



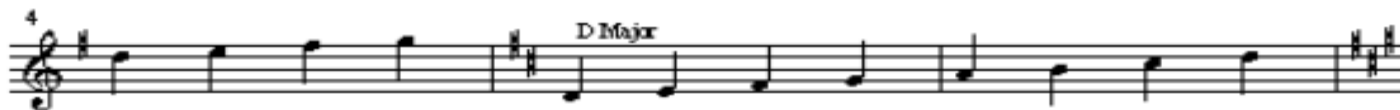
The Twelfth Annual University of Scranton

2015 Kane Competition

April 15th, 2015



Music, Waves, and Oscillations



Theme Overview

Music, waves, and oscillations will be covered throughout the day culminating in a guitar concert at the end of the competition. Teams will compete in hands-on events including an event involving a light wave detection circuit, an event covering acoustic path length differences, and an event with oversized electric guitars.

General Rules:

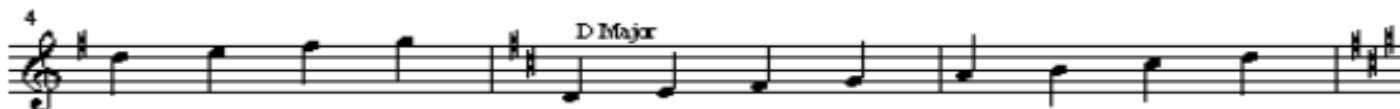
1. Teams may have between 5 and 7 members.
2. All teams must compete in all events.
3. Decisions of the judges are final in all events.
4. **Cell phones** and other electronic or communication devices will not be allowed in the competition.
5. Each student may bring one (1) calculator of any type (no cell phone calculators), but no other reference materials or devices are allowed apart from what is given to the teams on the day of the competition. Kane coaches are responsible for making sure graphing calculator memory does not contain anything to give their teams a competitive advantage.
6. Calculators **will not be provided**.

Competition Information

The Kane Competition is sponsored by the University of Scranton. This is a competition designed, organized, and administered by the physics and engineering students of the Department of Physics and Electrical Engineering. Financial sponsorship is provided by a gift from the Joseph Kane Estate and Mr. Edward Hayes. The wording of each event in this rule book has been prepared to define each task as much as possible. Please send all inquiries to:

Prof. Nicholas Truncale - Kane Competition Administrator

Nicholas.truncale@scranton.edu



Event 1:

Kane Quiz

The Kane Quiz will be a 30-minute multiple-choice test of general knowledge in mechanics, waves, optics, electromagnetism, and circuits. The students with the top three scores in the quiz event will advance to the Jeopardy Event at the conclusion of the competition. Quiz questions will be similar to those found on the AP physics test.

Rules

1. No outside materials other than your calculator may be used for the individual quiz competition. Pencils, scratch paper, and an equation sheet (similar to the one used in the AP physics test) will be supplied.
2. Team Competition: All students may compete in the quiz and the sum of the scores of all the students will be used to determine the team quiz score.
3. Jeopardy Qualifier: The students with the three highest quiz scores will qualify for the Jeopardy Event. In the case of a tie, a tie breaker quiz will be administered during lunch.

Scoring

On the written quiz, one point will be awarded for each correct answer. Incorrect answers will be penalized -0.2 points to discourage random guessing. The team score will be calculated as follows:

$$Score = 100 \times \frac{S}{T}$$

Where S is average score of the teams' members and T is highest average scores across all competing teams.

Event 2:

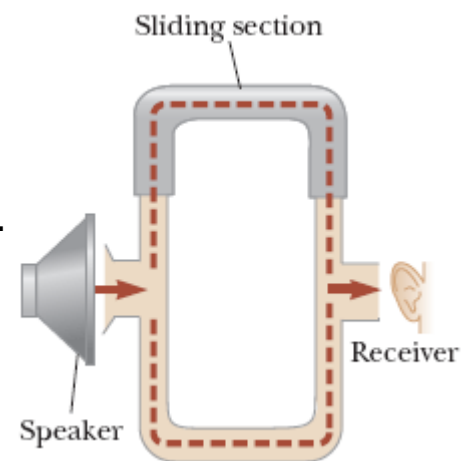
Acoustic Wave Fronts and Interferometry

Goal and Description

When you listen to music, multiple sounds/notes travel through the air and enter your ear for processing. What happens when multiple sounds with different frequencies and amplitudes enter your ear at the same time? Do the sound waves add together and if so how does that work? Teams will investigate wave fronts, path length difference, and interference by answering questions dealing with two apparatuses.

