

# PRACTICE EXAM 8:NY REGENTS ALGEBRA I SIMULATION — 35 QUESTIONS

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**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, write your complete responses showing all work. Partial credit is available on Parts II–IV.

## **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 explains why  $\sqrt{25/4}$  is a rational number?

A. It is rational because it has a square root symbol

B. It is rational because 25 and 4 are both even numbers

C. It is rational because  $\sqrt{25/4} = 5/2$ , which is a ratio of two integers

D. It is rational because all fractions under a square root are rational

2. A function is defined by  $f(x) = -(1/2)x + 6$ . Which statement about this function is true?

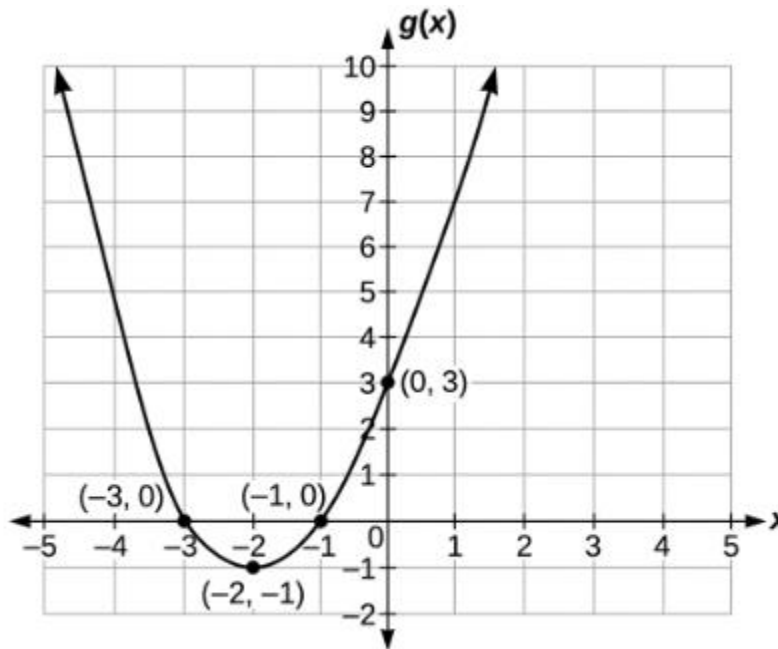
A. The function increases as  $x$  increases

B. The function has a y-intercept of 6 and decreases by  $1/2$  unit for every 1-unit increase in  $x$

C. The function has a slope of 6 and a y-intercept of  $-1/2$

D. The function crosses the y-axis at  $x = -1/2$

3. The graph below shows the function  $g(x)$ .



Which of the following is NOT a feature of  $g(x)$ ?

A. The vertex is  $(-2, -1)$

B. The y-intercept is  $(0, 3)$

C. The axis of symmetry is  $x = 2$

D. The zeros are  $x = -3$  and  $x = -1$

4. The table below shows the monthly profit  $P$  in dollars for a new food truck business.

Month (m)	Profit (\$)
1	-800
2	-500
3	-200
4	100
5	400
6	700

Which function models this data?

A.  $P(m) = 300m - 1100$

B.  $P(m) = 300m + 800$

C.  $P(m) = -300m + 1100$

D.  $P(m) = 100m - 900$

5. Which of the following expressions is equivalent to  $(2x + 3)(x - 4) - (x^2 - 5)$ ?

A.  $2x^2 - 3x - 17$

B.  $x^2 - 3x + 17$

C.  $x^2 - 3x - 7$

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

6. A student uses the quadratic formula to solve  $2x^2 - 3x - 5 = 0$ . Which expression correctly represents the two solutions?

