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Drill Problems: Week 2.6

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COLUMBIA ACADEMY

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Written by Jaehoon Song (Lecturer)

1. **Rectangle Area Function** (10 points)
A rectangle has a length that is 15 times its width. The function $y = (15w)(w)$ represents this situation, where y is the area, in square feet, of the rectangle and $y > 0$. Which of the following is the best interpretation of $15w$ in this context?

(A) The length of the rectangle, in feet

(B) The area of the rectangle, in square feet

(C) The difference between the length and the width of the rectangle, in feet

(D) The width of the rectangle, in feet

Answer:

2. **Quadratic Function Roots** (10 points)
The quadratic function h is defined as shown.

$$h(x) = 2(x - 4)^2 - 32$$

In the xy-plane, the graph of $y = h(x)$ intersects the x-axis at the points $(0, 0)$ and $(t, 0)$, where t is a constant.

What is the value of t?

(A) 1

(B) 2

(C) 4

(D) 8

Answer:

3. **Exponential Function Y-Intercept** (10 points)
The function f is defined by $f(x) = (-8)(2)^x + 22$. What is the y-intercept of the graph of $y = f(x)$ in the xy-plane?

(A) $(0, 14)$

(B) $(0, 2)$

(C) $(0, 22)$

(D) $(0, -8)$

Answer:

4. **Ball Height Interpretation** (10 points)

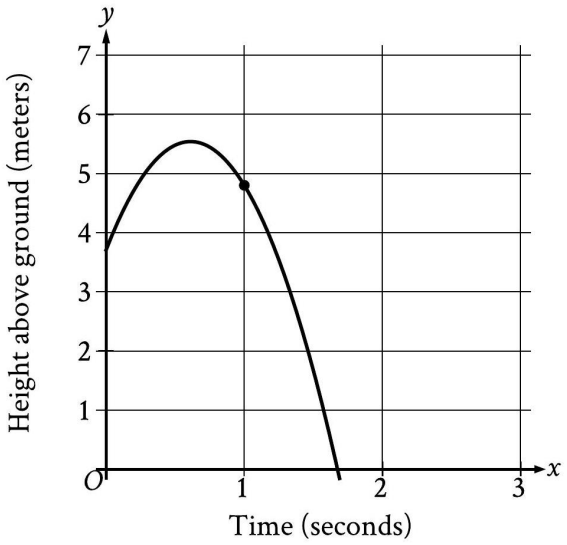

Figure 1: reference attached

The graph shows the height above ground, in meters, of a ball x seconds after the ball was launched upward from a platform. Which statement is the best interpretation of the marked point $(1.0, 4.8)$ in this context?

(A) 1.0 second after being launched, the ball's height above ground is 4.8 meters.

(B) 4.8 seconds after being launched, the ball's height above ground is 1.0 meter.

(C) The ball was launched from an initial height of 1.0 meter with an initial velocity of 4.8 meters per second.

(D) The ball was launched from an initial height of 4.8 meters with an initial velocity of 1.0 meter per second.

Answer:

5. **Exponential Decay Y-Intercept** (10 points)
The given function f models the number of advertisements a company sent to its clients each year, where x represents the number of years since 1997, and $0 \leq x \leq 5$.

$$f(x) = 9,000(0.66)^x$$

If $y = f(x)$ is graphed in the xy-plane, which of the following is the best interpretation of the y-intercept of the graph in this context?

(A) The minimum estimated number of advertisements the company sent to its clients during the 5 years was 1,708.

(B) The minimum estimated number of advertisements the company sent to its clients during the 5 years was 9,000.

(C) The estimated number of advertisements the company sent to its clients in 1997 was 1,708.

(D) The estimated number of advertisements the company sent to its clients in 1997 was 9,000.

Answer:

□

6. **Geometric Sequence Formula** (10 points)
The first term of a sequence is 9. Each term after the first is 4 times the preceding term. If w represents the nth term of the sequence, which equation gives w in terms of n?

