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| **Forces** | Forces and their interactions | 1. Scalar quantities have a magnitude (size) only and can be represented by a line.<br>2. Examples of Scalar quantities include speed, distance, time, mass, energy and power.<br>3. Vector quantities have a magnitude and direction and are represented by an arrow, showing the direction of the vector.<br>4. Examples of Vector quantities include velocity, acceleration, force, momentum, weight, gravitational field strength and displacement.<br>5. Displacement is defined as 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.<br>7. Forces work in pairs known as action reaction pairs.<br>8. Contact forces are only able to act when the objects are physically touching.<br>9. Examples of contact forces include, thrust, upthrust, lift, reaction, tension, friction and drag forces (air and water resistance)<br>10. Non-contact forces are able to act at a distance.<br>11. Examples of non-contact forces include weight, magnetic and electrostatic force.<br>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.<br>14. The magnitude of gravity on the earth is given as 9.8N/kg<br>15. Everything near the earth experiences gravity and weight due to the proximity to earth<br>16. The weight of an object is given as weight (N) = mass (kg) x gravitational field strength(N/kg)<br>17. The weight of an object is said to act from the objects centre of mass<br>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.<br>20. Resultant force is calculated by adding forces in the same direction and subtracting forces in the opposite direction.<br>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.*<br>22. *Resultant force diagrams must be drawn to scale and using arrows.*<br>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.<br>25. Friction forces are between solid surfaces and increase as the mass of the object increases.<br>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.<br>28. One joule of work is done when one newton of force causes and object to move 1 metre.<br>29. Work done (J) = force (N) x distance (moved along the line of action of the force) (m) |

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| **Forces** | **Moments** | **30. A moment is a turning effect caused by a force or system of forces.**<br>**31. The size of the moment is defined by the equation moment of force (Nm) = force (N) x distance (perpendicular distance from the pivot along the line of action of the force) (m)**<br>**32. Where an object is balanced the clockwise rotation is equal to the anticlockwise rotation**<br>**33. Force or distance can be calculated in a balanced system using the moment equations and rearrangements of this equation.**<br>**34. One Nm is equal to one Joule**<br>**35. Levers and gear systems can be used to reduce effort and increase force and can be described as force multipliers.**<br>**36. There are two types of gears, low gears (step up) which are designed to minimise the force and give a high turning effect, and high gears (step down) which require more force but give out greater speed and low turning effect.** |
| | Forces and elasticity | 37. An object can be changed shape if more than force is applied to it.<br>38. A stretching force puts an object under tension and a squashing force puts an object under tension.<br>39. An object is elastic if it returns to its original shape when the forces deforming are removed.<br>40. If an object reaches its elastic limit then it will no longer return to its original shape, this is known as inelastic deformation<br>41. The extension of an elastic object is directly proportional to the force applied, provided the limit of proportionality is not exceeded.<br>42. This is given by the equation, force (N) = spring constant (N/m) x extension (m)<br>43. A force that stretches or compresses a spring does work and elastic potential energy is stored. Provided the elastic limit has not been met. |
| | **Pressure and pressure differences in fluids** | **44. A fluid can be either a liquid or a gas**<br>**45. The pressure in a fluid causes a force that is normal (at right angles) to any surface.**<br>**46. Pressure (Pa) = force normal to a surface (N)/ area of the surface ($m^2$)**<br>**47. Pressure in fluids increases with depth as the weight of the particles above push down on the particles below.**<br>**48. This is given by the equation pressure (Pa) = height of the column (m) x density of the liquid ($kg/m^3$) x gravitational field strength (N/kg)**<br>**49. An object that is submerged (partially or totally) experiences a greater pressure on the bottom surface than the top surface caused by difference in height and this creates a resultant force upwards known as upthrust.**<br>**50. An object that displaces a greater mass of water than its own mass will float. This object will also have a density less than the fluid it is in.**<br>**51. The atmosphere of the earth is a thin (relative to the thickness of the earth) fluid layer round the earth.**<br>**52. The atmosphere gets less dense with increasing altitude.**<br>**53. Air molecules colliding with a surface creates atmospheric pressure.** |

