CLEP
College Algebra

Time—90 Minutes 60 Questions	For each question below, choose the best answer from the choices given.

1. $(4x + 2)^2 =$

(A) $4x^2 + 4$
(B) $16x^2 – 4$
(C) $16x^2 + 4$
(D) $16x^2 + 8x + 4$
(E) $16x^2 + 16x + 4$

2. Which of the following is a factor of $9 – (2x + 1)^2$?

(A) $2x + 1$
(B) $–2x + 1$
(C) $3 – 2x + 1$
(D) $3 + (2x + 1)$
(E) $9 + (2x + 1)$

3. $5b(3b^2 + 2) – (3b^3 + 10b – 8) – 6 =$

(A) $18b^3 + 2$
(B) $12b^3 + 2$
(C) $12b^3 + 14$
(D) $12b^3 + 20b – 6$
(E) $12b^3 + 20b – 14$

4. If $2a + 4 = b$, what is the value of $\left| \frac{b – 2a}{2} \right|$?

(A) –4
(B) –2
(C) 2
(D) 4
(E) It cannot be determined from the given information.

5. Where defined, $\dfrac{\dfrac{x^2-25}{x+10}}{\dfrac{x+5}{x=10}} =$

(A) $\dfrac{x-5}{x-10}$

(B) $\dfrac{(x-5)(x-10)}{x+10}$

(C) $\dfrac{x^2-5x-50}{x+10}$

(D) $\dfrac{1}{(x+5)(x-5)}$

(E) $\dfrac{x+10}{(x+5)(x-5)}$

6. Which of the following is a factor of $16x^2 - 2x - 18$?

(A) $x - 18$
(B) $2x - 2$
(C) $2x + 2$
(D) $2x + 6$
(E) $8x + 2$

7. Of the following, which is greatest?

(A) $(2^5)^3$
(B) $3^{(5^2)}$
(C) $(3^5)^2$
(D) $5^{(2^3)}$
(E) $(5^2)^3$

8. For any positive integer x, $\frac{(x-1)!}{x!} + x =$

(A) 0
(B) 1
(C) x
(D) $\frac{1}{x} + x$
(E) $-x$

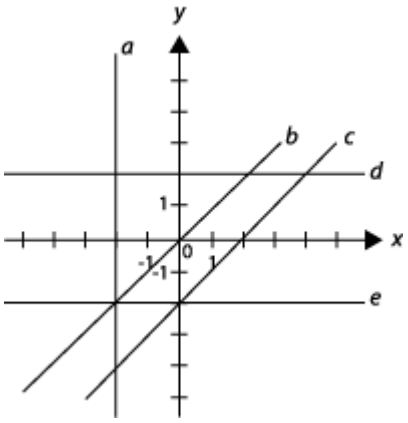
9. Which of the following is equal to $ab^{\frac{3}{5}}a^{-\frac{4}{5}}b^{\frac{2}{5}}$?

(A) $-a^5b$
(B) $a^{\frac{8}{5}}b^{\frac{3}{5}}$
(C) $\sqrt[5]{a} \times b$
(D) $\sqrt[5]{a} \times \sqrt{b}$
(E) $\sqrt[5]{a^4} \times \sqrt{b}$

10. Maureen is painting horizontal stripes on a wall for a mural. The first stripe is a certain number of centimeters, c. The second stripe is $\frac{3}{4}$ the length of the first stripe, and each subsequent stripe is $\frac{3}{4}$ the length of the previous stripe. For example, the second stripe is $\frac{3}{4}c$. Which of the following represents the total number of centimeters that Maureen will paint if she paints 9 stripes for the mural?

(A) $\sum_{i=1}^{\infty} c\left(\frac{3}{4}\right)^i$
(B) $\sum_{i=1}^{10} c\left(\frac{3}{4}\right)^i$
(C) $\sum_{i=1}^{9} c\left(\frac{3}{4}\right)^{i+1}$
(D) $\sum_{i=1}^{9} c\left(\frac{3}{4}\right)^{i-1}$
(E) $\sum_{i=1}^{9} c\left(\frac{3}{4}\right)^i$

11.



Which of the lines in the figure above is the graph of $y = -2$?

(A) *a*
(B) *b*
(C) *c*
(D) *d*
(E) *e*

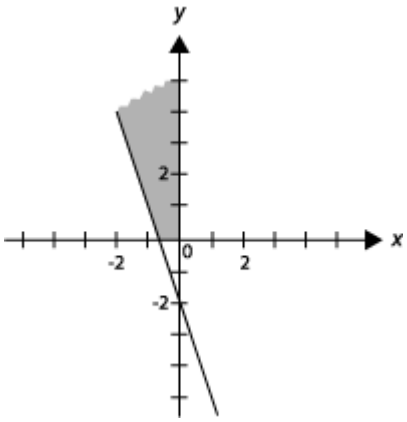
12. Which of the following gives all values of m for which $|m - 3| \leq 7$?

(A) $\{m|m \leq -10 \text{ or } m \geq 4\}$
(B) $\{m|-7 \leq m \leq 7\}$
(C) $\{m|-4 \leq m \leq 10\}$
(D) $\{m|m \leq -7\}$
(E) $\{m|m \leq -4 \text{ or } m \geq 10\}$

13. Which of the following are the solutions of the equation $4x^2 + 6x = 8 - 2x$?

(A) $x = 8$ and $x = -8$
(B) $x = 8$ and $x = -1$
(C) $x = 1 + \sqrt{3}$ and $x = 1 - \sqrt{3}$
(D) $x = -1 + \sqrt{3}$ and $x = -1 - \sqrt{3}$
(E) $x = -1 + \frac{\sqrt{2}}{2}$ and $x = -1 - \frac{\sqrt{2}}{2}$

14.



The shaded region in the figure above represents the intersection of the graphs of $y \geq 0$, $x \leq 0$, and which of the following inequalities?

(A) $y \leq -\frac{2}{3}x - 2$

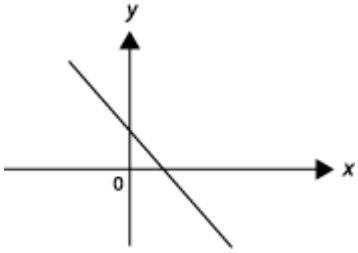
(B) $y \leq -3x + 2$

(C) $y \geq -\frac{2}{3}x - 2$

(D) $y \geq 3x - 2$

(E) $y \geq -3x - 2$

15.



The figure above shows the graph of the line with equation $ax - by = -1$. Which of the following must be true?

(A) $a < 0$ and $b > 0$

(B) $a < 0$ and $b < 0$

(C) $a < 0$ and $b \leq 0$

(D) $a = 1$ and $b > 0$

(E) $a > 0$ and $b = 1$

16. The set of all values for b for which the equation $x^2 + bx + 9 = 0$ has either one or two real roots is defined by

(A) $b < 6$.
(B) $b > 6$.
(C) $b < 6$ or $b > 6$.
(D) $b \leq -6$ or $b \geq 6$.
(E) $b \leq -9$ or $b \geq 9$.