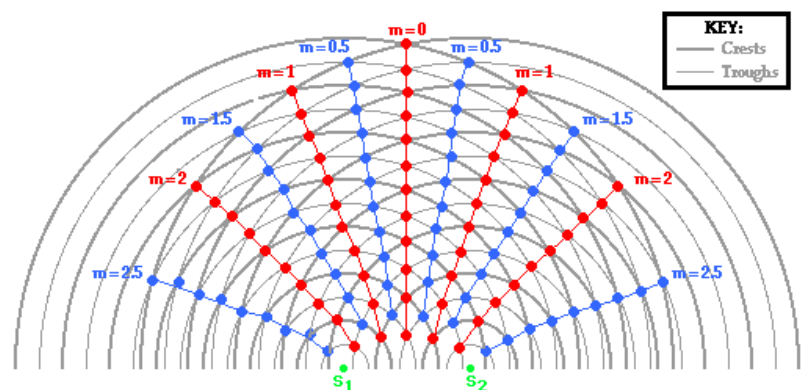
Apparatuses

One of the apparatuses consists of PVC pipes of varying lengths with one acoustic source at an opening and an acoustic receiver at another. A sample diagram of this apparatus is shown to the right as an example.



College Physics by Serway and Vuille, pg. 519 #34

The other apparatus consists of two acoustic sources with a common acoustic wave generator. The two sources mentioned will therefore be in phase with each other.



<http://www.physicsclassroom.com/class/light/Lesson-3/The-Path-Difference>

Materials

At the end of the event round, a demonstration of the solution using sample apparatuses will occur.

Event 3:

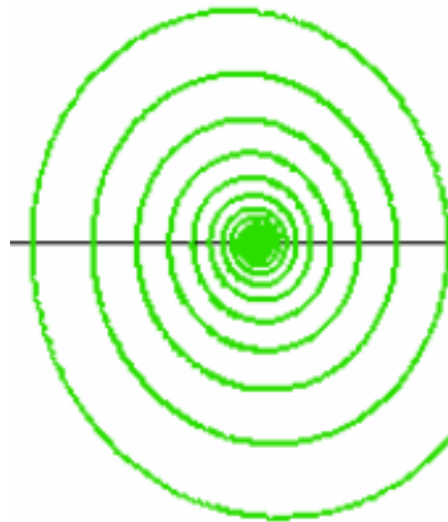
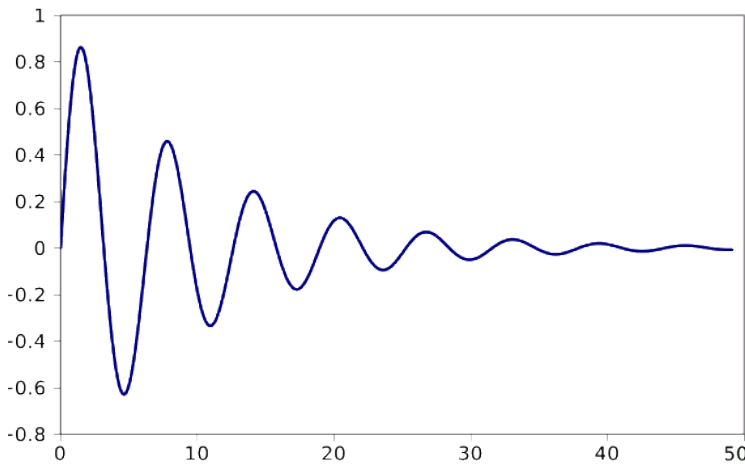
Reverse Engineering with Oscillators

Goal

A typical Kane event involves using a pre-defined procedure that is used to solve a problem. In this reverse engineering event, teams will be given the solutions to various problems and then will have to design and test procedures to verify those solutions. The solutions will involve types of simple harmonic oscillators.

Description

The theme of this event will be oscillations. Students will be given a variety of plots but the titles, axes, and units will be omitted. The teams will be tasked with creating a unique procedure to reproduce plots. Some sample plots are shown below:



Apparatus

Teams will be given a common set of equipment to use throughout the event. Each team will have access to linear and rotary motion sensors connected to iPads for their data collection. Clear directions will be given to teams so they know how to use the technology provided. Teams will be given time to choose *other* equipment and supplies for use during the event. It will be possible to re-create plots in a variety of different ways.

