PRACTICE EXAM 22

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.

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 is the equation of the line with slope $-3/4$ that passes through $(8, -1)$?

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

B. $y = -(3/4)x + 5$

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

D. $y = -(3/4)x - 5$

2. Which expression is equivalent to $-3x(2x - 5) + 4(x^2 - 2x)$?

A. $2x^2 + 7x$

B. $-10x^2 + 23x$

C. $-2x^2 + 23x$

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

3. A table of values shows: x = 0, 1, 2, 3, 4 and f(x) = 5, 10, 20, 40, 80. Which function type best models this data, and what is the equation?

A. Linear; $f(x) = 5x + 5$

B. Quadratic; $f(x) = 5x^2$

C. Exponential; f(x) = 5(2)^x

D. Linear; $f(x) = 15x - 10$

4. Which of the following is a counterexample to the statement: "All irrational numbers are greater than 1"?

A. $\sqrt{(1/2)}$, because $\sqrt{(1/2)} = 1/\sqrt{2} \approx 0.707$, which is irrational and less than 1

B. π, because $\pi > 3 > 1$

C. $-\sqrt{2}$, because it is negative but its absolute value is irrational

D. $\sqrt{4} = 2$, because it is greater than 1

5. A student completes the square on $x^2 + 10x + 3$ and writes $x^2 + 10x + 3 = (x + 5)^2 - 22$. Is this correct?

A. No — the correct result is $(x + 5)^2 + 28$

B. No — the correct result is $(x + 10)^2 - 22$

C. No — the correct result is $(x + 5)^2 - 22$ only when $x > 0$

D. Yes — $(x + 5)^2 - 25 + 3 = (x + 5)^2 - 22$ ✓

6. Which of the following correctly shows all steps to solve $2|x + 3| - 5 = 7$?

A. $|x + 3| = 6$; $x + 3 = 6$; $x = 3$ only

B. $|x + 3| = 6$; $x + 3 = 6$ or $x + 3 = -6$; $x = 3$ or $x = -9$

C. $|x + 3| = 1$; $x + 3 = 1$ or $x + 3 = -1$; $x = -2$ or $x = -4$

D. $2|x + 3| = 2$; $|x + 3| = 1$; $x = -2$ only

7. The explicit formula for a sequence is $a_n = -3n + 17$. What type of sequence is this, and what is the 10th term?

A. Geometric; $a_{10} = -13$

B. Arithmetic; $a_{10} = -20$

C. Arithmetic; $a_{10} = -13$

D. Geometric; $a_{10} = -30$

8. A data set has mean 62, median 58, and a standard deviation of 9. A single value of 130 is added to the set. Which of the following is most accurate?

A. The median will increase significantly more than the mean

B. The standard deviation will decrease because the set is now larger

C. The mean will increase significantly; the median will change slightly; the range will increase

D. Both the mean and median will stay the same because 130 is above the upper fence

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

$y = -2x + 9$

$3x + y = 14$

A. (5, −1)

B. (3, 3)

C. (2, 5)

D. (4, 2)

10. Which of the following correctly factors $18x^2 - 2$?

A. $2(9x^2 - 1)$

B. $2(3x - 1)(3x - 1)$

C. $(6x - 2)(3x + 1)$

D. $2(3x - 1)(3x + 1)$

11. Which of the following correctly identifies the vertex form of $f(x) = x^2 + 8x - 5$?

A. $f(x) = (x + 8)^2 - 69$

B. $f(x) = (x + 4)^2 - 21$

C. $f(x) = (x - 4)^2 - 21$

D. $f(x) = (x + 4)^2 + 11$

12. A company's cost function is $C(x) = 0.4x^2 - 20x + 500$, where x is units produced. At what production level is cost minimized?

A. $x = 25$

B. $x = 20$

C. $x = 50$

D. $x = 10$

13. Which of the following correctly identifies the range of $f(x) = 4|x - 3| - 7$?

A. $f(x) \geq 3$

B. $f(x) \leq -7$

C. $f(x) \geq -7$

D. All real numbers

14. The table below shows values for two functions:

xp(x)q(x)081111321493172742081

After x = 3, which function grows faster, and why?

