

S1 ENERGY and SOUND Need to Know Sheet

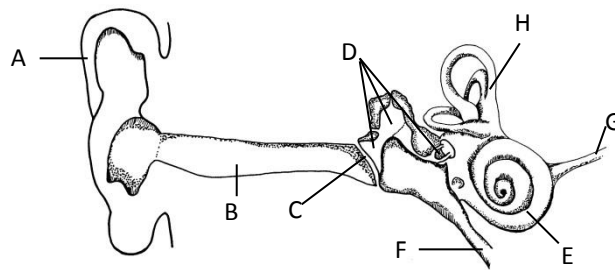
ENERGY

- Energy is needed to get jobs done, or make things work.
- To get a job done, energy must be transferred from one place to another or converted from one form to another.
- The unit of energy is the joule , and has the symbol (J)
- Five forms of energy make things happen – kinetic, electrical, heat, sound light and nuclear.
- Energy can be stored. Stored energy is called potential energy.
- Energy can be stored as chemical energy, strain/elastic energy, and gravitational potential energy.
- Energy can be stored in atoms and generate nuclear power.
- Movement energy is also called kinetic energy.
- Energy can be transferred from one object to another or can be converted from one form to another.
- Energy transfers can happen in more than one stage.
- The total amount of energy in a transfer is always the same – it is conserved.
- Falling objects transfer gravitational potential energy to kinetic energy, making the object speed up.
- The Energy Law: the amount of energy before a transfer is always equal to the amount of energy after the transfer, but not all of the energy is useful. Some energy is wasted in an energy transfer.
- Energy is wasted as heat during each energy transfer.

SOUND

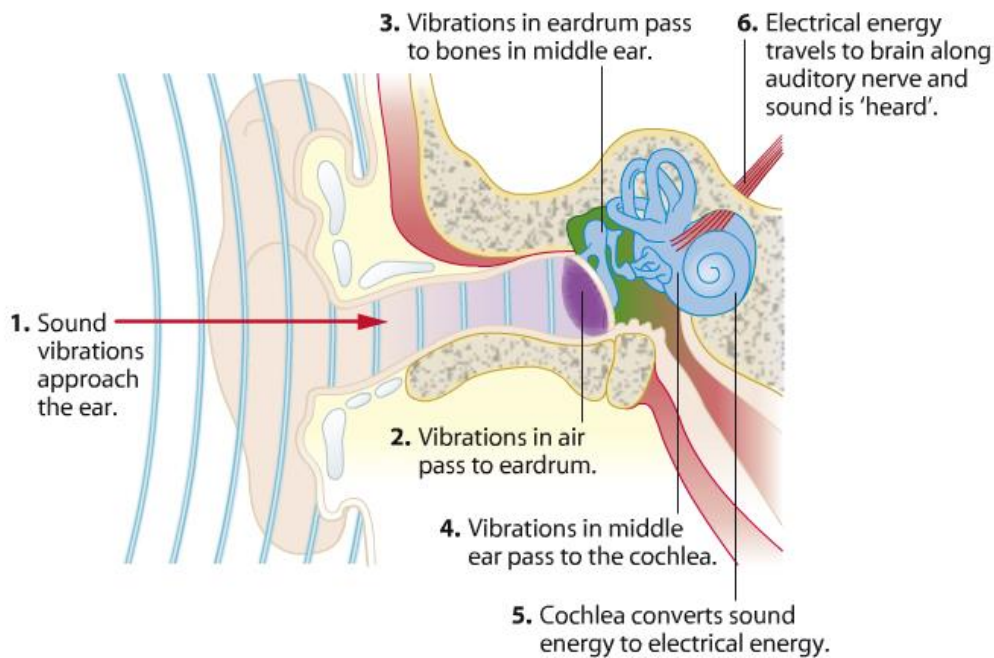
- Describe waves using the terms wavelength, amplitude, frequency, period, energy, crest or peak, trough.
- The greater the energy of the wave, the greater the wave's amplitude.
- Describe the two types of waves (longitudinal and transverse).
- Sound is a wave which carries energy from one place to another. The greater the energy of the wave the greater its amplitude.
- Sound is caused by vibrating objects.
- Sound is a longitudinal wave. Water waves and the EM spectrum are transverse waves.
- Sound travels through air at approximately 340 metres per second. (It can change depending on the pressure).
- Lightning and thunder is an example to show that speed of light is very much greater than the speed of sound.
- The speed of light in air is 300 million metres per second.
- Sound travels in solids, liquids and gases but not in a vacuum.
- Sound travels fastest in a solid and slower in a gas.
- An echo is reflected sound.
- Echo sounding (sonar) is used by ships, dolphins and bats. A ship records the time it takes for the sound it makes to be reflected back from the seabed or shoal of fish and, knowing how fast sound travels in seawater, it computes the depth.
- Describe an experiment to measure the speed of sound in air.
- To calculate speed of sound use $\text{speed} = \text{distance} \div \text{time}$
- When an echo is used to calculate speed use $\text{speed} = \text{total distance travelled} \div \text{time}$, **or** find the time to get to the object (half the total time) then use $\text{speed} = \text{distance} \div \text{time}$

