Key

Final Exam Review – Principles of Math 12

Chapter 1 – Transformations

1.2 Translation Functions Left\Right and Up\Down

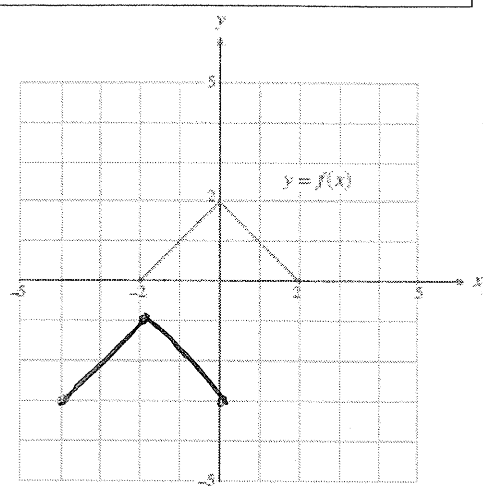
a. If the point (2, 3) is on $y = f(x)$ then what point must be on:

$y=f(x-2)$ (4,3)	$y=f(x+4)$ (-2,3)	$y=f(x)-3$ (2,0)	$y=f(x)+5$ (2,8)
$y+4=f(x)$ (2,-1)	$y-9=f(x)$ (2,12)	$y=f(x-9)+3$ (11,6)	$y-8=f(x+5)$ (-3,11)

b. If (4, 5) is on $y = f(x)$ and (7, 10) is on the translated graph find values of *a* and *b* that satisfy:

$y=f(x+a)+b$ $a=-3$ $b=5$	$y+b=f(x+a)$ $a=-3$ $b=-5$

c. Given the graph $y = f(x)$ shown below. Graph $y = f(x+2)-3$



1.3 Reflections:

a. Match change in the function on the left with the change to the graph on the right.

$y=f(x) \rightarrow y=f(-x)$	B	A. Reflect over line *y=x*
$y=f(x) \rightarrow y=-f(x)$	C	B. Reflect over y-axis
$y=f(x) \rightarrow y=f^{-1}(x)$	A	C. Reflect over x-axis

b. If the point (4, -5) is on the graph $y = f(x)$, then what point must be on:

a. $y=f(-x)$ (-4,-5)	b. $-y=f(x)$ can this be written another way? (4,5) $y=-f(x)$
c. $y=-f(-x)$ (-4,5)	c. $x=f(y)$ can this be written another way? (-5,4) $y=f^{-1}(x)$
d. $-x=f(y)$ (5,4)	e. $-y=f(x+3)$ (1,5)

c. If the point (5, 4) is on the curve $y = f(x)$, then what values of a and b will move the point to (-5, -4) on the curve $y = af(bx)$?

$a = -1$

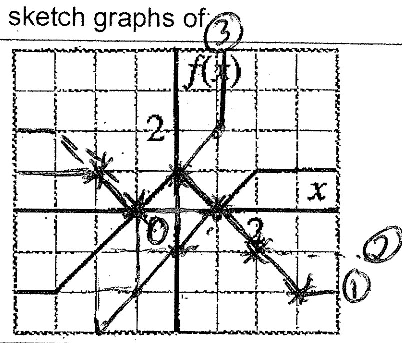
$b = -1$

d. Find the algebraic inverse:

$y = \frac{2}{3}x - 4$	$y = 5(x-3)^3$	$y = \frac{x-2}{5x-3}$
$y^{-1} = \frac{3}{2}(x+4)$	$y^{-1} = \sqrt[3]{\frac{x}{5}} + 3$	$y^{-1} = \frac{3x-2}{5x-1}$

e. Given the graph $y = f(x)$ shown on the right, sketch graphs of:

1. $y = f(-x)$ ✱✱
2. $-y = f(x)$ - - - -
3. $y = f^{-1}(x)$ o—o



1.4 Horizontal\Vertical Expansions & Compressions

a. Match the statement on the left with the equations on the right.

Horizontal Expansion by 2	D	A. $y = 2f(x)$
Horizontal Compression by 1/2	C	B. $y = \frac{1}{2}f(x)$
Vertical Expansion by 2	A, E	C. $y = f(2x)$
Vertical Compression by 1/2	B, F	D. $y = f\left(\frac{1}{2}x\right)$ or $y = f\left(\frac{x}{2}\right)$
		E. $\frac{1}{2}y = f(x)$ or $\frac{y}{2} = f(x)$
		F. $2y = f(x)$

b. If the point (2, 5) is on the curve $y = f(x)$, then what point must be on:

$y = f(4x)$	$y = 3f(x)$	$y = \frac{1}{2}f(x)$	$y = f\left(\frac{1}{5}x\right)$	$y = 2f(6x)$
(0.5, 5)	(2, 15)	(2, 2.5)	(10, 5)	($\frac{1}{3}$, 10)

c. If the point (10, 12) is on the curve $y = af(bx)$ and the point (5, 24) is on the curve $y = f(x)$, then what are the values of *a* and *b*?