(A) $w = 4\,(9^n)$

(B) $w = 4\,(9^{n-1})$

(C) $w = 9\,(4^n)$

(D) $w = 9\,(4^{n-1})$

Answer:

□

7. **Graph Y-Intercept** (10 points)

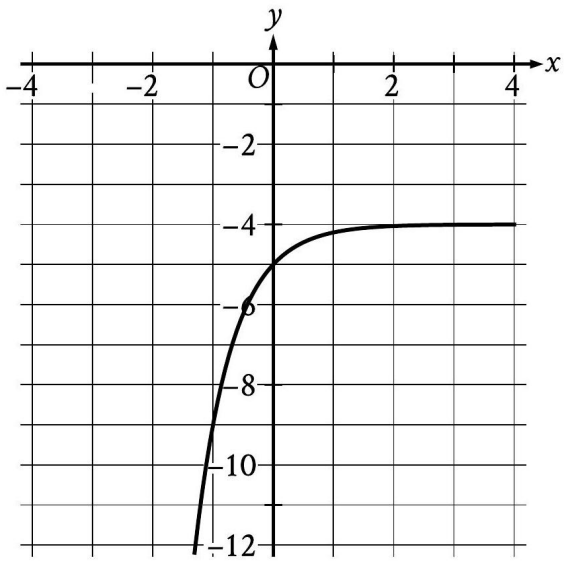

Figure 2: reference attached

What is the y-intercept of the graph shown?

(A) $(-1, -9)$
(B) $(0, -5)$
(C) $(0, -4)$
(D) $(0, 0)$

Answer:

8. **Savings Account Exponential Model** (10 points)
Rosa opened a savings account at a bank. The table shows the exponential relationship between the time t, in years, since Rosa opened the account and the total amount n, in dollars, in the account. If Rosa made no additional deposits or withdrawals, which of the following equations best represents the relationship between t and n?

Savings Account Balance

Time (years)	Total amount (dollars)
0	604.00
1	606.42
2	608.84

(A) $n = 604(1.004)^t$
(B) $n = 604(1.04)^t$
(C) $n = 604(1.004)^{t+1}$
(D) $n = 0.004(604)^t$

Answer:

□

9. **Exponential Function Parameters** (10 points)
Function f is defined by $f(x) = -a^x + b$, where a and b are constants. In the xy-plane, the graph of $y = f(x) - 12$ has a y-intercept at $\left(0, -\frac{75}{7}\right)$. The product of a and b is $\frac{320}{7}$. What is the value of a?

Answer:

□

10. **Ocean Water Level Model** (10 points)

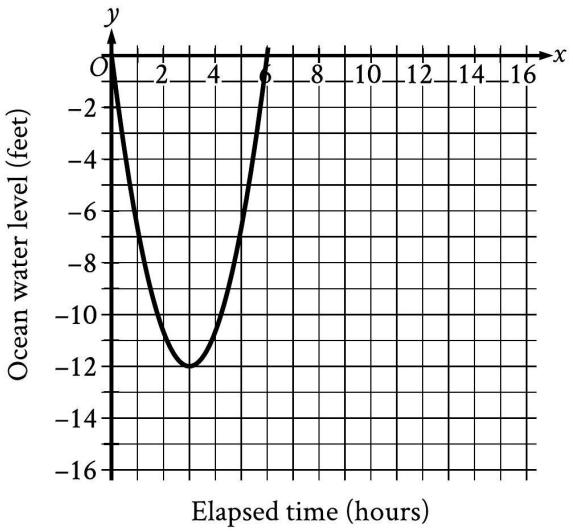

Figure 3: reference attached

Scientists recorded data about the ocean water levels at a certain location over a period of 6 hours. The graph shown models the data, where $y = 0$ represents sea level. Which table gives values of x and their corresponding values of y based on the model?

(A)

x	y
0	-12
0	3
6	6

(A)

x	y
0	0
3	12
0	-6

(A)

x	y
0	0
3	-12
6	0

(A)

x	y
0	0
12	6
-6	0

Answer:

11. **Square Root Function Evaluation** (10 points)
The function f is defined by $f(x) = 4 + \sqrt{x}$. What is the value of $f(144)$?

