MAT 155 Project X Spring 2014
Concavity and Inflection

Your work should be done neatly in the same format as previous labs and saved regularly as yourname10.mws and yourname10b.mws.

You should write comments as you work. To do so just backspace in front of the prompt > and type in the comments. They should appear in black not in red. When you finish the lab be sure to go over your comments and check the grammar.

Problem 1: a) Define the function g(x)=x^3-2x and graph it from -5 to 5. Approximately where is it increasing? Approximately where is it decreasing?

b) Find its derivative using D(g). Graph the derivative from -5 to 5. Use fsolve to find out exactly where it switches from positive to negative. Graph D(g) and g together using

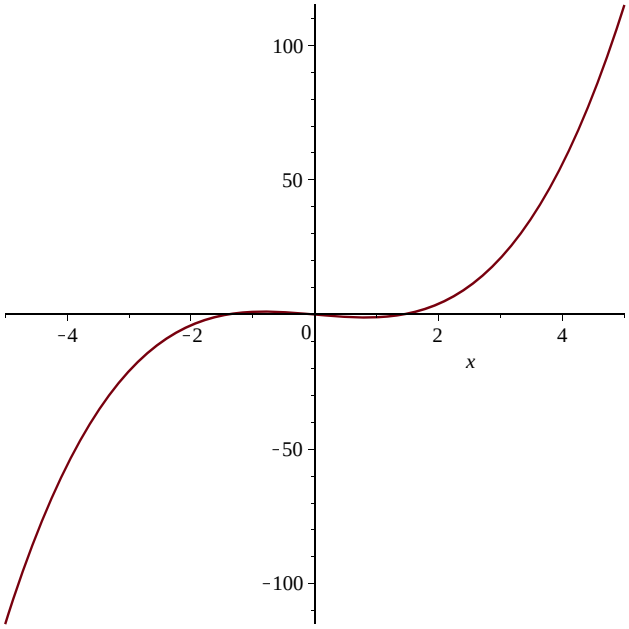
```
> plot({D(g)(x), g(x)}, x=-5..5);
```

Exactly where is g(x) increasing and decreasing?

c) Now find D(D(g)) and plot it with g. What is the sign of D(D(g)) at x where g has a local maximum? local minimum? Is g curving upward (concave up) when its second derivative is positive? What about when the second derivative is negative?

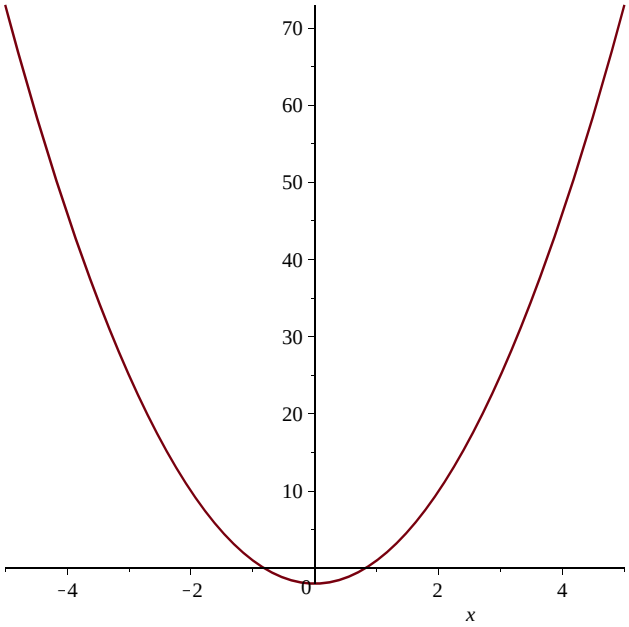
```
> g:=x->x^3-2*x; plot(g(x),x=-5..5);
```

$$g := x \rightarrow x^3 - 2\,x$$




```
> D(g); plot(D(g)(x),x=-5..5); fsolve(D(g)(x)=0,x=-2..0); fsolve(D
  (g)(x)=0,x=0..2);
```