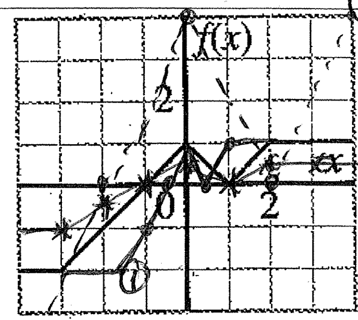
a=2
b=2

d. Given the graph $y = f(x)$ shown on the right, sketch graphs of:

(1) $y = f(2x)$ o—o

(2) $y = \frac{1}{2} f(x)$ *—*

(3) $y = 4f\left(\frac{1}{2}x\right)$ - - - -



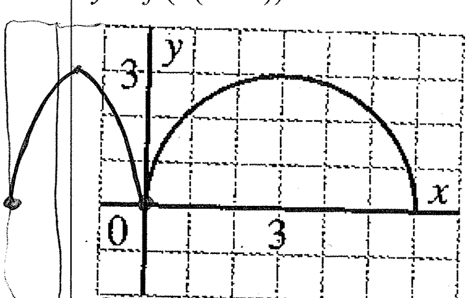
1.5 Combining Transformations

a. If the point (4, 6) is on the curve $y = f(x)$, then what point must be on:

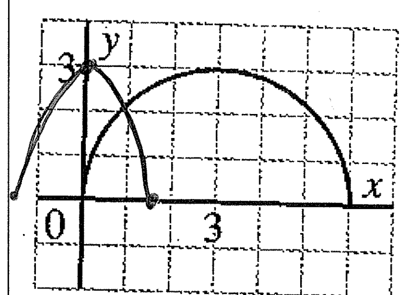
$y = f(2(x-3))$ (5,6)	$y = f(2x+4)$ (0,6)	$y = -f(3x+9)-5$ (-5/3, -11)
$y = 3f(2x-4)-1$ (4,17)	$2y = f(5x-10)+8$ (29/5, 7)	$y = -3f(-2x+6)-4$ (1, -22)

b. Given the graph of $y = f(x)$, shown below. Graph:

$y = f(2(x+3))$



$y = f(2x+3)$



1.6.a Graphing Absolute Value Functions

a. If the point (3, -5) is on the curve $y = f(x)$, then what point must be on:

$y = \lvert f(x)-3 \rvert$	$y = \lvert f(x) \rvert - 4$	$y = \lvert 2f(x)-3 \rvert$	$y = \lvert 2f(x) \rvert - 3$

Chapter 2 – Logarithms

2.1 Using Exponential Functions

Won't be assessed alone -- You need to know the formulas to solve problems later in the review:

$A = P\left(1+\frac{i}{n}\right)^{t\times n}$	$A = P(X)^{\frac{t}{n}}$

2.2 Definition of a Logarithm

a. Convert between exponential and logarithmic form

Write in exponential form: $\log_2 8 = 3$ $2^3 = 8$	Write in logarithmic form: $5^3 = 125$ $\log_5 125 = 3$
Write in exponential form: $\log_p q = r$ $p^r = q$	Write in logarithmic form: $x^y = z$ $\log_x z = y$

b. Evaluate logarithms with out a calculator:

$\log_3 27 = 3$	$\log_2 \frac{1}{16} = -4$	$\log_{81} 3 = \frac{1}{4}$	$\log_8\left(\frac{1}{2}\right) = -\frac{1}{3}$

2.3 Laws of Logarithms (no calculator anywhere folks)

a. Evaluate: (Using the change of base rule)

$4\log_{5.6} 84$ (oops! use a calculator for this one ☺) 10.29	$\log_{\sqrt{8}} 16$ $2.\overline{6}$

b. Write as a **single logarithm** (squish them all together!)

$2\log a + 4\log b - 5\log c - \frac{1}{2}\log d$ $\log\left(\frac{a^2b^4}{c^5\sqrt{d}}\right)$	$2 + \log_3 a + 2\log_3 b - \log_3 c$ $\log\left(\frac{9ab^2}{c}\right)$

c. Write as a sum/difference of logarithms (split those darn things up!)

$\log\left(\frac{1000a^3b^3}{c^2\sqrt[4]{d^5}}\right)$ $3 + 3\log a + 3\log b - 2\log c - \frac{5}{4}\log d$	$\log_2\left(\frac{x^2y^3}{8z^4}\right)$ $2\log_2 x + 3\log_2 y - 3 - 4\log_2 z$

d. If $\log 5 = x$ and $\log 4 = y$, write in terms of x and y

$\log 20$ $x + y$	$\log\left(\frac{5}{4}\right)$ $x - y$	$\log 10$ $x + \frac{y}{2}$	$\log_5 4$ $\frac{y}{x}$

Do work on a separate paper

2.4 Solving problems that involve logarithms:

a. How long does it take for \$250 take to grow to \$570 if it is invested in a saving account paying 4.75% p.a. compounded monthly?

