
UNIVERSITY OF
BATH
isaac
Physics. You work it out.
Greendale
FESTIVAL
Music in the hills

Name_____

Contents

How to join the Isaac Physics group

To create an account:

Go to isaacphysics.org

Click ‘Log in’ at the top right

Sign up with Google, Twitter, Facebook, or on the website

To join our teaching group:

Click on ‘Menu’ on the left, below the Isaac Physics logo

Click ‘My Account’

Choose the ‘Teacher Connections’ tab

Enter the code: _____ and click ‘Connect’

Click ‘Ok’ on the pop up message

Questions that have been set for you will appear in ‘Menu’ -> ‘My Assignments’

Town Hall
School Road
Greendale
GD1 5PP
0111 922 2000

Dear Project Manager,

Invitation to bid for **Greendale Music Festival**

Greendale Council is inviting bids for the contract to construct the stage at an upcoming music festival. This festival is a three-day event to be held at an outdoor site (shown on next page), which has a capacity of 15,000 people. Greendale Council is committed to environmental sustainability, and bidders are encouraged to prioritise this.

Each company will be expected to provide a plan including details of:

- Site layout
- Sound equipment
- Lighting equipment
- Staging

Bidders are also expected to give suggestions for five bands that would be suitable for the festival and a logo for the festival. Companies will need to suggest a ticket price for the festival. The ticket price must cover the costs of the festival and give your company a profit, but remember if your ticket price is too high people will not attend the festival.

A representative from the University of Bath will provide guidance over the coming weeks to help with process of selecting equipment and designing your proposal.

All bidders should provide a detailed proposal and details of the equipment they will use. The deadline for all bids is _____, at which time companies are expected to present a three-minute talk about their proposal to the council. The winning company will be the one that has the most complete proposal meeting the council's requirements, has the best understanding of why they have selected items in the plan and how much profit the company will make.

Yours faithfully,

Outdoor Event Manager

Greendale FESTIVAL

Music in the hills

Festival site

Details of the site:

- The festival site is on a hillside, sloping from the north-west to a peak in the south-east.
- All roads will need to remain open during the festival.

Music festival roles

Roles

In your groups you will need to divide up the jobs needed to produce your music festival. Choose which member of the group best fits the traits listed.

1 Creative Spatially aware Using diagrams Name_____ Job role_____ _____	**2** Analytical Using diagrams Numerical Name_____ Job role_____ _____	**3** Spatially aware Analytical Numerical Name_____ Job role_____ _____
4 Attention to detail Advising others Assessing risk Name_____ Job role_____ _____	**5** Organisation Leadership Planning Name_____ Job role_____ _____	**6** Creative Analytical Visual Name_____ Job role_____ _____

Between sessions

- Log on to Isaac Physics and complete this week's assignment

- Watch the video at https://goo.gl/hyeBWZ and answer the questions

What is an electrical engineer?

_____

_____

What do they do?

_____

_____

What would their role be in organising a music festival?

_____

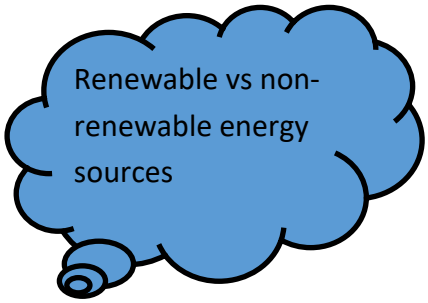
_____

_____

_____

Power

What are the benefits of renewable vs. non-renewable energy sources?



In my opinion:

The biggest benefit of renewable energy is :

_____

_____

_____

The biggest drawback of renewable energy is:

_____

_____

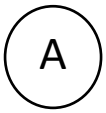
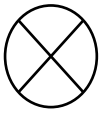
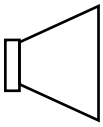
_____

Complete the table below:

	Symbol	Units	Description
Current			
Voltage			
Resistance			
Power			

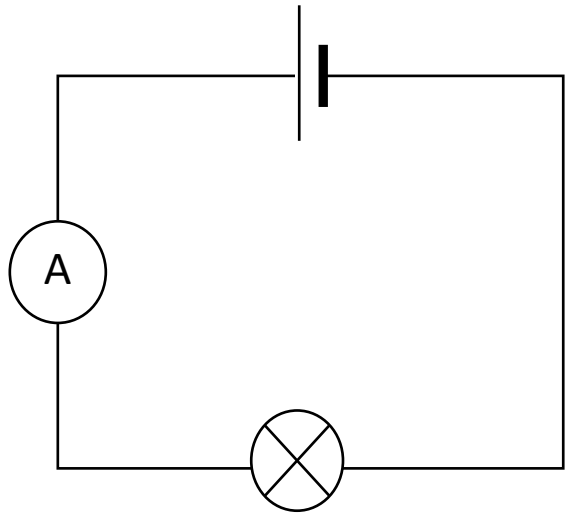
Write an equation for the relationship between current, voltage and resistance:

Write an equation for the relationship between current, voltage and power:

Symbol	Component	Symbol	Component
			
			
			

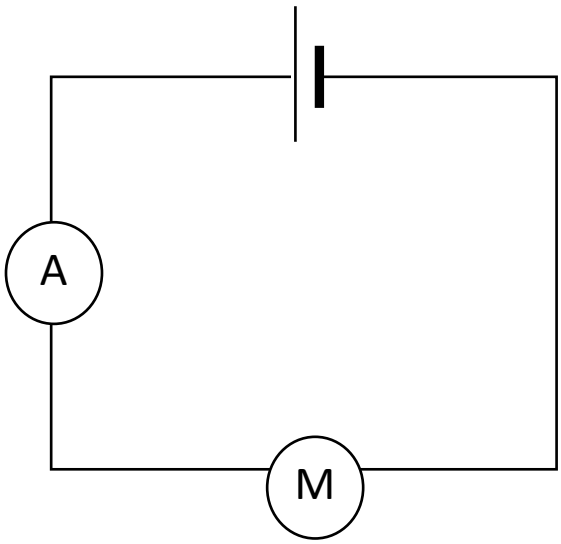
Power

Use the components to create the following circuits. Measure the current in the circuit and calculate the power.



