

Here is a circuit with an AC voltage source of 10V @ 1kHz. C1 = 0.1uF and R1 = 1000 Ohm.

Question 11 pts

What kind of filter is the circuit above?

- ☐ Band Stop
- ☐ Band Pass
- ☐ High Pass
- ☐ Low Pass

Question 21 pts

What is the cutoff point of this filter in Hertz?

- ☐ 1.59 Hz
- ☐ 1592.4 Hz
- ☐ 15.92 Hz
- ☐ 159.24 Hz

Question 31 pts

What is the peak voltage measured by voltage probe PR2?

- ☐ 9.88 V
- ☐ 4.62 V
- ☐ 5.32 V
- ☐ 2.42 V

Question 41 pts

What is the total impedance of the circuit in Ohms?

- ☐ 1433 Ohm
- ☐ 1880 Ohm
- ☐ 1592 Ohm
- ☐ 1013 Ohm



You are building a custom speaker cabinet on a budget, so you decide on a bass-reflex speaker design. You go out and buy a decent driver, a JBL 2123H, whose cone mass is 0.025kg and compliance is $1.4 \times 10^{-4} \text{ m/N}$.

Question 11 pts

What is the free-air **resonance** of the driver in hertz.

- ☐ 127.68 Hz
- ☐ 255.36 Hz
- ☐ 42.56 Hz
- ☐ 85.12 Hz

Question 21 pts

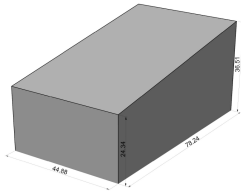
You will eventually put a tweeter in your speaker to take care of the high-frequencies. For now, you want to make part of a crossover network (low pass filter) that starts attenuating frequencies higher than 3000Hz. You rummage around in your parts bin for some electrical components. You find a 500 Ohm resistor. What value of capacitor in microfarads do you need to make a low pass filter with a cutoff point of 3000Hz?

- ☐ $0.1 \mu F$
- ☐ $10.0 \mu F$
- ☐ $0.01 \mu F$
- ☐ $1.0 \mu F$

Question 31 pts

In order to make a good speaker, you want to tune the helmholtz resonance of the ported speaker box to the free-air resonance of the driver. If the volume of the speaker enclosure is 0.01 m^3 and the length of the port is 0.01 m , what does the area of the port have to be in square meters?

- ☐ 0.00241 m^2
- ☐ 0.241 m^2
- ☐ 0.000241 m^2
- ☐ 0.0241 m^2



Reverb time becomes a problem in large rooms because the long distances that sounds have to travel increases the time between echoes and the volume of air in the room stores more energy. Reverb can add to the ambience of an interior space when controlled, but can also interfere with intelligibility if unabated. The room pictured above is not rectangular, but rather wedge-shaped. The dimensions are in **feet**.

Question 11 pts

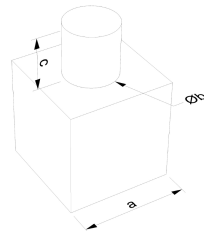
What is the RT_{60} @ 1000 Hz of the room if the average absorption coefficient of the surface materials is 0.25 Sabin?

- ☐ 2.42 s
- ☐ 6.05 s
- ☐ 1.44 s
- ☐ 3.38 s

Question 21 pts

How many occupied, upholstered chairs ($a=0.9$ Sabin each) must you put in this room to make the RT_{60} @ 1000 Hz 1 second?

- ☐ 66
- ☐ 96
- ☐ 126
- ☐ 166



A helmholtz resonator is made from a cubic cardboard box whose length, width and height are dimension a. The neck is made from a mailing tube whose diameter is b and length is c.

$$f = \frac{c}{2\pi} \sqrt{\frac{a}{V}}$$

The frequency of a helmholtz resonator is given by the above equation.