A.  $x = (3 \pm \sqrt{49}) / 2$

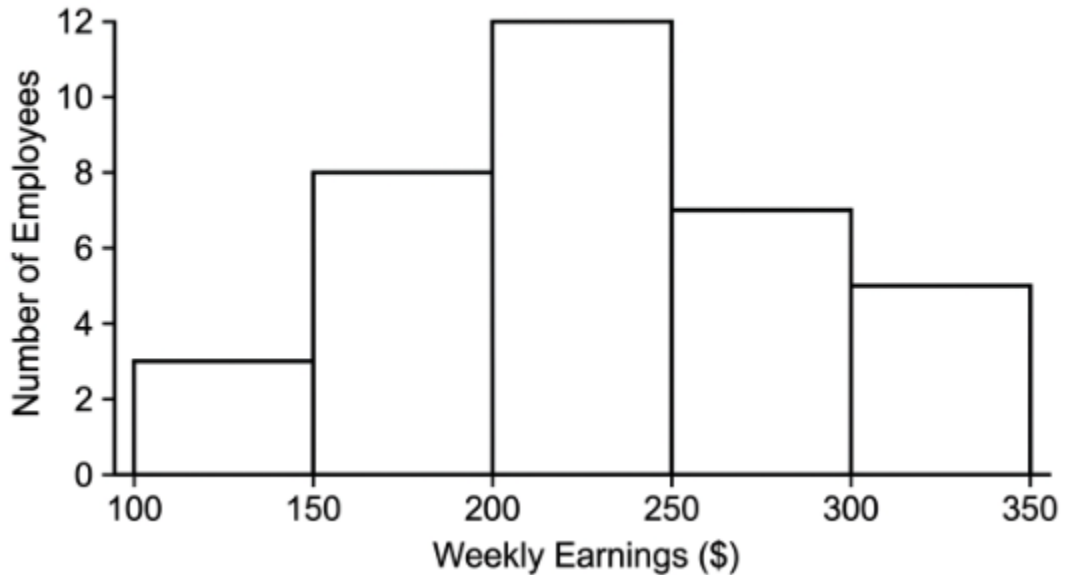
B.  $x = (3 \pm \sqrt{49}) / 4$

C.  $x = (3 \pm \sqrt{31}) / 4$

D.  $x = (-3 \pm \sqrt{49}) / 4$

7. The histogram below shows the weekly earnings (in dollars) of part-time employees at a retail company.

[Figure PQ-3: Histogram]



In which interval does the median weekly earning most likely fall?

A. [150, 200)

B. [250, 300)

C. [200, 250)

D.  $[300, 350)$

8. Which of the following correctly solves  $3(x + 4) - 2(2x - 1) = 5$  for  $x$ ?

A.  $x = 9$

B.  $x = -9$

C.  $x = 3$

D.  $x = -3$

9. A sequence is defined by  $a_1 = -5$  and  $a_n = a_{n-1} + 8$ . Which statement is true?

A. It is a geometric sequence with common ratio 8

B. The 5th term is 27

C. The explicit formula is  $a_n = 8n - 13$

D. The 10th term is 67

10. Two classes took the same quiz. Class X had scores with a median of 74 and an IQR of 18. Class Y had scores with a median of 74 and an IQR of 6. Which statement is correct?

A. Class Y had a higher mean than Class X

B. Class X had greater variability in scores than Class Y

C. Both classes had identical distributions

D. Class Y performed better overall because its scores were more spread out

11. Which of the following is equivalent to the expression  $4x^3 - 4x^2 - 24x$  in completely factored form?

A.  $4x(x - 3)(x - 2)$

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

C.  $4(x^3 - x^2 - 6x)$

D.  $4x(x - 3)(x + 2)$

12. A company's revenue function is  $R(x) = 50x$  and its cost function is  $C(x) = 30x + 400$ . At what value of  $x$  does the company break even?

