EDEXCEL

GCSE Separate

Physics

Year 10 Winter assessment

Outcomes Revision

Outcomes	Physics key concepts
Ph1 *Recall and use the SI unit for physical quantities, as listed in the specification*	The SI units defined in the specification are:

Distance Metre (m)	Mass Kilogram (kg)	Time Second (s)
Current Ampere (A)	Temperature Kelvin (K)	Amount of a substance Mole (mol)
Frequency Hertz (Hz)	Force Newton (N)	Energy Joule (J)
Power Watt (W)	Pressure Pascal (Pa)	Electric charge Coulomb (C)
Electric potential difference Volt (V)	Electric resistance Ohm (Ω)	Magnetic flux density Tesla (T)

Ph2 *Recall and use multiples and sub-multiples of units, including giga (G), mega (M), kilo (k), centi (c), milli (m), micro (μ) and nano (n)*	Some numbers are very large or very small, to make these easier to handle we use prefixes. Prefixes tell you how much bigger or smaller a unit is than the base unit. For example, 1 kg is 1000 times bigger than a gram and 1 mm is 1000 times smaller than a metre. These numbers are called the conversion factors. So, to convert 4.5 kg into grams you do the following: 4.5 x 1000 = 4500 g. To convert 45 mm in meters: 45 x 0.001 = 0.045 m. (N.B. 45 x 0.001 is the same as 4.5 ÷ 1000). A table of common prefixes and their conversion factors is here:

Tera (T)	Giga (G)	Mega (M)	Kilo (k)	Milli (m)	Micro (μ)	Nano (n)
10^{12}	**10^{9}**	**10^{6}**	**1000**	**0.001**	**10^{-6}**	**10^{-9}**

In a question you might get given a value such as 5.6 GHz, the first thing you need to do is convert this to Hz (not GHz) 5.6 GHz = 5.6 x 10^9 Hz. (5.6 x 1,000,000,000)
Or 2.3 μA, to convert this: 2.3 μA = 2.3 x 10^{-6} A. (2.3 x 0.000,001 or 2.3 ÷ 1,000,000)

Ph2a *Be able to convert between different units, including hours to seconds*	You may get given time in minutes, or even in hours, but we need time in seconds if we are using it in an equation. This is easy to convert as there are 60 seconds in a minute and 60 minutes in an hour. Convert 5 minutes into seconds: 5 x 60 = 300 s Convert 2 hours into seconds: 2 x 60 x 60 = 7200 s
Ph3 *Calculate mean averages, giving answer to appropriare number of significant figures*	To calculate a mean average, you must first find the sum of the individual values (add them all up and press equals). You then divide the sum by the number of values (often 3 or 5 for investigations). Find the average of 25, 28 and 25. 25 + 28 + 25 = 78 78 ÷ 3 = 26 Sometimes the average will not be a whole number, when presenting you average value you should never give your answer to more significant figures than were given in the original data. (See Ph4 for more information on significant figures.) Find the average of 5.6, 6.2 and 5.5 5.6 + 6.2 + 5.5 = 17.3 17.3 ÷ 3 = 5.766666, however the original data is only 2 significant figures so 5.8 should be written on the answer line.

