

### Solution to Homework Question

Determine  $\int x e^{-x} dx$

**Solution:** We have unrelated functions  $x$  and  $e^{-x}$  so integration by parts may be useful, since our other technique of substitution does not make sense here. We present the solution in tabular form which shows the parts in the left column and the integration in the right column. Note the use of equations and not simply expressions in the right column. Using a single letter (e.g.  $I$ ) for the integral can cut down on writing and be useful for organization.

$\begin{aligned} u &= x & dv &= e^{-x} dx \\ du &= dx & v &= -e^{-x} \end{aligned}$	$\begin{aligned} \int u dv &= uv - \int v du \\ I &= \int x e^{-x} dx \\ I &= -x e^{-x} - \int -e^{-x} dx \\ I &= -x e^{-x} - e^{-x} + C \end{aligned}$
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We can check that this is correct by differentiating our answer:

$$\frac{d}{dx}(-x e^{-x} - e^{-x} + C) = -e^{-x} + x e^{-x} + e^{-x} = x e^{-x}$$

### New Questions

Evaluate:

(a)  $\int x \sin x dx$

(b)  $\int t^2 e^t dt$

(c)  $\int \ln x dx$

(d)  $\int e^x \sin x dx$

Be sure to check your answers.

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