17. Which quadrants of the xy-plane contain points of the graph of $4x - 2y > 12$?

(A) I and IV only
(B) I, II, and III only
(C) I, III, and IV only
(D) II, III, and IV only
(E) I, II, III, and IV

18. Miguel buys a house for $120,000 and at the same time in a different town, Lucy buys a house for $80,000. The value of Miguel's house decreases by $500 per year, while the value of Lucy's house increases by $250 per year. Which of the following systems of equations could be used to find the number of years, y, that it will take for the values, v_1 (the value of Miguel's house) and v_2 (the value of Lucy's house) to be equal?

(A) $v_1 = 120{,}000 - y$ and $v_2 = 80{,}000 + y$
(B) $v_1 = 120{,}000 - 5y$ and $v_2 = 80{,}000 + y$
(C) $v_1 = 120{,}000 + 250y$ and $v_2 = 80{,}000 - 500y$
(D) $v_1 = 120{,}000 + 500y$ and $v_2 = 80{,}000 - 250y$
(E) $v_1 = 120{,}000 - 500y$ and $v_2 = 80{,}000 + 250y$

19. If $\log_b(m) = 12$, what is the value of b^{12}?

(A) $m - 12$
(B) $12m$
(C) m
(D) 12
(E) $m - b$

20. Which of the following numbers are irrational?

I. $\sqrt{9\pi}$
II. 0.66…
III. $\sqrt{\frac{2}{3}}$

(A) I only
(B) II only
(C) I and II only
(D) I and III only
(E) I, II, and III

21. When $\frac{5-5i}{3-i}$ is expressed in the form $a + bi$, what is the value of a?

(A) 1
(B) 2
(C) 3
(D) 4
(E) 5

22. If $a > 0 > b > c$, then each of the following must be true EXCEPT

(A) $ac < bc$
(B) $a^2b < b^2a$
(C) $abc > ab$
(D) $a^2 > b^2 > c^2$
(E) $a^3 > b^3$

23. $\left(\sqrt{3}\, i\right)^7 =$

(A) $-27\sqrt{3}\, i$
(B) $-27i$
(C) $81i$
(D) $27i$
(E) $27\sqrt{i}$

24. What are all real values of b for which $\frac{5}{2+b} = \frac{2}{3} + \frac{2}{16-b}$?

(A) $b = 4$ only
(B) $b = 4$ and $b = 20.5$
(C) $b = 6$ only
(D) $b = 6$ and $b = -6$
(E) There are no real solutions.

25. In which of the following equations is y a function of x?

(A) $x^2 + y^2 = 100$
(B) $|x| = y + 21$
(C) $y^2 = 25 + x$
(D) $2y - y^2 = 24 + x$
(E) $|y| = x$

26.

x	f(x)
0	-22
5	15
10	18
15	22
20	-30
25	-36
30	44
35	-56

The table above gives some values of a 6^{th} degree polynomial $f(x)$. Based on the values shown, what is the minimum number of real roots of the equation $f(x) = 0$?

(A) Five
(B) Four
(C) Three
(D) Two
(E) One

27. Shireen drew a pattern with rows of hexagons. The bottom row had 53 hexagons. The row above it had 49 hexagons, and each row above had 4 fewer hexagons than the row just below it. There is 1 hexagon in the top row. How many hexagons are in the pattern in all?

(A) 372
(B) 374
(C) 376
(D) 378
(E) 380

28. What is the middle term in the expansion of $\left(\frac{x}{6} - 3x\right)^6$?

(A) $-\frac{5x^9}{2}$
(B) $-\frac{5x^6}{2}$
(C) $\frac{15x^6}{6}$
(D) $\frac{5x^9}{2}$
(E) $\frac{15x^9}{2}$

29. If $x = -2$ is a solution to the equation $x^3 + 4x^2 - ax + 12 = 0$, what is the value of a?

(A) –20
(B) –15
(C) –10
(D) –5
(E) –4

30. The first three terms of a geometric sequence are $\frac{2}{7}, -\frac{4}{21}$, and $\frac{8}{63}$. Which of the following represents the n^{th} term of the sequence?

(A) $\frac{(2)(-2)^{n-1}}{(7)(3)^{n}}$

(B) $\frac{(2)(-2)^{n-1}}{(7)(3)^{n-1}}$

(C) $\frac{(2)(2)^{n}}{(7)(3n)}$

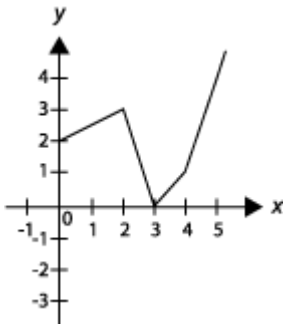
(D) $\frac{(2)(-2)^{n}}{(7)(3)^{n}}$

(E) $\frac{(2)(-2)^{n-1}}{(7)(3)^{n+1}}$

31. If the remainder is –6 when $x^3 + 3x^2 - px - 16$ is divided by $x - 5$, then $p =$

(A) –38
(B) 8
(C) 12
(D) 38
(E) 42

32.



The figure above shows the graph of the function *f*. What is the value of *f*(*f*(3))?

(A) 0
(B) 2
(C) 3
(D) 4
(E) 5

33. In the *xy*-plane, what is the *x*-intercept of the graph of $y = -\frac{3}{4}x - 6$?

(A) –8
(B) –6
(C) –4
(D) –2
(E) –1

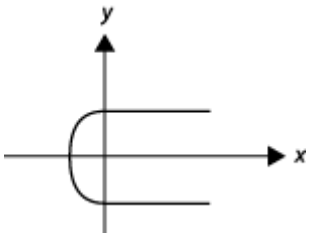
34. Which of the following define y as a function of x?

I. $4x^2 + 2y = -7$

II.

x	y
7	6
9	8
7	10
11	12

III.



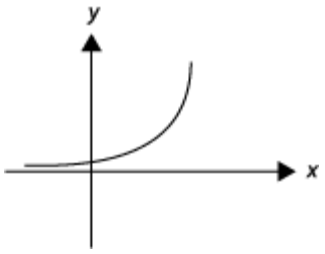
(A) None
(B) I only
(C) III only
(D) I and III only
(E) I, II, and III

35. If $5^{b+2} = 125^{2b-6}$, then $b =$

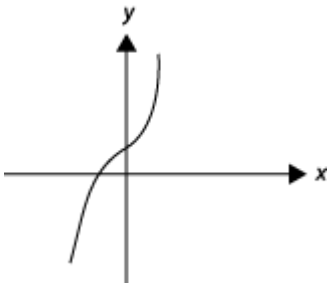
(A) 2
(B) 4
(C) 6
(D) 8
(E) 10

36. Which of the following could be the graph of $y = x^3 + x^2 + 2$?

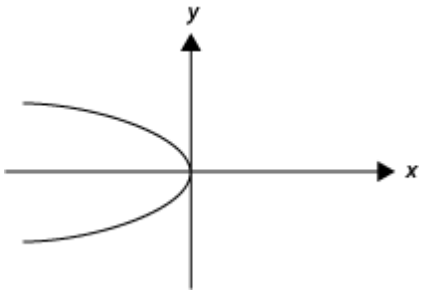
(A)