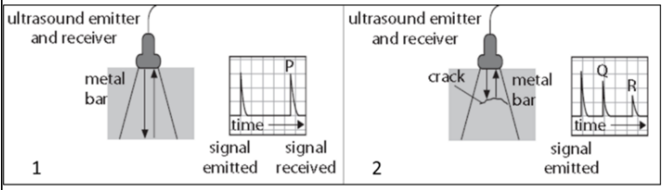
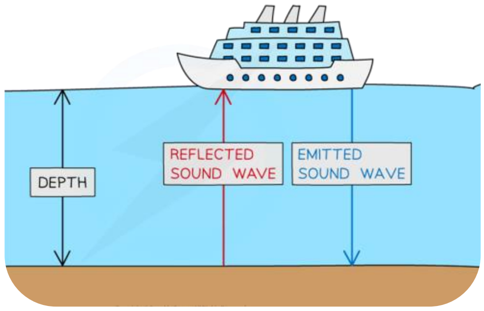
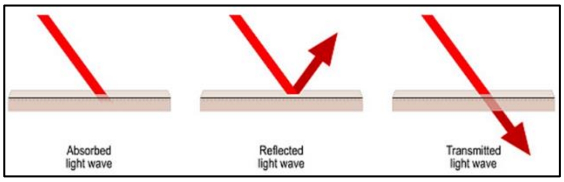
Outcomes	Physics key concepts
Ph3a *Calculate mean averages, identifying and handling anomolus results*	To calculate a mean average, you must first find the sum of the individual values (add them all up and press equals). You then divide the sum by the number of values (often 3 or 5 for investigations). Find the average of 25, 28 and 25. 25 + 28 + 25 = 78 78 ÷ 3 = 26 Sometimes there is a result that clearly does not fit the pattern, this is called an anomaly, is usually due to an error. When calculating the average, we ignore this value and calculate the average of the remaining values. Find the average of 4.5, 8.2, 4.3 and 5 8.2 is clearly an anomaly so we ignore it: 4.5 + 4.3 + 5 = 13.8 13.8 ÷ 3 = 4.6
Ph4 *Use significant figures where appropriate*	The first significant figure (s.f.) of a number is the first digit that is not a zero. The second and third significant figures come straight after the first (even if they are zeros). *Remember that:* *If the number you are rounding is followed by 5, 6, 7, 8, or 9, round the number up. Example: 38 rounded to the nearest ten is 40* *If the number you are rounding is followed by 0, 1, 2, 3, or 4, round the number off. Example: 33 rounded to the nearest ten is 30* Examples: Round 0.005642 to 2 s.f. = **0.0056** Round 56.42 to 2 s.f. = **56** Round 5642 to 2 s.f. = **5600** Round 7.685 to 2 s.f. = **7.7** *N.B. it is good practice to give your final answer to the lowest number of significant figures given in a question.*
Ph4a *Use decimal places where appropriate*	Sometimes you will get asked to give an answer to a certain number of decimal places (d.p.) - these are the digits that come after a decimal place. *Remember that:* *If the number you are rounding is followed by 5, 6, 7, 8, or 9, round the number up. Example: 38 rounded to the nearest ten is 40* *If the number you are rounding is followed by 0, 1, 2, 3, or 4, round the number off. Example: 33 rounded to the nearest ten is 30* Examples: Round 0.005642 to 2 d.p. = **0.01** Round 5.642 to 2 d.p. = **5.6** Round 5642 to 2 d.p. = **5642.00** Round 7.685 to 2 d.p. = **7.69**

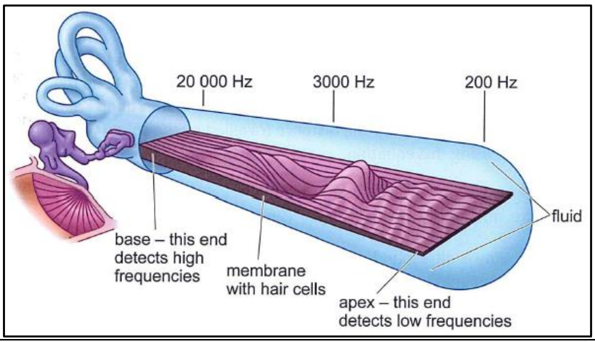
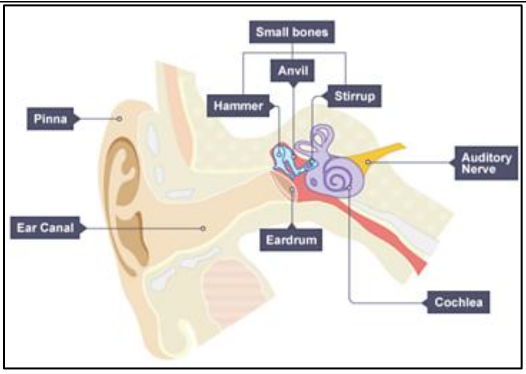
<table>
<tr><th>Outcomes</th><th>Physics key concepts</th></tr>
<tr><td>Ph4b
Use standard form where appropriate</td><td>Standard form, or standard index form, is a system of writing numbers which can be particularly useful for working with very large or very small numbers. It is based on using powers of 10 to express how big or small a number is.
Standard form uses the fact that the decimal place value system is based on powers of 10:
<table>
<tr><td>For larger numbers we use a positive power of 10</td><td>For smaller numbers we use a negative power of 10</td></tr>
<tr><td>$10^2 = 100$
$10^3 = 1000$
$10^4 = 10000$
$10^5 = 100000$
$10^6 = 1000000$</td><td>$10^{-2} = 0.01$
$10^{-3} = 0.001$
$10^{-4} = 0.0001$
$10^{-5} = 0.00001$
$10^{-6} = 0.000001$</td></tr>
<tr><td>**Example**
Write 50,000 in standard form.
50,000 can be written as: $5 \times 10,000$
$10,000 = 10 \times 10 \times 10 \times 10 = 10^4$
So: $50,000 = 5 \times 10^4$</td><td>**Example**
Write 0.0005 in standard form.
0.0005 can be written as 5×0.0001.
$0.0001 = 10^{-4}$
So $0.0005 = 5 \times 10^{-4}$</td></tr>
<tr><td>To input this into your calculator, press:

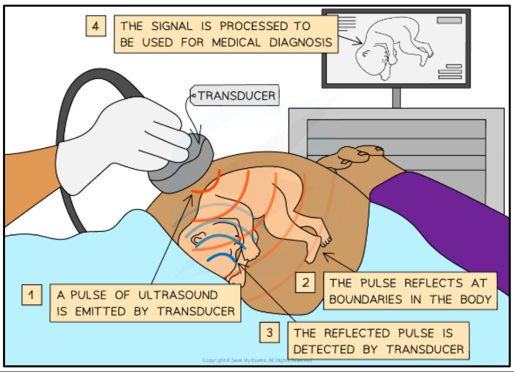
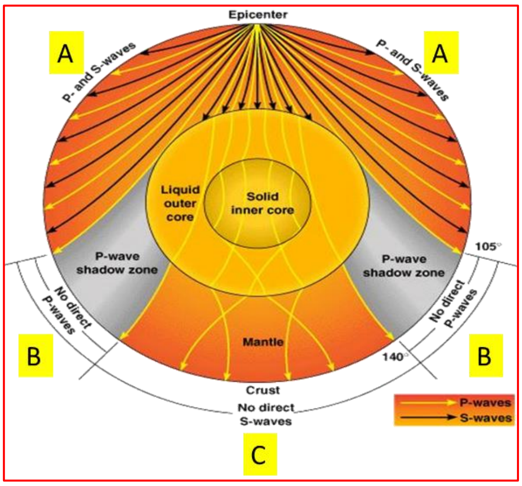
</td><td>To input this into your calculator, press:

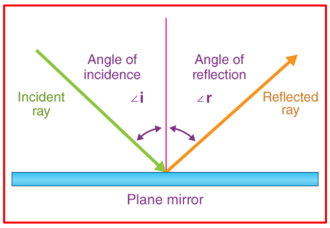
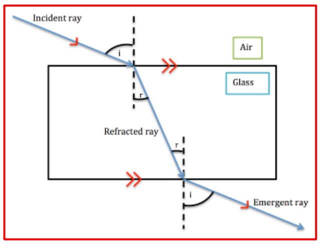
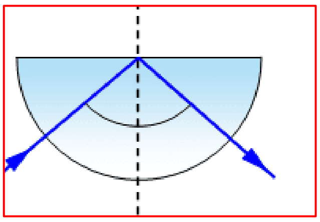
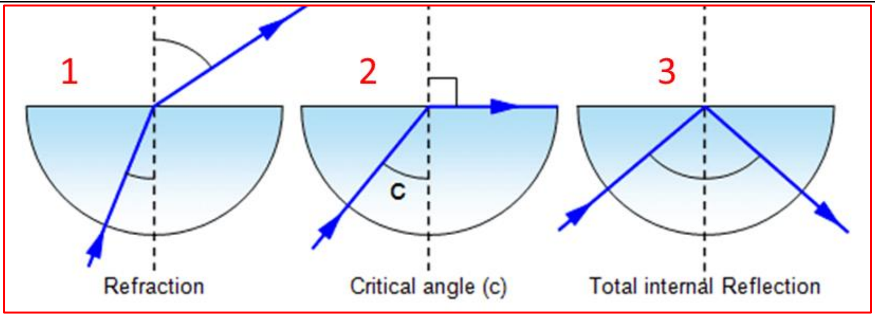
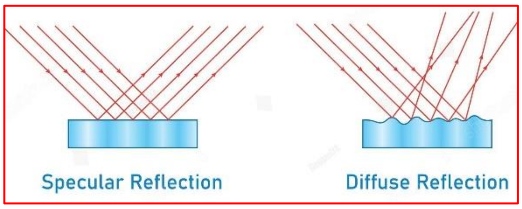
</td></tr>
</table></td></tr>
<tr><td>Ph5
Devise an investigation</td><td>You may be asked to describe how to carry out an investigation similar to one of the core practical tasks.
You should think about:
• The measurements you need to make
• The equipment you will use to make these measurements
• How the equipment should be used
• Any health and safety to consider?
• Describe any equations that would be used to complete the investigation
• Would you take repeats and find an average?
• What range of results you would collect</td></tr>
<tr><td>Ph5a
Can write, or comment on, a conclusion</td><td>In a conclusion you should say what your results show, and how this relates to any prediction given in the question.
e.g. As mass increased so did weight
In a conclusion we try to us evidence from our results to support our answer.
e.g. When mass was 3 kg, weight was 30 N and when mass 6 kg, weight was 60 N. When mass doubled so did weight.
For better marks we try to explain why we got those results
e.g. Mass and weight are linked by the equation ‘W = m x g’ so if the value of g does not change then mass and weight are directly proportional.
See Ph8a for more information on directly proportional relationships.</td></tr>
</table>