- Know the range of human hearing is 20 – 20,000 Hz
- Ultrasound is a sound wave which has a frequency above the upper range of human hearing. >20, 000 Hz
- Ultrasound can be used to scan pregnant women, or for cleaning jewellery. It is no longer used to breakdown kidney stones.
- Identify sounds from oscilloscope traces and understand that volume is indicated by the amplitude and frequency is represented by the pitch. Draw loud and quiet, high and low pitched sounds.
- Sound levels are measured in decibels dB
- Loud sounds can permanently damage hearing.
- The danger level at which sound can permanently damage hearing is 85dB.
- The louder the sound the shorter the time it will take to permanently damage hearing.
- Have an idea of the sound level of various sounds.
- If two notes are an octave apart the upper note has twice the frequency of the lower note.
- Curved reflectors can be used to increase the strength of a signal, the larger the curved reflector the greater the strength of the signal collected.
- Name and functions of the parts of the ear:



	Part	Function
A	Pinna	Funnels the sound waves travelling through the air into the ear canal.
B	Ear canal	Passage from outer ear to ear drum
C	Ear drum	The sound waves make the ear drum vibrate.
D	Middle ear bones	These pass the vibrations to the spiral cochlea.
E	Spiral cochlea	Contains a liquid and nerve cells. When the liquid vibrates it stimulates the nerve endings to create a signal
F	Throat tube	Lets air into the middle ear to keep the air pressure the same on both sides of the ear drum so that it will vibrate properly.
G	Nerve	Carries the signals from the ear to the brain.

- Some sounds appear louder to us, this is because our ears are better at detecting some frequencies than others (talking and screaming)
- Cupping our ears results in us collecting more sound and we hear more.
- Cupping our ears with our hands pointing backwards results in us reducing the sound level in our ears.
- Know how to look after the ears, for example cotton buds should not be placed in ears, and the sound level from ear phones should be kept to the lowest volume possible to protect hearing. You should not be exposed to sounds louder than 85dB without ear protection.



Notes

Forms of energy

Energy can be divided into 2 groups.

Energy can be STORED due to its position; if ENERGY is STORED we say it has POTENTIAL ENERGY.

Energy can be used to MAKE THINGS HAPPEN.

<http://physics.info/energy/>

POTENTIAL ENERGY

Energy can be stored in three ways

- **Chemical potential energy** e.g. tablets to make the steam engine work, fossil fuels, food, batteries.
- **Strain or elastic potential energy** e.g. when pulling back a catapult, bow, knickers, spring, wind up toys.
- **Gravitational potential energy.** This is energy you have because of where you are. If you climb stairs, a ladder or go in a plane you are gaining gravitational potential energy. You can release it by stepping out of the window, jumping or just climbing back down. It is converted into kinetic or movement energy and heat. When you land the kinetic energy is converted into heat and sound.

MAKING THINGS HAPPEN

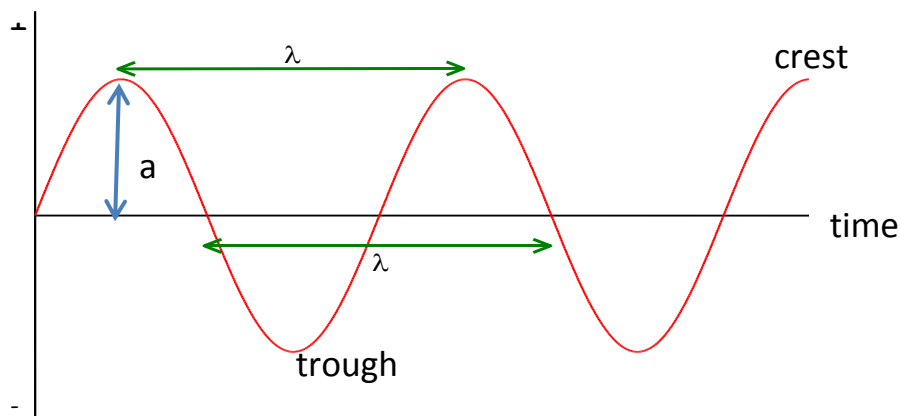
There are 5 ways in which we can use this stored energy.