Question 11 pts

If dimension a is 0.1m and dimension b is 0.05m, how **long** does the neck c have to be such that the resonant frequency is 1000Hz

- ☐ 50.24 mm
- ☐ 5.89 mm
- ☐ 11.83 mm
- ☐ 2.96 mm

Question 21 pts

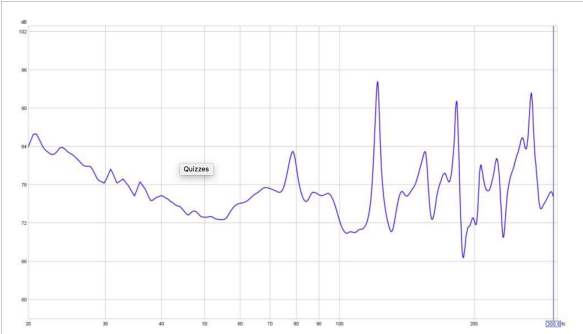
If dimension a is 0.1m and dimension c is .1m, what **diameter** neck is needed such that the resonant frequency is 500Hz?

- ☐ 50.24 mm
- ☐ 118.34 mm
- ☐ 103.12 mm
- ☐ 125.60 mm

Question 31 pts

If dimension b is 0.05m and dimension c is .5m, what does the box edge **length** a have to be such that the resonant frequency is 750Hz?

- ☐ 27.56 mm
- ☐ 56.25 mm
- ☐ 20.94 mm
- ☐ 14.13 mm



Small rooms have resonances due to standing waves that occur between surfaces in the room. These are typically more noticeable in small rooms because the distances are small and therefore the wavelengths of the standing waves are short, giving rise to frequencies in the audible region. If one were to conduct an experiment to determine the room modes empirically, one might play a number of frequencies of the same amplitude into the room and then record the sounds in the room for frequency analysis. If a particular frequency excites a room mode, it's amplitude will be greater than the other frequencies. Given the spectrum above, can you determine the X- and Y-dimensions of the room if the first peak (78Hz) is due to the X-axis axial mode and the second peak (130Hz) is due to the Y-axis?

Question 11 pts

What is the X-Dimension of the room in meters for a fundamental mode of 78Hz.

☐

1.105 m

☐

8.84 m

☐

4.42 m

☐

2.21 m

Question 21 pts

What is the Y-Dimension of the room in meters for a fundamental mode of 130Hz.

☐

1.32 m

☐

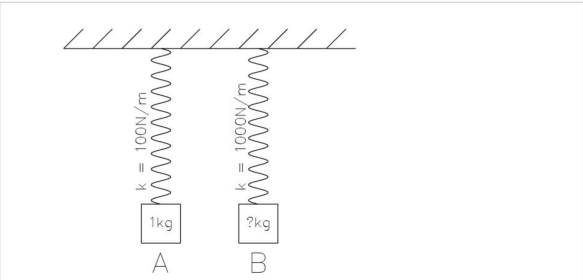
5.28 m

☐

2.64 m

☐

0.66 m



One spring-mass system A consists of a 1 kg mass suspended by a spring with a spring constant, $k = 100\text{N/m}$. Another spring-mass system B consists of a mass suspended by a spring with a spring constant of $k = 1000\text{N/m}$.

Question 11 pts

What is the extension **length** of the spring in system A in meters?

☐

0.98 m

☐

0.098 m

☐

.0098 m

☐

9.8 m

Question 21 pts

What would the **mass** in system B have to be such that both systems have the same extension length?

☐

10 kg

☐

0.1 kg

☐

1 kg

☐

100 kg

Question 31 pts

What **mass** would you have to suspend in system B so that both systems vibrate at the same frequency?

☐

10 kg

☐

1 kg

☐

0.1 kg

☐

100 kg

The drawing above depicts a string stretched between two walls that are some distance ℓ apart. The dotted lines show the standing wave pattern of the fundamental mode.

Dimension $\ell = 10\text{m}$, the diameter of the wire is 1mm and the density is 7700kg/m^3 and the tension is $1 \times 10^5\text{N}$

Question 11 pts

What is the **velocity** of a transverse wave on this string?

☐

604.50 m/s

☐

406.73 m/s

☐

1209.00 m/s

☐

4067.26 m/s

Question 21 pts

What is the **frequency** of the second harmonic?

☐

203.36 Hz

☐

813.52 Hz

☐

1220.28 Hz

☐

406.76 Hz

Question 31 pts

What is the **wavelength** of the third harmonic?

☐

6.67 m

☐

0.67 m

☐

3.33 m

☐

30 m