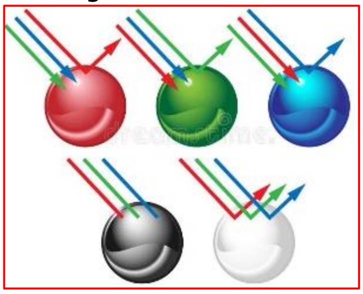
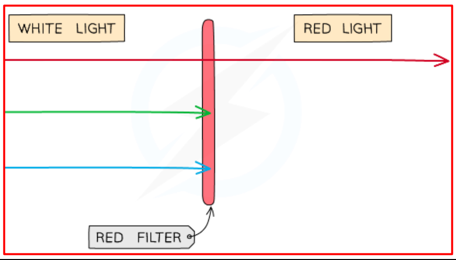
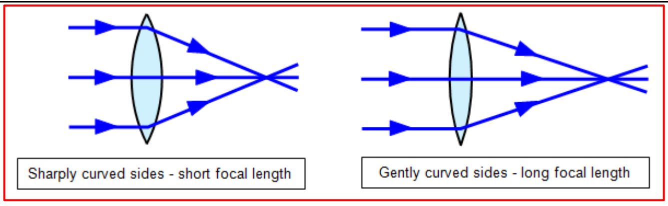
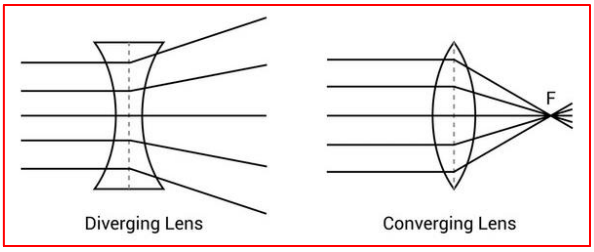
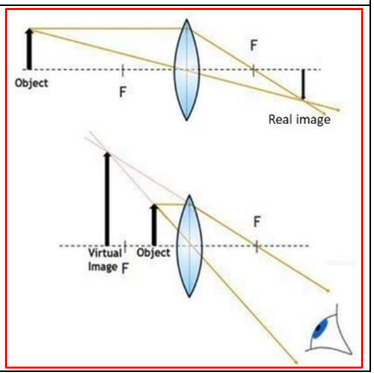
Outcomes	Physics key concepts
Ph6 *Apply a given equation*	Sometimes you get given an equation that you will never have seen before- don't let this throw you. Find the numbers that are reprinted in the equation and substitute the symbols with the numbers. Re-arrange the equation, if you need to. Resolve the equation- work out the answer.
Ph7 *Justify the use of equipment for an investigation*	Think about which equipment would be the best choice and why. For example, if you were measuring a small length or short distance you would use a ruler- but if you were measuring 300 m then you would use a trundle wheel or possibly a tape measure. When measuring time, we generally use a stopwatch however when recording short time intervals or timing things that move quickly then human riming error can become a problem and a digital timer may be a more accurate choice of equipment.
Ph8 *Interpret data from diagrams, tables and graphs*	These questions are about understanding information you are given in the question and will often be different to any question you may have seen before. **Diagrams** These could contain **values** that you need to **use in an equation** or **equipment** you may need to use in a **practical**. There is no set pattern to this- you will need to apply 'common sense' and think your way through what you are being asked. **Tables** For simple marks you are looking to **describe any relationships** you see- for example as mass increases so does weight. There may be **further patterns**- for example does weight keep going up by the same amount? Or **do the intervals getter smaller? Bigger?** Sometime you may need to use **values in an equation** to show a trend or relationship- for example a table could contain values for voltage and current- but you are asked about resistance. In this case you would need to calculate the resistance values. **Graphs** Is the graph **linear** (straight line) or **non-linear** (curved)? **What is the trend**? As the '**X axis values' increase**, what happens to the '**Y axis values'**, does it **increase or decrease**. Is there a **maximum** or a **minimum point**? Sometime you might have to **extract data** and 'do something with it' perhaps **use it in an equation** or work out a range.
Ph8a *Describe a directly proportional relastionship*	A directly proportional relationship is relationship between two variables that meets the following two rules: • If one value doubles, then the other value also doubles • If one value is zero, then the other value is also zero This type of relationship can be seen on a graph when: • You get a straight line of best fit • That passes through the origin (0,0)

