

1. (5pts) Find the equation of the line that contains $(-1, 3)$ and is parallel to the line $3x - 2y = 4$. Sketch both lines on the same coordinate system.

2. (8pts) Solve the inequalities and write the solution in interval notation:

a) $5 < 2x - 4 \leq 6$

b) $|x - 3| \geq 5$

3. (3pts) Solve for t :

$$v = -gt + v_0$$

4. (4pts) Put the complex number into form $a + bi$.

$$\frac{i(3 + 2i)}{1 + i} =$$

5. (5pts) Determine algebraically (Pythagorean theorem or another method) if the triangle with vertices $A = (-2, 0)$, $B = (4, 7)$ and $C = (5, 1)$ is a right triangle.

6. (5pts) The equation $y = x^4 - 2x^3 - 5x^2 - x - 7$ is given.

a) Use your calculator to accurately sketch the graph of the equation on paper. Indicate your viewing window.

b) What is the y -intercept of the graph?

c) Using your calculator, find the smallest x -intercept accurate to three decimal points.

Solve the equations:

7. (4pts) $x^2 - 3x + 15 = 0$

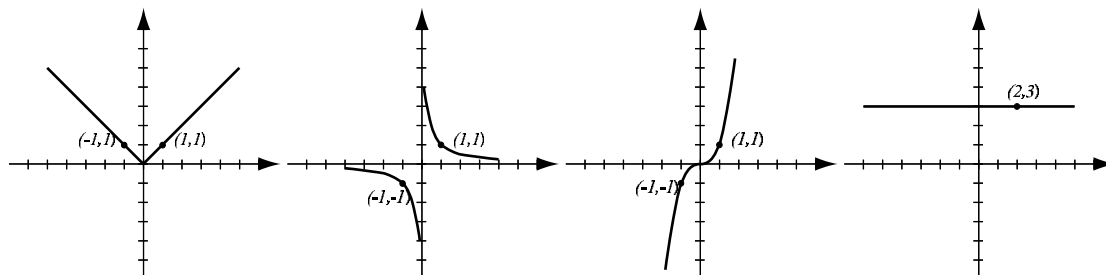
8. (5pts) $\sqrt{7 - 2x} = x - 2$

9. (5pts) Find the equation of the circle whose diameter has endpoints at $(2, 7)$ and $(4, -1)$. Sketch the circle. (*Hint: what is the center? The radius?*)

10. (6pts) How many liters of a 10% solution of green needs to be added to 20 liters of a 50% solution of green in order to get a 20% solution? Don't forget to write down what your variable means.

Bonus (5pts) It takes Batman 50 minutes to wipe out a gang of bad guys. Superman can finish with the same gang in 30 minutes (after all, he can fly!). How long would it take them if they worked together?

1. (4pts) The following are graphs of basic functions. Write the equation of the graph under each one.



2. (5pts) Let $f(x) = 3x + 7$ and $g(x) = \frac{5}{x^2 + 2x + 3}$. Find the following and simplify where possible:

$$g(-1) =$$

$$f(2u + 4) =$$

$$\left(\frac{f}{g}\right)(x) =$$

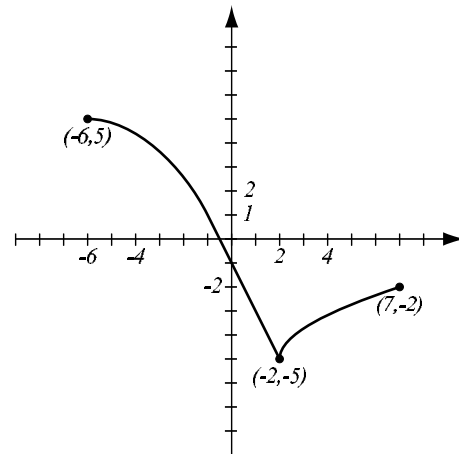
3. (6pts) The manager of a large clothing store wishes to find a function that relates the daily demand D for men's jeans and the price p of the jeans. The data below were obtained based on a price history of jeans sales.

