Pre-Calculus First Semester Review

NON CALCULATOR

For question 1-6, find following:
(a) Identify the parent function.
(b) State the transformation rule or describe the transformation.
(c) Graph the function including key points and any asymptotes.

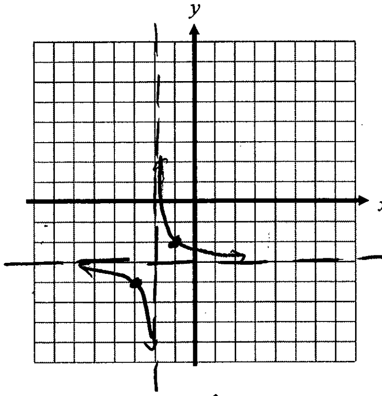
★ MUST DO THIS TO APPLY TRANS. RULES!

[1.5] 1. $f(x) = \dfrac{1}{x+2} - 3$

a) $y = \frac{1}{x}$

b) $(x-2, y-3)$

Left 2, Down 3



HA $y=-3$

VA $x=-2$

[1.5] 2. $f(x) = -3|2x+6|+1 = -3|2(x+3)|+1$

a) $y = |x|$

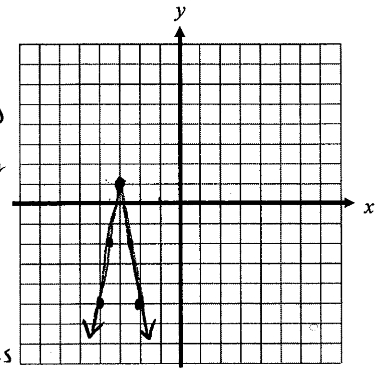
b) $(\frac{1}{2}x - 3, -3y+1)$

vertical Stretch by a factor of 3

Horizontal Shrink by a factor of $\frac{1}{2}$

Left 3, Up 1

Reflect over x-axis



[1.5] 3. $f(x) = \log_4(x-2)$

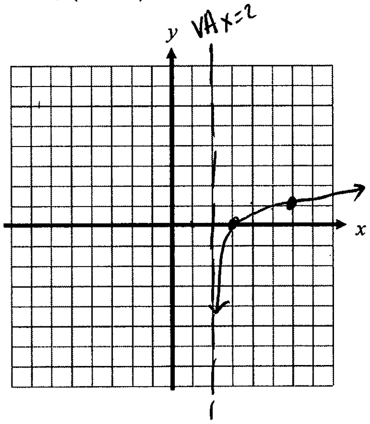
[3.3]

a) $y = \log_4(x)$

b) $(x+2, y)$

Right 2

VA $x=2$



[1.5] 4. $f(x) = -\frac{1}{3}x^3 + 4$

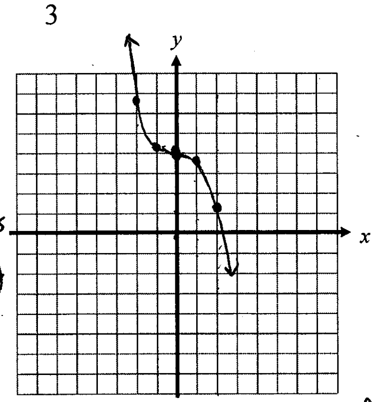
a) $y = x^3$

b) $(x, -\frac{1}{3}y + 4)$

Reflect over x-axis

Vertical Shrink by a factor of 1/3

Up 4



★ MUST REWRITE TO APPLY TRANSFORMATION RULES!

[1.5] 5. $f(x) = 3^{x+2} - 1$

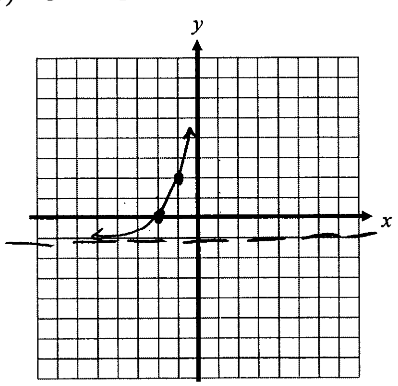
[3.3]

a) $y = 3^x$

b) $(x-2, y-1)$

Left 2

Down 1



HA $y=-1$

[1.5] 6. $f(x) = 3\sqrt{4-x} = 3\sqrt{-x+4} = 3\sqrt{-(x-4)}$

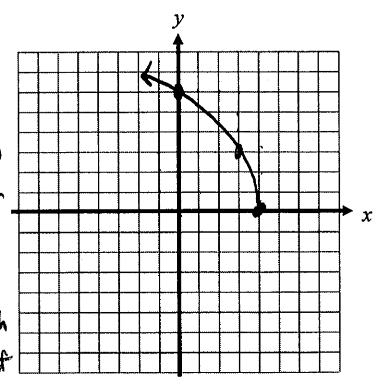
a) $y = \sqrt{x}$

b) $(-x+4, 3y)$

Reflect over y-axis

Right 4

Vertical Stretch by a factor of 3



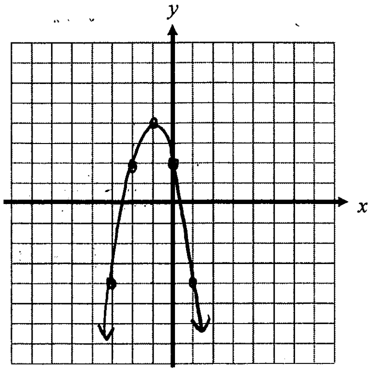
For questions 7-8, find the vertex (show work). Then graph the function including at least three points.

