

## MATH1220: Midterm 2 Practice Problems

The following are practice problems for the second exam.

1. Evaluate the following integrals:

$$(a) \int x e^{3x} dx = \frac{e^{3x}}{3} \left( x - \frac{1}{3} \right) + C$$

$$(b) \int x^2 \cos x dx = (x^2 - 2) \sin x + 2x \cos x + C$$

$$(c) \int \cos^3 x dx = \sin x - \frac{1}{3} \sin^3 x + C$$

$$(d) \int \tan^4(2x) dx = \frac{1}{6} \tan^3(2x) - \frac{1}{2} \tan(2x) + x + C$$

$$(e) \int \sin(3x) \sin(9x) dx = \frac{-1}{24} (\sin(12x) + 2 \sin(-6x)) + C$$

$$(f) \int \frac{x^2 dx}{\sqrt{16 - x^2}} = 8 \sin^{-1}(x/4) - 4 \sin(2 \sin^{-1}(x/4)) + C = 8 \sin^{-1}(x/4) - \frac{1}{2} x \sqrt{16 - x^2} + C$$

$$(g) \int \frac{dx}{\sqrt{x^2 + 4x + 5}} = \ln |\sqrt{x^2 + 4x + 5} + x + 2| + C = \sinh^{-1}(x + 2) + C$$

$$(h) \int \frac{x}{4x - x^2} dx = \ln |4 - x| + C$$

$$(i) \int \frac{5x}{2x^3 + 6x^2} dx = \frac{5}{6} (\ln |x| - \ln |2x + 6|) + C$$

$$(j) \int \frac{x^3 + x^2}{x^2 + 5x + 6} = \frac{x^2}{2} - 4x - 4 \ln |x + 2| + 18 \ln |x + 3| + C$$

$$(k) \int \frac{3x + 13}{x^2 + 4x + 3} dx = 5 \ln |x + 1| - 2 \ln |x + 3| + C$$

2. Compute the following limits:

$$(a) \lim_{x \rightarrow 1} \frac{x^2 - 2x + 1}{\sin(\pi x)} = 0$$

$$(b) \lim_{x \rightarrow 0} \frac{e^x - e^{-x}}{2 \sin x} = 1$$

3. Find an algebraic expression for  $\tan(\sin^{-1}(x/3))$ . **Answer:**  $\frac{x}{\sqrt{9 - x^2}}$