17.39 yrs

b. A radioactive sample of Carbon 16 has a half life of 50 days. How long does it take for another sample of Carbon 16 to decay from 70 grams to 12 grams?

127.22 days

c. A population of bunnies grows from 1200 to 5700 over a period of 70 days. Find the tripling time of this population.

49.36 days

d. The sound at a rock concert decreases by 10% for every 5 meters traveled. How far does it take for a volume of 2000 decibels to decrease to 20 decibels?

218.54m

2.5 Earthquakes, pH & Growth.

a. Earthquake A – Magnitude 10.7. Earthquake B – Magnitude 6.8.
How many times stronger is earthquake A compared to earthquake B? 7943.28 x stronger

b. Earthquake A – Magnitude 6.5. Find the magnitude of Earthquake B if:
Earthquake B is 2.5 times as strong (intense) 6.9
Earthquake B is $\frac{1}{3}$ times a strong (instense) 6.0

c. Solution A has a pH of 5.6. Solution B has a pH of 8.2. How many times more alkaline is solution B compared to solution A? 398.11 times more alkaline

d. Solution A has a pH of 8.2. Solution B has a pH of 7.5. How many times more acidic is solution B compared to solution A? 5.0

e. Solution A has a pH of 7.9. Find the pH of solution B if:
Solution B is 5 times as acidic 7.2
Solution B is 3 times as alkaline 8.4
Solution B is half as acidic 8.2

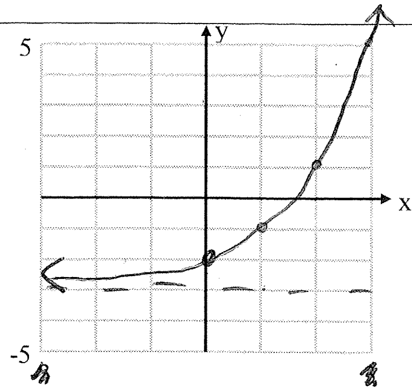
f. A population of cats triples every 40 weeks. By how much does the population grow between the 20th and 90th week? 6.84

g. A population of bears grows by 20% every 15 days. By how much does the population grow between the 3rd and 50th day? 1.77

2.6 Graphing Exponential Functions (No calculators here folks!)

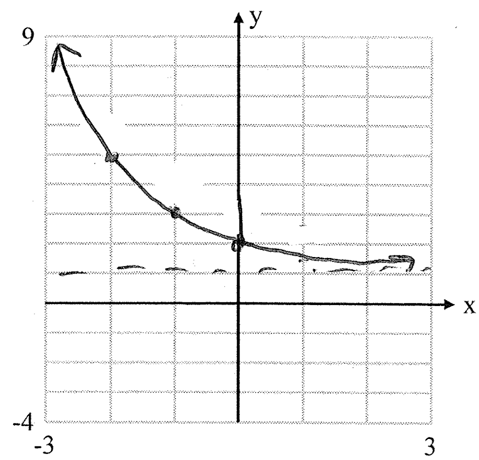
a. Given the function: $y = 2^x - 3$,

Range?	Asymptote	Graph
$y > -3$	$y = -3$	



b. Given the function: $y = \left(\frac{1}{2}\right)^x + 1$

Range?	Asymptote	Graph
$y > 1$	$y = 1$	



c. Find the inverse algebraically:

$y = 3^{x-4} + 8$	$y = 5^{2x-7} - 3$
$y^{-1} = \log_3(x-8)+4$	$y^{-1} = \frac{\log_5(x+3)+7}{2}$

2.7 Graphing Logarithmic Functions (No Calculators here!)

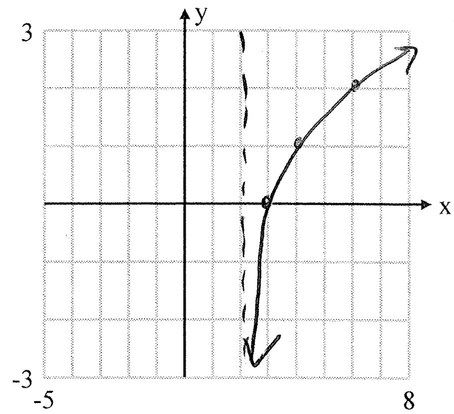
a. Find the domain without graphing:

$y = \log_6(-(x+4))$	$y = \log_{x-2}(9-x)$
$x < -4$	$2 < x < 9,\ x \neq 3$

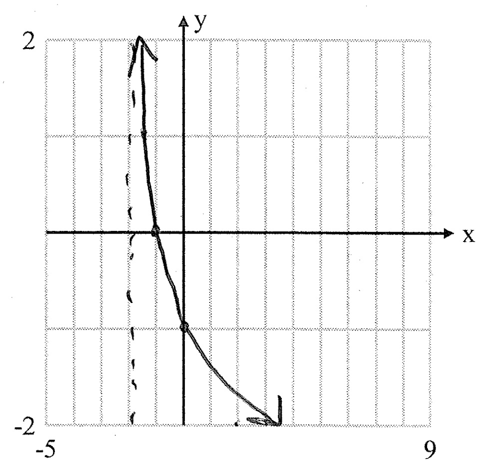
b. Find the inverse:

$y = \log_7(x-4)+2$	$y = \log_3(x-4)-9$
$y^{-1} = 7^{x-2}+4$	$y^{-1} = 3^{x+9}+4$

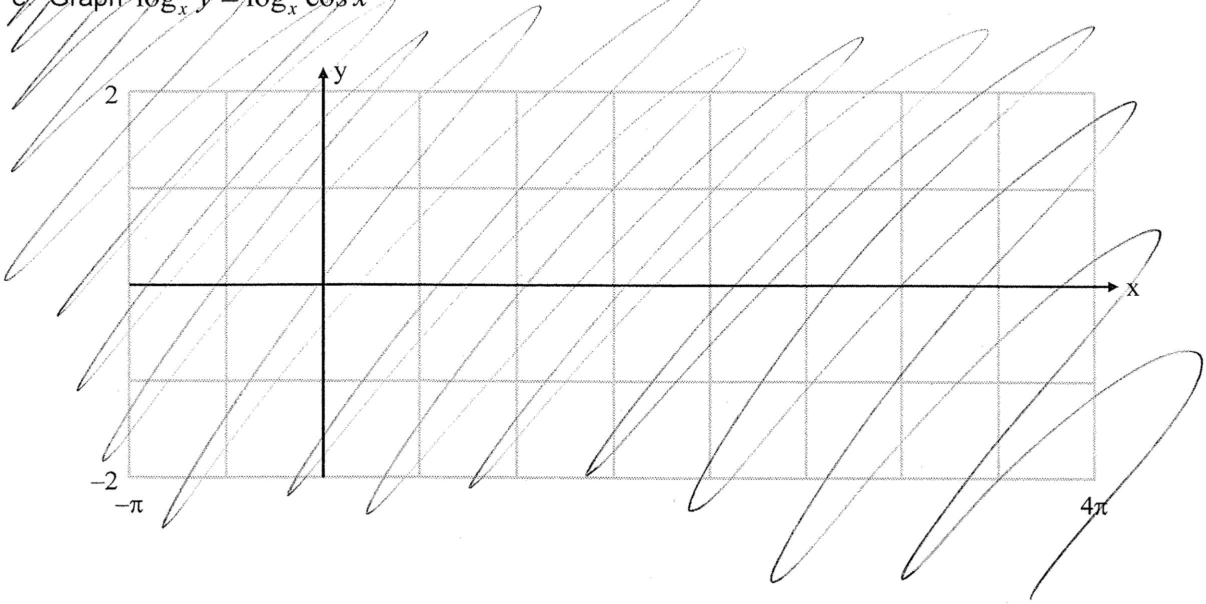
c. Given the function: $y = \log_2(x-2)$,

Domain?	Asymptote	Graph
$x > 2$	$x = 2$	

d. Given the function: $y = \log_{\frac{1}{3}}(x+2)$,

Domain?	Asymptote	Graph
$x > -2$	$x = -2$	

e. Graph $\log_x$ $y = \log_x \cos x$



****Do work on separate paper****

2.8 Solving Exponential Equations:

a. Solve:

$8^{x+4} = 16^{2x}$ X= 12/5	$5^{x-1} = 7^{x+3}$ X = -22.13	$a^{x+3} = bc^{2x}$ X = $\frac{\log b - 3\log a}{\log a - 2\log c}$

2.9 Solving Logarithmic Equations

a. Simplify:

$81^{\log_3 2x}$ 16x^4	$a^{\log_a 5x^2 + \log_a 2x}$ 10x^3	$\log_5 5^{2x} + \log_5 5^{3x} - \log_5 5^x$ 4x

b. Solve:

$\log_2 8 + \log_3 9 = \log x$ X= 100,000	$\log_4(\log_3 x) = \frac{1}{2}$ X=9	$36^{\log_2 x} = 216$ X = $\sqrt{8}$
$\log_3(x+4) + \log_3(6-x) = 2$ X= -3	$2\log(3-x) = \log 4 + \log(6-x)$ X=-3	$(\log_2 5)(\log_5 x) = 3$ X=8

~~2.10 Continuous Growth~~

~~The temperature of Ms. Poelzer's coffee decays *continuously* according to the formula: $T = T_0 e^{kt}$. The current temperature of Ms. Poelzer's coffee is $80°C$ and the temperature drops *continuously* at a rate of 5% per hour. How long does it take for the coffee to be $30°C$?~~

Chapter 4 – Trigonometric Graphing
4.1 – Introduction to Periodic Functions (not assessed)

4.2 – Radian Measure

a. Convert Radians into Degrees:

3π 540°

$\frac{5}{9}\pi$ 100°

1.25 radians 71.62°

b. Convert Degrees into Radians

i. 130° (express as a fraction of π) $\frac{13}{18}\pi$

ii. 260° (express as a fraction of π) $13\pi/9$

iii. 283° (don't express as a fraction of π, round correctly to 2 decimal places)

4.94 rad.

c. Use the arc length formula (ArcLength = Radius x Angle (in Radians))

i. An angle of $\frac{2}{3}\pi$ Radians subtends an arc of 20 cm. What is the radius of this circle?