[1.5] 7. $f(x) = -2(x+1)^2 + 4$

[2.1]

$v(-1, 4)$

$(x-1, -2y+4)$



[1.5] 8. $f(x) = x^2 + 8x + 11$

[2.1]

Vertex using

$x = -b/2a$

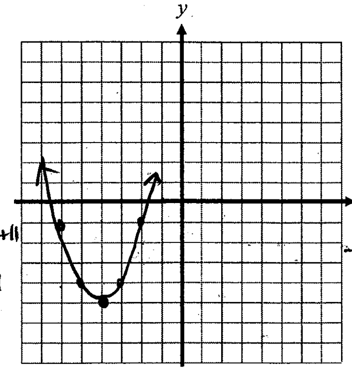
$x = -8/2(1) = -4$

$f(-4) = (-4)^2 + 8(-4) + 11$

$= 16 - 32 + 11$

$= -5$

$v(-4, -5)$



Vertex by CTS

$f(x) = x^2 + 8x + 11$

$f(x) - 11 = x^2 + 8x$

$f(x) - 11 = x^2 + 8x + 16$

$+16$

$f(x) + 5 = (x+4)^2$

$f(x) = (x+4)^2 - 5$

$v(-4, -5)$

Solve. Check for extraneous roots. Write your answers in interval notation where appropriate.

only necessary for problems with Domain Issues...

no zeros

$\sqrt{\text{no neg}}$

$\log(\text{no zeros } \& \text{ no neg})$

[P3] 9. $2(5-2y) - 3(1-y) \geq y + 1$

$10 - 4y - 3 + 3y \geq y + 1$

$7 - y \geq y + 1$

$6 \geq 2y$

$3 \geq y$

3

$\boxed{(-\infty, 3]}$

[P5] 10. $-3 \leq 1 - 2x < 7$

$-4 \leq -2x < 6$

$2 \geq x > -3$

-3 2

$\boxed{(-3, 2]}$

[P5] 11. $(3x-4)^2 - 8 = 18$

$(3x-4)^2 = 26$

$3x - 4 = \pm\sqrt{26}$

$3x = 4 \pm \sqrt{26}$

$\boxed{x = \frac{4 \pm \sqrt{26}}{3}}$

[P5] 12. $|-x+4| - 3 > 7$

-10 10

$|-x+4| > 10$

split

$-x + 4 < -10$ or $-x + 4 > 10$

$-x < -14$ $\quad$ $-x > 6$

$x > 14$ $\quad$ $x < -6$

-6 14

$\boxed{(-\infty, -6) \cup (14, \infty)}$

[P5] 13. $\frac{3x}{x+1} + \frac{5}{x-2} = \frac{15}{\cancel{x^2 - x - 2}}$ $\quad (x+1)(x-2)$

[2.8]

$(x+1)(x-2)$

$3x(x-2) + 5(x+1) = 15$

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

$3x^2 - x - 10 = 0$

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

$\boxed{x = -5/3}$ or $\cancel{x = 2}$

ONLY!

extraneous... because it makes the denominator of original equation $= 0$

[P5] 14. $4x^2 - 7x + 5 = 0$

$x = \frac{7 \pm \sqrt{49 - 4(4)(5)}}{2(4)}$

$x = \frac{7 \pm \sqrt{49 - 80}}{8} = \frac{7 \pm \sqrt{-31}}{8}$

$\boxed{x = \frac{7 \pm i\sqrt{31}}{8}}$

[P1] Simplify. Express your answer without negative exponents.

15. $\dfrac{(uv^{-2})^{-3}}{u^{-5}v^{2}} = \dfrac{u^{-3}v^{6}}{u^{-5}v^{2}} = \dfrac{u^{5}v^{6}}{u^{3}v^{2}} = \boxed{u^2v^4}$

16. $\dfrac{4x^3y}{x^2y^3}\cdot\dfrac{3y^2}{2x^2y^4} = \dfrac{12x^3y^3}{2x^4y^7} = \boxed{\dfrac{6}{xy^4}}$

[P4] 17. Write the equation of a line a) parallel to **and** b) perpendicular to $5x - y = 7$ and passing through the point $(3, -4)$.

Need the Slope! Solve for y...

$5x - y = 7$

$-y = 7 - 5x$

$y = -7 + 5x$

Slope = 5

a) Parallel Slope = 5

$\boxed{y + 4 = 5(x-3)}$

b) ⊥ Slope = $\frac{-1}{5}$

$\boxed{y + 4 = -\frac{1}{5}(x-3)}$

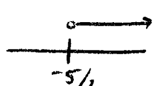
[1.2] Find the domain. Express the answer in interval notation.

18. $f(x) = \log_3(2x+5)$

$2x + 5 > 0$

$2x > -5$

$x > -5/2$

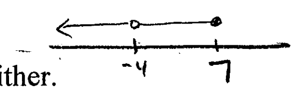


D: $\boxed{(-5/2, \infty)}$

19. $f(x) = \dfrac{\sqrt{7-x}}{x+4}$

$7 - x \geq 0$ and $x + 4 \neq 0$

$7 \geq x$ and $x \neq -4$



$\boxed{(-\infty, -4) \cup (-4, 7]}$

[1.2] Prove algebraically whether the function is even, odd, or neither.

