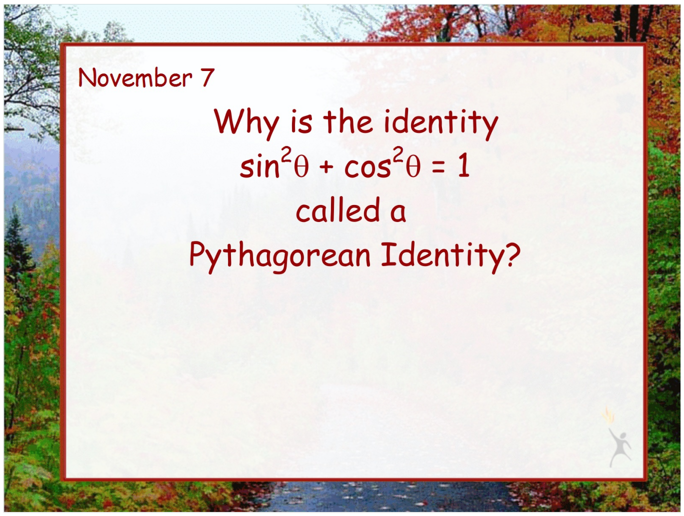


1. The function defined by $f(x) = x^3 - 3x^2$ for all real numbers x has a relative maximum at $x =$

(A) -2 (B) 0 (C) 1 (D) 2 (E) 4

$$f(x) = x^3 - 3x^2$$
$$f'(x) = 3x^2 - 6x$$
$$0 = 3x^2 - 6x = 3x(x-2)$$
$$x = 0,2$$

cp		0		2	
sign f'	+		-		+
behav f	inc		dec		inc

2 If $y = \cos^2 x - \sin^2 x$, then $y' =$

(A) -1 (B) 0 (C) $-2\sin(2x)$ (D) $-2(\cos x + \sin x)$ (E) $2(\cos x + \sin x)$

$$y = cos^2 x - sin^2 x$$
$$y' = -2(\cos x)(\sin x) - 2(\cos x)(\sin x)$$
$$y' = -4(\cos x)(\sin x) = -2(2(\cos x)(\sin x))$$
$$y' = -2\sin(2x)$$

$2\cos x \sin x = \sin(2x)$

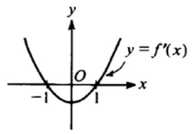
3 If $y = \arctan(\cos x)$, then $\frac{dy}{dx} =$

(A) $\frac{-\sin x}{1+\cos^2 x}$ (B) $-(arc\sec(\cos x))^2 \sin x$ (C) $-(arc\sec(\cos x))$

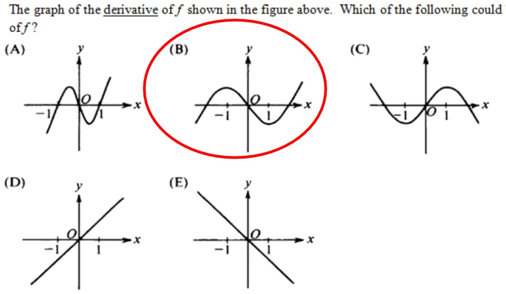
(D) $\frac{1}{(\arccos x)^2 + 1}$ (E) $\frac{1}{1+\cos^2 x}$

$$y' = \frac{1}{1 + cos^2 x}(-\sin x) = \frac{-\sin x}{1 + cos^2 x}$$

4



The graph of the derivative of f shown in the figure above. Which of the following could be the graph of f?



5. For what value of k will $x + \frac{k}{x}$ have a relative maximum at $x = -2$?

(A) -4 (B) -2 (C) 2 (D) 4 (E) None of these

$y = x + k x^{-1}$
$y' = 1 - kx^{-2}$

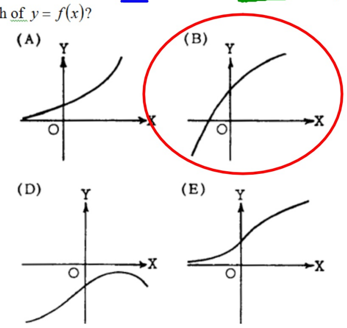
$0 = 1 - k(-2)^{-2} = 1 - K\left(\frac{1}{(-2)^2}\right)$
$0 = 1 - k(.25) = 1 - K\left(\frac{1}{4}\right) = 1 - \frac{K}{4}$
$1 = k(.25)$
$4 = k$

6 What is $\frac{d}{dx}\left(\frac{1}{x^3} - \frac{1}{x} + x^2\right)$ at $x = -1$?

(A) -6 (B) -4 (C) 0 (D) 2 (E) 6

$$\frac{d}{dx}\left(\frac{1}{x^3} - \frac{1}{x} + x^2\right) = \frac{d}{dx}\left(x^{-3} - x^{-1} + x^2\right) =$$
$$-3x^{-4} - (-x^{-2}) + 2x = \frac{-3}{x^4} + \frac{1}{x^2} + 2x$$
$$at\ x = -1 \rightarrow \rightarrow \frac{-3}{(-1)^4} + \frac{1}{(-1)^2} + 2(-1) = -3 + 1 - 2 = -4$$

7. If y is a function of x such that $y' > 0$ for all x and $y'' < 0$ for all x, which of the following could be part of the graph of $y = f(x)$?



increasing and concave down

8. The graph of $y = 5x^4 - x^5$ has point of inflection at

(A) (0, 0) only　(B) (3, 216) only　(C) (4, 256) only

(D) (0, 0) and (3, 162)　(E) (0, 0) and (4, 256)

$y' = 20x^3 - 5x^4$
$y'' = 60x^2 - 20x^3$
$0 = 20x^2(3 - x)$
$0 = 20x^2$　　$0 = 3 - x$
$0 = x$　　$3 = x$

cp		0	3
sign f''	+	+	-
behav f	cu	cu	cd

$y(3) = 5(3)^4 - (3)^5 = 216$

9. An equation for a tangent to the graph of $y = \arcsin\left(\frac{x}{2}\right)$ at the origin is

(A) $x - 2y = 0$　(B) $x - y = 0$　(C) $x = 0$　(D) $y = 0$　(E) $\pi x - 2y = 0$

(0, 0)

$$y' = \frac{1}{\sqrt{1 - (\frac{x}{2})^2}}\left(\frac{1}{2}\right)$$

$$y'(0) = \frac{1}{\sqrt{1 - (\frac{0}{2})^2}}\left(\frac{1}{2}\right) = \frac{1}{\sqrt{1 - (0)^2}}\left(\frac{1}{2}\right) = \frac{1}{2}$$

$$y - 0 = \frac{1}{2}(x - 0) \longrightarrow y = \frac{1}{2}x$$

$2y = x$ ----> $x - 2y = 0$

10. The *derivative* of $f(x) = \frac{x^4}{3} - \frac{x^5}{5}$ attain its maximum value at $x =$

(A) -1　(B) 0　(C) 1　(D) $\frac{4}{3}$　(E) $\frac{5}{3}$

$f'(x) = 4x^3/3 - x^4 = g(x)$
$f''(x) = 4x^2 - 4x^3 = g'(x)$
$0 = 4x^2 - 4x^3 = 4x^2(1 - x)$
$0 = 4x^2$　　$0 = 1 - x$
$0 = x$　　$1 = x$

cp		0	1
sign f''	+	+	-
behav f'	inc	inc	dec