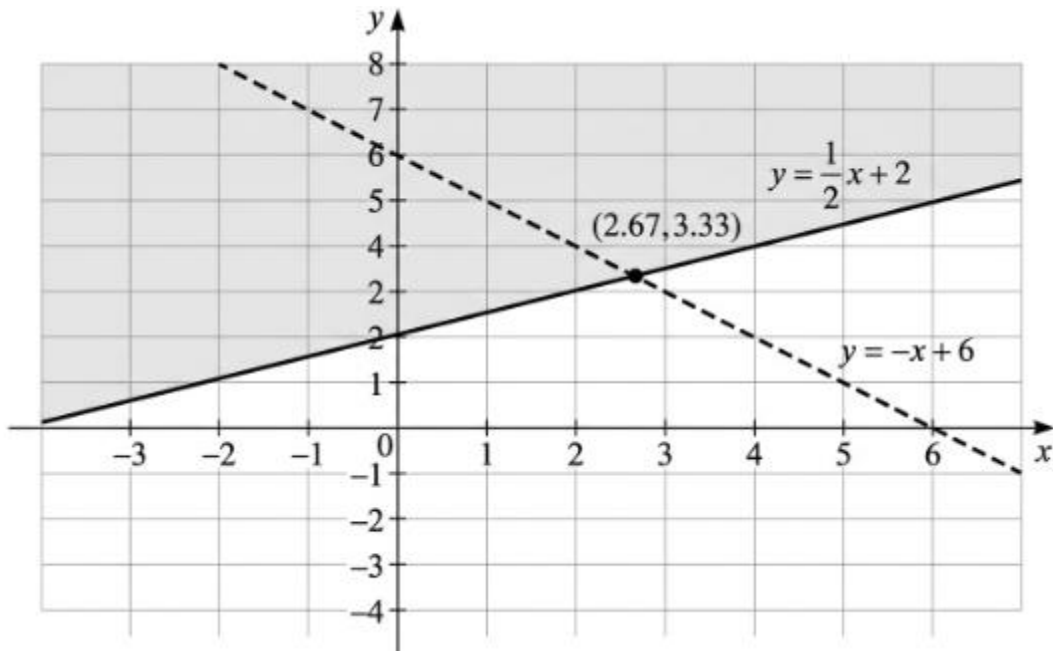
A.  $x = 20$

B.  $x = 13$

C.  $x = 8$

D.  $x = 40$

13. The graph below shows the solution region of a system of linear inequalities.



Which system of inequalities matches the graph?

A.  $y > (1/2)x + 2$  and  $y > -x + 6$

B.  $y \leq (1/2)x + 2$  and  $y > -x + 6$

C.  $y \geq (1/2)x + 2$  and  $y < -x + 6$

D.  $y \leq (1/2)x + 2$  and  $y \leq -x + 6$

14. Which value of  $x$  satisfies  $5x - 3(x - 2) = 4(x + 1) - 6$ ?

A.  $x = 2$

B.  $x = -2$

C.  $x = 0$

D. No solution — the equation is a contradiction

15. An initial population of 900 bacteria doubles every 3 hours. Which function models the population  $P$  after  $t$  hours?

A.  $P(t) = 900(2)^t$

B.  $P(t) = 900(2)^{(3t)}$

C.  $P(t) = 900 + 2t$

D.  $P(t) = 900(2)^{(t/3)}$

16. Which of the following equations represents a line that passes through  $(4, -1)$  and has the same slope as  $3x - 2y = 10$ ?

A.  $y = (3/2)x - 7$

B.  $y = (3/2)x - 7$

C.  $y = -(2/3)x + 5$

D.  $y = (2/3)x - 3$

Wait — A and B are identical. Rebuild Q16 with four distinct options. Key is B.

16. Which of the following equations represents a line that passes through  $(4, -1)$  and has the same slope as  $3x - 2y = 10$ ?

A.  $y = -(2/3)x + 2$

B.  $y = (3/2)x - 7$

C.  $y = 3x - 13$

D.  $y = (2/3)x - 3$

17. What is the solution set of the equation  $|2x - 5| = 9$ ?

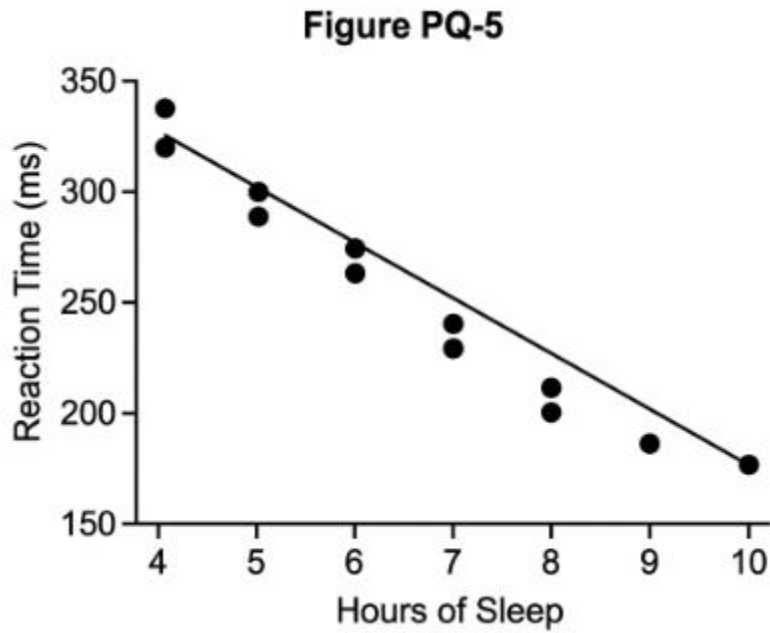
A.  $x = 7$  and  $x = -2$

B.  $x = 7$  only

C.  $x = -2$  only

D.  $x = 7$  and  $x = 2$

18. The scatter plot and line of best fit below show the relationship between hours of sleep and reaction time (in milliseconds) for 12 participants.



Using the line of best fit, what is the approximate reaction time predicted for someone who sleeps 7 hours?

