Annotated AH Relationships Sheet

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| **First derivative of displacement = velocity** |
| **Second derivative of displacement = acceleration****First derivative of velocity = acceleration** |
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| **First derivative of angular displacement = angular velocity** |
| **Second derivative of angular displacement = angular acceleration****First derivative of angular velocity = angular acceleration** |
| **Equation for motion for uniform angular acceleration** |
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| **To convert from angular quantity to linear equivalent. Angles must be in radians** |
| **To convert from angular quantity to linear equivalent.** |
| **To convert from angular quantity to linear equivalent** |
| **Converts between angular velocity and period *NB 2π rad = 1 revolution*** |
| **Converts between angular velocity, frequency** |
| **Radial or centripetal acceleration for uniform speed in a circle or radius r** |
| **Centripetal (central) force is the unbalanced force acting towards the centre of a circle** |
| **Moment of inertia** ***NB the equation for individual shapes of rigid bodies around a point of rotation is given in the relationships sheet.***  |
| **Torque is also known as the moment of force (or the turning effect of a force)****For this equation the force perpendicular to the axis of rotation, you might need to find the component of force acting perpendicular to the axis of rotation.**  |
| **Torque, moment of inertia and angular acceleration.** |
| **Angular momentum of a particle** |
| **Angular momentum of a rigid body** |
| **Rotational Kinetic Energy of a rigid body** |
| **For objects rolling down a slope****NB this assumes no slipping and no energy losses due to friction** |
| **Universal Law of Gravitation** **The separation distance is from the centre to centre of the masses.** |
| **For equating the gravitational force providing the central force to keep objects in orbit** |
| **Gravitational potential is the work done (energy transferred) per unit mass needed to move an object from infinity to that location. As 0 J is at infinity all gravitational potentials are negative** |
| **Gravitational potential energy is the work done (energy transferred) needed to move an object from infinity to that location. As 0 J is at infinity all gravitational potential energies are negative****As the gravitational potential is negative the equation is Vm and not -Vm!**  |
| **Escape velocity is the minimum speed required for a free, non-propelled object to escape from the gravitational influence of a massive body, to eventually reach an infinite distance from it. As this has the number 2 in the equation it is derived from energy and not from forces.** |
| **The Schwarzchild radius- the radius of the event horizon of a black hole** |
| **Apparent brightness how bright the star appears to a detector here on Earth** |
| **Power radiated per unit surface area from a black body****NB The Stefan Boltzmann Constant can be found on page 2 of the exam paper on the Data Sheet and is equal to**  |
| **Equation for the luminosity of a star****NB The Stefan Boltzmann Constant can be found on page 2 of the exam paper on the Data Sheet and is equal to**  |
| ***NB Planck’s constant = 6.63 x 10-34 J s*** |
| **Bohr’s Quantisation of Angular Momentum****The 2π is an indication of the circular nature equalling 1 full circle. *NB Planck’s constant = 6.63 x 10-34 J s*** |
| **The de Broglie wavelength, when a particle behaves like a wave and this is the wavelength associated with that.** |
| **Uncertainty principle as it refers to position and momentum****NB In some old resources this was incorrectly marked as divided by 2π as h was given as**  |
| **Uncertainty principle as it refers to energy and time****NB In some old resources this was incorrectly marked as divided by 2π as h was given as ħ** |
| **Magnetic Force****This occurs where F and B are perpendicular, if they are not some trigonometry is required.**   |
| **Centripetal Force** |
| **Proof for an object moving in SHM, and equation for force on a spring.****The negative sign indicates the Force (and hence acceleration) is in the opposite direction to the displacement. Other units are possible but remember these quantities do have units** |
| **Converts between angular velocity, frequency and period*****NB 2π rad = 1 revolution*** |
| **Definition of S.H.M**  |
| ***Solution to SHM equation******Sine function occurs when y=0 and t=0, cosine function occurs when y=A at t=0*****or** |
| **Velocity of a particle undergoing SHM** |
| **Kinetic energy of a particle undergoing SHM****NB Ek is at a maximum when y = 0 and zero when y = A** |
| **Potential energy of a particle undergoing SHM****NB The sum of Ep and Ek remains constant****Ep is maximum when y = A and zero when y = 0** |
| **Energy of a wave****Other equivalent units are possible, but the quantities do have units** |