→ MUST SHOW ALL STEPS!

20. $f(x) = 3x^3 - 2x$

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

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

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

$f(-x) = -f(x)$ $\boxed{\therefore f(x) \text{ is ODD}}$

21. $f(x) = -2x^4 - 4x + 7$

$f(-x) = -2(-x)^4 - 4(-x) + 7$

$f(-x) = -2(x^4) - 4(-x) + 7$

$f(-x) = -2x^4 + 4x + 7$

$\left.\begin{array}{l} f(-x) \neq f(x) \\ f(-x) \neq -f(x) \end{array}\right\}$ $\boxed{\therefore f(x) \text{ is neither even nor odd}}$

[1.4] Given $f(x) = (x-4)^2$, $g(x) = 2x - 3$ and $h(x) = \sqrt{x+5}$. Find and simplify the answer.

22. $(f \circ h)(4) = f(h(4))$

$h(4) = \sqrt{4+5}$

$h(4) = 3$

$= f(3)$

$= (3-4)^2$

$\boxed{= 1}$

23. $h(g(x)) = h(2x-3) = \sqrt{(2x-3)+5}$

$\boxed{= \sqrt{2x+2}}$

24. $(g - f)(x) = g(x) - f(x)$

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

$= 2x - 3 - [x^2 - 8x + 16]$

$= 2x - 3 - x^2 + 8x - 16$

$\boxed{= -x^2 + 10x - 19}$

25. $(fg)(x) = f(x) \cdot g(x)$

$= (x-4)^2 \cdot (2x-3)$

$= (x^2 - 8x + 16)(2x - 3)$

$= 2x^3 - 3x^2 - 16x^2 + 24x + 32x - 48$

$\boxed{= 2x^3 - 19x^2 + 56x - 48}$

[1.4] 26. Given: $f(x) = x^3 + 2$. Find $f^{-1}(x)$.

$x = y^3 + 2$

$x - 2 = y^3$

$\sqrt[3]{x-2} = y$

$\boxed{\therefore\ f^{-1}(x) = \sqrt[3]{x-2}}$

[1.4] 27. **Verify** that f and g are inverses of each other: $f(x) = 2x + 8$ and $g(x) = \dfrac{x-8}{2}$.

MUST SHOW ALL THESE STEPS!

MUST SHOW $f(g(x)) = x$ AND $g(f(x)) = x$

$f(g(x)) = f\left(\frac{x-8}{2}\right) = 2\left(\frac{x-8}{2}\right) + 8$

$= x - 8 + 8$

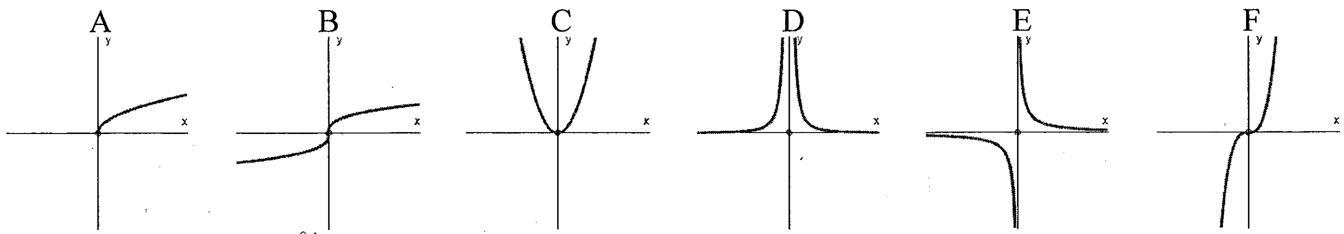
$= x$ ✓

$g(f(x)) = g(2x+8) = \dfrac{(2x+8) - 8}{2}$

$= \dfrac{2x}{2}$

$= x$

[2.2] For questions 28 & 29, identify the letter of the graph below that best matches the given function.



28. $f(x) = \frac{1}{2}x^{-5}$ neg ODD → $\boxed{E}$

positive

29. $f(x) = 3x^{1/4}$ even Root → $\boxed{A}$

positive

[2.3&2.7] Describe the end behavior of the polynomial or rational function using **limit** notation.

30. $f(x) = \boxed{-2x^3} + 4x^2 + 1$

opposite direction

$\lim_{x\to\infty} f(x) = -\infty$

$\lim_{x\to-\infty} f(x) = \infty$

31. $f(x) = \boxed{3x^4} + x^2 - 5$

same direction

$\lim_{x\to\infty} f(x) = \infty$

$\lim_{x\to-\infty} f(x) = \infty$

32. $g(x) = \dfrac{2x^3 + 6x^2 - x + 12}{x^2 + 2}$

$\frac{2x^3}{x^2} = \frac{2x}{1}$

$\lim_{x\to\infty} g(x) = \infty$

$\lim_{x\to-\infty} g(x) = -\infty$

[2.3] For each function below…

a) Tell the degree.

b) Find the zeros of the function with their multiplicities.

c) Sketch a graph of the function including zeros, multiplicities and end behavior.

