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| **AQA Physics (8463) from 2016 Topics P4.5. Forces** |
| **Topic** | **Student Checklist** | **R** | **A** | **G** |
| **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 |   |   |   |
| **4.5.2 Work done and energy transfer** |  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 |   |   |   |
| **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: ***[ Ee= ½ke2 ]*** |   |   |   |
|  ***Required practical 6:*** *investigate the relationship between force and extension for a spring.*  |   |   |   |
| **4.5.4 Moments, levers and gears** |  *PHY ONLY: State that a body in equilibrium must experience equal sums of clockwise and anticlockwise moments, recall and apply the equation:* ***[ M = Fd ]*** |   |   |   |
|  *PHY ONLY: Apply the idea that a body in equilibrium experiences an equal total of clockwise and anti-clockwise moments about any pivot* |   |   |   |
|  *PHY ONLY: Explain why the distance, d, must be taken as the perpendicular distance from the line of action of the force to the pivot* |   |   |   |
|  *PHY ONLY: Explain how levers and gears transmit the rotational effects of forces* |   |   |   |

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| **4.5.5 Pressure and pressure differences in fluid** |  *PHY ONLY: 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* |   |   |   |
|  *PHY ONLY: Recall and apply the equation:* ***[ p = F/A ]*** |   |   |   |
|  *PHY ONLY: Describe a simple model of the Earth's atmosphere and of atmospheric pressure, explaining why atmospheric pressure varies with height above a surface* |   |   |   |
| **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 = v t ]*** |   |   |   |
|  Explain the vector–scalar distinction as it applies to displacement, distance, velocity and speed |   |   |   |
|  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 = Δv/t ]*** |   |   |   |
|  Represent motion using velocity–time graphs, finding the acceleration from its gradient and distance travelled from the area underneath |   |   |   |
|  Apply, but not recall, the equation: ***[ v2 – u2 = 2as ]*** |   |   |   |
|  *PHY ONLY: Draw and interpret velocity-time graphs for objects that reach terminal velocity* |   |   |   |
|  *PHY ONLY: Interpret and explain the changing motion of an object in terms of the forces acting on it* |   |   |   |
|  *PHY ONLY: 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 ]***  |   |   |   |
|  **Estimate the speed, accelerations and forces of large vehicles involved in everyday road transport** |   |   |   |
|  ***Required practical 7:*** *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 |   |   |   |
|  *PHY ONLY: Estimate the distance required for an emergency stop in a vehicle over a range of typical speeds* |   |   |   |
|  *PHY ONLY: 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 |   |   |   |

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| **AQA Physics (8463) from 2016 Topics P4.6. Waves** |
| **Topic** | **Student Checklist** | **R** | **A** | **G** |
| **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 λ] 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 |   |   |   |
|  *PHY ONLY: Demonstrate how changes in velocity, frequency and wavelength are inter-related in the transmission of sound waves from one medium to another* |   |   |   |
|  ***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*  |   |   |   |
|  *PHY ONLY: Discuss the importance of understanding both mechanical and electromagnetic waves by giving examples, such as designing comfortable and safe structures and technologies* |   |   |   |
|  *PHY ONLY: Describe a wave's ability to be reflected, absorbed or transmitted at the boundary between two different materials* |   |   |   |
|  *PHY ONLY: Draw the reflection of a wave at a surface by constructing ray diagrams* |   |   |   |
| ***Required practical 9*** *(physics only): investigate the reflection of light by different types of surface and the refraction of light by different substances.*  |   |   |   |

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| **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 |   |   |   |
|  Illustrate the refraction of a wave at the boundary between two different media by constructing ray diagrams |   |   |   |
|  ***Required practical activity 10:*** *investigate how the amount of infrared radiation absorbed or radiated by a surface depends on the nature of that surface.*  |   |   |   |
|  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 |   |   |   |
|  *PHY ONLY: 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* |   |   |   |
|  *PHY ONLY: Explain that images produced by a convex lens can be either real or virtual, but those produced by a concave lens are always virtual* |   |   |   |
|  *PHY ONLY: Construct ray diagrams for both convex and concave lenses* |   |   |   |
|  *PHY ONLY: Calculate magnification as a ratio with no units by applying, but not recalling, the formula: [ magnification = image height / object height ]* |   |   |   |
|  *PHY ONLY: Explain how the colour of an object is related to the differential absorption, transmission and reflection of different wavelengths of light by the object* |   |   |   |
|  *PHY ONLY: Describe the effect of viewing objects through filters or the effect on light of passing through filters and the difference between transparency and translucency* |   |   |   |
|  *PHY ONLY: Explain why an opaque object has a particular colour, with reference to the wavelengths emitted* |   |   |   |
|  *PHY ONLY: 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* |   |   |   |
|  *PHY ONLY: 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* |   |   |   |
|  *PHY ONLY: 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* |   |   |   |

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| **AQA Physics (8463) from 2016 Topics P4.7. Magnetism and electromagnetism** |
| **TOPIC** | **Student Checklist** | **R** | **A** | **G** |
| **4.7.1 Permanent and induced magnetism, magnetic forces and fields** |  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) |   |   |   |
|  *PHY ONLY: Interpret diagrams of electromagnetic devices in order to explain how they work* |   |   |   |

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| **AQA Physics (8463) from 2016 Topics P4.8. Space physics** |
| **TOPIC** | **Student Checklist** | **R** | **A** | **G** |
| **4.8.1 Solar system; stability of orbital motions; satellites** |  *PHY ONLY: List the types of body that make up the solar system and describe our solar system as part of a galaxy* |   |   |   |
|  *PHY ONLY: Explain how stars are formed* |   |   |   |
|  *PHY ONLY: Describe the life cycle of a star the size of the Sun and of a star which is much more massive than the Sun* |   |   |   |
|  *PHY ONLY: Explain how fusion processes lead to the formation of new elements and how supernovas have allowed heavy elements to appear in later solar systems* |   |   |   |
| **4.8.2 Red-shift** |  *PHY ONLY: Explain, qualitatively, the red-shift of light from galaxies that are receding and how this red-shift changes with distance from Earth* |   |   |   |
|  *PHY ONLY: Explain why the change of each galaxy’s speed with distance is evidence of an expanding universe* |   |   |   |
|  *PHY ONLY: 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* |   |   |   |