

INTEGRALS

5.6 Integration by parts

Objective: Evaluate integrals using integration by parts

I. Formula for integration by parts: $\int u dv = uv - \int v du$

II. You must be able to differentiate “u” and integrate “dv”

- A. Always let $\ln(x) = u$
- B. Usually let a power term = u

III. Evaluate $\int x \sin(x) dx$

- A. let $u = x$ and $dv = \sin(x) dx$
 then $du = dx$ and $v = -\cos(x)$

B. $\int x[\sin(x) dx] = x[-\cos(x)] - \int [-\cos(x)](dx) = -x \cos(x) + \int [\cos(x)](dx)$
 $= -x \cos(x) + \sin(x) + C$

IV. Evaluate $\int \ln(x) dx$

- A. let $u = \ln x$ and $dv = dx$
 then $du = \frac{dx}{x}$ and $v = x$

B. $\int \ln(x) dx = x[\ln(x)] - \int x \frac{dx}{x} = x \ln(x) - \int dx = x \ln(x) - x + C$

V. Evaluate $\int x^2 e^x dx$

- A. let $u = x^2$ and $dv = e^x dx$
 then $du = 2x dx$ and $v = e^x$

B. $\int x^2 e^x dx = x^2 e^x - 2 \int x e^x dx$

C. Apply the procedure again to the remaining integral: $\int x e^x dx$

- D. let let $u = x$ and $dv = e^x dx$
 then $du = dx$ and $v = e^x$

E. $\int x e^x dx = x e^x - \int e^x dx = x e^x - e^x$

F. $\int x^2 e^x dx = x^2 e^x - 2 \int x e^x dx = x^2 e^x - 2(x e^x - e^x) + C$
 $= x^2 e^x - 2x e^x + 2e^x + C$