Current: _____

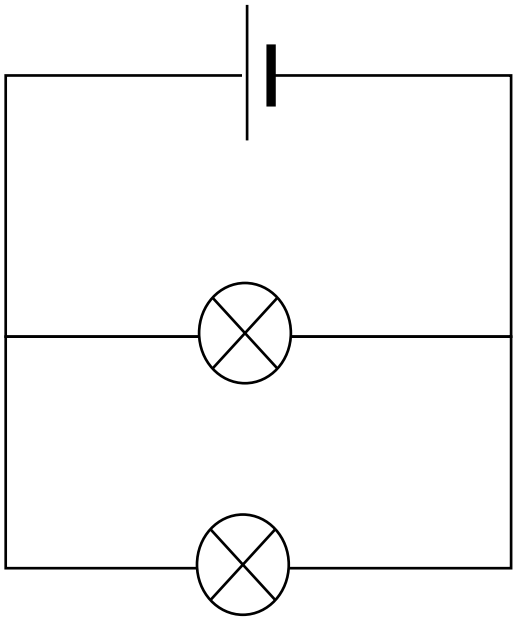
Power:_____



Current: _____

Power:_____

Use the components to create the following circuits. Measure the voltage and current for each bulb. Are they both using the same power?



Current: _____

Power:_____

Current: _____

Power:_____

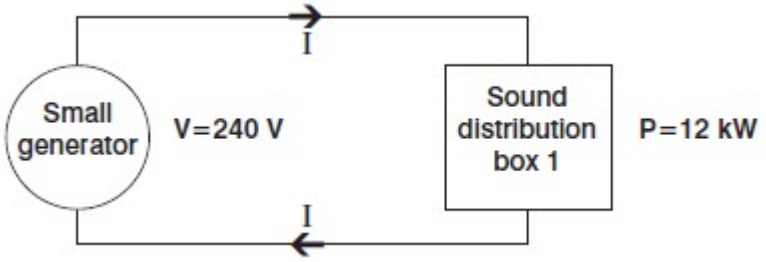
How will we use this in our music festival?

You will need to hire equipment and buy fuel to provide enough power for all you lighting and sound systems. You will also need to select the right cables to carry the current you need. Try the following examples:

1. Our speaker system consists of four speakers requiring 10kW of power each and a bass speaker requiring 2kW of power. What is the total power that you need from your generator?

2. You hire a diesel generator which can provide power of up to 60kW. Fuel for the generator costs £1 per litre, and the generator consumes 0.5 litres of fuel per kW per hour. How much will the fuel cost to power your speakers for 10 hours per day at a 3-day festival?

3. Your generator is connected to a distribution box as shown in the diagram below. Which cables should you choose for your circuit (tick the box next to your selection)?



Cable diameter	Maximum current	Cost	
2.5mm	16A	£10	
4mm	32A	£20	
16mm	63A	£30	
35mm	125A	£50	

Between sessions

- Log on to Isaac Physics and complete this week's assignment

- Watch the video at https://goo.gl/rAVQaD and answer the questions

What is a sound engineer?

_____

_____

What do they do?

_____

_____

What would their role be in organising a music festival?

_____

_____

_____

_____

- Watch the video at https://goo.gl/CDE7d4 and answer the questions

What is a lighting engineer?

_____

_____

What do they do?

_____

_____

What would their role be in organising a music festival?