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| | Forces and Motion | 54. Speed is a scalar quantity.<br>55. Velocity is a vector quantity and represents speed with a direction.<br>56. The speed of an object can be calculated using the equation,<br>speed (m/s) = distance (m) ÷ time (s) |
| **Forces** | Distance-Time Graphs | 57. The gradient of a line on a distance-time graph represents the speed<br>58. The object is stationary if the line is horizontal and the gradient of the line is 0.<br>59. The object is moving at a constant speed if the gradient is a straight line sloping upwards.<br>60. The steeper the gradient on a distance-time graph, the faster the speed of the object.<br>61. *For an object moving at changing speed, the speed, at any instant in time, can be calculated by drawing a tangent to the line and finding the gradient of the tangent.* |
| | Acceleration | 62. Two moving objects can have the same speed but different velocities if they are moving in different directions.<br>63. *An object moving in a circle may have a constant speed but a changing velocity as it's direction is continuously changing as it goes round.*<br>64. Acceleration is the change in velocity per second.<br>65. Acceleration can be calculated using the equation,<br>Acceleration ($m/s^2$) = change in velocity (m/s) ÷ time taken for the change (s)<br>66. The change in velocity can be calculated using the equation,<br>Change in velocity (m/s) = final velocity (m/s) – initial velocity (m/s)<br>67. Deceleration is the change in velocity per second when an object slows down and can be calculated using the same equation as acceleration.<br>68. The following calculation can be useful when time taken is not given and acceleration is constant, $(\text{final velocity})^2 - (\text{initial velocity})^2$ = 2 x acceleration x distance. |
| | Velocity-Time Graphs | 69. The gradient of a line on a velocity-time graph represents the acceleration.<br>70. A horizontal line with a gradient of 0 means the acceleration is 0, this means the object is moving at a constant velocity.<br>71. A straight line sloping upwards represents acceleration and therefore an increasing velocity.<br>72. A straight line sloping downwards represents deceleration and therefore a decreasing velocity.<br>73. A steeper the gradient on a velocity-time graph, tells you an object accelerates faster.<br>74. *The area under the line on a velocity-time graph represents the distance travelled. You can use the equation, area = base x height (for a rectangle) or area = ½ x base x height (for a triangle)* |
| | Force and Acceleration | 75. If a resultant force of an object is zero, a stationary object will remain stationary and a moving object will continue to move at the same speed and direction (velocity).<br>76. Resultant force (N) = mass (kg) x acceleration ($m/s^2$)<br>77. The greater the resultant force on an object, the greater the acceleration.<br>78. The greater the mass of an object, the smaller its acceleration (for a given force).<br>79. Acceleration is always in the same direction as the resultant force.<br>*80. The inertia of an object is its tendency to stay at rest of in uniform motion.*<br>81. *Inertial mass is a measure of how difficult it is to change the velocity of an object.* |

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| **Forces** | Terminal Velocity | 82. Weight is the force due to gravity, measured in Newtons. Mass is the amount of matter in an object, measured in kilograms.<br>83. An object on earth that is free falling under gravity has an acceleration of about 9.8m/$s^2$.<br>84. The terminal velocity of an object is the velocity it eventually reaches when it is falling.<br>85. At terminal velocity, the resultant force acting on the object will be zero. |
| | Newton's Laws | 86. Newton's first law of motion states that an object remains in the same state of motion unless a resultant force acts on it.<br>87. If the resultant force is zero, a stationary object remains stationary and an object in motion continues to move at the same velocity.<br>88. Newton's second law of motion can be describe by the equation Resultant force (N) = mass (kg) x acceleration (m/$s^2$)<br>89. Newton's third law of motion states that when two objects interact they exert equal and opposite forces on each other. |
| | Forces and Braking | 90. Friction and air resistance oppose the driving force of a vehicle.<br>91. Stopping distance is the shortest distance a vehicle can stop in.<br>92. Thinking distance is the distance travelled by the vehicle in the time it takes the driver to react.<br>93. Braking distance is the distance travelled during the time the braking force is applied.<br>94. Stopping distance (m) = thinking distance (m) + braking distance (m).<br>95. Force (N) = mass (kg) x acceleration (m/$s^2$) gives the braking force of a vehicle.<br>96. Reaction time can be affected by factors such as tiredness, drugs and alcohol.<br>97. Braking distance can be affected by factors such as the condition of the vehicle and adverse road and weather conditions.<br>98. The greater the speed a vehicle is travelling, the greater the braking force needed to stop the vehicle.<br>99. The greater the mass of a vehicle, the greater the braking force needed for a given deceleration. |
| | *Momentum* | *100. Momentum (kg m/s) = mass (kg) x velocity (m/s)*<br>*101. A closed system is a system in which the momentum before an event is equal to the total momentum after the event. This is called conservation of momentum.*<br>*102. The conservation of momentum only exists if there are no external forces acting on the objects.*<br>*103. Momentum is a vector quantity, so it is important to consider both magnitude and direction. For example, if travelling east is given a positive value, travelling west is given a negative value.*<br>***104. Two objects pushing apart in opposite directions will have equal and opposite momentum causing the total momentum of the system to be zero. The two objects may be of different masses and therefore travelling at different speeds.***<br>***105. For the two objects (A and B) we can use this equation; (mass A x velocity A) + (mass B x velocity B) = 0*** |

