Quiz #1 **Math 180** Name:

Problem 1 ((5pts)). *Given a function* $f(x) = x^2 - 2x$.

1. *Find the average rate of change over the following intervals:* $(1.99, 2)$, $(1.999, 2)$, $(1.9999, 2)$, $(2, 2.01)$, $(2, 2.001)$, $(2, 2.0001)$;
2. *Estimate the instantaneous ROC of* $f(x)$ *at* $x = 2$;
3. [1] *Find the tangent line of* $f(x)$ *at* $x = 2$.

Solution. *1.*

$Interval$	$(1.99, 2)$	$(1.999, 2)$	$(1.9999, 2)$	$(2, 2.01)$	$(2, 2.001)$	$(2, 2.0001)$
$\frac{f(x_1) - f(x_0)}{x_1 - x_0}$	1.99	1.999	1.9999	2.01	2.001	2.0001

2. The instantaneous ROC is 2.
3. Since the slope of tangent line equals the instantaneous ROC, i.e. 2, the defining equation of the tangent line is given by y-f(2)=2(x-2), equivalently, y=2x-4.

Problem 2 ((5pts) (Show your work completely)). *Estimate the limit numerically or state that the limit does not exist .*

1. $\lim_{x\to 0} \frac{x}{\ln(1+x)}$;
2. $\lim_{x\to 0} \sin(\frac{1}{x})$.

Solution. *1.*

x	0.001	0.0005	0.0001	-0.001	-0.0005	-0.0001
$f(x)$	1.000499917	1.000249979	1.000049999	0.9989996662	0.9997499791	0.999949999

Therefore $\lim_{x\to 0} \frac{x}{\ln(1+x)} = 1$.
2. The limit does not exist because the graph of the function $\sin(\frac{1}{x})$ *oscillates when* x *approaches 0.* *See the graph showing on next page.*

[1] Do it for your own credit. To find the tangent line is a kind of typical problem which you will see later. In fact, as you will see, the instantaneous ROC of a function at a point x is the same as the first derivative at x. They are both equal to the slope of the tangent line of the function at x.

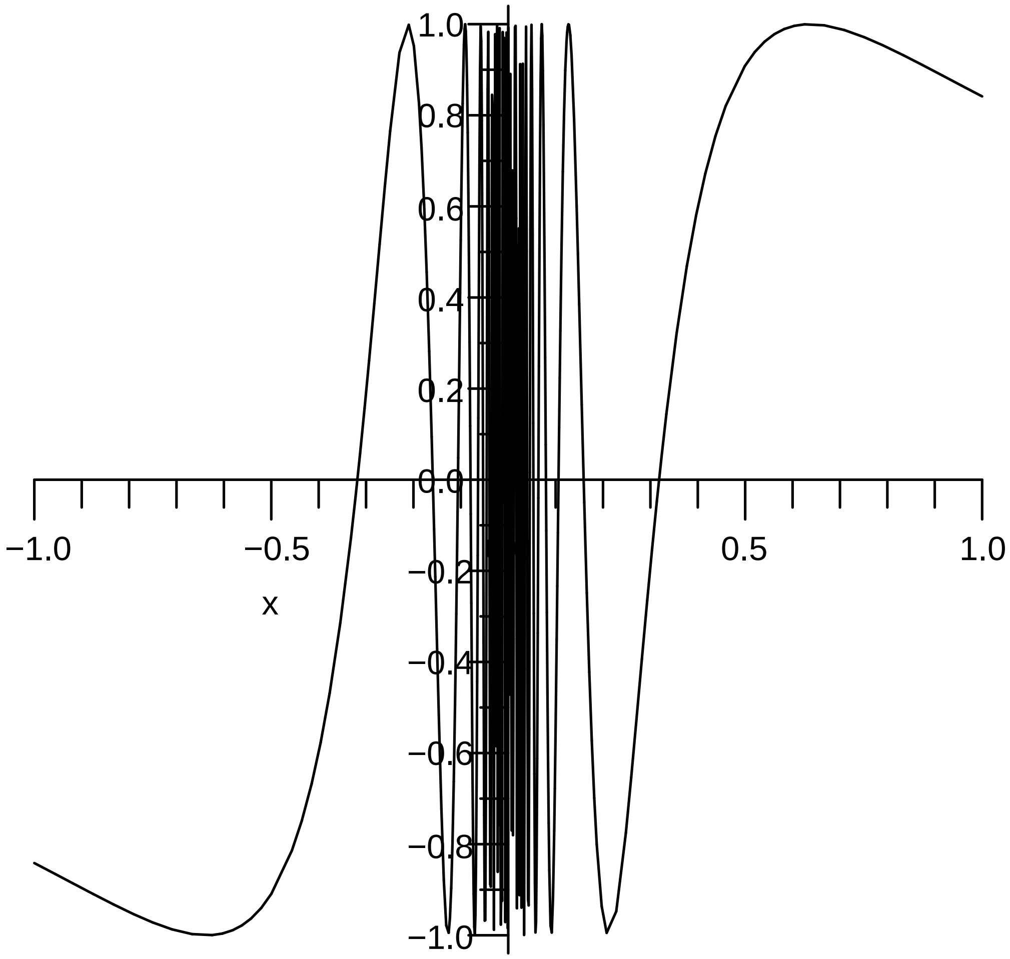

Figure 1: Graph of $\sin \frac{1}{x}$