Year 11 Physics Fact Sheet – Paper 2 – combined

Italics – higher only

Forces	Forces and their interactions	1. Scalar quantities have a magnitude (size) only and can be represented by a line. 2. Examples of Scalar quantities include speed, distance, time, mass, energy and power. 3. Vector quantities have a magnitude and direction and are represented by an arrow, showing the direction of the vector. 4. Examples of Vector quantities include velocity, acceleration, force, momentum, weight, gravitational field strength and displacement. 5. Displacement is defined a distance without a change of direction.
	Forces between objects	6. A force can be a push a pull or a twist and changes the shape or motion of an object. 7. Forces work in pairs known as action reaction pairs. 8. Contact forces are only able to act when the objects are physically touching. 9. Examples of contact forces include, thrust, upthrust, lift, reaction, tension, friction and drag forces (air and water resistance) 10. Non-contact forces are able to act at a distance. 11. Examples of non-contact forces include weight, magnetic and electrostatic force. 12. Scale diagrams can be used to show the size of forces in free body force diagrams, the size of the arrow represents the size of the force.
	Weight and Gravity	13. Weight is the force action on an object due to gravity. 14. The magnitude of gravity on the earth is given as 9.8N/kg 15. Everything near the earth experiences gravity and weight due to the proximity to earth 16. The weight of an object is given as weight (N) = mass (kg) x gravitational field strength(N/kg) 17. The weight of an object is said to act from the objects centre of mass 18. Weight is measure in Newton's using a calibrated spring balance called a Newtonmeter
	Resultant force	19. A number of forces acting on an object may be replaced by a single force that has the same effect as all the original forces. This is known as resultant force. 20. Resultant force is calculated by adding forces in the same direction and subtracting forces in the opposite direction. 21. *A single force can be calculated using Pythagoras theorem when the forces are at right angles. Using parallelograms of forces when they are at any other angle.* 22. *Resultant force diagrams must be drawn to scale and using arrows.* 23. *A single force can also be resolved to give two forces acting at right angles to each other. Often known as the horizontal and vertical component.*
	Friction and Drag	24. Friction and drag forces oppose motion. 25. Friction forces are between solid surfaces and increase as the mass of the object increases. 26. Drag forces, (air resistance and water resistance) are caused by the collision of the particles in the medium the object is moving through with the object.
	Work done and energy	27. When a force causes and object to move through a distance work is done on the object. 28. One joule of work is done when one newton of force causes and object to move 1 metre. 29. Work done (J) = force (N) x distance (moved along the line of action of the force) (m)

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	Forces and elasticity	30. An object can be changed shape if more than force is applied to it. 31. A stretching force puts an object under tension and a squashing force puts an object under tension. 32. An object is elastic if it returns to its original shape when the forces deforming are removed. 33. If an object reaches its elastic limit then it will no longer return to its original shape, this is known as inelastic deformation 34. The extension of an elastic object is directly proportional to the force applied, provided the limit of proportionality is not exceeded. 35. This is given by the equation, force (N) = spring constant (N/m) x extension (m) 36. A force that stretches or compresses a spring does work and elastic potential energy is stored. Provided the elastic limit has not been met.
Waves	General wave properties	37. Waves transfer energy without a transfer of matter, there are two type mechanical and electromagnetic 38. Mechanical waves are vibrations that travel through a medium (a substance) and include water waves, sound waves, waves on a spring or rope and seismic waves 39. Electromagnetic waves are able to travel through a vacuum at the speed of light, 3 x 10^8 m/s and include light, radiowaves and microwaves. 40. In transverse waves the oscillations are perpendicular to the direction of energy transfer. All electromagnetic waves are transverse 41. In longitudinal waves the oscillations are parallel to the direction of energy transfer. 42. Mechanical waves can be either transverse or longitudinal 43. In longitudinal waves there are areas of compression (squashing) and rarefaction (spreading out) 44. The wavelength (λ) of a wave is the distance from one point on one wave to the same point on the next wave and is measured in meters. 45. The amplitude of a wave is the maximum displacement of a point on the wave from its undisturbed position. Eg from the middle to the peak. 46. The bigger the amplitude of the waves the more energy the waves carry. 47. Frequency is the number of waves that pass a fixed point every second and is measured in Hertz 48. The (time) period of a wave is the time taken for each wave to pass a fixed point and is measured in seconds 49. Frequency and time period are related with the following equation. (This equation is given to you.) $time\ period\ (seconds) = \frac{1}{frequency\ (Hertz)}$ 50. The speed of the wave is the distance travelled by each wave every second. 51. The wave speed can be calculated using the following equation. $wave\ speed\ v\ = frequency\ f\ x\ wavelength\ \lambda$ $m/s\ \ = Hertz\ Hz\ \ x\ \ metres$