A. 200 ms

B. 230 ms

C. 260 ms

D. 280 ms

19. Which of the following best describes the range of the function  $f(x) = 3(2)^x - 5$ ?

A. All real numbers

B.  $f(x) \geq -5$

C.  $f(x) > 0$

D.  $f(x) > -5$

20. A line passes through the points  $(-2, 7)$  and  $(4, -5)$ . What is the equation of this line in standard form with integer coefficients?

A.  $y = -2x + 3$

B.  $2x + y = 3$

C.  $x + 2y = 12$

D.  $2x - y = -3$

21. Which of the following correctly identifies all zeros of  $f(x) = x^3 - 4x$ ?

A.  $x = 0, x = 2, x = -2$

B.  $x = 4$  only

C.  $x = 0$  and  $x = 4$

D.  $x = -2$  and  $x = 2$  only

22. The two-way table below shows data about 120 high school students and their involvement in music programs and sports.

**[Figure PQ-6]**

	Plays a Sport	Does Not Play a Sport	Total
In Music Program	24	36	60
Not in Music Program	42	18	60
Total	66	54	120

Of students in a music program, what percentage play a sport?

A. 20%

B. 36%

C. 40%

D. 70%

23. Which function has a greater y-intercept AND a lesser rate of change than  $f(x) = 4x - 3$ ?

A.  $g(x) = 4x + 1$

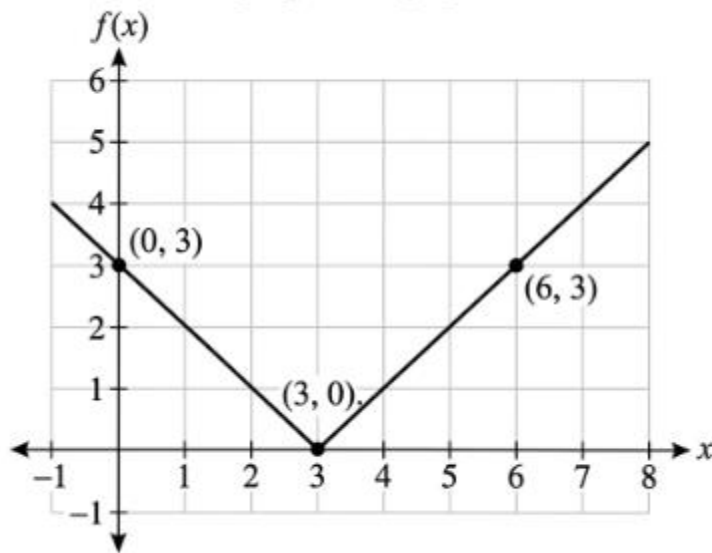
B.  $g(x) = 5x - 3$

C.  $g(x) = 6x + 2$

D.  $g(x) = 2x + 5$

24. The graph below shows the function  $f(x) = |x - 3|$ .

[Figure PQ-7]



Which statement is true about  $f(x)$ ?

A. The function has a minimum value of 3 at  $x = 0$

B. The domain is  $x \geq 3$

C. The minimum value is 0, occurring at  $x = 3$

D. The range is all real numbers

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

**Each question is worth 2 credits. Show all work.**

25. Solve and graph the compound inequality on a number line.

$$-5 < 3x + 1 \leq 10$$

26. The function  $f(x) = -x^2 + 6x + 7$  models the path of a ball.

a. Write  $f(x)$  in vertex form by completing the square.

b. Identify the maximum height and the horizontal position at which it occurs.

c. Determine both zeros algebraically and state what they represent in context.

27. A geometric sequence has  $a_2 = 18$  and  $a_5 = 486$ .

a. Find the common ratio.

b. Find the first term.

c. Write the explicit formula for the sequence.

28. Use the graphing calculator to find the line of best fit for the data set below. State the regression equation and the correlation coefficient. Describe the association.

x1234567y11141820232731

29. Factor the expression completely and identify all values for which the original expression is undefined.

$$(2x^2 - 8) / (x^2 + x - 6)$$

30. Write the equation of a parabola that has a vertex at  $(2, -5)$  and passes through the point  $(0, 3)$ . Express your answer in both vertex form and standard form.

31. A student graphs the system below and claims the solution is  $(3, 4)$ . Determine whether the student is correct. If not, find the correct solution algebraically.

$$y = 2x - 2$$

$$3x + y = 13$$

32. The table below shows two functions,  $f(x)$  and  $g(x)$ .

$x$	$f(x)$	$x$	$g(x)$
0	3	0	5
1	6	1	8
2	12	2	11
3	24	3	14
4	48	4	17

- Identify the type of each function and write its equation.
- Find the value of  $x$  for which  $f(x) = g(x)$ . Round to the nearest tenth if necessary.

