```matlab
%MP2 for GEOL647

clear;
clearvars;
%hello

%q1.4
freq = linspace(0.3,100,10000);
w = 2*pi*freq;


%q1.5
k_M = 400*pi^2;
D_M = 0.05;
ARF = w.^2 ./ (sqrt((k_M - w.^2) .^ 2 + (D_M .* w) .^ 2));
plot(w,ARF,'DisplayName',num2str(D_M))
xlabel('Frequency');ylabel('Amplitude Response')
%The seismometer is most sensitive at about 63 rad^-1, or 10 Hz

%q1.6
set(gca,'xscale','log','yscale','log')
%The sensitivity of the seismometer below the resonant is higher than the
sensitivity above the resonant frequency.

%q1.7
hold on;
xlabel('Frequency');ylabel('Amplitude Response');title('Amplitude Response
while varying damping coefficient')
for i = [0.3,1,3,10]
    ARF = w.^2 ./ (sqrt((k_M - w.^2) .^ 2 + (i .* w) .^ 2));
    plot(w,ARF,'DisplayName',num2str(i))
end

legend

%As D/M increases, the overshoot in the ARF at the resonant frequency is
decreased.

%q1.8
figure;
xlabel('Frequency');ylabel('Phase Delay');title('Phase Delay while varying
damping coefficient')
hold on;
for i = [0.05,0.3,1,3,10]
    PD = atan2(-w .* i,k_M - w .^ 2);
    plot(w,PD,'DisplayName',num2str(i))
end

legend
%Damping causes a "smoothing out" effect in the phase delay around the
resonant frequency. At low D/M, the phase delay occurs abruptly at the
resonant frequency, but an increase in D/M causes this change to occur more
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gradually.

%q1.9
%Based on the results of 7 and 8, a value of D/m that is somehwere in the
middle between 0.05 and 10, say, 3 would be the ideal balance between a
signal that is the most even, but also the least distorted.

%q1.10

figure;
xlabel('Frequency');ylabel('Amplitude Response');title('Amplitude Response,
varying fundamental frequency of spring')
set(gca,'xscale','log','yscale','log')
hold on;
D_M = 3;
for i = linspace(16*pi^2,16000*pi^2,10)
    ARF = w.^2 ./ (sqrt((i - w.^2) .^ 2 + (D_M .* w) .^ 2));
    plot(w,ARF,'DisplayName',num2str(i))
end
legend

figure;
xlabel('Frequency');ylabel('Phase Delay');title('Phase Delay, varying
fundamental frequency of spring')
hold on;
for i = linspace(16*pi^2,16000*pi^2,10)
    PD = atan2(-w .* D_M,i - w .^ 2);
    plot(w,PD,'DisplayName',num2str(i))
end
legend

%Changing k/M changes the resonant frequency of the seismometer, so it
shifts the peak and the dropoff for the ARF and the PD, respectively.

%q1.11

%To maximize sensitivity for long period motion (i.e. low frequency), I
would reduce k and increase m. D does not changes the sensitivity, but
rather the distortion of the signal.