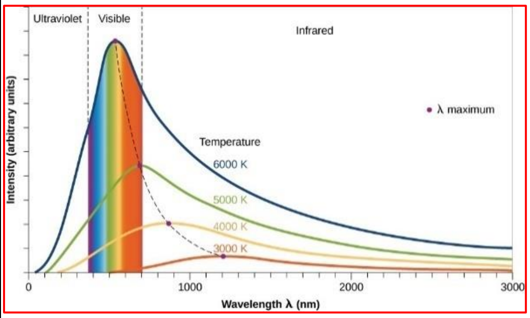
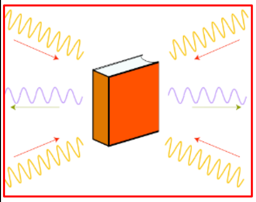
Outcomes	**Separate Waves**
Ph74 *HT ONLY: Calculate depth or distance from time and wave velocity*	Sonar is used to find distance or depth using the principles of wave speed and reflection. Pulses of ultrasound are sent out through material and the time for the reflection to return is used to determine how far the wave has travelled. This principle can be used to investigate the depth of the sea floor or even used to detect cracks in solid materials.  Diagram 1 shows a wave travelling through a metal bar without a crack and reflecting from the edge of the metal bar (pulse P). Diagram 2 shows that if there is a crack then some of the wave gets reflected from the crack (pulse Q) and a weaker signal is reflected from the edge of the metal bar (pulse R). This diagram shows a pulse of ultrasound being sent towards the ocean floor and then reflecting back to the boat.  In both cases, if the speed of sound is known in the material and the time can be measured then the distance travelled by the wave can be calculated- remember that the wave goes there and back. **Distance = speed x time** *The ship in the diagram above sends out a pulse of ultrasound that takes 0.5 seconds to return. The speed of sound in sea water is 1500 m/s.* *Calculate the depth of the sea floor at this point.* **Distance = speed x time** Distance = 1500 x 0.5 Distance (travelled by the wave) = 750 m Depth is equal to half the distance covered Depth = 750 ÷ 2 = **375 m**
Ph75 *Describe the effects of reflection, refraction, transmission, absorption of waves at material interfaces*	The boundary between two materials is called the interface. When waves meet an interface, they can be absorbed, reflected or transmitted. Waves that are transmitted are often also refracted. **Absorbed-** when the waves energy is transferred to the material (usually as thermal energy).  **Reflected-**when the wave 'bounces back' off the material (the angle of incidence is always equal to the angle of reflection). **Transmitted-** when the wave passes through the material. **Refracted-** when the wave passes through the material at an angle and changes direction (due to a change in speed).
Ph78 *HT ONLY: Recall that different substances may absorb, transmit, refract or reflect waves in ways that vary with wavelength*	The light we see from lamps is usually what we call 'white light'. It is a mixture of all the different colour of light, different colours of light have different frequencies and therefor different wavelengths. When light waves are **transmitted** through different materials the different frequencies of light change speed by different amounts at the interface- so they are **refracted** by different amounts- this is why we see a rainbow (or a visible spectrum of light). As sound waves are **transmitted** through different materials the frequency does not change, but the speed and wavelength do. Sound waves travel faster in solids than in the air (solids are denser) and their wavelength increases **(speed = frequency x wavelength)**.

