Problem 1: Find the difference quotient $\frac{f(x+h)-f(x)}{h}$ for the function $f(x) = x^2 + 3x$.

Problem 2: Find the domains of the following functions:
(a). $f(x) = \frac{x}{|x+4|+2}$
(b). $g(x) = \frac{x}{|x+4|-2}$
(c). $h(x) = \log\left(\frac{(x+7)^3(7-x)}{x^3-3x}\right)$
(d). $j(x) = \sec x$
(e). $k(x) = \tan\left(x + \frac{\pi}{4}\right)$
(f). $l(x) = \sqrt{x^2 + 4x - 5}$
(g). $m(x) = \frac{a(x)}{b(x)}$, where $a(x) = \frac{5}{x^2-4}$ and $b(x) = \frac{x}{x-2}$.
(h). $n(x) = (b \circ a)(x)$, where $a(x)$ and $b(x)$ are as in part (g).
(i). $p(x) = (c \cdot d)(x)$, where $c(x) = \frac{5}{x^2-4}$ and $d(x) = \frac{x-2}{x-5}$.

Problem 3: Compute the average rate of change of the function $f(x) = e^x$ on the interval $[0, 5]$.

Problem 4: Given the function $f(x) = x^2$, describe the resulting function g created when f undergoes the following sequences of transformations.
(a). shifted left by 3, then compressed horizontally by a factor of 2, then reflected about the x-axis.
(b). stretched horizontally by a factor of 2, then shifted left by 3, then reflected about the y-axis.

Problem 5: State whether the following functions are even, odd, or neither.
(a). $f(x) = \tan x$
(b). $g(x) = \sec x$
(c). $h(x) = \ln x$.
(d). $j(x) = \cos(x^3)$
(e). $k(x) = x^4 + 3x^2 + 7$
(f). $l(x) = (x-4)^4 + 2$
(g). $m(x) = \sin(x^3 - 3x)$

Problem 6: Write the quadratic functions in vertex form and identify their vertices and whether they are maxima or minima. Then, identify the number of x-intercepts and find the ranges of the functions.
(a). $f(x) = 5x^2 + 10x + 9$.
(b). $g(x) = -3x^2 - 3x + 1$.

Problem 7: Determine the end behaviors of the following functions. Then, identify the zeroes and asymptotes and the behavior/sign near these points.
(a). $f(x) = 4(2x-5)(3-x)(7-6x)$.
(b). $g(x) = \frac{4x^3-8x^2-x+2}{x^2(1-x)}$
(c). $h(x) = \frac{10x^4-160}{5(x+2)^3}$

Problem 8: Does the Intermediate Value Theorem guarantee a zero for the function $f(x) = 4x^3 - 8x^2 - x + 2$ on the interval $[0, 1]$?

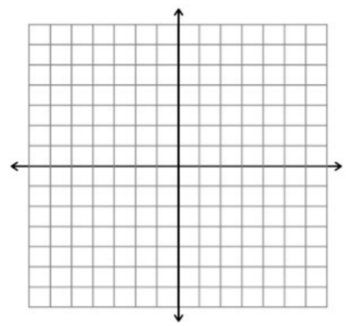
Problem 9: Compute the quotient $(5 - x^2 + 2x + x^3) \div (x^2 + 1)$. Use this to write $5 - x^2 + 2x + x^3$ in quotient-remainder form in terms of $x^2 + 1$.

Problem 10: Is $(4x + 1)$ a factor of the polynomial $x^7 + 3x^4 + 2$? How do you know? If not, what is the remainder when $x^7 + 3x^4 + 2$ is divided by $4x + 1$?

Problem 11: Find a degree 6 polynomial with integer coefficients that has zeros at 3 (multiplicity 2), $1 - 5i$, and $2 + 4\sqrt{3}$.

Problem 12: Solve the inequalities.
(a). $\frac{3x-7}{x+2} \leq 7$
(b). $\frac{x^4}{x^2+4} < 0$.
(c). $\frac{x}{x-2} > \frac{2x}{7x-14}$.

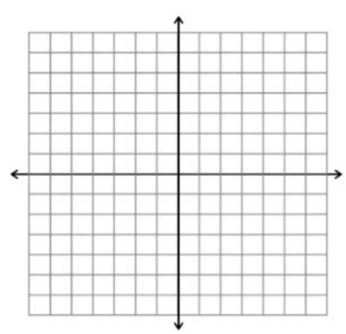
<u>**4.1, # 48:**</u> Consider the function $s(x) = \frac{2}{x-3}$.
(a). Sketch the graph, and identify any asymptotes.



(b). Is s one-to-one? If so, find the inverse of s.

(c). Identify the domain and range of s^{-1} if s^{-1} exists.

<u>**4.2, # 28:**</u> Consider the function $g(x) = 4^{x+1} + 2$.
(a). Sketch the graph, and identify any asymptotes.



(b). Give the domain and range of g.

(c). Find the inverse function of g.

Problem 13: Determine whether the functions $w(x) = \frac{6}{x+2}$ and $z(x) = \frac{6-2x}{x}$ are inverses.

Problem 14: Consider the following relations? Are they functions? Are they one-to-one?

(a). $\{(0,2),(1,1),(3,5),(-2,3),(-3,2),(5,7),(1,-1)\}$

(b). $\{(0,2),(1,1),(3,5),(-2,3),(1,-1)\}$

(c). $\{(0,2),(1,1),(3,5),(-2,3),(5,7)\}$

4.2, # 46: Suppose that \$8000 is invested at 3.5% interest for 20 years.

(a). What is the resulting amount if the interest is compounded monthly? Leave your answer as you would plug it into your calculator.