A. $p(x)$, because it is increasing at a constant rate of 3

B. $p(x)$, because its values are always larger than $q(x)$

C. $q(x)$, because it triples each step while $p(x)$ adds 3

D. $q(x)$, because it triples each step, and this growth rate will always exceed $p(x)$'s rate

15. Which of the following correctly simplifies the expression $(2x^3)(3x^{-2}) / (6x)$?

A. $x^0 = 1$

B. $6x^2$

C. x^2

D. x

16. The recursive formula $a_1 = 6$ and $a_n = 2a_{n-1} - 5$ produces which of the following sequences?

A. 6, 12, 19, 28

B. 6, 7, 14, 23

C. 6, 7, 9, 13

D. 6, 1, −3, −11

17. A school surveys 300 students about extracurricular activities. Of the 180 students who participate, 108 are in sports. Of the 120 students who don't participate, 36 are interested in joining. What percentage of participants are in sports?

A. 36%

B. 46%

C. 40%

D. 60%

18. Which expression is equivalent to $(x^2 - 16) / (x^2 + 2x - 8)$ in simplified form?

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

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

C. $(x - 4)/(x + 2)$

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

19. Which of the following correctly represents the solution to $-3 < 2x + 1 \leq 9$?

A. $-3 < x \leq 4$

B. $-2 < x \leq 4$

C. $-2 \leq x < 4$

D. $-3 < x \leq 9$

20. A student writes the equation of a line parallel to $4x - 2y = 10$ through the point (3, 1) as $y = 2x - 5$. Is this correct?

A. Yes — the slope of $4x-2y=10$ is 2; using point-slope with (3,1): $y=2x-5$ ✓

B. No — the slope of the original line is 4, not 2

C. No — parallel lines must have the same y-intercept

D. No — the line through (3,1) with slope 2 is $y = 2x - 3$

21. A store sells candles at $8 each and diffusers at $15 each. A customer buys at least 10 items and spends no more than $110. Which system of inequalities models this situation?

A. $c + d = 10$ and $8c + 15d = 110$

B. $c + d \leq 10$ and $8c + 15d \leq 110$

C. $c + d \geq 10$ and $8c + 15d \geq 110$

D. $c + d \geq 10$ and $8c + 15d \leq 110$

22. Which of the following correctly describes the end behavior of $f(x) = -2x^2 + 5x - 1$?

A. As $x \to +\infty$, $f(x) \to +\infty$ and as $x \to -\infty$, $f(x) \to +\infty$

B. As $x \to +\infty$, $f(x) \to -\infty$ and as $x \to -\infty$, $f(x) \to +\infty$

C. As $x \to \pm\infty$, $f(x) \to +\infty$

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

23. Which of the following is an equation of a line that is perpendicular to $y = (2/5)x + 3$ and has the same y-intercept?

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

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

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

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

24. A geometric sequence has $a_1 = 81$ and $r = -(1/3)$. What is the 5th term?

A. -9

B. 1

C. −27

D. 3

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

Each question is worth 2 credits. Show all work.

25. Solve the quadratic equation $6x^2 + x - 12 = 0$ using the quadratic formula. Show all work and verify both solutions.

26. A car depreciates in value. Its initial value is $24,000 and it loses 15% of its value each year.

a. Write the exponential decay model V(t).

b. Find the value after 4 years. Round to the nearest dollar.

c. In approximately how many years will the car be worth less than $10,000?

27. The function $f(x) = -2x^2 + 16x - 24$ models the profit (in hundreds of dollars) of a product.

a. Factor completely.

b. Find the zeros and interpret each in context.

c. Find the vertex and state the maximum profit.

28. Determine whether the following system has one solution, no solution, or infinitely many solutions. Show all algebraic work.

$4x + 6y = 18$

$2x + 3y = 9$

29. Solve and graph the solution to the compound inequality:

$4x - 3 \geq 5$ AND $x - 7 < -2$

Express the solution in inequality notation and interval notation. Show all steps.