(A) 0
(B) 16
(C) 40
(D) 76

Answer:

12. **Rectangular Court Dimensions** (10 points)
A rectangular volleyball court has an area of 162 square meters. If the length of the court is twice the width, what is the width of the court, in meters?

(A) 9
(B) 18
(C) 27
(D) 54

Answer:

□

13. **Softball Height Equation** (10 points)
A machine launches a softball from ground level. The softball reaches a maximum height of 51.84 meters above the ground at 1.8 seconds and hits the ground at 3.6 seconds. Which equation represents the height above ground h, in meters, of the softball t seconds after it is launched?

(A) $h = -t^2 + 3.6$
(B) $h = -t^2 + 51.84$
(C) $h = -64(t - 2.7)^2 + 51.84$
(D) $h = -16t^2 + 57.6t$

Answer:

□

14. **Exponential Function Intercepts** (10 points)
The function f is defined by $f(x) = a^x + b$, where a and b are constants. In the xy-plane, the graph of $y = f(x)$ has an x-intercept at $(2, 0)$ and a y-intercept at $(0, -323)$. What is the value of b?

Answer:

□

15. **Salary Growth Model** (10 points)
The function S above models the annual salary, in dollars, of an employee n years after starting a job, where a is a constant.

$$S(n) = 38,000a^n$$

If the employee's salary increases by 4% each year, what is the value of a?

(A) 0.04
(B) 0.4
(C) 1.04
(D) 1.4

Answer:

□

16. **Revenue Function Interpretation** (10 points)
The revenue $f(x)$, in dollars, that a company receives from sales of a product is given by the function f above, where x is the unit price, in dollars, of the product.

$$f(x) = -500x^2 + 25\,000x$$

The graph of $y = f(x)$ in the xy-plane intersects the x-axis at 0 and a. What does a represent?

(A) The revenue, in dollars, when the unit price of the product is \$0

(B) The unit price, in dollars, of the product that will result in maximum revenue

(C) The unit price, in dollars, of the product that will result in a revenue of \$0

(D) The maximum revenue, in dollars, that the company can make

Answer:

17. **Bacteria Growth Prediction** (10 points)
A culture of bacteria is growing at an exponential rate, as shown in the table above. At this rate, on which day would the number of bacteria per milliliter reach 5.12×10^8?

Growth of a Culture of Bacteria

Day	Number of bacteria per milliliter at end of day
1	2.5×10^5
2	5.0×10^5
3	1.0×10^6

(A) Day 5

(B) Day 9

(C) Day 11

(D) Day 12

Answer:

18. **Data Traffic Model Interpretation** (10 points)
The equation above estimates the global data traffic D, in terabytes, for the year that is t years after 2010.

$$D = 5,640(1.9)^t$$

What is the best interpretation of the number 5,640 in this context?

(A) The estimated amount of increase of data traffic, in terabytes, each year
(B) The estimated percent increase in the data traffic, in terabytes, each year
(C) The estimated data traffic, in terabytes, for the year that is t years after 2010
(D) The estimated data traffic, in terabytes, in 2010

Answer:

□

19. **Quadratic Function Properties** (10 points)
In the given quadratic function, a and c are constants. The graph of $y = f(x)$ in the xy-plane is a parabola that opens upward and has a vertex at the point (h, k), where h and k are constants.

$$f(x) = ax^2 + 4x + c$$

If $k < 0$ and $f(-9) = f(3)$, which of the following must be true?

(I) $c < 0$
(II) $a \geq 1$

(A) I only
(B) II only
(C) I and II
(D) Neither I nor II

Answer:

□

20. **Exponent Rules** (10 points)
Which expression is equivalent to $(m^4q^4z^{-1})\,(mq^5z^3)$, where m, q, and z are positive?