(b). What is the resulting amount if the interest is compounded continuously? Leave your answer as you would plug it into your calculator.

(c). If compounded continuously, how long did it take for the investment to earn \$100 in interest?

Problem 15: Compute the following (exact answers).

(a). $\log_{16}(\log_{81} 3)$

(b). $\log 100000 - \log 100$

(c). $\log_\pi 1$

(d). (in rectangular form) $(-3+3\sqrt{3})^{10}$.

(e). $2\sin^{-1}\left(-\frac{\sqrt{2}}{2}\right) - \tan^{-1}\left(-\frac{\sqrt{3}}{3}\right) + \cos^{-1}\left(-\frac{\sqrt{3}}{2}\right)$

(f). $\arcsin\left(\sin\frac{4\pi}{3}\right)$

(g). $\cos\left(2\sin^{-1}\frac{4}{5}\right)$

Problem 16: Find all angles on $[0,2\pi)$ where $\sin x = \frac{\sqrt{3}}{2}$.

Problem 17: Find all angles on $[0,2\pi)$ where $\sin x = -\frac{1}{5}$.

5.3, #61: Find all angles on $[0,2\pi)$ where $\tan x = -\frac{\sqrt{3}}{3}$.

Problem 18: Given $\cos(\alpha) = \frac{4}{5}$, $\frac{3\pi}{2} < \alpha < 2\pi$, and $\sin\beta = -\frac{5}{13}$, $\cos\beta < 0$, determine $\tan(\alpha+\beta)$ and $\cos\frac{\alpha}{2}$.

Problem 19: Determine both the point on the unit circle and the unit vector determined by $\theta = \frac{5\pi}{6}$. How do they compare?

Problem 20: Identify the period and phase shift (relative to $y = \cos x$) for the graph of $y = -3\cos\left(4x+\frac{\pi}{2}\right)$. Then, graph one full period of $y = -3\cos\left(4x+\frac{\pi}{2}\right)$, identifying the key points on that period.

Problem 21: The half-life of ^{226}Ra is 1620 years. Find the exponential form (in terms of e) of $Q(t)$, the quantity of radium left in a sample after t years after 1920, if there were originally 125g of it in the sample in 1920.

Problem 22: Prove the following identities.

(a). $\sin 2A - \tan A = \tan A \cos 2A$

(b). $\cos x \tan x + \sec(-x)\cot(-x) = -\cot x \cos x$

(c). $\ln|\sec\theta + \tan\theta| = -\ln|\sec\theta - \tan\theta|$

(d). $\frac{\cot x}{\csc x} - \frac{\csc x}{\cot x} = -\sin x \tan x$

(e). $\frac{\sin^3 t - \cos^3 t}{\cos t \sin t - \cos^2 t} = \sec t + \sin t$.

(f). $\sec(x-y) = \frac{\cos(x+y)}{\cos^2 x - \sin^2 y}$

(g). $\frac{\sin(\alpha-\beta)}{\sin(\alpha+\beta)} = \frac{\tan\alpha - \tan\beta}{\tan\alpha - \tan\beta}$

(h). $\frac{\sin 4\theta}{1-\cos 4\theta} = \cot 2\theta$.

(i). $\sin^2\frac{\theta}{2} = \frac{\csc\theta - \cot\theta}{2\csc\theta}$

Problem 23: Consider triangle(s) ΔABC with angles A,B,C and sides a, b, c. Solve the triangle(s) given:

(a). $a = 132.5$, $b = 108.2$, and $B = 13.1°$.

(b). $a = 2.3$, $b = 10.8$, $c = 9.7$.

Problem 24: Solve the following equations.

(a). $\log_3(\log_4 x) = 1$.

(b). $\cos(3\theta) - \cos(\theta) = \sin(2\theta)$

(c). $6\cos^2 x - 7\sin x - 1 = 0$

(d). $\cos 4x - 3\cos 2x - 1 = 0$

(e). $e^x + 3 - 4e^{-x} = 0$

(f). $(\log x)^2 = \log x^3$

(g). $4^{2x-7} = 5^{3x+1}$

Problem 25: Write the quotient $(2-2i)/(3+3i)$ in polar form.

Problem 26: A force $\mathbf{F}$ of 300 lb is exerted $N15°W$ on an object. If N is the positive y direction and E is the positive x-direction, what is the component form of $\mathbf{F}$? If another force of $3\mathbf{i}+7\mathbf{j}$ is exerted on the object, what additional force is required to keep the object at equilibrium?

Problem 27: Given $\mathbf{u} = \langle -7, 5\rangle$ and $\mathbf{v} = \langle 3, 2\rangle$, calculate $\text{proj}_{\mathbf{v}}\mathbf{u}$ and the angle θ between $\mathbf{u}$ and $\mathbf{v}$.

Problem 28: Solve the system of equations (1) $-3x+4y-z=-4$; (2) $x+2y+z=4$; (3) $-12x+16y-4z=-16$.

Problem 29: Find the major axis, vertices, foci, and eccentricity for $16x^2+9y^2=144$.

Problem 30: Find the foci, vertices, asymptotes, and eccentricity for $16y^2-9x^2=144$.

Problem 31: Find the focus, vertex, directrix, focal diameter, and endpoints of the latus rectum for $4y^2 = 16x$

Problem 32: Find the equations of the conics centered at the origin with the following properties.

(a). hyperbola with eccentricity 5/4, foci at $(0,\pm 5)$

(b). ellipse with foci at $(\pm 4, 0)$ and a vertex at $(5,0)$.

(c). parabola with directrix $x = 3$.