- Draw the scatterplot of the data on paper. Does the relationship look linear?
- Use the calculator to find the "line of best fit" to the data. Draw the line on paper.
- Interpret the slope of the line of best fit.
- How many jeans would the store expect to sell daily if the price is \$25?

p (\$/pair)	D (pairs of jeans sold per day)
20	60
22	57
23	56
23	53
27	52
29	49
30	44

4. (6pts) Use the graph of the function f at right to answer the following questions.

- What is $f(3)$?
- What are the x -intercepts?
- Where is the function increasing?
- Where does f have a local minimum? What is its value?
- What are the solutions of the equation $f(x) = 9$?

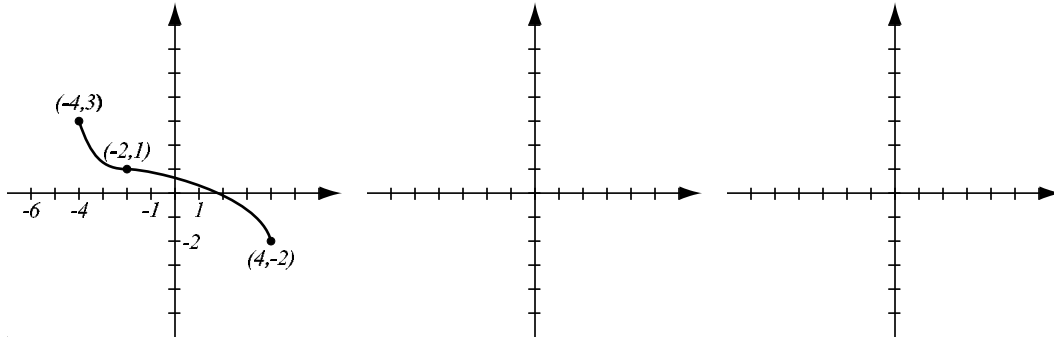


5. (3pts) Algebraically determine if the function $f(x) = \frac{x^2 + 2}{x^3 + 4x}$ even, odd or neither.

6. (7pts) The quadratic function $f(x) = -x^2 + 6x + 7$ is given. Do the following without using the calculator.

- Find the x -intercepts of its graph, if any.
- Find the vertex of the graph.
- Sketch the graph of the function.
- What is the range of the function?

7. (4pts) The graph of $f(x)$ is drawn below. Find the graphs $f(x) - 3$ and $f(2x)$ and label all the relevant points.



8. (8pts) Consider the rational function $f(x) = \frac{2x - 5}{x^2 - 7x + 10}$.

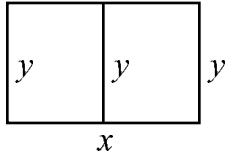
- Find the domain of the function and the vertical asymptotes.
- Algebraically find the x -intercepts of the graph and the y -intercept.
- Sketch the graph of the function on paper (large and clear — make Mom proud!).
- Find the horizontal asymptote of the graph.

9. (7pts) Farmer George has 300ft of fencing that he will use to enclose a rectangular pen and divide it in half (picture).

a) Express the area A of the pen as a function of the width x .

b) Draw a rough graph of the function $A(x)$.

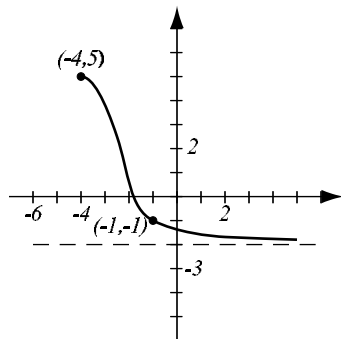
c) Algebraically find the dimensions of the pen that maximize its area.



Bonus (5pts) Algebraically find the domain of $g(x) = \sqrt{x^2 - 3x - 5}$. (*Hint: a graph of $x^2 - 3x - 7$ will help.*)

1. (3pts) Let $f(x) = x^2 + x$. Find $(f \circ f)(x)$ and simplify.

2. (4pts) The graph of f is given. Explain why f has an inverse and find the graph of its inverse function. Label the relevant points and indicate any asymptotes on the graph of f^{-1} .