_____

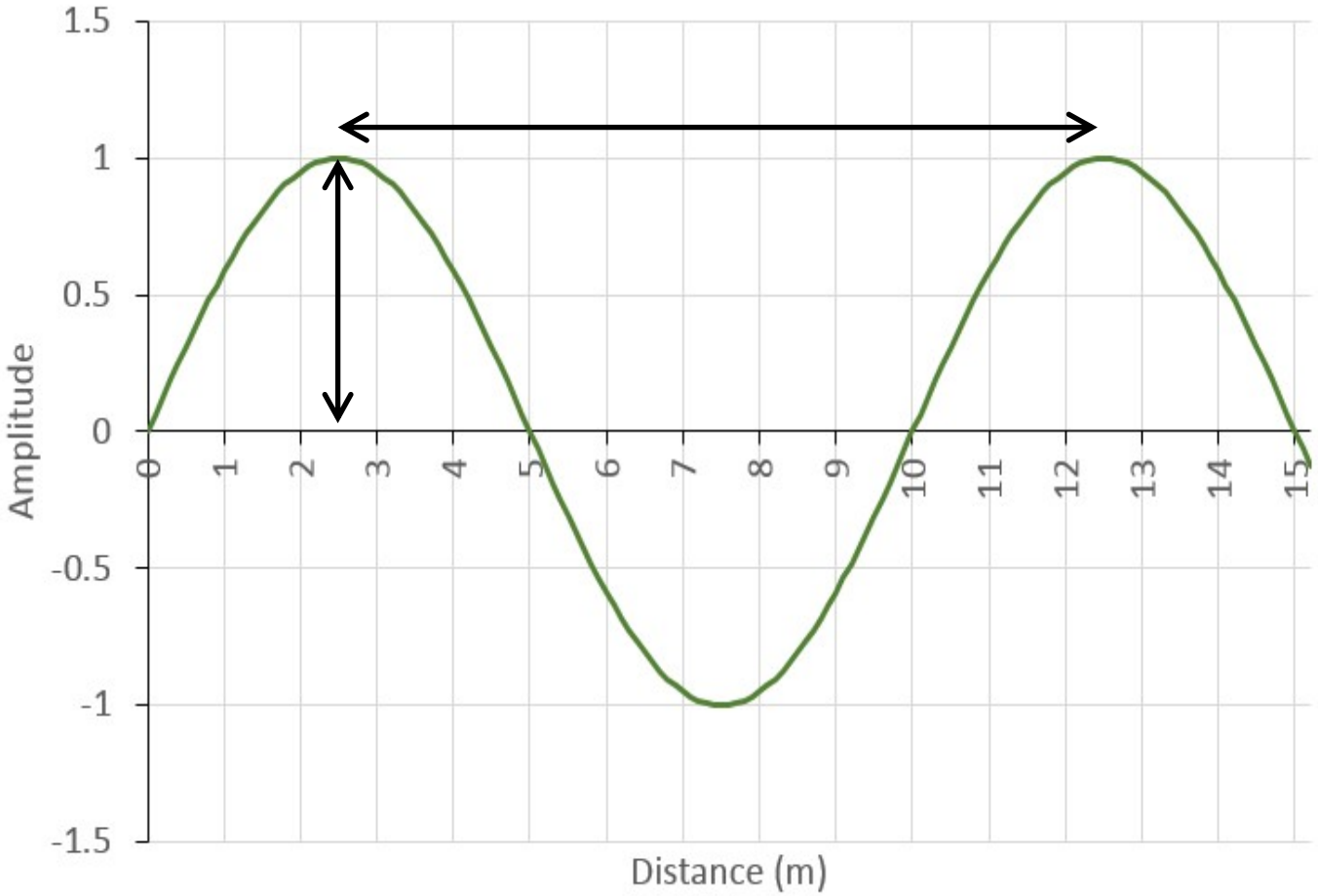
_____

_____

_____

Sound

Light



Sound

Light

Write an equation for the relationship between frequency, wavelength and speed of a wave:

Wave property	Symbol	Units	Light wave	Sound wave
Frequency				
Wavelength				
Speed				
Amplitude				

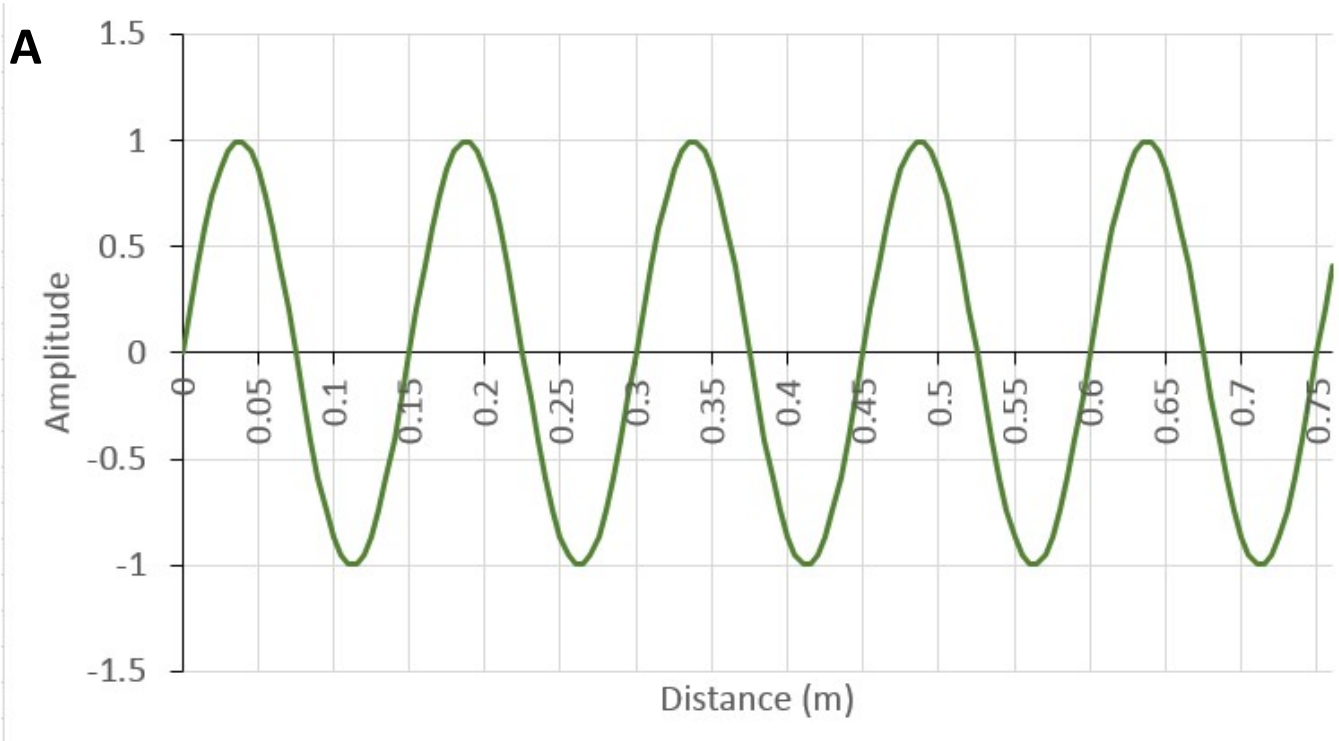
Sound

Sound level	Example
0dB	Threshold of human hearing
10dB	Breathing
20dB	Rustling leaves
30dB	Whispering
40dB	Quiet library
50dB	Rain
60dB	Normal conversation (from 1m distance)
70dB	Vacuum cleaner
80dB	Alarm clock
90db	Lawn mower
100dB	Motorcycle
110dB	Screaming baby
120dB	Thunderclap
130dB	Threshold of pain