9.55cm

ii. A circle with a radius of 10 cm has a central angle of 130°, what is the length of the arc it subtends?

22.69 cm

iii. A circle with radius of 25 cm subtends an arc of 50 cm. What is the measure of this angle in radians and in degrees?

114.59°

4.3 – Angles in Standard Position Part I

a. Find 2 co-terminal angles and the reference angle for:

130°	−170°	$\frac{7}{9}\pi$	$-\frac{4}{5}\pi$	$\frac{17}{6}\pi$
ref ∠ = 50°	ref ∠ : 10°	ref ∠ : $2\pi/9$	ref ∠ = $\pi/5$	ref ∠ = $\pi/6$
coterm: 490°, −230°	coterm: 190°, −530°	coterm: $-\frac{11\pi}{9}$, $\frac{25\pi}{9}$	coterm: $\frac{6\pi}{5}$, $-\frac{14\pi}{5}$	coterm: $\frac{5\pi}{6}$, $-\frac{7\pi}{6}$

4.4 – Angles in Standard Position in Part II

$\sin\theta = \frac{y}{r}$	$\cos\theta = \frac{x}{r}$	$\tan\theta = \frac{y}{x}$
$\csc\theta = \frac{r}{y}$	$\sec\theta = \frac{r}{x}$	$\cot\theta = \frac{x}{y}$

a. If $\sin\theta = -\frac{5}{12}$ and $\pi < \theta < \frac{3}{2}\pi$, find the exact value of $\tan\theta$

$\frac{5}{\sqrt{119}}$

b. If $\cot\theta = -\frac{2}{5}$ and $\frac{\pi}{2} < \theta < \pi$, find the exact value of $\sec\theta$

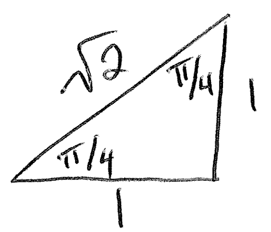
$\frac{\sqrt{29}}{-2}$

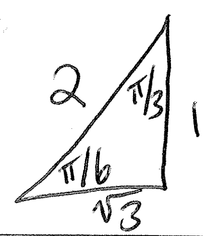
c. What quadrant are you in if: $\sin\theta < 0$ and $\sec\theta < 0$?

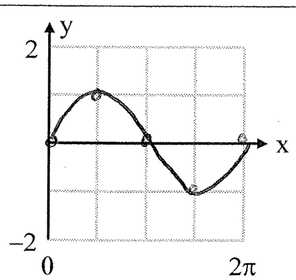
III

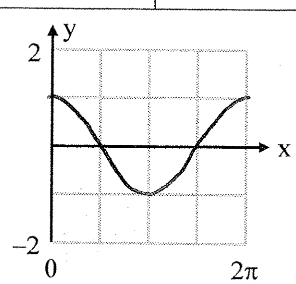
4.5 – Special Triangles

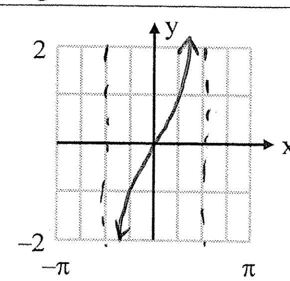
You'd better memorize them soon!) and the graphs of sine, cosine and tangent!
Draw the two special triangles and the graphs of sine cosine and tangent











a. Using the graphs and special triangles, determine **the exact value of**:

$\sin\left(\frac{\pi}{3}\right)$ $\frac{\sqrt{3}}{2}$	$\cos\left(\frac{11\pi}{6}\right)$ $\frac{\sqrt{3}}{2}$	$\tan\left(-\frac{5}{4}\pi\right)$ -1	$\sec\left(\frac{7\pi}{3}\right)$ 2
$\sin\left(\frac{3}{2}\pi\right)$ -1	$\sec\left(\frac{\pi}{2}\right)$ undef.	$\cot\left(\frac{\pi}{4}\right)$ 1	$\sin\left(-\frac{45}{6}\pi\right)$ 1

