

Given these functions, answer the following questions in simplified form:

$$f(x) = 3x^2 + 4x - 6$$

$$g(x) = 4x^2 - 3x + 9$$

$$h(x) = 3x + 2$$

$$j(x) = 5x - 4$$

$$1. f(x) + g(x) = \frac{7x^2 + x + 3}{3x^2 + 4x - 6 + 4x^2 - 3x + 9}$$

$$2. f(x) - g(x) = \frac{-x^2 + 7x - 15}{3x^2 + 4x - 6 - 4x^2 + 3x - 9}$$

$$3. h(x) \cdot j(x) = \frac{15x^2 - 2x - 8}{(3x+2)(5x-4)}$$

$$15x^2 - 12x + 10x - 8$$

$$4. f(x) \div h(x) = \frac{x + \frac{2}{3} - \frac{\frac{22}{3}}{3x+2}}{3x+2}$$

$$\begin{array}{r} x + \frac{2}{3} - \\ \underline{3x+2} \sqrt{3x^2 + 4x - 6} \\ - 3x^2 + 2x \\ \hline 2x - 6 \\ - 2x + \frac{4}{3} \\ \hline -\frac{22}{3} \end{array}$$

Given a polynomial: $P(x) = ax^7 + bx^6 + cx^5 + dx^4 + ex^3 + fx^2 + gx + h$

5. How many total roots would $P(x)$ have (including Real and imaginary)?

7

6. List all of the possible combinations of Real and imaginary roots of $P(x)$.

7 reals

1 real M4 1 real M3

1 real M7

5 real 2 imaginary

1 real M6 1 real

3 real 4 imaginary

1 real M5 2 real M2

7. If $a > 0$, describe the end function behavior of $P(x)$.

$$x \rightarrow -\infty \quad f(x) \rightarrow -\infty$$

$$x \rightarrow \infty \quad f(x) \rightarrow \infty$$

8. Given a polynomial with factors $(x+2)(x+3)(x-3)$, write the polynomial in expanded form.

$$x^2 + 3x + 2x + 6$$

$$(x^2 + 5x + 6)(x - 3)$$

$$x^3 + 2x^2 - 9x - 18$$

$$x^3 - 3x^2 + 5x^2 - 15x + 6x - 18$$

9. Find the zeros of $f(x) = x^2 + 2x + 17$

$$\frac{-b \pm \sqrt{b^2 - 4ac}}{2a} = \frac{-2 \pm \sqrt{(2)^2 - 4(1)(17)}}{2(1)} = \frac{-2 \pm \sqrt{-64}}{2} = \frac{-2 \pm 8i}{2} = -1 \pm 4i$$

10. Given $x = 2$ is a zero of the polynomial $f(x) = x^3 - 3x^2 - 18x + 40$, write the polynomial in factored form.

Must show work for credit.

$$\begin{array}{r}
 x^2 - x - 20 \\
 x-2 \overline{) x^3 - 3x^2 - 18x + 40} \\
 \underline{-x^3 + 2x^2} \\
 -x^2 - 18x \\
 \underline{-x^2 + 2x} \\
 -20x + 40 \\
 \underline{-20x + 40} \\
 0
 \end{array}$$

$$\begin{array}{r}
 x^2 - x - 20 \\
 (x+4)(x-5) \quad \begin{array}{l} -20 \\ 4 \quad -5 \\ -1 \end{array}
 \end{array}$$

$$(x-2)(x+4)(x-5)$$

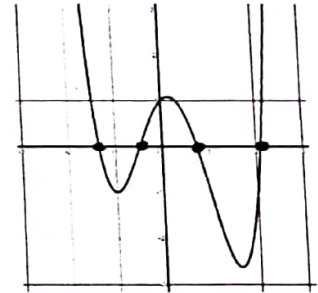
D 11. Which of the following polynomials could create the graph shown here:

A. $f(x) = ax + b$

B. $f(x) = ax^2 + bx + c$

C. $f(x) = ax^3 + bx^2 + cx + d$

D. $f(x) = ax^4 + bx^3 + cx^2 + dx + e$



B 12. Which of the following functions has the smallest growth rate as $x \rightarrow \infty$.

