1.

$$\begin{aligned}\int_{-\infty}^{\infty}(x^2-x)1_{[0,a]}(x)dx &= \int_0^a (x^2-x)dx \\ &= \left(\frac{x^3}{3}-\frac{x^2}{2}\right)\Bigg|_0^a \\ &= \frac{a^3}{3}-\frac{a^2}{2}=0 \\ \implies a &= \frac{3}{2}\end{aligned}$$

2.

$$\begin{aligned}\iint_R xydxdy &= \int_0^1 \int_0^{x^2} xydydx \\ &= \int_0^1 x \cdot \frac{y^2}{2}\bigg|_{y=0}^{x^2} dx \\ &= \int_0^1 \frac{x^5}{2} \\ &= \frac{x^6}{12}\bigg|_0^1 \\ &= \frac{1}{12}\end{aligned}$$

From the Fubini's theorem, we know that

$$\iint_R xydxdy = \int_0^1 \int_0^{x^2} xydydx = \int_0^1 \int_0^{x^2} xydxdy$$

To be clear,

$$\begin{aligned}\iint_R xydxdy &= \int_0^1 \int_{\sqrt{y}}^1 xydxdy \\ &= \int_0^1 y \cdot \frac{x^2}{2}\bigg|_{x=\sqrt{y}}^{1} dy \\ &= \int_0^1 \left(\frac{y}{2} - \frac{y^2}{2}\right) dy \\ &= \left(\frac{y^2}{4} - \frac{y^3}{6}\right)\bigg|_0^1 \\ &= \frac{1}{4} - \frac{1}{6} = \frac{1}{12}\end{aligned}$$

3.

Since $0 \leq 0 < \lambda \leq \lambda$, we have that

$$P([0, \lambda]) = e^{\lambda} - e^{0} = e^{\lambda} - 1 = 1$$

and hence

$$e^{\lambda} = 2 \implies \lambda = \ln 2$$

4.

$$
\begin{aligned}
P((-2,-1) \cup (1,2]) &= F(-1) - F(-2) + F(2) - F(1) \\
&= 0.202
\end{aligned}
$$