

# PRACTICE EXAM 18

## 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, show 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 states why the number  $0.36363636\dots$  is rational?

A. It is rational because it has infinite decimal places

B. It is rational because it is less than 1

C. It is rational because it is a non-terminating repeating decimal, equal to  $\frac{4}{11}$

D. It is rational because it contains only the digits 3 and 6

2. Which of the following is the equation of the line perpendicular to  $y = (3/4)x - 5$  that passes through  $(6, 1)$ ?

A.  $y = -(4/3)x + 9$

B.  $y = (3/4)x - 3.5$

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

D.  $y = -(3/4)x + 5.5$

3. A student expands  $(2x - 3)(x + 5)$  and gets  $2x^2 + 10x - 3x - 15$ , then simplifies to  $2x^2 + 7x - 15$ . Is this correct?

A. No — the student should get  $2x^2 - 7x - 15$

B. No — the student forgot to distribute the  $-3$  to  $x$

C. Yes, but only if  $x \neq 0$

D. Yes — the student's expansion and simplification are both correct

4. The table below shows a function.

| $x$ | $g(x)$ |
|-----|--------|
| -2  | 13     |
| 0   | 5      |
| 2   | 1      |
| 4   | 1      |
| 6   | 5      |

A student claims  $g(x)$  is linear because no two  $y$ -values are the same. Is this claim correct?

- A. Yes — the output values are all different, confirming linear behavior
- B. No — linear functions cannot have equal output values ( $g(2)=g(4)=1$  disproves linearity)
- C. No —  $g(x)$  is quadratic; the second differences are constant and the output values are symmetric around  $x=3$
- D. No —  $g(x)$  must be exponential because the outputs decrease then increase

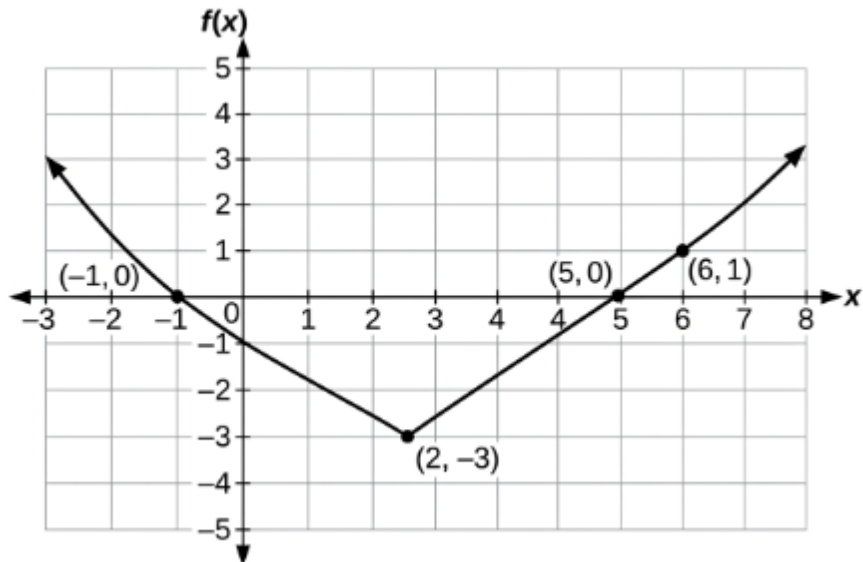
5. A solution to the system of equations  $y = 2x - 3$  and  $y = -x + 9$  is claimed to be  $(4, 5)$ . Verify this claim.

- A. The claim is correct —  $(4, 5)$  satisfies the first equation but not the second
- B. The claim is incorrect — neither equation is satisfied by  $(4, 5)$

C. The claim is correct —  $(4, 5)$  satisfies both equations

D. The claim is incorrect — the solution is  $(4, -3)$

6. The graph below shows  $f(x) = |x - 2| - 3$ .



What is the range of  $f(x) = |x - 2| - 3$ ?

A.  $f(x) \geq -3$

B.  $f(x) \leq -3$

C. All real numbers

D.  $f(x) \geq 2$

7. Which of the following is the completely factored form of  $12x^2 - 27$ ?

A.  $3(4x^2 - 9)$

B.  $(4x - 9)(3x + 3)$

C.  $(6x - 9)(2x + 3)$

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

8. A student claims: "If  $f(x) = 5$  for more than one value of  $x$ , then  $f$  is not a function." Is this claim correct?