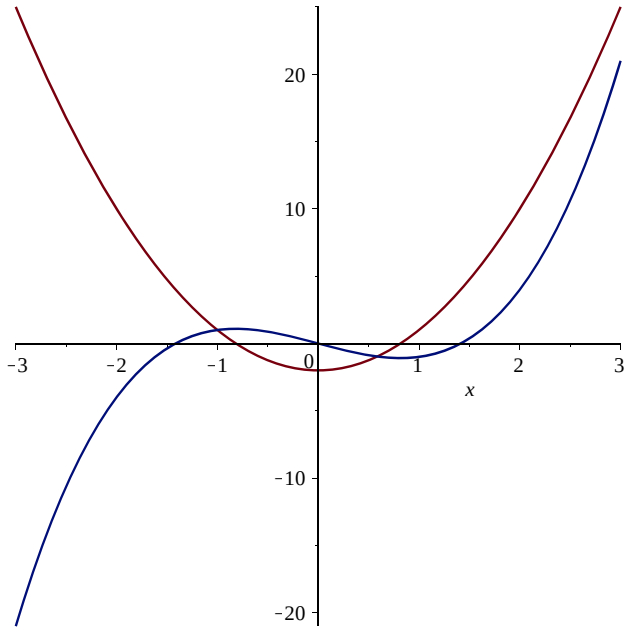
$$x \rightarrow 3\,x^2 - 2$$



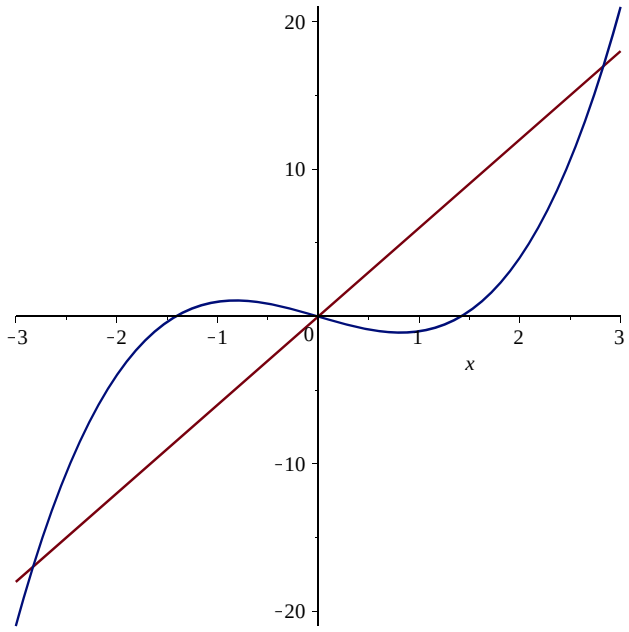
$$-0.8164965809$$

$$0.8164965809 \qquad \textbf{(1)}$$

```
> plot({D(g)(x), g(x)}, x=-3..3);
```



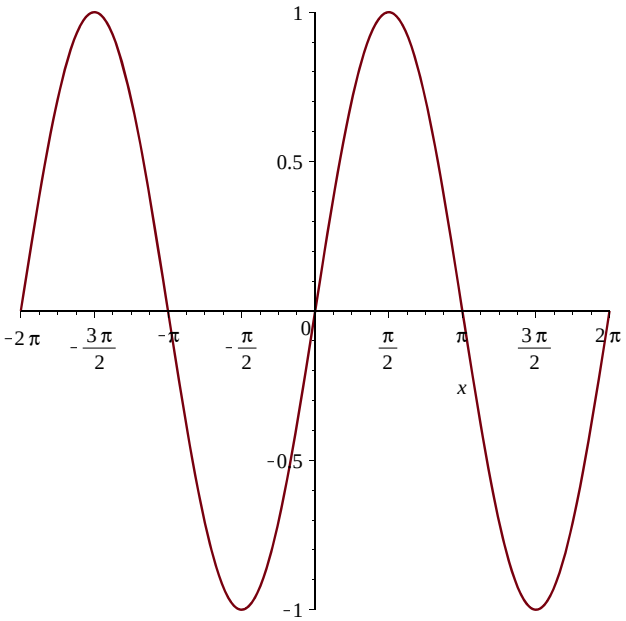

```
> plot({D(D(g))(x), g(x)}, x=-3..3);
```



Problem 2: Repeat problem 1 for f(x)=sin(x) focusing on x= -2Pi to 2Pi..

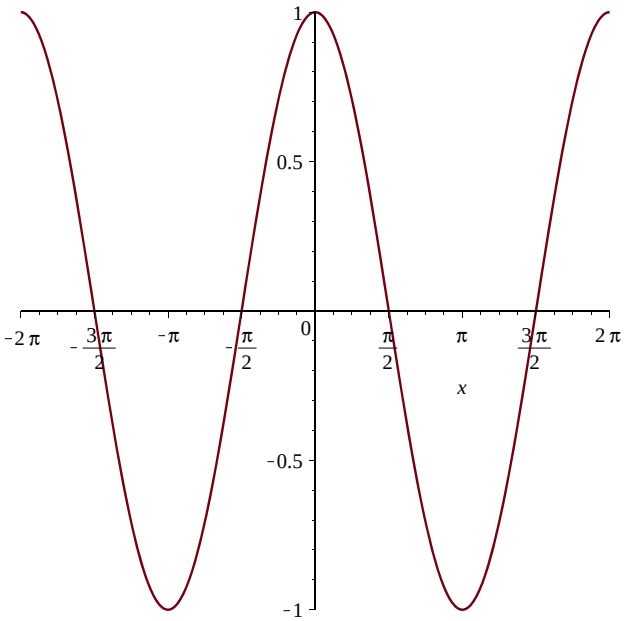
```
> f:=x->sin(x); plot(f(x),x=-2*Pi..2*Pi);
```