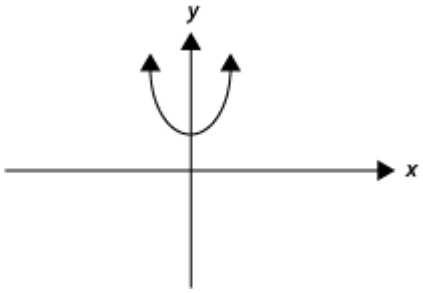
(B)



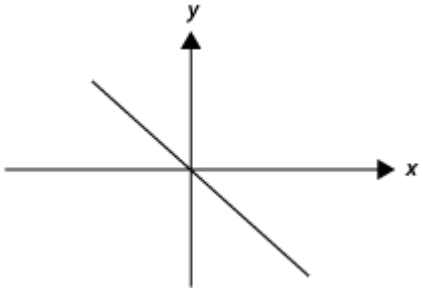
(C)



(D)



(E)



37. If $f(x) = 6x - 4$ and $d(x) = 4x + 4$, then $f(d(x)) =$

(A) $24x^2 + 8x - 16$
(B) $24x + 24$
(C) $24x + 20$
(D) $2x - 8$
(E) $10x$

38. If $\log_6 (x - 4) = 3$, what is the value of x ?

(A) 22
(B) 212
(C) 216
(D) 220
(E) 224

39. Jackie puts a container with 128 ounces of water outside on a hot day. If $\frac{1}{8}$ of the water evaporates every 90 minutes, about how many ounces will there be after 6 hours?

(A) 58
(B) 66
(C) 75
(D) 85
(E) 98

40. Which of the following must be true?

I. $\ln 5^{\frac{2}{3}} = \ln 5 + \ln \frac{2}{3}$

II. $\log_2 \frac{a}{b} = \log_2 a - \log_2 b$

III. $\log_{12} 12^x = x$

(A) I only
(B) II only
(C) I and III only
(D) II and III only
(E) I, II, and III

41. If $d(x) = 9 + 4x^3$ and d^{-1} represents the inverse function of d, then $d^{-1}(x) =$

(A) $\sqrt[3]{\frac{x-9}{4}}$

(B) $\sqrt[3]{\frac{x-9}{4}}$

(C) $\sqrt[3]{\frac{9-x}{4}}$

(D) $\frac{1}{9+4x^3}$

(E) $9x^3 - 4$

42. $\frac{5x-4}{2x-1} - \frac{x+3}{5x+4} =$

(A) $\frac{4x-1}{-3x+3}$

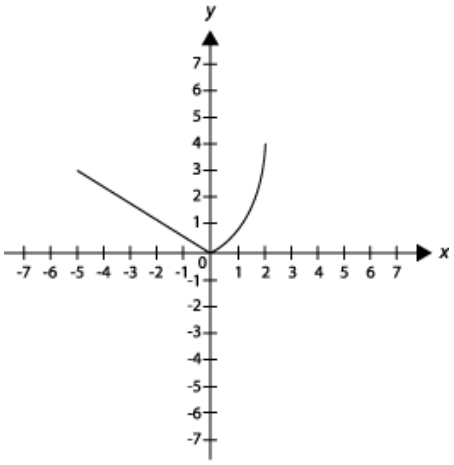
(B) $\frac{4x-7}{(2x-1)(5x+4)}$

(C) $\frac{6x-1}{(2x-1)(5x+4)}$

(D) $\frac{23x^2-5x-13}{(2x-1)(5x+4)}$

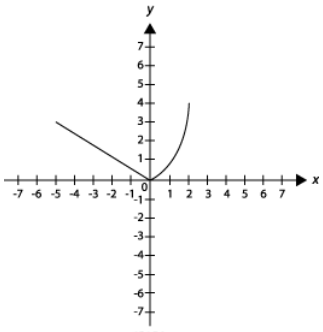
(E) $\frac{23x^2+5x-19}{(2x-1)(5x+4)}$

43.

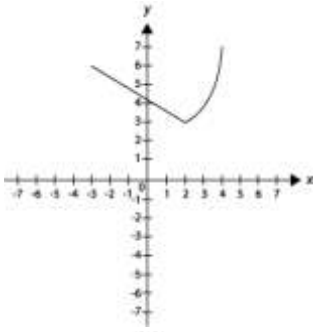


The graph of the function $y = d(x)$ is shown in the diagram above. Which of the following is the graph of $y = d(x + 2) + 3$?

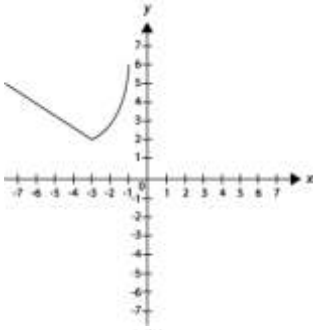
(A)



(B)



(C)



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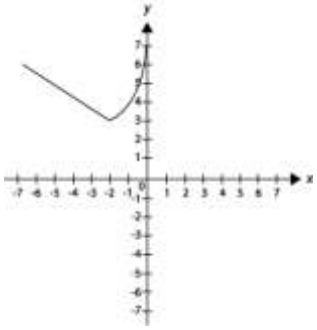
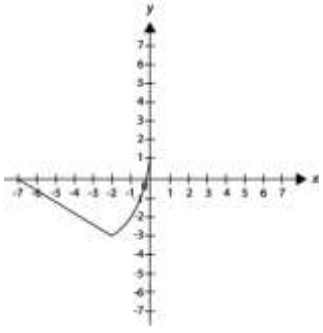


(E)



44. $(i + 6)(1 - i) + (3i - 2) =$

(A) $9 - 8i$
(B) $9 - 2i$
(C) $7 - 5i$
(D) $5 - 2i$
(E) $3 - 2i$

45. f is an exponential function defined by $f(x) = lm^x$, where l and m are positive constants. If $f(3) = 128$ and $f(4) = 512$, what is the value of l?

(A) 5
(B) 4
(C) 3
(D) 2
(E) 1

46. Which of the following will result in a perfect square for all integer values of x, when added to $25x^2 + 4$?

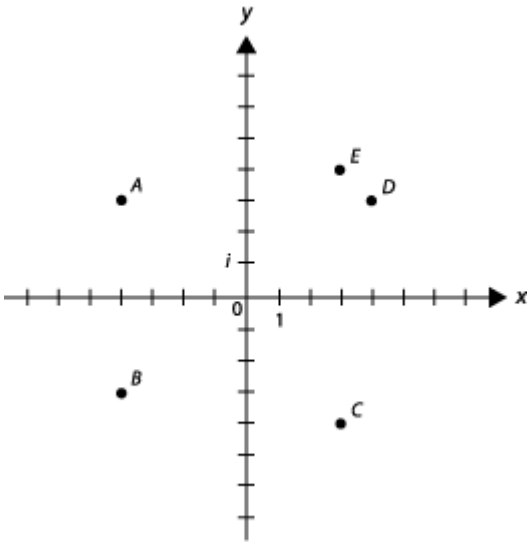
(A) $20x$
(B) $15x$
(C) $10x$
(D) $5x$
(E) 0

47. $x + y = 3$
$x^2 + y^2 = 29$

For what values of x will (x, y) be a solution to the above system of equations?

