Spring '06/MAT 140/Exam 1b **Name:** *Show all your work.*

1. (3pts) Identify each of the following numbers as integer, rational or irrational.

$\sqrt{11}$ $4.263145297\ldots$ (nonrepeating digits) $\frac{3}{4}$

2. (2pts) Convert to or from scientific notation:

$5.76 \times 10^{-4} =$

$34,492,135 =$

3. (4pts) Simplify and write the answer so all exponents are positive:

$$\frac{(2x)^3(x^{-4}y^4)^2}{(10x)^2y^{-7}} =$$

4. (4pts) Simplify.

$$\frac{x+4}{x^2+4x-21} - \frac{x}{x^2-9} =$$

5. (4pts) Use a known formula to factor:

$16x^2 - 25 =$

$x^3 + 27 =$

6. (3pts) Which of the points $A = (-4, 5)$ and $B = (6, -2)$ is closer to the origin? Justify your answer by a computation.

7. (5pts) The equation $y = x^3 + 5x^2 + 7x - 8$ is given.
a) Use your calculator to help you sketch the graph (yes, on paper!). Make sure all the features of the graph are visible and indicate your viewing window.
b) Find the all the x-intercepts and the y-intercept to two decimal places.

8. (15pts) Solve the equations for x.

$cx - dx + 2d = d^2x + 5c - d$

$x^2 - 4x = x + 36$

$|5x - 2| = 14$

$x + 2 = \sqrt{x + 14}$

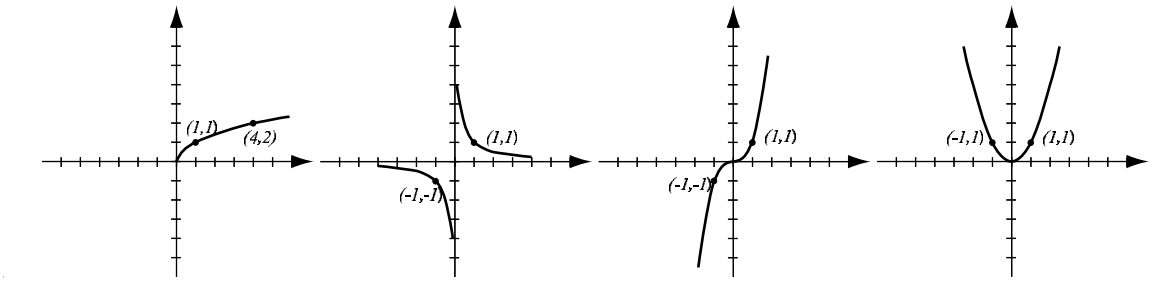
9. (4pts) Mary-Kate can sign a stack of promotional photos in 40 minutes, while Ashley needs 30 minutes to accomplish the same job. How long does it take them to sign a stack of photos if they work together? (Of course, each photo gets signed only once.)

10. (6pts) The area of a rectangle is 40 square in. If the length is 4in greater than the width, what are the dimensions of the rectangle?

Bonus. (5pts) Two cars drive along the same highway and start in the same spot. The faster car drives 10 mph faster than the slower car. If the faster car starts 10 minutes after the slower car, and catches up after 20 minutes of driving, how fast was each car going?

Spring '06/MAT 140/Exam 2b **Name:** *Show all your work.*

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



2. (4pts) Find the domain of the function $f(x) = \sqrt{3x - 7}$.

3. (5pts) Find the equation of the line that passes through $(-2, 3)$ and is perpendicular to the line $3x + 2y = 6$. Draw both lines in the same coordinate system.

4. (5pts) Find the equation of the circle whose center is $(3, -2)$ that contains the point $(1, 1)$. Draw the circle.

5. (10pts) Use the graph of the function f at right to answer the following questions.

a) What is the domain of f?

b) What is the range of f?

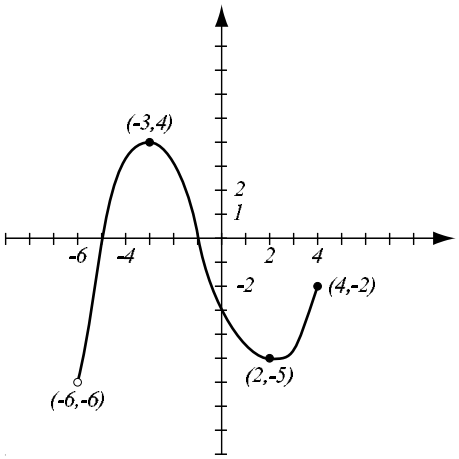
c) Find $f(4)$ and $f(2)$.

d) List the x-intercepts of the graph.

e) Where does f have a local maximum? What is its value?

f) What are the solutions of the equation $f(x) = -1$?

g) For which x is $f(x) > 0$?



