To show the critical point is at around $x=0$

Soln

$$y = -20e^{-x^2/8} - e^{\frac{1}{2}\cos(2\pi x)} + 20 + e$$

We differentiate the function w.r.t x once to obtain 1^{st} derivative

$$\frac{dy}{dx} = -20 \cdot -\frac{2x}{8} e^{-x^2/8} + 2\pi \cdot \frac{1}{2} \sin 2\pi x \cdot e^{\frac{1}{2}\cos(2\pi x)}$$

$$\Rightarrow 5x\, e^{-x^2/8} + \pi \sin 2\pi x . e^{\frac{1}{2}\cos 2\pi x}$$

$$\Rightarrow \left.\frac{dy}{dx}\right|_{x=0} = \left. 5x\, e^{-x^2/8} + \pi \sin 2\pi x\, e^{\frac{1}{2}\cos 2\pi x} \right|_{x=0} = 0$$

$\Rightarrow$ So this function does have a critical point around the 0.0 value mark

$\Rightarrow$ To determine it maximum or minimum,
$\Rightarrow$ we obtain the 2^{nd} derivative as follows

$$\frac{d^2y}{dx^2} = 5x \cdot -\frac{2x}{8} \cdot e^{-x^2/8} + 5e^{-x^2/8}$$

$$\left.\frac{d^2y}{dx^2}\right|_{x=0} = 5 > 0$$

= Thus the point will be a minimum point

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