3. (5pts) Find the inverse of $f(x) = \frac{2x}{x+7}$ and the range of f .

4. (4pts) Evaluate without using the calculator:

$$\log_2 32 =$$

$$\log_4 \frac{1}{256} =$$

$$\log_{25} \frac{1}{5} =$$

$$\ln \sqrt[3]{e^7} =$$

5. (7pts) Solve the equations

$$\log_3(2x - 1) = -2$$

$$8^{x^2+x} = \left(\frac{1}{2}\right)^{3x-9}$$

6. (3pts) Write as a sum of logarithms. Express powers as factors. Simplify if possible.

$$\log_7 \frac{49^{x+2}}{(x-4)^5} =$$

7. (3pts) Write as a single logarithm. Simplify if possible.

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

8. (6pts) A rabbit population grows according to the law $N(t) = N_0 e^{kt}$.
- Given that the population doubles in 18 months, find k .
 - How long does it take for the rabbit population to triple?

9. (2pts) Roughly sketch angles of measure 140° and $-\frac{2\pi}{3}$ radians.

10. (5pts) Suppose $\sin \theta = \frac{2}{5}$ and $0 < \theta < \frac{\pi}{2}$. Find $\cos \theta$, $\tan \theta$ and $\sec \theta$.

11. (3pts) Simplify using basic trigonometric identities. Do not use the calculator.

$$\sin 42^\circ \csc 48^\circ - \tan 42^\circ =$$

12. (5pts) You would like to get a wedge of pizza that is exactly 15in^2 in area. If the *diameter* of the pizza is 12in, what is the angle (in degrees) of the desired wedge?

Bonus (5pts) Simplify:

$$\log_{\pi^2} \pi^9 =$$

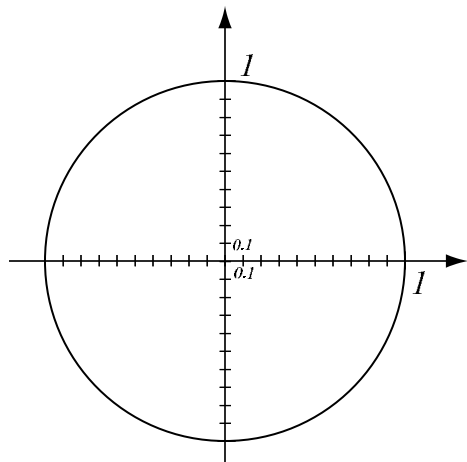
$$\log_2 3 \cdot \log_3 4 \cdot \log_4 5 \cdots \log_n (n+1) \cdot \log_{n+1} 2 =$$

$$\begin{aligned} \sin(\alpha \pm \beta) &= \sin \alpha \cos \beta \pm \cos \alpha \sin \beta & \sin(2\theta) &= 2 \sin \theta \cos \theta & \sin^2 \frac{\theta}{2} &= \frac{1 - \cos \theta}{2} \\ \tan(\alpha \pm \beta) &= \frac{\tan \alpha \pm \tan \beta}{1 \mp \tan \alpha \tan \beta} & \cos(2\theta) &= \cos^2 \theta - \sin^2 \theta & \tan^2 \frac{\theta}{2} &= \frac{1 - \cos \theta}{1 + \cos \theta} \\ & & \tan(2\theta) &= \frac{2 \tan \theta}{1 - \tan^2 \theta} & & \end{aligned}$$

1. (8pts) Without using the calculator, find the exact values of the following expressions. Draw the unit circle and the appropriate angle under the expression.

$$\cos 30^\circ = \qquad \sec \frac{3\pi}{4} = \qquad \arctan \sqrt{3} = \qquad \arcsin 1.3 =$$

2. (4pts) Use the picture below to estimate $\cos 18^\circ$ and $\arcsin(-0.4)$ (in degrees). Then evaluate these numbers using a calculator and compare your answers.



3. (5pts) Draw two periods of the graph of $y = -3 \sin(2\theta)$. What is the amplitude? The period? Indicate where the special points are (x -intercepts, peaks, valleys).