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Waves	Reflection and refraction	52. When waves such as water waves sound waves and light waves hit a solid surface they reflect at the same angle as the incident angle. This is called the law of reflection. 53. At the boundary between two materials waves can either be transmitted (pass through) or absorbed. 54. When waves such as light cross a boundary between mediums they are refracted, this is because waves travel slower in more dense mediums and consequently bend towards the normal. 55. Refraction also occurs in water waves at different depths. Water waves travel slower in shallower water than they do in deeper water.
	Sound waves	56. Sound waves cannot travel in a vacuum as they require particles 57. Sound waves can travel in all three states of matter and travel the fastest in solids ass the particles are closest together 58. The speed of a wave in solids can be measured using a frequency generator attached to a vibration generator and a length of string under tension to set up a standing wave. 59. The speed of a wave in a liquid can be measured using a frequency generator attached to a paddle/dibber in a ripple tank. A slow motion camera can be used to measure the wavelength and frequency to determine the speed. 60. The speed of a sound wave in air can be measured by making a sound and waiting to hear the echo off of a smooth solid object such a wall. 61. On an oscilloscope the louder the sound the larger the amplitude of the wave, the higher the pitch of the sound the shorter the wavelength is. 62. The human hearing range is between 20 – 20 000 Hz
	Electro-magnetic waves	63. The order of the electromagnetic spectrum from longest wavelength to shortest wavelength is Radio waves, Microwaves, Infra-red, Visible light, Ultraviolet, X-rays, Gamma rays. 64. Radio waves can be up to 1x 10^4 m (10 km) they are used for sending sound and images in TVs and radios and for Bluetooth signals. They have the lowest frequency between 300 000 to 3000 million Hz 65. Microwaves have shorter wavelengths than radio waves and higher frequencies. They are used for satellite TV, mobile phone signals and heating food in microwave ovens. 66. Infra-red waves are shorter in wavelength and higher in frequency than microwaves. Anything that is hot emits infrared radiation and they can be used for remote controls, body scanning, thermal imaging and optical fibres. 67. Visible light can be divided into the seven colours of light. Red, Orange, Yellow, Green, Blue, Indigo, Violet. They are used in cameras and to be able to see. 68. UV radiation is shorter in wavelength and higher frequency than visible light. It can be used for tanning, security checks on money, finding body fluids at a crime scene. 69. X rays are shorter wavelength and higher frequency than UV rays It is used for detecting broken bones and airport security. 70. Gamma rays are the shortest wavelength and the highest frequency. They carry the most energy and can be used for sterilising medical equipment, treating cancer and detecting flaws in metals or concrete. 71. Electromagnetic waves are given off when electrons are excited to higher energy levels and drop back down.