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| | ***Change in momentum*** | ***106. When a force acts on an object that is able to move, a change in momentum occurs.***<br>***107. To calculate the force involved when a change in momentum occurs we can use these two equations;***<br>***Force = mass x velocity and acceleration = change in velocity ÷ time***<br>***Combined to form the following equation;***<br>***Force (N) = (mass (kg) x change in velocity (m/s) ) ÷ time***<br>***108. The force is therefore equal to the rate of change of momentum.***<br>***109. For a collision, the shorter the impact time, the greater the impact force.***<br>***110. Car safety features such as seatbelts, airbags and crumple zones all work to change the shape of the car, which increases the time taken for the collision and therefore reduce the impact force.*** |
| **Waves** | General wave properties | 111. Waves transfer energy without a transfer of matter, there are two type mechanical and electromagnetic<br>112. 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<br>113. 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.<br>114. In transverse waves the oscillations are perpendicular to the direction of energy transfer. All electromagnetic waves are transverse<br>115. In longitudinal waves the oscillations are parallel to the direction of energy transfer.<br>116. Mechanical waves can be either transverse or longitudinal<br>117. In longitudinal waves there are areas of compression (squashing) and rarefaction (spreading out)<br>118. 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.<br>119. 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.<br>120. The bigger the amplitude of the waves the more energy the waves carry.<br>121. Frequency is the number of waves that pass a fixed point every second and is measured in Hertz<br>122. The (time) period of a wave is the time taken for each wave to pass a fixed point and is measured in seconds<br>123. Frequency and time period are related with the following equation. (This equation is given to you.)<br>$$time\ period\ (seconds) = \frac{1}{frequency\ (Hertz)}$$<br>124. The speed of the wave is the distance travelled by each wave every second.<br>125. The wave speed can be calculated using the following equation.<br>$$wave\ speed\ v\ = frequency\ f\ x\ wavelength\ \lambda$$<br>$$m/s\ \ \ = Hertz\ Hz\ \ x\ \ metres$$ |