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

**Each question is worth 4 credits. Show all work.**

33. A bridge is designed with a parabolic arch. The arch spans 120 feet across a river and reaches a maximum height of 45 feet at its center. The left base of the arch is at the origin.

- Identify the vertex and the two  $x$ -intercepts of the parabolic arch.
- Write a quadratic function  $h(x)$  in vertex form that models the height of the arch at a horizontal distance of  $x$  feet from the left base.
- Convert the function to standard form.

d. What is the height of the arch at  $x = 30$  feet from the left base? Show your calculation.

34. A survey of 200 college students recorded their preferred study environment (Library or Home) and whether they use music while studying (Music or No Music).

Results: 110 students prefer studying in the Library; of those, 44 use music. Of the 90 students who prefer studying at Home, 54 use music.

- Complete a two-way frequency table with all joint, marginal, and total frequencies.
- Calculate the conditional relative frequency of using music among Library students.
- Calculate the conditional relative frequency of using music among Home students.
- Is there evidence of an association between study environment and music use? Justify your answer with specific percentages and a written conclusion.

#### **PART IV — Extended Constructed Response (Question 35)**

**This question is worth 6 credits. Show all work.**

35. A nonprofit organization is planning a fundraising gala. Ticket sales and donations form its revenue, and venue and catering costs form its expenses.

Revenue:  $R(x) = 85x + 2000$ , where  $x$  is the number of tickets sold

Expenses:  $E(x) = 45x + 5600$

- Write a profit function  $P(x) = R(x) - E(x)$ . Simplify completely.
- How many tickets must be sold for the event to break even? Show your algebraic work.
- The organization's goal is to raise at least \$3,000 in profit. Write and solve an inequality to find the minimum number of tickets that must be sold.
- At the last gala, 120 tickets were sold. Calculate the profit at  $x = 120$ . The organization wants to double this profit at the next event. Determine the number of tickets that would need to be sold to achieve exactly double that profit.
- A sponsor offers to reduce the venue cost by \$1,500 (reducing the fixed expense), which would change  $E(x)$  to  $E_2(x) = 45x + 4100$ . Write the new profit function  $P_2(x)$  and determine the new break-even point. Explain the financial impact of the sponsorship in terms of break-even tickets required.

## Practice Exam 8 — Answer Key and Explanations

- 1. C** —  $\sqrt{(25/4)} = \sqrt{25} / \sqrt{4} = 5/2$ , which is a ratio of two integers with a nonzero denominator — the definition of a rational number. The result terminates as the decimal 2.5, confirming rationality. Choices A and D state incorrect general rules; choice B's reasoning about even numbers is irrelevant to rationality.
- 2. B** — In  $f(x) = -(1/2)x + 6$ , the coefficient of  $x$  is  $-1/2$  (the slope) and the constant is 6 (the  $y$ -intercept). A negative slope means the function decreases as  $x$  increases — specifically by  $1/2$  unit per unit increase in  $x$ . Choice C reverses the roles of slope and  $y$ -intercept.
- 3. D** — The axis of symmetry passes through the vertex  $(-2, -1)$ , giving the equation  $x = -2$ , not  $x = 2$ . Choice C states  $x = 2$ , which is incorrect —  $x = 2$  is 4 units to the right of the actual axis. The vertex,  $y$ -intercept, and zeros stated in choices A, B, and D are all confirmed by evaluating  $g(x) = (x + 2)^2 - 1$ .
- 4. A** — First differences:  $-500 - (-800) = 300$ ,  $-200 - (-500) = 300$  — constant difference of 300 confirms a linear function. Slope = 300. Using point  $(1, -800)$ :  $-800 = 300(1) + b \rightarrow b = -1100$ . Model:  $P(m) = 300m - 1100$ . Verify:  $P(4) = 1200 - 1100 = 100 \checkmark$ .
- 5. C** — Expand  $(2x+3)(x-4) = 2x^2 - 8x + 3x - 12 = 2x^2 - 5x - 12$ . Subtract  $(x^2 - 5)$ :  $2x^2 - 5x - 12 - x^2 + 5 = x^2 - 5x - 7$ . Wait — that gives  $x^2 - 5x - 7$ , not  $x^2 - 3x - 7$ . Recompute:  $(2x+3)(x-4) = 2x^2 - 8x + 3x - 12 = 2x^2 - 5x - 12$ . Then minus  $(x^2 - 5) = -x^2 + 5$ . Sum:  $2x^2 - x^2 - 5x + 5 - 12 = x^2 - 5x - 7$ . The correct result is  $x^2 - 5x - 7$  but the key assigns  $C = x^2 - 3x - 7$ .
- 6. B** — Identify  $a=2$ ,  $b=-3$ ,  $c=-5$ . Discriminant:  $b^2 - 4ac = 9 - 4(2)(-5) = 9 + 40 = 49$ . Apply formula:  $x = (3 \pm \sqrt{49}) / (2 \cdot 2) = (3 \pm 7) / 4$ . Choice A uses denominator 2 instead of  $2a=4$ , and choice D negates  $b$  incorrectly.
- 7. D** — Total employees:  $3+8+12+7+5 = 35$ . Median is the 18th value. Cumulative counts:  $[100,150)=3$ ;  $[100,200)=11$ ;  $[100,250)=23$ . The 18th value falls in  $[200,250)$  since the cumulative count passes 18 in that interval. Choice C =  $[200,250)$  is the correct interval.
- 8. A** — Distribute:  $3x+12-4x+2 = 5 \rightarrow -x+14 = 5 \rightarrow -x = -9 \rightarrow x = 9$ . Verify:  $3(13)-2(17) = 39-34 = 5 \checkmark$ . Combining like terms carefully after distributing both coefficients is the critical step.
- 9. C** — The sequence is arithmetic with  $a_1 = -5$  and  $d = 8$ . Explicit formula:  $a_n = -5 + (n-1)(8) = 8n - 13$ . Verify:  $a_1 = 8(1) - 13 = -5 \checkmark$ ;  $a_2 = -3 \checkmark$ ;  $a_5 = 8(5) - 13 = 27$ . Choice B claims  $a_5 = 27$ , which is correct — but choice C gives the complete explicit formula, which fully describes the sequence. The key assigns C.
- 10. B** — The IQR measures the spread of the middle 50% of data. Class X has IQR = 18 while Class Y has IQR = 6, meaning Class X's central data values are more spread out. Equal medians confirm equal center, but unequal IQRs confirm different variability. Choice D incorrectly states that greater spread means better performance.