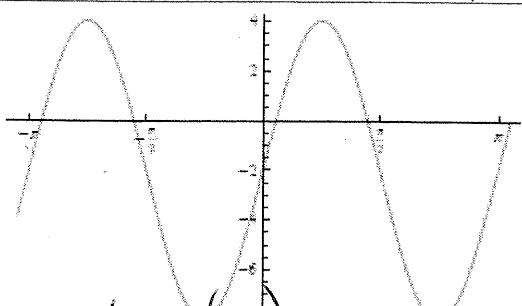
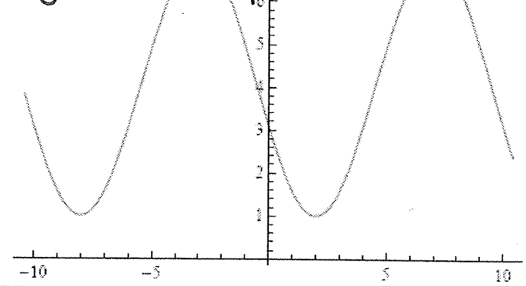
Do on separate paper

4.6 Graphing Sine & Cosine

a. List all of the characteristics of the following functions:
In order (Amplitude, Vertical Displacement, Period, Phase Shift, Maximum, Minimum)

$y = 6\sin\left(3\left(x - \frac{\pi}{3}\right)\right) - 2$ ⑤ 4 ① 6 ③ 2π/3 ⑥ -8 ② down 2 ④ π/3 right	$y = -3\cos(5x - 20\pi) + 8$ ⑤ 11 ① 3 ③ 2π/5 ⑥ 5 ② 8 up ④ 4π right
$y = 2\sin\frac{2\pi}{14}x + 8$ ⑤ 10 ① 2 ③ 14 ⑥ 6 ② 8 up. ④ ∅	$y = -4\cos\frac{\pi}{9}(x - 2) + 4$ ⑤ 8 ① 4 ③ 18 ⑥ 0 ② 4 up ④ 2 R

b. Given the graph, write the sinusoidal (sine/cosine) equation:

 $y = 6\sin(2x) - 2$	$y = -3\cos\left(\frac{2\pi}{16}(x-2)\right) + 4$ 

c. A sinusoidal function has a maximum at (2, 10) and its next minimum (5, -2). Find an equation that represents this situation $y = 6\cos\left(\frac{2\pi}{6}(x-2)\right) + 4$

d. A sinusoidal function has a zero at (5, 0) and its next minimum is (7, -4). Find an equation that represents this situation.

$y = -4\sin\left(\frac{2\pi}{8}(x-5)\right)$

e. A sinusoidal function has a maximum at $\left(\frac{\pi}{4}, 10\right)$ and its next minimum is $\left(\frac{7}{8}\pi, -2\right)$. Find an equation that represents this situation.

$y = 6\cos\left(\frac{8}{5}\left(x - \frac{\pi}{4}\right)\right) + 4$

4.7 Modeling with sine/cosine.

a. A Ferris wheel has a diameter of 30 m. The bottom of the wheel is 1.5 m off the ground. It takes 3.5 minutes to do one complete revolution. If a person gets on the Ferris wheel at its lowest point,

Write an equation that represents a person's height above the ground (*h*) at any time (*t*). $y = -15\cos\left(\frac{2\pi}{210}t\right) + 16.5$
How high off the ground is the person at *t* = 25 seconds? 5.5 m
How long (in one rotation) is the person above 27 m? 53.2

b. In Vancouver on a certain day, high tide is 20 m at 2AM. The next low tide is 8 m at 6 AM.
Write an equation that represents the height (*h*) of the water at any time (*t*) (since midnight) $h = 6\cos\left(\frac{2\pi}{8}(t-2)\right) + 14$
What is the height of the water at 8:45 AM? 17.33 m
What is the height of the water at 8:30 PM? 11.70 m

4.8 Graphing Reciprocal Functions

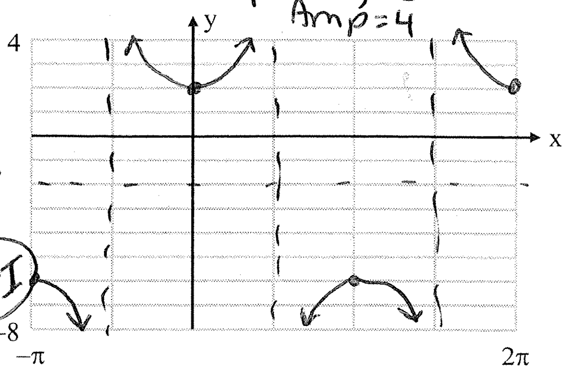
a. Graph the following functions and identify (Domain, Range, Asymptotes, Amplitude, Period, Phase Shift, Vertical Displacement)

$y = 4\sec x - 2$ $p = 2\pi$, VD: 2 down, Amp = 4

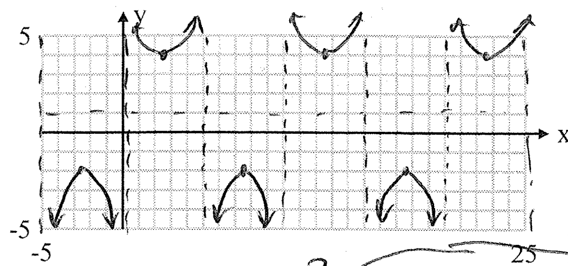
$\{x \mid x \neq -\pi/2, \pi/2, \dots\}$

