

## Physics GCSE - Personal Learning Checklist

### AQA Physics (8463) from 2016 Topics P4.5. Forces - PAPER 2

**Remember to test yourself by doing an exam question!**

#### AQA Physics (8463) from 2016 Topics P4.5. Forces

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4.5.1 Forces and their interactions	Identify and describe scalar quantities and vector quantities Identify and give examples of forces as contact or non-contact forces Describe the interaction between two objects and the force produced on each as a vector Describe weight and explain that its magnitude at a point depends on the gravitational field strength Calculate weight by recalling and using the equation: $[ W = mg ]$ Represent the weight of an object as acting at a single point which is referred to as the object's 'centre of mass' Calculate the resultant of two forces that act in a straight line <b>HT ONLY:</b> describe examples of the forces acting on an isolated object or system <b>HT ONLY:</b> Use free body diagrams to qualitatively describe examples where several forces act on an object and explain how that leads to a single resultant force <b>or no force</b> <b>HT ONLY:</b> Use free body diagrams and accurate vector diagrams to scale, to resolve multiple forces and show magnitude and direction of the resultant <b>HT ONLY:</b> Use vector diagrams to illustrate resolution of forces, equilibrium situations and determine the resultant of two forces, to include both magnitude and <b>direction</b>			
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4.5.2 Work done and energy	Describe energy transfers involved when work is done and calculate the work done by recalling and using the equation: $[ W = Fs ]$ Describe what a joule is and state what the joule is derived from Convert between newton-metres and joules. Explain why work done against the frictional forces acting on an object causes a rise in the temperature of the object			
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4.5.3 Forces and elasticity	Describe examples of the forces involved in stretching, bending or compressing an object Explain why, to change the shape of an object (by stretching, bending or compressing), more than one force has to be applied – this is limited to stationary objects only Describe the difference between elastic deformation and inelastic deformation caused by stretching forces Describe the extension of an elastic object below the limit of proportionality and calculate it by recalling and applying the equation: $[ F = ke ]$ Explain why a change in the shape of an object only happens when more than one force is applied Describe and interpret data from an investigation to explain possible causes of a linear and non-linear relationship between force and extension Calculate work done in stretching (or compressing) a spring (up to the limit of proportionality) by applying, but not recalling, the equation: $[ E_e = \frac{1}{2}ke^2 ]$ <b>Required practical 6:</b> investigate the relationship between force and extension for a spring.			
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4.5.4 Moments, levers and gears	<b>PHY ONLY:</b> State that a body in equilibrium must experience equal sums of clockwise and anticlockwise moments, recall and apply the equation: $[ M = Fd ]$ <b>PHY ONLY:</b> Apply the idea that a body in equilibrium experiences an equal total of clockwise and anti-clockwise moments about any pivot <b>PHY ONLY:</b> Explain why the distance, $d$ , must be taken as the perpendicular distance from the line of action of the force to the pivot <b>PHY ONLY:</b> Explain how levers and gears transmit the rotational effects of forces			
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4.5.5 Pressure and pressure differences in fluid	<b>PHY ONLY:</b> Describe a fluid as either a liquid or a gas and explain that the pressure in a fluid causes a force to act at right angles (normal) to the surface of its container <b>PHY ONLY:</b> Recall and apply the equation: $[ p = F/A ]$ <b>PHY &amp; HT ONLY:</b> Explain why the pressure at a point in a fluid increases with the height of the column of fluid above and calculate differences in pressure in a liquid by applying $[ p = h \rho g ]$ <b>PHY &amp; HT ONLY:</b> Describe up thrust an object and explain why the density of the fluid has an effect on the up thrust experienced by an object submerged in it <b>PHY &amp; HT ONLY:</b> Explain why an object floats or sinks, with reference to its weight, volume and the up thrust it experiences <b>PHY ONLY:</b> Describe a simple model of the Earth's atmosphere and of atmospheric pressure, explaining why atmospheric pressure varies with height above a surface			