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Waves	Communications and harm	72. Radio waves, microwaves, infra-red and visible light can all be used to send messages 73. Infra-red and visible light can be used to send messages down optical fibres using a process called total internal reflection. 74. Radio waves can be used to send information signals around the world by bouncing them off the ionosphere. Radio waves can not pass through the atmosphere 75. Microwaves can be used to send information around the world by bouncing them of satellites. 76. Microwaves spread out less than radio waves and therefore give a higher quality signal. Hence the switch to digital signals in recent years. 77. Radio waves have different ranges. MW and LW over 100m are used for international broadcasts. FM are used in local broadcasts as they can travel only short distances. 78. *Sound is converted into an AC current using a microphone, in a modulator this is causes an electron to become excited and emit radio waves. These are then received by a different radio mast and converted back into AC current which can be converted into sound by a speaker.* 79. Microwaves, radio waves and infra-red radiation all pose a risk to health through heating. There is a strong correlation between mobile phones and cancer possible caused by heating molecules. 80. High frequency UV radiation, X-rays and Gamma rays are all ionising, this means they can cause mutations in DNA leading to cancer. 81. UV radiation is lowly penetrating and can be stopped using sunscreen and sun glasses. It can cause skin cancer and cataracts. 82. X-rays and Gamma rays are more penetrating and a film badge is used to monitor exposure. 83. X rays and gamma rays are used in hospitals because the benefits outweigh the risks. 84. X rays can pass through soft tissues but are absorbed by denser tissues such as bones and teeth. These areas show up clear on a film.
	Infra-red radiation	85. Infra-red radiation is absorbed and emitted by all objects. The hotter they are the more infra-red radiation is given off. 86. An object at a constant temperature emits as much infrared radiation as it absorbs. 87. The perfect absorber of radiation is called a black body. It is also by the same logic a perfect emitter of radiation. 88. Black matt surfaces are the best absorbers/emitters of infrared. White shiny surfaces are the worst absorbers/emitters of infrared. 89. This can be proved using a Leslie cube, or black and white cans with boiling water.

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Magnetism	Magnets	90. The three magnetic elements iron, cobalt and nickel. Steel is magnetic because it contains iron. They are magnetic because of the dipoles. 91. The poles of a magnet are north and south. The magnetic field flows from north to south. 92. Like poles repel, opposite poles attract. 93. The magnetic field can be determined by using a compass or iron filings. 94. The stronger the magnetic field is, the closer the lines of the magnetic field are together. This is called magnetic flux density. 95. There are three types of magnet: permanent magnets, induced magnets and electromagents. 96. Steel is used to make permanent magnets because it does not easily lose its magnetic abilities. Iron is used to make electromagnets because it does not retain its magnetic ability for long. 97. The earth also has a magnetic field similar to that of a bar magnet.
	Electro-magnets	98. Any wire carrying a current generates a magnetic field. This can be predicted using the right had grip rule, where your thumb gives the direction of flow and your curled fingers give the direction of the field 99. Wrapping the wire into a coil increases the strength of the magnetic field. This is called a solenoid. 100. The electromagnetic field is strongest inside a solenoid and is similar to a bar magnet. 101. The north pole of a solenoid is where the current is flowing in an anticlockwise direction. The south pole is where the current is flowing in a clockwise direction 102. An electromagnet is made when that solenoid is wrapped around a soft iron core. 103. Increasing the current makes the magnetic field stronger. Reversing the current reverses the direction of the magnetic field.
	The motor effect	104. *When a current carrying wire is put in a magnetic field a force is experienced. This causes one to move. This is called the motor effect.* 105. *This movement can be predicted using Flemings left hand rule. The thu**M**b represents **M**ovement, the **F**irst finger represents **F**ield, the se**C**ond finger represents **C**urrent.* 106. *The size of the force can be increased by increasing the current or using a stronger magnet.* 107. *The force is greatest when the wire is perpendicular to the magnetic field. There is no force when they two are parallel.* 108. *The equation that links the force, magnetic field strength and current is* $force\ F = magnetic\ flux\ density\ B\ x\ Current\ I\ x\ length\ l$ $Newtons\ N = \quad tesla\ T \quad x\ \ amperes\ A \quad x\ metres\ m$ *109. An electric motor uses the motor effect by using a coil of wire. A split ring commutator keeps the motor spinning in the same direction. Because the current flows around the circuit. One side moves up and the other moves down in the magnetic field.*