4. (5pts) Use a half-angle formula to find the exact value of $\cos 165^\circ$.

5. (4pts) Find all the solutions of the equation $2 \sin \theta + 1 = 0$.

6. (6pts) Solve the triangle: $\alpha = 42^\circ$, $\gamma = 57^\circ$, $b = 5$

7. (5pts) Show the identity: $1 - \frac{\sin^2 \theta}{1 - \cos \theta} = -\cos \theta$.

8. (4pts) Find the exact values of the expressions below. Draw a picture if helpful and do not use the calculator.

$$\sin(\arcsin 0.57) =$$

$$\arctan \left(\tan \frac{7\pi}{8} \right) =$$

9. (9pts) Suppose that $\pi < \alpha < \frac{3\pi}{2}$ and $\frac{\pi}{2} < \beta < \pi$ are angles so that $\tan \alpha = \frac{3}{2}$ and $\cos \beta = -\frac{3}{7}$. Use addition and double formulas to find:

a) $\sin(\alpha - \beta)$

b) $\cos(2\beta)$

Bonus. (5pts) You take a sighting of the top of a building from a certain point and find that the angle of elevation is 33° . Then you move 200ft towards the building and take another sighting, finding the angle of elevation to be 51° now. How tall is the building?

$$\sin(\alpha \pm \beta) = \sin \alpha \cos \beta \pm \cos \alpha \sin \beta$$

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

$$\sin^2 \frac{\theta}{2} = \frac{1 - \cos \theta}{2}$$

$$\tan(\alpha \pm \beta) = \frac{\tan \alpha \pm \tan \beta}{1 \mp \tan \alpha \tan \beta}$$

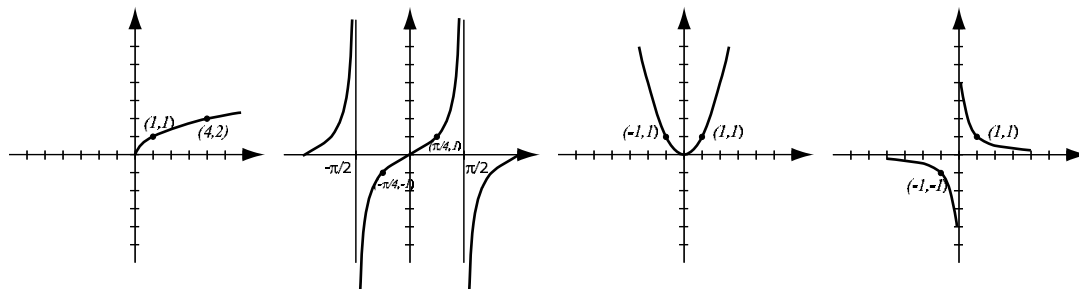
$$\cos(2\theta) = \cos^2 \theta - \sin^2 \theta$$

$$\tan^2 \frac{\theta}{2} = \frac{1 - \cos \theta}{1 + \cos \theta}$$

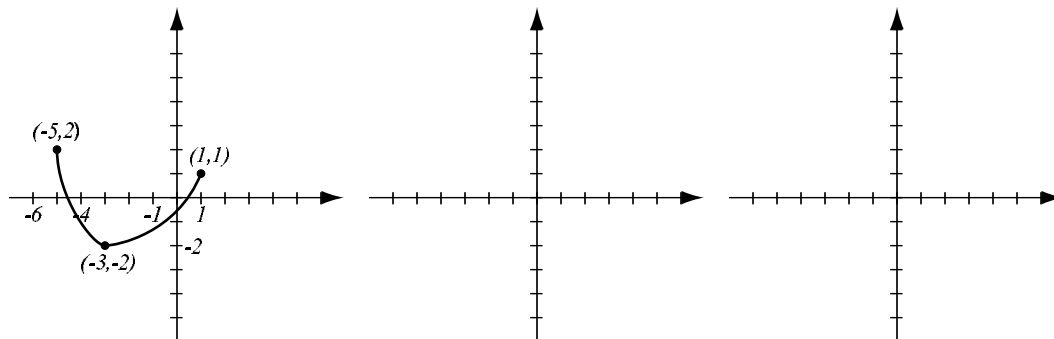
$$\tan(2\theta) = \frac{2 \tan \theta}{1 - \tan^2 \theta}$$

1. (4pts) Find the equation of the line that contains the points $(-2, 4)$ and $(4, -3)$. Then find the equation of the line that is perpendicular to this one and passes through the origin.

