

- This is a closed-book examination. No books, notes, calculators, cell phones, communication devices of any sort, or other aids are permitted.
- Numerical answers such as $\sin\left(\frac{\pi}{6}\right)$, $4^{\frac{3}{2}}$, $\frac{3}{\sqrt{3}}$, $\arctan(\sqrt{3})$, $e^{\ln 4}$, $\ln(e^7)$, or $e^{3 \ln 3}$ should be simplified.
- Please *show* all of your work and *justify* all of your answers. (You may use the backs of pages for additional work space.)

1. Limits [30 Points total, 10 Points each] Evaluate each of the following. Please justify/simplify.

(a) Show that $\lim_{x \rightarrow 0} \frac{\cos(3x) - \arctan(2x) + 2x - 1}{e^{-4x} - 1 + 4x} = \boxed{-\frac{9}{16}}$

(b) Show that $\lim_{x \rightarrow 0^+} \sqrt{x} \cdot \ln x = \boxed{0}$

(c) Show that $\lim_{x \rightarrow \infty} \left(1 - \arcsin\left(\frac{2}{x^6}\right)\right)^{x^6} = \boxed{e^{-2}}$

Integrals [34 Points total] Compute each of the following Definite Integrals. Please justify/simplify.

2. Show that $\int_{-2}^2 \sqrt{4 - x^2} \, dx = \boxed{2\pi}$

3. Show that $\int_0^{\ln \sqrt{3}} \frac{e^x}{\sqrt{4 - e^{2x}}} \, dx = \boxed{\frac{\pi}{6}}$

4. Show that $\int_e^{e^3} \frac{1}{x[3 + (\ln x)^2]} \, dx = \boxed{\frac{\pi}{6\sqrt{3}}}$

More Integrals [36 Points total] Compute the following Indefinite Integrals. Please justify/simplify.

5. Compute $\int x \arcsin x \, dx$

6. Compute $\int \frac{1}{(9 + x^2)^{\frac{7}{2}}} \, dx$ Hint: $3^6 = 729$

7. Compute $\int \ln(x^2 + 9) \, dx$