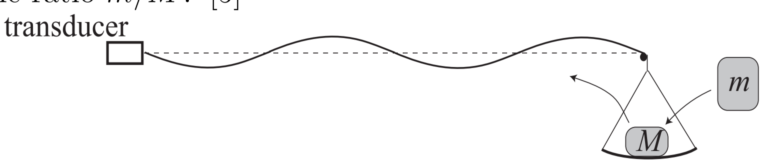
Name: ________________ **Section:** __________ **Score:** __________/20

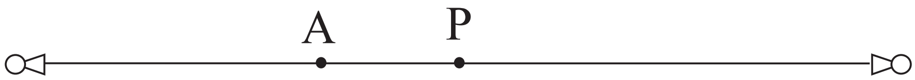
1. WILL Channel 12 TV carrier wave was about 200 MHz. What is the wavelength of this electromagnetic wave in vacuum? The speed of light in vacuum is 3×10^8 m/s. [5]

2. A uniform string is stretched between a transducer of a constant frequency and a smooth peg. The tension in the string is provided by a block of mass M on a massless tray as illustrated below. The number of nodes of the standing wave in the figure is 5 (including both ends). We wish to replace the block of mass M on the tray with another block of mass m (as illustrated) to produce a standing wave with 7 nodes on the string (including both ends). What is the ratio m/M? [5]



(**3** and **4** on the next page)

3. Let the loudness you hear at the midpoint P of two sirens be β. Now, you move to the point A. Is the loudness you hear at A due to these two sirens larger or smaller than β? You must justify your answer. [5]

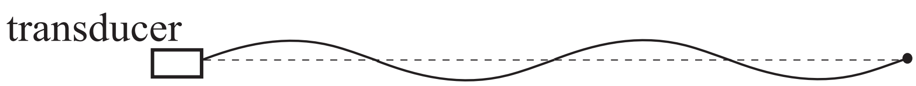


4. You stand on the roadside and are watching a police car approaching you and then receding from you at a constant speed v along a straight road. When the police car approaches you, you observe its siren frequency as 890 Hz. When the police car is receding from you, the frequency you observe is 790 Hz. What is the speed v of the police car? Assume that the speed of sound is 330 m/s. [5]

Name: ____________________ **Section:** __________ **Score:** __________/**20**

1. The wavelength of a sound wave in medium A is 1.2 m, and that in medium B is 2.3 m. What is the ratio of the sound speeds in these two media, c_A/c_B, where c_A (resp., c_B) is the sound speed in medium A (resp., B)? [5]

2. A uniform string is stretched with a tension T between a transducer of a constant frequency and a peg. The number of nodes of the standing wave in the figure is 5 (including both ends). We wish to produce a standing wave with 7 nodes on the string (including both ends) by modifying the tension from T to T'. What is the ratio T'/T? [5]



(**3** and **4** on the next page)

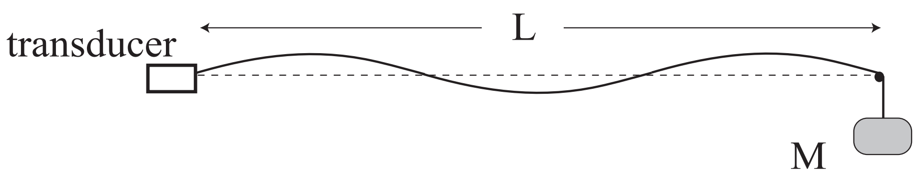
3. The loudness you hear is β from two identical sirens placed 2 m away from you. Now, you prepare 5 of the same sirens and place all of them L m away from you. Then, you observe the identical loudness β as before. What is L? [5]

4. You are driving a car at a speed 18 m/s along a straight road. Then, a police car catches up and passes you at a constant speed v. You hear the siren frequency change from 650 Hz to 620 Hz. What is the speed of the police car? Assume that the speed of sound is 330 m/s. [5]

Name: ____________ **Section:** ________ **Score:** ________/20

1. A gravitational wave produced by a supernova propagates at the speed of light ($= 3 \times 10^8$ m/s). The frequency is 1.2 GHz. What is the wavelength? [5]

2. A uniform string of linear density μ_0 is stretched with a tension T between a transducer of a constant frequency and a peg, and the tension is provided by a mass M. The number of nodes in the figure is 4 (including both ends). We wish to to produce a standing wave with 5 nodes on the string (including both ends) by replacing the string with a different linear density μ_1. What is the ratio μ_1/μ_0? [5]



(**3** and **4** on the next page)

3. The loudness you hear is β from three identical sirens placed 3 m away from you. Now, you prepare 5 of the same sirens and place all of them 5 m away from you. The loudness you hear now is β'. What is the difference $\beta' - \beta$? [5]

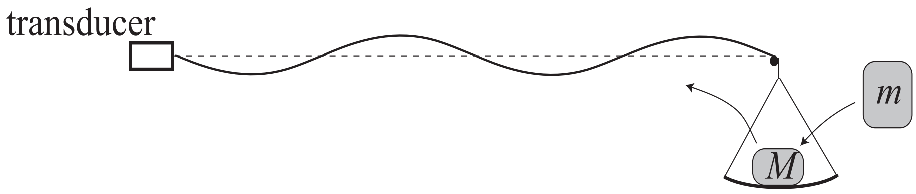
4. You are driving a car at a speed of 18 m/s along a straight road. Then, a police car comes along the opposite lane toward you and passes you. You hear the siren frequency change from 850 Hz to 620 Hz. What is the speed v of the police car? Assume that the speed of sound is 330 m/s. [5]

Physics 101 (F11) **Q10D**

Name: ____________ **Section:** ________ **Score:** ________/20

1. What is the frequency of light of wavelength $\lambda = 350$ nm? The speed of light is 3×10^8 m/s and 1 nm = 10^{-9} m. [5]

2. A uniform string of linear density μ_0 is stretched with a tension T between a transducer of a constant frequency and a peg, and the tension is provided by a mass M. The number of nodes in the figure is 5 (including both ends). We wish to produce a standing wave with 4 nodes on the string (including both ends) by replacing the mass M with another mass m. What is the ratio m/M?[5]



(**3** and **4** on the next page)

3. Which is larger, the loudness β_1 due to 100 identical sirens placed at 50 m or that β_2 due to 200 sirens (the same ones as before) placed at 70 m? [5]

4. On a salt flat a car propelled by a jet engine reaches a speed of $c/3$, where c is the speed of sound. The car zips past you along a straight trajectory. A siren is placed on the car. What is the ratio of the frequency f_A you hear while the car is approaching and the frequency f_R you hear while the car is receding from you? [5]