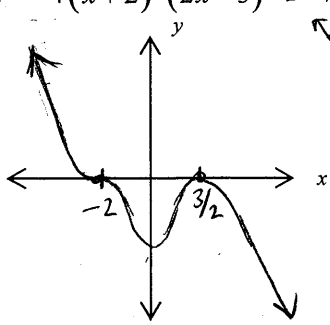
33. $f(x) = -4(x+2)^3(2x-3)^2 = -16x^5 + \cdots$

$-4x^3 \quad 4x^2$

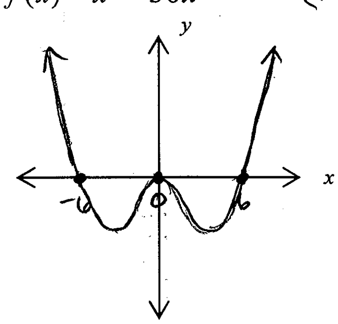
a) deg = 5

b)

zero	mult
-2	3
3/2	2



34. $f(x) = x^4 - 36x^2 = x^2(x^2 - 36) = x^2(x+6)(x-6)$



a) deg = 4

b)

zero	mult
0	2
-6	1
6	1

[2.5] 35. Write in $a + bi$ form: $\dfrac{(2+4i)(3+2i)}{(3-2i)(3+2i)} = \dfrac{6+4i+12i+8i^2}{9+6i-6i-4i^2} = \dfrac{6+16i-8}{9+4} = \dfrac{-2+16i}{13}$

$\boxed{-\frac{2}{13} + \frac{16}{13}i}$

[2.6] Find the zeros of the function and write the function as a product of linear and irreducible quadratic factors all with real coefficients.

36. $f(x) = x^3 - x^2 - x - 2$, given that $x = 2$

$$\begin{array}{r|rrrr} 2 & 1 & -1 & -1 & -2 \\ & & 2 & 2 & 2 \\ \hline & 1 & 1 & 1 & 0 \end{array}$$

$x^2 + x + 1 = 0$

$x = \dfrac{-1 \pm \sqrt{1-4(1)(1)}}{2} = \dfrac{-1 \pm \sqrt{-3}}{2} = \dfrac{-1 \pm i\sqrt{3}}{2}$

Zeros: $x = 2$, $x = \dfrac{-1 + i\sqrt{3}}{2}$, $x = \dfrac{-1 - i\sqrt{3}}{2}$

$\boxed{f(x) = (x-2)(x^2+x+1)}$

37. $f(x) = x^4 + 3x^3 - 3x^2 + 3x - 4$, given that $x = 1$ and $x = -4$

$$\begin{array}{r|rrrrr} 1 & 1 & 3 & -3 & 3 & -4 \\ & & 1 & 4 & 1 & 4 \\ \hline -4 & 1 & 4 & 1 & 4 & \boxed{0} \\ & & -4 & 0 & -4 & \\ \hline & 1 & 0 & 1 & \boxed{0} & \end{array}$$

$x^2 + 1 = 0$

$x^2 = -1 \Rightarrow x = \pm i$

Zeros: $x = 1$, $x = -4$, $x = i$, $x = -i$

$\boxed{f(x) = (x-1)(x+4)(x^2+1)}$

[2.7] Find (if it exists) the a) equations of any horizontal or slant asymptote, b) equations of any vertical asymptote(s) and coordinates of any holes, c) x-intercept and y-intercept, and d) graph the function including additional points in each region of the domain.

38. $g(x) = \dfrac{4x^2 - x - 5}{x^2 - 2x - 3} = \dfrac{(4x-5)\cancel{(x+1)}}{(x-3)\cancel{(x+1)}}$

Hole @ $x = -1$

a) HA: $y = 4$

b) VA: $x = 3$

Hole: $(-1, 9/4)$

$\dfrac{4(-1)-5}{-1-3} = \dfrac{-9}{-4}$

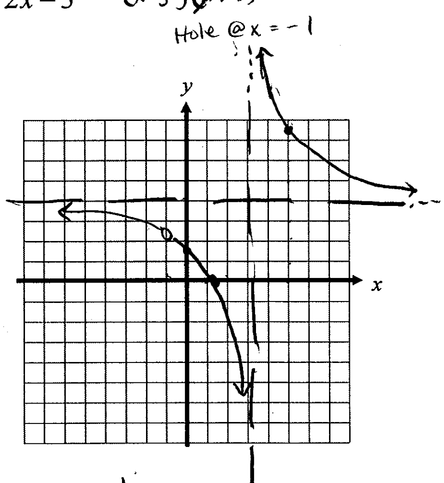
c) x-int: $4x - 5 = 0$

$x = 5/4$

$(5/4, 0)$

y-int: $y = \frac{-5}{-3} = 5/3$

$(0, 5/3)$



x	y	
4	11	$\frac{(4)(4)-5}{4-3} = \frac{11}{1}$
5		$\frac{4(5)-5}{5-3} = \frac{15}{2} = 7.5$

