1 | **1.**

Done on Friday

2 | **2.**

$$\int_{-\infty}^{0} xe^{-x}\,dx = 0 - (-\infty) = \infty \tag{1}$$

We know that the limit of xe^{-x} as x goes to negative infinity is zero because as x decreases past zero e^{-x} approaches infinity.

3 | **3.**

We know that $\int_1^\infty e^{-x}\,dx$ is finite because e^{-x} converges to 0. If we write e^{-x} as a function f, then the gaussian curve (e^{-x^2}) can be written as $\frac{1}{f(x)^2}$, or $f(x)^{-2}$. With reverse chain rule we can easily integrate this: $\int_1^\infty f(x)^{-2}\,dx = F(1)^{-1} - F(\infty)^{-1}$ We know that $F(\infty)^{-1}$ is finite because $F(\infty)$ is finite because the integral of e^{-x} earlier is finite. Of course, $F(1)^{-1}$ is also finite. Therefore, the entire integral is finite.

4 | **4.**

The orthogonal direction is the cross product:

$$\begin{aligned}\vec{r}\times\vec{s} &= (\vec{r}_y\vec{s}_z - vecr_z\vec{s}_y)\hat{i} + (\vec{r}_z\vec{s}_x - \vec{r}_x\vec{s}_z)\hat{j} + (\vec{r}_x\vec{s}_y - \vec{r}_y\vec{s}_x)\hat{k}\\ &= ((-2)(-3) - (6)(1))\hat{i} + ((6)(-5) - (10)(-3))\hat{j} + ((10)(1) - (-5)(-2))\hat{k}\\ &= 0\hat{i} + 0\hat{j} + 0\hat{k}\end{aligned}$$

This makes sense because $\vec{r}$ and $\vec{s}$ are colinear.