Some Potentially Useful Mathematical Formulae

Integrals

$$\int_0^\infty e^{-ax^2}dx = \frac{1}{2}\left(\frac{\pi}{a}\right)^{1/2}$$

$$\int_a^b udv = uv\Big|_a^b - \int_a^b vdu$$

$$\int_0^\infty xe^{-ax^2}dx = \frac{1}{2a}$$

$$\int_0^\infty x^2e^{-ax^2}dx = \frac{1}{4a}\left(\frac{\pi}{a}\right)^{1/2}$$

$$\int_0^\infty x^3e^{-ax^2}dx = \frac{1}{a^2}$$

$$\int_0^\infty x^ne^{-ax^2}dx = \begin{cases} \dfrac{(n-1)!}{2a^{(n+1)/2}}, & n \text{ odd} \\ \dfrac{1\bullet 3\bullet 5\bullet\bullet\bullet(n-1)}{2(2a)^{n/2}}\left(\dfrac{\pi}{a}\right)^{1/2}, & n \text{ even} \end{cases}$$

$$\int_0^\pi \sin\theta d\theta \int_0^{2\pi} d\phi = 4\pi$$

Other

$$\begin{vmatrix} a & b \\ c & d \end{vmatrix} = ad - cb$$

$$\begin{bmatrix} a & b \\ c & d \end{bmatrix}\begin{bmatrix} e \\ f \end{bmatrix} = \begin{bmatrix} ae + bf \\ ce + df \end{bmatrix}$$

$$\sqrt{-1} = i = -\frac{1}{i}$$

$$e^{i\theta} = \cos\theta + i\sin\theta$$

volume element in spherical polar coordinates: $r^2\sin\theta drd\theta d\phi$

Some Operators

$x \equiv$ multiply by x

$$T = -\frac{1}{2r^2}\left(\frac{\partial}{\partial r}r^2\frac{\partial}{\partial r} - L^2\right) \text{ [spherical polars]}$$

$$p_x \equiv -i\hbar\frac{d}{dx}$$

$$H = T + V$$

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