30. A data set contains the values: 5, 9, 14, 20, 27, 35, 44, 54, 65, 150.

a. Compute the mean and median.

b. Apply the $1.5 \times IQR$ rule to determine if 150 is an outlier.

c. State which measure of center best represents the data and explain.

31. A researcher records the number of hours students sleep and their performance on a standardized test. The data produces a regression equation $\hat{y} = 8.4x - 12.6$ with $r = 0.87$.

a. Interpret the slope in context.

b. Interpret the y-intercept in context and comment on its practical meaning.

c. Predict the score for a student who sleeps 8 hours.

d. A student who sleeps 7 hours scores 50. Calculate the residual.

32. For the sequence defined by $a_1 = 3$, $d = 7$:

a. Write the recursive and explicit formulas.

b. Find the 20th term.

c. Find the sum of the first 20 terms using $S_n = n/2 \cdot (a_1 + a_n)$.

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

Each question is worth 4 credits. Show all work.

33. A river restoration project models the population of a native fish species. Currently there are 400 fish. The population is expected to grow by 18% annually.

a. Write the exponential growth model P(t).

b. Create a table of values at t = 0, 2, 5, 8, 10. Round to the nearest whole number.

c. In approximately what year will the population first exceed 2,000 fish? Show algebraic or calculator-based work.

d. A second species starts with 1,200 fish and grows by 5% annually. Write its model and determine when the first species' population exceeds the second species' population. Use the graphing calculator or a table.

34. A student is simplifying the expression below and makes errors at two distinct steps. Identify both errors and show the complete correct work.

Student's work:

Step 1: Simplify $(x^2 - 9) / (x^2 - x - 6)$

Step 2: $= (x - 3)(x + 3) / (x - 3)(x + 2)$

Step 3: Cancel $(x - 3)$: $= (x + 3) / (x + 2)$

Step 4: "Since both $(x + 3)$ and $(x + 2)$ are factors, they cancel: result = 1"

PART IV — Extended Constructed Response (Question 35)

This question is worth 6 credits. Show all work.

35. A scientist studying a population of bacteria uses three models to predict population size N (in thousands) over time t (in hours):

Model A (Linear): $A(t) = 50t + 200$

Model B (Quadratic): $B(t) = 10t^2 + 30t + 200$

Model C (Exponential): $C(t) = 200(1.35)^t$

a. Verify that all three models give $N = 200$ at $t = 0$.

b. Create a table of values for t = 0, 2, 4, 6, 8, 10. Round to the nearest whole number.

c. At $t = 6$, rank the three models from smallest to largest predicted population. Show all three calculations.

d. According to Model B, at what time does the population reach its minimum? Explain why Model B has a minimum rather than a maximum, and compute that minimum value.

e. Compare all three models at $t = 10$. Which predicts the largest population? Explain in terms of each function's growth pattern why the models diverge increasingly over time.

Practice Exam 22 — Answer Key and Explanations

1. B — Using point-slope with slope $-3/4$ and point $(8, -1)$: $y+1=-(3/4)(x-8) \rightarrow y=-(3/4)x+6-1=-(3/4)x+5$. Verify: $f(8)=-6+5=-1$ ✓. Choice A uses +7 as the y-intercept, which results from incorrectly computing $-(3/4)(8)=-8$ instead of -6.

2. D — Distribute: $-3x(2x-5)=-6x^2+15x$ and $4(x^2-2x)=4x^2-8x$. Combine: $(-6x^2+4x^2)+(15x-8x)=-2x^2+7x$. The two x^2 terms combine to $-2x^2$, and the x terms combine to $+7x$. Choice C incorrectly applies the first distribution only.

3. C — Check ratios: 10/5=2, 20/10=2, 40/20=2, 80/40=2. The constant ratio of 2 with initial value 5 gives $f(x)=5(2)^x$. First differences (5,10,20,40) are not constant, eliminating linear. Choice A gives $f(0)=5$ ✓ but $f(1)=10$ ✗ ($5(1)+5=10$, seems right, but $f(2)=15\neq20$).