A. $y = \log_2 x$

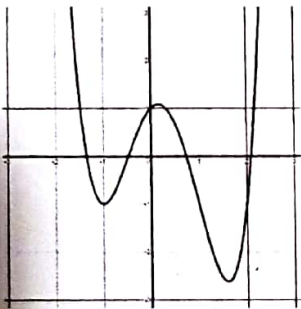
B. $y = \log x$

C. $y = x^2$

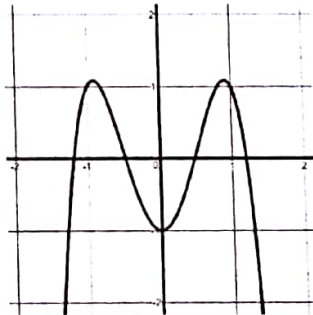
D. $y = 2^x$

For the following graphs, write ODD, EVEN, or NEITHER in the blank to describe the function.

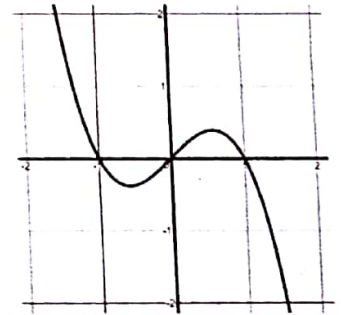
Even 13.



Even 14.



Odd 15.



16. Describe the end function behavior of the graph shown in question #15 above.

$$x \rightarrow -\infty \quad f(x) \rightarrow \infty$$

$$x \rightarrow \infty \quad f(x) \rightarrow -\infty$$

17. Completely factor the polynomial $f(x) = x^3 - 8$.

$$(x-2)(x^2 + 2x + 4)$$

Matching: A) Linear B) Exponential C) Quadratic for the following functions.

B 18.

x	y
0	1
1	2
2	4
3	8

A 19.

x	y
0	4
1	6
2	8
3	10

C 20.

x	y
0	3
1	4
2	7
3	12

21. Write the explicit formula for the function in question #18.

$$f(x) = 2^x$$

22. Write the explicit formula for the function in question # 19.

$$f(x) = 2x + 4$$

23. Write the explicit formula for the function in question #20.

$$f(x) = x^2 + 3$$

24. Write the expanded form of $h(x) = (x-2)^3$.

$$\begin{array}{r}
 \begin{array}{cccc}
 | & 3 & 3 & | \\
 x^3 & x^2 & x^1 & x^0 \\
 (-2)^0 1 & (-2)^1 3 & (-2)^2 3 & (-2)^3 1 \\
 \hline
 x^3 & -6x^2 & +12x & -8
 \end{array}
 \end{array}$$

$$\begin{array}{cccc}
 & & & 1 \\
 & & & 11 \\
 & & 1 & 2 & 1 \\
 1 & 3 & 3 & 1
 \end{array}$$

25. Determine if $(x-1)$ is a factor of $x^3 - 3x^2 - 18x + 40$ by using long division. Show your work.

$$\begin{array}{r}
 x^2 - 2x - 20 \\
 x-1 \overline{) x^3 - 3x^2 - 18x + 40} \\
 \underline{-(x^3 - x^2)} \\
 -2x^2 - 18x \\
 \underline{-(-2x^2 + 2x)} \\
 -20x + 40 \\
 \underline{-(-20x + 20)} \\
 20
 \end{array}$$

Not a factor

Multiple Choice. Write the answer in the blank.

A 26. Which of the following functions is a polynomial?

- a. $f(x) = x$ b. $g(x) = \log_2 x$ c. $r(x) = 2^x$ d. $s(x) = |x + 2|$

A 27. Which of the following is NOT an even function?

