(5) (a) $P(\sqrt{x^2+y^2} \geq r) = 1 - P(\sqrt{x^2+y^2} < r)$

$$= 1 - \iint_{x^2+y^2 \leq r} f_{x,y}(x,y)\,dx\,dy$$

$$f_{x,y}(x,y) = \frac{1}{2\pi\sigma^2} \exp\left(-\frac{(x^2+y^2)}{2\sigma^2}\right) \quad \text{as } \mu_x = \mu_y = 0$$

$$\sigma_x = \sigma_y = \sigma$$

$$\therefore P(\sqrt{x^2+y^2} \geq r) = 1 - \iint_{x^2+y^2 \leq r} \frac{1}{2\pi\sigma^2} \exp\left(-\frac{(x^2+y^2)}{2\sigma^2}\right) dx\,dy$$

$$\boxed{\begin{aligned} & r = \sqrt{x^2+y^2} \\ & x = r\cos\theta \\ & y = r\sin\theta \\ & \theta = \tan^{-1}\left(\frac{y}{x}\right) \end{aligned}}$$

$$= 1 - \frac{1}{2\pi\sigma^2} \int_0^{2\pi}\int_0^{R} \exp\left(\frac{-r^2}{2\sigma^2}\right) r\,dr\,d\theta$$

$$= e^{-R^2/2\sigma^2}$$

(b) $F_R(r) = P(R \leq r) = 1 - e^{-r^2/2\sigma^2}$

$$f_R(r) = \frac{d}{dr} F_R(r) = \frac{2r}{2\sigma^2} e^{-r^2/2\sigma^2}$$

$$= \frac{r}{\sigma^2} e^{-r^2/2\sigma^2}$$ a Cauchy distribution