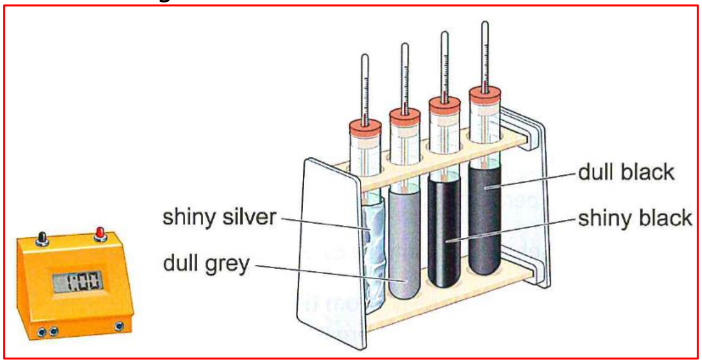
Ph79 *HT ONLY: Describe the processes which convert wave disturbances between sound waves and vibrations in solids*	Sound waves are **longitudinal** (the particles oscillate parallel to the direction of wave transmission). When a sound wave hits a solid some of the energy is **reflected** and some is **transmitted** or **absorbed**. The longitudinal wave causes the particles at the surface of the solid to vibrate, these vibrations can cause both **longitudinal** and **transverse** waves in the solid. The **shape**, **size** and **structure** of the material will determine how different frequencies of waves will affect it.
Ph80 *HT ONLY: Explain why processes that convert wave disturbances only work over a limited frequency range*	Human ears detect sounds with a frequency between 20 and 20,000 Hz. As humans evolved it was not beneficial to hear lower or higher frequencies so the structure of our ears did not evolve to hear them. The **shape**, **size** and **structure** of the different parts of ear determine how different frequencies of waves will affect them. Our **ear drums** will detect sounds between 20 and 20,000 Hz and these sounds waves are amplified by the three small bones.  Different frequencies of sound are detected by different parts of the **cochlea**. The **base** of the cochlea is **thick** and detects **higher frequency** sounds (20,000 Hz), this becomes **thinner** towards the **apex** which detects **lower frequency** sounds (20 Hz).
Ph81 *HT ONLY: Use the process that converts wave disturbances to explain the way the human ear works*	Sound waves are funnelled into our ears by the pinna and travel through the ear canal. When sound waves strike the **eardrum,** they make it **vibrate**. These vibrations are **amplified** the **three small bones** before being passed into the **cochlea**. The **liquid** inside the cochlea **vibrates** and causes **hairs on membrane to vibrate**. The hairs are connected to **neurones** which send **electrical impulses**, via the **auditory nerve**, to our brain. 
Ph82 *HT ONLY: Recall the frequency of ultrasound and state its units*	Ultrasound waves are sound waves that are **too high pitch** for **humans to hear**. The prefix "ultra" means above or beyond. Ultrasound waves have a frequency **higher than 20,000 Hz** (or 20 kHz).
Ph82a *HT ONLY: Recall uses of ultrasound and infrasound*	**Ultrasound waves** (frequencies higher than 20,000 Hz) can be used in **sonar** to **measure the depth** of ocean floors or to **detect flaws** (cracks) in solid objects (such as aeroplane wings). They are also used medically in **foetal scans** or to **treat muscle injuries**. They can be used to **clean jewellery** and are also used in **echolocation** by bats and dolphins. **Infrasound waves** (frequencies lower than 20 Hz) can be used to monitor and detect **volcanic eruptions, earthquakes or avalanches**. They can also be used to **track large animals** such as elephants and whales because these animals use infrasound to communicate. **Seismic waves** caused by earthquakes give scientists lots of information about the **structure of the Earth.**
Ph82b *HT ONLY: Recall the frequency of infrasound and state its units*	Infrasound waves are sound waves that are **too low pitch** for **humans to hear**. The prefix "infra" means below. Infrasound waves have a frequency **lower than 20 Hz**.

