

```

freq_list = [1192.5486, 1255.3804, 1289.3096, 1319.4689, 1359.6813, 1389.8406,
1437.5928, 1500.4247, 1535.6105, 1647.4512, 1678.8671, 1749.2388, 1755.522,
1822.1237, 1940.2476, 2055.8582, 2109.8936, 2167.6989, 2241.8405, 2343.6281,
2470.5485, 2636.4246, 2715.5927, 2909.1148, 3347.6811, 4051.3979, 4424.6191,
5203.7341, 6302.0349, 7458.141]; % freq

water_data = [200, 232, 249, 260, 281, 291, 305, 322, 337, 363, 371, 377, 393, 401,
421, 436, 442, 449, 457, 465, 476, 486, 493, 500, 515, 525, 535, 543, 552, 560]; %
in mL (-200)

```

```
%parameters
```

```

water_density = 1000;
air_density = 1.204;
gamma_air = 7/5 ;
P0 = 1.01325e5;
neck_diameter = 19.03e-3;
neck_length = 79.1e-3;
empty_bottle_mass = 200e-3;
filled_bottle_mass = 580e-3;

area_cx = pi*(neck_diameter/2)^2;
neck_volume = area_cx * neck_length;
neck_air_mass = air_density * neck_volume;
bottle_volume = 380e-6 ;
empty_cavity_volume = 325e-6;
water_mass_list = (water_data - 200) * 1e-3; % kg (1 mL water = 1 g)
water_volume_list = water_mass_list / water_density; % m^3
air_volume_list = bottle_volume - water_volume_list; % m^3 total air

% plots
max_volume = max(air_volume_list);
max_freq = max(freq_list);
figure;
hold on;
%axis([0, 1.1*max_volume, 0, 1.1*max_freq]);
ylim([0 7500]);
plot(air_volume_list, freq_list, 'ro', 'markerfacecolor', 'r');

xlabel('Total Air Volume (m^3)');
ylabel('Angular Frequency \omega (rad/s)');
title('Angular Frequency vs Total Air Volume');

% theoretical prediction (from model)
n_points = 100;
V0_list = linspace(empty_cavity_volume/100, empty_cavity_volume, n_points); % m^3

% predicted stiffness

```

```

predicted_k_list = gamma_air * (area_cx^2) * P0 ./ V0_list; % N/m
m_eff = air_density * area_cx * neck_length; % kg
predicted_freq_list = sqrt(predicted_k_list ./ m_eff); % rad/s
predicted_total_volume = V0_list + neck_volume; % m^3

plot(predicted_total_volume, predicted_freq_list, 'b--', 'linewidth', 2);

% Legend
mylegend = legend('Measured Data', 'Predicted Model');
legend_loc = 'northeast';
set(mylegend, 'location', legend_loc);

grid on;

```