%q2.3
w_0 = 20*pi;
ep = 1;
bt = 1;
figure;
xlabel('Frequency');ylabel('Amplitude Respone');title('Force Feedback
Seismometer')
set(gca,'xscale','log','yscale','log');
hold on;
for AK = linspace(0.1,30,10)
    ARF = (AK .* w .^2) ./ (sqrt((((1+bt*AK) .* w .^2) - w_0^2) .^2 +
(4*ep^2 .* w .^2)));
    plot(w,ARF,'DisplayName',num2str(AK))
end
```
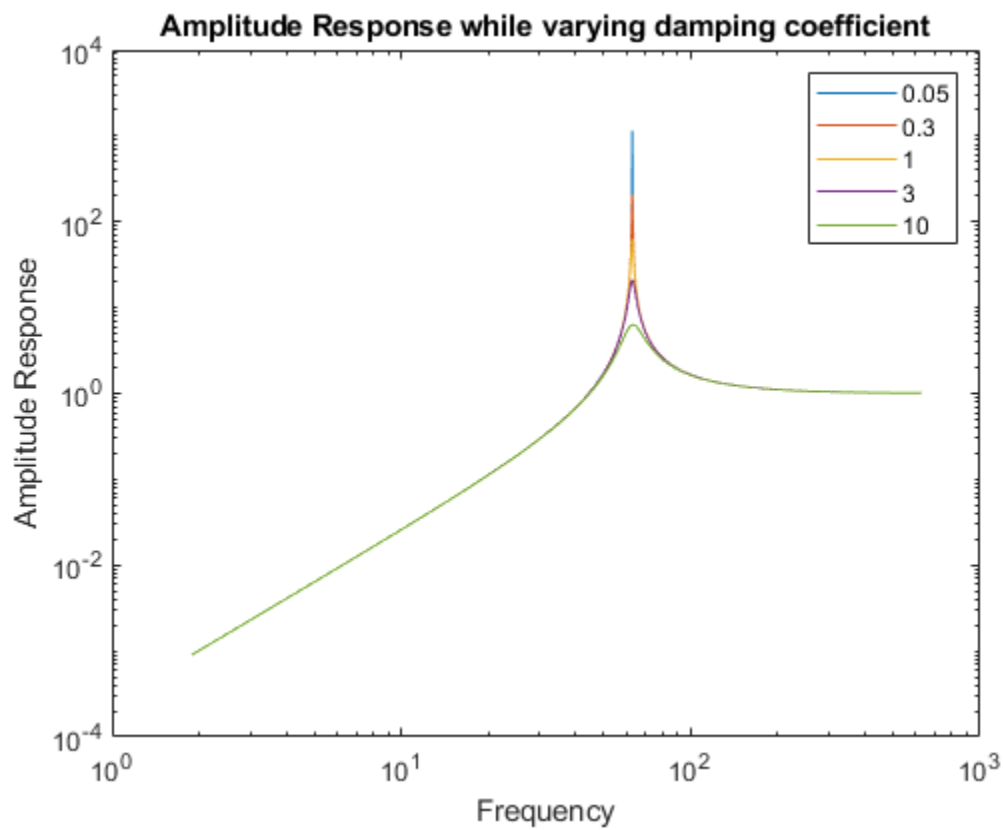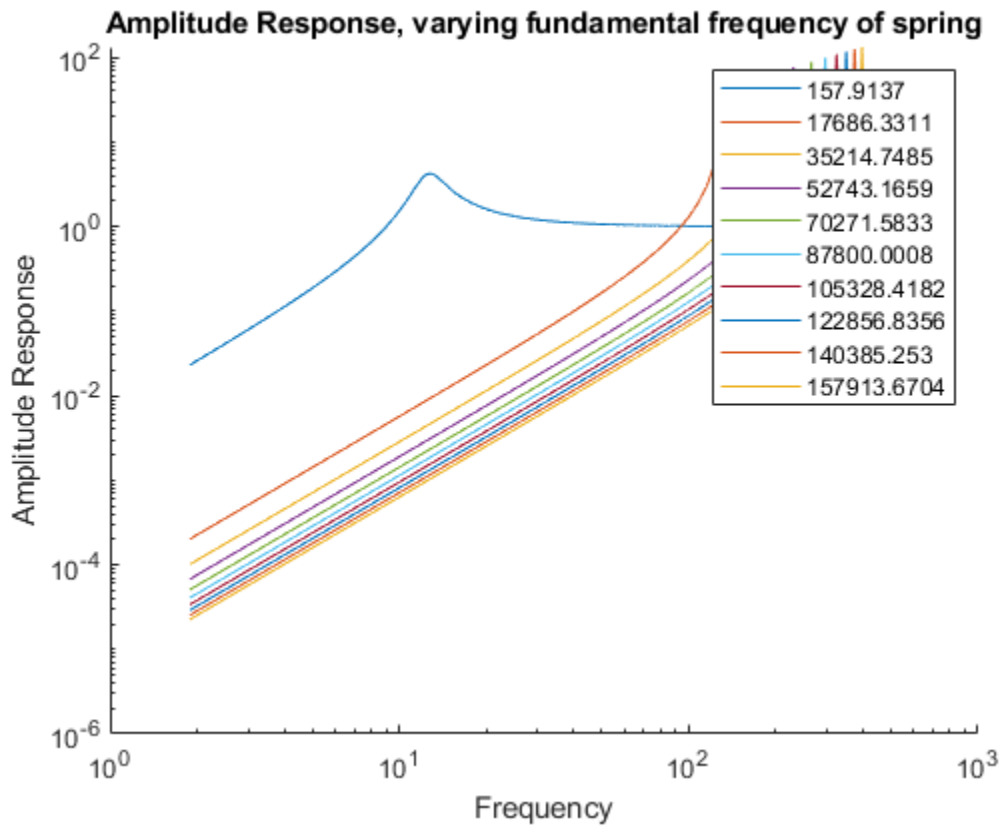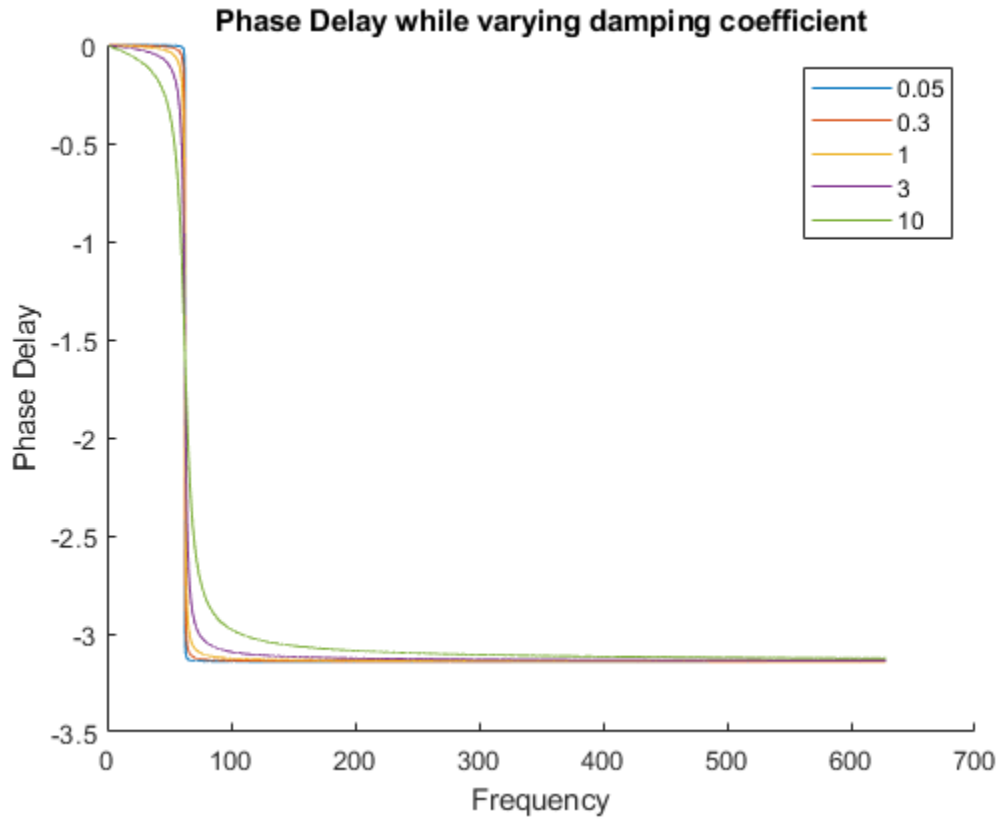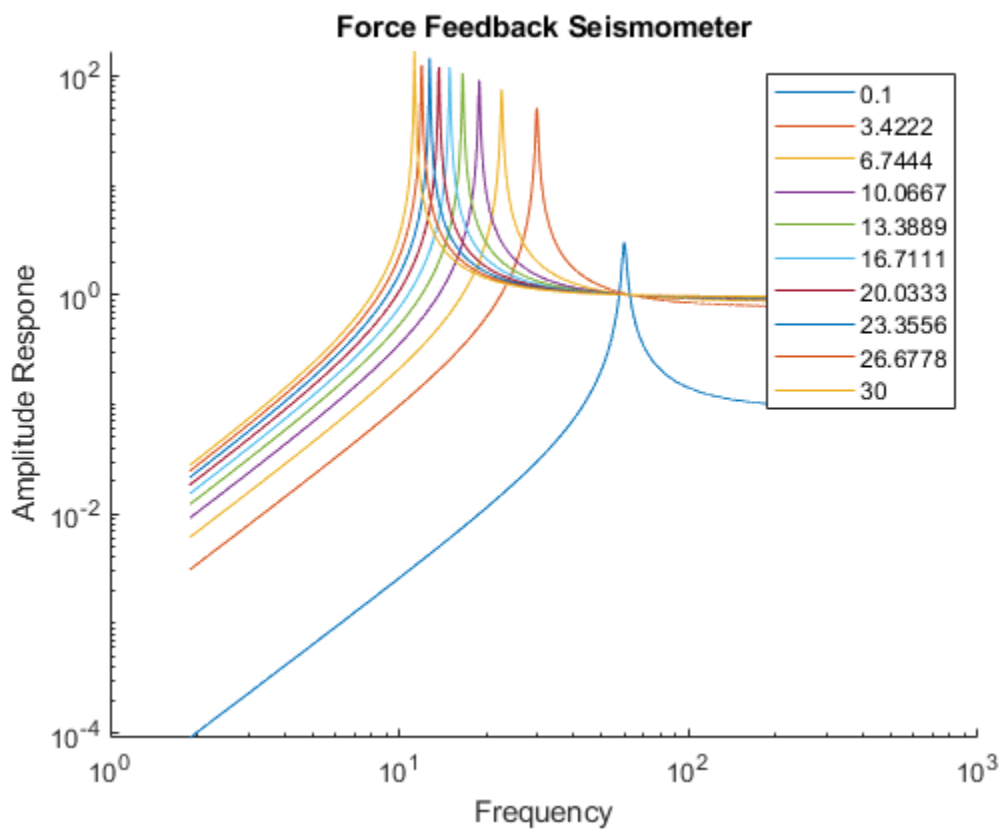
```
legend

%q2.4
%As AK is increased, the resonant frequency decreases. This is different
from part 1, since the fundamental frequency w_0 does not need to change for
