Name: ________________________ ________ / 12

Instructor: **Bueler** | **Jurkowski** | **Maxwell**

- There are 12 points possible on this proficiency: one point per problem with no partial credit.
- You have 30 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. $\int 9\cos(x) - \sqrt{x} + e^9 \; dx$

$$\boxed{9\sin(x) - \frac{2}{3}x^{3/2} + e^9 x + C}$$

b. $\int_0^2 t^2(1-t) \; dt$

$$\int_0^2 t^2 - t^3 dt = \frac{t^3}{3} - \frac{t^4}{4} \Big|_0^2 = \left(\frac{8}{3} - \frac{16}{4}\right) - \left(\frac{0}{3} - \frac{0}{4}\right)$$

$$= \frac{8-12}{3} = \boxed{-\frac{4}{3}}$$

c. $\int \sec^2(9x) \, dx$

$u = 9x$

$du = 9dx$

$$\int \sec^2(u) \frac{1}{9} du = \frac{1}{9}\tan(u) + C$$

$$= \boxed{\frac{1}{9}\tan(9x) + C}$$

d. $\displaystyle\int \frac{x^2}{\sqrt{x^3-7}}\,dx$

$u = x^3 - 7$

$du = 3x^2 dx$

$\frac{1}{3} du = x^2 dx$

$$\int \frac{1}{\sqrt{u}} \frac{1}{3} du = \frac{1}{3} \int u^{-1/2} du$$

$$= \frac{2}{3} u^{1/2} + C$$

$$= \boxed{\frac{2}{3}(x^3-7)^{1/2} + C}$$

e. $\displaystyle\int \frac{\cos(x)}{\sin(x)}\,dx$

$u = \sin(x)$

$du = \cos(x) dx$

$$\int \frac{du}{u} = \ln(|u|) + C$$

$$= \boxed{\ln(|\sin(x)|) + C}$$

f. $\displaystyle\int w\sqrt{3+w}\,dw$

$u = 3 + w$

$du = dw$

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

$$= \frac{2}{5} u^{5/2} - 3 \cdot \frac{2}{3} u^{3/2} + C$$

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

g. $\int e^t - t^3 \sin(t^4)\, dt$

$$\int e^t dt = e^t + C$$

$$\int t^3 \sin(t^4)\, dt = \frac{1}{4}\int \sin(u)\, du = -\frac{\cos(u)}{4} + C$$

$u = t^4$

$du = 4t^3$

$$= -\frac{\cos(t^4)}{4} + C$$

$$\int e^t - t^3 \sin(t^4)\, dt = \boxed{e^t + \frac{\cos(t^4)}{4} + C}$$

h. $\int \frac{8}{\sqrt{1-x^2}}\, dx$

$$\boxed{8 \arcsin(x) + C}$$

i. $\int \frac{(2+\ln(x))^2}{x}\, dx$

$u = 2 + \ln(x)$

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

$$\int u^2 du = \frac{u^3}{3} + C = \boxed{\frac{(2+\ln(x))^3}{3} + C}$$

j. $\displaystyle\int \frac{x^2-9}{x}\,dx$

$$\int x - \frac{9}{x} = \boxed{\frac{x^2}{2} - 9\ln(|x|) + C}$$

k. $\displaystyle\int \sec^2(x)\tan^5(x)\,dx$

$u = \tan(x)$

$du = \sec^2(x)dx$

$$\int u^5\,dx = \frac{u^6}{6} + C = \boxed{\frac{\tan^6(x)}{6} + C}$$

l. $\displaystyle\int e^{\pi x}\,dx$

$u = \pi x$

$du = \pi dx$

$$\int e^u \frac{1}{\pi}\,du = \frac{1}{\pi}e^u + C$$

$$= \boxed{\frac{1}{\pi}e^{\pi x} + C}$$