2. a). $\mathbb{F} = \frac{e}{c} \mathbb{V} \times \mathbb{B}$

$$= |m\dot{v}| = \left|\frac{e}{c} v\right| |\mathbb{B}| \cancel{\operatorname{sen} 90^\circ}^{\,1}$$

$$= m\dot{v} = \frac{e}{c} v B \longrightarrow \text{Ed lineal}$$

$$= \int \frac{1}{v} dv = \int \frac{e}{cm} B\, dt$$

$$\ln|v| = \frac{e}{cm} B t \qquad ; \ \omega_c = \frac{e}{cm} B$$

$$= V = e^{\omega_c t}$$

$$\int dr = \int e^{\omega_c t} dt$$

$$r = \frac{e^{\omega_c t}}{\omega_c} = \frac{V}{\omega_c} = \frac{cmV}{eB}$$

b.) $\mathbb{E} = (0, E_y, E_z)$; $\mathbb{B} = (0, 0, B)$

$$m\dot{\mathbb{V}} = e\mathbb{E} + \underbrace{\frac{e}{c} \mathbb{V} \times \mathbb{B}}$$

$$\frac{e}{c} \begin{vmatrix} \hat{e}_x & \hat{e}_y & \hat{e}_z \\ V_x & V_y & 0 \\ 0 & 0 & B \end{vmatrix} = V_y B \hat{e}_x - V_x B \hat{e}_y$$

$$m(\dot{v}_x, \dot{v}_y, \dot{v}_z) = e(0, E_y, E_z) + \frac{e}{c}(v_y B, -v_x B, 0)$$

$$m\dot{v}_z = eE_z$$

$$\int dv_z = \int \frac{e}{m} E_z \, dt$$

$$v_z = \frac{e}{m} E_z t + c_1$$

$$\int dz = \int \left(\frac{e}{m} E_z t + c\right) dt$$

$$z = \frac{e}{2m} E_z t^2 + c_1 t + c_2$$

resolviendo el PVI

$$z_0 = c_2$$

$$\dot{z}_0 = c_1$$

$$z = \frac{e}{2m} E_z t^2 + \dot{z}_0 t + z_0$$

c.) • Componente x

$$m\dot{v}_x = \frac{e}{c} v_y B$$

$$\frac{dv_x}{dt} = \omega_c v_y \quad (1)$$

componente y

$$m\dot{v}_y = eE_y - \frac{e}{c} v_x B$$

$$\frac{dv_y}{dt} = \frac{e}{m} E_y - \omega_c v_x$$

derivamos (1) y remplazamos $\dot{v}_y$

$$\frac{d^2 v_x}{dt^2} = \omega_c \dot{v}_y$$

$$\ddot{v}_x = \omega_c \left(\frac{e}{m} E_y - \omega_c v_x \right)$$

$$\ddot{v}_x + \omega_c^2 v_x = \frac{\omega_c e E_y}{m}$$ (Ed movimiento armonico Forzado)

(3)

analogamente para v_y

$$\ddot{v}_y = -\omega_c \dot{v}_x$$

$$\ddot{v}_y = -\omega_c^2 v_y$$ (Ed movimiento armonico simple)

(4)

la sol de (3)

$$v_x(t) = v_{xc} + v_{xp}$$

$$\alpha^2 + w_c^2 = 0 \rightarrow \alpha = i\, w_c$$

$$V_{xc} = A\, \text{sen}(w_c t) + B \cos(w_c t)$$

$$W = \begin{vmatrix} \text{sen}(w_c t) & \cos(w_c t) \\ w_c \cos(w_c t) & -w_c \text{sen}(w_c t) \end{vmatrix}$$

$$= -w_c\, \text{sen}^2(w_c t) - w_c \cos^2(w_c t)$$

$$= -w_c$$

$$W_1 = \begin{vmatrix} 0 & \cos(w_c t) \\ w_c \frac{e}{m} E_y & -w_c\, \text{sen}(w_c t) \end{vmatrix}$$

$$W_1 = -w_c \frac{e}{m} E_y \cos(w_c t)$$

$$u_1 = \int \frac{e}{m} E_y \cos(w_c t)\, dt = \frac{e}{w_c m} E_y\, \text{sen}(w_c t)$$

$$W_2 = \begin{vmatrix} \text{sen}(w_c t) & 0 \\ w_c \cos(w_c t) & w_c \frac{e}{m} E_y \end{vmatrix}$$

$$= \frac{e}{m} E_y\, \text{sen}(w_c t)$$

$$u_2 = \int -\frac{e}{m} E_y \operatorname{sen}(\omega_c t)\, dt = \frac{e}{\omega_c m} E_y \cos(\omega_c t)$$

$$V_{xp} = \frac{e}{\omega_c m} E_y \left[\operatorname{sen}^2 \omega_c t + \cos^2 \omega_c t \right]$$

$$V_{xp} = \frac{e}{\omega_c m} E_y$$

$$V_x(t) = A \operatorname{sen}(\omega_c t) + B \cos(\omega_c t) + \frac{e}{\omega_c m} E_y$$

↳ sol (4)

$$\alpha^2 + \omega_c^2 = 0 \rightarrow \alpha = i\omega_c$$

$$V_y(t) = A \operatorname{sen}(\omega_c t) + B \cos(\omega_c t)$$

para calcular el valor medio de un periodo completo usamos

$$\langle f(t) \rangle = \frac{1}{T} \int_0^T f(t)\, dt$$

$$\langle V_x \rangle = \int_0^1 A \operatorname{sen} \omega_c t + B \operatorname{sen} \omega_c t + \frac{e}{\omega_c m} E_y \, dt$$

en un periodo completo los terminos sen y cos sen hacen 0

$$\langle v_x \rangle = \frac{e E_y}{\omega_c m} = \frac{c E_y}{B}$$

$$\langle V_y \rangle = 0$$

D.)

$$x(t) = \int A \sin(\omega_c t) + B \cos \omega_c t + \frac{c E_y}{B} \, dt$$

$$x(t) = -\frac{A}{\omega_c} \cos(\omega_c t) + \frac{B}{\omega_c} \sin(\omega_c t) + \frac{c E_y}{B} t$$

si $x(0) = 0 \rightarrow 0 = -\frac{A}{\omega_c} \longrightarrow A = 0$

$$x(t) = \frac{B}{\omega_c} \sin(\omega_c t) + \frac{c E_y}{B} t$$

$$y(t) = \int A \sin \omega_c t + B \cos \omega_c t \, dt$$

$$y(t) = -\frac{A}{\omega_c} \cos \omega_c t + \frac{B}{\omega_c} \sin \omega_c t$$

si $y(0) = 0 \longrightarrow 0 = \frac{A}{\omega_c} \rightarrow A = 0$

$$y(t) = \frac{B}{\omega_c} \sin(\omega_c t) = -\frac{B}{\omega_c} (\cos \omega_c t - 1)$$