Event 4:

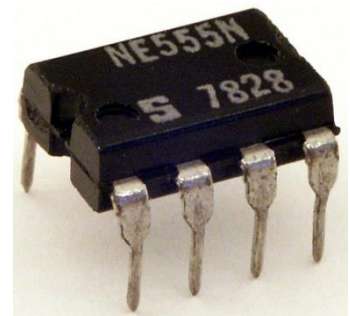
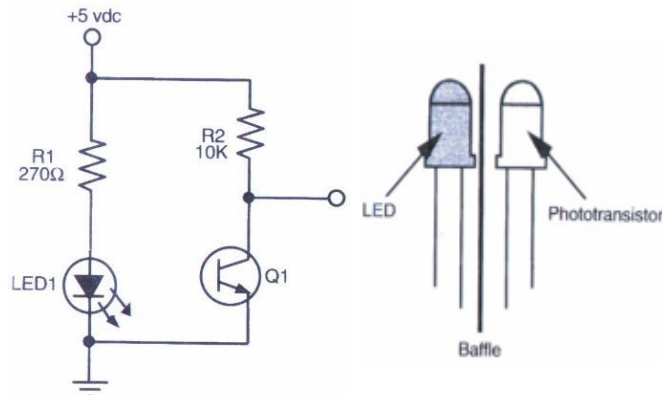
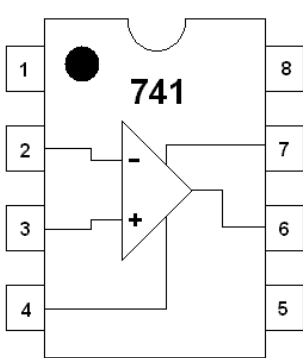
Has the Band Arrived Yet?

Goal

Teams will attempt to create a detection system using, among other things, light and sound. This detection system will provide the concert venue with a notification that the band has arrived with both a visual and auditory components.

Description

Separate introductory circuits will be needed to create the detection system. Students should prepare for this event by studying resistor color band codes, learn about how LEDs can be connected in a circuit, and learn (at a very introductory level) how an operation amplifier works as well as a 555 timer. All necessary knowledge on how to use breadboards, read circuit diagrams, and using an RC time constant to create a signal, will be provided to the teams. Don't be intimidated by these components. We will teach you everything you need to know!



Apparatus

Each team will be given their own set of equipment to use throughout the event. Some of the equipment includes breadboards, jumper wires, resistors, a power source, an operational amplifier and 555 timer with appropriate documentation, etc. Each team will also have access to a hot wheels track where part of their circuit will be used to detect a moving car simulating the arrival of the band.

Event 5:

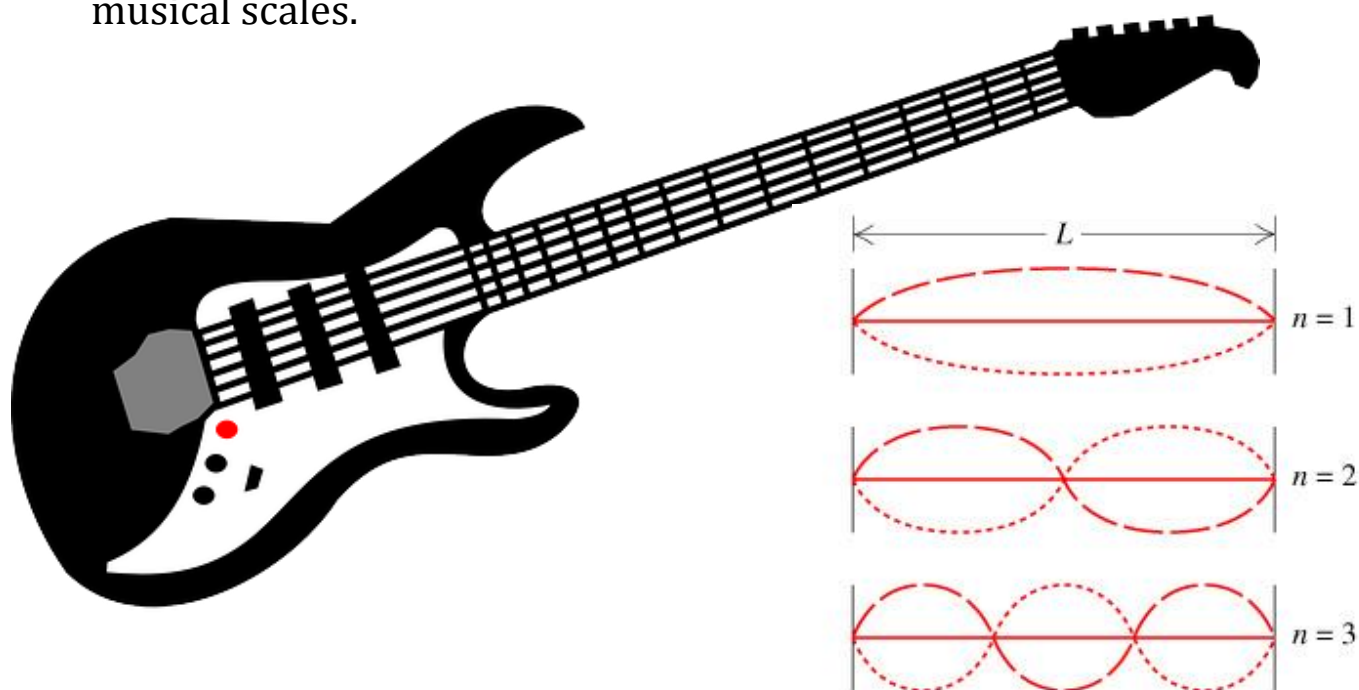
Guitar Concert

Goal

The band playing at the concert venue is late to their show so the audience decides to play their own music on the band's equipment. Teams will collaborate to play a song on oversized electric guitars.

Description

When a guitar string is plucked, a standing wave forms on the mono-filament string. Each team will be assigned a variety of musical notes (frequencies) from which they will determine the tension needed and/or the depressed fret needed to produce the correct note. All of the teams will display their notes on large blank musical scales.



Apparatus

Each team will be given a common set of equipment to use throughout the event. At the end of the event round, the song composed across all the teams will be played to the audience. And if the band ever arrives, a musical performance may ensue! Musically inclined Kane coaches should expect to be involved!



Awards

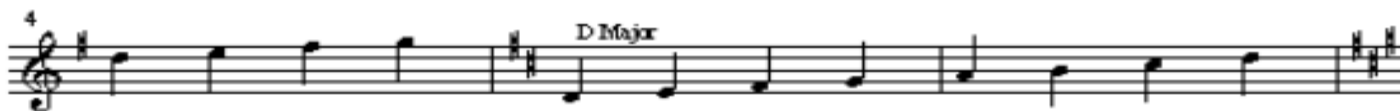
Team Prizes:

- Gold, silver, and bronze medals along with a trophy will be awarded to the three teams with the highest aggregate scores. A perpetual trophy, the “Kane Cup” will be awarded to the school sponsoring the team achieving the highest aggregate score.
- The Kane Ingenuity Awards will honor the best answers to each event. The judges will select those entries that have that certain something that brightens a physics teacher’s day; it is part flair, style, or panache and part pure ingenuity.

Individual Prizes:

- A \$1500 University of Scranton Scholarship will be awarded to the highest placing student in the Jeopardy round. The University of Scranton must be the recipient’s choice for post-secondary education and begin attending in the fall of 2015. Otherwise it will be granted to the student with the highest written quiz score attending The University of Scranton in the fall of 2015.¹
- Plaques will be presented to the top three Kane Quiz participants along with college bookstore gift cards to the university/college they will attend. These prizes will be tiered \$500, \$300, and \$200.
- The theme this year is Music, Waves, and Oscillations, which we assume may inspire many students to dress in costume. We encourage students to dress up as long as it is appropriate for school. A best costume award will be granted based upon the opinion of a committee of Kane volunteers.

¹ In the event the recipient of The University of Scranton Scholarship cannot accept the scholarship due to financial aid reasons, an alternative prize worth up to \$600 will be awarded. Any questions about this should be directed to the Kane Competition Administrator.



Event Schedule

Time	Team Groups		
8:00 – 8:30	Registration		
8:30 – 8:40	Welcome, Introduction, Organization, and Rules Summary		
8:45 – 9:15	Event 1: Kane Quiz		
9:20 - 10:00	Event 2	Event 3	Event 4
10:05 – 10:45	Event 3	Event 4	Event 2
10:50 - 11:30	Event 4	Event 2	Event 3
11:35 - 12:25	Lunch and Photographs		
12:30 – 1:10	Event 5: Guitar Concert		
1:20 – 1:45	Jeopardy Quiz Finals in Moscovitz Theater		
1:45 – 2:00	Award Ceremony		

Note to Kane Coaches

When we created the competition we chose the term “Kane coaches” because we hope you can spend time in your classes prepping for Kane *but also* after school or during open periods to prepare your students so they may excel at the competition. We appreciate the extra time you put in to prepare your students. Our mission is to increase interest in physics and engineering which we know is a goal we all share. We are looking forward to this year’s competition!

-The Kane Team

