1. Q) Convergent/Divergent? $\int_{-\infty}^{\infty} 11xe^{-x^2}dx$

A) $11\left[\int_{-\infty}^{0} xe^{-x^2}dx + \int_{0}^{\infty} xe^{-x^2}dx\right]$

$= 11\lim_{t\to\infty^+}\int_t^0 xe^{-x^2}dx + 11\lim_{t\to\infty^-}\int_0^t xe^{-x^2}dx$

$\int xe^{-x^2}dx = -\frac{1}{2}\int e^u du$, for $u = -x^2$, and $xdx = -\frac{1}{2}du$

$= -\frac{e^u}{2} = -\frac{e^{-x^2}}{2}$

$\therefore \left[-\frac{e^{-x^2}}{2}\right]_t^0 = -\frac{1}{2}\left[e^0 - e^{-t^2}\right] = -\frac{1}{2}\left[1 - \frac{1}{e^{t^2}}\right]$

$\therefore -\frac{1}{2}\lim_{t\to\infty^+}\left[1 - \frac{1}{e^{t^2}}\right] = -\frac{1}{2}\left[1-0\right] = -\frac{1}{2}$

and $\left[-\frac{e^{-x^2}}{2}\right]_0^t = -\frac{1}{2}\left[e^{-t^2} - e^0\right] = -\frac{1}{2}\left[\frac{1}{e^{t^2}} - 1\right]$

and $-\frac{1}{2}\lim_{t\to\infty^-}\left[\frac{1}{e^{t^2}} - 1\right] = -\frac{1}{2}\left[0-1\right] = \frac{1}{2}$

$\therefore I = 11(0) = 0$