

6.6 Integration by Parts (IBP)

p. 471-473 #3, 5, 13, 17, 23, 25, 31, 35, 37

$$* \int u dv = uv - \int v du \quad \text{or} \quad \int f(x)g'(x) = f \cdot g - \int f'g$$

*LIATE

$$3) \int x e^{2x} dx \quad \begin{array}{l} f = x \\ f' = 1 \end{array} \quad \begin{array}{l} g' = e^{2x} dx \\ g = \frac{1}{2} e^{2x} \end{array}$$

$$\frac{1}{2} x e^{2x} - \int \frac{1}{2} e^{2x} dx$$

$$\frac{1}{2} x e^{2x} - \frac{1}{2} \cdot \frac{1}{2} e^{2x} + C$$

$$\rightarrow \boxed{\frac{1}{2} x e^{2x} - \frac{1}{4} e^{2x} + C}$$

$$5) \int x \cos x dx \quad \begin{array}{l} f = x \\ f' = 1 \end{array} \quad \begin{array}{l} g' = \cos x dx \\ g = \sin x \end{array}$$

$$x \sin x - \int \sin x dx$$

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

$$\rightarrow \boxed{x \sin x + \cos x + C}$$

$$13) \int x^2 \sin x dx \quad \begin{array}{l} f = x^2 \\ f' = 2x \end{array} \quad \begin{array}{l} g' = \sin x dx \\ g = -\cos x \end{array}$$

$$-x^2 \cos x - \int -2x \cos x dx$$

f	g'
+ x ²	sin x
- 2x	-cos x
+ 2	-sin x
- 0	cos x

$$\boxed{-x^2 \cos x + 2x \sin x + 2 \cos x + C}$$

6.6 HW

17) $\int x^2 \ln x \, dx$

$$f = \ln x \quad g' = x^2$$

$$f' = \frac{1}{x} \quad g = \frac{x^3}{3}$$

$$\frac{x^3 \ln x}{3} - \int \frac{1}{x} \cdot \frac{x^3}{3} \, dx \rightarrow \frac{x^3 \ln x}{3} - \frac{1}{3} \int x^2 \, dx$$

$$\frac{x^3 \ln x}{3} - \frac{1}{3} \cdot \frac{x^3}{3} + C \rightarrow \boxed{\frac{x^3 \ln x}{3} - \frac{1}{9} x^3 + C}$$

~~23)~~ $\int (\ln x)^3 \, dx$

(OMIT)

$$f = (\ln x)^3 \quad g' = 1 \, dx$$

$$f' = 3(\ln x)^2 \cdot \frac{1}{x} \quad g = x$$

$$x(\ln x)^3 - \int 3(\ln x)^2 \, dx$$

37) $\int_0^2 x^2 e^{-3x} \, dx$

f	g'
+ x ²	e ^{-3x}
- 2x	- $\frac{1}{3}$ e ^{-3x}
+ 2	$\frac{1}{9}$ e ^{-3x}
- 0	- $\frac{1}{27}$ e ^{-3x}

$$\left. -\frac{1}{3}x^2 e^{-3x} - \frac{2}{9}x e^{-3x} - \frac{2}{27}e^{-3x} \right|_0^2$$

$$-\frac{1}{3}(4) \cdot e^{-6} - \frac{2}{9}(2)e^{-6} - \frac{2}{27}e^{-6} - \left(0 - 0 - \frac{2}{27}e^0\right)$$

$$-\frac{4}{3e^6} - \frac{4}{9e^6} - \frac{2}{27e^6} + \frac{2}{27}$$

$$\frac{-36}{27e^6} - \frac{12}{27e^6} - \frac{2}{27e^6} + \frac{2}{27}$$

$$\boxed{\frac{-50}{27e^6} + \frac{2}{27}}$$