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| **Waves** | Reflection and refraction | 126. 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.<br>127. At the boundary between two materials waves can either be transmitted (pass through) or absorbed.<br>128. Refraction occurs in water waves at different depths. Water waves travel slower in shallower water than they do in deeper water. |
| | Sound waves | 129. Sound waves cannot travel in a vacuum as they require particles<br>130. Sound waves can travel in all three states of matter and travel the fastest in solids ass the particles are closest together<br>131. 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.<br>132. 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.<br>133. 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.<br>134. 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.<br>135. The human hearing range is between 20 – 20 000 Hz<br>*136.* ***Sound waves are detected by the ear. Vibrations in the air are caught by the pinna and cause the eardrum to vibrate. These vibrations are amplified by the ossicles before passing into the cochlea where they are converted into electrical signals to be sent to the brain.***<br>*137.* ***Sounds above 20 000 Hz are called ultrasound. They can be used in pregnancy scanning, breaking down kidney stones and echo sounding.***<br>*138.* ***Echo sounding and pregnancy scanning both work by sending a high frequency sound wave which reflects on a boundary before being detected. The distance to the object is then therefore equal to half the speed x time. S= 1/2vt***<br>*139.* ***In pregnancy scanning the ultrasound wave is partially reflected a boundary between tissues and detected by the transducer. This allows a 2D or 3D image to be viewed on a screen.***<br>140. ***Ultrasound waves are not ionising and therefore safer than an X-ray.*** |
| | Seismic waves | ***141. Seismic waves are produced in an earthquake and can travel through the earth spreading out from the epicentre.***<br>***142. Primary seismic waves (P waves) are longitudinal waves. Secondary seismic waves (S waves) are transverse waves.***<br>***143. P waves can travel through liquids and solids but refract at the boundaries. S waves can not travel through the liquid core.***<br>***144. S waves can only be detected up to 105$^o$ to either side of the earthquake. P waves can be detected up to 105$^o$ and after 142$^o$. Between these two points is called the shadow zone where there are no P or S waves.***<br>**145.** ***It is the information on earthquake waves that has allowed us to determine the structure of the earth.*** |

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| **Waves** | Electro-magnetic waves | 146. 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.<br>147. 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<br>148. 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.<br>149. 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.<br>150. 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.<br>151. 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.<br>152. X rays are shorter wavelength and higher frequency than UV rays It is used for detecting broken bones and airport security.<br>153. 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.<br>154. Electromagnetic waves are given off when electrons are excited to higher energy levels and drop back down. |
| | Communica tions | 155. Radio waves, microwaves, infra-red and visible light can all be used to send messages<br>156. Infra-red and visible light can be used to send messages down optical fibres using a process called total internal reflection.<br>157. 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<br>158. Microwaves can be used to send information around the world by bouncing them of satellites.<br>159. Microwaves spread out less than radio waves and therefore give a higher quality signal. Hence the switch to digital signals in recent years.<br>160. 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.<br>161. *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.* |

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| Waves | Harm | 162. Microwaves, radiowaves 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.<br>163. High frequency UV radiation, X-rays and Gamma rays are all ionising, this means they can cause mutations in DNA leading to cancer.<br>164. UV radiation is lowly penetrating and can be stopped using sunscreen and sun glasses. It can cause skin cancer and cataracts.<br>165. X-rays and Gamma rays are more penetrating and a film badge is used to monitor exposure.<br>166. X rays and gamma rays are used in hospitals because the benefits outweigh the risks.<br>167. 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 | 168. Infra-red radiation is absorbed and emitted by all objects. The hotter they are the more infra-red radiation is given off.<br>169. An object at a constant temperature emits as much infrared radiation as it absorbs.<br>170. The perfect absorber of radiation is called a black body. It is also by the same logic a perfect emitter of radiation.<br>171. Black matt surfaces are the best absorbers/emitters of infrared. White shiny surfaces are the worst absorbers/emitters of infrared.<br>172. This can be proved using a Leslie cube, or black and white cans with boiling water. |
| Light | Reflection and refraction | **173. Light travels in straight lines.**<br>**174. When light hits a smooth shiny surface, it is reflected according the laws of reflection and give a clear image. This is known as specular reflection.**<br>**175. When it hits a rough object the light is reflected according to the law of reflection but is scattered in all directions called diffuse scattering.**<br>**176. The law of reflections states that angle of incidence is equal to the angle of refraction.**<br>**177. The angle of incidence is measured between the normal line and the incident ray.**<br>**178. The normal line is perpendicular to the surface.**<br>**179. Light travels slower in more dense materials and refracts.**<br>**180. When light waves cross a boundary between mediums they are refracted, this is because waves travel slower in more dense mediums and consequently bend towards the normal.**<br>**181. When a light ray refracts as it travels from air to glass, the angle of incidence is less than the angle of incidence. When it exits the glass the opposite is true.**<br>182. **The refraction of light in a prism is called dispersion and it splits light into the seven colours.**<br>183. **Violet light is the shortest wavelength and is refracted the most in a prism. Red light is refracted the most with the longer wavelength** |