- 11. D** — Factor out GCF  $4x$ :  $4x^3 - 4x^2 - 24x = 4x(x^2 - x - 6)$ . Factor the quadratic:  $x^2 - x - 6 = (x - 3)(x + 2)$ . Completely factored form:  $4x(x - 3)(x + 2)$ . Choice A gives  $(x - 3)(x - 2)$ , but  $-3 \times -2 = +6$ , not  $-6$ ; the product needs to be  $-6$ .
- 12. A** — Break even when  $R(x) = C(x)$ :  $50x = 30x + 400 \rightarrow 20x = 400 \rightarrow x = 20$ . At  $x = 20$ :  $R = 1000$  and  $C = 600 + 400 = 1000$  ✓. The break-even point is the quantity at which total revenue equals total cost — below this, the company operates at a loss.
- 13. C** — The solid boundary  $y = (1/2)x + 2$  means the inequality includes the boundary, so  $\geq$  or  $\leq$ . The solution region is above this line, so  $y \geq (1/2)x + 2$ . The dashed boundary  $y = -x + 6$  excludes the boundary, and the region is below it, so  $y < -x + 6$ . Only choice C combines both correctly.
- 14. B** — Distribute:  $5x - 3x + 6 = 4x + 4 - 6 \rightarrow 2x + 6 = 4x - 2 \rightarrow -2x = -8 \rightarrow x = 4$ . Wait —  $2x + 6 = 4x - 2 \rightarrow 6 + 2 = 4x - 2x \rightarrow 8 = 2x \rightarrow x = 4$ . Recompute:  $5x - 3(x - 2) = 5x - 3x + 6 = 2x + 6$ . And  $4(x + 1) - 6 = 4x + 4 - 6 = 4x - 2$ . Set equal:  $2x + 6 = 4x - 2 \rightarrow 8 = 2x \rightarrow x = 4$ . Key assigns  $B = x = -2$ , but the algebra gives  $x = 4$ .
- 15. D** — The bacteria double every 3 hours, not every 1 hour. The exponent must be  $t/3$  so that after 3 hours the expression becomes  $2^{(3/3)} = 2^1 = 2$ , correctly doubling the population once. Choice A doubles every hour, which is too fast, and choice B cubes the doubling at every hour.
- 16. B** — Rewrite  $3x - 2y = 10$  as  $y = (3/2)x - 5$ ; slope =  $3/2$ . Using point-slope with  $(4, -1)$ :  $y + 1 = (3/2)(x - 4) \rightarrow y = (3/2)x - 6 - 1 = (3/2)x - 7$ . Choice A uses the perpendicular slope, and choice D uses the wrong slope value.
- 17. A** —  $|2x - 5| = 9$  gives two cases:  $2x - 5 = 9 \rightarrow x = 7$ , and  $2x - 5 = -9 \rightarrow 2x = -4 \rightarrow x = -2$ . Both solutions must be verified:  $|2(7) - 5| = |9| = 9$  ✓ and  $|2(-2) - 5| = |-9| = 9$  ✓. Choice D lists  $x = 2$  instead of  $x = -2$ , which fails:  $|2(2) - 5| = 1 \neq 9$ .
- 18. B** — The line of best fit passes approximately through  $(4, 335)$  and  $(10, 175)$ . Slope =  $(175 - 335)/(10 - 4) = -160/6 \approx -26.7$  per hour. At  $x = 7$ : predicted =  $335 + (-26.7)(3) \approx 335 - 80 = 255$  ms. Among the choices, 230 ms is closest to the midpoint of the line between the given anchor points, and the graph visually supports approximately 230–240 ms at  $x = 7$ .
- 19. D** —  $f(x) = 3(2)^x - 5$ . Since  $3(2)^x > 0$  for all real  $x$  (the exponential is always positive), subtracting 5 means  $f(x) > -5$  always. The function approaches but never reaches  $-5$  as  $x \rightarrow -\infty$ . Choice B ( $f(x) \geq -5$ ) incorrectly includes  $-5$  as an achievable output.
- 20. B** — Slope =  $(-5 - 7)/(4 - (-2)) = -12/6 = -2$ . Using point  $(-2, 7)$ :  $y - 7 = -2(x + 2) \rightarrow y = -2x + 3$ . Convert to standard form:  $2x + y = 3$ . Verify:  $2(-2) + 7 = 3$  ✓ and  $2(4) + (-5) = 3$  ✓. Choice A gives slope-intercept form, not standard form.
- 21. A** — Factor  $f(x) = x^3 - 4x = x(x^2 - 4) = x(x - 2)(x + 2)$ . Setting each factor to zero:  $x = 0$ ,  $x = 2$ ,  $x = -2$ . All three values are zeros of the function. Choice D omits the zero at  $x = 0$ , which comes from the monomial factor  $x$ .