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AQA Physics (8463) from 2016 Topics P4.5. Forces			R	A	G
4.5.6 Forces and motion	Define distance and displacement and explain why they are scalar or vector quantities				
	Express a displacement in terms of both the magnitude and direction				
	Explain that the speed at which a person can walk, run or cycle depends on a number of factors and recall some typical speeds for walking, running, cycling				
	Make measurements of distance and time and then calculate speeds of objects in calculating average speed for non-uniform motion				
	Explain why the speed of wind and of sound through air varies and calculate speed by recalling and applying the equation: $[s = vt]$				
	Explain the vector–scalar distinction as it applies to displacement, distance, velocity and speed				
	<b>HT ONLY:</b> Explain qualitatively, with examples, that motion in a circle involves constant speed but changing velocity				
	Represent an object moving along a straight line using a distance-time graph, describing its motion and calculating its speed from the graph's gradient				
	Draw distance–time graphs from measurements and extract and interpret lines and slopes of distance–time graphs,				
	Describe an object which is slowing down as having a negative acceleration and estimate the magnitude of everyday accelerations				
	Calculate the average acceleration of an object by recalling and applying the equation: $[a = \Delta v/t]$				
	Represent motion using velocity–time graphs, finding the acceleration from its gradient and distance travelled from the area underneath				
	<b>HT ONLY:</b> Interpret enclosed areas in velocity–time graphs to determine distance travelled (or displacement)				
	<b>HT ONLY:</b> Measure, when appropriate, the area under a velocity– time graph by counting square				
	Apply, but not recall, the equation: $[v^2 - u^2 = 2as]$				
	<b>PHY ONLY:</b> Draw and interpret velocity-time graphs for objects that reach terminal velocity				
	<b>PHY ONLY:</b> Interpret and explain the changing motion of an object in terms of the forces acting on it				
	<b>PHY ONLY:</b> Explain how an object falling from rest through a fluid due to gravity reaches its terminal velocity				
	Explain the motion of an object moving with a uniform velocity and identify that forces must be in effect if its velocity is changing, by stating and applying Newton's First Law				
	Define and apply Newton's second law relating to the acceleration of an object				
	Recall and apply the equation: $[F = ma]$				
	<b>HT ONLY:</b> Describe what inertia is and give a definition				
	<b>Estimate the speed, accelerations and forces of large vehicles involved in everyday road transport</b>				
4.5.7 Momentum	<b>Required practical 7:</b> investigate the effect of varying the force on the acceleration of an object of constant mass, and the effect of varying the mass of an object on the acceleration				
	Apply Newton's Third Law to examples of equilibrium situations				
	Describe factors that can affect a driver's reaction time				
	Explain methods used to measure human reaction times and recall typical results				
	Interpret and evaluate measurements from simple methods to measure the different reaction times of students				
	Evaluate the effect of various factors on thinking distance based on given data				
	<b>PHY ONLY:</b> Estimate the distance required for an emergency stop in a vehicle over a range of typical speeds				
	<b>PHY ONLY:</b> Interpret graphs relating speed to stopping distance for a range of vehicles				
	State typical reaction times and describe how reaction time (and therefore stopping distance) can be affected by different factors				
	Explain methods used to measure human reaction times and take, interpret and evaluate measurements of the reaction times of students				
	Explain how the braking distance of a vehicle can be affected by different factors, including implications for road safety				
	Explain how a braking force applied to the wheel does work to reduce the vehicle's kinetic energy and increases the temperature of the brakes				
	Explain and apply the idea that a greater braking force causes a larger deceleration and explain how this might be dangerous for drivers				
	<b>HT ONLY:</b> Estimate the forces involved in the deceleration of road vehicles				