$$f := x \rightarrow \sin(x)$$




```
> D(f); plot(D(f)(x),x=-2*Pi..2*Pi); fsolve(D(f)(x)=0,x=-2*Pi..-Pi);
  fsolve(D(f)(x)=0,x=-Pi..0); fsolve(D(f)(x)=0,x=0..Pi); fsolve(D
  (f)(x)=0,x=Pi..2*Pi);
```

cos



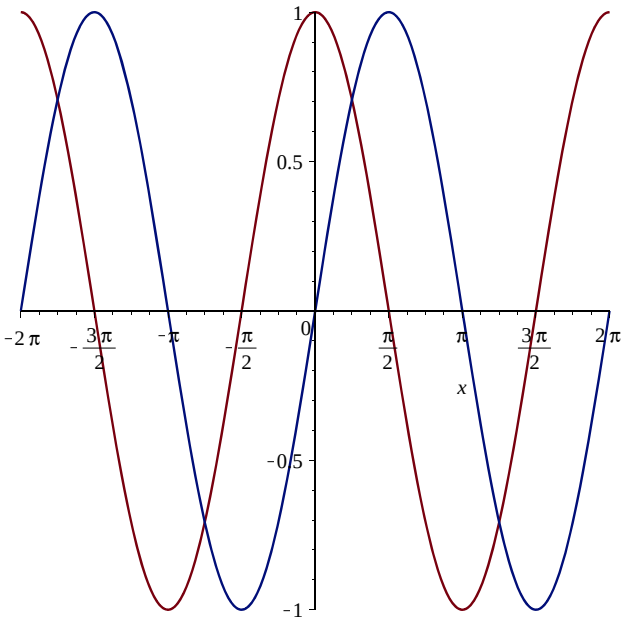
-4.712388980

-1.570796327

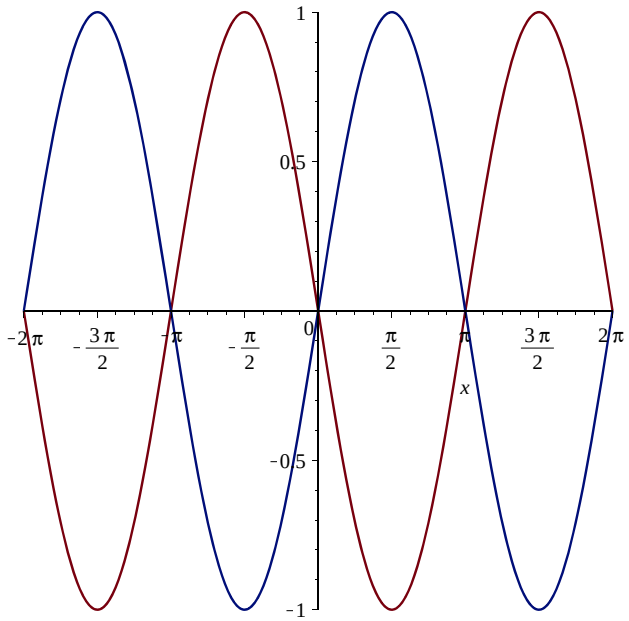
1.570796327

4.712388980 **(2)**

```
> plot({D(f)(x), f(x)}, x=-2*Pi..2*Pi);
```



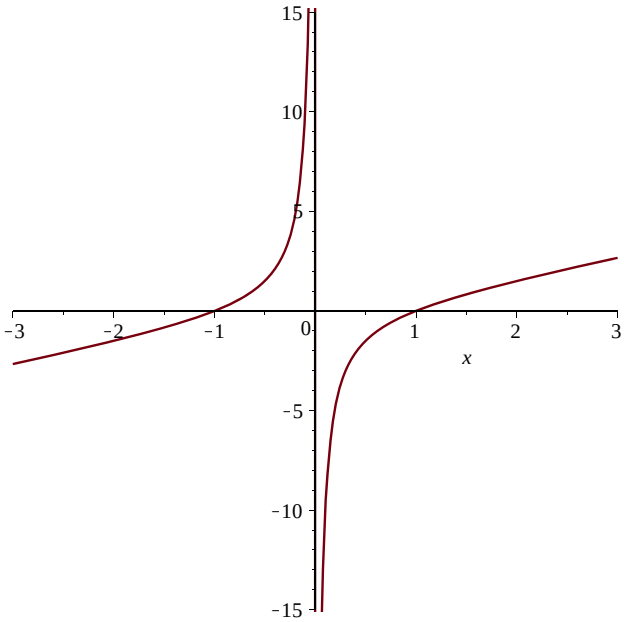

```
> plot({D(D(f))(x), f(x)}, x=-2*Pi..2*Pi);
```



Problem 3: Repeat problem 1 for f(x)=(x^2-1)/x focusing on x= -3 .. 3.