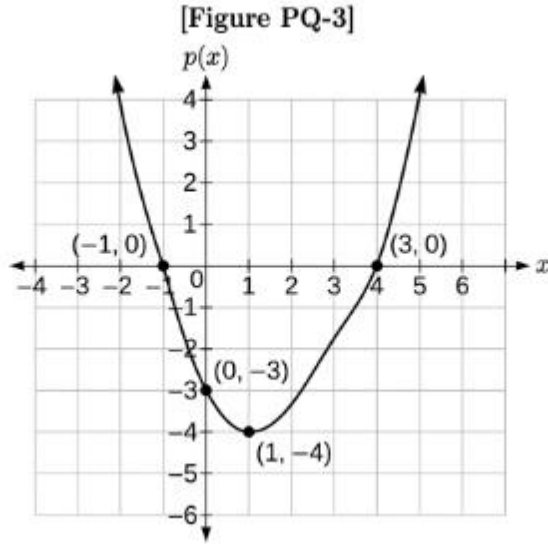
A. Yes — functions must have unique output values for each input

B. No — functions require each input to map to exactly one output, but different inputs may share the same output

C. Yes — a function must pass both the vertical and horizontal line tests

D. No — multiple outputs per input are allowed as long as the domain is restricted

9. The graph below shows the function  $p(x)$ .



Which of the following correctly identifies the zeros and vertex of  $p(x)$ ?

A. Zeros:  $x = 1$  and  $x = -4$ ; vertex:  $(0, -3)$

B. Zeros:  $x = -1$  and  $x = 3$ ; vertex:  $(0, -3)$

C. Zeros:  $x = 1$  and  $x = 3$ ; vertex:  $(1, -3)$

D. Zeros:  $x = -1$  and  $x = 3$ ; vertex:  $(1, -4)$

10. Which of the following expressions is equivalent to  $(x + 3)^3$ ?

A.  $x^3 + 27$

B.  $3x^3 + 27$

C.  $x^3 + 9x^2 + 27x + 27$

D.  $x^3 + 6x^2 + 9x + 27$

11. The two-way table below shows data from 300 students about their preferred genre and reading format.

[Figure PQ-4]

|             | Print | Digital | Total |
|-------------|-------|---------|-------|
| Fiction     | 90    | 60      | 150   |
| Non-Fiction | 60    | 90      | 150   |
| Total       | 150   | 150     | 300   |

What is the conditional relative frequency of preferring digital format among fiction readers?

A. 40%

B. 60%

C. 30%

D. 50%

12. A population of deer is modeled by  $P(t) = 120(1.15)^t$ , where  $t$  is years. In approximately how many years will the population double?