4. A — $\sqrt{1/2}=1/\sqrt{2}=\sqrt{2}/2\approx0.707$. Since $\sqrt{2}$ is irrational and dividing by a rational number preserves irrationality, $\sqrt{1/2}$ is irrational and less than 1. This directly disproves the claim. Choice C uses $-\sqrt{2}$ which is less than 1 but is negative, while choice A uses a positive irrational less than 1, making it the most direct counterexample.

5. D — Complete the square: $x^2+10x+3=(x^2+10x+25)-25+3=(x+5)^2-22$. Half of 10 is 5; $5^2=25$ is added and subtracted. The student's work is correct ✓. Choice A incorrectly adds 25 to the constant rather than subtracting.

6. B — Add 5, then divide by 2: $|x+3|=6$. Absolute value equation: $x+3=6 \rightarrow x=3$, or $x+3=-6 \rightarrow x=-9$. Both solutions are valid. Verify: $|3+3|=6$ ✓ and $|-9+3|=|-6|=6$ ✓. Choice A takes only the positive case.

7. C — The formula $a_n=-3n+17$ is linear in n, confirming it's an arithmetic sequence with $d=-3$. At $n=10$: $a_{10}=-3(10)+17=-30+17=-13$. Choice B gives -20, which would require $a_{10}=-30+10=-20$ — using the wrong calculation.

8. C — Adding an extreme value (130) well above the mean (62) pulls the mean substantially upward, since the mean incorporates every value. The median changes only slightly because it depends on position, not magnitude. The range increases because 130 becomes the new maximum. These three effects are all correct and well-supported.

9. A — Substitute equation 1 into equation 2: $3x+(-2x+9)=14 \rightarrow x+9=14 \rightarrow x=5$. Then $y=-2(5)+9=-1$. Solution: $(5,-1)$. Verify: $3(5)+(-1)=14$ ✓ and $-2(5)+9=-1$ ✓. Choice B $(3,3)$: $-2(3)+9=3$ ✓ but $3(3)+3=12\neq14$ ✗.

10. D — Factor out GCF 2: $18x^2-2=2(9x^2-1)$. Apply difference of squares: $9x^2-1=(3x-1)(3x+1)$. Completely factored: $2(3x-1)(3x+1)$. Choice A stops at $2(9x^2-1)$, which is only partially factored — the difference of squares must be resolved.

11. B — Complete the square: $x^2+8x-5=(x^2+8x+16)-16-5=(x+4)^2-21$. Half of 8 is 4; $4^2=16$ is added inside and subtracted outside. Vertex form: $(x+4)^2-21$, confirming the vertex is $(-4,-21)$. Choice C uses $(x-4)^2$, which shifts right instead of left.

12. A — Axis of symmetry: $x=-(-20)/[2(0.4)]=20/0.8=25$. This is the production level minimizing cost. Minimum cost: $C(25)=0.4(625)-20(25)+500=250-500+500=250$. The vertex of an upward-opening parabola ($a=0.4>0$) is the minimum point.

13. C — The function $f(x)=4|x-3|-7$ has its vertex (minimum) at $x=3$, where $f(3)=4(0)-7=-7$. Since $4|x-3|\geq0$ for all x, $f(x)\geq-7$ always. The range is $f(x)\geq-7$, meaning -7 is the minimum achievable output value.

14. D — At $x=4$: $p(4)=20$ and $q(4)=81$. From $x=3$ onward, q triples each step while p adds 3. This means q grows multiplicatively while p grows additively — the gap widens indefinitely, and $q(x)$ permanently dominates after $x=3$. Choice C is also true but choice D adds the crucial additional fact that this rate advantage persists permanently.

15. A — Simplify: $(2x^3)(3x^{-2})/(6x) = 6x^{(3+(-2))}/(6x) = 6x^1/(6x) = 6x/(6x) = 1 = x^0$. All x-factors cancel completely, leaving the coefficient $6/6=1$. Any nonzero number or expression divided by itself equals 1.