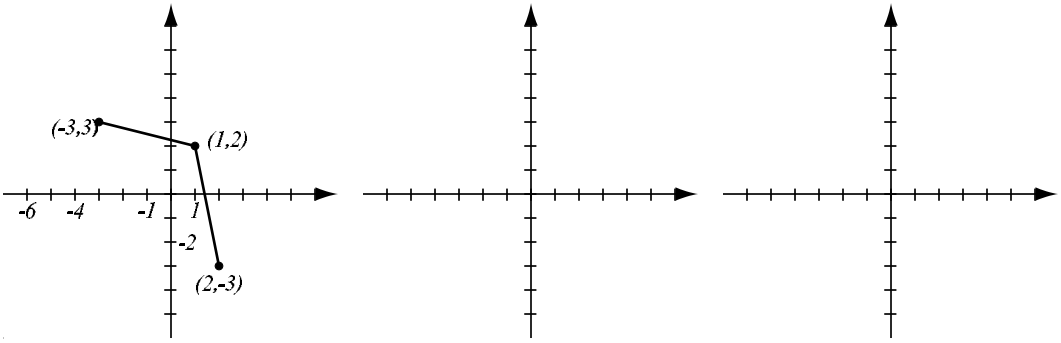
6. (5pts) A bank offers a 30-year loan with a certain fixed interest rate. Under the terms of such a loan, one borrower secured a 30-year loan of \$110,000 with a montly payment of \$700.
a) Write the function that relates the monthly payment y to the amount borrowed x on such a loan. (y is proportional to x).
b) What is the monthly payment of a borrower who gets a \$170,000 loan?

7. (7pts) The function $f(x) = x^4 - 6x^2 + 5$ is given.
a) Determine algebraically whether this function is even, odd or neither.
b) Sketch the graph of f on paper. Why does your picture support what you found in a)?
c) List the intervals where f is increasing or decreasing. Accuracy: 2 decimal points.

8. (5pts) Sketch the graph of the piecewise-defined function:

$$f(x) = \begin{cases} x+1, & \text{if } -5 < x \leq -1 \\ -2x+4, & \text{if } -1 < x. \end{cases}$$

9. (5pts) The graph of the function f is given below. On separate graphs, sketch the graphs of the functions $f(x) - 3$ and $-f(2x)$. Label all the relevant points.



Bonus. (5pts) The following is an equation of a circle. Bring the equation into standard form in order to find its center and radius.

$x^2 + 10x + y^2 - 4y + 15 = 0$

1. (8pts) The quadratic function $f(x) = x^2 + 4x + 6$ is given. Do the following without using the calculator.
a) Find the x-intercepts of its graph, if any.
b) Find the vertex of the graph.
c) Sketch the graph of the function.
d) What is the range of the function?

2. (2pts) The table gives values of f and g for some x's. Find $(g \circ f)(3)$ and $(f \circ f)(1)$.

x	1	2	3
$f(x)$	2	3	2
$g(x)$	2	1	3

3. (5pts) Let $f(x) = 3x + 5$ and $g(x) = \sqrt{x - 7}$. Find the following composites (simplify if possible):

$(g \circ f)(x) =$ $(f \circ f)(x) =$

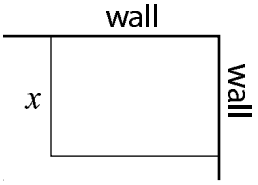
4. (3pts) Let $h(x) = \dfrac{2}{x^2+1}$. Break up this function into a composite of two functions f and g. That is, find f and g so that $h(x) = (f \circ g)(x)$.

5. (11pts) Consider the polynomial $P(x) = -(x-3)(x+4)(x-5)$. Answer the following (decimal answers should have accuracy to two decimal places).
a) Find the x-intercepts of the graph and the y-intercept.
b) P behaves like what function for large $|x|$?
c) Find the turning points of P.
d) Sketch the graph of the function on paper. Make sure scale is marked and all features you found in a)-c) are indicated.
e) Use the graph to determine where the function is increasing.

