Answer the problems on separate paper. You do <u>not</u> need to rewrite the problem statements on your answer sheets. Do your own work. Show all relevant steps which lead to your solutions. Retain this question sheet for your records.

1. Find the derivative of y with respect to x, t or r as appropriate. Simplify where appropriate.

a. $y = (9x^2 - 6x + 2)\, e^{3x}$

b. $y = \dfrac{\ln r}{1 + \ln r}$

c. $y = (t^2 + 1)^t$

2. Evaluate the following integrals.

a. $\displaystyle\int \dfrac{e^{\frac{1}{x}}}{x^2}\, dx$

b. $\displaystyle\int_2^{11} \dfrac{dx}{2x + 5}$

c. $\displaystyle\int \dfrac{4}{x \ln x}\, dx$

3. Find each of the following limits, if the limits exist. If, in calculating the limit, you apply l'Hôpital's Rule, identify the form of the indeterminancy.

a. $\displaystyle\lim_{x \to 0} \dfrac{3^x - 1}{2^x - 1}$

b. $\displaystyle\lim_{x \to \infty} \dfrac{\ln(x^2 + 2x)}{\ln x}$

c. $\displaystyle\lim_{\theta \to \frac{\pi}{2}} \dfrac{1 - \sin\theta}{1 - \cos 2\theta}$

d. $\displaystyle\lim_{x \to 0^+} x\,(\ln x)^2$

4. Consider $f(x) = \ln(\ln(x^2 + 1))$ and $g(x) = \ln(2x + 1)$. As $x \to \infty$ does f grow faster than g, at the same rate as g or slower than g?

5. Dawson County was first settled in 1870. State law stipulated that the county could not be formally organized until the county population reach 3,000. The 1890 census estimated the population of Dawson County at 2,000 and the 1910 census estimated the population of Dawson County at 4,000. Assuming that over the time period 1880 to 1920 that the population of Dawson County could be reasonably modeled by an exponential growth model, when did Dawson County met the state requirements for county organization?

6. Evaluate each of the following (not using a calculator).

a. $\sin\left(\tan^{-1}\left(-\dfrac{1}{\sqrt{3}}\right)\right)$

b. $\cos\left(\tan^{-1}\left(\dfrac{y-1}{y+1}\right)\right)$

c. $\cos\left(\sin^{-1}\left(\dfrac{3}{5}\right) + \cos^{-1}\left(\dfrac{5}{13}\right)\right)$