(A) The system has no solutions.
(B) $x = -5$ and $x = 2$
(C) $x = -2$ and $x = 5$
(D) $x = 2$ and $x = 1$
(E) $x = 6$ and $x = -3$

48.



Which of the points in the above figure represents the complex number $-4 + 3i$?

(A) *A*
(B) *B*
(C) *C*
(D) *D*
(E) *E*

49. What is the amount, in dollars, of an investment if $12,000 is invested at 6% compounded monthly for 8 years? Round your answer to the nearest dollar.

(A) 19,730
(B) 19,370
(C) 17,930
(D) 17,390
(E) 13,790

50. For the function $f(x) = \log_3 x$, which of the following must be true?

I. $f(x)$ decreases with decreasing values of x.
II. The domain is $[0, \infty)$.
III. The range is $(0, \infty)$.

(A) I only
(B) II only
(C) III only
(D) II and III only
(E) I, II, and III

51. $4x(3x^2 - 2) - (8 + 5x^3 - 2x) + 6 =$

(A) $7x^3 - 10x - 8$
(B) $7x^3 - 6x - 8$
(C) $7x^3 - 6x - 2$
(D) $7x^3 + 6x - 8$
(E) $17x^3 - 10x - 2$

52. Which of the following is the determinant of the matrix $\begin{bmatrix} 34 & 1 \\ 17 & 1 \end{bmatrix}$?

(A) –17
(B) 0
(C) 17
(D) 32
(E) 51

53. Which of the following numbers are real?

I. $\frac{i^2}{5}$
II. $\sqrt{-4i^2}$
III. $-16i$

(A) I only
(B) II only
(C) III only
(D) I and II only
(E) I, II, and III

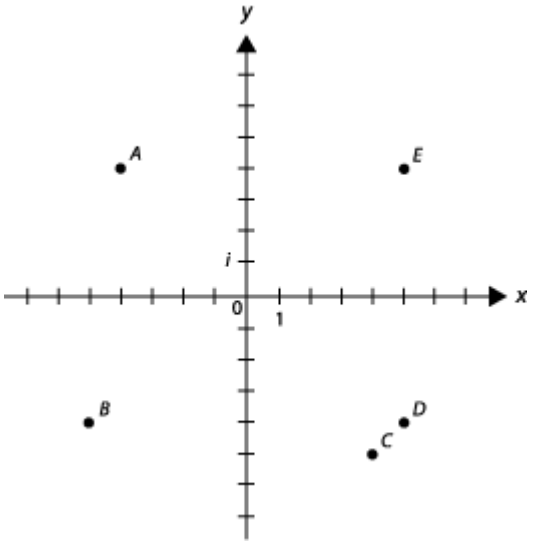
54. The first three terms of a geometric sequence are 7, 24.5, and 85.75. Which of the following represents the n^{th} term of the sequence?

(A) $7(17.5^{n-1})$
(B) $7(3.5^{n-1})$
(C) $7(2.5^{n-1})$
(D) $7(3.5^n)$
(E) $7(3^n)$

55. If $3 + a = b$, what is the value of $(a - b) + |b - a|$?

(A) It cannot be determined from the given information.
(B) –3
(C) 0
(D) 3
(E) 6

56.



Which of the points in the above figure represents the complex number $5 - 4i$?

(A) *A*
(B) *B*
(C) *C*
(D) *D*
(E) *E*

57. The first three terms in an arithmetic sequence are $\frac{x}{7} - 21$, $\frac{x}{7} - 25$, $\frac{x}{7} - 29$. What is the 16^{th} term in the sequence?

(A) $\frac{x}{7} + 39$

(B) $\frac{x}{7} - 66$

(C) $\frac{x}{7} - 77$

(D) $\frac{x}{7} - 81$

(E) $\frac{x}{7} - 85$

58.

x	$d(x)$
12	384
6	265
0	–127
–6	32
–12	76
–18	–108
–24	212
–30	253

The table above gives several values of a 5^{th} degree polynomial $d(x)$. Based on the values in the table, what is the minimum number of real roots of the equation $d(x) = 0$?

(A) Five
(B) Four
(C) Three
(D) Two
(E) One

59. Which of the following numbers are rational?

I. $\sqrt{\pi^2}$

II. $\sqrt{\frac{22}{7}}$

III. $\sqrt{\frac{25}{9}}$

(A) I only
(B) II only
(C) III only
(D) I and III only
(E) I, II, and III

60. $-7b(6 - 4b^2) - (9 + 23b^3 + 2b) - 8 =$

(A) $5b^3 - 44b - 17$
(B) $5b^3 - 44b - 8$
(C) $5b^3 - 40b - 17$
(D) $5b^3 - 40b - 1$
(E) $51b^3 - 40b - 17$

1. The correct answer is E. You can use FOIL (First, Outer, Inner, Last) to multiply $(4x + 2)(4x + 2)$. Start by multiplying the first terms: $(4x)(4x) = 16x^2$. Then multiply the outer terms: $(4x)(2) = 8x$ and the inner terms: $(2)(4x) = 8x$. Finally, multiply the last terms: $(2)(2) = 4$. Now add all the terms: $16x^2 + 8x + 8x + 4 = 16x^2 + 16x + 4$.

2. The correct answer is D. $9 - (2x + 1)^2$ is the difference of two squares. Remember that $a^2 - b^2 = (a + b)(a - b)$. In this case, 9 is the first term and $(2x + 1)$ is the second term. So, $9 - (2x + 1)^2 = (3 + (2x + 1))(3 - (2x + 1))$.

3. The correct answer is B. This problem is best solved by breaking it into two parts:
First find $5b \times (3b^2 + 2)$; $5b \times (3b^2 + 2) = 15b^3 + 10b$.

Now the problem becomes $15b^3 + 10b - (3b^3 + 10b - 8) - 6$. Rewrite the terms in parentheses and find the answer. Be sure to rewrite the numbers with the correct signs:
$15b^3 + 10b - 3b^3 - 10b + 8 - 6 = 12b^3 + 2$.

4. The correct answer is C. First rewrite the equation to isolate $b - 2a$ on one side of the equation: $4 = b - 2a$. Now divide both sides of the equation by 2: $2 = \frac{b-2a}{2}$. Since $\frac{b-2a}{2} = 2$, the absolute value of $\frac{b-2a}{2}$ is also equal to 2.