AQA Physics (8463) from 2016 Topics P4.6. Waves			
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4.6.1 Waves in air, fluids and solids	Describe waves as either transverse or longitudinal, defining these waves in terms of the direction of their oscillation and energy transfer and giving examples of each		
	Define waves as transfers of energy from one place to another, carrying information		
	Define amplitude, wavelength, frequency, period and wave speed and Identify them where appropriate on diagrams		
	State examples of methods of measuring wave speeds in different media and Identify the suitability of apparatus of measuring frequency and wavelength		
	Calculate wave speed, frequency or wavelength by applying, but not recalling, the equation: $[v = f\lambda]$ and calculate wave period by recalling and applying the equation: $[T = 1/f]$		
	Identify amplitude and wavelength from given diagrams		
	Describe a method to measure the speed of sound waves in air		
	Describe a method to measure the speed of ripples on a water surface		
	<i>PHY ONLY: Demonstrate how changes in velocity, frequency and wavelength are inter-related in the transmission of sound waves from one medium to another</i>		
	<i>Required practical 8: make observations to identify the suitability of apparatus to measure the frequency, wavelength and speed of waves in a ripple tank and waves in a solid</i>		
	<i>PHY ONLY: Discuss the importance of understanding both mechanical and electromagnetic waves by giving examples, such as designing comfortable and safe structures and technologies</i>		
	<i>PHY ONLY: Describe a wave's ability to be reflected, absorbed or transmitted at the boundary between two different materials</i>		
	<i>PHY ONLY: Draw the reflection of a wave at a surface by constructing ray diagrams</i>		
	<i>Required practical 9 (physics only): investigate the reflection of light by different types of surface and the refraction of light by different substances.</i>		
	<i>PHY &amp; HT ONLY: Describe, with examples, processes which convert wave disturbances between sound waves and vibrations in solids</i>		
	<i>PHY &amp; HT ONLY: Explain why such processes only work over a limited frequency range and the relevance of this to the range of human hearing, which is from 20 Hz to 20 kHz</i>		
	<i>PHY &amp; HT ONLY: Define ultrasound waves and explain how these are used to form images of internal structures in both medical and industrial imaging</i>		
	<i>PHY &amp; HT ONLY: Compare the two types of seismic wave produced by earthquakes with reference to the media they can travel in and the evidence they provide of the structure of the Earth</i>		
	<i>PHY &amp; HT ONLY: Describe how echo sounding using high frequency sound waves is used to detect objects in deep water and measure water depth</i>		
4.6.2 Electromagnetic waves	Describe what electromagnetic waves are and explain how they are grouped		
	List the groups of electromagnetic waves in order of wavelength		
	Explain that because our eyes only detect a limited range of electromagnetic waves, they can only detect visible light		
	<b>HT ONLY:</b> Explain how different wavelengths of electromagnetic radiation are reflected, refracted, absorbed or transmitted differently by different substances and types of surface		
	Illustrate the refraction of a wave at the boundary between two different media by constructing ray diagrams		
	<b>HT ONLY:</b> Describe what refraction is due to and illustrate this using wave front diagrams		
	<i>Required practical activity 10: investigate how the amount of infrared radiation absorbed or radiated by a surface depends on the nature of that surface.</i>		
	<b>HT ONLY:</b> Explain how radio waves can be produced by oscillations in electrical circuits, or absorbed by electrical circuits		
	Explain that changes in atoms and the nuclei of atoms can result in electromagnetic waves being generated or absorbed over a wide frequency range		
	State examples of the dangers of each group of electromagnetic radiation and discuss the effects of radiation as depending on the type of radiation and the size of the dose		
	State examples of the uses of each group of electromagnetic radiation, explaining why each type of electromagnetic wave is suitable for its applications		
	<b>PHY ONLY:</b> State that a lens forms an image by refracting light and that the distance from the lens to the principal focus is called the focal length		
	<b>PHY ONLY:</b> Explain that images produced by a convex lens can be either real or virtual, but those produced by a concave lens are always virtual		
	<b>PHY ONLY:</b> Construct ray diagrams for both convex and concave lenses		
	<b>PHY ONLY:</b> Calculate magnification as a ratio with no units by applying, but not recalling, the formula: [magnification = image height / object height]		
	<b>PHY ONLY:</b> Explain how the colour of an object is related to the differential absorption, transmission and reflection of different wavelengths of light by the object		
	<b>PHY ONLY:</b> Describe the effect of viewing objects through filters or the effect on light of passing through filters and the difference between transparency and translucency		
	<b>PHY ONLY:</b> Explain why an opaque object has a particular colour, with reference to the wavelengths emitted		
	<b>PHY ONLY:</b> State that all bodies, no matter what temperature, emit and absorb infrared radiation and that the hotter the body, the more infrared radiation it radiates in a given time		
	<b>PHY ONLY:</b> Describe a perfect black body as an object that absorbs all the radiation incident on it and explain why it is the best possible emitter		
	<b>PHY ONLY:</b> Explain why when the temperature is increased, the intensity of every wavelength of radiation emitted increases, but the intensity of the shorter wavelengths increases more rapidly		
	<b>PHY &amp; HT ONLY:</b> Explain and apply the idea that the temperature of a body is related to the balance between incoming radiation absorbed and radiation emitted		
	<b>PHY &amp; HT ONLY:</b> Describe how the temperature of the Earth as dependent on the rates of absorption and emission of radiation and draw and interpret diagrams that show this		