16. C — Apply the rule: $a_1=6$; $a_2=2(6)-5=7$; $a_3=2(7)-5=9$; $a_4=2(9)-5=13$. Each term doubles the previous then subtracts 5. Choice D gives $a_2=1$, which would require $2(6)-5$ to equal 1 — incorrect.

17. D — Of 180 participants, 108 are in sports: $108/180=0.60=60\%$. The question asks the percentage of participants (the 180-person denominator), not all students (300). Choice A (36%) uses 108/300, which incorrectly uses the grand total.

18. A — Factor numerator: $x^2-16=(x-4)(x+4)$. Factor denominator: x^2+x-6... wait — $x^2+2x-8=(x+4)(x-2)$. Cancel $(x+4)$: result$=(x-4)/(x-2)$. This matches choice A. Undefined when $x=-4$ and $x=2$.

19. B — Subtract 1 throughout: $-3-1<2x\leq9-1 \rightarrow -4<2x\leq8$. Divide by 2: $-2<x\leq4$. The left endpoint is strict (open) and the right endpoint is closed. Choice A mistakenly carries -3 directly without subtracting 1 first.

20. A — Rewrite $4x-2y=10$: $-2y=-4x+10 \rightarrow y=2x-5$. Slope=2. Using point-slope with $(3,1)$ and slope 2: $y-1=2(x-3) \rightarrow y=2x-6+1=2x-5$. The student's equation $y=2x-5$ is correct ✓. Verify: $f(3)=6-5=1$ ✓.

21. D — "At least 10 items" means $c+d \geq 10$. "Spends no more than \$110" means $8c+15d \leq 110$. Both constraints are inequalities, not equations. Choice A uses equalities instead of inequalities, failing to model the "at least" and "no more than" language.

22. D — For $f(x)=-2x^2+5x-1$, the leading term is $-2x^2$ (even degree, negative leading coefficient). Both ends of an even-degree polynomial with a negative leading coefficient point downward: as $x \to \pm\infty$, $f(x) \to -\infty$. Choice A is wrong because a negative leading coefficient cannot produce upward end behavior.

23. A — Perpendicular slope to 2/5 is −5/2. Same y-intercept means +3. Equation: $y=-(5/2)x+3$. The negative reciprocal slope relationship is the defining criterion for perpendicularity, and the same y-intercept is explicitly required by the problem. Choice D uses the perpendicular slope but the wrong y-intercept.

24. B — $a_5=81(-1/3)^4=81 \cdot (1/81)=1$. The exponent 4 is even, so $(-1/3)^4=(1/3)^4=1/81$. Multiplying: $81 \cdot (1/81)=1$. Choice A gives −9, which would be $a_3=81(-1/3)^2=81(1/9)=9$ — not negative and not a_5.

25. A — $a=6$, $b=1$, $c=-12$. Discriminant=1+288=289. $x=(-1 \pm 17)/12$. Solutions: $x=16/12=4/3$ and $x=-18/12=-3/2$. Verify $x=4/3$: $6(16/9)+(4/3)-12=32/3+4/3-36/3=0$ ✓. Verify $x=-3/2$: $6(9/4)+(-3/2)-12=27/2-3/2-24/2=0$ ✓.

26. D — Model: $V(t)=24000(0.85)^t$. After 4 years: $V(4)=24000(0.85)^4 \approx 24000(0.5220) \approx \$12{,}528$. For $V(t)<10000$: $24000(0.85)^t=10000 \to (0.85)^t=5/12 \to t=\ln(5/12)/\ln(0.85) \approx 5.46$. The car's value falls below \$10,000 during year 6.

27. C — Factor: $-2x^2+16x-24=-2(x^2-8x+12)=-2(x-6)(x-2)$. Zeros: $x=6$ and $x=2$ — the product breaks even (zero profit) when 200 or 600 items are sold. Axis of symmetry: $x=4$; vertex: $f(4)=-2(16)+64-24=-32+64-24=8$. Maximum profit is \$800 (8 hundred dollars) at 400 items sold.

28. B — Divide equation 1 by 2: $2x+3y=9$, which is identical to equation 2. The system has infinitely many solutions — consistent and dependent. Every point on $2x+3y=9$ (or equivalently $4x+6y=18$) satisfies both equations.

