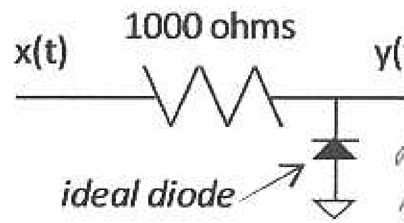
ECEN4503 Quiz #8 1 April 2011 Name Solution

1) A 0.5 watt noise waveform x(t) has a Laplacian distributed voltage with PDF $f_X(x) = e^{-2|x|}$, and autocorrelation $R_{XX}(\tau) = 0.5\delta(\tau)$. This waveform is run into an ideal half wave rectifier shown, yielding y(t).



shorts negative voltages to ground

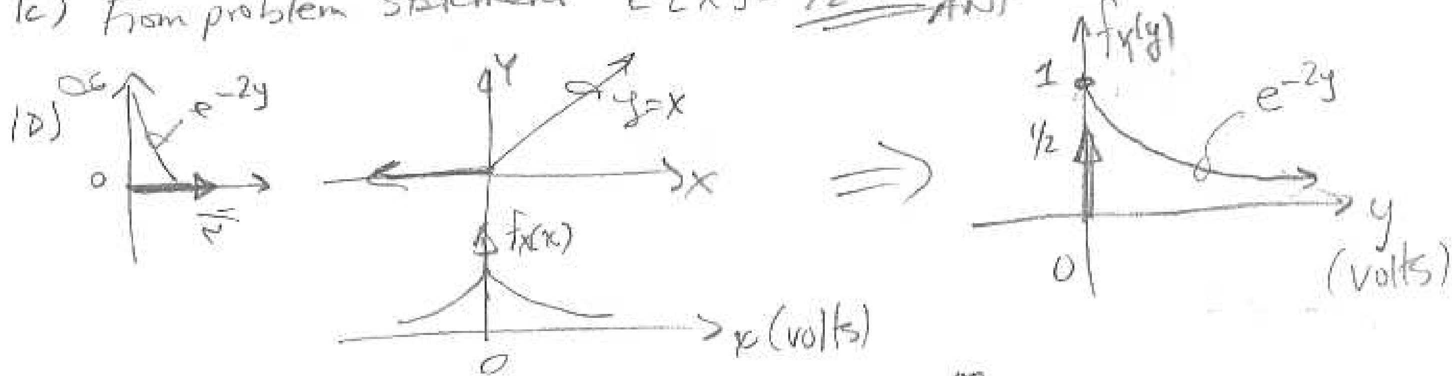
1a) [1] **Determine** the DC value of x(t)
1b) [1] **Determine** the AC power of x(t)
1c) [1] **Determine** the total power of x(t)
1d) [3] **Write an equation** or **sketch** the PDF of y(t)
1e) [1] **Determine** the DC value of y(t)
1f) [1] **Determine** the AC power of y(t)
1g) [1] **Determine** the total power of y(t)
1h) [1] If you put a volt-ohm meter on the output and flipped it to "Volts AC", what value would your read?

1a) $V_{DC} = 0$ as $\lim_{\tau \to \infty} R_{XX}(\tau) = 0$ = ANS

1b) $\sigma_x^2 = E[X^2] - E[X]^2 = \frac{1}{2} - 0 = \underline{\underline{\frac{1}{2}\text{ watt}}}$ ANS

1c) From problem statement $E[X^2] = \underline{\underline{\frac{1}{2}\text{ watt}}}$ ANS

1d)



1e) $E[Y] = \int_0^\infty Y\left(\frac{1}{2}\delta(y) + e^{-2y}\right)dy = 0 + \int_0^\infty y e^{-2y} dy = e^{-2y}\left[\frac{y}{-2} - \frac{1}{4}\right]_0^\infty$

$= 0 - 1\left[0 - \frac{1}{4}\right] = \underline{\underline{\frac{1}{4}\text{ volts}}}$ ANS

1g) $E[y^2] = \int_0^\infty y^2\left[\frac{1}{2}\delta(y) + e^{-2y}\right]dy = 0 + \int_0^\infty y^2 e^{-2y} dy$

½ the signal is shorted to ground

$= e^{-2y}\left[\frac{y^2}{-2} - \frac{2y}{4} - \frac{2}{8}\right]\Big|_0^\infty = 0 - 1\left[0 - 0 - \frac{1}{4}\right] = \underline{\underline{\frac{1}{4}\text{ watt}}}$ ANS

1f) $\sigma_y^2 = E[y^2] - E[y]^2 = \frac{1}{4} - \frac{1}{4}^2 = \frac{4}{16} - \frac{1}{16} = \frac{3}{16}$ watts ANS

1h) $V_{AC} = \sigma = \sqrt{\frac{3}{16}} = .433 V_{rms}$ ANS