Exponent Rules

RULE	Rewrite using rational exponents.		
$\sqrt[3]{x^2} = x^{\frac{2}{3}}$	1. $\sqrt[5]{x^3}$ $x^{3/5}$	2. $\sqrt[3]{3^2}$ $3^{2/3}$	3. $\sqrt[3]{e^2}$ $e^{2/3}$

RULE	Rewrite without negative or rational exponents.		
$x^{-\frac{1}{2}} = \frac{1}{\sqrt{x}}$	1. $x^{\frac{1}{3}}$ $\sqrt[3]{x}$	2. 4^{-2} $\frac{1}{4^2} = \frac{1}{16}$	3. $e^{\frac{1}{2}}$ $\sqrt{e}$

RULE	Simplify.		
$x^2 \cdot x^3 = x^5$	1. $x^3 \cdot x^4$ x^7	2. $2^3 \cdot 2^x$ 2^{3+x}	3. $e^{3x}e^{2x}$ $e^{3x+2x} = e^{5x}$

RULE	Simplify.		
$\frac{x^2}{x^3} = x^{-1} = \frac{1}{x}$	1. $\frac{2^5}{2^7}$ $2^{5-7} = 2^{-2} = \frac{1}{2^2}$ $\frac{1}{4}$	2. $\frac{e^{3x}}{e^2}$ e^{3x-2}	3. $\frac{x^4}{\sqrt{x}} = \frac{x^4}{x^{1/2}}$ $x^{4-\frac{1}{2}} = x^{7/2} = \sqrt{x^7}$

RULE	Simplify.		
$(x^3)^2 = x^6$	1. $(2x^5)^3$ 2^3x^{15} $8x^{15}$	2. $(4^x)^2$ 4^{2x}	3. $(\sqrt{e})^5$ $e^{5/2}$

Logarithmic Rules

RULE	Rewrite		
$a \log_b x = \log_b x^a$	1. $3 \log_5 x$ $\log_5 x^3$	2. $2\log_7 e$ $\log_7 e^2$	3. $\frac{1}{2}\ln 4$ $\ln 4^{1/2} = \ln\sqrt{4}$ $\ln 2$

Logarithmic Rules

RULE	Rewrite		
$\log_b x + \log_b y = \log_b xy$	1. $\log_4 x + \log_4 5$ $\log_4(5x)$	2. $\log e^2 + \log y^3$ $\log(e^2 y^3)$	3. $5\ln 3 + \ln x$ $\ln 3^5 + \ln x$ $\ln(3^5 x)$

RULE	Condense		
$\log_b x - \log_b y = \log_b \frac{x}{y}$	1. $\log_4(2x) - \log_4(5)$ $\log_4\left(\frac{2x}{5}\right)$	2. $\log e^x - \log x^3$ $\log\left(\frac{e^x}{x^3}\right)$	3. $2\ln x - \ln x$ $\ln x^2 - \ln x$ $\ln\left(\frac{x^2}{x}\right) = \ln x$

CHANGE OF BASE $\log_b x = \frac{\log_c x}{\log_c b}$	Change base to 3 1. $\log_2 x$ $\frac{\log_3 x}{\log_3 2}$	Change base to 2 2. $\log_8 7$ $\frac{\log_2 7}{\log_2 8} = \frac{\log_2 7}{3}$ $\frac{1}{3}\log_2 7$	Change base to 10 3. $\log_3 100$ $\frac{\log 100}{\log 3} = \frac{2}{\log 3}$

