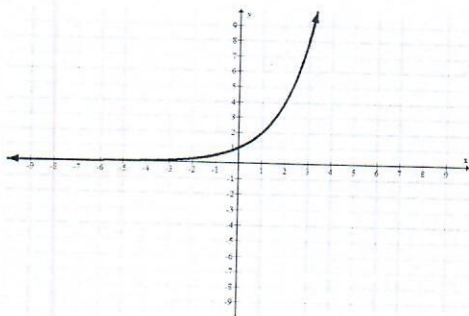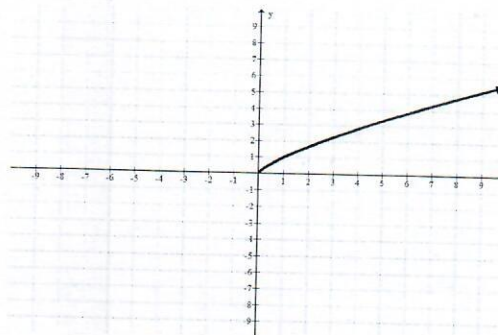All of the district portion will be multiple choice, with calculator allowed. Check your answers on mskmath.com!

1. The graph of f(x) and g(x) is shown below.

   f(x)   g(x)

   Fill out the following table:

	f(x)	g(x)
Is the function continuous?	yes	yes
Asymptotes	$Y=0$	none
Domain	$(-\infty, \infty)$	$[0, \infty)$
Increasing or Decreasing?	increasing	increasing from $(0,\infty)$

2. A finite series is shown below. What is the sum?

$$\sum_{n=1}^{4}\left(n^{3}-1\right) = \left((1)^3-1\right) + \left((2)^3-1\right) + \left((3)^3-1\right) + \left((4)^3-1\right) = \boxed{96}$$

3. Given that $f(x)=3^{2x}$ and $g(x)=9^{x}$, graph the functions to determine the relationship between f(x) and g(x).

   They're the same!

4. Westin purchased a piece of land in the shape of a right triangle on which to plant an apple orchard. On the first row of trees Westin planted 20 trees. Each subsequent row contained 2 less trees. How many apple trees would be planted on the sixth row?

   20, 18, 16, ... $a_6 = 20 + (-2)(6-1)$

   Arithmetic
   $a=20$ $d=-2$ $\boxed{10 \text{ trees}}$

5. The free-fall speed of an object, in terms of distance, measured in meters, can be modeled by the function $s(d) = 4d^{\frac{1}{2}}$. If the free-fall speed is measured at 5.657 meters/second, approximately how far has the object fallen?

   $5.657 = 4d^{1/2}$ $\dfrac{5.657}{4} = \dfrac{4d^{1/2}}{4}$

   (calculator) $(1.41429)^2 = (d^{1/2})^2$ $d = \boxed{2\text{ m}}$
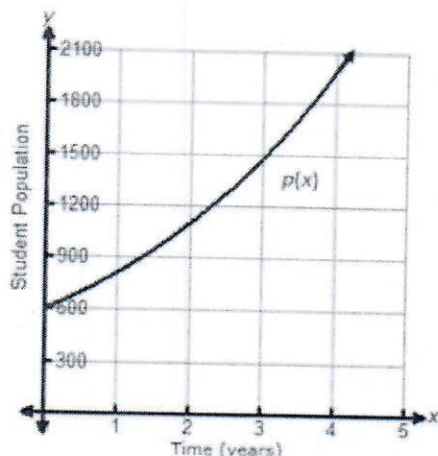
6. Find the inverse for the function $f(x) = (x-2)^3 + 1$

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

7. A new high school starts with a population of 600 freshmen and sophomore students. Each year, the population increases by 35% per year. The school's population can be modeled by the function $p(x) = 600(1.35)^x$, where x represents time in years and p(x) represents population of students.
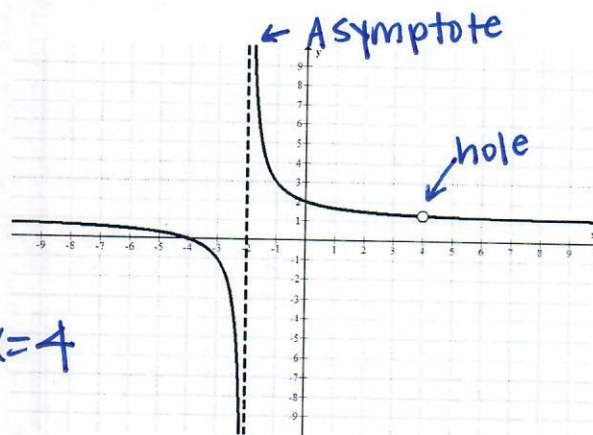
Describe the end behavior of the function.