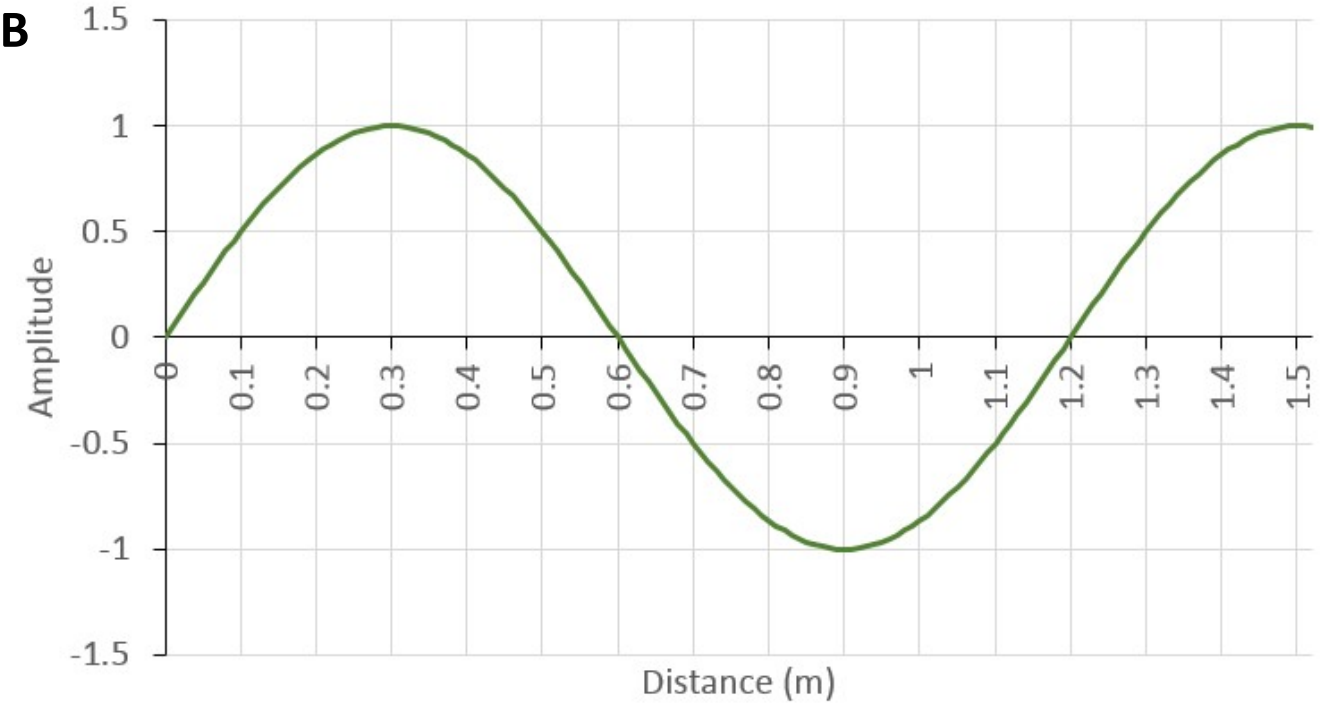
Calculate the amplitude, wavelength and frequency of the waves A-C.

Use a frequency generator to produce a sound that matches the waveform.

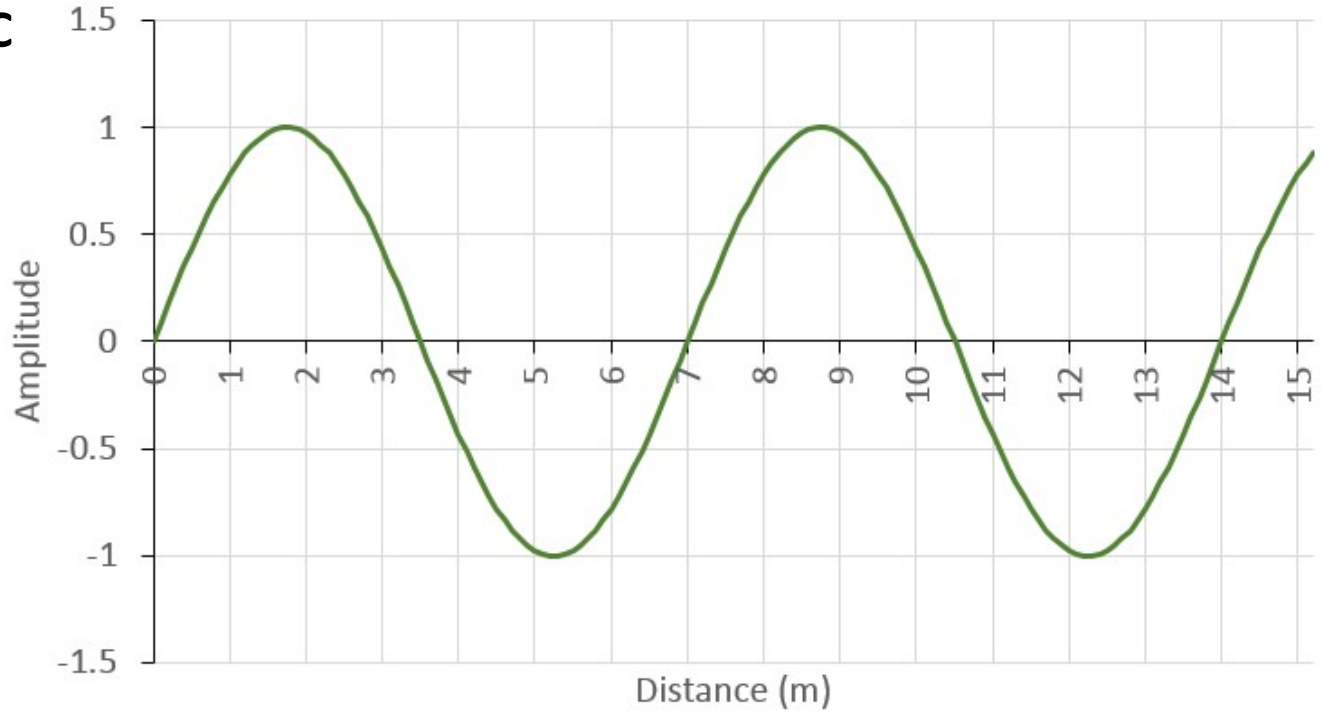
A



B

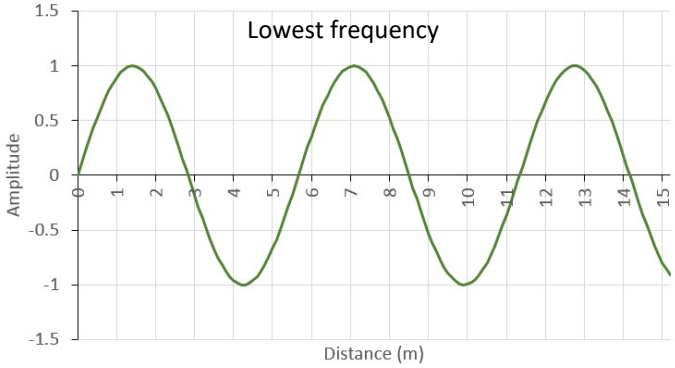

1.5
1
0.5
0
-0.5
-1
-1.5
Amplitude
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
1.2
1.3
1.4
1.5
Distance (m)