5. The correct answer is B. Remember that dividing by a fraction is the same as multiplying by the fraction's reciprocal:

$$\frac{\frac{x^2-25}{x+10}}{\frac{x+5}{x=10}} = \frac{\left(x^2-25\right)}{\left(x+10\right)} \times \frac{\left(x-10\right)}{\left(x+5\right)}.$$

If you recognize that $x^2 - 25$ is the difference of two squares, you can easily factor it: $x^2 - 25 = (x + 5)(x - 5)$. Now the problem becomes $\frac{\left(x+5\right)\left(x-5\right)}{\left(x+10\right)} \times \frac{\left(x-10\right)}{\left(x+5\right)}$. Cancel both sets of $(x + 5)$ and you are left with $\frac{(x-5)(x-10)}{x+10}$.

6. The correct answer is C. Check each answer choice and set up the factor that you could use to yield $16x^2$ and -18. Start with choice A, $x - 18$. To get a product that includes $16x^2$ and -18, the other factor needs to be $(16x + 1)$. Use FOIL to check the product of $(x - 18)$ and $(16x + 1)$:

$$\begin{aligned}(x-18)(16x+1) &= 16x^2 + x - 288x - 18 \\ &= 16x^2 - 287x - 18.\end{aligned}$$

Since this product does not match the one in the question, choice A is incorrect. Find the other factor for choice B: (8*x* + 9). Check to see if these factors yield the product in the question:

$$(2x-2)(8x+9) = 16x^2 + 18x - 16x - 18$$
$$= 16x^2 + 2x - 18.$$

Choice B is incorrect. Find the other factor for choice C: (8*x* – 9). Check to see if these factors yield the product in the question:

$$(2x+2)(8x-9) = 16x^2 - 18x + 16x - 18$$
$$= 16x^2 - 2x - 18.$$

This product matches the one in the question, so Choice C is correct. You can confirm that D and E are incorrect in a similar manner.

7. The correct answer is B. Use the laws of exponents to find that choice A becomes 2^{15}, choice B becomes 3^{25}, choice C becomes 3^{10}, choice D becomes 5^8, and choice E becomes 5^6. Eliminate choices C and E because they are clearly not the largest. Find the values of the remaining choices. Choice A: 32,768. Choice B: 8.47×10^{11}. Choice D: 390,625. Choice B is the greatest amount, so it is correct.

8. The correct answer is D. Rewrite the factorials in the fraction to solve this equation: $\frac{(x-1)!}{x!} + x = \frac{(x-1)(x-2)(x-3)...(1)}{(x)(x-1)(x-2)(x-3)...(1)} + x$. All the factors in the fraction can be cancelled except *x* in the denominator. Simplify the fraction so that you are left with $\frac{1}{x} + x.$

9. The correct answer is C. First rewrite the expression so that the *a*'s and *b*'s are next to each other: $(a)a^{-\frac{4}{5}}b^{\frac{3}{5}}b^{\frac{2}{5}}$. Now use the rules of exponents to add the exponents of *a* and the exponents of *b*: $(a)a^{-\frac{4}{5}}b^{\frac{3}{5}}b^{\frac{2}{5}} = a^{\frac{1}{5}}b$. This expression can be rewritten as $\sqrt[5]{a} \times b$.

10. The correct answer is D. You need to find the total number of centimeters from the first to the ninth stripe, so *i* = 1 is the lower limit and the upper limit is 9. From this, you can eliminate choices A and B To find the number of centimeters for each stripe, you need to find $\left(\frac{3}{4}\right)^{i-1}$. Choice D is the only choice that shows this.

11. The correct answer is E. The graph of *y* = –2 is a horizontal line that passes through (0, –2) and all other points with a *y*-coordinate of –2.

12. The correct answer is C. Remember that when you work with absolute value and inequalities, you need to find the solution to two inequalities. To solve this problem, you need to find the solutions to $m - 3 \leq 7$ and $m - 3 \geq -7$. For $m - 3 \leq 7$, $m \leq 10$. For $m - 3 \geq -7$, $m \geq -4$. So m must be both less than or equal to 10 and greater than or equal to –4.

13. The correct answer is D. You will need to use the Quadratic Formula to answer this question: $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$. Rewrite the equation in the question in the form of $ax^2 + bx + c = 0$ to make sure that you have the correct values for a, b, and c: $4x^2 + 6x = 8 - 2x$ becomes $4x^2 + 8x - 8 = 0$. Before applying the Quadratic Formula, factor out the greatest common factor, 4, by dividing both sides by 4.

$4(x^2 + 2x - 2) = 4\ (0)$, so $x^2 + 2x - 2 = 0$.

Now use $a = 1$, $b = 2$, and $c = -2$. Substitute these values into the Quadratic Formula.

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$
$$x = \frac{-2 \pm \sqrt{2^2 - 4(1)(-2)}}{2(1)}$$
$$x = \frac{-2 \pm \sqrt{4 + 8}}{2}$$
$$x = \frac{-2 \pm \sqrt{12}}{2}$$
$$x = \frac{-2 \pm 2\sqrt{3}}{2}$$
$$x = -1 \pm \sqrt{3}$$

14. The correct answer is E. Use the diagram to find the y-intercept of the boundary line. The y-intercept is –2. Use (0, –2) and another point on the line, like (1, –1), to find the slope,

$$\frac{y_2 - y_1}{x_2 - x_1} = \frac{-2 - 1}{0 - (-1)}$$
$$= \frac{-3}{1}$$
$$= -3$$

.

Using the form $y = mx + b$ where m is the slope and b is the y-intercept, you can write the equation of the boundary line: $y = -3x - 2$. You can see that choice E is the only inequality that matches the boundary line. To determine that choice E is correct, pick a point in the shaded region, like (-1, 3), and plug it into $y \geq -3x - 2$:

$$y \geq -3x - 2$$
$$3 \geq -3(-1) - 2$$
$$3 \geq 1.$$

The inequality is true, so choice E is correct.

15. The correct answer is A. First rewrite the equation in standard form: $y = \left(\frac{a}{b}x\right) \times \left(\frac{1}{b}\right)$. Recall that $\frac{a}{b}$ represents the slope of the line. Since the line goes down from left to right, its slope is negative. You should also remember that $\frac{1}{b}$ represents the *y*-intercept. You can see from the graph that the *y*-intercept is positive, so *b* must be greater than 0. Based on this information, eliminate choice B. Now pick numbers to find the answer choice that will yield a negative slope. For choice A, let $a = -1$ and $b = 2$: $-\frac{1}{2}$. This slope is negative, so *a* must be negative and choice A is correct. You can confirm that choices C, D, and E are incorrect by picking numbers.

16. The correct answer is D. You can use $b^2 - 4ac$ to solve this problem. When $b^2 - 4ac$ is positive, the equation has two real roots, and when $b^2 - 4ac$ is equal to 0, the equation has one real root. First set $b^2 - 4ac$ equal to 0 and solve for *b*:

$$b^2 - 4(1)(9) = 0$$
$$b^2 - 36 = 0$$

so $b = \pm 6$. When $b = \pm 6$, the equation has one real root. In order for $b^2 - 36$ to be positive, *b* must be either greater than 6 or less than –6. Choice D is the only choice that shows these options.

