Name: ______________________ **Instructor (circle):** **Maxwell** **Jurkowski** **Sus**

- There are 12 points possible on this proficiency: one point per problem with no partial credit.
- You have 60 minutes to complete this proficiency.
- No aids (book, calculator, etc.) are permitted.
- You do **not** need to simplify your expressions.
- For at least one problem you must indicate correct use of a constant of integration.
- Circle your final answer.

1. [12 points] Compute the following definite/indefinite integrals.

a. $\int (\sec(x)\tan(x) - 3)\ dx$

$$\boxed{\sec(x) - 3x + C}$$

b. $\int \frac{x^2+\sqrt{x}+2}{\sqrt{x}}\ dx$

$$\int x^{3/2} + 1 + 2x^{-1/2}\, dx = \boxed{\frac{2}{5}x^{5/2} + x + 4x^{1/2} + C}$$

c. $\int_1^2 (x^3+e^3)\ dx$

$$\left.\frac{x^4}{4} - e^3x\right|_1^2 = \left(\frac{2^4}{4} - e^3\cdot 2\right) - \left(\frac{1}{4} - e^3\right)$$

$$= 4 - \frac{1}{4} - e^3$$

$$= \boxed{15/4 - e^3}$$

d. $\int \sec^2(\pi x)\,dx$

$u = \pi x$

$du = \pi\,dx \Rightarrow \frac{1}{\pi}\,du = dx$

$$\int \sec^2(u)\,\frac{1}{\pi}\,du = \frac{1}{\pi}\tan(u)$$

$$\boxed{\frac{1}{\pi}\tan(\pi x) + C}$$

e. $\int \frac{\sin(1+\ln x)}{x}\,dx$

$u = 1 + \ln(x)$

$du = \frac{1}{x}\,dx$

$$\int \sin(u)\,du = -\cos(u)$$

$$\boxed{-\cos(1 + \ln(x)) + C}$$

f. $\int (x^2+1)(x-3)\,dx$

$$\int x^3 - 3x^2 + x - 3\,dx$$

$$= \boxed{\frac{x^4}{4} - x^3 + \frac{x^2}{2} - 3x + C}$$

g. $\displaystyle\int \frac{3}{\sqrt{1-x^2}} + e^x\, dx$

$$\boxed{3\arcsin(x) + e^x + C}$$

h. $\displaystyle\int x\sqrt{2+x}\, dx$

$u = 2+x$
$du = dx$

$$\int (u-2)\sqrt{u}\, du = \int u^{3/2} - 2u^{1/2}\, du$$

$$= \frac{2}{5}u^{5/2} - \frac{4}{3}u^{3/2}$$

$$\boxed{\frac{2}{5}(2+x)^{5/2} - \frac{4}{3}(2+x)^{3/2} + C}$$

i. $\displaystyle\int \frac{\cos(x)}{\sin^2(x)}\, dx$

$u = \sin(x)$
$du = \cos(x)dx$

$$\int u^{-2} du = -u^{-1} = -\frac{1}{u}$$

$$\boxed{-\frac{1}{\sin(x)} + C}$$

j. $\int \frac{\cos(1/x)}{x^2}\,dx$

$u = 1/x$

$du = -1/x^2\, dx$

$\int \cos(u)\cdot(-1)\,du = -\sin(u)$

$\boxed{-\sin(1/x) + C}$

k. $\int \frac{x^2}{4x^3+6}\,dx$

$u = 4x^3+6$

$du = 12x^2\, dx$

$\int \frac{1}{u}\cdot\frac{1}{12}\,du = \frac{1}{12}\ln(|u|)$

$\boxed{\frac{1}{12}\ln(|4x^3+6|) + C}$

l. $\int \sin(x)e^{(2\cos(x))}\,dx$

$u = 2\cos(x)$

$du = -2\sin(x)\,dx$

$\int e^u\left(\frac{-1}{2}\right)du = -\frac{1}{2}e^u$

$\boxed{-\frac{1}{2}e^{2\cos(x)} + C}$