- a. $y = |x|$ b. $y = 3x^2$ c. $y = (x - 5)^4$ d. $y = 3 - x^4$

B 28. Which statement best describes the roots of $f(x) = x^3 - 1$?

- a. 1 real, Multiplicity of 3 b. 1 real, 2 imaginary/complex
c. 2 real, 1 imaginary/complex d. 3 real

D 29. As $x \rightarrow -\infty, f(x) \rightarrow \infty$ and as $x \rightarrow \infty, f(x) \rightarrow -\infty$. Which of these functions could be $f(x)$?

- a. $y = 3 - x^4$ b. $y = x^4 - 2x^3 + x - 1$
c. $y = 2x^5 + 2x^2 + 3x + 5$ d. $y = -x^3 - x^2 + 7x - 4$

B 30. Select the function below that has roots of 3 and -4.

- a. $f(x) = x^2 + 7x + 12$ b. $f(x) = x^2 + x - 12$
c. $f(x) = x^2 - x - 12$ d. $f(x) = x^2 - 7x + 12$

$$(x-3)(x+4) \\ x^2 + 4x - 3x - 12 \\ x^2 + x - 12$$

B 31. Which of the following types of functions could NOT also be considered a polynomial function?

- a. Linear b. Exponential c. Quadratic d. Cubic

D 32. If you know that $f(x) + g(x) = x + 3$, which of the following are possibilities for $f(x)$ and $g(x)$?

- a. $f(x) = x^2 + 3$ and $g(x) = x$
b. $f(x) = x^2 + 5x - 3$ and $g(x) = -x^2 - 4x + 3$
c. $f(x) = 3x^2 + 5$ and $g(x) = -2x^2 + x - 2$
 d. $f(x) = 5x^3 - 4x^2 + 10x - 2$ and $g(x) = -5x^3 + 4x^2 - 9x + 5$

B 33. If $f(x) = 3x^2 - 3x + 3$ and $g(x) = 2x + 5$, then $f(x) \cdot g(x) = (3x^2 - 3x + 3)(2x + 5)$

- a. $5x^3 - 9x^2 - 11x + 15$ b. $6x^3 + 9x^2 - 9x + 15$
c. $3x^2 - x + 8$ d. $3x^2 - 5x - 2$

$$6x^2$$

Given these functions, answer the following questions in simplified form:

$$f(x) = 4x^2 + 3x - 2$$

$$g(x) = 5x^2 - 6x + 7$$

$$h(x) = 2x + 3$$

$$j(x) = 3x - 4$$

$$1. f(x) + g(x) = \underline{9x^2 - 3x + 5}$$

$$4x^2 + 3x - 2 + 5x^2 - 6x + 7$$

$$2. f(x) - g(x) = \underline{-x^2 + 9x - 9}$$

$$4x^2 + 3x - 2 - 5x^2 + 6x - 7$$

$$3. h(x) \cdot j(x) = \underline{6x^2 + x - 12}$$

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

$$6x^2 - 8x + 9x - 12$$

$$4. f(x) \div h(x) = \underline{2x - \frac{3}{2} + \frac{\frac{5}{2}}{2x + 3}}$$

