1. Find an equation of the line through $(1, -3)$ and perpendicular to the line $4x + y + 7 = 0$.

$4x+y+7=0 \rightarrow y=-4x-7 \rightarrow$ slope $=-4$

$\rightarrow$ slope of perpendicular line is $\frac{-1}{-4} = \frac{1}{4}$

Use slope $\frac{1}{4}$ and point $(1,-3)$.

Equation of line is $y-(-3) = \frac{1}{4}(x-1)$

$\rightarrow 4(y+3) = x-1$

$\rightarrow 4y+12 = x-1 \rightarrow 0 = x-4y-13$

A. $4x + y - 1 = 0$
B. $4x - y - 7 = 0$
C. $x + 4y + 11 = 0$
D. $x - 4y - 13 = 0$
E. $x - 3y + 7 = 0$

2. Solve the inequality $2 - 3x < 5$.

$\rightarrow -3x < 3$

$\rightarrow x > \frac{3}{-3}$

$\rightarrow x > -1$

A. $x < -1$
B. $x < 1$
C. $x > -1$
D. $x > 1$
E. $x > \frac{7}{3}$

3. Find the domain of the function $f(x) = \dfrac{\ln(x-1) + \sqrt{x}}{\sqrt{x+2}}$.

$\ln(x-1) \rightarrow x-1>0 \rightarrow x>1$

$\sqrt{x} \rightarrow x \geq 0$ (from numerator)

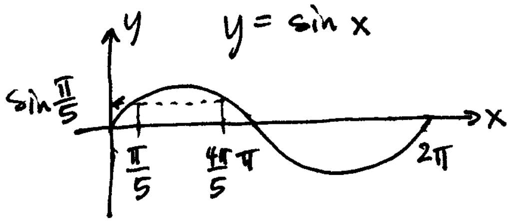
$\sqrt{x+2} \rightarrow x+2>0$ (from denominator)

$\rightarrow x>-2$

A. $x > 1$
B. $x > 0$
C. $x > -2$
D. $0 < x < 1$
E. all real numbers x

$x>1$ and $x \geq 0$ and $x>-2 \rightarrow x>1$

4. Find all numbers x such that $\sin x = \sin \frac{\pi}{5}$ and $0 \leq x \leq 2\pi$.



A. $\frac{\pi}{5}$ only

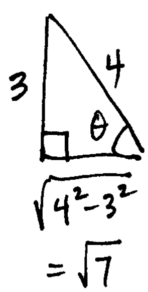
B. $\frac{\pi}{5}$ and $\frac{4\pi}{5}$

C. $\frac{\pi}{5}$ and $\frac{6\pi}{5}$

D. $\frac{\pi}{5}$ and $\frac{9\pi}{5}$

E. $\frac{\pi}{5}, \frac{4\pi}{5}, \frac{6\pi}{5}$, and $\frac{9\pi}{5}$

5. Find $\tan\left(\sin^{-1}\left(\frac{3}{4}\right)\right)$.



Let $\theta = \sin^{-1}\left(\frac{3}{4}\right)$

Then $\tan\left(\sin^{-1}\left(\frac{3}{4}\right)\right)$

$= \tan\theta$

$= \frac{3}{\sqrt{7}}$

A. $\frac{3}{5}$

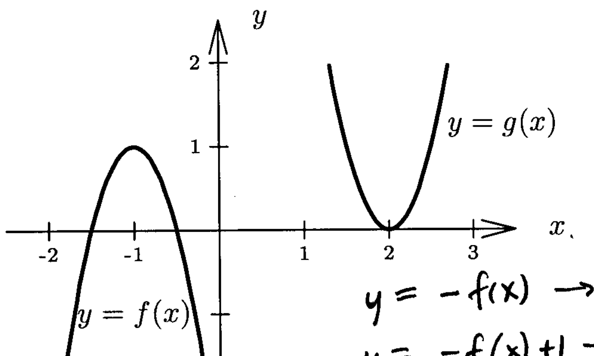
B. $\frac{4}{5}$

C. $\frac{4}{3}$

D. $\frac{3}{\sqrt{7}}$

E. $\frac{4}{\sqrt{7}}$

6. Given the following graph of two functions f and g, $g(x) =$



$y = -f(x) \rightarrow$ flip

$y = -f(x) + 1 \rightarrow$ move up

$y = -f(x-3) + 1$ move right

A. $-f(x-2)$

B. $1 - f(x-2)$

C. $f(x+3) - 1$

D. $-f(x+3) - 1$

E. $-f(x-3) + 1$

7. Starting with the graph of $y = e^{-2x}$, write the equation of the graph that results from reflecting about the x–axis and then about the y–axis.

