$$\int e^{-y}\cos y\,dy$$

$u = \cos y \qquad v = -e^{-y}$

$du = -\sin y\,dy \qquad dv = e^{-y}\,dy$

$$= -e^{-y}\cos y - \int e^{-y}\sin y\,dy$$

$u = \sin y \qquad v = -e^{-y}$

$du = \cos y\,dy \qquad dv = e^{-y}\,dy$

$$= -e^{-y}\cos y - \left(-e^{-y}\sin y - \int -e^{-y}\cos y\,dy\right)$$

$$= -e^{-y}\cos y + e^{-y}\sin y - \int e^{-y}\cos y\,dy$$

Recap:

$$\int e^{-y}\cos y\,dy = \text{stuff} - \int e^{-y}\cos y\,dy$$

$$2\int e^{-y}\cos y\,dy = \text{stuff}$$

$$\int e^{-y}\cos y\,dy = \frac{\text{stuff}}{2} + C$$

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

easier?

$$\int x^7 e^{x^2}\,dx$$

$u = x^6$ $\quad v = e^{x^2}$

$du = 6x^5\,dx$ $\quad dv = 2xe^{x^2}\,dx$

$$= \frac{1}{2}\int x^6 \cdot 2xe^{x^2}\,dx$$

$$= \frac{1}{2}\left[x^6 e^{x^2} - \int 6x^5 e^{x^2}\,dx\right]$$

$$= \frac{1}{2}\left[x^6 e^{x^2} - 6\int x^5 e^{x^2}\,dx\right]$$

$$\int x^5 e^{x^2}\,dx$$

$u = x^4$ $\quad v = e^{x^2}$

$du = 4x^3\,dx$ $\quad dv = 2xe^{x^2}\,dx$

$$= \frac{1}{2}\int x^4 \cdot 2xe^{x^2}\,dx$$

$$= \frac{1}{2}\left[x^4 e^{x^2} - 4\int x^3 e^{x^2}\,dx\right]$$

$$= \frac{1}{2}x^4 e^{x^2} - 2\int x^3 e^{x^2}\,dx$$

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

. . .

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$$\int \frac{3x^2-2x+12}{(x^2+4)^2}\,dx$$

I ♡ u.

$$= \int \frac{3x^2+12}{(x^2+4)^2}\,dx + \int \frac{-2x}{(x^2+4)^2}\,dx$$

$$3\int \frac{x^2+4}{(x^2+4)^2}\,dx$$

$$= 3\int \frac{1}{x^2+4}\,dx$$

like #5
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hint: $\frac{d}{dx}\left[\tan^{-1}(x)\right]$

$$= \frac{1}{x^2+1}$$

$$\int \frac{1}{x^2+4}\,dx \qquad u = x/2 \longrightarrow x = 2u$$

$$du = \frac{1}{2}\,dx$$

$$= 2\int \frac{1}{2}\cdot\frac{1}{x^2+4}\,dx$$

$$= 2\int \frac{1}{(2u)^2+4}\,\boxed{du}$$

$$= 2\int \frac{1}{4u^2+4}\,du$$

$$= \frac{2}{4}\int \frac{1}{u^2+1}\,du$$

$$= \frac{1}{2}\tan^{-1} u + C$$

$$= \frac{1}{2}\tan^{-1}(x/2) + C$$