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| | Colours of light | **184. A coloured object appears to be the colour it is because it reflects the colour of light that it is. Eg a red object reflects red light**<br>**185. A coloured filter is transparent or translucent. It allows the colour of light the same as the filter to pass through it. Eg a red filter transmits red light.**<br>**186. The primary colours of light are Red, Green and Blue.**<br>**187. The secondary colours of light are made by mixing the primary colours. Red and green make yellow, red and blue make magenta, green and blue make cyan.**<br>**188. Secondary colour filters let through the colour of the filter plus the two primary colours they are made up from. Eg a Yellow filter will let yellow, red and green light through.**<br>**189. If a coloured object is seen under a coloured light then it will appear black unless the colour of the object is present in the colour of the light. in that case it will appear the colour that can be reflected. Eg a magenta object under a blue or cyan light will appear blue, but would appear black under a green light.** |
| | Lenses | **190. Lenses change the direction of light passing through it by refraction.**<br>**191. A convex lens (converging lens) makes parallel rays converge to a focus. This is called the focal point. An example is a magnifying glass.**<br>**192. A concave lese (diverging lens) makes parallel rays diverge (spread out). The point where the light appears to come from is the principle focus. An example is a glasses used to fix short sightedness.**<br>**193. The distance from the middle of the lens to the focal point or principle focus is called the focal length.**<br>**194. Convex lens will give a real image (one that can be projected onto a screen) if the object is placed further than the focal length from the lens.**<br>**195. A convex lens will give a virtual image if the object is placed between focal point and the lens.**<br>**196. A concave lens can only ever give a virtual image.**<br>**197. The magnification of a lens is** $\boldsymbol{magnification = \frac{image\ height}{object\ height}}$<br>**198. Lens diagrams can be constructed to calculate the size and position of the image by drawing the 3 rays of light.** |
| **Magnetism** | Magnets | 199. The three magnetic elements iron, cobalt and nickel. Steel is magnetic because it contains iron. They are magnetic because of the dipoles.<br>200. The poles of a magnet are north and south. The magnetic field flows from north to south.<br>201. Like poles repel, opposite poles attract.<br>202. The magnetic field can be determined by using a compass or iron filings.<br>203. The stronger the magnetic field is, the closer the lines of the magnetic field are together. This is called magnetic flux density.<br>204. There are three types of magnet: permanent magnets, induced magnets and electromagents.<br>205. 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.<br>206. The earth also has a magnetic field similar to that of a bar magnet. |

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| **Magnetism** | Electromagnets | 207. 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<br>208. Wrapping the wire into a coil increases the strength of the magnetic field. This is called a solenoid.<br>209. The electromagnetic field is strongest inside a solenoid and is similar to a bar magnet.<br>210. 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<br>211. An electromagnet is made when that solenoid is wrapped around a soft iron core.<br>212. Increasing the current makes the magnetic field stronger. Reversing the current reverses the direction of the magnetic field.<br>213. **Electromagnets are used in many devices such as scrapyard cranes, circuit breaker, electric bell and relay switch.**<br>214. **The electromagnet works in relays, circuit breakers and relay switches using an iron armature** |
| | The motor effect | 215. *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.*<br>216. *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.*<br>217. *The size of the force can be increased by increasing the current or using a stronger magnet.*<br>218. *The force is greatest when the wire is perpendicular to the magnetic field. There is no force when they two are parallel.*<br>219. *The equation that links the force, magnetic field strength and current is*<br>$force\ F = magnetic\ flux\ density\ B\ x\ Current\ I\ x\ length\ l$<br>$Newtons\ N = \quad tesla\ T \quad x\ \ amperes\ A \quad x\ metres\ m$<br>*220. 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.* |