Trig Identities

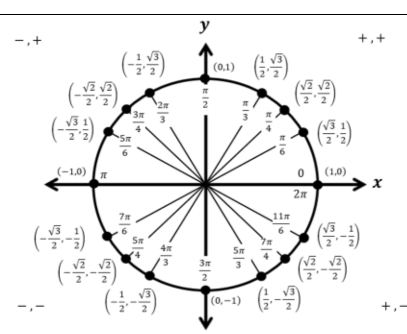
Pythagorean:	**Sum/Difference:**	**Double Angle:**
$\sin^2 x + \cos^2 x = 1$ $\sin^2 x = 1 - \cos^2 x$ $\cos^2 x = 1 - \sin^2 x$ $1 + \cot^2 x = \csc^2 x$ $\tan^2 x + 1 = \sec^2 x$	$\sin(\alpha + \beta) = \sin\alpha\cos\beta + \cos\alpha\sin\beta$ $\sin(\alpha - \beta) = \sin\alpha\cos\beta - \cos\alpha\sin\beta$ $\cos(\alpha + \beta) = \cos\alpha\cos\beta - \sin\alpha\sin\beta$ $\cos(\alpha - \beta) = \cos\alpha\cos\beta + \sin\alpha\sin\beta$	$\sin(2\alpha) = 2\sin\alpha\cos\alpha$ $\cos(2\alpha) = \cos^2\alpha\sin^2\alpha$ $= 1 - 2\sin^2\alpha$

TRIGONOMETRY

$$\csc x = \frac{1}{\sin x} \qquad \tan x = \frac{\sin x}{\cos x}$$

$$\sec x = \frac{1}{\cos x} \qquad \cot x = \frac{\cos x}{\sin x}$$

$$\cot x = \frac{1}{\tan x} \qquad \sin^{-1} x = \arcsin x$$



Free Response Question #4

AP Precalculus

PRACTICE

NO CALCULATOR – Answer the following practice FRQ #4 question. Grade using the scoring rubric.

1.

(A) The functions *g* and h are given by

$4 = \log_3(2x-5)$

$3^4 = 3^{\log_3(2x-5)}$

$81 = 2x - 5$

$+5 \qquad +5$

$\frac{86}{2} = \frac{2x}{2}$

$43 = x$

Solution 1 point

$\frac{\pi}{4} = \sin^{-1}(6x)$

$\sin\left(\frac{\pi}{4}\right) = \sin\left(\sin^{-1}(6x)\right)$

$\frac{\frac{\sqrt{2}}{2}}{6} = \frac{6x}{6}$

$\frac{\sqrt{2}}{12} = x$

Solution 1 point

(B) The functions *j* and *k* are given by

domain: $\cos x \neq 0$ $\quad j(x) = (\tan^2 x)(1 - \sin^2 x)$

$j(x) = \tan^2 x(\cos^2 x)$

$j(x) = \frac{\sin^2 x}{\cancel{\cos^2} x} \cdot \cancel{\cos^2} x$

$j(x) = \sin^2 x$

Expression 1 point

$k(x) = \frac{e^{3x}(e^{2x})}{(\sqrt{e})^{6x}} = \frac{e^{5x}}{e^{\frac{6x}{2}}}$

$k(x) = e^{5x-3x}$

$k(x) = e^{2x}$

Expression 1 point

(C) The function *m* is given by

$4 = 2\cos(2x) + 3$

$-3 \qquad -3$

$\frac{1}{2} = \frac{\cancel{2}\cos(2x)}{\cancel{2}}$

$\frac{1}{2} = \cos(2x)$

$\cos^{-1}\left(\frac{1}{2}\right) = \cos^{-1}(\cos(2x))$

$\frac{\pi}{3} = 2x$

$\frac{5\pi}{3} = 2x$

One value of x 1 point

$\frac{\cancel{2}x}{\cancel{2}} = \frac{\frac{\pi}{3} + 2\pi n}{2}$ $\qquad$ $\frac{\cancel{2}x}{\cancel{2}} = \frac{\frac{5\pi}{3} + 2\pi n}{2}$

$x = \frac{\pi}{6} + \pi n$ $\qquad$ $x = \frac{5\pi}{6} + \pi n$

where n is an integer

All values of x 1 point

Your Score: ____ out of 6 points

Free Response Question #4

AP Precalculus

PRACTICE

NO CALCULATOR – Answer the following practice FRQ #4 question. Grade using the scoring rubric.

2.