$\{y \mid y \leq -6, y \geq 2\}$

$x = \frac{\pi}{2} + k\pi, k \in I$



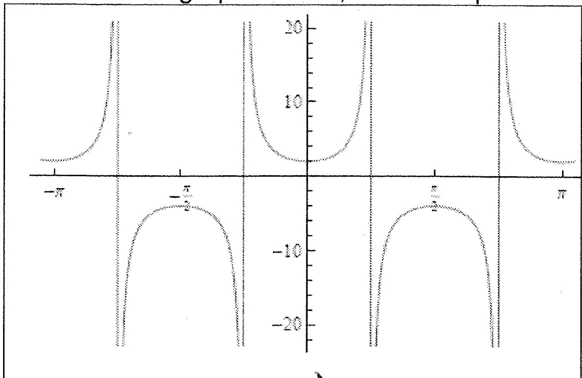
$y = 3\csc\frac{\pi}{10}x + 1$ $p = 10$, Amp = 3, VD: 1 up



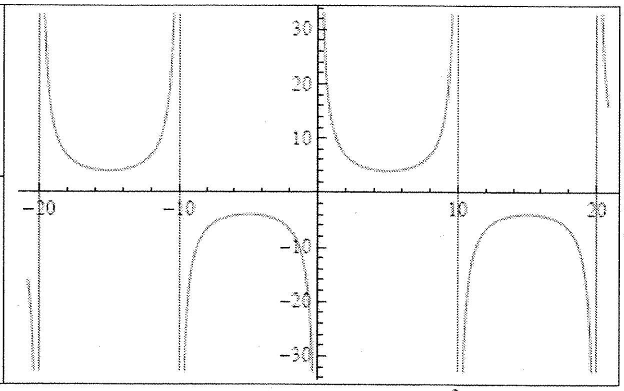
$\{x \mid x \neq 0, 5, 10, \dots\}$ $x = 5k, k \in I$

$\{y \mid y \leq 2, y \geq 4\}$

b. Given the graphs below, find the equations



$y = 3\sec(2\theta) - 2$



$y = 2\csc\left(\frac{2\pi}{20}x\right)$

4.9 Graphing Tangent/Co-Tangent

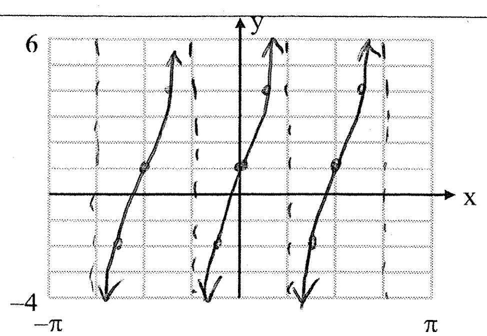
Find the characteristics of the following equations (Domain, Asymptotes, Period, Amplitude, Vertical Displacement) and graph

$y = 3\tan(2x) + 1$

$p = \pi/2$

VD: 1 up

Amp: 3

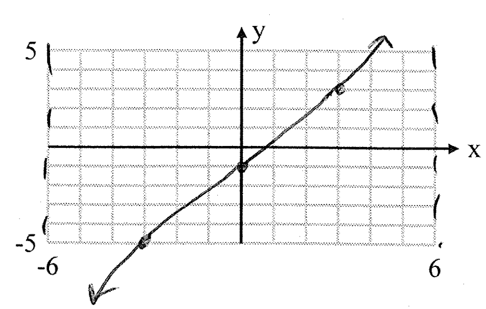


$\{x \mid x \neq -\pi/4, \pi/4, \dots\}$

$\{y \in \mathbb{R}\}$

$\boxed{x = \frac{\pi}{4} + \frac{k\pi}{2}, k \in I}$

$y = 4\tan\left(\frac{\pi}{12}x\right) - 1$ $p = 12$, VD: 1 down, Amp = 4



$\{x \mid x \neq -6, 6, \dots\}$

$\boxed{x = 6 + 12k, k \in I}$

Chapter 5 – Trigonometric Proofs & Equations

5.1 Reciprocal and Pythagorean Identities

a. Evaluate:

$\csc\left(\frac{11}{7}\pi\right)$ = -1.03	$3\sec(11.45)$ = 6.83

b. Simplify:

$\sin x\csc x+\sec x\cos x$ 2	$\cos^2 x\csc^2 x+1$ $\csc^2 x$	$\frac{\cos x}{1-\sin x}+\frac{\cos x}{1+\sin x}$ $\sec x$

c. Prove:

$\frac{1+\csc x}{\cot x+\cos x}=\frac{\cot x}{\csc x-\sin x}$	$\frac{\tan\theta}{\sec\theta+1}=\frac{\sec\theta-1}{\tan\theta}$

5.2 Sum and Difference Identities

a. Simplify (write as a single trig. statement)