AS $X \to \infty$, $Y \to \infty$

8. Describe the discontinuities for the graph of the function shown.

↰ where you have to pick up your pencil

Vertical asymptote at X=-2

Removeable discontinuity @ X=4

← Asymptote

hole

9. An algebraic expression involving logarithms is shown below. Condense to a single log.

$$2\log(x-2) - \frac{1}{2}\log(x+2) + 6\log(x-1)$$

$\log(x-2)^2 - \log(x+2)^{1/2} + \log(x-1)^6$
(same base, can condense!)

$\log\left(\dfrac{(x-2)^2(x-1)^6}{\sqrt{x+2}}\right)$

10. The equation of a rational function is shown below.

$$f(x) = \frac{x^2-16}{x^2-6x+8} = \frac{(x-4)(x+4)}{(x-4)(x-2)}$$

hole @ X=4 $Y = \frac{4+4}{4-2} = \frac{8}{2} = 4$ (4,4)
(plug into remaining)

Describe the left-sided behavior and right-sided behavior of the rational function as $x \to 4$.

AS $X \to 4^+$, $Y \to 4$ AS $X \to 4^-$, $Y \to 4$
     right side   left side

11. Which series of function compositions can be used to represent $f(x) = \dfrac{x^2+4}{x^2+1}$?

$h(j(x)) = h(x^2)$
         $= x^2+4$

$g(x) = \dfrac{x}{x-3}$

$h(x) = x+4$

$j(x) = x^2$

$g(h(j(x))) = g(x^2+4) = \dfrac{x^2+4}{x^2+4-3} = \dfrac{x^2+4}{x^2+1}$

~~A. $f(x) = h(j(x))$~~   B. $f(x) = g(h(j(x)))$ C. $f(x) = j(h(g(x)))$ D. $f(x) = g(j(h(x)))$

12. Write a rational function that has both a vertical and an oblique asymptote.

bottom=0 ↗   ↑ one degree higher on top $y = \dfrac{x^2 + 2x + 1}{x + 2}$ etc

13. The cost to inoculate x% of a population from a single strain of flu virus in billions of dollars, C, is given by the formula $C(x) = \dfrac{320}{100 - x}$. If the CDC has a budget of 7 billion dollars to spend on inoculations, then what is the maximum percentage of the population that it can afford to inoculate, rounded to the nearest hundredth?

$y_2 = 7$
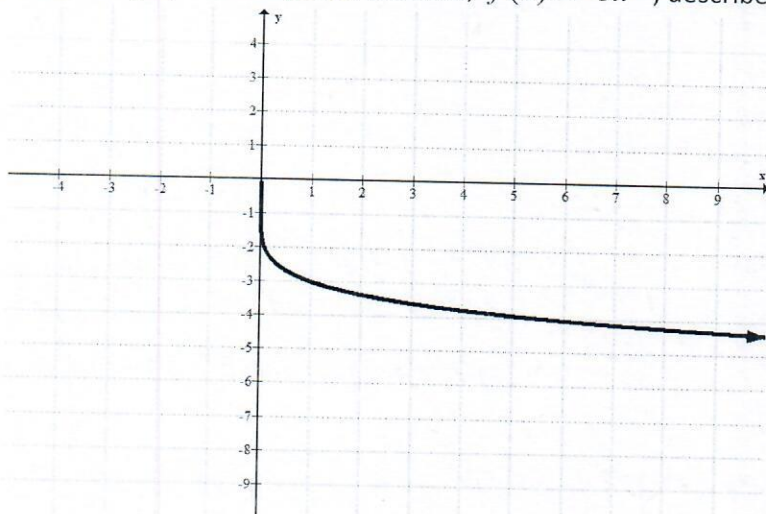
calculator

Y=   54.29%   OR $7 = \dfrac{320}{100 - x}$ x = 54.29

14. Given the graph of the power function, $f(x) = -3x^{\frac{1}{6}}$, describe the end behavior of the graph.


AS $x \to \infty$, $y \to -\infty$

15. Given the polynomial function $f(x) = \dfrac{1}{3}(x + 4)^2 - 5$, describe the transformations of the parent function. Write "none" if the transformation does not apply.