17. The correct answer is C. Since the boundary line is $y = 2x - 6$, you can see that the *y*-intercept is (0, –6) and that the line has a positive slope. Find several points to plot to determine where the line passes: (0, –6), (2, –2), and (2, –10). The original graph in slope-intercept form is $y < 2x - 6$, so its points will be below the boundary line, in Quadrants I, III, and IV.

18. The correct answer is E. The value of Miguel's house is equal to the original amount he spent ($120,000), minus $500 per year. So after the first year, the value of his house will be equal to $120,000 – $500. After the second year, the value of his house will be equal to $120,000 – $500 – $500, or $120,000 – $500(2). This can be translated into algebra as $v_1 = 120{,}000 - 500y$. The value of Lucy's house is equal to the original amount she spent ($80,000), plus $250 per year. So after the first year, the value of her house will be equal to $80,000 + $250. After the second year, the value of her house will be equal to $80,000 + $250 + $250, or $80,000 + $250(2). This can be translated into algebra as $v_2 = 80{,}000 + 250y$. Choice E shows these two equations.

19. The correct answer is C. The equivalent equation for $\log_b(m) = 12$ is the exponential equation $m = b^{12}$. This can also be written as $b^{12} = m$. The expression b^{12} is therefore equal to *m*.

20. The correct answer is D. I is irrational since the square root of an irrational number, such as π will also be irrational. II is rational because a repeating decimal is rational. III is irrational because the square root of a number which is itself not a perfect square is irrational.

21. The correct answer is 2. To solve this problem you need to multiply $\frac{5-5i}{3-i}$ by $\frac{3+i}{3+i}$ to eliminate the complex number in the denominator:

$$\frac{5-5i}{3-i} \times \frac{3+i}{3+i} = \frac{15+5i-15i-5i^2}{9+3i-3i-i^2}$$

When you combine like terms in the numerator and the denominator, remember that $i^2 = -1$. Rewrite $\frac{15+5i-15i-5i^2}{9+3i-3i-i^2}$ as $\frac{15-10i+5}{9+1}$. The fraction becomes $\frac{20-10i}{10}$. Now factor the numerator to simplify the fraction: $\frac{10(2-i)}{10} = 2-i$. So, the value of *a* is 2.

22. The correct answer is D. Assign values for *a*, *b*, and *c*, plug those values into each answer choice, and determine which inequality does not make sense. Let $a = 2$, $b = -2$, and $c = -3$.

For choice A:

$$\begin{array}{l}(2)(-2) < (-2)(-3) \\ -4 < 6\end{array}$$ this inequality is true.

For choice B:

$$\begin{array}{l}2^2(-2) < (-2)^2(2) \\ -8 < 8\end{array}$$ this inequality is true.

For choice C:

$$\begin{array}{l}(2)(-2)(-3) > (2)(-2) \\ 12 > -4\end{array}$$ this inequality is true.

For choice D:

$$\begin{aligned} 2^2 &> (-2)^2 \\ &> (-3)^2 \\ 4 &> 4 \\ &> 9 \end{aligned}$$ this inequality is not true, so choice D is correct.

For choice E:

$$\begin{aligned} 2^3 &> (-2)^3 \\ 8 &> -8 \end{aligned}$$ this inequality is true.

23. The correct answer is A. Try writing the problem as $\left(\sqrt{3}\right)\left(\sqrt{3}\right)\left(\sqrt{3}\right)\left(\sqrt{3}\right)\left(\sqrt{3}\right)\left(\sqrt{3}\right)\left(\sqrt{3}\right) \times i \times i \times i \times i \times i \times i$. Look at the first part of the rewritten problem. Each $\left(\sqrt{3}\right)\left(\sqrt{3}\right) = 3$, so $\left(\sqrt{3}\right)\left(\sqrt{3}\right)\left(\sqrt{3}\right)\left(\sqrt{3}\right)\left(\sqrt{3}\right)\left(\sqrt{3}\right)\left(\sqrt{3}\right) = 3 \times 3 \times 3 \times \sqrt{3} = 27\sqrt{3}$. Now consider the second part of the rewritten problem. Each $i \times i = i^2 = -1$, so $i \times i \times i \times i \times i \times i \times i = i^2 \times i^2 \times i^2 \times i = (-1) \times (-1) \times (-1) \times i = -i$. Now you can combine the two parts of the problem: $27\sqrt{3} \times (-i) = -27\sqrt{3}\,i$.

24. The correct answer is B. To solve this problem, substitute each value for *b* into the equation. For choice A:

$$\begin{aligned} \frac{5}{2+4} &= \frac{2}{3} + \frac{2}{16-4} \\ \frac{5}{6} &= \frac{2}{3} + \frac{2}{12} \\ \frac{5}{6} &= \frac{8}{12} + \frac{2}{12} \\ \frac{10}{12} &= \frac{10}{12} \end{aligned}$$

This is true, so A could be the correct answer.

For choice B: You know that 4 works, so try 20.5:

$$\frac{5}{2+20.5}=\frac{2}{3}+\frac{2}{16-20.5}$$
$$\frac{5}{22.5}=\frac{2}{3}+\frac{2}{-4.5}$$
$$\frac{2}{9}=\frac{6}{9}+\frac{-4}{9}$$
$$\frac{2}{9}=\frac{2}{9}$$

This is true, so B could be the correct answer and A is incorrect.

For choice C:

$$\frac{5}{2+6}=\frac{2}{3}+\frac{2}{16-6}$$
$$\frac{5}{8}=\frac{2}{3}+\frac{2}{10}$$
$$\frac{5}{8}=\frac{20}{30}+\frac{6}{30}$$
$$\frac{5}{8}=\frac{26}{30}$$
$$\frac{150}{240}=\frac{208}{240}$$

This is not true. Choice D cannot be correct since you know that 6 does not work. For choice E: You know that *b* can be equal to 4, so E is incorrect.

25. The correct answer is B. In order for *y* to be a function of *x*, for each value of *x*, there must be only one corresponding value of *y*. The absolute value equation $|x| = y + 21$ fits this definition, because for each value of *x*, there can be only one value of *y*. The absolute value equation $|y| = x$ is not a function, because for each value of *x*, there could be two values for *y*.

26. The correct answer is B. Look at the chart. When the signs of two numbers in the *f*(*x*) column changes, there is a real root between those numbers. So, determine the number of times that the value of *f*(*x*) changes signs: from –22 to 15, from 22 to –30, from –36 to 44, and from 44 to –56. So, there are at least 4 real roots.

27. The correct answer is D. This question is about an arithmetic sequence, 53, 49, 45, 41,…Once you have determined that there are 14 terms in the sequence, you can use the formula for finding the sum of the first *n* terms: $S=\frac{n}{2}\left[2a+(n-1)d\right]$ where *n* = the total number of terms, *a* = the first term, and *d* = the common

difference between the terms. In this case, $n = 14$, $a = 53$, and $d = -4$ (d is negative since the terms decrease). So the formula becomes $S = \frac{14}{2}\left[2(53) + (14-1)(-4)\right] = 7(106 - 52) = 7(54) = 378$.

