1. From the **log** plots, the gain and phase at DC ($\omega = 0$) and $\omega = 100$ are:
   ω=0: Gain=(0 dB)=1; Phase=0. **ω=100:** Gain=(-20 dB)=0.1; Phase=-45^o.

1a. (i) $0.1\cos(100t - 45^o)$; (ii) $7 + 0.3\cos(100t - 25^o)$.

1b. (i) $10\cos(100t + 45^o)$; (ii) $7 + 30\cos(100t + 65^o)$.

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2. Plotted below **left**. Approaching an **exponential** function ($e^{3-t}, 0 < t < 3$, in fact).
3. Gain at $\omega = 2$ is 15/3=5; Gain at $\omega = 8$ is 10/5=2. Solve 2 equations in 2 unknowns: $B/(2^2 + A^2)=5 \rightarrow B-5A^2=20$; $B/(8^2 + A^2)=2 \rightarrow B-2A^2=128$. Solving→**A=±6,B=200.**

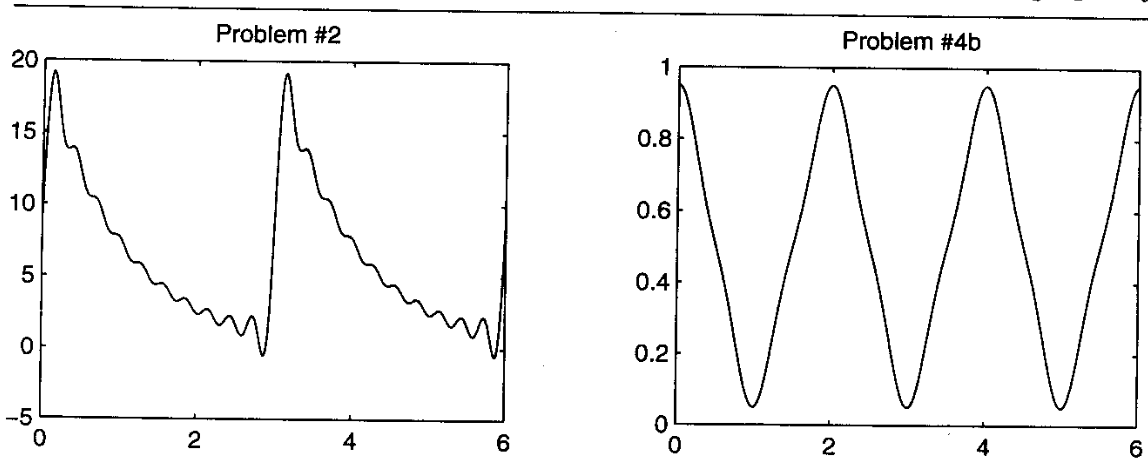
4a. $x(t) = \begin{cases} 1-t, & \text{for } 0 < t < 1; \\ 1+t, & \text{for } -1 < t < 0 \end{cases}$. Period=T=2→ $\omega_o = \frac{2\pi}{2} = \pi$.
Since $x(t)$ is an *even* function (symmetric about $t = 0$), we have b_n=**0**.

$$a_n = \frac{2}{2}\int_{-1}^{0}(1+t)\cos(n\pi t)dt + \frac{2}{2}\int_0^1(1-t)\cos(n\pi t)dt = 2\int_0^1(1-t)\cos(n\pi t)dt$$
$$= 2\int_0^1 \cos(n\pi t)dt - 2\int_0^1 t\cos(n\pi t)dt = \frac{2}{n\pi}\sin(n\pi t)|_0^1 - 2\frac{\cos(n\pi t)}{\pi^2 n^2}|_0^1 - 2\frac{t\sin(n\pi t)}{n\pi}|_0^1$$
$$= \frac{2}{\pi^2 n^2}(1-(-1)^n) = \begin{cases} 4/(\pi^2 n^2), & \text{for n odd;} \\ 0, & \text{for n even} \end{cases}$$. Only middle term above is non-zero.

$$a_o = \frac{1}{2}\int_{-1}^{0}(1+t)dt + \frac{1}{2}\int_0^1(1-t)dt = \frac{2}{2}\int_0^1(1-t)dt = 1/2 \text{ using symmetry.}$$

$$x(t) = \frac{1}{2} + \frac{4}{\pi^2}\cos(\pi t) + \frac{4}{9\pi^2}\cos(3\pi t) + \frac{4}{25\pi^2}\cos(5\pi t) + \frac{4}{49\pi^2}\cos(7\pi t) + \ldots$$

4b. 2 Hertz⇔ $\omega = 4\pi$ →keep 1^{st} 3 terms of this series: $\frac{1}{2} + \frac{4}{\pi^2}\cos(\pi t) + \frac{4}{9\pi^2}\cos(3\pi t)$.
Plotted below **right**. Attenuation of high freqs→round corners: can't change quickly.

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%m-file for Problem Set #2, EECS 210, Winter 2001
%Problem #2
T=linspace(0,6,1000); TT=2*pi/3*T;
X=6.3+5.4373*cos(TT-1.1425)+2.9302*cos(2*TT-1.3709)+1.9832*cos(3*TT-1.4646);
X=X+1.4954*cos(4*TT-1.5208)+1.1992*cos(5*TT-1.5616)+1.0005*cos(6*TT-1.5946);
X=X+0.8581*cos(7*TT-1.6231)+0.7511*cos(8*TT-1.6488)+0.6677*cos(9*TT-1.6726);
X=X+0.6010*cos(10*TT-1.6951);
subplot(2,2,1),plot(T,X),title('Problem #2')
%Problem #4b
X=pi^2/2+4*cos(pi*T)+4/9*cos(3*pi*T); X=X/pi/pi;
subplot(2,2,2),plot(T,X),title('Problem #4b')
```