5.5 $\sigma_\eta = 0$, $\hat{k}_\beta = 0$

A)

5.154 $$\tilde{I}(w) = \frac{\mu_{oo} - \Delta V/2\rho}{4w} - \frac{1}{4\hat{\sigma}_x^2} - \int_{-\infty}^{0} d\tau \, \frac{\tau e^{-\cancelto{0}{\hat{\sigma}_\eta^2 \tau^2/2} - i\mu_{oo}\tau}}{[(1+i\cancelto{0}{\hat{k}_\beta^2 \hat{\sigma}_x^2 \tau}) + 2w]^2 - 4w^2 \cancelto{1}{\cos^2(\hat{k}_\beta \tau)}} = \phi$$

$$\frac{\mu_{oo} - \Delta V/2\rho}{4w} - \frac{1}{4\hat{\sigma}_x^2} - \int_{-\infty}^{0} \frac{\tau e^{-i\mu_{oo}\tau}}{[(1+2w)^2 - 4w^2} = \phi$$

$$\frac{\mu_{oo} - \Delta V/2\rho}{4w} - \frac{1}{4\hat{\sigma}_x^2} - \frac{1}{[(1+4w+\cancel{4w^2}-\cancel{4w^2})]} \int_{-\infty}^{0} d\tau \, \tau e^{-i\mu_{oo}\tau} = 0$$

$$\frac{\mu_{oo} - \Delta V/2\rho}{4w} - \frac{1}{4\hat{\sigma}_x^2} - \frac{1}{(1+4w)} \left(\frac{1}{\mu_{oo}^2} \right) = \phi$$

$$\boxed{\mu_{oo} - \frac{\Delta V}{2\rho} - \frac{w}{\hat{\sigma}_x^2} = \frac{4w}{\mu_{oo}^2 (4w+1)}}$$

5.155 $$\frac{\mu_{oo} - \Delta V/2\rho}{4w^2} = \int_{-\infty}^{0} d\tau \, \frac{[4(1+i\cancelto{0}{\hat{k}_\beta^2 \hat{\sigma}_x^2 \tau}) + 8w\cancelto{0}{\sin(\hat{k}_\beta \tau)}]\tau e^{-\cancelto{0}{\hat{\sigma}_\eta^2 \tau^2/2} - i\mu_{oo}\tau}}{\{[(1+i\cancelto{0}{\hat{k}_\beta^2 \hat{\sigma}_x^2 \tau}) + 2w]^2 - 4w^2 \cancelto{1}{\cos^2(\hat{k}_\beta \tau)}\}^2}$$

$$\frac{\mu_{oo} - \Delta V/2\rho}{4w^2} = \int_{-\infty}^{0} d\tau \, \frac{4\tau e^{-i\mu_{oo}\tau}}{[1+4w+\cancel{4w^2}-\cancel{4w^2}]^2}$$

$$\frac{\mu_{oo} - \Delta V/2\rho}{4w^2} = \frac{4}{[1+4w]^2} \frac{1}{\mu_{oo}^2}$$

$$\boxed{\mu_{oo} - \frac{\Delta V}{2\rho} = \frac{16w^2}{\mu_{oo}^2 (1+4w)^2}}$$