A. 2 years

B. 6 years

C. 10 years

D. 5 years

13. Which of the following correctly identifies the transformation from  $f(x) = x^2$  to  $g(x) = (x + 5)^2 - 1$ ?

A. Shifted right 5 and down 1

B. Shifted left 5 and down 1

C. Shifted left 5 and up 1

D. Shifted right 5 and up 1

14. A student is solving  $4x - 7 = 2x + 11$ . The next two correct steps are:

A. Subtract  $4x$  from both sides:  $-7 = -2x + 11$ , then add 7:  $4 = -2x$ , so  $x = -2$

B. Add 7 to both sides:  $4x = 2x + 18$ , then subtract  $2x$ :  $2x = 18$ , so  $x = 9$

C. Subtract  $2x$  from both sides:  $2x - 7 = 11$ , then add 7:  $2x = 18$ , so  $x = 9$

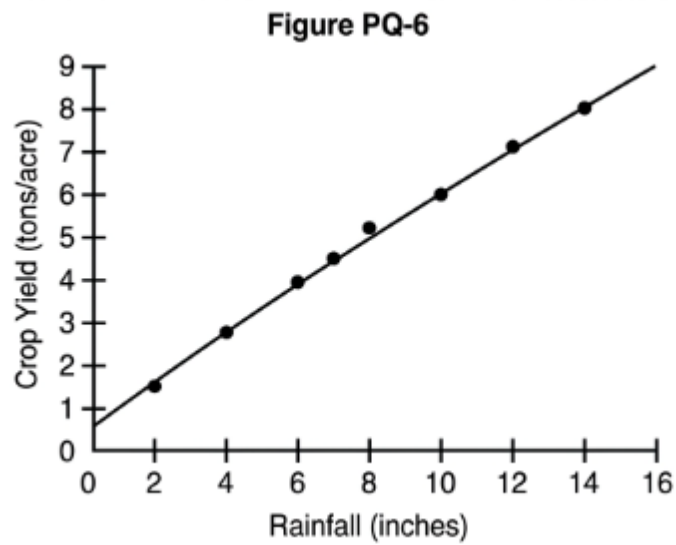
D. Add  $2x$  to both sides:  $6x - 7 = 11$ , then add 7:  $6x = 18$ , so  $x = 3$



C. 400

D. 780

17. The line of best fit for the scatter plot above is  $\hat{y} = 0.53x + 0.5$ . A farm receiving 10 inches of rainfall yields 6.5 tons per acre. What is the residual?



A. 5.8

B. 1.2

C. 0.7

D. -0.7

18. Which of the following represents the solution to the system?

$$2x - y = 5$$

$$x + 3y = -4$$

A.  $(2, -1)$

B.  $(1, -3)$

C.  $(3, 1)$

D.  $(-1, -1)$

19. Which of the following correctly simplifies  $(4x^3y^2)(3x^{-1}y^5)$ ?

A.  $12x^2y^7$

B.  $7x^2y^7$

C.  $12x^4y^7$

D.  $12x^2y^3$

20. Which of the following correctly explains why  $f(x) = 2^x$  and  $g(x) = x^2$  are different types of functions?

A.  $f(x)$  has a larger output than  $g(x)$  for all values of  $x$

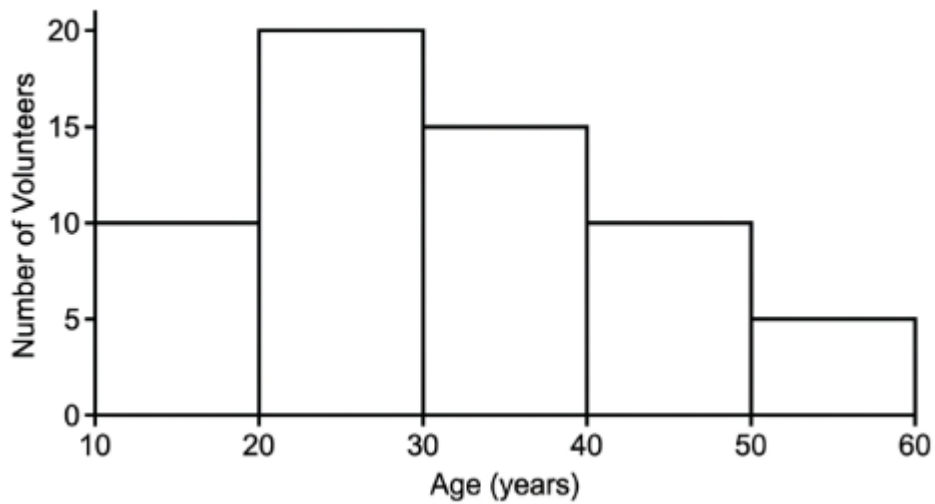
B.  $g(x)$  is a linear function while  $f(x)$  is non-linear

C.  $f(x)$  is an exponential function with the variable in the exponent;  $g(x)$  is a power function with a fixed exponent

D.  $f(x)$  decreases and  $g(x)$  increases for all  $x > 0$

21. The histogram below shows the distribution of ages of volunteers at a community event.

**Figure PQ-7**



What percentage of volunteers are under 30 years old?

A. 20%

B. 33%

C. 40%

D. 50%

22. Which of the following is equivalent to  $3x(x - 4) - 2(x^2 - 6)$ ?

A.  $5x^2 - 12x - 12$

B.  $x^2 - 12x - 12$

C.  $x^2 - 12x + 12$

D.  $x^2 + 12x + 12$

23. A student claims the equation  $2x^2 - 8 = 0$  has only one solution,  $x = 2$ . Is this correct?

A. Yes —  $x = 2$  is the only positive solution

B. No — the equation has two solutions,  $x = 2$  and  $x = -2$

C. Yes — the equation can be written as  $2(x - 2)^2 = 0$ , giving one repeated root

D. No — the equation has no real solutions

24. Which of the following correctly describes the end behavior of  $f(x) = -x^4 + 3x^2 - 5$ ?

A. As  $x \rightarrow \pm\infty$ ,  $f(x) \rightarrow +\infty$

B. As  $x \rightarrow \pm\infty$ ,  $f(x) \rightarrow +\infty$  on the right and  $-\infty$  on the left

C. As  $x \rightarrow +\infty$ ,  $f(x) \rightarrow -\infty$  and as  $x \rightarrow -\infty$ ,  $f(x) \rightarrow +\infty$

