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Algebra Reviews / 1105 (2024 Fall) Final Knowledge Check Practice

First Knowledge Check Practice
Question 20 of 27 (0 points) | Question Attempt: 1 of Unlimited

16 17 18 19 20 21 22 23 24 25 26 27

Use the properties of logarithms to expand the following expression.

$$\log \sqrt{\frac{y^3}{x^5}}$$

Each logarithm should involve only one variable and should not have any radicals or exponents.
You may assume that all variables are positive.

$\sqrt{49} = 49^{\frac{1}{2}} = 7$

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

$\log \left(\frac{y^3}{x^5} \right)^{\frac{1}{2}} = \frac{1}{2} [\log y + 3 \log z - 5 \log x]$

8 9 10 11 12 13 14 15 16 17 18 19 20

Alan is exploring the formula for the circumference of a circle. He computed the circumferences of several circles with different radii. He then plotted the results and connected them with a line, as shown below. The graph shows the circumference (in m) versus the radius (in m).

Find the range and the domain of the function shown.

Circumference (m)

Radius (m)

Domain - all x values
Left to Right
 $[0, \infty)$

Range - all y values
Down to Up
 $[0, \infty)$

Write your answers as inequalities, using x or y as appropriate.
Or, you may instead click on "Empty set" or "All reals" as the answer.

(a) range: $x \geq 0$

(b) domain: $y \geq 0$

First Knowledge Check Practice
Question 19 of 27 (0 points) | Question Attempt: 1 of Unlimited

16 17 18 19 20 21 22 23 24 25 26 27

Fill in the missing values to make the equations true.

(a) $\log_3 1 = \log_3 1 = \log_3 1$

(b) $\log_3 8 = \log_3 8 = \log_3 8$

(c) $\log_3 \frac{1}{4} = \log_3 2 = -2 \log_3 2$

$2 = \frac{1}{4}$

$2^2 = 4$ $2^{-2} = \frac{1}{2^2} = \frac{1}{4}$

$\log a + \log b = \log(ab)$

$\log a - \log b = \log\left(\frac{a}{b}\right)$

$a \log x = \log x^a$

First Knowledge Check Practice
Question 16 of 27 (0 points) | Question Attempt: 1 of Unlimited

8 9 10 11 12 13 14 15 16 17 18 19 20

Use the graph of the function $y = g(x)$ to answer the questions.

$y = g(x)$
inside is your x

(a) Is $g(-2)$ positive? $x = -2$ $y = 3$
Yes ☒ No ☐

(b) For which value(s) of x is $g(x) > 0$? $x = ?$ $y > 0$
Write your answer using interval notation.
 $[-3, 5]$

(c) For which value(s) of x is $g(x) = 0$? $x = ?$ $y = 0$
If there is more than one value, separate them with commas.
 -3

8 9 10 11 12 13 14 15 16 17 18 19 20

Graph the solution to the following system of inequalities:

$$\begin{cases} x - y \leq -2 \\ x^2 + y^2 \leq 4 \end{cases}$$

Vertex (0,0) $r = 2$

$x - y \leq -2$
 $-y \leq -x - 2$
 $y \geq x + 2$

If you divide by a negative...

More above the line and inside circle

Circle (h, k) Vertex r radius
 $(x-h)^2 + (y-k)^2 = r^2$

$y \geq x + 2$
 $m = 1 = \frac{1}{1}$ up right
 $b = 2$ start at $(0, 2)$

to shade
 Plug in a point
 Not on the line
 $(0, 0)$ $0 \geq 0 + 2$ False
 $0 \geq 2$ False
 Shade away from $(0, 0)$

2 different
 ① $<$ dashed
 $\geq$ solid
 ② Shade

For the real-valued functions $f(x) = \frac{x+4}{x-3}$ and $g(x) = 2x+9$ find the composition $f \circ g$ and specify its domain using interval notation.