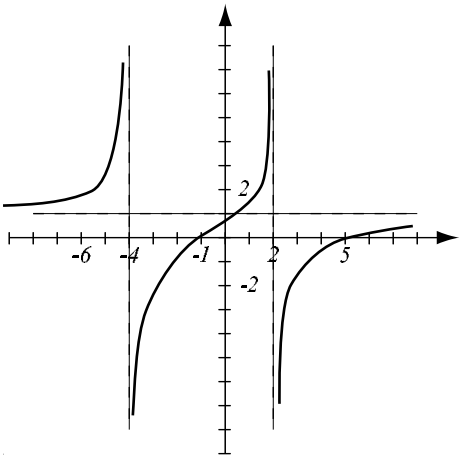
6. (2pts) Write a formula for a polynomial of degree 3 whose zeroes are -3 (multiplicity 2) and 4 (multiplicity 1).

7. (11pts) Consider the rational function $Q(x) = \dfrac{3x+5}{x^2-3x-10}$.
Answer the following (decimal answers should have accuracy to two decimal places).
a) Find the domain of the function and where the vertical asymptotes are.
b) Find the x-intercepts of the graph and the y-intercept.
c) Find the horizontal asymptote, if any.
d) Sketch the graph of the function on paper. Make sure scale is marked and all features you found in a)-c) are indicated.
e) Find the intervals where the function is increasing.

8. (8pts) Shannon has 100ft of fencing to enclose a rectangular play pen. Two sides of the pen are walls (see picture) and fence is used for the remaining two sides.
a) Express the area A of the play pen as a function of the width x.
b) Draw an accurate graph of the function $A(x)$.
c) For what x is the area the largest? What is the maximum area?

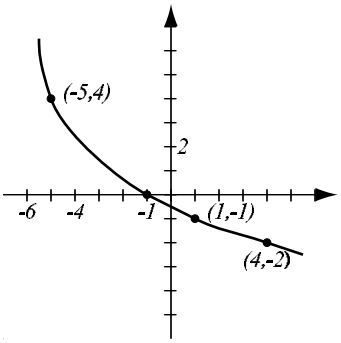


Bonus (5pts) Find the formula for a rational function whose graph is shown. (Hint: what will give you the correct vertical asymptotes? The correct x-intercepts?)



Spring '06/MAT 140/Exam 4b **Name:** *Show all your work.*

1. (4pts) The graph of a function f is given.
a) Explain why the function has an inverse.
b) Find the graph of f^{-1}, labeling the relevant points.



2. (4pts) Let $f(x) = \dfrac{3x-7}{4x}$.
a) Find $f^{-1}(x)$.
b) Find the range of f^{-1}.

3. (4pts) Evaluate without using the calculator:

$\log_2 32 =$ $\log_3 \frac{1}{27} =$ $\log_9 3 =$ $\log_a \sqrt[3]{a^4} =$

4. (3pts) What is the domain of the function $f(x) = \log_4(x-7)$?

5. (3pts) Draw the general shape of the graph for these functions. Indicate the x- and y-intercepts.

$y = a^x$, $a < 1$ $\qquad\qquad$ $y = \log_a x$, $a > 1$.

Solve the equations:

6. (2pts) $\log_x 3 = 2$

7. (4pts) $2^{x^2} = 4^{12-x}$

8. (5pts) Solve and then use the calculator to find the decimal value for x.

$3^x = 4^{5x+1}$

9. (2pts) Use your calculator to find $\log_7 0.25$ with accuracy 4 decimal places. Show how you obtained your number.

10. (6pts) Write as a sum and/or difference of logarithms. Express powers as factors. Simplify if possible.

$\log_7(49x^2\sqrt[4]{y^7-8}) =$

$\ln\dfrac{(x+9)^5}{e^3} =$

11. (6pts) Write each the following as a single logarithm. Simplify if possible.

$3\log x^4 + 4\log\sqrt{x} =$

$3\ln(x+2) - \ln(x^2-x-6) =$

12. (7pts) One of the radioactive elements released into the air after the accident at Chernobyl (20 years ago this week) was iodine 131, whose half-life is 8 days. The function describing the decay of iodine 131 is $A(t) = A_0 e^{kt}$, $k < 0$.
a) Find the k for iodine 131.
b) Livestock feed contaminated by iodine 131 is deemed safe for animal consumption once 10% of the original amount of iodine 131 remains. How long after contamination is it OK to use the feed?

Bonus. (5pts) The probability that a car will pull up to a bank's drive-through within t minutes of 1PM is modeled by the formula $P(t) = 1 - e^{-0.2t}$. Solve the following with accuracy 2 decimal points.
a) What is the probability that a car will come within 5 minutes of 1PM?
b) How many minutes are needed for probability to reach 99%?