29. B — Solve inequality 1: $4x-3 \geq 5 \to 4x \geq 8 \to x \geq 2$. Solve inequality 2: $x-7<-2 \to x<5$. Intersection (AND): $2 \leq x<5$. Inequality notation: $2 \leq x<5$. Interval notation: [2, 5). Graph: closed circle at 2, open circle at 5, segment between them.

30. C — Sum=5+9+…+65+150=423. Mean=423/10=42.3. Median=(27+35)/2=31. Q1=(9+14)/2=11.5; Q3=(54+65)/2=59.5; IQR=48. Upper fence=59.5+1.5(48)=59.5+72=131.5. Since 150>131.5, the value 150 is an outlier. The median (31) better represents the typical value because the outlier inflates the mean substantially.

31. D — Slope 8.4: each additional hour of sleep predicts a 8.4-point increase in test score. Y-intercept −12.6: a student sleeping 0 hours is predicted to score −12.6 points, which is not physically meaningful — the model is only reliable within the observed data range. Predicted score at 8 hours: $\hat{y}=8.4(8)-12.6=67.2-12.6=54.6$. Residual for 7-hour student scoring 50: predicted=8.4(7)−12.6=46.2;

residual=50−46.2=3.8. The positive residual means this student scored 3.8 points above the model's prediction.

32. B — Recursive: $a_1=3$; $a_n=a_{n-1}+7$. Explicit: $a_n=7n-4$. $a_{20}=7(20)-4=136$. Verify: $a_1=7(1)-4=3$ ✓. $S_{20}=20/2\cdot(3+136)=10\cdot139=1{,}390$.

33. A — Model: P(t)=400(1.18)^t. Table (rounded): t=0: 400; t=2: $400(1.18)^2\approx556$; t=5: 400(1.18)^5≈914; t=8: ≈1,501; t=10: ≈2,090. For P(t)>2000: 400(1.18)^t=2000 → (1.18)^t=5 → t=ln(5)/ln(1.18)≈9.85. Population first exceeds 2,000 during year 10. Second species: Q(t)=1200(1.05)^t. Set equal: 400(1.18)^t=1200(1.05)^t → (1.18/1.05)^t=3 → (1.124)^t=3 → t=ln(3)/ln(1.124)≈9.36. Species 1 first exceeds Species 2 during year 10 (approximately t=9.4).

34. C — Steps 1–3 are correct: $(x^2-9)/(x^2+x-6)=(x-3)(x+3)/[(x-3)(x+2)]$. Cancel (x−3) (with restriction x≠3): result=(x+3)/(x+2). The error is in Step 4 — (x+3) and (x+2) share no common factor and therefore cannot be cancelled. Cancellation applies only to identical factors, not to similar-looking binomials. The fully simplified expression is (x+3)/(x+2), and both restriction values (x≠3 and x≠−2) must be stated.

35. D — At t=0: A(0)=200 ✓; B(0)=200 ✓; C(0)=200 ✓. Table (rounded): t=0: A=200, B=200, C=200; t=2: A=300, B=300, C=365; t=4: A=400, B=500, C=665; t=6: A=500, B=800, C=1,213; t=8: A=600, B=1,200, C=2,213; t=10: A=700, B=1,700, C=4,034. At t=6: A=500<B=800<C=1,213. Ranking smallest to largest: A, B, C. Model B vertex: axis=−30/[2(10)]=−1.5. Since a=10>0, Model B opens upward — it has a minimum, not a maximum. B(−1.5)=10(2.25)+30(−1.5)+200=22.5−45+200=177.5 thousand bacteria. This occurs at t=−1.5 hours (before the observation period), meaning within the observable domain (t≥0), the population is always increasing. At t=10: A=700, B=1,700, C=4,034. Model C predicts the largest population. Linear Model A adds a fixed 50 per hour; quadratic Model B adds increasingly large amounts; exponential Model C multiplies by 1.35 each hour — the exponential's growth rate itself grows proportionally to current value, creating the widest divergence over time.