$y = -e^{-2x}$ reflects e^{-2x} about x-axis

$y = -e^{-2(-x)}$ reflects $-e^{-2x}$ about y-axis

Thus let $y = -e^{2x}$.

A. $y = -e^{2x}$
B. $y = -e^{-2x}$
C. $y = e^{2x}$
D. $y = e^{-2x}$
E. $y = \ln(2x)$

8. Under ideal conditions a certain bacteria population is known to double every 5 hours. Suppose there are initially 150 bacteria. Then, after t hours the number of bacteria in the population is

let $y = 150 \cdot 2^{t/5}$.

Note: $y(0) = 150\, e^{0} = 150$

$y(5) = 150 \cdot 2^{5/5} = 300$

$y(10) = 150 \cdot 2^{10/5} = 600$

etc...

A. e^{5t}
B. $150e^{5t}$
C. 2^{5t}
D. $2^{t/5}$
E. $150 \cdot 2^{t/5}$

9. The solution of $4^{2x-3} = 3$ is $x =$

$4^{2x-3} = 3$

$\rightarrow \log_4(4^{2x-3}) = \log_4(3)$

$\rightarrow 2x - 3 = \log_4(3)$

$\rightarrow 2x = \log_4(3) + 3$

$\rightarrow x = (\log_4 3 + 3)/2$

A. $\ln 6^2$
B. $\log_4 3^2$
C. $\log_3 4^2 + 3$
D. $\frac{1}{2}[3 + \log_4 3]$
E. $\frac{1}{2}[3 + \log_3 4]$

10. $\lim_{t\to 0} \dfrac{\sqrt{2-t}-\sqrt{2}}{t} = \dfrac{\sqrt{2}-\sqrt{2}}{0} = \dfrac{0}{0}$!

A. $\dfrac{1}{4}$

B. $-\dfrac{1}{2\sqrt{2}}$

C. $\dfrac{1}{2}$

D. $-\dfrac{1}{\sqrt{2}}$

E. $2\sqrt{2}$

$$\frac{\sqrt{2-t}-\sqrt{2}}{t}\cdot\frac{\sqrt{2-t}+\sqrt{2}}{\sqrt{2-t}+\sqrt{2}} = \frac{(2-t)-2}{t(\sqrt{2-t}+\sqrt{2})}$$

$$= \frac{-t}{t(\sqrt{2-t}+\sqrt{2})} = \frac{-1}{\sqrt{2-t}+\sqrt{2}} \text{ if } t\neq 0$$

and $\lim_{t\to 0} \dfrac{-1}{\sqrt{2-t}+\sqrt{2}} = \dfrac{-1}{\sqrt{2}+\sqrt{2}} = \dfrac{-1}{2\sqrt{2}}$

11. $\lim_{x\to 0} |x| \sin\left(\dfrac{1}{x^2}\right) =$

A. 0

B. 1

C. 2

D. ∞

E. does not exist

Note that $-1 \le \sin\left(\frac{1}{x^2}\right) \le 1$ if $x\neq 0$

$\longrightarrow -|x| \le |x|\sin\left(\frac{1}{x^2}\right) \le |x|$

and $\lim_{x\to 0} -|x| = \lim_{x\to 0} |x| = 0$

Thus by Squeeze Theorem, $\lim_{x\to 0} |x|\sin\left(\frac{1}{x^2}\right) = 0$

12. $\lim_{x\to 0^+} \dfrac{\ln x}{x} = \dfrac{-\infty}{0^+} = -\infty$

A. $-\infty$

B. 0

C. 1

D. 2

E. ∞

13. There are two values of a such that the function

$$f(x) = \begin{cases} x^3 & \text{if } x \leq a \\ x^2 & \text{if } x > a \end{cases}$$

is continuous at the point $x = a$. These values are

A. $-2, 2$

B. $1, 2$

C. $-1, 1$

D. $0, 1$

E. $-1, 0$

f will be continuous at $x = a$ if graphs of $y = x^3$ and $y = x^2$ have same values at $x = a$.

Thus we want $a^3 = a^2$

$\rightarrow a^3 - a^2 = 0$

$\rightarrow a^2(a-1) = 0$

$\rightarrow a = 0, 1$

14. Suppose you drive for 60 miles at 60 miles per hour and then for 60 miles at 30 miles per hour. In miles per hour, your average velocity is

A. 30

B. 40

C. 42

D. 45

E. 50

$$\text{Average velocity} = \frac{\text{change in distance}}{\text{change in time}}$$

$$= \frac{120 \text{ miles}}{3 \text{ hours}}$$

$$= 40 \text{ mph.}$$