$$2x + 3 \overline{) 4x^2 + 3x - 2}$$

$$\underline{-4x^2 + 6x}$$

$$-3x - 2$$

$$\underline{-3x - \frac{9}{2}}$$

$$\frac{5}{2}$$

Given a polynomial: $P(x) = ax^6 + bx^5 + cx^4 + dx^3 + ex^2 + fx + g$

5. How many total roots would $P(x)$ have (including Real and imaginary)?

6

6. List all of the possible combinations of Real and imaginary roots of $P(x)$.

6 reals

1 real M4 1 real M2

1 real M6

1 real M3 1 real M3

1 real M5 1 real 4 real 2 imaginary

2 real 4 imaginary

7. If $a > 0$, describe the end function behavior of $P(x)$.

6 imaginary

$$x \rightarrow -\infty \quad f(x) \rightarrow \infty$$

$$x \rightarrow \infty \quad f(x) \rightarrow \infty$$

8. Given a polynomial with factors $(x + 5)(x + 2)(x - 2)$, write the polynomial in expanded form.

$$x^2 + 2x + 5x + 10$$

$$x^3 - 2x^2 + 7x^2 - 14x + 10x - 20$$

$$(x^2 + 7x + 10)(x - 2)$$

$$\boxed{x^3 + 5x^2 - 4x - 20}$$

9. Find the zeros of $f(x) = x^2 + 2x + 10$

$$\frac{-b \pm \sqrt{b^2 - 4ac}}{2a} = \frac{-2 \pm \sqrt{(2)^2 - 4(1)(10)}}{2(1)} = \frac{-2 \pm \sqrt{-36}}{2} = \frac{-2 \pm 6i}{2} = \boxed{-1 \pm 3i}$$

10. Given $x = 3$ is a zero of the polynomial $f(x) = x^3 + x^2 - 17x + 15$, write the polynomial in factored form.

Must show work for credit.

$$\begin{array}{r}
 x^2 + 4x - 5 \\
 x-3 \overline{) x^3 + x^2 - 17x + 15} \\
 \underline{-x^3 - 3x^2} \\
 4x^2 - 17x \\
 \underline{-4x^2 - 12x} \\
 -5x + 15 \\
 \underline{-5x + 15} \\
 0
 \end{array}$$

$$\begin{aligned}
 &x^2 + 4x - 5 \\
 &(x-1)(x+5)
 \end{aligned}$$

$$(x-3)(x-1)(x+5)$$

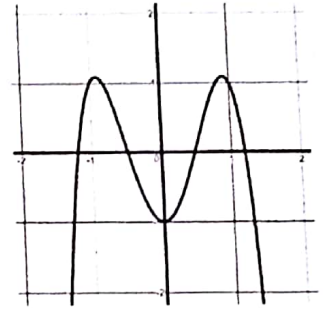
A 11. Which of the following polynomials could create the graph shown here:

(A) $f(x) = ax^4 + bx^3 + cx^2 + dx + e$

B. $f(x) = ax^2 + bx + c$

C. $f(x) = ax^3 + bx^2 + cx + d$

D. $f(x) = ax + b$



D 12. Which of the following functions has the largest growth rate as $x \rightarrow \infty$.

A. $y = \log_9 x$

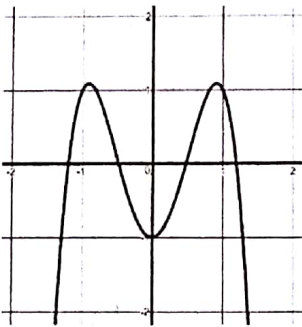
B. $y = \log_5 x$

C. $y = x^3$

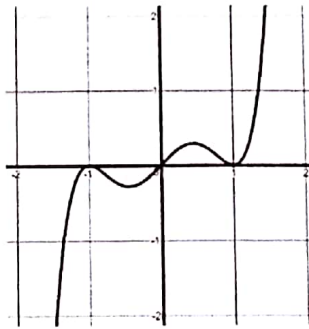
D. $y = 3^x$

For the following graphs, write ODD, EVEN, or NEITHER in the blank to describe the function.

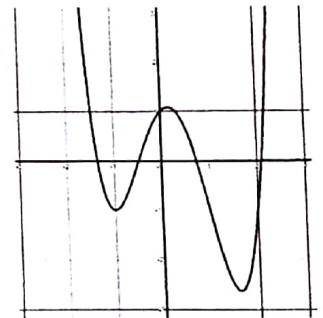
Even 13.



Odd 14.



Even 15.