$(f \circ g)(x) = \frac{2x+13}{2x+6}$

Domain of $f \circ g$: $\frac{2x+13}{2x+6}$

Domain
 Figure out what x 's x cannot be
 Can't divide by 0
 Set denom = 0
 $2x+6=0$
 $2x=-6$
 $x=-3$

Domain: $(-\infty, -3) \cup (-3, \infty)$

$(f \circ g)(x) = f(g(x)) = f(2x+9)$
 $= \frac{(2x+9)+4}{(2x+9)-3} = \frac{2x+13}{2x+6}$
 4 terms
 Only divide if you can make all 4 by 2

A wire that is 48 centimeters long is shown below. The wire is cut into two pieces, and each piece is bent and formed into the shape of a square. Suppose that the side length (in centimeters) of one square is x , as shown below.

Area of square
 $A = s^2$

$x^2 + (12-x)^2$
 $x^2 + 144 - 24x + x^2$
 $2x^2 - 24x + 144$
 $A(x) = 2x^2 - 24x + 144$
 Since positive $\downarrow$ min
 $a=2$ $b=-24$
 $x = \frac{-b}{2a} = \frac{24}{4} = 6$
 $A(6) = 2(6)^2 - 24(6) + 144 = 72 - 144 + 144 = 72$

(a) Find a function that gives the total area $A(x)$ enclosed by the two squares (in square centimeters) in terms of x .
 $A(x) = \frac{2x^2 - 24x + 144}{2}$

(b) Find the side length x that minimizes the total area of the two squares.
 Side length x : 6 centimeters

(c) What is the minimum area enclosed by the two squares?
 Minimum area : 72 square centimeters

Graph the solution to the following system of inequalities.

$y > 4x + 3$
 $y \leq -3x - 7$

$y > 4x + 3$
 $m = 4$ $\frac{4}{1}$ up 4 right 1
 $b = 3$ start here

$y <= -3x - 7$
 $m = -3$ down 3 right 1
 $b = -7$ start here

$>$ dashed
 $<=$ solid
 Shade

$0 > 4(0) + 3$
 $0 > 3$ No
 Shade away from $(0, 0)$

$0 <= -3(0) - 7$
 $0 <= -7$ No
 Shade away from $(0, 0)$

Suppose the functions f and g are defined as follows.

$f(x) = \frac{1}{5x^2+3}$
 $g(x) = \sqrt{3x+4}$

Find $f \circ g$ and $f \circ f$. Then, give their domains using interval notation.

$(f \circ g)(x) = f(g(x)) = \frac{1}{5(\sqrt{3x+4})^2+3} = \frac{1}{5(3x+4)+3} = \frac{1}{15x+23}$

Domain: $5x^2+3=0$
 $5x^2=-3$
 $x^2=-\frac{3}{5}$
 $x = \pm \sqrt{-\frac{3}{5}}$
 imaginary number
 $(-\infty, \infty)$

$(f \circ f)(x) = f(f(x)) = \frac{1}{5(\frac{1}{5x^2+3})^2+3} = \frac{1}{5 \cdot \frac{1}{(5x^2+3)^2} + 3} = \frac{(5x^2+3)^2}{5 + 3(5x^2+3)^2}$

Domain: $3x+4 \geq 0$
 $3x \geq -4$
 $x \geq -\frac{4}{3}$
 $[-\frac{4}{3}, \infty)$

First Knowledge Check Practice
Question 10 of 27 (9 points) | Question Attempt: 1 of Unlimited

1 2 3 4 5 6 7 8 9 10 11 12 13

D and E are sets of real numbers defined as follows:
 $D = \{x \mid x \geq 4\}$
 $E = \{x \mid x < 8\}$

Write $D \cap E$ and $D \cup E$ using interval notation.
 If the set is empty, write $\emptyset$.

$D \cap E = [4, 7]$
 $D \cup E = (-\infty, \infty)$

*Union "or" bring together
 Intersection "and" share*

*Subtract
 "and" share
 "or" bring together*

Anywhere the number line is green or blue, which is everywhere

Check

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First Knowledge Check Practice
Question 11 of 27 (9 points) | Question Attempt: 1 of Unlimited

1 2 3 4 5 6 7 8 9 10 11 12 13

Below is the graph of a polynomial function with real coefficients. All local extrema of the function are shown in the graph.

Use the graph to answer the following questions.