(A) $m^4q^{20}z^{-3}$
(B) $m^5q^9z^2$
(C) $m^6q^8z^{-1}$
(D) $m^{20}q^{12}z^{-2}$

Answer:

□

21. **Polynomial Factoring** (10 points)
Which of the following is a factor of the polynomial above?

$$4a^2 + 20ab + 25b^2$$

(A) $a + b$
(B) $2a + 5b$
(C) $4a + 5b$
(D) $4a + 25b$

Answer:

22. **Polynomial Operations** (10 points)
If $p = 3x + 4$ and $v = x + 5$, which of the following is equivalent to $pv - 2p + v$?

(A) $3x^2 + 12x + 7$
(B) $3x^2 + 14x + 17$
(C) $3x^2 + 19x + 20$
(D) $3x^2 + 26x + 33$

Answer:

23. **Linear Expression Simplification** (10 points)
Which of the following is equivalent to the given expression?

$$(x + 5) + (2x - 3)$$

(A) $3x - 2$
(B) $3x + 2$
(C) $3x - 8$
(D) $3x + 8$

Answer:

24. **Rational Expression Simplification** (10 points)
Which expression is equivalent to $\frac{8x(x-7)-3(x-7)}{2x-14}$, where $x > 7$?

(A) $\frac{x-7}{5}$
(B) $\frac{8x-3}{2}$
(C) $\frac{8x^2-3x-14}{2x-14}$
(D) $\frac{8x^2-3x-77}{2x-14}$

Answer:

□

25. **Polynomial Factoring** (10 points)
Which of the following is equivalent to the expression $x^4 - x^2 - 6$?

(A) $(x^2+1)(x^2-6)$
(B) $(x^2+2)(x^2-3)$
(C) $(x^2+3)(x^2-2)$
(D) $(x^2+6)(x^2-1)$

Answer:

□

26. **Polynomial Expansion** (10 points)
Which of the following is equivalent to the expression above?

$$(2x+5)^2 - (x-2) + 2(x+3)$$

(A) $4x^2 + 21x + 33$
(B) $4x^2 + 21x + 29$
(C) $4x^2 + x + 29$
(D) $4x^2 + x + 33$

Answer:

□

27. **Polynomial Multiplication** (10 points)
The equation above is true for all x, where a and b are constants.

$$(ax+3)\left(5x^2-bx+4\right)=20x^3-9x^2-2x+12$$

What is the value of ab?

(A) 18
(B) 20
(C) 24
(D) 40

Answer:

□

28. **Difference of Squares** (10 points)
Which of the following expressions is equivalent to x^2-5?

(A) $(x+\sqrt{5})^2$
(B) $(x-\sqrt{5})^2$
(C) $(x+\sqrt{5})(x-\sqrt{5})$
(D) $(x+5)(x-1)$

Answer:

□

29. **Quadratic Factoring** (10 points)
Which of the following expressions is(are) a factor of $3x^2+20x-63$?

(I) $x-9$
(II) $3x-7$

(A) I only
(B) II only
(C) I and II
(D) Neither I nor II

Answer:

□

30. **Rational Exponent Simplification** (10 points)
If $\frac{\sqrt{x^5}}{\sqrt[3]{x^4}}=x^{\frac{a}{b}}$ for all positive values of x, what is the value of $\frac{a}{b}$?

Answer:

□

31. **Polynomial Factoring** (10 points)
The expression $90y^5 - 54y^4$ is equivalent to $ry^4(15y - 9)$, where r is a constant. What is the value of r?

Answer:

32. **Rational Equation** (10 points)
The equation above is true for all $x > 2$, where r and t are positive constants.

$$\frac{2}{x-2} + \frac{3}{x+5} = \frac{x+t}{(x-2)(x+5)}$$

What is the value of rt?

(A) -20
(B) 15
(C) 20
(D) 60

Answer:

33. **Polynomial Simplification** (10 points)
Which of the following is an equivalent form of $(1.5x - 2.4)^2 - (5.2x^2 - 6.4)$?

