

問4.1

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(a)

$$(\text{与式}) \equiv \int_{-\infty}^{\infty} dx \int_{-\infty}^{\infty} dy \delta(r - a)$$

$$= \int_0^{2\pi} d\theta \int_0^{\infty} r dr \delta(r - a) \quad (\text{変数変換})$$

$$= 2\pi a \quad (QED)$$

(b)

$$\begin{aligned} (\text{与式}) &\equiv \int_{-\infty}^{\infty} dx \int_{-\infty}^{\infty} dy \int_{-\infty}^{\infty} dz \delta(r - a) \\ &= \int_0^{2\pi} d\varphi \int_{-1}^1 d \cos \theta \int_0^{\infty} r^2 dr \delta(r - a) \quad (\because \text{変数変換}) \\ &= 4\pi a^2 \quad (QED) \end{aligned}$$