39. $g(x) = \dfrac{-2x}{x^2 - x - 6} = \dfrac{-2x}{(x-3)(x+2)}$

a) HA: $y = 0$

b) VA: $x = 3$

VA: $x = -2$

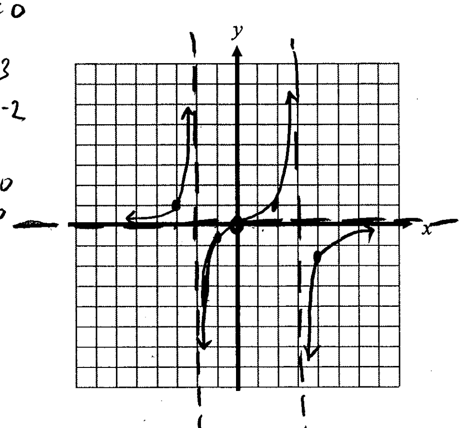
c) x-int: $2x = 0$

$x = 0$

$(0,0)$

y-int: $\frac{0}{-6}$

$(0,0)$



x	y	
-3	1	$\frac{(-2)(-3)}{(-3-3)(-3+2)} = \frac{6}{(-6)(-1)} = \frac{6}{6} = 1$

x	y	
4	-4/3	$\frac{-8}{1(6)}$

x	y	
-1	-1/2	$\frac{-2(-1)}{(-4)(1)} = \frac{2}{-4}$
2	1	$\frac{-4}{(-1)(4)} = 1$

[2.7] 40. Use the rational function below, along with the listed attributes, to graph the function. Include additional points in each region of the domain.

$$f(x) = \frac{x^3 + x^2 - 9x - 9}{x^2 + 2x - 3} = \frac{\cancel{(x+3)}(x-3)(x+1)}{\cancel{(x+3)}(x-1)}$$

SA: $y = x - 1$

VA: $x = 1$

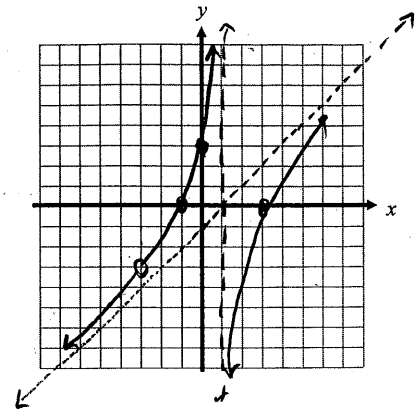
x-intercepts: (3, 0) and (–1, 0)

y-intercept: (0, 3)

HOLE @ $x = -3$

$(-3, -3)$

$\frac{(-3-3)(-3+1)}{(-3-1)} = \frac{(-6)(-2)}{-4} = -3$



[2.8] Solve questions 41-43 using as sign chart.

41. $12x^3 - 14x^2 - 6x \geq 0$

$2x(6x^2 - 7x - 3) \geq 0$

$2x(2x-3)(3x+1) \geq 0$ pos or 0

$2x$, $2x-3$, $3x+1$

neg | pos | neg | pos

$-1/3$ $\quad 0 \quad$ $3/2$

$\boxed{[-1/3, 0] \cup [3/2, \infty)}$

42. $\frac{2x+1}{x^2 + 2x - 3} \leq 0$

$\frac{2x+1}{(x+3)(x-1)} \leq 0$ neg or 0

$2x+1$, $x+3$, $x-1$

neg | pos | neg | pos

-3 DNE $\quad -1/2 \quad$ 1 DNE

$\boxed{(-\infty, -3) \cup [-1/2, 1)}$

43. $\frac{2}{x+1} - \frac{3}{x-5} > 0$

$\frac{2(x-5)}{(x+1)(x-5)} - \frac{3(x+1)}{(x-5)(x+1)} > 0$

$\frac{2x-10-3x-3}{(x+1)(x-5)} > 0$

$\frac{-x-13}{(x+1)(x-5)} > 0$ pos

$-x-13$, $x+1$, $x-5$

pos | neg | pos | neg

$-13 \quad -1 \quad 5$

$\boxed{(-\infty, -13) \cup (-1, 5)}$

[3.3] 44. Simplify

a) $\log_{11} 11^4 = \boxed{4}$

b) $\log_5 1 = \boxed{0}$

c) $\ln \frac{1}{e} = \ln e^{-1} = \boxed{-1}$

d) $\log \sqrt[4]{10} = \log 10^{1/4} = \boxed{1/4}$

e) $\log_9 \frac{1}{27} = x$

$9^x = \frac{1}{27}$

$3^{2x} = 3^{-3}$

$2x = -3$

$x = \boxed{-3/2}$

f) $3^{\log_3 7} = \boxed{7}$

[3.5] 45. Solve.

a) $\log x = -2$

$10^{-2} = x$

$\boxed{\frac{1}{100} = x}$

b) $\log_3(2 - 3x) + 5 = 9$

$\log_3(2-3x) = 4$

$3^4 = 2 - 3x$

$81 = 2 - 3x$

$79 = -3x$

$\boxed{-\frac{79}{3} = x}$

c) $\log(x^2 + 21x) = 2$

$10^2 = x^2 + 21x$

$0 = x^2 + 21x - 100$

$0 = (x+25)(x-4)$

$\boxed{x = -25 \text{ or } x = 4}$

d) $\log_2(x - 1) - \log_2(2x - 3) = 3$

$\log_2\left(\frac{x-1}{2x-3}\right) = 3$

$2^3 = \frac{x-1}{2x-3}$

$8 = \frac{x-1}{2x-3}$

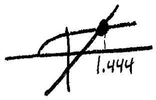
$16x - 24 = x - 1$

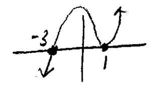
$15x = 23$

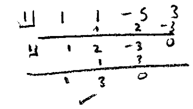
$\boxed{x = 23/15}$

Graphing Calculator Allowed

[P.5] Solve by graphing.