(A) $-2.2x^2 + 1.6$
(B) $-2.2x^2 + 11.2$
(C) $-2.95x^2 - 7.2x + 12.16$
(D) $-2.95x^2 - 7.2x + 0.64$

Answer:

34. **Root Expression Simplification** (10 points)
For what value of x is the given expression equivalent to $(70n)^{30x}$, where $n > 1$?

$$\sqrt[5]{70n}(\sqrt[6]{70n})^2$$

Answer:

35. **System of Equations Solutions** (10 points)

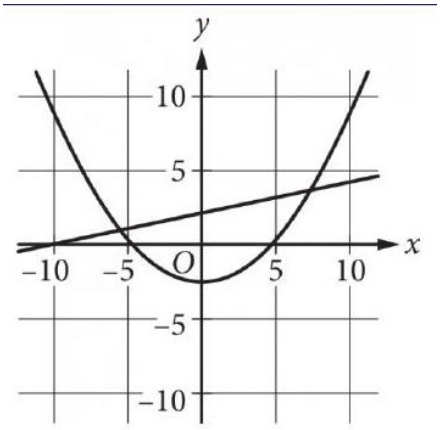

Figure 4: reference attached

A system of equations consists of a quadratic equation and a linear equation. The equations in this system are graphed in the xy-plane above. How many solutions does this system have?

(A) 0
(B) 1
(C) 2
(D) 3

Answer:

36. **Linear Inequality** (10 points)
Which of the following inequalities is equivalent to the inequality above?

$$6x - 9y > 12$$

(A) $x - y > 2$
(B) $2x - 3y > 4$
(C) $3x - 2y > 4$
(D) $3y - 2x > 2$

Answer:

37. **System of Equations Solution** (10 points)
If (x, y) is a solution to the system of equations above, which of the following could be the value of x?

$$y = x + 1$$
$$y = x^2 + x$$

(A) -1
(B) 0
(C) 2
(D) 3

Answer:

□

38. **Quadratic Equation Solutions** (10 points)
What values satisfy the equation above?

$$x^2 - x - 1 = 0$$

(A) $x = 1$ and $x = 2$
(B) $x = -\frac{1}{2}$ and $x = \frac{3}{2}$
(C) $x = \frac{1+\sqrt{5}}{2}$ and $x = \frac{1-\sqrt{5}}{2}$
(D) $x = \frac{-1+\sqrt{5}}{2}$ and $x = \frac{-1-\sqrt{5}}{2}$

Answer:

□

39. **Function Intersection** (10 points)
The graphs of the given equations intersect at the point (x, y) in the xy-plane.

$$x = 49$$
$$y = \sqrt{x} + 9$$

What is the value of y?

(A) 16
(B) 40
(C) 81
(D) 130

Answer:

□

40. **Absolute Value Equation** (10 points)
What is the positive solution to the given equation?

$$2|4 - x| + 3|4 - x| = 25$$

Answer:

□

41. **Quadratic Equation Solution** (10 points)
One solution to the given equation can be written as $1 + \sqrt{k}$, where k is a constant.

$$x^2 - 2x - 9 = 0$$

What is the value of k?

(A) 8
(B) 10
(C) 20
(D) 40

Answer:

□

42. **Parabola and Line Intersection** (10 points)
In the xy-plane, a line with equation $2y = 4.5$ intersects a parabola at exactly one point. If the parabola has equation $y = -4x^2 + bx$, where b is a positive constant, what is the value of b?

Answer:

□

43. **System of Equations Solution** (10 points)
Which ordered pair is a solution to the system of equations above?

$$x - y = 1$$
$$x + y = x^2 - 3$$

(A) $(1 + \sqrt{3}, \sqrt{3})$
(B) $(\sqrt{3}, -\sqrt{3})$
(C) $(1 + \sqrt{5}, \sqrt{5})$
(D) $(\sqrt{5}, -1 + \sqrt{5})$

Answer:

□

44. **Variable Isolation** (10 points)
The given equation relates the variables r, s, and t. Which equation correctly expresses s in terms of r and t?

$$6r = 7s + t$$

(A) $s = 42r - t$
(B) $s = 7(6r - t)$
(C) $s = \frac{6}{7}r - t$
(D) $s = \frac{6r-t}{7}$

Answer:

