[20] 1. Compute the following limits. If the limit does not exist, explain why. Do not use L'Hopital's rule.

a) $\lim_{x\to\infty} \dfrac{3+4x^2}{6-x-x^2}$

b) $\lim_{x\to 2} \dfrac{x^2+2x-8}{x^2-8x+12}$

c) $\lim_{x\to 0} \dfrac{2x}{\tan 3x}$

d) $\lim_{x\to -1} \dfrac{x+2}{(x+1)^2}$

[10] 2. Suppose $f(x) = \dfrac{1}{x^2+2}$. Find $f'(x)$ from the DEFINITION of the derivative.

[36] 3. Find $f'(x)$ for the following functions. You need not simplify your answers.

a) $f(x) = 2\tan 3x - 4e^{2x}$

b) $f(x) = \sin^2 x + \sin x^2$

c) $f(x) = \dfrac{x^2 + 3x}{4 + \cos 2x}$

d) $f(x) = (1 + \sin x)^{2x}$

e) $f(x) = \displaystyle\int_3^{x^2} \frac{dt}{1 + t^3}$

f) $f(x) = x^2 \ln(1 + \sec 3x)$

[8] 4. Find dy/dx by implicit differentiation if $ye^x - xe^y = x^2$.

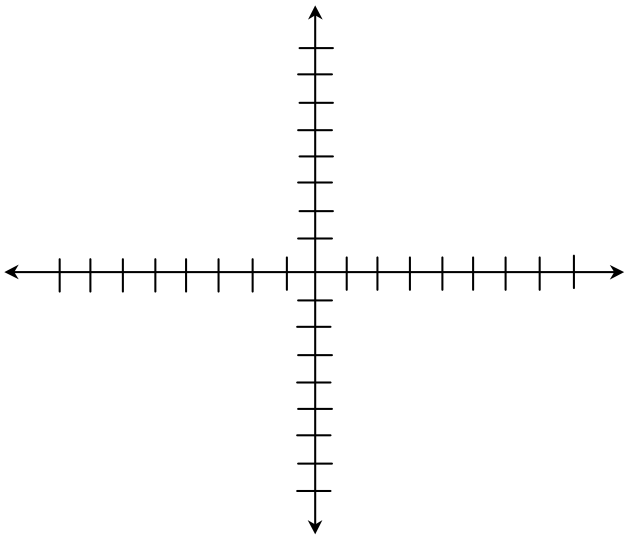
[10] 5. Find an equation of *the* tangent line to $f(x) = x \ln x$ at $x = 2$.

[8] 6. Find the absolute maximum and absolute minimum of $f(x) = \dfrac{x^2 - 4}{x^2 + 4}$ on $[-4, 4]$.

[10] 7. If a snowball melts so that its surface area decreases at a rate of 1 cm^2/min, find the rate at which the diameter decreases when the diameter is 10 cm.

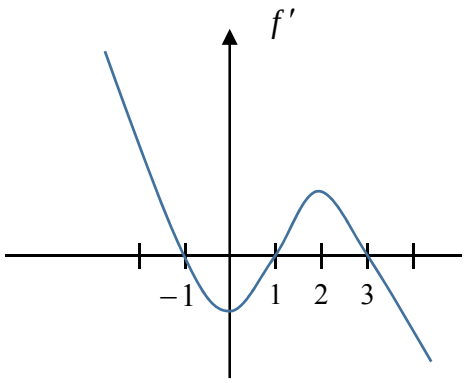
[8] 8. Graph the function which satisfies the following conditions.

$\lim_{x\to\infty} f(x) = 0,$	$\lim_{x\to-\infty} f(x) = 0,$	$\lim_{x\to 0^-} f(x) = \infty$	$\lim_{x\to 0^+} f(x) = -\infty$
$f' > 0$ on	$(-2,0)\cup(0,\infty);$	$f' < 0$ on	$(-\infty,-2)$
$f'' > 0$ on	$(-4,0);$	$f'' < 0$ on	$(-\infty,-4)\cup(0,\infty)$



[10] 9. A box with a square base and open top must have a volume of 32,000 cm^3. Find the dimensions of the box that minimizes the amount of material used.

[10] 10. Suppose that the DERIVATIVE f' of a function f has the graph



This graph is not the graph of the function. It is the graph of the derivative of f.

a) Find the intervals where f is increasing/decreasing.

b) Find the intervals where f is concave up/down.

[30] 11. Evaluate the following indefinite integrals.

a) $\int (x+2)(x+3)dx$

b) $\int (\tan x - 3\csc^2 x)dx$

c) $\int \frac{dx}{x \ln x}$

d) $\int xe^{-x^2}\, dx$

e) $\displaystyle\int \frac{x+\sqrt{x}}{x^3}\,dx$

[18] 12. Find the following definite integrals.

a) $\displaystyle\int_0^3 x\sqrt{x+1}\,dx$

b) $\displaystyle\int_0^{\pi/8} (\sin 4x + 3\cos 2x)dx$

[20] 13. Let R be the region bounded by $y = e^x$ and $y = 1$ and $x = 2$. Find the following.

a) Area of R.

b) Volume of the solid obtained by rotating R about the line $y-$axis. SETUP ONLY.

c) Volume of the solid obtained by rotating R about the line $y = -1$. SETUP ONLY.