46. $\underbrace{3x-2}_{y_1} = \underbrace{\sqrt{x+4}}_{y_2}$ $\boxed{x \approx 1.444}$

calculate intersection

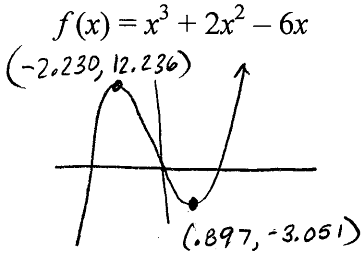
47. $0 = \underbrace{x^3 + x^2 - 5x + 3}_{y_1}$

Calculate zero

$\boxed{\begin{array}{l} x = -3 \\ x = 1 \ (\text{mult} = 2) \end{array}}$

[1.2] 48. Find all a) local maxima and minima and b) identify intervals on which the function is increasing and decreasing. "y-values" (on x-axis)

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



Local MAX = 12.236

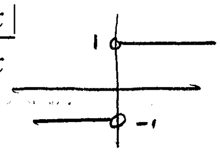
Local MIN = -3.051

INCREASING: $(-\infty, -2.230] \cup [.897, \infty)$

DECREASING: $[-2.230, .897]$

[1.2] Graph the function and tell whether or not it has a point of discontinuity at $x = 0$. If there is a discontinuity, tell whether it is removable or non-removable.

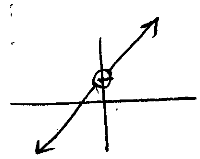
49. $f(x) = \dfrac{|x|}{x}$



Non-Removable Discontinuity at $x=0$

50. $h(x) = \dfrac{x^2 + x}{x} = \dfrac{\cancel{x}(x+1)}{\cancel{x}}$

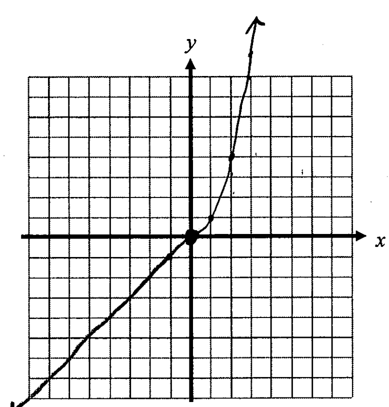
Hole @ $x=0$



Removable discontinuity at $x=0$

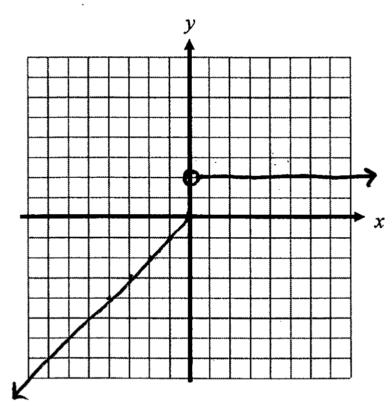
[1.3] Graph the piecewise-defined function. State whether the function is continuous or discontinuous at $x = 0$.

51. $f(x) = \begin{cases} x & \text{if } x \le 0 \\ x^2 & \text{if } x > 0 \end{cases}$



continuous @ $x=0$

52. $f(x) = \begin{cases} -|x| & \text{if } x \le 0 \\ 2 & \text{if } x > 0 \end{cases}$



discontinuous @ $x=0$

[1.3] Using the twelve basic parent functions provided in the box, list the equation of the function(s) that fit the description given.

$f(x)=x$	$f(x)=\ln x$	$f(x)=e^x$	$f(x)=x^2$	$f(x)=\|x\|$	$f(x)=x^3$
$f(x)=\sqrt{x}$	$f(x)=\frac{1}{x}$	$f(x)=\sin x$	$f(x)=\cos x$	$f(x)=\text{int}(x)$	$f(x)=\frac{1}{1+e^{-x}}$

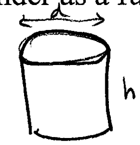
53. Bounded (3 functions). $f(x)=\sin x$; $f(x)=\cos x$, $f(x)=\frac{1}{1+e^{-x}}$

54. Increasing on the entire domain (6 functions).
$f(x)=\frac{1}{1+e^{-x}}$, $f(x)=x$, $f(x)=\ln x$, $f(x)=e^x$, $f(x)=x^3$, $f(x)=\sqrt{x}$

55. Even (3 functions).

$f(x)=x^2$, $f(x)=|x|$, $f(x)=\cos x$

[1.6] 56. The height of a right circular cylinder equals its diameter. Write the volume of the cylinder as a function of its radius.



$h=d$, $d=2r$ $\Big\}$ $\therefore h=2r$

$V=\pi r^2 h$

$V=\pi r^2(2r)$

$V=\pi 2r^3$

$\boxed{V=2\pi r^3}$

[1.6] 57. Sue invested \$10,000, part at 3.6% annual interest and the balance 7.8% annual interest. How much is invested at each rate if a 1-year interest payment is \$667.02?