16. Describe the end function behavior of the graph shown in question #13 above.

$$x \rightarrow -\infty \quad f(x) \rightarrow -\infty$$

$$x \rightarrow \infty \quad f(x) \rightarrow -\infty$$

17. Completely factor the polynomial $f(x) = x^3 - 27$.

$$(x-3)(x^2 + 3x + 9)$$

Matching: A) Linear B) Exponential C) Quadratic for the following functions.

A 18.

x	y
0	5
1	8
2	11
3	14

C 19.

x	y
0	4
1	5
2	8
3	13

B 20.

x	y
0	1
1	3
2	9
3	27

21. Write the explicit formula for the function in question #18.

$$f(x) = 3x + 5$$

22. Write the explicit formula for the function in question #19.

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

23. Write the explicit formula for the function in question #20.

$$f(x) = 3^x$$

24. Write the expanded form of $h(x) = (x-1)^3$.

$$\begin{array}{cccc}
 1 & 3 & 3 & 1 \\
 x^3 & x^2 & x^1 & x^0 \\
 (-1)^3 & (-1)^2 & (-1)^1 & (-1)^0 \\
 \hline
 x^3 - 3x^2 + 3x - 1
 \end{array}$$

$$\begin{array}{cccc}
 & & 1 & \\
 & & 1 & 1 \\
 & 1 & 2 & 1 \\
 1 & 3 & 3 & 1
 \end{array}$$

25. Determine if $(x-2)$ is a factor of $x^3 - 3x^2 - 18x + 40$ by using long division. Show your work.

$$\begin{array}{r}
 x^2 - x - 20 \\
 x-2 \overline{) x^3 - 3x^2 - 18x + 40} \\
 \underline{-x^3 - 2x^2} \\
 -x^2 - 18x \\
 \underline{-7x^2 + 2x} \\
 -20x + 40 \\
 \underline{-20x + 40} \\
 0
 \end{array}$$

It is a factor!

Multiple Choice Write the answer in the blank.

C 26. Which of the following functions is a polynomial?

- a. $f(x) = 2^x$ b. $g(x) = \log_2 x$ c. $r(x) = 2x$ d. $s(x) = |x + 2|$

A 27. Which of the following is NOT an even function?

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D 29. As $x \rightarrow -\infty, f(x) \rightarrow \infty$ and as $x \rightarrow \infty, f(x) \rightarrow -\infty$. Which of these functions could be $f(x)$?

- a. $y = 3 - x^4$ b. $y = x^4 - 2x^3 + x - 1$
c. $y = 2x^5 + 2x^2 + 3x + 5$ d. $y = -x^3 - x^2 + 7x - 4$

C 30. Select the function below that has roots of -4 and 3.

- a. $f(x) = x^2 - 7x + 12$ b. $f(x) = x^2 - x - 12$
 c. $f(x) = x^2 + x - 12$ d. $f(x) = x^2 + 7x + 12$

D 31. Which of the following types of functions could NOT also be considered a polynomial function?

- a. Linear b. Quadratic c. Cubic d. Exponential

B 32. If you know that $f(x) + g(x) = x + 3$, which of the following are possibilities for $f(x)$ and $g(x)$?

- a. $f(x) = -2x^2 + x - 2$ and $g(x) = 3x^2 + 5$
 b. $f(x) = -5x^3 + 4x^2 - 9x + 5$ and $g(x) = 5x^3 - 4x^2 + 10x - 2$
c. $f(x) = x$ and $g(x) = x^2 + 3$
d. $f(x) = -x^2 - 4x + 3$ and $g(x) = x^2 + 5x - 3$

A 33. If $f(x) = 3x^2 - 3x + 3$ and $g(x) = 2x + 5$, then $f(x) \cdot g(x) =$

- a. $6x^3 + 9x^2 - 9x + 15$ b. $5x^3 - 9x^2 - 11x + 15$
c. $3x^2 - 5x - 2$ d. $3x^2 - x + 8$