□

45. **Rational Equation Solution** (10 points)
If x is a solution to the given equation, which of the following is a possible value of $x + 5$?

$$\frac{1}{x^2 + 10x + 25} = 4$$

(A) $\frac{1}{2}$
(B) $\frac{5}{2}$
(C) $\frac{9}{2}$
(D) $\frac{11}{2}$

Answer:

□

46. **Acceleration Equation** (10 points)
During a 5-second time interval, the average acceleration a, in meters per second squared, of an object with an initial velocity of 12 meters per second is defined by the equation

$$a = \frac{v_f - 12}{5}$$

, where v_f is the final velocity of the object in meters per second. If the equation is rewritten in the form $v_f = xa + y$, where x and y are constants, what is the value of x?

Answer:

□

47. **Function Intersection** (10 points)
The graphs of the given equations in the xy-plane intersect at the point (x, y).

$$y = 76$$
$$y = x^2 - 5$$

What is a possible value of x?

(A) $-\frac{76}{5}$
(B) -9
(C) 5
(D) 76

Answer:

48. **Variable Isolation** (10 points)
The given equation relates the positive numbers m, n, and p. Which equation correctly gives n in terms of m and p?

$$7m = 5(n + p)$$

(A) $n = \frac{5p}{7m}$
(B) $n = \frac{7m}{5} - p$
(C) $n = 5(7m) + p$
(D) $n = 7m - 5 - p$

Answer:

49. **Quadratic Equation Solution** (10 points)
Which of the following is a solution to the equation above?

$$2x^2 - 2 = 2x + 3$$

(A) 2
(B) $1 - \sqrt{11}$
(C) $\frac{1}{2} + \sqrt{11}$
(D) $\frac{1+\sqrt{11}}{2}$

Answer:

50. **Parabola and Line Intersection** (10 points)
In the xy-plane, a line with equation $2y = c$ for some constant c intersects a parabola at exactly one point. If the parabola has equation $y = -2x^2 + 9x$, what is the value of c?

Answer:

51. **System of Equations Solution** (10 points)

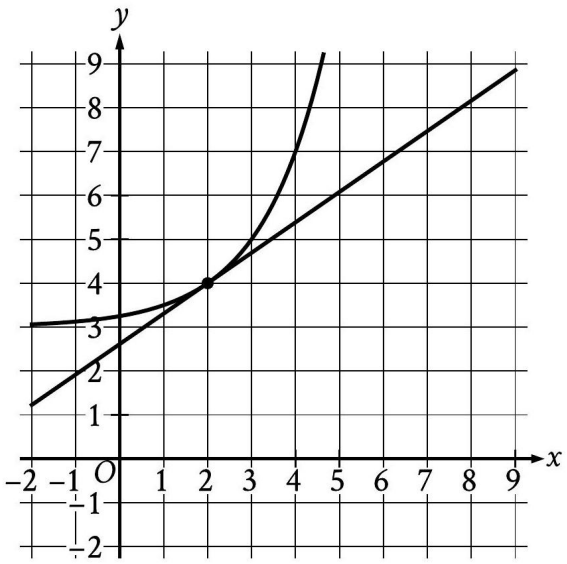

Figure 5: reference attached

The graph of a system of a linear equation and a nonlinear equation is shown. What is the solution (x, y) to this system?

(A) $(0, 0)$

(B) $(0, 2)$

(C) $(2, 4)$

(D) $(4, 0)$

Answer:

□

52. **Polynomial Roots Product** (10 points)
What is the product of the solutions to the given equation?

$$(x - 4)(x + 2)(x - 1) = 0$$

(A) 8

(B) 3

(C) -3

(D) -8

Answer:

□

53. **Rational Equation Solution** (10 points)
What is the solution to the equation above?

$$\frac{2(x+1)}{x+5} = 1 - \frac{1}{x+5}$$

(A) 0
(B) 2
(C) 3
(D) 5

Answer:

□

54. **Radical Equation** (10 points)
What is the smallest solution to the given equation?

$$\sqrt{(x-2)^2} = \sqrt{3x+34}$$

Answer:

□