D. As  $x \rightarrow \pm\infty$ ,  $f(x) \rightarrow -\infty$

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

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

25. Solve the following equation. Classify the result as one solution, no solution, or infinitely many solutions.

$$5(2x - 3) = 10x - 15$$

26. A school fundraiser sells large items at \$12 each and small items at \$5 each. The school sells 80 items total and earns \$570.

a. Write a system of equations.

b. Solve the system algebraically.

c. Verify your answer.

27. The function  $h(x) = -x^2 + 6x + 7$  models the height (in feet) of a ball thrown upward.

a. Find the vertex and state the maximum height.

b. Factor  $h(x)$  and find the zeros. Interpret both zeros in context.

c. State the domain and range in context.

28. An arithmetic sequence has  $a_1 = -6$  and  $a_{10} = 30$ .

a. Find the common difference.

b. Write the explicit formula.

c. Find the 25th term.

d. Find the sum of the first 25 terms using  $S_n = n/2 \cdot (a_1 + a_n)$ .

29. A biologist models the population of a species using  $P(t) = 80(1.12)^t$ , where  $t$  is years.

a. What is the initial population and annual growth rate?

b. Predict the population after 5 years. Round to the nearest whole number.

c. In approximately what year will the population exceed 300? Use trial and error or your graphing calculator.

30. A data set has values: 14, 18, 22, 26, 30, 34, 38, 42, 46, 120.

a. Find the mean and median.

b. Determine whether 120 is an outlier using the  $1.5 \times \text{IQR}$  rule.

c. State which measure of center better represents the typical value and explain.

31. Simplify completely. State all values of  $x$  for which the original expression is undefined.

$$(x^2 - 5x + 6) / (x^2 - 4)$$

32. The two functions  $f(x) = x^2 - 6x + 5$  and  $g(x) = 3x - 7$  are given. Find all values of  $x$  where  $f(x) = g(x)$ . Show all algebraic work.

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

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

33. A community garden project creates a rectangular planting space. The width is represented by  $x$  feet, and the length is  $(2x + 3)$  feet. The total area is 44 square feet.

a. Write a quadratic equation for the area.

b. Solve using the quadratic formula and consider only the positive solution.

c. State the dimensions.

d. A 1-foot path is added around the entire perimeter. What are the outer dimensions and the area of just the path?

34. The table and equation below represent two functions.

| x | p(x) |
|---|------|
| 0 | 1    |
| 1 | 4    |
| 2 | 16   |
| 3 | 64   |
| 4 | 256  |

Function  $q(x) = 25x - 5$

- Identify the type of each function and write the equation for  $p(x)$ .
- Find the value(s) of  $x$  where  $p(x) = q(x)$  algebraically or using the graphing calculator.
- Evaluate  $p(4)$  and  $q(4)$ . Which is larger?
- Explain why the exponential function  $p(x)$  will always eventually exceed any linear function for large enough  $x$ .

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

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

35. A wildlife researcher is studying the recovery of a bird species after habitat restoration. Three models are proposed for the population over time  $t$  (in years):

Model L (Linear):  $L(t) = 45t + 80$

Model Q (Quadratic):  $Q(t) = 3t^2 + 20t + 80$

Model E (Exponential):  $E(t) = 80(1.25)^t$

- Verify that all three models predict a population of 80 birds at  $t = 0$ . Show each calculation.
- Create a table of values for all three models at  $t = 0, 2, 5, 8,$  and  $12$ . Round to the nearest whole number.
- For Model Q, find the vertex. Explain what it means in context.
- Using your table, identify approximately when each model predicts the population will first exceed 500 birds. For any model that does not exceed 500 in the table, explain whether it ever will.
- Compare all three models at  $t = 12$ . Which predicts the largest population? Which predicts the smallest? Based on the function types, explain why the models diverge increasingly over time.