28. The correct answer is B. To solve this problem, you need to use the Binomial Formula for $(a + b)^n$: $(a + b)^n = a^n + na^{n-1}b + \frac{n(n-1)}{2!}a^{n-2}b^2 + \frac{n(n-1)(n-2)}{3!}a^{n-3}b^3 + \ldots b^n$ and then take the middle term. In this case, $a = \frac{x}{6}$, $b = -3x$, and $n = 6$. So, the expression is expanded as

$$\frac{x^6}{6} + 6(-3x)^5 + \frac{6(5)}{2!}\left(\frac{x}{6}\right)^4(-3x)^2 + \frac{6(5)(4)}{3!}\left(\frac{x}{6}\right)^3(-3x)^3 + \frac{6(5)(4)(3)}{4!}\left(\frac{x}{6}\right)^2(-3x)^4 + \frac{6(5)(4)(3)(2)}{5!}\left(\frac{x}{6}\right)(-3x)^5 + (-3x)^6$$

The middle term is

$$\begin{aligned}\frac{6(5)(4)}{3!}\left(\frac{x}{6}\right)^3(-3x)^3 &= \frac{120}{6}\left(\frac{x^3}{216}\right)(-27x^3)\\ &= \frac{(120)(x^3)(-27x^3)}{(6)(216)}\\ &= \frac{(20)(x^3)(-x^3)}{8}\\ &= \frac{-5x^6}{2}\end{aligned}.$$

29. The correct answer is C. Substitute -2 for x in the equation and solve for a:

$$\begin{aligned}(-2)^3 + 4(-2)^2 - a(-2) + 12 &= 0\\ -8 + 4(4) - (-2a) + 12 &= 0\\ -8 + 16 + 2a + 12 &= 0\\ 20 + 2a &= 0\\ 2a &= -20\\ a &= -10\end{aligned}$$

30. The correct answer is B. You will need to remember the formula for finding the n^{th} term of a geometric sequence: n^{th} term $= ar^{n-1}$, where a = the first term and r = the common ratio. In this case, $a = \frac{2}{7}$ and $r = -\frac{2}{3}$. So the formula becomes $\left(\frac{2}{7}\right)\left(-\frac{2}{3}\right)^{n-1} = \frac{(2)(-2)^{n-1}}{(7)(3)^{n-1}}$.

31. The correct answer is D. You will need to use synthetic division to solve this problem. Use 5 as the divisor:

$$\begin{array}{r|cccc} 5 & 1 & +3 & -p & -16 \\ & & 5 & 40 & (200-5p) \\ \hline & 1 & 8 & (40-p) & (184-5p) \end{array}$$

The problem tells you that the remainder, $184 - 5p$, is equal to –6. Now you can solve for p:

$$\begin{aligned} 184-5p &= -6 \\ -5p &= -190 \\ p &= 38. \end{aligned}$$

32. The correct answer is B. First find $f(3)$: What is the value of y when $x = 3$? $f(3) = 0$. Now find $f(0)$: What is the value of y when $x = 0$? $f(0) = 2$. So, $f(f(3)) = 2$.

33. The correct answer is A. To find the x-intercept, substitute 0 for y and solve for x: $0 = -\frac{3}{4}x - 6$; $\frac{3}{4}x = -6$; $x = -8$.

34. The correct answer is B. Remember that in a function, each number in the domain (x) must be matched with exactly one number in the range (y). I is a function because for each value for x (the domain), there will be exactly one value for y (the range). II is not a function because the 7 in the x-column (the domain) is paired with two numbers in the y-column (the range): 6 and 11. III is not a function because each x-coordinate (the domain) appears to be paired with both a positive and negative y-coordinate (the range).

35. The correct answer is B. Rewrite 125^{2b-6} as $(5^3)^{2b-6}$. Then use the rules of exponents to rewrite the exponents: $5^{b+2} = (5^3)^{2b-6}$, so $5^{b+2} = 5^{6b-18}$. Now you can set the exponents equal and solve for b: $b + 2 = 6b - 18$; $5b - 18 = 2$; $5b = 20$; $b = 4$.

36. The correct answer is B. Choice A shows the graph of an exponential function with an equation such as $y = 2^x$, so it is incorrect. Choice C shows the graph of a parabola with an equation such as $y^2 = -4x$, so it is incorrect. Choice D also shows the graph of a parabola with an equation such as $x^2 + 2 = y$, so it is incorrect. Choice E shows the graph of a line with an equation such as $y = -x$, so it is incorrect. Therefore, the correct answer is choice B.

37. The correct answer is C. To find the answer, you need to substitute $4x + 4$ for x in $6x - 4$: $6(4x + 4) - 4$. Now you can evaluate the expression:

$$\begin{aligned} 6(4x+4)-4 &= 24x+24-4 \\ &= 24x+20. \end{aligned}$$

38. The correct answer is D. Remember that you can rewrite logs in exponential: $\log_6 (x - 4) = 3$ is the same as $6^3 = x - 4$. Now you can solve for x :

$$\begin{aligned} 6^3 &= x - 4 \\ 216 &= x - 4 \\ 220 &= x. \end{aligned}$$

39. The correct answer is C. You may notice that this problem involves an exponential function. This function is defined by $128\left(\frac{7}{8}\right)^x$, where x = each period of 90 minutes. 128 is the initial number of ounces of water, and $\frac{7}{8}$ represents the amount of water that is left after every 90-minute period. There are 4 90-minute periods, so plug 4 in for x and solve:

$$\begin{aligned} 128\left(\frac{7}{8}\right)^x &= 128\left(\frac{2401}{4096}\right) \\ &= 128(0.586) \\ &= 75.008. \end{aligned}$$

Choice C is closest to this number.

40. The correct answer is D. I is not true because $\ln 5^{\frac{2}{3}} = \frac{2}{3}\ln 5$. II is true because of the laws of logarithms. III is true because it is the definition of a logarithm.

41. The correct answer is A. To find the inverse function, reverse the x's and y's in the original equation: $x = 9 + 4y^3$. Then solve for y : $x - 9 = 4y^3$

$$\begin{aligned} \frac{x-9}{4} &= y^3 \\ \sqrt[3]{\frac{x-9}{4}} &= y \end{aligned}$$

42. The correct answer is D. Before you can subtract, you need to give the fractions common denominators. Multiply $\frac{5x-4}{2x-1}$ by $\frac{5x+4}{5x+4}: \frac{(5x-4)(5x+4)}{(2x-1)(5x+4)} = \frac{25x^2-16}{(2x-1)(5x+4)}$. Now multiply

$$\frac{x+3}{5x+4}\times\frac{2x-1}{2x-1}=\frac{(x+3)(2x-1)}{(5x+4)(2x-1)}$$
$$=\frac{2x^2+5x-3}{(2x-1)(5x+4)}.$$

Now you are ready to subtract:

$$\frac{25x^2-16}{(2x-1)(5x+4)}-\frac{2x^2+5x-3}{(2x-1)(5x+4)}=\frac{25x^2-16-2x^2-5x+3}{(2x-1)(5x+4)}$$
$$=\frac{23x^2-5x-13}{(2x-1)(5x+4)}$$

43. The correct answer is D. You need to find the graph that shows a shift of 2 units to the left and a shift of 3 units up. Choice A shows the original graph with no change. Choice B shows a shift of 2 units to the right and 3 units up. Choice C shows a shift of 3 units to the left and 2 units up. Choice D —the correct answer —shows a shift of 2 units to the left and 3 units up. Choice E shows a shift of 2 units to the left and 3 units down.

