1. Evaluate
$$\lim_{t\to 0} \frac{1}{t}\left(\tan^{-1}\left(\frac{1}{x+t}\right) - \tan^{-1}\left(\frac{1}{x}\right)\right)$$

2. Find the minimum value of $e^x - x - \frac{x^3}{3}$.

3. Given $\displaystyle\int_{-\infty}^{\infty} e^{tx} f(x)\,dx = \sin^{-1}\left(t - \sqrt{1/2}\right)$, find $\displaystyle\int_{-\infty}^{\infty} xf(x)\,dx$.

4. Find the values of x that maximize $f(x) = \left|\dfrac{3x+1}{9x^2+6x+2}\right|$.

5. A rectangular pyramid tower is being built on a circular island of radius two. The height of the tower is equal to its width. What is the maximum volume of the tower?

6. Evaluate
$$\sum_{k=0}^{\infty} ke^{-13}\frac{13^k}{k!}.$$

7. Calculate $\dfrac{d}{dt}\left[\displaystyle\int_{-\ln 1/t}^{\ln 1/t} \cos(te^x)dx\right]$.

8. Evaluate
$$\frac{1}{1} + \frac{1}{2} - \frac{2}{3} + \frac{1}{4} + \frac{1}{5} - \frac{2}{6} + \frac{1}{7} + \frac{1}{8} - \frac{2}{9} + \cdots$$

9. Find the value of k which minimizes
$$F(k) = \int_0^4 |x(4-x) - k|\,dx.$$

10. Let $f(x) = x^6 - 6x^2 + 6x - 7$. It is known that this polynomial has three critical points. Find the parabola passing through these critical points.