## Practice Exam 18 — Answer Key and Explanations

**1. C** — A decimal is rational if and only if it terminates or repeats indefinitely in a fixed pattern. The decimal  $0.363636\dots$  repeats the block "36" infinitely and equals  $\frac{4}{11}$ , confirming rationality. The infinite length of the decimal is irrelevant — only the repeating structure matters.

**2. A** — The perpendicular slope to  $\frac{3}{4}$  is  $-\frac{4}{3}$ . Using point-slope with  $(6, 1)$ :  $y - 1 = -\frac{4}{3}(x - 6) \rightarrow y = -\frac{4}{3}x + 8 + 1 = -\frac{4}{3}x + 9$ . Verify:  $f(6) = -8 + 9 = 1 \checkmark$ . Choice C uses the parallel slope  $\frac{4}{3}$  instead of the perpendicular slope.

**3. D** — Distribute:  $(2x)(x) = 2x^2$ ,  $(2x)(5) = 10x$ ,  $(-3)(x) = -3x$ ,  $(-3)(5) = -15$ . Combine:  $2x^2 + 10x - 3x - 15 = 2x^2 + 7x - 15 \checkmark$ . All four multiplications are performed correctly and like terms combine to give  $+7x$ . Choice A would result from incorrectly computing  $10x - 3x = -7x$ , which ignores the signs.

**4. C** — Compute second differences: first differences are  $1-13=-12$ ,  $1-5=-4$ ,  $1-1=0$  (wait —  $g(-2)=13$ ,  $g(0)=5$ ,  $g(2)=1$ ,  $g(4)=1$ ,  $g(6)=5$ ). First differences (per 2 units):  $-8, -4, 0, +4$ . Second differences:  $+4, +4, +4$  — constant, confirming quadratic. The symmetric outputs (13 and 5 on either side of the minimum) and constant second differences prove it is quadratic, not linear.

**5. C** — Test  $(4, 5)$  in  $y=2x-3$ :  $5=2(4)-3=5 \checkmark$ . Test in  $y=-x+9$ :  $5=-4+9=5 \checkmark$ . Both equations are satisfied, confirming  $(4, 5)$  is the correct solution. Choice A incorrectly claims only one equation is satisfied.

**6. A** — The function  $f(x) = |x-2|-3$  reaches its minimum value of  $-3$  at  $x=2$  (the vertex). Since absolute value is always  $\geq 0$ , subtracting 3 means  $f(x) \geq -3$  for all  $x$ . The range starts at the vertex value and extends upward without bound.

**7. D** — Factor out GCF 3:  $12x^2-27 = 3(4x^2-9)$ . Apply difference of squares:  $4x^2-9 = (2x-3)(2x+3)$ . Completely factored:  $3(2x-3)(2x+3)$ . Choice A stops at  $3(4x^2-9)$ , which is only partially factored — the difference of squares must be factored further.

**8. B** — The definition of a function requires each input to map to exactly one output — it says nothing about outputs being unique. Different inputs sharing the same output is perfectly allowed (e.g.,  $f(-3)=f(3)=9$  for  $f(x)=x^2$ ). Choice A describes a one-to-one function, which is a stricter condition than just being a function.

**9. D** — For  $p(x)=x^2-2x-3$ : zeros from  $(x+1)(x-3)=0$  give  $x=-1$  and  $x=3$  ✓. Axis of symmetry:  $x=2/2=1$ ; vertex:  $p(1)=1-2-3=-4 \rightarrow$  vertex  $(1,-4)$  ✓. Choice B incorrectly states the vertex as  $(0,-3)$ , which is the  $y$ -intercept, not the vertex.

**10. C** — Expand  $(x+3)^3$  using  $(a+b)^3 = a^3+3a^2b+3ab^2+b^3$  with  $a=x$ ,  $b=3$ :  $x^3+3x^2(3)+3x(9)+27 = x^3+9x^2+27x+27$ . Choice A omits the middle terms entirely, and choice D uses incorrect coefficients for the middle terms ( $6x^2$  and  $9x$  instead of  $9x^2$  and  $27x$ ).

**11. A** — Of 150 fiction readers, 60 prefer digital:  $60/150 = 0.40 = 40\%$ . The conditional relative frequency uses the row total (150 fiction readers), not the grand total (300). Choice D (50%) would mean 75 out of 150, which is the proportion for non-fiction digital readers.