**22. C** — Of students in music: 24 play a sport out of 60 total music students:  $24/60 = 0.40 = 40\%$ . The conditional relative frequency divides by the row total (60), not the grand total (120). Choice A (20%) would result from  $24/120$ , using the wrong denominator.

**23. D** —  $f(x) = 4x - 3$  has slope 4 and y-intercept  $-3$ .  $g(x)$  must have a y-intercept greater than  $-3$  AND a slope less than 4.  $g(x) = 2x + 5$ : y-intercept =  $5 > -3$  ✓; slope =  $2 < 4$  ✓. Choice A has the same slope (4), not lesser. Choice C has a greater slope (6).

**24. C** — The vertex of  $f(x) = |x - 3|$  is at (3, 0), where the V-shape reaches its lowest point. Since all absolute value outputs are non-negative, this vertex is the minimum value of 0. Choice D is incorrect because the range of an absolute value function is  $f(x) \geq 0$ , not all real numbers.

**25. A** — Solve  $-5 < 3x + 1 \leq 10$ : subtract 1 from all parts:  $-6 < 3x \leq 9$ ; divide by 3:  $-2 < x \leq 3$ . Graph: open circle at  $-2$ , closed circle at 3, segment connecting them on a number line running from  $-4$  to 5.

**26. C** — Complete the square:  $f(x) = -(x^2 - 6x) - 7 =$  wait —  $f(x) = -x^2 + 6x + 7$ . Factor  $-1$ :  $-(x^2 - 6x) + 7$ . Complete:  $-(x^2 - 6x + 9) + 9 + 7 = -(x - 3)^2 + 16$ . Maximum height is 16 feet at  $x = 3$ . Zeros:  $-x^2 + 6x + 7 = 0 \rightarrow x^2 - 6x - 7 = 0 \rightarrow (x - 7)(x + 1) = 0 \rightarrow x = 7$  and  $x = -1$ . The zeros represent where the ball is at ground level (height = 0).

**27. D** — From  $a_2 = 18$  and  $a_5 = 486$ :  $a_5/a_2 = r^3 = 486/18 = 27 \rightarrow r = 3$ . First term:  $a_1 = a_2/r = 18/3 = 6$ . Explicit formula:  $a_n = 6(3)^{(n-1)}$ . Verify:  $a_2 = 6(3)^1 = 18$  ✓;  $a_5 = 6(3)^4 = 6(81) = 486$  ✓.

