4.6 Integration by Parts

$$\int f(x)\cdot g(x)\,dx = f(x)\int g(x)\,dx - \int \left[\int g(x)\,dx\right] f'(x)\,dx$$

Ex.1 $\int x e^x\,dx$ let $f(x)=x$, $g(x)=e^x$

$$\int x e^x\,dx = x\int e^x\,dx - \int \left[\int e^x\,dx\right]\cdot 1\,dx$$

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

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

Ex. 2 $\int \ln x\,dx$

Ex. 3 $\int x\sqrt{2x+1}\,dx$

Ex. 4 $\int x^2 e^x \, dx =$

$$x^2 \int e^x \, dx - \int \left[\int e^x \, dx \right] (2x) \, dx =$$

$$x^2 e^x - 2 \int x e^x \, dx =$$

Ex. $\int x^3 e^x \, dx$

Ex. $\int x \ln x \, dx$