| **Travelling Wave Equation****Lengths could be in units other than m but would need to be stated, the default position is metres****A wave travelling in the positive direction (left to right) has a negative sign in the equation, a wave travelling in the negative direction (right to left) has a positive in the equation.****Check out the various combinations of this equation where 2π could be multiplied out, a number can appear on the top which would equal 1/λ, and 2πf can be replaced with ω.****It must be a travelling wave as the value of y changes with time.** |
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| **Phase difference or phase angle between two positions on a travelling wave.** |
| **An equation which governs whether waves in materials travelling different routes will be in phase or out of phase.** |
| **Conditions for constructive and destructive interference** |
| **Fringe separation for a thin wedge****Beware, in a few questions only the distance between a certain number of fringes is given and this is (n-1) for the fringe separation, eg the distance between 11 fringes is 2.0 × 10-4 m. This is 10 fringe separations so Δx = 2.0× 10-5 m**  |
| **Non- reflection lens coating thickness** |
| **Fringe spacing for Young’s Double Slit which only applies when D>>Δx****Beware, sometimes the distance between a certain number of fringes is given and this is n-1 for the fringe separation** |
| **Brewster Angle or polarising angle formula** |
| **Coulomb’s Inverse Square Law****Like charges will repel, opposite charges will attract** |
| **Electric Potential** |
| **Electric field strength** |
| **Use for the definition of Electric field strength** |
| **Relationship for a uniform electric field / parallel plates** |
| **Work done moving a charge through a potential difference.** |
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| **Magnetic induction at a perpendicular distance from an “infinite” straight current carrying conductor.**

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| **Force on a current carrying conductor in a magnetic field** |
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| **The time constant is the time required to charge the capacitor, through the resistor, from an initial charge voltage of zero to approximately 63.2% of the value of an applied DC voltage, or to discharge the capacitor through the resistor to approximately 36.8% of its initial charge voltage.** |
| **Reactance (opposition to A.C.) of a capacitor. V and I may either both be peak or r.m.s.** |
| **Reactance (opposition to A.C.) of a capacitor.**  |
| **The negative sign indicates the induced e.m.f opposes the change causing it. ε is also a negative and the two negatives cancel.** |
| **Energy stored in the magnetic field of an inductor** |
| **Reactance (opposition to A.C.) of an inductor. V and I may either both be peak or r.m.s.** |
| **Reactance (opposition to A.C.) of an inductor.**  |
| **Equation to calculate the speed of light and all electromagnetic radiations in a vacuum.** |
| **A method for combining uncertainties in a single measurement****NB the units of X,Y and Z are the units of the measurement** |
| **A method of combining fractional (or percentage) uncertainties in different variables.** |
| **A method of calculating an uncertainty raised to a power** |
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| ***NB time can be in other units as this is a ratio, but both times must be in the same unit. c = 3.0 × 108 ms-1*** |
| ***c = 3.0 × 108 ms-1*** |
| **ADD when the object moves AWAY from the observer and****TAKE AWAY (subtract) when the object comes TOWARDS the observer**  |
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| ***NB for this course the Hubble Constant Ho is given as 2·3 x 10-18 s-1*** |
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| ***NB the speed of light squared is equal to 9.0 × 1016  m2s-2*** |
| *NB Planck’s constant = 6.63 x 10-34 Js* |
| ***NB Planck’s constant = 6.63 x 10-34 Js******hfo is also known as the work function (J), hf is the energy of the incident photon (J)*** |
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| **NB This equation is for constructive interference** |
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| ***This formula really applies to material 1 being a vacuum, but there is not much difference between the refractive indexes of air and a vacuum ∴ we assume for Higher they have the same value.*** |
| **The critical angle is the angle in the material when the angle in air is 90°** |
| **This is more easily understood as**  |
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| **For resistors in series** |
| ***For resistors in parallel*** |
| **This can also be written as** **I is the total current in the circuit, r is in series with the combined circuit resistance** |
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| **For resistances in series (potential divider circuits)****Ratio of the voltages in series = ratio of the resistance in series**  |
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| **NB for the random uncertainty in a value the units of the random uncertainty are the same as for the quantity you are finding the uncertainty for.** |