Ph83 *HT ONLY: Explain uses of ultrasound*	For more information about how sonar can be used to investigate depth or distance see outcome Ph74. **Sonar** works by sending out **pulses of ultrasound** that **reflect** when they hit solid objects (such as the ocean floor or a whale). The reflection is detected and the **time between** sending out the pulse and detecting the reflection can be used to calculate the distance travelled by the ultrasound. Ultrasound waves are not only reflected by solid surfaces, some of the wave is reflected every time the **wave passes into material with a different density**- such as when it passes a crack in a metal block. **Foetal scans** use an ultrasound transmitter that sends out **pulses of ultrasound** into a mother's womb, whenever the waves **pass a boundary** between two materials that have different densities (such as fluid, skin, muscle or bone) some of the **wave is reflected** and detected. The timings of the reflected waves are used to form the image that we see in a foetal scan. 
Ph83a *HT ONLY: Explain uses of infrasound*	**Seismic waves** tell scientists a lot about the structure of the Earth. The main seismic waves are P waves and S waves. **P waves** are **longitudinal** and **travel through solids, liquids** & gases. **S waves** are **transverse**, they are **slower** than P waves and can **only travel through solids**. Seismic waves are detected by seismometers and this diagram shows the pattern of waves typically detected.  **Section A** shows both S and P waves so the mantle must be **solid** (as S waves only travel through a solid). The lines are **curved,** this tells us that the rock has **changing density** and causes the waves to **refract**. **Section B** shows no waves detected. This is due to the large **refraction** caused as the P waves pass into the **liquid outer core** (large change in density). S waves are absorbed by the liquid. **Section C** shows only **P waves**- this proves that part of the core must be **liquid**- because **S waves cannot travel through liquids**. *The large refraction of P waves is caused as the waves pass between solid and liquid as there are large changes in density.* Section B, where no P waves are detected, is called the **P wave shadow zone**. Section B and C, where no S waves are detected, is called the **S wave shadow zone.**
Ph84 *Describe how changes, if any, in velocity, frequency and wavelength, in the transmission of sound waves from one medium to another are inter-related*	Sound waves travel faster in liquids than they do in gases, and faster in solids than they do in liquids. When a wave passes into a new material and changes speed the frequency of the wave stays the same. **Speed = frequency x wavelength** If the frequency stays the same and the **speed increases** then the **wavelength** must also **increase.** If the speed decreases and the frequency stays the same then the wavelength must also decrease.

Outcomes	Separate Light and the electromagnetic spectrum
Ph86 *Explain, with the aid of ray diagrams, reflection, refraction and total internal reflection (TIR), including the law of reflection and critical angle*	There is a lot in this criterion point- which bit do you need to revise? **Reflection**  The **angle of incidence** is always **equal to** the **angle of reflection.** **Refraction**  As light enters the glass it **slows down** and r**efracts towards** the normal. As it leaves the glass and enters the air it **speeds up** and **refracts away from** the normal. **TIR & the critical angle**  When a wave travels through a dense material like glass, towards a less dens material, like air, it can be reflected from the surface back into the material- this is called **total internal reflection (TIR).** TIR only happens when the angle of incidence is larger than a specific angle called the **critical angle.** TIR reflection is used in fibre optic cables- such as for delivering broadband or for an endoscopy.
Ph86a *Describe how to investigate total internal reflection (TIR)*	 1- Shine a thin beam of light through the **curved edge** of a glass block, the angle of incidence should be low. Light will be **refracted** at the flat edge. 2- **Increase the angle of incidence**, by moving the ray box, until the refracted **ray shine along the edge** of the flat edge. Measure the angle of incidence, with a protractor, this is **the critical angle**. This is the point that **total internal reflection (TIR) begins.** 3- As you increase the angle of incidence even further you now see (TIR) the **angle of incidence** is **equal to** the **angle of reflection**.
Ph87 *Explain the difference between specular and diffuse reflection*	 **Specular reflection** is when waves are reflected in a **single direction**, from a **smooth surface**- we see a **clear reflection**. **Diffuse reflection** is when the waves are reflected in **different directions**, from a **rough surface**- we do **NOT see a clear reflection**.

