1. (5 pts) For a differentiable function, $f(x)$ at $x = a$, state the limit definition of $f'(a)$.

2. (5 pts) Evaluate and simplify $\cosh(\ln(10))$.

3. (10 pts) Consider the function $f(x) = 10 - 3e^{-0.5x}$

   (a) Determine the inverse function $f^{-1}(x)$.

   (b) Determine $(f^{-1})'(7)$. (Note that $f(0) = 7$.)

4. (5 pts each) Differentiate the following functions. You do not need to simplify your answer.

(a) $f(x) = \sqrt{3x + 2e^{-2x}}$

(b) $y = \dfrac{4 + \sin(3x)}{x\cos(x)}$

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

(d) $y = \dfrac{10}{(8x + 6e^{-0.5x})^2}$

(e) $y = (3x+1)^2 \cos(3x)$

(f) $f(x) = 4\arctan(2x) - 3\arcsin(3x)$

(g) $y = (2+\sin(x))^x$

(h) $f(x) = \int_4^{2x^3} e^u \tan(u)\, du$

5. (15 pts) Determine the limit (show all work)

(a) $\lim_{x\to\infty} (\ln(2x+1) - \ln(x+3))$

(b) $\lim_{x\to 0^+} x^{x/2}$

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

6. (10 pts) Oil is dripping from a tank forming a circular puddle whose circumference is changing at a rate of 6 inches per second. Determine the rate at which the area of the circle is changing when the radius is 40 inches.

7. (10 pts) Determine the range (interval from the minimum value to the maximum value) on $0 \leq x \leq \pi$ of the function $f(x) = \cos(x) + \cos^2(x)$.

8. (20 pts) Answer the following for the function $f(x) = \dfrac{x-1}{x^2}$ $\left(= \dfrac{1}{x} - \dfrac{1}{x^2}\right)$

(a) (5 pts) State any vertical asymptotes. List the critical values of $f(x)$ and state whether there is a local maximum, local minimum, inflection point, or the derivative does not exist.

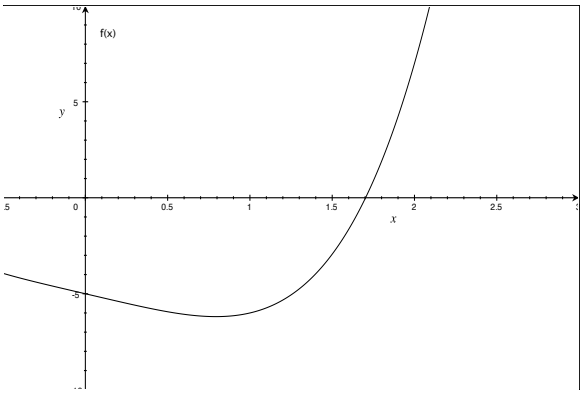
(b) (5 pts) Determine the $x$ value of any points of inflection.

(c) (5 pts) $\lim_{x \to -\infty} f(x) =$_____ $\lim_{x \to \infty} f(x) =$_____

(d) (5pts) Graph the function. Show asymptote(s), intercept(s) and the exact points $(x,\ y)$ where the function has any local maximum or local minimum values. Also be specific as to where there is any change in concavity.

9. (15 pts) A rectangle is to be inscribed in a right triangle having length of sides 6 and 8 and hypotenuse 10. Determine the dimensions of the rectangle (length and width) having the largest area. (It would help to put this on an $xy$-coordinate system with the right angle at the origin.)

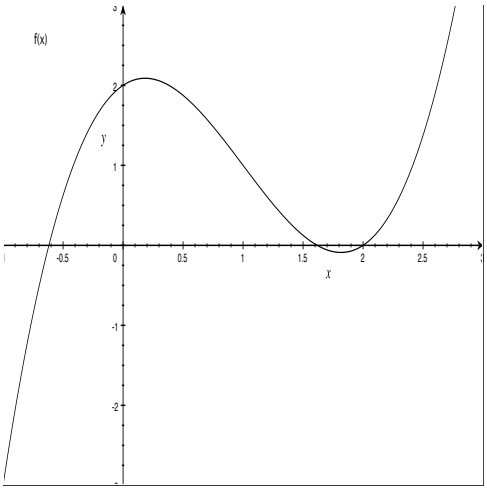
10. (10 pts) Use Newton's Method once to approximate the first postitive root of the function $f(x) = x^4 - 2x - 5$

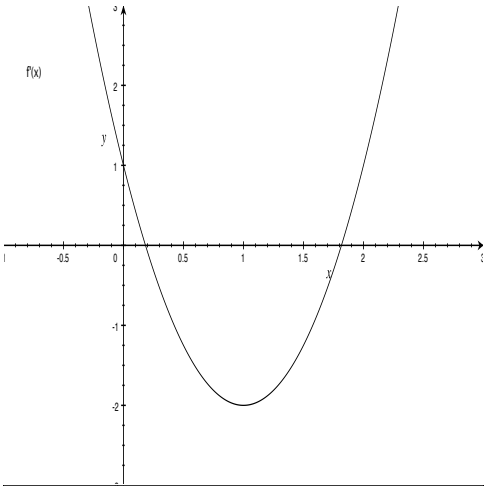



11. (10 pts) At the point $(3, 2)$, determine the equation of the tangent line to the curve

$$6\sqrt{x + 3y} + x^2\, y - y^2 = 32.$$

12. (10 pts) Below is the plot of $f(x)$ on the left and $f'(x)$ on the right.




(a) Determine $\int_0^2 f'(x)\,dx$.

(b) Determine the equation of the tangent line to the curve $f(x)$ at $x = 1$.

13. (10 pts) A particle moves along a line with velocity function $v(t) = 6t^2 - 6t$, where $v$ is measured in meters per second.

(a) Find the displacement of the particle during the time interval $[0, 5]$.

(b) Find the distance traveled by the particle during the time interval $[0, 5]$.

14. (30 pts)Evaluate the following integrals.

(a) $\int_0^{1/2} \left( \frac{4}{\sqrt{1-x^2}} + \sqrt{8+2x} \right) dx$ (give a numerical evaluation))

(b) $\int 2x^3 \ln(x)\, dx$

(c) $\int \frac{3x}{e^{2x}}\, dx$

(d) $\int 4\sin^3(3x)\,dx$

(e) $\int \dfrac{3x}{(1+x^2)^4}\,dx$

(f) $\displaystyle\int_{-5}^{4} |x+3|\,dx$