(A) The functions g and h are given by

$2e = e^{(x-2)} + e$

$-e \qquad -e$

$e = e^{(x-2)}$

$\ln e = \ln e^{(x-2)}$

$1 = x-2$

$+2 \qquad +2$

$3 = x$

Solution 1 point

$2\pi = 3\arccos(\pi x)$

$\frac{2\pi}{3} = \frac{3\arccos(\pi x)}{3}$

$\frac{2\pi}{3} = \cos^{-1}(\pi x)$

$\cos\left(\frac{2\pi}{3}\right) = \cos(\cos^{-1}(\pi x))$

$-\frac{1}{2} = \pi x$

$\frac{-\frac{1}{2}}{\pi} = \frac{\pi x}{\pi}$

$-\frac{1}{2\pi} = x$

Solution 1 point

(B) The functions j and k are given by

$j(x) = \csc x - \sin x$ domain: $\sin x \neq 0$

$j(x) = \frac{1}{\sin x} - \sin x$

$j(x) = \frac{1}{\sin x} - \frac{\sin x \cdot \sin x}{1 \cdot \sin x}$

$j(x) = \frac{1}{\sin x} - \frac{\sin^2 x}{\sin x}$

$j(x) = \frac{1-\sin^2 x}{\sin x}$

$j(x) = \frac{\cos^2 x}{\sin x}$

$j(x) = \frac{\cos x \cos x}{\sin x}$

$j(x) = \cot x \cos x$

Expression 1 point

$k(x) = 2\ln(4x^2) - \frac{1}{2}\ln(4x^4)$ domain: $x > 0$

$k(x) = \ln(4x^2)^2 - \ln(4x^4)^{1/2}$

$k(x) = \ln(16x^4) - \ln\sqrt{4x^4}$

$k(x) = \ln(16x^4) - \ln(2x^2)$

$k(x) = \ln\left(\frac{16x^4}{2x^2}\right)$

$k(x) = \ln(8x^2)$

Expression 1 point

(C) The function m is given by

$0 = 2\sin^2 x - \sin x$

$0 = \sin x(2\sin x - 1)$

$\sin x = 0$

$x = \sin^{-1}(0)$

$x = 0 + \pi n$

One value of x 1 point

$2\sin x - 1 = 0$

$+1 \qquad +1$

$\frac{2\sin x}{2} = \frac{1}{2}$

$\sin x = \frac{1}{2}$

$x = \sin^{-1}\left(\frac{1}{2}\right)$

$x = \frac{\pi}{6}$ and $\frac{5\pi}{6} + 2\pi n$

$x = 0 + \pi n$

$x = \frac{\pi}{6} + 2\pi n$

$x = \frac{5\pi}{6} + 2\pi n$

where n is an integer

All values of x 1 point

Your Score: ____ out of 6 points

Free Response Question #4

AP Precalculus

PRACTICE

NO CALCULATOR – Answer the following practice FRQ #4 question. Grade using the scoring rubric.

3.

(A) The functions *g* and h are given by

$$6 = \ln(x-5) + 4$$

$-4 \quad -4$

$2 = \ln(x-5)$

$e^2 = e^{\ln(x-5)}$

$e^2 = x - 5$

$+5 \quad +5$

$e^2 + 5 = x$

Solution 1 point

$$\frac{-\pi}{4} = \frac{4 \arctan x}{4}$$

$-\frac{\pi}{4} = \tan^{-1}(x)$

$\tan\left(-\frac{\pi}{4}\right) = \tan\left(\tan^{-1}(x)\right)$

$-1 = x$

Solution 1 point

(B) The functions *j* and *k* are given by

domain: $\cos x \neq 0$

$$j(x) = \frac{\sin(2x)}{2\cos(x)}$$

$j(x) = \frac{2\sin x \cdot \cos x}{2\cos x}$

$j(x) = \frac{\cancel{2}\sin x \cdot \cancel{\cos x}}{\cancel{2}\cancel{\cos x}}$