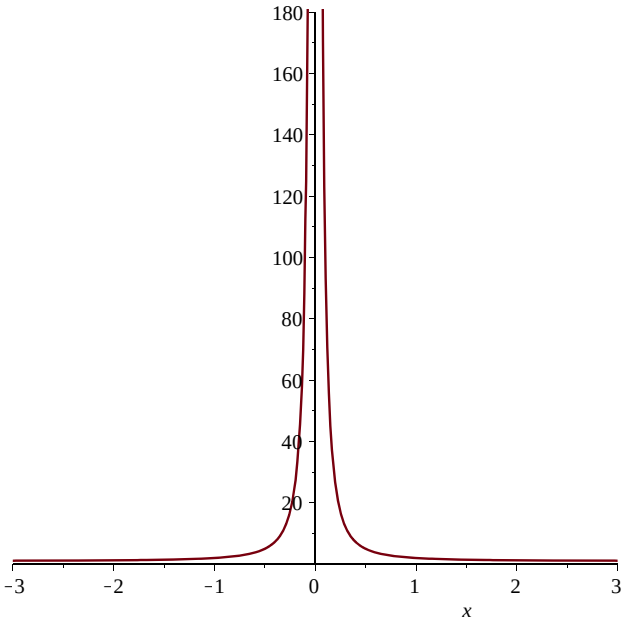
```
> f:=x->(x^2-1)/x; plot(f(x),x=-3..3);
```

$$f := x \rightarrow \frac{x^2 - 1}{x}$$

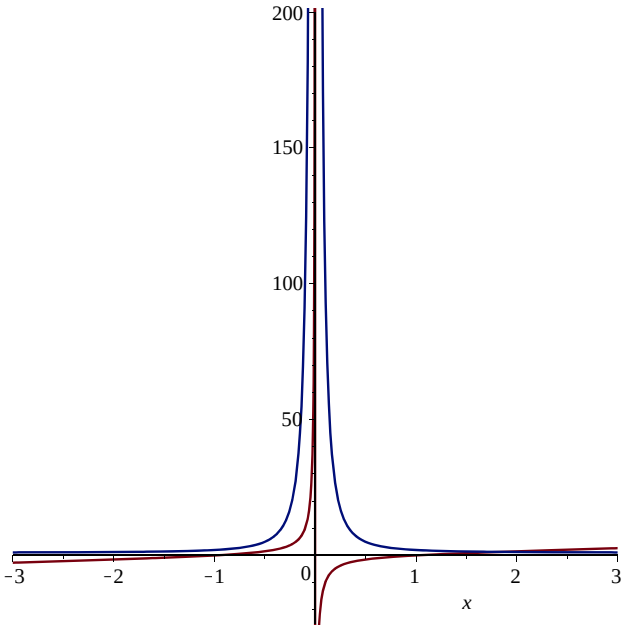



```
> D(f); plot(D(f)(x),x=-3..3);
```

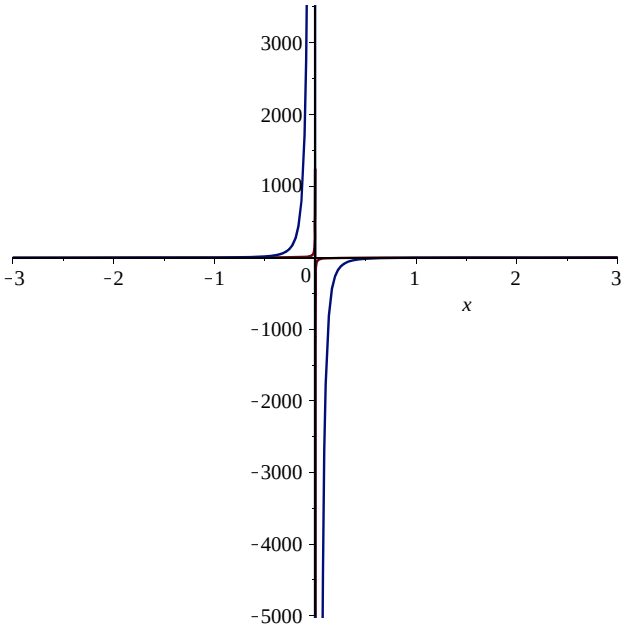
$$x \to 2 - \frac{x^2 - 1}{x^2}$$




```
> plot({D(f)(x), f(x)}, x=-3..3);
```




```
> plot({D(D(f))(x), f(x)}, x=-3..3);
```



Exploration: Try some other functions.