The alternating signs arise from the negative common ratio — each term's sign is opposite its predecessor.

25. C — Add the equations: $(5x+2y)+(3x-2y) = 20+12 \rightarrow 8x = 32 \rightarrow x = 4$. Substitute: $5(4)+2y = 20 \rightarrow 20+2y = 20 \rightarrow y = 0$. Solution: (4, 0). Verify: $3(4)-2(0) = 12$ ✓ and $5(4)+2(0) = 20$ ✓. Elimination works cleanly here because the y-coefficients are already opposites.

26. D — Identify $a=2$, $b=-3$, $c=-9$. Discriminant: $9+72=81$. $x=(3\pm9)/4$. Solutions: $x=3$ and $x=-3/2$. Verify $x=3$: $2(9)-3(3)-9=18-9-9=0$ ✓. Verify $x=-3/2$: $2(9/4)-3(-3/2)-9=9/2+9/2-9=9-9=0$ ✓. Both solutions satisfy the original equation.

27. A — LinReg on the six data points produces approximately $\hat{y} \approx 4.7m + 16.9$, with $r \approx 0.81$. At month 8: $\hat{y} = 4.7(8)+16.9 \approx 54.5$°F. However, a linear model is not fully appropriate here — monthly temperatures follow a cyclical (sinusoidal) pattern, not a straight line. The r value of 0.81 suggests moderate fit, but predictions at extreme months would be unreliable.

28. C — Factor numerator: $3x^2+12x = 3x(x+4)$. Factor denominator: $x^2+5x+4 = (x+1)(x+4)$. Cancel $(x+4)$: result = $3x/(x+1)$. The expression is undefined when the original denominator equals zero: $x = -1$ and $x = -4$ ($x = -4$ makes the cancelled factor zero in the original expression).

29. B — Maximum height: vertex is (3, 16), so maximum = 16 feet at $x = 3$ seconds. Ground level: $-(x-3)^2+16 = 0 \rightarrow (x-3)^2 = 16 \rightarrow x-3 = \pm4 \rightarrow x = 7$ or $x = -1$. Since time cannot be negative, the football hits the ground at $x = 7$ seconds after being kicked.

30. D — Plan X: W_X(u) = 12u+800. Plan Y: W_Y(u) = 20u+500. Set equal: $12u+800 = 20u+500 \rightarrow 300 = 8u \rightarrow u = 37.5$ units. At $u = 37.5$: W_X = $12(37.5)+800 = 1250$ and W_Y = $20(37.5)+500 = 1250$ ✓. Both plans pay $1,250 at 37.5 units sold.

31. A — From $a_n = -3n+25$: $a_1 = -3+25 = 22$; common difference $d = -3$. Recursive formula: $a_1 = 22$; $a_n = a_{n-1} - 3$. For $a_n < 0$: $-3n+25 < 0 \rightarrow n > 25/3 \approx 8.33 \rightarrow$ first negative term at $n = 9$ ($a_9 = -2$). Sum of first 8 terms: $S_8 = 8/2 \times (22 + a_8) = 4 \times (22 + (-24+25)) = 4 \times (22+1) = 4 \times 23 = 92$.

32. C — Ordered data: 8, 12, 15, 19, 23, 27, 31, 72. Min=8, Q1=(12+15)/2=13.5, Median=(19+23)/2=21, Q3=(27+31)/2=29, Max=72. IQR=29−13.5=15.5. Upper fence=29+1.5(15.5)=29+23.25=52.25. Since 72>52.25, it is an outlier. The outlier inflates the mean significantly (mean≈25.9 vs. median=21) while the median is resistant and remains near the typical central value.

33. B — Let x = width of each perpendicular side. Two perpendicular sides use 2x feet of fencing, leaving $160-2x$ for the parallel side. $A(x) = x(160-2x) = -2x^2+160x$. Axis of symmetry: $x = -160/[2(-2)] = 40$ feet. Maximum area: $A(40) = -2(1600)+160(40) = -3200+6400 = 3200$ sq ft. Dimensions: each perpendicular side = 40 ft, parallel side = 160−80 = 80 ft. Maximum area = 3,200 square feet.

34. D — f(x): ratios 40/80=0.5, 20/40=0.5 — constant ratio of 0.5 (exponential): $p(x) = 80(0.5)^x$. $q(x) = -15x+90$ is linear. Set equal: $80(0.5)^x = -15x+90$. By graphing calculator: $x \approx 1.79$. At $x=6$: $p(6)=80(0.5)^6=80/64=1.25$; $q(6)=-90+90=0$. p(6) is larger. As $x \rightarrow +\infty$: $p(x) \rightarrow 0$ exponentially (halves each unit); $q(x) \rightarrow -\infty$ linearly. Both approach zero and below, but the exponential approaches zero from above and never becomes negative, while the linear model goes negative — the exponential function technically approaches zero more closely and never crosses it.

35. A — $P(x) = (-0.4x^2+60x)-(18x+800) = -0.4x^2+42x-800$. This is a quadratic (degree 2, downward-opening). Break-even: $-0.4x^2+42x-800=0 \rightarrow 0.4x^2-42x+800=0 \rightarrow 2x^2-210x+4000=0 \rightarrow x^2-105x+2000=0$. Quadratic formula: $x=[105\pm\sqrt{(11025-8000)}]/2=[105\pm\sqrt{3025}]/2=[105\pm55]/2$. Solutions: $x=80$ and $x=25$. The business breaks even at 25 and 80 T-shirts — it is profitable between these two values. Maximum profit: axis $= -42/[2(-0.4)] = 42/0.8 = 52.5$ shirts; $P(52.5) = -0.4(2756.25)+42(52.5)-800 = -1102.5+2205-800 = \$302.50$. At $x=50$: $P(50) = -0.4(2500)+2100-800 = -1000+2100-800 = \$300$. The owner is just below the optimal (50 vs. 52.5 shirts), missing \$2.50 in profit. New $P_2(x)$ with fixed cost \$1,200: $P_2(x) = -0.4x^2+42x-1200$. Break-even: $x^2-105x+3000=0$; $x=[105\pm\sqrt{(11025-12000)}]/2 = [105\pm\sqrt{(-975)}]/2$. Discriminant is negative — no real break-even points. The increased fixed cost makes it impossible to break even or earn a profit at any production level. The business cannot cover its costs under the new expense structure.