44. The correct answer is D. This problem is best solved by breaking it into two parts. First use FOIL to find the product of $(i + 6)(1 – i)$: $i – i^2 + 6 – 6i = –i^2 – 5i + 6$. Now add the product to $(3i – 2)$: $(–i^2) – 5i + 6 + 3i – 2 = –i^2 – 2i + 4$. Remember that $i^2 = –1$, so substitute –1 for i^2: $1 – 2i + 4 = 5 – 2i$.

45. The correct answer is D. You know that $lm^3 = 128$ and $lm^4 = 512$. Divide the first equation by m^3 to find the value of l: $l = \frac{128}{m^3}$. Now you can substitute to find the value of m: $lm^4 = 512$; $\left(\frac{128}{m^3}\right)m^4 = 512$; $128m = 512$; $m = 4$. Once you know the value of m, you can substitute to find the value of l: $l = \frac{128}{4^3}=\frac{128}{64}=2$.

46. The correct answer is A. Remember the definition of a perfect square trinomial: $(a + b)^2 = a^2 + 2ab + b^2$. In this case, $a^2 = 25x^2$, so $a = \pm 5x$, and $b^2 = 4$, so $b = \pm 2$. To find the value of $2ab$, multiply: $(2)(\pm 5x)(\pm 2) = \pm 20x$. Only 20x is among the answer choices.

47. The correct answer is C. First rewrite $x + y = 3$ in terms of y : $y = 3 – x$. Now you can substitute for the value of y in the second equation:

$$x^2 + (3 - x)^2 = 29$$
$$x^2 + 9 - 6x + x^2 = 29$$
$$2x^2 - 6x - 20 = 0$$

Here you can divide the equation by 2 and then factor to find the values for x:

$$x^2 - 3x - 10 = 0$$
$$(x-5)(x+2) = 0$$
$$x = 5$$
$$x = -2$$

48. The correct answer is A. Remember that the *x*-axis shows the real numbers, and the *y*-axis shows the imaginary numbers. To locate the point, start at the origin and count 4 units to the left and 3 units up.

49. The correct answer is B. You need to know the formula for computing compound interest in order to solve this problem: $A = P\left(1+\frac{r}{n}\right)^{nt}$, where P = the principal amount, r = the annual interest rate, n = the number of times it is compounded per year, and t = the number of years. In this case, P = 12,000; r = 0.06; n = 12; and t = 8. So the formula becomes

$$A = 12{,}000\left(1+\frac{0.06}{12}\right)^{(12)(8)}$$
$$A = 12{,}000(1.005)^{96}$$
$$A \approx 19{,}369.712$$
$$\approx 19{,}370$$

50. The correct answer is A. I is true because as x decreases, y will also decrease. II is not true because the domain cannot be equal to 0, since 3^y can never be equal to 0. III is not true because the range can include negative numbers.

51. The correct answer is C. This problem is best solved by breaking it into two parts: First find $4x(3x^2 - 2)$: $4x(3x^2 - 2) = 12x^3 - 8x$. Then combine that product with the rest of the terms. Now the problem becomes $12x^3 - 8x - (8 + 5x^3 - 2x) + 6$. Rewrite the terms in parentheses and find the answer. Be sure to rewrite the numbers with the correct signs: $12x^3 - 8x - 8 - 5x^3 + 2x + 6 = 7x^3 - 6x - 2$.

52. The correct answer is C. Convert the matrix to a determinant: $\begin{vmatrix} 34 & 1 \\ 17 & 1 \end{vmatrix}$. Multiply along the diagonals: top-left to bottom-right (34×1) and bottom-left to top-right (17×1). Subtract the second product from the first: $34 - 17 = 17$.

53. The correct answer is D. Remember that $i = \sqrt{-1}$, so

$$\frac{i^2}{5} = -\frac{1}{5}$$
$$= -\frac{1}{5}.$$

$-\frac{1}{5}$ is real.

II is real because

$$\begin{aligned}\sqrt{-4i^2} &= \left(\sqrt{4}\right)\left(\sqrt{-i^2}\right)\\ &= 2(1)\\ &= 2.\end{aligned}$$

III is imaginary because *i* is imaginary.

54. The correct answer is B. You will need to remember the formula for finding the n^{th} term of a geometric sequence: n^{th} term = ar^{n-1}, where a = the first term and r = the common ratio. In this case, $a = 7$ and $r = 3.5$. So the formula becomes $(7)(3.5^{n-1})$.

55. The correct answer is C. First rewrite the equation to isolate $a - b$ on one side of the equation: $a - b = -3$. Now rewrite the equation to isolate $b - a$: $b - a = 3$. Now you can fill in the values in the equation: $(a - b) + |b - a| = -3 + 3 = 0$.

56. The correct answer is D. Remember that the *x*-axis shows the real numbers, and the *y*-axis shows the imaginary numbers. To locate the point, start at the origin and count 5 units to the right and 4 units down.

57. The correct answer is D. Use the formula for finding the n^{th} term of an arithmetic sequence: n^{th} term = $a + (n - 1)(d)$, where a = the first term, n = the total number of terms, and d = the common difference. In this case, $a = \frac{x}{7} - 21$, $n = 16$, and $d = -4$. So, the formula becomes

$$\begin{aligned}\left(\frac{x}{7}-21\right)+(16-1)(-4) &= \left(\frac{x}{7}-21\right)+15(-4)\\ &= \left(\frac{x}{7}-21\right)+(-60)\\ &= \frac{x}{7}-81.\end{aligned}$$

58. The correct answer is B. Look at the chart. When the signs of two numbers in the $d(x)$ column changes, there is a real root between those numbers. So, determine the number of times that the value of $d(x)$ changes signs: from 265 to –127, from –127 to 32, from 76 to –108, and from –108 to 212. So, there are 4 real roots.

59. The correct answer is C. I is irrational because $\sqrt{\pi^2} = \pi$ and π is irrational because it is a non-terminating, non-repeating decimal. II is irrational because the square root of a number which is itself not a perfect square is irrational. III is rational because $\sqrt{\frac{25}{9}} = \frac{5}{3}$, which is rational.

60. The correct answer is A. This problem is best solved by breaking it into two parts: First find $-7b \times (6 - 4b^2)$: $-7b \times (6 - 4b^2) = -42b + 28b^3$. Then combine that product with the rest of the terms. Now the problem becomes $-42 + 28b^3 - (9 + 23b^3 + 2b) - 8$. Now you can rewrite the terms in parentheses and find the answer. Be sure to rewrite the numbers with the correct signs: $-42b + 28b^3 - 9 - 23b^3 - 2b - 8 = 5b^3 - 44b - 17$.