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(3.) $J[f] = \int_0^2 \left[\left(\frac{df}{dx}\right)^2 + f \right] dx.$

$$= \int_0^2 \left((f')^2 + f \right) dx \qquad a = 0, \quad b = 2$$

$$\therefore F \Rightarrow f + (f')^2$$

$$\therefore \frac{\partial F}{\partial f} - \frac{d}{dx}\left(\frac{\partial F}{\partial f'}\right) = 0$$

$$\Rightarrow \frac{\partial F}{\partial f} \Rightarrow 1 \quad ; \quad \frac{\partial F}{\partial f'} \Rightarrow 2(f')$$

$$\therefore 1 - \frac{d}{dx}(2f') = 0$$

$$1 - 2\frac{d^2 f}{dx^2} = 0$$

$$\frac{d^2 f}{dx^2} = \frac{1}{2} \Rightarrow f \Rightarrow \frac{x^2}{4} + c_1 x + c_2$$

$$\frac{4}{4} + c_1(2) = 2$$

$f(0) = 0 \Rightarrow c_2 = 0,$

$f(2) = 2 \Rightarrow c_1 = 1/2$

$$\Rightarrow f \Rightarrow \left(\frac{x^2}{4} + \frac{x}{2}\right)$$

A ~~Random~~ $f^n \Rightarrow \cancel{\frac{x^2}{3}} \cancel{\frac{3x}{3}}$

Another random f^n that satisfies the B/C

$$f(2) \Rightarrow \left.\frac{x^2}{8} + px\right|_2 = 2$$

$$\Rightarrow$$

$$\frac{1}{2} + 2p = 2$$

$$\Rightarrow \quad p \Rightarrow 3/4$$

$$\therefore f_{new}(x) \Rightarrow \frac{x^2}{8} + \frac{3}{4}x \qquad \frac{df}{dx} \Rightarrow \frac{x}{4} + \frac{3}{4}$$

$$\therefore J \Rightarrow \int_0^2 \left[\left(\frac{x+3}{4}\right)^2 + \left(\frac{x^2}{8} + \frac{3x}{4}\right)\right] dx$$

$$\Rightarrow \int_0^2 \left[\frac{x^2+9+6x}{4} + \frac{x^2}{8} + \frac{3x}{4}\right] dx$$

$$\Rightarrow \int_0^2 \left(\frac{3x^2}{8} + \frac{9x}{4} + \frac{9}{4}\right) dx$$

$$= \quad 10 > 0$$