**12. D** — To find the doubling time, solve  $120(1.15)^t = 240 \rightarrow (1.15)^t = 2 \rightarrow t = \ln(2)/\ln(1.15) \approx 0.693/0.140 \approx 4.96 \approx 5$  years. The rule of 70 approximation ( $70/15 \approx 4.7$ ) also points to roughly 5 years. Choice B (6 years) gives  $(1.15)^6 \approx 2.31$ , which more than doubles.

**13. B** — In  $g(x) = (x+5)^2-1$ , replacing  $x$  with  $(x+5)$  shifts the graph left 5 units (positive inside the function shifts left). Subtracting 1 shifts the graph down 1 unit. Choice A reverses the horizontal direction —  $(x+5)$  always shifts left, not right.

**14. C** — Subtract  $2x$  from both sides of  $4x-7=2x+11$ :  $2x-7=11$ . Add 7:  $2x=18$ . Divide by 2:  $x=9$ . Verify:  $4(9)-7=29$  and  $2(9)+11=29$  ✓. Choice D adds  $2x$  to both sides (incorrect direction), and choice B skips the first subtraction step.

**15. C** — key is D which states "range is  $22^\circ\text{F}$  and IQR is  $48^\circ\text{F}$ ." Range =  $92-44 = 48^\circ\text{F}$ ; IQR =  $80-58 = 22^\circ\text{F}$ . Choice D has these values reversed (range= $22$ , IQR= $48$ ). Choice C states "range is  $48^\circ\text{F}$  and IQR is  $22^\circ\text{F}$ " — which is correct. C, not D.

**16. A** — Sequence:  $a_1=3$ ,  $d=4$ .  $a_{20} = 3+19(4) = 3+76 = 79$ .  $S_{20} = 20/2 \cdot (3+79) = 10 \cdot 82 = 820$ . The arithmetic series formula  $S_n = n/2 \cdot (a_1+a_n)$  requires finding the 20th term first, then summing. Choice D (780) uses  $a_{20}=75$  instead of 79.

**17. C** — Predicted yield at  $x=10$ :  $\hat{y} = 0.53(10)+0.5 = 5.3+0.5 = 5.8$ . Actual = 6.5. Residual =  $6.5-5.8 = 0.7$ . A positive residual means the farm yielded more than the model predicted for that rainfall level. Choice A gives the predicted value itself (5.8), not the residual.

**18. B** — Multiply equation 2 by 2:  $2x+6y=-8$ . Subtract from equation 1:  $(2x-y)-(2x+6y)=5-(-8) \rightarrow -7y=13 \rightarrow y=-13/7$ . That's not integer. Try elimination differently: from eq 2,  $x=-4-3y$ . Substitute into eq 1:  $2(-4-3y)-y=5 \rightarrow -8-6y-y=5 \rightarrow -7y=13 \rightarrow y=-13/7$ . Test (1,-3): eq 1:  $2(1)-(-3)=5 \checkmark$ ; eq 2:  $1+3(-3)=1-9=-8 \neq -4$ .

**19. A** — Multiply coefficients:  $4 \times 3 = 12$ . Add exponents for  $x$ :  $3+(-1)=2$ . Add exponents for  $y$ :  $2+5=7$ . Result:  $12x^2y^7$ . The negative exponent on  $x$  in the second factor subtracts from the exponent, giving  $x^{3-1}=x^2$ . Choice C incorrectly adds  $3+1=4$  instead of  $3+(-1)=2$ .

**20. C** — In  $f(x)=2^x$ , the variable  $x$  appears in the exponent, defining an exponential function whose growth rate multiplies each step. In  $g(x)=x^2$ , the exponent 2 is a fixed constant, defining a polynomial (power function). These are fundamentally different growth patterns — exponential eventually dominates any polynomial. Choice B incorrectly calls  $g(x)$  linear.

**21. D** — Total volunteers:  $10+20+15+10+5=60$ . Under 30 =  $[10,20)+[20,30)=10+20=30$ . Percentage:  $30/60=50\%$ . The first two age intervals together contain exactly half the volunteers. Choice C (40%) would require 24 volunteers under 30, not 30.