(a) Over which intervals is the function concave up? Choose all that apply.
☒ $(-\infty, -5)$ ☒ $(-5, -2)$ ☐ $(-2, 2)$ ☒ $(2, 5)$ ☐ $(-2, 5)$ ☐ $(5, \infty)$

(b) At which x -values does the function have local maxima? If there is more than one value, separate them with commas.
☒ $-5, 2$

(c) What is the sign of the function's leading coefficient?
☒ Positive

(d) Which of the following is a possibility for the degree of the function? Choose all that apply.
☐ 4 ☐ 5 ☒ 6 ☐ 7 ☐ 8 ☐ 9

both up = LC Positive
*Count # of turns = 5
 max # of turns = deg - 1*

Check

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First Knowledge Check Practice
Question 12 of 27 (9 points) | Question Attempt: 2 of Unlimited

1 2 3 4 5 6 7 8 9 10 11 12 13

Graph the rational function.
 $f(x) = \frac{6}{2x-1}$

Start by drawing the vertical and horizontal asymptotes. Then plot two points on each piece of the graph; finally, click on the graph-a-function button.

degree - highest exponent
*VA: set denom = 0
 $2x-1=0 \Rightarrow x=\frac{1}{2}$*
*HA: deg numerator = deg denominator
 $\frac{deg: 0}{deg: 1} \Rightarrow y=0$*
*deg num < deg den: $\frac{y=0}{LC num / LC den}$
 $\frac{6}{2x-1} \Rightarrow \frac{3}{x-\frac{1}{2}}$*
deg num > deg den: No HA
*Left of VA: $x=0 \Rightarrow \frac{6}{-1} = -6$
 $x=-1 \Rightarrow \frac{6}{-2} = -3$*
*Right of VA: $x=1 \Rightarrow \frac{6}{1} = 6$
 $x=2 \Rightarrow \frac{6}{3} = 2$*

Check

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First Knowledge Check Practice
Question 13 of 27 (9 points) | Question Attempt: 1 of Unlimited

1 2 3 4 5 6 7 8 9 10 11 12 13

Suppose that the functions u and w are defined as follows:
 $u(x) = -2x - 1$
 $w(x) = 2x^2 + 1$

Find the following.

$(w \circ u)(-1) = w(u(-1))$
 $u(-1) = -2(-1) - 1 = 1$
 $w(1) = 2(1)^2 + 1 = 3$

$(v \circ w)(-1) = v(w(-1))$
 $w(-1) = 2(-1)^2 + 1 = 3$
 $v(3) = -2(3) - 1 = -7$

Check

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$$x^2 - 18x + 81$$



$$(x-9)(x-9)$$

or $(x-9)^2$

$$\begin{array}{r} -9 \times -9 \\ \hline -18 \end{array}$$

FOIL back
out to check
answer

$$-4 + \sqrt{u-8} = -3$$

$$\sqrt{u-8} = 1$$

$$u-8 = 1$$

$$u = 9$$

Plug back in to check answer

$$-4 + \sqrt{9-8} = -3$$

$$-4 + 1 = -3$$

$$\left(\frac{m^6 n^3}{m^3 n^5} \right)^5$$

$m: 6-3=3$ positive top
 $n: 3-5=-2$ negative bottom

$$\frac{m^3}{n^2}$$

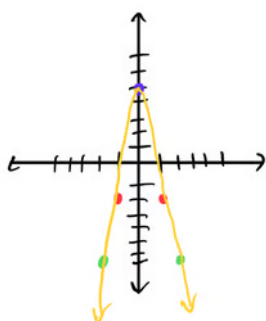
OR

$$\frac{m^2}{n^2}$$

$$\left(\frac{m^3}{n^2} \right)^5 = \frac{m^{15}}{n^{10}}$$

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

Graph one point with $x=0$, two negative points, two positive points



x	y
-2	-7
-1	2
0	5
1	2
2	-7

use symmetry

$$\begin{aligned} h(-2) &= -3(-2)^2 + 5 \\ &= -3(4) + 5 \\ &= -12 + 5 \\ h(-2) &= -7 \end{aligned}$$

$$\begin{aligned} h(-1) &= -3(-1)^2 + 5 \\ &= -3(1) + 5 \\ &= -3 + 5 \\ h(-1) &= 2 \end{aligned}$$

