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Si $$\frac{d^2y}{dt^2} + g - \gamma\left(\frac{dy}{dt}\right)^2 = 0$$

Si tomamos $\frac{dy}{dt} = v(t)$

$$\frac{dv}{dt} + g - \gamma\left(v(t)\right)^2 = 0$$

Por separable.

$$\int \frac{dv}{g - \gamma v^2} = \int dt$$

$$\frac{1}{g}\int \frac{dv}{\left(1 - \frac{\gamma}{g}v^2\right)} \Rightarrow$$

Si $u = \frac{i\sqrt{\gamma}}{\sqrt{g}}v$

$$\frac{\sqrt{g}\,du}{i\sqrt{\gamma}} = dv$$

$$\frac{i}{\sqrt{r}\sqrt{g}}\int_{v_0}^{v}\frac{du}{u^2+1} = \frac{i}{\sqrt{r}\sqrt{g}}\tan^{-1}(u)$$

$$= -\frac{1}{\sqrt{r}\sqrt{g}}\tanh^{-1}\left(\frac{\sqrt{r}}{\sqrt{g}}v\right) = t$$

$$\frac{1}{\sqrt{r}\sqrt{g}}\tanh^{-1}\left(\frac{\sqrt{r}}{\sqrt{g}}v\right) = -t + \frac{1}{\sqrt{r}\sqrt{g}}\tanh^{-1}\left(\frac{\sqrt{r}v_0}{\sqrt{g}}\right)$$

$$r\tanh^{-1}\left(\frac{\sqrt{r}}{\sqrt{g}}v\right) = -\sqrt{r}\sqrt{g}t + \tanh^{-1}\left(\frac{\sqrt{r}v_0}{\sqrt{g}}\right)$$

$$\frac{\sqrt{r}}{\sqrt{g}}v = \tanh\left(-\sqrt{r}\sqrt{g}t + \tanh^{-1}\left(\frac{\sqrt{r}v_0}{\sqrt{g}}\right)\right)$$

$$v = \frac{\sqrt{g}}{\sqrt{r}}\tanh\left(\qquad \right)$$

$$v(t) = \frac{\sqrt{g}}{\sqrt{r}} \tanh\left(-\sqrt{r}\sqrt{g}\,t + \tanh^{-1}\left(\frac{\sqrt{r}\,v_0}{\sqrt{g}}\right)\right)$$

$$\int_0^y dy = \int_0^t v(t)\,dt$$

$$= \int_0^t \frac{\sqrt{g}}{\sqrt{r}} \tanh\left(-\sqrt{r}\sqrt{g}\,t + \tanh^{-1}\left(\frac{\sqrt{r}\,v_0}{\sqrt{g}}\right)\right) dt$$

$$= \frac{\sqrt{g}}{\sqrt{r}} \int_0^t \tanh\left(-\sqrt{r}\sqrt{g}\,t + \tanh^{-1}\left(\frac{\sqrt{r}\,v_0}{\sqrt{g}}\right)\right) dt$$

$$u = t\sqrt{r}\sqrt{g} + \tanh^{-1}\left(\frac{\sqrt{r}\,v_0}{\sqrt{g}}\right)$$

$$du = \sqrt{r}\sqrt{g}\,dt \Rightarrow \frac{du}{\sqrt{r}\sqrt{g}} = dt$$

$$\frac{\cancel{\sqrt{g}}}{\sqrt{\gamma}} \frac{1}{\cancel{\sqrt{g}}\sqrt{\gamma}} \int_0^t \tanh(u)\, du$$

$$= \frac{1}{\gamma} \int \frac{\sinh(u)\, du}{\cosh(u)} \Rightarrow s = \cosh(u)$$

$$ds = \sinh(u)\, du$$

$$= \frac{1}{\gamma} \int \frac{ds}{s}$$

$$= \frac{1}{\gamma} \ln(s) = \frac{1}{\gamma} \ln(\cosh(u))$$

$$= \frac{1}{\gamma} \ln\left[\cosh\left(-t\sqrt{g}\sqrt{\gamma} + \tanh^{-1}\left(\frac{\sqrt{\gamma}\, v_0}{\sqrt{g}}\right)^{-1}\right)\right]\Bigg|_0^t$$

$$= \frac{1}{\gamma} \ln\left(\frac{1}{\cosh\left(-t\sqrt{\gamma}\sqrt{g} + \tanh^{-1}\left(\frac{\sqrt{\gamma}\, v_0}{\sqrt{g}}\right)\right)}\right)\Bigg|_0^t$$

$$y(t) = y_0$$

$$+ \frac{1}{\sigma} \ln\left[\frac{\cosh\left(\tanh^{-1}\left(\frac{\sqrt{\sigma}\, v_0}{\sqrt{g}}\right)\right)}{\cosh\left(-t\sqrt{\sigma}\sqrt{g} + \tanh^{-1}\left(\frac{\sqrt{\sigma}\, v_0}{\sqrt{g}}\right)\right)} \right] //$$

→ Punto 6 → punto 2

si $$\frac{dF}{dx} = \frac{F(x+h) - F(x-h)}{h}$$

si $$\frac{d''F}{dx^2} = \frac{F'(x+h) - F'(x-h)}{2h}$$

$$= \frac{\frac{F(x+h) - F(x)}{h} - \frac{F(x) - F(x-h)}{h}}{h}$$

$$= \frac{F(x+h) - 2F(x) + F(x-h)}{h^2}$$

si $\boxed{2h' = 2h}$

$$\frac{F(x+(2h')) - 2F(x) + F(x-2h')}{4(h')^2}$$

si $2h' \rightarrow$ es 2 pasos adelante de h.

$$\frac{F(x+2) - 2F(x) + F(x-2)}{4h^2}$$

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