the resonant frequency to drop. The general shape of the amplitude response
function. however, is the same for both the inertial seismometer and the
force feedback seismometer.

%q2.5
% A force feedback system gives you a way of easily tuning the fundamental
frequency of your seismometer without adjusting any of the mechanical
components of the system (e.g. spring constant and damping coefficient)
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Amplitude Response while varying damping coefficient

Phase Delay while varying damping coefficient

Legend:
- 0.05
- 0.3
- 1
- 3
- 10

Y-axis: Phase Delay

X-axis: Frequency

Amplitude Response, varying fundamental frequency of spring

Legend:
- 157.9137
- 17686.3311
- 35214.7485
- 52743.1659
- 70271.5833
- 87800.0008
- 105328.4182
- 122856.8356
- 140385.253
- 157913.6704

Y-axis: Amplitude Response

X-axis: Frequency

Phase Delay, varying fundamental frequency of spring

	157.9137
	17686.3311
	35214.7485
	52743.1659
	70271.5833
	87800.0008
	105328.4182
	122856.8356
	140385.253
	157913.6704

Phase Delay (y-axis)
Frequency (x-axis)

Force Feedback Seismometer

	0.1
	3.4222
	6.7444
	10.0667
	13.3889
	16.7111
	20.0333
	23.3556
	26.6778
	30

Amplitude Respone (y-axis)
Frequency (x-axis)