$$\int \frac{3x^2}{\sqrt{x^3+1}}\,dx =$$

Opener

(A) $2\sqrt{x^3+1}+C$

(B) $\frac{3}{2}\sqrt{x^3+1}+C$

(C) $\sqrt{x^3+1}+C$

(D) $\ln\sqrt{x^3+1}+C$

(E) $\ln(x^3+1)+C$

$$\int_2^3 \frac{x}{x^2+1}\,dx =$$

(A) $\frac{1}{2}\ln\frac{3}{2}$ (B) $\frac{1}{2}\ln 2$ (C) $\ln 2$ (D) $2\ln 2$ (E) $\frac{1}{2}\ln 5$

If the substitution $u = \frac{x}{2}$ is made, the integral $\int_2^4 \frac{1-\left(\frac{x}{2}\right)^2}{x}\,dx =$

(A) $\int_1^2 \frac{1-u^2}{u}\,du$ (B) $\int_2^4 \frac{1-u^2}{u}\,du$ (C) $\int_1^2 \frac{1-u^2}{2u}\,du$

(D) $\int_1^2 \frac{1-u^2}{4u}\,du$ (E) $\int_2^4 \frac{1-u^2}{2u}\,du$

6-3 day 1 Integration by Parts

Learning Objectives:

I evaluate an integral using integration by parts.

Integration by Parts

der

$$\int u\,dv = uv - \int v\,du$$

A.D.

Ex1. Evaluate

$$\int u\,dv = u\cdot v - \int v\,du$$

1.) $\int x \sin x\,dx$

$u = x \longleftrightarrow dv = \sin x\,dx$

$du = 1\,dx \longleftrightarrow v = -\cos x$

$$\int x\sin x\,dx = x\cdot -\cos x - \int -\cos x \cdot 1\,dx$$

$$\int x\sin x\,dx = -x\cos x + \int \cos x\,dx$$

$$= \boxed{-x\cos x + \sin x + C}$$

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2.) $\int xe^x dx$

$\int u\,dv = uv - \int v\,du$

$u = x \quad dv = e^x dx$

$du = 1dx \quad v = e^x$

$\int xe^x dx = xe^x - \int e^x dx$

$= xe^x - e^x + C$

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3.) $\int x^4 \ln x\,dx$

$u = \ln x \longleftrightarrow dv = x^4$

$du = \frac{1}{x} \longleftrightarrow v = \frac{1}{5}x^5$

$$\int \ln x (x^4)\,dx = (\ln x)\frac{1}{5}x^5 - \int \frac{1}{5}x^{\cancel{5}\,4}\,\cancel{\frac{1}{x}}\,dx$$

$$= (\ln x)\frac{1}{5}x^5 - \frac{1}{25}x^5 + C$$

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4.) $\int \frac{\ln x}{x^2}\,dx = \int \frac{1}{x^2} \cdot \ln x \, dx$

$= \int x^{-2} \cdot \ln x \, dx$

$u = \ln x \qquad dv = x^{-2}$

$du = \frac{1}{x} \qquad v = -x^{-1}$

$= -x^{-1} \cdot \ln x - \int -x^{-1} \cdot \frac{1}{x}\,dx$

$= -\frac{\ln x}{x} + \int \frac{1}{x^2}\,dx \qquad x^{-2}$

$= -\frac{\ln x}{x} - \frac{1}{x} + C$

Ex2. Evaluate $\int_1^4 \sqrt{t}\ln t\,dt$ $\qquad \int_1^4 t^{1/2}\ln t\,dt$

$u = \ln t \qquad dv = t^{1/2}$

$du = \frac{1}{t} \qquad v = \frac{2}{3}t^{3/2}$

$$\int_1^4 t^{1/2}\ln t\,dt = \ln t\cdot\frac{2}{3}t^{3/2} - \int_1^4 \frac{2}{3}t^{\cancel{3/2}\ 1/2}\cdot\frac{1}{\cancel{t}}\,dt$$

$$= \frac{2}{3}t^{3/2}\ln t - \frac{2}{3}\int_1^4 t^{1/2}\,dt$$

$$= \frac{2}{3}t^{3/2}\ln t - \frac{2}{3}\cdot\frac{2}{3}t^{3/2}\Big|_1^4$$

$$= \left[\frac{2}{3}t^{3/2}\ln t - \frac{4}{9}t^{3/2}\right]_1^4$$

$$= \left[\frac{2}{3}\cdot 4^{3/2}\ln 4 - \frac{4}{9}\cdot 4^{3/2}\right] - \left[\frac{2}{3}\cdot 1^{3/2}\ln 1 - \frac{4}{9}\cdot 1^{3/2}\right]$$

$$= \left[\frac{2}{3}\cdot 8\ln 4 - \frac{4}{9}\cdot 8\right] - \left[0 - \frac{4}{9}\right]$$

$$= \frac{16}{3}\ln 4 - \frac{32}{9} + \frac{4}{9}$$

$$= \boxed{\frac{16}{3}\ln 4 - \frac{28}{9}}$$

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Homework

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