

**Physics 221**  
**Exam 1**  
**Take home portion**

Name: \_\_\_\_\_

Read [Acoustic Communication](#) from “Elephant Voices”

You are encouraged to discuss this article with your classmates but are required to do your own work.

**Directions:** Use your own words to demonstrate your understanding of the concepts. Direct quotes from the article are not acceptable unless they are followed by an interpretation in your own words. In all cases be sure to describe exactly how and why something works.

Note: Be careful with your terminology. For example, make sure you don't mix up vibration and resonate.

1. Discuss what the two graphs on the first page are showing and how it correlates with the sound you hear. Be very specific.
2. When we generalized how musical instruments work we came up with three features that an instrument needed to make music. Apply this generalization to elephant voices. *Describe* the three mechanisms that elephants use to make sound, produce a variety of notes and amplify the sound.
3. Describe in detail how the elephant can produce lower frequencies than humans can.
4. Describe in detail the multiple features of elephants' ears that have adapted to sensing very low frequency sounds.
5. What is localization of sound? Can elephants do this better than humans? Explain your reasoning.
6. Explain why the article says an elephant call can range from 27 Hz to 470 Hz but then it says it can range from 5 Hz to 10,000 Hz. What is the difference here?
7. The article states that sound attenuates “...6 db for every doubling of distance from the source.” *Mathematically demonstrate* that this is the case. Use values that are not offered as examples in the article.
8. Do high frequencies follow the 6 dB rule? Explain your reasoning.
9. How far can elephants typically communicate? What is the Intensity Level of a sound at this range if the call is 110 dB at the source? Show your calculations.
10. By what mechanism are elephants able to determine the distance another elephant is away?