$$\begin{aligned} h(0) &= -3(0)^2 + 5 \\ &= -3(0) + 5 \\ h(0) &= 5 \end{aligned}$$

$$\log_5 (2x-5) = 2$$

$$5^2 = 2x-5$$

$$25 = 2x-5$$

$$\frac{30}{2} = \frac{2x}{2}$$

$$x = 15$$

Plug in to check answer

$$\log_5 (2(15)-5) = 2$$

$$\log_5 (25) = 2$$

$$5^2 = 25 \checkmark$$

How to convert log:

$$3^x = 27$$

$$\log_3 27 = x$$

$$\log_5 x = 2$$

$$5^2 = x$$

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

$$x\text{-int: } -2, 3$$

$$y\text{-int: } 6$$

$$y\text{-int } x=0$$

$$f(0) = -(0)^2 + (0) + 6$$

$$f(0) = 6$$

$x\text{-int } y=0$
 $Set = 0$
 $0 = -x^2 + x + 6$
 $0 = x^2 - x - 6$
 $0 = (x+2)(x-3)$
 $x+2=0 \quad x-3=0$
 $x=-2 \quad x=3$

Don't want front # to be negative

$\begin{array}{r} -6 \\ +2 \\ -1 \end{array}$

$$h(t) = 120t - 16t^2$$

$$-16t^2 + 120t + 0$$

$$a = -16 \quad b = 120 \quad c = 0$$

$$\frac{-120}{2(-16)} = \frac{-120}{-32} = 3.75 \text{ sec}$$

what is max height?



Vertex
 $\left(\frac{-b}{2a}, \text{plug in} \right)$

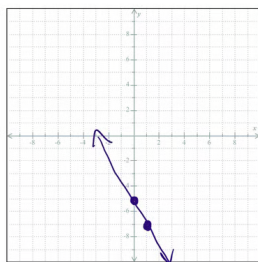


Plug in
 $t = 3.75$

$$h(3.75) = 120(3.75) - 16(3.75)^2$$

$$h(3.75) = 22.5 \text{ ft max height}$$

Graph the function $g(x) = -2x - 5$.



$$g(x) = -2x - 5$$

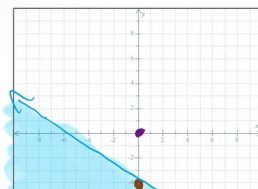
$$y = mx + b$$

$$m = -2 = \frac{2}{1} \text{ down 2, right 1}$$

$$b = -5 \text{ start at } (0, -5)$$

Graph the inequality.

$$y \leq -\frac{1}{2}x - 4$$



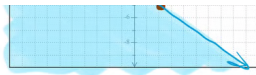
to shade
 plug in point not on the line
 $(0, 0) \quad 0 \leq -\frac{1}{2}(0) - 4$
 $0 \leq -4$ False
 shade away from (0,0)

$$y \leq -\frac{1}{2}x - 4$$

$$y = mx + b$$

$$m = -\frac{1}{2} \text{ down 1, right 2}$$

$$b = -4 \text{ start at } (0, -4)$$



2 differences:

- ① $<, >$ dashed $\leq, \geq$ solid
- ② shade

$$\ln 7^{y-3} = \ln 9$$

$$(y-3) \ln 7 = \ln 9$$

$$y \ln 7 - 3 \ln 7 = \ln 9$$

$$+ 3 \ln 7 \quad 3 \ln 7$$

$$\frac{y \ln 7}{\ln 7} = \frac{\ln 9 - 3 \ln 7}{\ln 7}$$

$$y = \frac{\ln 9 - 3 \ln 7}{\ln 7} = -1.871$$

Exact = in terms $\ln$

Approx = decimal

$$\log_2 8 = 3 \quad 2^3 = 8$$

$$\log_e y = x \quad e^x = y$$

$$e = 2.718 \dots$$

$$\ln y = x \quad e^x = y$$

The Natural log

$$f(x) = 8(x-9)^2(x+11)(x-5)^2$$

opposite

look at
the exponent
to see
multiplicity

Zeros of multiplicity one: -11

Zeros of multiplicity two: 9, 5

Zeros of multiplicity three:

$x-9=0$	$x+11=0$	$x-5=0$
$x=9$	$x=-11$	$x=5$
two of these		two of these