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| **Magnetism** | The generator effect | ***221. When a wire is moved in a magnetic field a potential difference is induced (created) as it crosses the field lines. If this wire is connected to a circuit then a current will flow. This is called the generator effect.***<br>***222. The faster the wire cuts through the magnetic field the bigger the induced potential difference.***<br>***223. The direction of the an induced current always opposes the original change that caused it.***<br>***224. Current is only produced when the magnet or wire is moving. Reversing the direction of movement reverses the direction of current flow.***<br>*225.* ***AC current can be generated using the generator effect by using a coil of wire that spins in a uniform magnetic field.***<br>*226.* ***This produces the typical AC trace because the most current is produced when the coil is perpendicular to the magnetic field, none is produced when it is parallel and as the coil changes rotates the current changes direction.***<br>*227.* ***The faster the coil rotates the bigger the frequency of the AC and the bigger the peak value.***<br>*228.* ***A DC generator works in a similar way but has a split ring commutator which keeps the current flowing in the same direction.***<br>*229.* ***Microphones use the generator effect to convert vibration into AC current.***<br>*230.* ***Speakers use the motor effect to convert AC into vibrations into sound waves.*** |
| | Transformers. | ***231. Transformers can be used to change the size of alternating potential difference from mains 230V to the required potential difference.***<br>***232. Step up transformers have more coils on the secondary coil and increase the size of the potential difference.***<br>***233. Step down transformers have less coils on the secondary coil and decreases the size of the potential difference.***<br>***234. The first coil on a transformer works as an electromagnet. An AC current wrapped around the soft iron core causes a magnetic field that changes direction 50 times a second.***<br>***235. The second coil works as the generator effect. The moving magnetic field induces a current in the second coil.***<br>***236. Transformers only work with AC as DC does not cause a moving magnetic field. We use AC in the national grid because we can use transformers to increase the potential difference and reduce wasted energy***<br>***237. The transformer equations is***<br>$\frac{\text{potential difference accross primary coil } V_p}{\text{potential difference accross secondary coil } V_s} = \frac{\text{number of turns on primary coil } n_p}{\text{number of turns on secondary coil } n_s}$<br>***238. Transformers are almost 100% efficient. Which gives the equation:***<br>$\text{primary potential differnce } V_p x \text{ primary current } I_p = \text{secondary potential difference } V_s x \text{ seconday current } I_s$ |

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| **Space** | Life cycle of stars | **239. A solar system comprises the planets, dwarf planets, moons and asteroids that orbit a star called a sun.**<br>**240. A star is formed in stellar nebular, the remaining dust and gas left over from this stars formation will become the planets and other structures in the solar system.**<br>**241. In a stellar nebula the dust and gas are pulled together by their own gravitational field attraction forming a protostar**<br>**242. When it is dense enough fusion starts and the star is in the main sequence. Energy is released that balances the force of gravity pulling it in. converting hydrogen to helium.**<br>**243. When the hydrogen runs out the star collapses until the pressure and temperature increases and fusion of helium can begin to form heavier elements up to iron, this is red giant phase.**<br>***244.*** **Depending on the size of the red giant it will form a white dwarf or a supernova.**<br>***245.*** **Smaller stars eventually run out fuel and collapse forming a white dwarf which cools to form a black dwarf.**<br>***246.*** **Larger stars turn into red supergiants before exploding into a supernova. The very largest stars become a black hole. Elements heavier than iron are only made in these.** |
| | Planets, satellites and orbits | **247. Planets orbit the sun in a circuit called an ellipse. Moons and satellites orbit planets in a circular orbit.**<br>**248. In a circular orbit the speed is constant but the velocity is constantly changing because the direction is always changing**<br>**249.** ***Gravity pulls the object to the centre of the circuit, the velocity of the object is perpendicular to gravity. The planet experiences acceleration towards the centre of the circle***<br>**250.** ***To stay in orbit the satellite must move at the right speed around the larger body.***<br>**251.** ***If a satellite is launched to close or too slow it will fall to earth. Too high or too fast and it will leave orbit.*** |
| | Big Bang | **252. The current theory of the start of the universe is the big bang theory. We know the universe is getting bigger and if you reverse time there must be a point where the whole universe was closer together. This is known as the singularity.**<br>**253. The main evidence for an expanding universe is red shift. This is where light from stars has shifted towards the red end of the spectrum. This happens when the object is moving away.**<br>**254. The faster the galaxy is moving away from you the bigger the red shift is.**<br>**255. Further evidence for the big bang is the existence of cosmic microwave background radiation CMBR. This is high frequency radiation produced in an explosion that has spread out as the universe has grown.**<br>**256. Although other theories exist the big bang is the only one that explains all the evidence.** |