
Complete the following problems by completing the following integrals. Show all work to receive full credit.

1. $\int_0^3 \frac{3}{x-1} dx$

$$\begin{aligned}\int_0^3 \frac{3}{x-1} dx &= \int_0^1 \frac{3}{x-1} dx + \int_1^3 \frac{3}{x-1} dx \\ \int_0^1 \frac{3}{x-1} dx &= \lim_{t \rightarrow 1^-} \int_0^t \frac{3}{x-1} dx \\ &= \lim_{t \rightarrow 1^-} \ln |x-1| \Big|_0^t \\ &= \lim_{t \rightarrow 1^-} 3 \ln |0-1| - 3 \ln |t-1| \\ &= 3 \ln 1 + \infty \\ &= \infty\end{aligned}$$

So the integral diverges.

2. $\int x^2 \sin(1-x) dx$

$$\begin{aligned}u &= x^2 & dv &= \sin(1-x) dx \\ du &= 2x dx & v &= \cos(1-x) \\ \int x^2 \sin(1-x) dx &= x^2 \cos(1-x) - \int 2x \cos(1-x) dx \\ u &= 2x & dv &= \cos(1-x) dx \\ du &= 2 dx & v &= -\sin(1-x) \\ &= x^2 \cos(1-x) - \left(-2x \sin(1-x) + \int 2 \sin(1-x) dx \right) \\ &= x^2 \cos(1-x) + 2x \sin(1-x) - \int 2 \sin(1-x) dx \\ &= x^2 \cos(1-x) + 2x \sin(1-x) - 2 \cos(1-x) + C\end{aligned}$$