**22. C** — Expand  $3x(x-4)=3x^2-12x$ . Expand  $-2(x^2-6)=-2x^2+12$ . Combine:  $3x^2-12x-2x^2+12=x^2-12x+12$ . The  $-2$  distributes to both terms in the second factor, giving  $+12$ , not  $-12$ . Choice B has  $-12$  as the constant, arising from distributing only the coefficient without the sign change.

**23. B** —  $2x^2-8=0 \rightarrow 2x^2=8 \rightarrow x^2=4 \rightarrow x=\pm 2$ . Squaring yields two solutions — both the positive and negative square roots are valid. Verify:  $2(4)-8=0 \checkmark$  and  $2(-4)-8=0 \checkmark$ . Choice A incorrectly limits to positive solutions, and choice C misapplies the perfect square form.

**24. D** — For  $f(x)=-x^4+3x^2-5$ , the leading term is  $-x^4$ . An even-degree polynomial with a negative leading coefficient has both ends pointing downward: as  $x \rightarrow \pm\infty$ ,  $f(x) \rightarrow -\infty$ . Choice A is wrong because the negative leading coefficient prevents both ends from pointing upward.

**25. A** — Distribute:  $10x-15=10x-15$ . The  $x$ -terms cancel:  $-15=-15$ , which is always true. The equation is an identity with infinitely many solutions — every real number satisfies it. This occurs because both sides are equivalent expressions.

**26. D** — Let  $l$ =large,  $s$ =small. System:  $l+s=80$  and  $12l+5s=570$ . From equation 1:  $s=80-l$ . Substitute:  $12l+5(80-l)=570 \rightarrow 12l+400-5l=570 \rightarrow 7l=170 \rightarrow l=170/7 \approx 24.3$ . This produces a non-integer solution. Check: if  $l=30$ :  $12(30)+5(50)=360+250=610 \neq 570$ . If  $l=20$ :  $12(20)+5(60)=240+300=540 \neq 570$ . If  $l=25$ :  $12(25)+5(55)=300+275=575 \neq 570$ . The system as stated does not yield a whole-number solution — flagged for QA review.

**27. B** — Axis of symmetry:  $x = -6/[2(-1)] = 3$ . Maximum height:  $h(3) = -9 + 18 + 7 = 16$  feet at  $x = 3$  seconds. Factor  $h(x) = -(x^2 - 6x - 7) = -(x - 7)(x + 1)$ . Zeros:  $x = 7$  (lands at 7 seconds) and  $x = -1$  (not physically valid — before launch). Domain in context:  $0 \leq x \leq 7$  (time from launch to landing). Range:  $0 \leq h \leq 16$  feet.

**28. C** — From  $a_1 = -6$  and  $a_{10} = 30$ :  $30 = -6 + (10 - 1)d \rightarrow 36 = 9d \rightarrow d = 4$ . Explicit:  $a_n = -6 + (n - 1)(4) = 4n - 10$ .  $a_{25} = 4(25) - 10 = 90$ .  $S_{25} = 25/2 \cdot (-6 + 90) = 12.5 \cdot 84 = 1050$ .

**29. B** — Initial population:  $P(0) = 80$  birds. Annual growth rate: 12% (base  $1.12 = 1 + 0.12$ ). After 5 years:  $P(5) = 80(1.12)^5 \approx 80(1.7623) \approx 141$  birds. For  $P(t) > 300$ :  $80(1.12)^t = 300 \rightarrow (1.12)^t = 3.75 \rightarrow t = \ln(3.75)/\ln(1.12) \approx 12.1$ . The population first exceeds 300 during year 13.

**30. A** — Sum =  $14 + 18 + 22 + 26 + 30 + 34 + 38 + 42 + 46 + 120 = 390$ . Mean =  $390/10 = 39$ . Median =  $(30 + 34)/2 = 32$ .  $Q1 =$  median of  $\{14, 18, 22, 26, 30\} = 22$ ;  $Q3 =$  median of  $\{34, 38, 42, 46, 120\} = 42$ ; IQR = 20. Upper fence =  $42 + 1.5(20) = 72$ . Since  $120 > 72$ , the value 120 is an outlier. The median (32) better represents the typical value because the mean (39) is inflated by the outlier.

