Read each problem carefully. Please show all your work for each problem! Use only those methods discussed thus far in class. Always simplify when possible. No calculators!

1. (8 points) Use the definition of derivative to calculate $f'(x)$, if $f(x) = x^2 - x + 4$.

2. (9 points) Differentiate the following functions:

$$(a)\ f(x) = \frac{3x+2}{5+x}, \qquad (b)\ g(y) = y^{2/3}(7-y)^{1/3}, \qquad (c)\ h(z) = \tan^2(2z+3).$$

3. (9 points) Compute the following limits:

$$(a)\ \lim_{x\to 2} \frac{1}{\sqrt{1-2x+3x^2}}, \qquad (b)\ \lim_{x\to 1^-} \frac{|x-1|}{x^2-1}, \qquad (c)\ \lim_{x\to 0} \frac{\sqrt{1+x}-1}{x}.$$

4. (10 points)

   (a) Find an equation of a tangent line to the curve $y = x\cos x$ at the point $(-\pi, \pi)$.

   (b) Find an approximate solution of the equation $x^3 - x^2 - 1 = 0$ by performing two iterations of the Newton's method, starting with $x_0 = 1$.

5. (8 points) Find the point on the line $y = 4x - 7$ that is closest to the origin.

6. (8 points) Find the particle's position, $x(t)$, if it moves with acceleration $a(t) = -3 + 2t$ and has initial position and velocity $x(0) = 1$ and $v(0) = 2$, respectively. At what times is the particle moving left and right, respectively?

7. (9 points) Integrate:

$$(a)\ \int \frac{(x+1)^2}{x^4}\,dx, \qquad (b)\ \int 3t(2+t^2)^{3/2}dt, \qquad (c)\ \int_0^{\pi/3} \sin x\,\cos^2 x\,dx$$

8. (8 points) Find the area between the curves $y = 1 + \sqrt{x}$ and $y = \frac{3+x}{3}$.

9. (8 points) Find the volume of the solid generated by rotating the plane region bounded by the curves $y = x^{2/3}$, $x = 1$, $y = 0$, around the y-axis.

10. (8 points) Calculate the trapezoidal approximation T_3 (i.e. with $n = 3$) to the integral

$$\int_{\frac{1}{2}}^{2} \frac{1}{x^2}\,dx.$$

    Compare it with the exact value of the integral.

11. (15 points) For the function

$$f(x) = \frac{x+2}{\sqrt{x^2+2}},$$

    find the following, if they exist: (i) all local extrema, (ii) intervals where the function increases or decreases, (iii) all points of inflection, (iv) intervals of upward or downward concavity, (v) all asymptotes. Also, sketch a plot of the curve $y = f(x)$.