# A party trick

$$\begin{pmatrix} 3 & 6 \\ 8 & 4 \end{pmatrix}$$

$$= \frac{7}{2}\,\underset{\begin{pmatrix}1&0\\0&1\end{pmatrix}}{\underset{\uparrow}{\mathbb{I}_2}} + 7\,\underbrace{\underset{\begin{pmatrix}0&1\\1&0\end{pmatrix}}{\underset{\uparrow}{\sigma_1}} + (-i)\,\underset{\begin{pmatrix}0&-i\\i&0\end{pmatrix}}{\underset{\uparrow}{\sigma_2}} + \left(-\frac{1}{2}\right)\underset{\begin{pmatrix}1&0\\0&-1\end{pmatrix}}{\underset{\uparrow}{\sigma_3}}}_{\text{Hermitian, traceless}}$$

Pauli Matrices

$$\uparrow$$

$$(M^T)^* = M$$

$$3\begin{pmatrix}1&0\\0&0\end{pmatrix} + 6\begin{pmatrix}0&1\\0&0\end{pmatrix} + 8\begin{pmatrix}0&0\\1&0\end{pmatrix} + 4\begin{pmatrix}0&0\\0&1\end{pmatrix}$$

$$3\frac{dg(y)}{dy} - 1 = 0$$

function $g$ , variable $y$

first-order, linear in $g(y)$, non-homogeneous $\underbrace{\text{ordinary D.E.}}_{\text{O.DE.}}$

$$g_g(y) = g_c(y) + g_p(y)$$

↑ expect one arbitrary constant

complementary solution

$$3\frac{dg_c(y)}{dy} = 0 \Rightarrow g_c'(y) = 0$$

$$g_c(y) = A$$

Particular Solution

$$3g_p'(y) = 1$$

Guess: $Cy = g_p(y)$ ↙ $+d+ey^2+f\sin(y)$

$$g_p'(y) = C$$

$$3C = 1 \Rightarrow C = \frac{1}{3}$$

$$g_p(y) = g_c(y) + g_p(y) = A + \frac{y}{3}$$

SHO $1\,\ddot{q}(t) + \omega_0^2 q(t) = 0$ homo.

$\frac{k}{m}$ or $\frac{g}{\ell}$

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Damping $\ddot{q}(t) - 2\beta\dot{q}(t) + \omega_0^2 q(t) = 0$ homo.

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Driving $\ddot{q}(t) - 2\beta\dot{q}(t) + \omega_0^2 q(t) = \frac{F_0}{m}\cos(\omega_D t)$

natural frequency

driving frequency