4.7.1 Permanent magnetism, and induced magnetic forces and	Describe the attraction and repulsion between unlike and like poles of permanent magnets and explain the difference between permanent and induced magnets		
	Draw the magnetic field pattern of a bar magnet, showing how field strength and direction are indicated and change from one point to another		
	Explain how the behaviour of a magnetic compass is related to evidence that the core of the Earth must be magnetic		
	Describe how to plot the magnetic field pattern of a magnet using a compass		
4.7.2 The motor effect	State examples of how the magnetic effect of a current can be demonstrated and explain how a solenoid arrangement can increase the magnetic effect of the current		
	Draw the magnetic field pattern for a straight wire carrying a current and for a solenoid (showing the direction of the field)		
	<i>PHY ONLY: Interpret diagrams of electromagnetic devices in order to explain how they work</i>		
	<b>HT ONLY:</b> State and use Fleming's left-hand rule and explain what the size of the induced force depends on		
	<b>HT ONLY:</b> Calculate the force on a conductor carrying a current at right angles to a magnetic field by applying, but not recalling, the equation: $[ F = BIL ]$		
	<b>HT ONLY:</b> Explain how rotation is caused in an electric motor		
4.7.3 Induced potential, transformers and the National Grid	<b>PHY &amp; HT ONLY:</b> Explain how a moving-coil loudspeaker and headphones work		
	<b>PHY &amp; HT ONLY:</b> Describe the principles of the generator effect, including the direction of induced current, effects of Lenz' Law and factors that increase induced p.d.		
	<b>PHY &amp; HT ONLY:</b> Explain how the generator effect is used in an alternator to generate a.c. and in a dynamo to generate d.c.		
	<b>PHY &amp; HT ONLY:</b> Draw/interpret graphs of potential difference generated in the coil against time		
	<b>PHY &amp; HT ONLY:</b> Explain how a moving-coil microphone works		
	<b>PHY &amp; HT ONLY:</b> Explain how the effect of an alternating current in one coil inducing a current in another is used in transformers		
	<b>PHY &amp; HT ONLY:</b> Explain how the ratio of the potential differences across the two coils depends on the ratio of the number of turns on each		
	<b>PHY &amp; HT ONLY:</b> Apply the equation linking the p.d.s and number of turns in the two coils of a transformer to the currents and the power transfer		
4.8.1 Solar system; stability of orbital motions; satellites	<b>PHY &amp; HT ONLY:</b> Apply but not recalling the equations: $[ Vs \times Is = Vp \times Ip ]$ and $[ vp / vs = np / ns ]$ for transformers		
	<b>AQA Physics (8463) from 2016 Topics P4.8. Space physics</b>	<b>R</b>	<b>A</b>
	<b>PHY ONLY:</b> List the types of body that make up the solar system and describe our solar system as part of a galaxy		
	<b>PHY ONLY:</b> Explain how stars are formed		
	<b>PHY ONLY:</b> Describe the life cycle of a star the size of the Sun and of a star which is much more massive than the Sun		
	<b>PHY ONLY:</b> Explain how fusion processes lead to the formation of new elements and how supernovas have allowed heavy elements to appear in later solar systems		
	<b>PHY &amp; HT ONLY:</b> Explain that, for circular orbits, the force of gravity leads to a constantly changing velocity but unchanged speed		
4.8.2 Red-shift	<b>PHY &amp; HT ONLY:</b> Explain that, for a stable orbit, the radius must change if the speed changes		
	<b>PHY ONLY:</b> Explain, qualitatively, the red-shift of light from galaxies that are receding and how this red-shift changes with distance from Earth		
	<b>PHY ONLY:</b> Explain why the change of each galaxy's speed with distance is evidence of an expanding universe		
	<b>PHY ONLY:</b> Explain how scientists are able to use observations to arrive at theories, such as the Big Bang theory and discuss that there is still much about the universe that is not understood		