- **KINETIC** energy- Making things move, anything that moves has kinetic energy whether it is a snail or Richard Hammond in a fast car. The faster you travel and the heavier you are the more kinetic energy you have.
- **HEAT** energy, when things are hot they have heat energy, actually even cold things have some heat energy. Heat is produced as particle vibrate. The faster they move the hotter the object. Rubbing your hands together causes heat, burning coal makes heat.
- **SOUND** energy Sound is produced when things vibrate or move.
- **ELECTRICAL** energy, moves energy round a circuit to make things work, like the torch, the buzzer etc.
- **LIGHT** energy the electricity in the circuit makes light when the energy gets to the light bulb, a Bunsen burner makes light when the chemical energy in the gas is burned.

- **NUCLEAR** energy is the energy released when the nucleus of atoms break up (nuclear fission) or join together (nuclear fusion). This is because mass is changed into energy according to $E=mc^2$

Waves

- The bigger the amplitude of the wave the more energy it transfers.
- a = amplitude, this is the height of the wave from the middle to the top.
- Amplitude is measured in metres. The amplitude is the distance from the middle position to the crest, or trough.
- **wavelength**, λ wavelength is the distance between successive points on corresponding waves (eg the distance between two consecutive crests or troughs). It is measured in metres
- **frequency**, f is measured in Hertz. Frequency is the number of waves produced or passing a point per second.

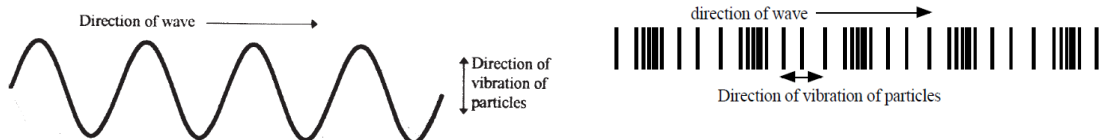


PROPERTIES OF WAVES

There are two types of waves, longitudinal and transverse.

In a transverse wave the particles move at 90° to the direction of the flow of energy.

In a longitudinal wave the particles move along the line of the direction of travel of energy.



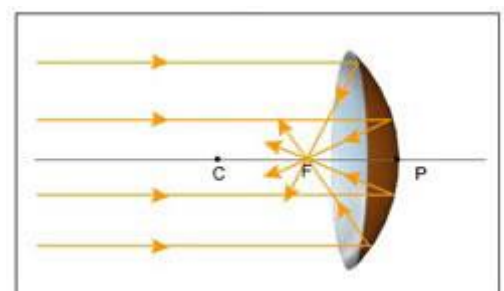
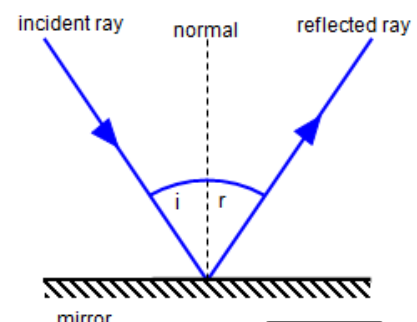
Sound waves and p-waves (caused by an earthquake) are longitudinal waves. Water waves, s-waves (caused by earthquakes) the electromagnetic spectrum (Radio, Microwaves, Infra-Red, visible light, UV, X-rays and gamma rays) are all examples of transverse waves.

We know all waves

- Carry energy
- Are either transverse or longitudinal
- All have crests troughs and an amplitude
- **REFLECT**, **REFRACT**, **DIFFRACT** and INTERFERE.

Reflection

When a wave hits any object some of the wave is reflected. Objects like mirrors are designed to reflect most of the incident wave, in this case light.



Sound notes

When we talk about the range of human hearing we mean the frequency range that we can hear.

The frequency of a sound note is given by the pitch.

The range of human hearing is roughly 20-20,000 Hz or 20Hz-20KHz

The energy of the sound is given by it's amplitude.

As you get older you lose the ability to hear high pitched sounds.

Sounds above the range of human hearing are called ultrasounds.

The volume of a sound note is indicated by the amplitude.

Some sounds appear louder than others but our ears are more sensitive to these sounds. We are good at hearing people talking and people screaming.

Sound levels- volume are measured in decibels.

(This is a funny scale as the volume doubles every 3 decibels, so an increase in 10dB is 10x louder.)

Danger level is about 85dB. Above 85db and you can permanently damage your hearing.

To protect your hearing you should have your music as quietly as you can hear when you listen with earphones.

We can increase the effectiveness of our ears by cupping our hands behind our ears, this directs more sound waves into our ears. If sounds are loud cup your hands in front of your ears and direct the sound away from your ears. Do not put things in your ears to reduce sound levels unless they are designed for this purpose.