\$x at 3.6% | \$y at 7.8%

\$10000 = TOTAL INVESTMENT

TOTAL INTEREST = 667.02

$\boxed{\begin{aligned} x+y&=10000 \\ .036x+.078y&=667.02\end{aligned}}$ $\Rightarrow$ $y=10000-x$

$.036x+.078(10000-x)=667.02$

$.036x+780-.078x=667.02$

$-.042x=-112.98$

$x=2690$

Invest \$2,690 @ 3.6%
Invest \$7310 @ 7.8%

[1.6] 58. The chemistry lab at the University of Hardwoods keeps two acid solutions on hand. One is 20% acid and the other is 35% acid. How much 20% acid solution and how much 35% acid solution should be used to prepare 25 liters of a 26% acid solution?

20% acid: x L | 35% acid: y L

25 L, 26% Acid

$\boxed{\begin{aligned} x+y&=25 \\ .2x+.35y&=.26(25)\end{aligned}}$ $\Rightarrow$ $y=25-x$

$.2x+.35(25-x)=.26(25)$

$.2x+8.75-.35x=6.5$

$-.15x=-2.25$

$x=15$

15 L of 20% acid
10 L of 35% acid

[2.1] 59. Write an equation for the linear function f with $f(-3)=-2$ and $f(4)=-8$.

$\text{Slope}=\frac{-8-(-2)}{4-(-3)}=\frac{-6}{7}$

solve for y...

$y+2=-\frac{6}{7}(x+3)$

$y=-\frac{6}{7}x-\frac{18}{7}-2$

$y=-\frac{6}{7}x-\frac{32}{7}$

$\boxed{\therefore f(x)=-\frac{6}{7}x-\frac{32}{7}}$

[2.2] 60. Write the statement as a power function equation and answer the question. The electrical resistance of a wire varies directly as its length and inversely as the square of the diameter of the wire.

a) Write a model for this situation.

$$\boxed{R = \frac{k \cdot L}{D^2}}$$

b) Suppose 50 mm of a wire of diameter 3 mm has a resistance of 8 Ω. Use this information to find the constant k.

$L=50$
$D=3$
$R=8$

$8 = \frac{k \cdot 50}{3^2}$

$72 = 50k$

$\boxed{1.44 = k}$

$R = \frac{1.44L}{D^2}$

c) What is the resistance of 40 mm of the same type of wire if the diameter is 4 mm?

$L=40$
$D=4$

$R = \frac{1.44(40)}{4^2} = \boxed{3.6\ \Omega}$

[2.1] 61. The table below gives the weight and pulse rate of selected mammals.

a) Write a power regression equation and state the power and constant of variation.

$y = 231.2039179x^{-.2968764553}$

Constant of variation ≈ 231.204

Power $\approx -.297$

Mammal	Body Weight	Pulse Rate (beats/min)
Rat	0.2	420
Guinea Pig	0.3	300
Rabbit	2	205
Small Dog	5	120
Large Dog	30	85
Sheep	50	70
Human	70	72

b) Use the regression equation to determine the pulse rate of a human weighing 12 pounds.

STORED AS Y_1

$Y_1(12) \approx 110.563$

Is your answer the same to 3 Decimal Places?

[2.4] Divide. Write a summary statement in polynomial form. Determine if the first polynomial is a factor of the second polynomial.

62. $2x+1$; $6x^3 - 5x^2 + 9$

$$\begin{array}{r} 3x^2 - 4x + 2 \\ 2x+1 \overline{)\ 6x^3 - 5x^2 + 0x + 9} \\ -(6x^3 + 3x^2) \quad\quad\quad \\ -8x^2 + 0x \quad\ \\ -(-8x^2 - 4x) \quad\ \\ 4x + 9 \\ -(4x + 2) \\ 7 \end{array}$$

$$\boxed{(3x^2 - 4x + 2)(2x+1) + 7 = 6x^3 - 5x^2 + 9}$$

$(2x+1)$ is not a factor of $6x^3 - 5x^2 + 9$

63. $x - 5$; $x^3 - 4x^2 - 7x + 10$

$$\begin{array}{r|rrrr} 5 & 1 & -4 & -7 & 10 \\ & & 5 & 5 & -10 \\ \hline & 1 & 1 & -2 & 0 \end{array}$$

$$\boxed{(x^2 + x - 2)(x-5) = x^3 - 4x^2 - 7x + 10}$$

$(x-5)$ **is** a factor of $x^3 - 4x^2 - 7x + 10$

[2.4 & 2.6] Find a polynomial equation with the given zeros. Express function in standard form.