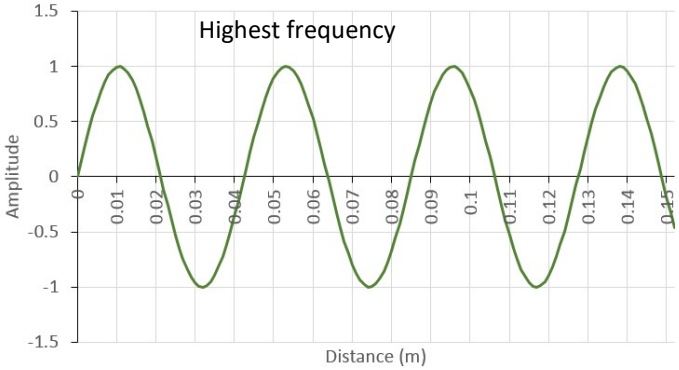
C


1.5
1
0.5
0
-0.5
-1
-1.5
Amplitude
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Distance (m)

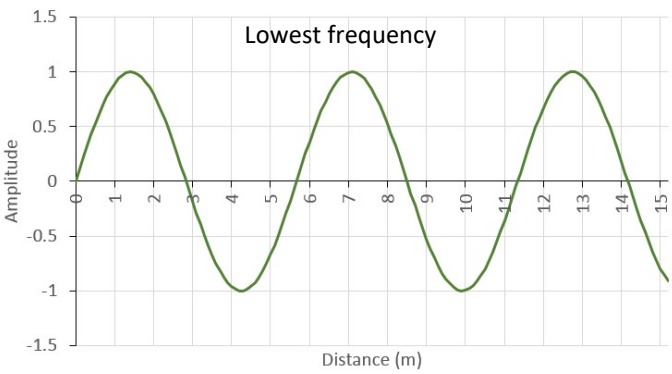
Useful information: Typical frequency ranges for different musical genres

