Name: Solutions ______ / 12

- There are 12 points possible on this proficiency: **One point per problem. No partial credit.**
- A passing score is 10/12.
- You have 60 minutes to complete this proficiency.
- No aids (book, calculator, etc.) are permitted.
- You do **not** need to simplify your expressions.
- Be sure to include constants of integration when appropriate.
- Circle your final answer.

Compute the following integrals.

1. $\int_1^2 \frac{x^3-1}{x^2}\,dx$

$$\int_1^2 \frac{x^3-1}{x^2}\,dx = \int_1^2 (x - x^{-2})\,dx$$

$$= \left(\frac{x^2}{2} + x^{-1}\right)\Big|_1^2 = 2 + \frac{1}{2} - \left(\frac{1}{2}+1\right) = \boxed{1}$$

2. $\int (\cos(x) - 1)\,dx$

$$\sin(x) - x + C$$

3. $\int \frac{4-2\ln x}{x}\,dx$

$$\int \frac{\ln(x)}{x}\,dx \qquad u = \ln(x) \qquad du = 1/x\,dx$$

$$\int u\,du = \frac{u^2}{2} = \frac{(\ln(x))^2}{2}$$

$$\boxed{4\ln(|x|) - (\ln(x))^2 + C}$$

4. $\int \tan^2 x \sec^2 x\, dx$

$u = \tan(x) \quad du = \sec^2(x)\,dx$

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

5. $\int x\sqrt{4-x}\,dx$

$u = 4-x \quad du = -dx$

$$-\int (4-u)\sqrt{u}\,du = \int u^{3/2} - 4u^{1/2}\,du$$

$$= \frac{2}{5}u^{5/2} - \frac{8}{3}u^{3/2} + C$$

$$= \boxed{\frac{2}{5}(4-x)^{5/2} - \frac{8}{3}(4-x)^{3/2} + C}$$

6. $\int \frac{1+x^2}{2} + \frac{2}{1+x^2}\,dx$

$$\boxed{\frac{x}{2} + \frac{x^3}{6} + 2\arctan(x) + C}$$

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

$u = \cos(x) \quad du = -\sin(x)\,dx$

$$\int -e^{u}\,du = -e^{u} = \boxed{-e^{\cos(x)} + C}$$

8. $\int (x+3)(x-2)\, dx$

$$\int x^2 + x - 6\,dx = \boxed{\frac{x^3}{3} + \frac{x^2}{2} - 6x + C}$$

9. $\int x\cos(2-7x^2)\, dx$

$u = 2-7x^2$

$du = -14x\,dx$

$$\int \frac{-1}{14}\cos(u)\,du = \frac{-1}{14}\sin(u)$$

$$= \boxed{\frac{-1}{14}\sin(2-7x^2) + C}$$

10. $\int \sqrt{x}(x^2+3x+2)\,dx$

$$\int x^{5/2} + 3x^{3/2} + 2x^{1/2}\,dx = \boxed{\frac{2}{7}x^{7/2} + \frac{6}{5}x^{5/2} + \frac{4}{3}x^{3/2} + C}$$

11. $\int \left(7e^x - \frac{1}{x^3}\right)dx$

$$\boxed{7e^x + \frac{x^{-2}}{2} + C}$$

12. $\int \frac{x^2}{x^3-2}\,dx$

$u = x^3 - 2$

$du = 3x^2 dx$

$$\int \frac{1}{3}\frac{1}{u}\,du = \frac{1}{3}\ln(|u|) = \boxed{\frac{1}{3}\ln(|x^3-2|) + C}$$