64. $\frac{1}{3}, -2, 5$

$y = (x - \frac{1}{3})(x+2)(x-5)$

$y = (x - \frac{1}{3})(x^2 - 3x - 10)$

$y = x^3 - 3x^2 - 10x - \frac{1}{3}x^2 + x + \frac{10}{3}$

$\boxed{y = x^3 - \frac{10}{3}x^2 - 9x + \frac{10}{3}}$

65. $-1, 2 - i$

$y = (x+1)[x-(2-i)][x-(2+i)]$

$y = (x+1)[x-2+i][x-2-i]$

$y = (x+1)(x^2 - 4x + 4 + 1)$

$y = (x+1)(x^2 - 4x + 5)$

$y = x^3 - 4x^2 + 5x + x^2 - 4x + 5$

$\boxed{y = x^3 - 3x^2 + x + 5}$

66. $3, 4i$

$y = (x-3)(x-4i)(x+4i)$

$y = (x-3)(x^2 + 16)$

$y = x^3 + 16x - 3x^2 - 48$

$\boxed{y = x^3 - 3x^2 + 16x - 48}$

[3.2] 67. Fruit flies are placed in a container with a banana and yeast plants. Suppose the fruit fly population after t days is given by $P(t) = \dfrac{230}{1 + 56.5e^{-0.37t}}$.

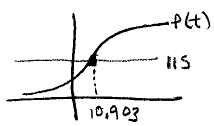
a) What is the maximum number of fruit flies the container can hold? $\boxed{230}$

b) How many fruit flies were originally placed in the container?

$P(0) = \boxed{4}$

c) How long does it take for the number of fruit flies to reach one-half of the maximum flies that the container can hold?

$\underbrace{115}_{y_1} = \underbrace{\dfrac{230}{1 + 56.5e^{-.37t}}}_{y_2}$ calculate intersection...



$\boxed{\approx 10.903 \text{ days}}$

[3.2] 68. Write the equation of the logistic function of the form $f(x) = \dfrac{c}{1 + ae^{-bt}}$ whose initial population is 16, limit to growth is 128 and that passes through the point (5, 32).

(0,16)

$c = 128$

$y = \dfrac{128}{1 + ae^{-bt}}$

$16 = \dfrac{128}{1 + ae^{-b(0)}}$

$16 = \dfrac{128}{1 + a}$

$16 + 16a = 128$

$16a = 112$

$a = 7$

$\boxed{y = \dfrac{128}{1 + 7e^{-bt}}} \Rightarrow 32 = \dfrac{128}{1 + 7e^{-b(5)}}$

$32 + 224e^{-5b} = 128$

$224e^{-5b} = 96$

$e^{-5b} = 3/7$

$-5b = \ln(3/7)$

$b = -\frac{1}{5}\ln(3/7) \approx .169$

$\boxed{f(x) = \dfrac{128}{1 + 7e^{-.169t}}}$

For questions 69-70, write a model for the situation. Be sure to clearly define your variables. Then use your model to answer the question. Solve algebraically AND graphically.

[3.2] [3.6] 69. Shan invested \$100 at 3.5% interest compounded monthly. How long will it take for her investment to double?

$200 = 100\left(1 + \frac{.035}{12}\right)^{12t}$

$2 = \left(1 + \frac{.035}{12}\right)^{12t}$

$\log_{(1 + \frac{.035}{12})}(2) = 12t$

$t = \frac{1}{12}\log_{(1 + \frac{.035}{12})}(2)$

$\boxed{t \approx 19.833 \text{ years}}$

[3.2] 70. A radioactive isotope decays at a rate of 3% per day. A scientist has an initial amount of 50 g. Determine approximately how many days it will take for half the isotope to decay.

$y = 50(.97)^x$

$25 = 50(.97)^x$

$\frac{1}{2} = (.97)^x$

$\log_{.97}\left(\frac{1}{2}\right) = x$

$\boxed{x \approx 22.757 \text{ days}}$

[3.4] 71. Rewrite the expression as a sum or difference of multiple logarithms.

a) $\log_3(a^2 b)$

$\log_3 a^2 + \log_3 b$

$\boxed{2\log_3 a + \log_3 b}$

b) $\log_3 \frac{\sqrt{a}}{bc} = \log_3 \frac{a^{1/2}}{bc}$

$= \log_3 a^{1/2} - \log_3 (bc)$

$= \frac{1}{2}\log_3(a) - [\log_3(b) + \log_3(c)]$

$\boxed{= \frac{1}{2}\log_3(a) - \log_3(b) - \log_3(c)}$

[3.4] 72. Express as a single logarithm. Simplify.

a) $2\log r - \log q + 3\log w$

$\log r^2 - \log q + \log w^3$

$\boxed{\log\left(\frac{r^2 w^3}{q}\right)}$

b) $\frac{1}{3}\log 27 - 2\log 4$

$\log 27^{1/3} - \log 4^2$

$\log\left(\frac{27^{1/3}}{4^2}\right) = \boxed{\log\left(\frac{3}{16}\right)}$

[3.5] 73. Solve algebraically and check graphically.

a) $2(5)^x = 26$

$5^x = 13$

$\boxed{\log_5(13) = x}$ $\boxed{\approx 1.594}$

b) $4 + 3e^{x-5} = 157$

$3e^{x-5} = 153$

$e^{x-5} = 51$

$\ln(51) = x - 5$

$\boxed{x = \ln(51) + 5}$

$\boxed{x \approx 8.932}$

c) $\ln\left(\frac{x}{5}\right) = -0.2$

$e^{-.2} = \frac{x}{5}$

$\boxed{5e^{-.2} = x}$

$\boxed{4.094 \approx x}$

d) $5 = 21 - 2\log_3(x-7)$

$-16 = -2\log_3(x-7)$

$8 = \log_3(x-7)$

$3^8 = x - 7$

$3^8 + 7 = x$

$\boxed{6568 = x}$