1.18 given (1.126) $\int_{-\infty}^{\infty} \exp(-\frac{1}{2\sigma^2}x^2)\,dx = (2\pi\sigma^2)^{\frac{1}{2}}$

Let $u = r^2$, the right hand side can be rewritten as

$$S_D \int_0^{\infty} e^{-r^2} r^{D-1}\,dr = S_D \int_0^{\infty} e^{-u} u^{\frac{1}{2}(D-1)} \frac{1}{2} u^{-\frac{1}{2}}\,du$$

$$= \frac{1}{2} S_D \int_0^{\infty} e^{-u} u^{\frac{D}{2}-1}\,du$$

$$= \frac{1}{2} S_D \Gamma(D/2)$$

using (1.126) the left hand side can be written as

$$\prod_i^D \int_{-\infty}^{\infty} e^{-x_i^2}\,dx_i = \pi^{D/2}$$

Therefore. $S_D = \dfrac{(2\pi)^{D/2}}{\Gamma(D/2)}$