   a.   Vertical Shift: down 5
   b.   Horizontal Shift: left 4
   c.   Vertical Compression/Stretch: by a factor of ⅓
   d.   Horizontal Compression/Stretch: none

vert. comp/stretch → multiply on outside

horiz. comp/stretch → multiply on inside
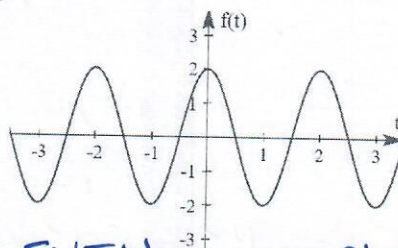
16. Find and justify the symmetry of the graph shown.   EVEN, symmetric over y-axis

17. The price per unit, p(q), of a popular copy machine, in terms of the quantity of copy machines demanded, q, is given by the formula $p(q) = 1500 - 150\ln(q)$. Predict the number of copy machines demanded if the price per unit is $500.
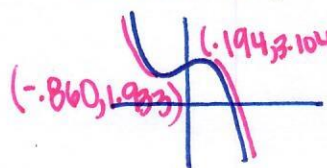
$500 = 1500 - 150\ln q$
$-1500 \quad -1500$
$\dfrac{-1000}{-150} = \dfrac{-150\ln q}{-150}$ → $6.67 = \ln q$
$e^{6.67} = q$

786 machines

18. Graph the function $f(x) = -2x^3 - 2x^2 + x + 3$. List the domain and range and where the function is increasing and/or decreasing.   CALCULATOR

(.194, 3.104)
(-.860, 1.933)

domain: $(-\infty, \infty)$ increasing: $(-.860, .194)$

range: $(-\infty, \infty)$ decreasing: $(-\infty, -.860) \cup (.194, \infty)$

19. Find a function for which an inverse function does not exist.

constant function, ex. $y=2$ (inverse would be $x=2$, which is not a function!)

20. The weight of a radioactive material in grams, w, over a period of weeks, t, is given by the table shown below.

t	0	1	2	3	4	5
w	50	47	43	40	37	35

Using the table of values, which equation best represents the data? *Plug each answer choice into [Y=], which table matches best?*

A. $w = 50 - 3t$ ~~B. $w = 50t^{0.93}$~~   C. $w = 50(0.93)^t$ ~~D.~~ $w = 50 + (0.93)^t$

21. Describe the following behavior.
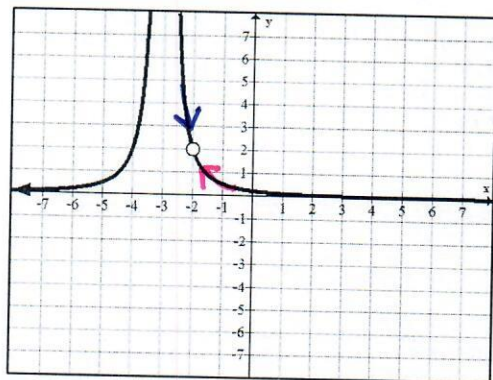
- Right side behavior as $x \to -2$, $f(x) \to$ *2*

- Left side behavior as $x \to -2$, $f(x) \to$ *2*

If there WASN'T a hole at $x=-2$, what would the y-value be?

22. List all solutions to the equation $x^3 - 7x^2 + 12x = 0$.

$\{0, 3, 4\}$

$x(x^2 - 7x + 12) = 0$
$x(x-3)(x-4) = 0$
$x = 0 \quad x-3 = 0 \quad x-4 = 0$

23. If $f(x) = \log x$, list all of the transformations for the function $f(0.5(x-3)) + 1$.
   a. Vertical Shift: *up 1*
   b. Horizontal Shift: *right 3*
   c. Vertical Compression/Stretch: *none*
   d. Horizontal Compression/Stretch: *by scale factor of 2*

new function:
$\log(0.5(x-3)) + 1$

24. A new employee earns $53,000 during his first year of work and receives a 2% raise each year. Write a sigma notation that could be used to determine the total amount earned by this employee over the first 10 years. Remember, it's a RAISE, he doesn't lose the money!

geometric
$a = 53000 \quad r = 1.02$ [NOT 0.02]

$\sum_{n=1}^{10} 53000(1.02)^{n-1}$

25. The equation for a rational function is given below.

$f(x) = \dfrac{2}{x+3} - 4$

Fill in the following information:
   a. Domain: *$(-\infty, -3) \cup (-3, \infty)$*
   b. Range: *$(-\infty, -4) \cup (-4, \infty)$*
   c. Horizontal asymptote: *$y = -4$*
   d. Vertical asymptote: *$x = -3$*
   e. Is the function increasing or decreasing? *decreasing on domain $(-\infty, -3) \cup (-3, \infty)$*