$\sin 5x\cos 2x-\cos 5x\sin 2x$ $\sin(3x)$	$\cos 3x\cos 4x+\sin 3x\,\overset{\sin}{\cancel{\cos}}\,4x$ $\cos(-x)$

b. If $\sin\theta=-\frac{5}{13}$ and $\frac{3}{2}\pi<\theta<2\pi$, find the exact value of:

$\sin\left(\frac{\pi}{2}+\theta\right)$ $12/13$	$\cos\left(\theta+\frac{\pi}{6}\right)$ $\frac{6\sqrt{3}}{13}+\frac{5}{26}$

5.3 Double Angle Identities

a. Simplify (write as a single trig statement)

$10\sin 3x\cos 3x$ $5\sin(6x)$	$10\cos^2 8x-5$ $5\cos(16x)$	$4\cos^2 7x-\sin^2 7x$ $4\cos(14x)$

b. If $\cos\theta=-\frac{5}{13}$ and $\pi<\theta<\frac{3}{2}\pi$, find the exact value of:

$\sin 2\theta$ $120/169$	$\cos 2\theta$ $-119/169$

c. Prove:

$\frac{\cos 2x}{\sin x}=\frac{\cot^2 x-1}{\csc x}$	$\frac{\sin 2x}{1+\cos 2x}=\frac{\sec^2 x-1}{\tan x}$

5.4 Restrictions

a. Find the restrictions in terms of $\sin x$ and $\cos x$

$\frac{\tan x}{\csc x-1}$ $\cos x\neq 0$ $\sin x\neq 0, 1$	$\frac{\cos x}{3\csc x-4}$ $\sin x\neq 0, \frac{3}{4}$	$\frac{\cot x}{3\sin x-2}$ $\sin x\neq 0, \frac{2}{3}$

5.5 Solving 'simple' Trigonometric Equations:

Solve the following equations (as exact values where possible)

$2\sin x - \sqrt{3} = 0$, $0 < x \le 2\pi$	$2\cos x + 1 = 0$; $-\pi \le x < \pi$	$5\cot x - 1 = 0$, $-\frac{\pi}{2} < x < \frac{\pi}{2}$

$X_1 = \frac{\pi}{3}$, $X_2 = \frac{2\pi}{3}$ $\quad$ $X_1 = \frac{-\pi}{3}$, $X_2 = \frac{-2\pi}{3}$ $\quad$ $X_1 = -1.37$

5.6 Solving trigonometric equations by factoring:

a. Solve (by factoring a common term):

$2\sin x\cos x + \cos x = 0$, $0 < x \le 2\pi$	$\sqrt{3}\tan x\sin x + \sin x = 0$, $-\pi \le x < \pi$

$X = \pi/2, 3\pi/2, 7\pi/6, 11\pi/6$ $\quad$ $X = 0, -\pi, 5\pi/6, \pi/6$

b. Write the general solution for questions in a.

$X = \pi/2 + 2k\pi$ (same for all), $k \in \mathbb{Z}$

$X \begin{cases} -\pi + 2k\pi \\ 5\pi/6 + 2k\pi \\ \pi/6 + 2k\pi \end{cases}$, $k \in \mathbb{Z}$

c. Solve (by trinomial factoring):

$6\sin^2 - \sin x - 2 = 0$, $-\pi \le x < \pi$	$\sec^2 x + \sec x - 6 = 0$, $0 < x \le 2\pi$

$X = -\pi/6, -5\pi/6, 0.7297, 2.412$ $\quad$ $X = 1.911, 4.373, \pi/3, 5\pi/3$

d. Solve over the real numbers the question in c.

$X = \begin{cases} \pi/6 + 2k\pi \\ -5\pi/6 + 2k\pi \end{cases}$ $k \in \mathbb{Z}$ (with others)

$X = \begin{cases} 1.911 + 2k\pi \\ 4.373 + 2k\pi \\ \pi/3 + 2k\pi \\ 5\pi/3 + 2k\pi \end{cases}$, $k \in \mathbb{Z}$

5.7 Double angle equations:

Solve, write answers as a general solution

$4\sin 5x\cos 5x = 1$	$2\cos^2 6x - 2\sin^2 6x = \sqrt{3}$

5.8 Solving Using the graphing calculator

Use the graphing calculator to solve:

$3\tan x = 2^x$, $-\pi \le x < \pi$ $\quad X = 0.42, -3.1$	$3\cos x = \log x$, $0 < x \le 2\pi$ $\quad x = 1.51, 4.96$

$4\sin 5x\cos 5x = 1$

$X = \begin{cases} \frac{\pi}{60} + \frac{2\pi}{10}k \\ \frac{\pi}{12} + \frac{2\pi k}{10} \end{cases}$ $k \in \mathbb{Z}$

$2\cos^2 6x - 2\sin^2 6x = \sqrt{3}$

$X = \begin{cases} \frac{\pi}{72} + \frac{2\pi}{12}k \\ \frac{-\pi}{72} + \frac{2\pi}{12}k \end{cases}$, $k \in \mathbb{Z}$