$j(x) = \sin x$

Expression 1 point

$$k(x) = \frac{(4^{3x})(8^x)}{2}$$

$k(x) = \frac{(2^2)^{3x}(2^3)^x}{2}$

$k(x) = \frac{2^{6x} \cdot 2^{3x}}{2}$

$k(x) = \frac{2^{9x}}{2^1}$

$k(x) = 2^{9x-1}$

Expression 1 point

(C) The function *m* is given by

$$0 = 2e^{2x} - e^x$$

Factor out e^x

1 point

$0 = e^x(2e^x - 1)$

$e^x = 0$

Does not exist

$2e^x - 1 = 0$

$+1 \quad +1$

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

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

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

$\ln e^x = \ln \frac{1}{2}$

$x = \ln \frac{1}{2}$

Value of x 1 point

Your Score: ____ out of 6 points

Free Response Question #4

AP Precalculus

PRACTICE

NO CALCULATOR – Answer the following practice FRQ #4 question. Grade using the scoring rubric.

4.

(A) The functions g and h are given by

$$9 = 3^{(x-5)}$$

$\log_3 9 = \log_3 3^{(x-5)}$

$\log_3 3^2 = x - 5$

$2 = x - 5$

$+5 \qquad +5$

$\boxed{7 = x}$

Solution 1 point

values of x in the interval of $[0, \pi]$

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

$-\cos x \qquad -\cos x$

$0 = 2\cos x \sin x - \cos x$

$0 = \cos x(2\sin x - 1)$

$\cos x = 0$

$x = \cos^{-1}(0)$

$x = \frac{\pi}{2} \quad \cancel{\frac{3\pi}{2}}$

$2\sin x - 1 = 0$

$+1 \qquad +1$

$\frac{2\sin x}{2} = \frac{1}{2}$

$\sin x = \frac{1}{2}$

$x = \sin^{-1}\left(\frac{1}{2}\right)$

$x = \frac{\pi}{6}$ and $\frac{5\pi}{6}$

$\boxed{x = \frac{\pi}{2}, \frac{\pi}{6}, \text{ and } \frac{5\pi}{6}}$

Solution 1 point

(B) The functions j and k are given by

domain: $\cos x \neq 0$

$\sin x \neq 0$

$$j(x) = (1 + \tan^2 x)(\cot^2 x)$$

$j(x) = \sec^2 x \cot^2 x$

$j(x) = \frac{1}{\cancel{\cos^2} x} \cdot \frac{\cancel{\cos^2} x}{\sin^2 x}$

$j(x) = \frac{1}{\sin^2 x}$

$\boxed{j(x) = \csc^2 x}$

Expression 1 point

$$k(x) = \log_2(x+2) - 4\log_2(x) + \log_2(x^2)$$ domain: $x > -2$

$k(x) = \log_2(x+2) - \log_2(x^4) + \log_2(x^2)$

$k(x) = \log_2\left(\frac{(x+2)(x^2)}{x^4}\right)$

$k(x) = \log_2\left(\frac{(x+2)\cancel{x^2}}{x^{\cancel{4}2}}\right)$

$\boxed{k(x) = \log_2\left(\frac{x+2}{x^2}\right)}$

Expression 1 point

(C) The function m is given by

$\frac{2\pi}{3} - \frac{\pi}{2}$

$\frac{4\pi}{6} - \frac{3\pi}{6}$

$$\frac{2\pi}{3} = \sin^{-1}(\cos x) + \frac{\pi}{2}$$

$-\frac{\pi}{2} \qquad -\frac{\pi}{2}$

$\frac{\pi}{6} = \sin^{-1}(\cos x)$

$\sin\left(\frac{\pi}{6}\right) = \sin(\sin^{-1}(\cos x))$

$\frac{1}{2} = \cos x$

$\cos^{-1}\left(\frac{1}{2}\right) = x$

One value of x 1 point

$x = \frac{\pi}{3} + 2\pi n$

$x = \frac{5\pi}{3} + 2\pi n$

where n is an integer

All values of x 1 point

Your Score: ____ out of 6 points