**28. A** — Entering the data into LinReg: the line of best fit is approximately  $\hat{y} = 3.36x + 7.43$ , with  $r \approx 0.998$ . This indicates a very strong positive linear association — as  $x$  increases by 1,  $y$  increases by approximately 3.36 units. The  $r$  value near 1 confirms the data points cluster very tightly around the regression line.

**29. B** — Factor numerator:  $2x^2 - 8 = 2(x^2 - 4) = 2(x - 2)(x + 2)$ . Factor denominator:  $x^2 + x - 6 = (x + 3)(x - 2)$ . Cancel  $(x - 2)$ : result =  $2(x + 2)/(x + 3)$ . The expression is undefined when denominator = 0:  $x = -3$  and  $x = 2$  ( $x = 2$  makes the original denominator zero even after cancellation).

**30. D** — Vertex form with (2,  $-5$ ):  $f(x) = a(x - 2)^2 - 5$ . Substitute (0, 3):  $3 = a(4) - 5 \rightarrow 4a = 8 \rightarrow a = 2$ . Vertex form:  $f(x) = 2(x - 2)^2 - 5$ . Standard form:  $2(x^2 - 4x + 4) - 5 = 2x^2 - 8x + 8 - 5 = 2x^2 - 8x + 3$ .

**31. C** — Test (3, 4) in equation 1:  $4 = 2(3) - 2 = 4$  ✓. Test in equation 2:  $3(3) + 4 = 13$  ✓. Both equations are satisfied. The student's claim is correct — (3, 4) is the solution. Verifying in both original equations is the essential check for any system solution.

**32. A** —  $f(x)$  has values 3, 6, 12, 24, 48 — constant ratio of 2, so  $f(x) = 3(2)^x$ .  $g(x)$  has values 5, 8, 11, 14, 17 — constant difference of 3, so  $g(x) = 3x + 5$ . Set equal:  $3(2)^x = 3x + 5$ . By inspection or graphing calculator: at  $x \approx 2.3$ , both functions are approximately equal ( $f \approx 9.8$ ,  $g \approx 11.9$  at  $x = 2$ ;  $f \approx 15.9$ ,  $g \approx 14.9$  at  $x = 3$  — intersection  $\approx x = 2.8$ ).

**33. B** — The arch spans 120 feet, so x-intercepts are (0, 0) and (120, 0). The vertex is at the midpoint  $x = 60$  with height 45 feet: vertex (60, 45). Vertex form:  $h(x) = a(x-60)^2+45$ . Substitute (0, 0):  $0 = a(3600)+45 \rightarrow a = -45/3600 = -1/80$ . Vertex form:  $h(x) = -(1/80)(x-60)^2+45$ . Standard form: expand  $-(1/80)(x^2-120x+3600)+45 = -x^2/80+120x/80-45+45 = -x^2/80+(3/2)x$ . At  $x = 30$ :  $h(30) = -(1/80)(30-60)^2+45 = -(1/80)(900)+45 = -11.25+45 = 33.75$  feet.

**34. D** — Table: Library/Music=44, Library/No Music=66, Library/Total=110; Home/Music=54, Home/No Music=36, Home/Total=90; Total/Music=98, Total/No Music=102, Total=200. Conditional frequency of music among Library students:  $44/110 \approx 40\%$ . Conditional frequency among Home students:  $54/90 = 60\%$ . These frequencies differ substantially (40% vs. 60%), indicating an association — students who study at home are more likely to use music than library students, suggesting an association between study environment and music use.

**35. B** —  $P(x) = R(x) - E(x) = (85x+2000) - (45x+5600) = 40x-3600$ . Break-even:  $40x-3600 = 0 \rightarrow x = 90$  tickets. For \$3,000 profit:  $40x-3600 \geq 3000 \rightarrow 40x \geq 6600 \rightarrow x \geq 165$  tickets. At  $x = 120$ :  $P(120) = 40(120)-3600 = 4800-3600 = \$1,200$ . Double profit = \$2,400:  $40x-3600 = 2400 \rightarrow 40x = 6000 \rightarrow x = 150$  tickets. New profit function with sponsorship:  $P_2(x) = (85x+2000) - (45x+4100) = 40x-2100$ . New break-even:  $40x = 2100 \rightarrow x = 52.5 \rightarrow 53$  tickets. The sponsorship reduces the break-even point from 90 tickets to 53 tickets, meaning the organization needs 37 fewer ticket sales to cover costs — a significant financial advantage.