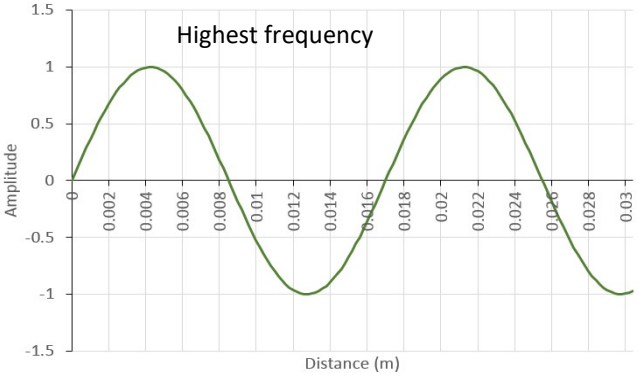
Rock



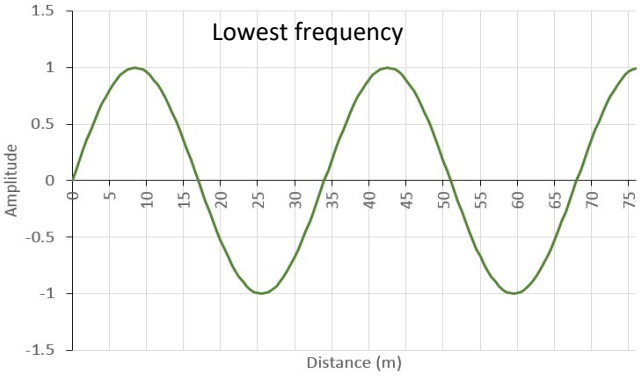


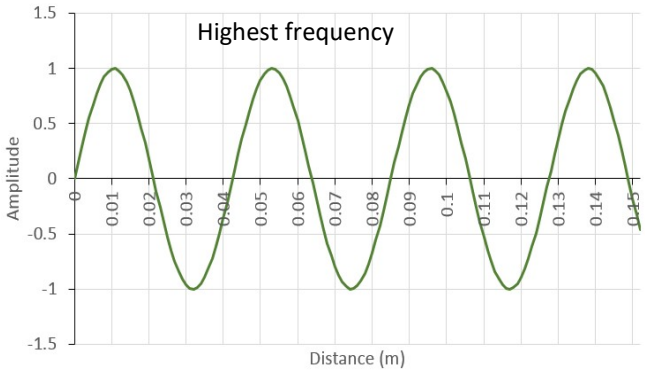
Pop



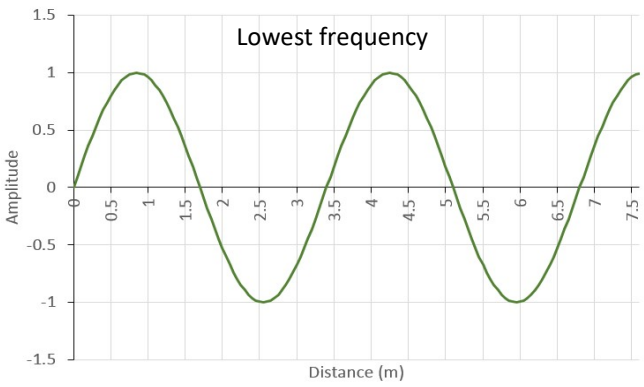


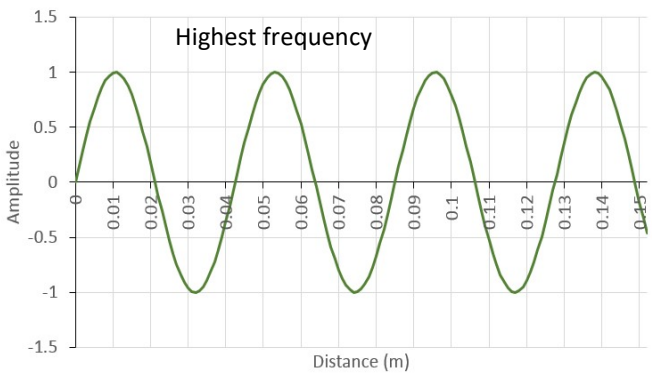
Drum and Bass



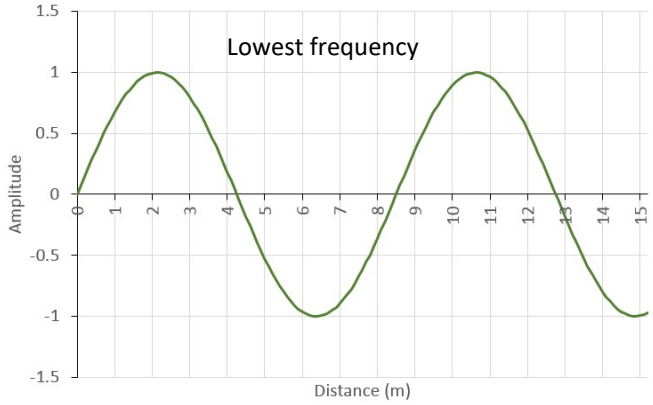


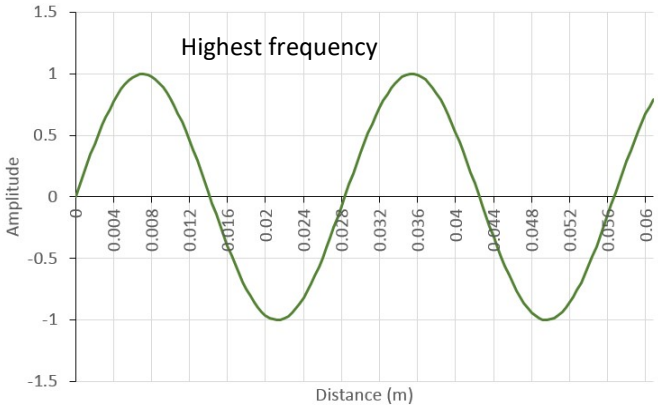
Country



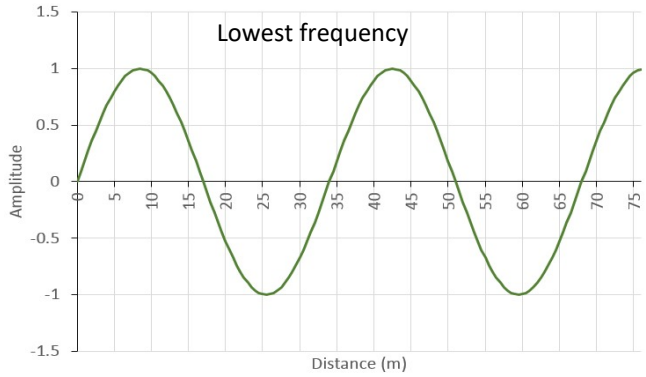


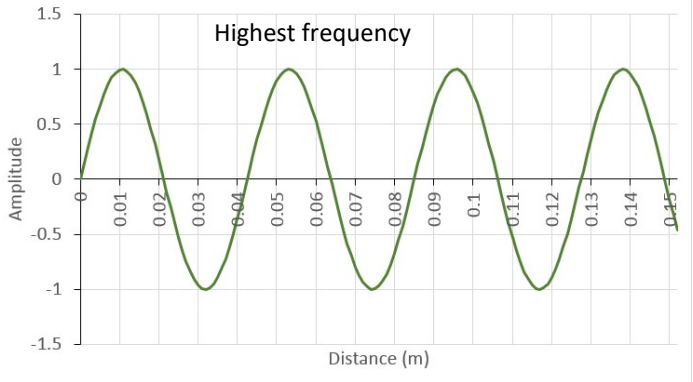
Classical



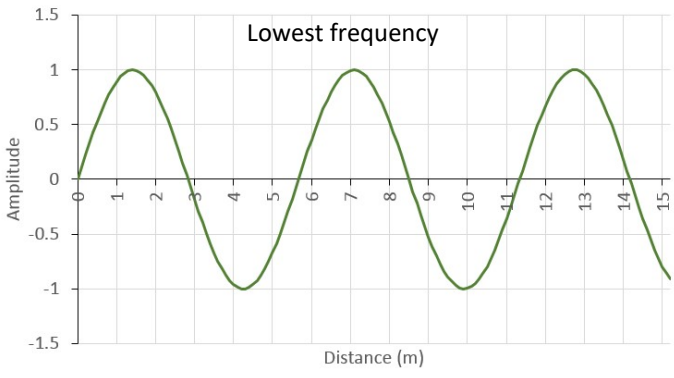


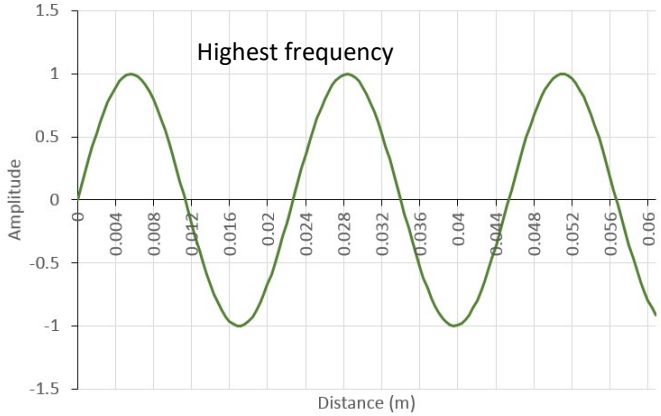
Hip Hop



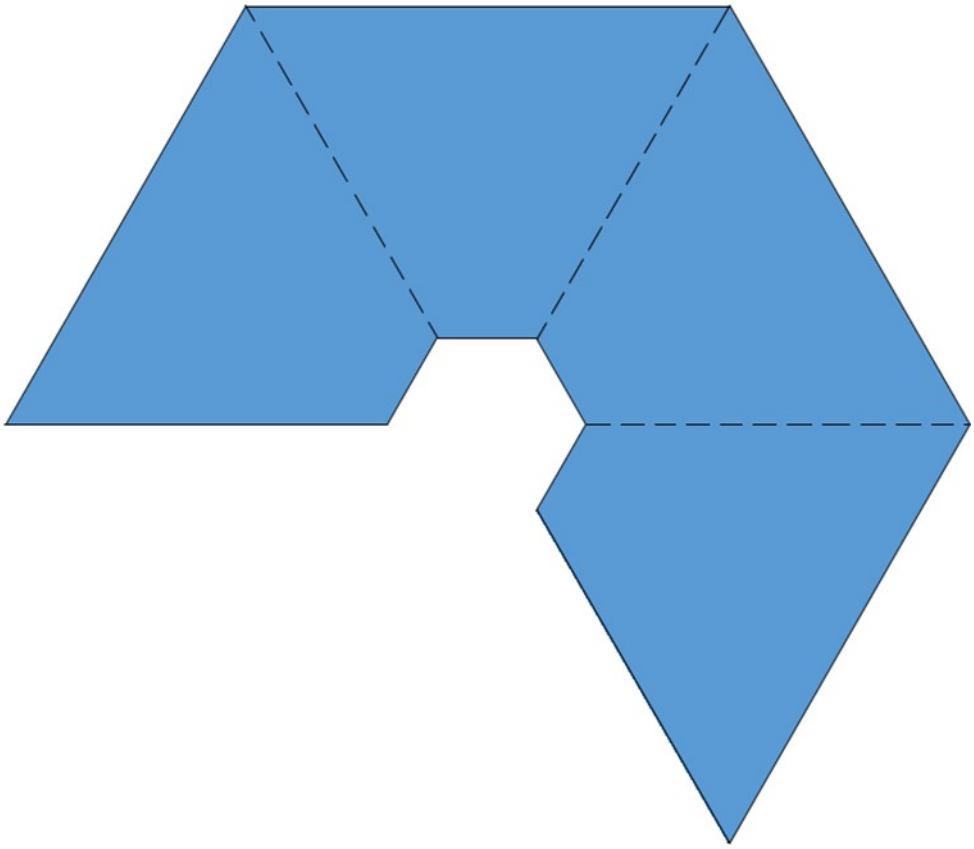


Jazz



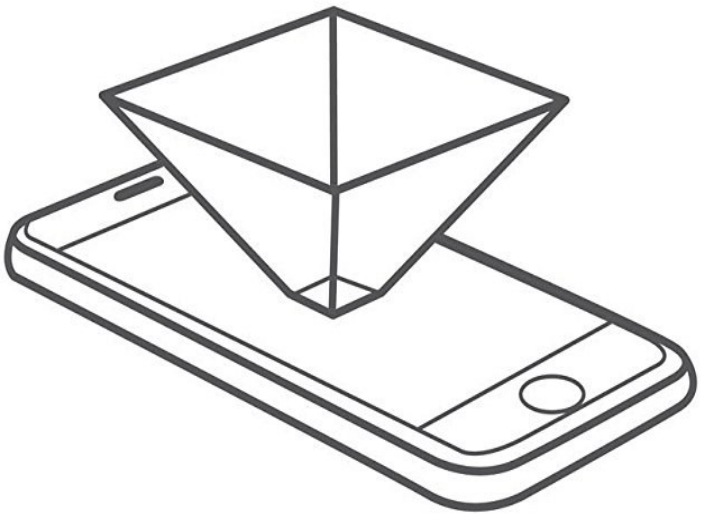


Trace the template below onto a sheet of acetate.



Light

Cut along the solid lines and fold along the dotted lines to form the pyramid shape shown below.



Stick in place with tape.