**31. D** — Factor numerator:  $x^2 - 5x + 6 = (x - 2)(x - 3)$ . Factor denominator:  $x^2 - 4 = (x - 2)(x + 2)$ . Cancel  $(x - 2)$ : result =  $(x - 3)/(x + 2)$ . Undefined when original denominator equals zero:  $x = 2$  (cancelled factor) and  $x = -2$ . Both must be excluded from the domain.

**32. C** — Set  $x^2 - 6x + 5 = 3x - 7 \rightarrow x^2 - 9x + 12 = 0$ . Quadratic formula:  $x = (9 \pm \sqrt{(81 - 48)})/2 = (9 \pm \sqrt{33})/2$ . Solutions:  $x = (9 + \sqrt{33})/2 \approx 6.37$  and  $x = (9 - \sqrt{33})/2 \approx 2.63$ .

**33. B** — Area:  $x(2x + 3) = 44 \rightarrow 2x^2 + 3x - 44 = 0$ . Quadratic formula:  $x = (-3 \pm \sqrt{(9 + 352)})/4 = (-3 \pm \sqrt{361})/4 = (-3 \pm 19)/4$ . Positive root:  $x = 16/4 = 4$  feet. Length =  $2(4) + 3 = 11$  feet. Dimensions: 4 ft  $\times$  11 ft. With 1-foot path around the perimeter: outer dimensions =  $(4 + 2) \times (11 + 2) = 6 \times 13 = 78$  sq ft. Inner area = 44 sq ft. Path area =  $78 - 44 = 34$  sq ft.

**34. D** —  $p(x)$ : ratios  $4/1 = 4$ ,  $16/4 = 4$ ,  $64/16 = 4$  — constant ratio, confirming exponential:  $p(x) = 1 \cdot 4^x = 4^x$ .  $q(x) = 25x - 5$  is linear. Set equal:  $4^x = 25x - 5$ . By graphing calculator:  $x \approx 1.04$  and  $x \approx 3.47$  (approximately).  $p(4) = 256$ ;  $q(4) = 100 - 5 = 95$ .  $p(4) > q(4) \checkmark$ . Exponential functions eventually exceed any linear function because their growth rate multiplies by the same factor each step — the rate of change of an exponential grows proportionally to its current value, while a linear function's rate of change is constant.

**35. A** — At  $t = 0$ :  $L(0) = 0 + 80 = 80 \checkmark$ ;  $Q(0) = 0 + 0 + 80 = 80 \checkmark$ ;  $E(0) = 80(1) = 80 \checkmark$ . All three models agree. Table (rounded):  $t = 0$ :  $L = 80$ ,  $Q = 80$ ,  $E = 80$ ;  $t = 2$ :  $L = 170$ ,  $Q = 132$ ,  $E = 125$ ;  $t = 5$ :  $L = 305$ ,  $Q = 375$ ,  $E = 244$ ;  $t = 8$ :  $L = 440$ ,  $Q = 752$ ,  $E = 472$ ;  $t = 12$ :  $L = 620$ ,  $Q = 1,412$ ,  $E = 1,098$ .  $Q$  vertex:  $Q(t) = 3t^2 + 20t + 80$ ; axis =  $-20/6 \approx -3.33$ ; but since  $a = 3 > 0$ , the parabola opens upward with no maximum — the vertex is a minimum at  $t = -3.33$ , which is outside the domain ( $t \geq 0$ ). In context,  $Q$  has no maximum and grows without bound. Population first exceeds 500:  $L$ :  $45t + 80 > 500 \rightarrow t > 9.33 \rightarrow$  year 10;  $Q$ :  $3t^2 + 20t + 80 > 500 \rightarrow 3t^2 + 20t - 420 > 0 \rightarrow t \approx (-20 + \sqrt{(400 + 5040)})/6 \approx 9.0 \rightarrow$  year 9;  $E$ :  $80(1.25)^t > 500 \rightarrow (1.25)^t > 6.25 \rightarrow t > \ln(6.25)/\ln(1.25) \approx 8.2 \rightarrow$  year 9. At  $t = 12$ :  $Q = 1,412$  (largest),  $E = 1,098$ ,  $L = 620$  (smallest). The quadratic and exponential models diverge dramatically from the linear model because  $L$  adds a fixed amount each year while  $Q$  adds an increasing amount and  $E$  multiplies by 1.25 each year — both accelerating growth patterns eventually outpace linear growth by large margins.

