5.2-5.5 Logs/Exponential Integrals Review WS #1

$\int \frac{1}{u}\,du = \ln\lvert u\rvert + C$	**Power Rule**: $\int u^n\,du = \frac{u^{n+1}}{n+1} + C$	$\int e^u\,du = e^u + C$	$\frac{d}{dx}[\ln u] = \frac{u'}{u}$	$\frac{d}{dx}[e^u] = e^u u'$

Integrals Checklist Order: **1)**Expand/Power Rule **2)** U-Sub/Change of Variable **3)**Long Division/Synthetic Division

Possible u-value locations: **1)** exponent **2)** value inside parentheses **3)** denominator

Find the Indefinite Integral of functions below

1. $\int \frac{10}{3-2x}\,dx$

2. $\int \frac{5\sqrt{x} - 9x}{x^2}\,dx$

3. $\int \frac{3x^3-5x^2+10}{x^2-2}\,dx$

4. $\int \cos(2x) - \tan(3x)\,dx$

5. $\int \frac{(\ln x)^3}{5x}\,dx$

$\int \tan u \, du = -\ln|\cos u| + C$

$\int \cot u \, du = \ln|\sin u| + C$

$\int \sec u \, du = \ln|\sec u + \tan u| + C$

$\int \csc u \, du = -\ln|\csc u + \cot u| + C$

$\int \cos u \, du = \sin u + C$

$\frac{d}{dx}[\sin u] = (\cos u)u'$

$\int a^u \, du = \left(\frac{1}{\ln a}\right)a^u + C$

6. $\int (3-6x)e^{x-x^2}dx$

7. $\int \frac{e^{5x}}{7-2e^{5x}}dx$

8. $\int \frac{e^{4x}-5e^{2x}-6}{e^x}dx$

9. $\int 2e^{5x}\sec(e^{5x})dx$

10. $\int 4^{\sin(2x)}\cos(2x)\,dx$

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Key

$\int \frac{1}{u}du = \ln\lvert u\rvert + C$	**Power Rule**: $\int u^n\,du = \frac{u^{n+1}}{n+1} + C$	$\int e^u\,du = e^u + C$	$\frac{d}{dx}[\ln u] = \frac{u'}{u}$	$\frac{d}{dx}[e^u] = e^u u'$

Integrals Checklist Order: **1)**Expand/Power Rule **2)** U-Sub/Change of Variable **3)**Long Division/Synthetic Division

Possible u-value locations: **1)** exponent **2)** value inside parentheses **3)** denominator

Find the Indefinite Integral of functions below

1. $\int \frac{10}{3-2x}dx$

*u-sub

$u = 3-2x$

$\frac{du}{dx} = -2$

$dx(-2) = du$

$dx = \frac{du}{-2}$

$\int \frac{10}{u}\cdot\frac{du}{-2} = -\frac{10}{2}\int\frac{1}{u}du$

$-5\int\frac{1}{u}du = -5\ln|u| + C$

$\boxed{-5\ln|3-2x| + C}$

2. $\int \frac{5\sqrt{x} - 9x}{x^2}dx$

*Expand

$\int(5x^{1/2} - 9x)x^{-2}dx$

$\int 5x^{-3/2} - 9x^{-1}dx$

$\int 5x^{-3/2} - \frac{9}{x}dx$

$\frac{5x^{-1/2}}{-1/2} - 9\ln|x| + C$

$-2\cdot 5x^{-1/2} - 9\ln|x| + C$

$\boxed{-10x^{-1/2} - 9\ln|x| + C}$

$\boxed{\frac{-10}{\sqrt{x}} - 9\ln|x| + C}$

3. $\int \frac{3x^3 - 5x^2 + 10}{x^2-2}dx$

*Long Division:

$3x - 5 + \frac{6x}{x^2-2}$

$x^2-2\overline{)3x^3 - 5x^2 + 10}$

$\ominus 3x^3 \oplus 6x$

$-5x^2 + 6x + 10$

$\oplus 5x^2 \ominus 10$

$6x$

$\int 3x - 5 + \frac{6x}{x^2-2}dx$

$u = x^2-2$

$\frac{du}{dx} = 2x$

$2x\,dx = du$

$dx = \frac{du}{2x}$

$\int\frac{6x}{u}\cdot\frac{du}{2x}$

$\frac{6}{2}\int\frac{1}{u}du$

$\frac{3x^2}{2} - 5x + 3\ln|u| + C$

$\boxed{\frac{3}{2}x^2 - 5x + 3\ln|x^2-2| + C}$

4. $\int \cos(2x) - \tan(3x)dx$

$u = 2x$ $\quad$ $u = 3x$

$\int\cos u\,du - \int\tan u\,du$

$\frac{1}{2}\sin(2x) - \left(-\frac{1}{3}\ln|\cos u|\right) + C$

$\boxed{\frac{1}{2}\sin(2x) + \frac{1}{3}\ln|\cos(3x)| + C}$

5. $\int \frac{(\ln x)^3}{5x}dx$

$u = \ln x$

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

$dx = x\,du$

$\int\frac{u^3}{5\cancel{x}}\cdot\cancel{x}du$

$\frac{1}{5}\int u^3du$

$\frac{1}{5}\cdot\frac{u^4}{4} + C$

$\frac{1}{20}u^4 + C$

$\boxed{\frac{1}{20}(\ln x)^4 + C}$

$\int \tan u\, du = -\ln|\cos u| + C$

$\int \cot u\, du = \ln|\sin u| + C$

$\int \sec u\, du = \ln|\sec u + \tan u| + C$

$\int \csc u\, du = -\ln|\csc u + \cot u| + C$

$\int \cos u\, du = \sin u + C$

$\frac{d}{dx}[\sin u] = (\cos u)u'$

$\int a^u\, du = \left(\frac{1}{\ln a}\right)a^u + C$

6. $\int (3-6x)e^{x-x^2}\,dx$

$u = x - x^2$

$\frac{du}{dx} = 1 - 2x$

$(1-2x)dx = du$

$dx = \frac{du}{1-2x}$

$\int (3-6x)e^u \cdot \frac{du}{1-2x}$

$\int 3\cancel{(1-2x)} \cdot e^u \cdot \frac{du}{\cancel{(1-2x)}}$

$3\int e^u du = 3e^u + C$

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

7. $\int \frac{e^{5x}}{7-2e^{5x}}\,dx$

$u = 7 - 2e^{5x}$

$\frac{du}{dx} = -2e^{5x} \cdot 5$

$\frac{du}{dx} = -10e^{5x}$

$-10e^{5x}dx = du$

$dx = \frac{du}{-10e^{5x}}$

$\int \frac{\cancel{e^{5x}}}{u} \cdot \frac{du}{-10\cancel{e^{5x}}}$

$\frac{-1}{10}\int \frac{1}{u}du$

$\frac{-1}{10}\ln|u| + C$

$\boxed{\frac{-1}{10}\ln|7-2e^{5x}| + C}$

8. $\int \frac{e^{4x}-5e^{2x}-6}{e^x}\,dx$

$\int (e^{4x} - 5e^{2x} - 6)e^{-1x}\,dx$

$\int e^{3x} - 5e^{x} - 6e^{-x}\,dx$

$\int e^{3x}dx - \int 5e^{x}dx - 6\int e^{-x}dx$

$\frac{1}{3}e^{3x} - 5e^{x} - (-6e^{-x}) + C$

$\boxed{\frac{1}{3}e^{3x} - 5e^{x} + 6e^{-x} + C}$

9. $\int 2e^{5x}\sec(e^{5x})dx$

$u = e^{5x}$

$\frac{du}{dx} = e^{5x} \cdot 5$

$5e^{5x}dx = du$

$dx = \frac{du}{5e^{5x}}$

$\int 2\cancel{e^{5x}} \cdot \sec(u) \cdot \frac{du}{5\cancel{e^{5x}}}$

$\frac{2}{5}\int \sec u\, du$

$\frac{2}{5}\ln|\sec u + \tan u| + C$

$\boxed{\frac{2}{5}\ln|\sec(e^{5x}) + \tan(e^{5x})| + C}$

10. $\int 4^{\sin(2x)}\cos(2x)\,dx$

$u = \sin(2x)$

$\frac{du}{dx} = \cos(2x) \cdot 2$

$dx \cdot 2\cos(2x) = du$

$dx = \frac{du}{2\cos(2x)}$

$\int 4^u \cdot \cancel{\cos(2x)} \cdot \frac{du}{2\cancel{\cos(2x)}}$

$\frac{1}{2}\int 4^u du$

$* \int a^u du = \frac{1}{\ln a} \cdot a^u + C$

$\frac{1}{2}\int 4^u du = \frac{1}{2\ln 4} \cdot 4^u + C$

$= \boxed{\frac{4^{\sin(2x)}}{2\ln 4} + C}$