If you have a smartphone, you can search for ‘smartphone hologram videos’ or download and app called *Holapex.* If you do not have a smartphone ask to use one.

Place your Pepper’s ghost maker onto the smartphone to see the effect

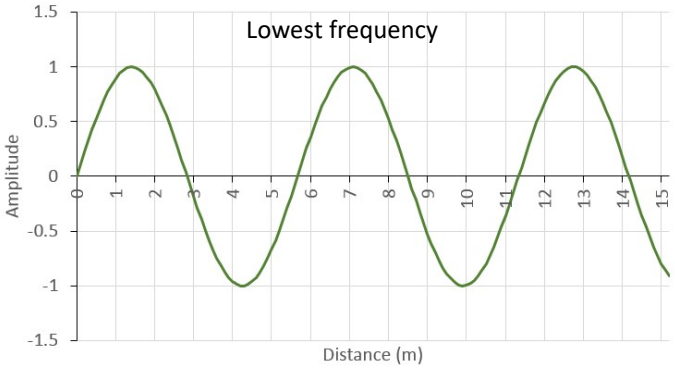
How will we use this in our music festival?

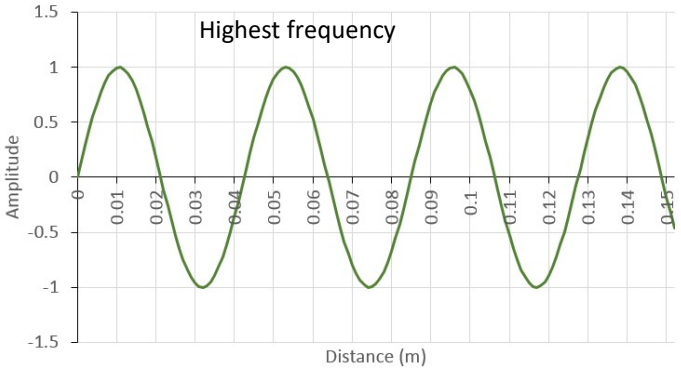
You will need to choose speakers to provide enough volume for the audience to hear the music (but not damage their ears!) The speakers need to produce the right frequencies for your chosen genre of music.

Lighting systems will be chosen based on your creative vision for the festival—but remember, you will need to have enough power to run everything!

Try the examples below:

1. These waveforms are for the lowest and highest frequency notes used by one of your bands. Calculate the frequency range that your speakers will need to operate at.





