1. (a) Baseband equivalent impulse reponse

$$h_B(t) = \sum_k a_k \exp(-j2\pi f_c \tau_k)\delta(t - \tau_k).$$

Note that $f_c\tau_k$ are all integer and, hence, the phases are all equal to zero and

$$h_B(t) = \sum_k a_k \delta(t - \tau_k).$$

(b) The frequency response in general is

$$H_B(f) = \sum_k a_k \exp(-j2\pi f_c \tau_k) \exp(-j2\pi f \tau_k)$$

which simplifies to

$$H_B(f) = \sum_k a_k \exp(-j2\pi f \tau_k)$$

(c) MATLAB code:

```
tau = 1e-6*[0.5 1 1.3];
aa  = [1 0.7 0.3];
HH = aa.*exp(-j*2*pi*fc*tau) * exp(-j*2*pi*tau'*ff);
plot(1e-6*ff,20*log10(abs(HH)))
grid
xlabel( 'Frequency (MHz)' )
ylabel( '|H(f)| (dB)')
```

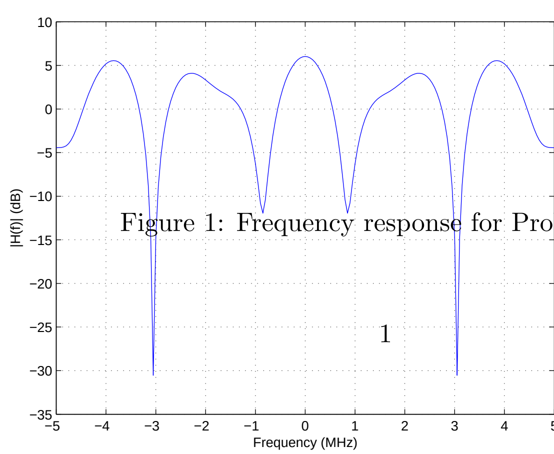

Figure 1: Frequency response for Problem 2.c

(d) The distance traveled by the mobile is approximately equal to $|\Delta\tau| \cdot c \approx 0.15$ m.

(e) The changes in delays induce phase shifts of π for the first and third path. The resulting impulse response and frequency response have the same form as above with differnt coeeficients. The spectrum is plotted in Figure 2.

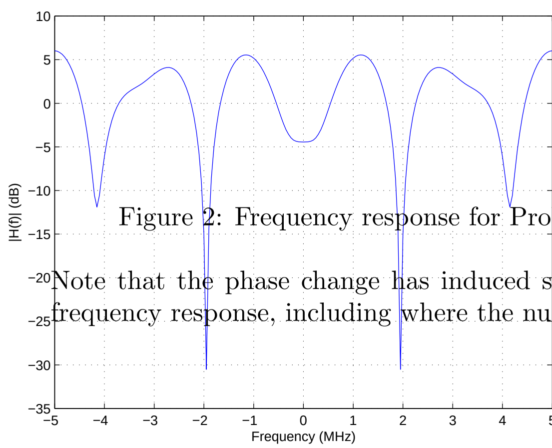

Figure 2: Frequency response for Problem 2.e

Note that the phase change has induced significant changes in the frequency response, including where the nulls are located.