Outcomes	Separate Light and the electromagnetic spectrum
Ph88 *Explain how colour of light is related to differential absorption at surfaces and transmission of light through filters*	White light is a mixture of all the different colours of light. **Colour related to absorption at surfaces** Different surfaces reflect or absorb different frequencies (colours) of light. A red book **reflects red** light, it **absorbs blue** and **green**.  **Colour related to transmission of light through filters**  Filters transmit some frequencies (colours) of light and absorb others. A red filter **transmits red** light, it **absorbs blue** and **green**.
Ph89 *Relate the power of a lens to its focal length and shape*	 A **thicker lens** causes light to refract through bigger angles- we say it is **more powerful.** The focal length is the distance between the centre of the lens and the focal point (the point where the light rays meet). A **thicker lens** has a **shorter focal length**.
Ph90 *Use ray diagrams to show the similarities and differences in the refraction of light by converging and diverging lenses*	 A **concave** lens is **thinner at** the **middle**, they cause light to **diverge** (move away from each other). We call these **diverging** lenses. **Convex** lenses are **thicker** at the **middle,** they cause light to c**onverge** (come together). We call theses **converging** lenses.
Ph91 *Explain the effects of different types of lens in producing real and virtual images*	A **real image** is formed when the light rays **actually meet** to form the image. A real image **can be seen on a screen**. A **virtual image** is formed when the light rays **appear to be coming** from a **different place** to where they are actually coming from. The light rays **do not actually meet** where the image forms- it just appears that they do. A virtual image **cannot be seen on a screen.** 

Outcomes	Separate Light and the electromagnetic spectrum
Ph100 *Explain that all bodies emit radiation, that the intensity and wavelength distribution of any emission depends on their temperature*	All objects are emitting (and absorbing) electromagnetic radiation all the time.  **Hotter** objects **emit** radiation with **higher frequencies**. If an object gets hot enough then the frequency of the radiation emitted moves from infrared to visible light- we can see the radiation emitted. Objects emitting yellow light are hotter than object emitting red light (yellow light has a higher frequency that red light).
Ph101 *HT ONLY: Explain that for a body to be at a constant temperature it needs to radiate the same average power that it absorbs*	All objects are constantly radiating (emitting) and absorbing EM radiation. The amount of radiation **radiated** or **absorbed per second** is called the **power.** If an object **radiates and absorbs at the same average power** then its **temperature will be constant** (remain the same).  If an object **radiates more power than it absorbs then its temperature will increase**. If an object **radiates less power than it absorbs then its temperature will decrease.** *This image shows that the book is radiating less power than it is absorbing- the temperature of the book will increase.*
Ph102 *HT ONLY: Explain what happens to a body if the average power it radiates is less or more than the average power that it absorbs*	If an object **radiates more power than it absorbs** its **temperature will decrease** because it is giving out more energy than it is taking in. As the **temperature decreases** it will start to **radiate less power**, until eventually the it will **radiate and absorb at the same power**- it will now be at a **lower constant temperature**. If an **object radiates less power than it absorbs** its **temperature will increase** because it is giving out less energy than it is taking in. As the **temperature increases** it will start to **radiate more power**, until eventually the it will **radiate and absorb at the same power**- it will now be at a **higher constant temperature.**
Ph103 *HT ONLY: Explain how the temperature of the Earth is affected by factors controlling the balance between incoming radiation and radiation emitted*	The average temperature on Earth is determined by the amount of radiation it reflects, absorbs and radiates (emits). **Energy is transferred to the Earth from the Sun**, during the day most of this energy is absorbed, some it is reflected, by the atmosphere, by clouds and by the surface. At night energy is emitted to space. Overall, the Earth's temperature is fairly constant (when its night time here it is daytime somewhere else). Scientist believe that increased levels of greenhouse gases (such as carbon dioxide) are affecting the average global temperature. Greenhouse gases are believed to absorb energy- reducing the amount of energy that the Earth emits to space. This means that the **Earth** will still **absorb** the **same power** but will **radiate less**- the **temperature of the Earth increases**. As the Earth's **temperature rises** it will begin to **radiate more power**, until the Earth **radiates and absorbs at the same power**- however, it will now be at a **higher constant temperature.**

Outcomes	Separate Light and the electromagnetic spectrum
Ph104 *Core Practical: Investigate how the nature of a surface affects the amount of thermal energy radiated or absorbed*	It is possible to investigate how well different surfaces emit radiation.  Wrap four identical boiling tubes in different material or paint them different colours. Add equal amounts of boiling water to each tube. Use a **thermometer** to **record the temperature** every minute. The material that is the **'best emitter'** will **cool down the fastest.** You should find that the **dull black surface cools down the fastest** because dull black surfaces **emit radiation better** than white or shiny ones. Take note- dull black objects are also better at absorbing heat- so if we used cold water and placed the tubes Infront of a heater- the dull black tube would heat up fastest. *Some students find this confusing but dull, black objects are better at absorbing and emitting heat- if they are cold, they heat up faster but if they are hot, they cool down faster (than white or shiny objects).*