Sound

Light

2. You have chosen three packages of lighting effects: a set of colour mixing lights requiring 12kW power; lighting for a Pepper's ghost illusion requiring 3kW of power; and a laser light display requiring 500W of power. What is the total power required to run all three at once.

Between sessions

- Log on to Isaac Physics and complete this week's assignment

- Watch the video at https://goo.gl/i1fWTY and answer the questions

What is an construction engineer?

_____

_____

What do they do?

_____

_____

What would their role be in organising a music festival?

_____

_____

_____

_____

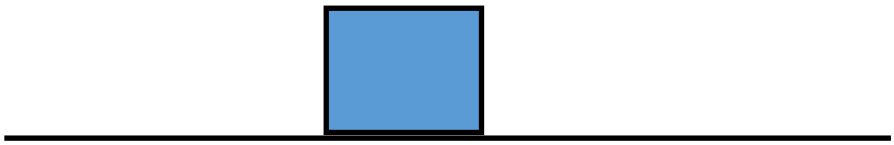
Notes

Write an equation for the relationship between weight and mass:

What is the value of the gravity of Earth?

g=_____

An object with mass, m, is at rest on a horizontal surface. Draw the forces acting on the object:



Are the forces acting on the object balanced?

What would happen to the object if there were no reaction force from the surface?

Use the material provided to build a girder between two tables. Make it as strong as you can—the one that holds the most weight will win!

Sketch your design below and draw on the forces acting on your girder:

How will we use this in our music festival?

You will need to choose an appropriate stage and trusses to support lights and speakers being suspended from the ceiling. Try the example below.

1. You have selected two speakers, each with mass of 750kg, two lighting bars, each with a mass of 30kg, and a special effects system with a mass of 40kg, all to be suspended from your stage roof.

What is the total mass to be suspended from the stage roof?

2. What is the total force the stage roof will need to support?

Equipment List

Power

Power

Power generation

	Voltage	Maximum Power	Cost	Fuel consumption (litres per kW per hour)	Number required
Small generator Runs on diesel fuel	240V	30kW	£2000	0.5	
Large generator Runs on diesel fuel	240V	150kW	£5000	0.5	
Wind turbine Needs to be positioned in a windy area (e.g. on a hill)	240V	6kW	£200	N/A	
Solar panels Only produce power during daylight hours	240V	4kW	£150	N/A	

Fuel for generators costs £1 per litre. Litres of fuel required:_____

Power distribution

Electrical distribution box Allows power to be delivered from generators to different locations	Maximum power: 20kW	Cost: £500	Number required

Equipment

Cables

Cable diameter	Maximum current	Cost per 10m	Number required
2.5mm	16A	£10	
4mm	32A	£20	
16mm	63A	£30	
35mm	125A	£50	
70mm	400A	£100	

Total cost for electrical equipment: _____

Calculations

Equipment

Sound

Speakers	Sound level	Power required	Frequency range	Cost	Number required
Midrange *Two mid-range speakers will provide complete coverage for one stage.* *Mid-range speakers will need to be mounted from the stage roof. Mass: 750kg* *Power usage will depend on the sound level required.*	80dB 90dB 100dB 110dB	1kW 2kW 10kW 20kW	1kHz—10kHz 1kHz—10kHz 1kHz—10kHz 1kHz—10kHz	£10,000 £10,000 £10,000 £10,000	
Bass *Ten bass speakers will provide coverage for one stage. Bass speakers can be placed on the stage.* *Power usage will depend on the sound level required.*	80dB 90dB 100dB 110dB	0.1kW 0.5kW 2kW 6kW	20Hz—100Hz 20Hz—100Hz 20Hz—100Hz 20Hz—100Hz	£500 £500 £500 £500	
Tweeter *Ten tweeter speakers will provide coverage for one stage.* *Tweeters can be placed on the stage.* *Power usage will depend on the sound level required.*	80dB 90dB 100dB 110dB	0.1kW 0.5kW 2kW 6kW	10kHz– 30kHz 10kHz– 30kHz 10kHz– 30kHz 10kHz– 30kHz	£500 £500 £500 £500	

Total cost for sound equipment: _____

Calculations

Equipment

Light

Lighting system	Power required	Mass to be suspended	Cost	Number required
Six-lamp bar *This illumination system comprises six lamps on each bar and can be made up of any combination of red, green and blue lights to produce coloured lighting effects.*	10kW	30kg	£1000	
Spotlight *This light provides a bright circular spot for highlighting and following individual performers.*	4kW	40kg	£2000	
Intelligent moving light *Remotely controlled, this light can produce strobe effects, pattern projection and a spotlight effect.*	4kW	40kg	£3000	
Laser system *Produces a very narrow, powerful beam of light in either green or red. Comes with a lens system to produce patterned effects.*	500W	40kg	£3000	
Pepper's Ghost illusion *A system of lighting and glass panels to produce a ghostly projection that appears on the stage.*	1kW	N/A	£2000	
Display screen *A large screen (10m^2 area) with projector and laptop to display any images.*	20kW	N/A	£10,000	
Pyrotechnics *Multiple fireworks and remote launch system*	N/A	10kg	£1500	

Total cost for lighting equipment: _____

Calculations

Equipment

Construction

Stages

	Size (width x depth x height)	**Max load on roof**	**Cost**	**Number required**
Small stage	12m x 6m x 6m	40kN	£2500	
Medium stage	16m x 8m x 8m	80kN	£5000	
Large stage	18m x 9m x 9m	120kN	£10,000	

Trusses

	Mass	**Max load**	**Cost**	**Number required**
Simple bar	5kg	1kN	£100	
Framework truss	20kg	3kN	£150	
Lightweight framework truss	10kg	3kN	£250	

Total cost for construction equipment: _____

Calculations

Equipment

Proposal

Company name	
Total cost of equipment	
Suggested ticket prices	
Estimated profit	
Band suggestions	
Environmental impact statement	
Suggested logo	

Greendale Music Festival site

Please indicate location of stage, speakers and power generation equipment.

Proposal

Notes

Notes

UNIVERSITY OF BATH

Physics. You work it out.