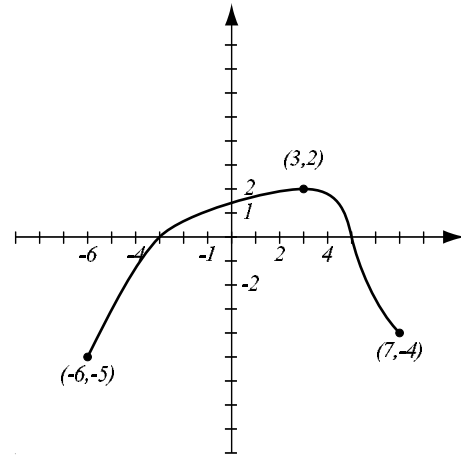
2. (4pts) The following are graphs of basic functions that we have had in this course. Write the equation of the graph under each one.



3. (4pts) The graph of $f(x)$ is drawn below. Find the graphs $f(x - 3)$ and $2f(x)$ and label all the relevant points.



4. (6pts) Use the graph of the function f at right to answer the following questions.
- What is $f(3)$?
 - What are the x -intercepts?
 - State the intervals of x 's where $f(x) > 0$.
 - What are the solutions of the equation $f(x) = -3$?



5. (6pts) The quadratic function $f(x) = x^2 + 2x - 4$ is given. Do the following without using the calculator.
- Find the x -intercepts of its graph, if any.
 - Find the vertex of the graph.
 - Sketch the graph of the function.

6. (8pts) The polynomial $f(x) = x^4 - 4x^2 - 3$ is given. Use your calculator to solve the following with accuracy 3 decimal points.

- a) Find the x -intercepts and the y -intercept. Does f have the maximum number of x -intercepts that a fourth-degree polynomial can have?
- b) Find the intervals of increase and decrease of this function.
- c) What is the range of f ?
- d) Sketch the graph of the function on paper (large and clear — make Dad proud!).

7. (5pts) Solve the equation $x + 3 = \sqrt{4x + 18}$.

8. (3pts) Let $f(x) = x + 3$, $g(x) = x^2 + 3x - 1$ Find $(g \circ f)(x)$ and simplify.

9. (4pts) Evaluate without using the calculator:

$$\log_4 16 = \quad \log_3 \frac{1}{27} = \quad \log_{49} 7 = \quad \log_a \sqrt[7]{a^3} =$$

10. (3pts) Write as a difference of logarithms. Express powers as factors. Simplify if possible.

$$\ln \frac{e^{x+2}}{(x-7)^4} =$$

11. (3pts) Solve the equation: $3^{2x-4} = 17$.

12. (6pts) Without using the calculator, find the exact values of the following expressions. Draw the unit circle and the appropriate angle under the expression.

$$\sin 150^\circ = \qquad \tan \frac{3\pi}{4} = \qquad \arccos \frac{\sqrt{3}}{2} =$$

13. (5pts) If $\cos \theta = \frac{2}{5}$ and θ is in the fourth quadrant, find $\sin \theta$ and $\cos(2\theta)$.

14. (4pts) A building 300ft high casts a shadow 50ft long. What is the angle of elevation of the Sun?

15. (5pts) Sandra is paid time-and-a-half for hours worked in excess of 40 hours. If she had weekly wages of \$442 for 48 hours worked, what is her regular hourly rate?

Bonus (7pts) After the release of radioactive material into the atmosphere from Chernobyl in 1986, the hay in parts of Europe was contaminated by iodine 131, whose half-life is 8 days. If it is all right to feed the hay to cows when 10% of the iodine 131 remains, how long do the farmers need to wait to use this hay? (*Hints: use the model $A(t) = A_0e^{kt}$ and start by finding k first.*)