Physics Formulas

Chapter 2 - Linear Kinematics

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| Formulas:*x**v**t*Δ*v**a**t* | Symbols and units:*vavg* - average velocity (m/s)*Δv* - change in velocity (m/s) *x* - displacement (m)*vi* - initial velocity (m/s)*vf* - final velocity (m/s)*a* - acceleration (m/s/s)*t* - elapsed time (s) |
| Distance and time:1 hr = 60 min = 3600 sec1 day = 86400 sec1 km = 1000 m ≈ 0.6214 mile1 mile = 5280 ft = 1760 yards ≈ 1609 m1 foot = 12 inches ≈ 30.48 cm1 cm = 2.54 cm (defined)1 m ≈ 3.281 ft1 yard = 3 feet | Shortcuts: (mph = miles/hour)1 m/s = 3.6 km/hr ≈ 2.237 mph ≈ 3.281 ft/s1 mph ≈ 1.467 f/s (1.46666666…) ≈ 1.609 km/hr ≈ 0.4470 m/s1 f/s = 0.3048 m/s ≈ 0.6818 mph (.6818181818…) ≈ 1.0973 km/hr1 km/hr ≈ 0.2778 m/s ≈ 0.6214 mph ≈ 0.9113 ft/s |
| Free Fall Problems:Making the direction down negative (-)a = -9.8 m/s/s (always)v at top = 0 (because.....)If starts and ends at same elevation:½ total time to topTotal time in air = 2x time to topvf = -vi |  |

**Chapter 3 - Two dimensional motion and vectors:**

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| **Vectors:****Finding Components:**1. Draw components from tail to tipUse arrows for components2. Find the length of the sides:θhypoppadjopp = hyp Sin(θ)adj = hyp Cos(θ)3. Decide x or y, + or -(+, +)(+, -)(-, +)(-, -)4. Write it as units $\overbrace{x}$ + units $\overbrace{y}$**Adding two component vectors:** A = 1 m x + 2 m y B = 2 m x + 3 m yA+B = 3 m x + 5 m y (Add x to x and y to y)**Converting Components to Angle Magnitude:**1. Draw the vectorDraw x, and from there draw y as arrowsThe vector goes from the tail of the x to the tip of the y4.0 m3.0 mθmag.e.g. 3.0 m x + -4.0 m y:2. Find the angle using Tan-13. Find the magnitude using the Pythagorean theorem | **Projectile Motion:**Fill in given, solve. Time is shared by both sides**Cliff Problems:** Purely horizontal initial velocity, so Vi vertical = 0**Arc Problems:**1. Break launch velocity into components2. Fill in H/V table 3. For level range remember vertical Vf = -Vi4. To get greatest height remember vertical Vf at top = 0**Boat Crossing River:**1. Fill this in:Solve. Time is shared by both sides.**Range Equation:**e.g. v2/9.8\*sin(2\*angle), e.g. sin-1(9.8\*range/v2)/2 |

Chapters 4, 5 and 6 Force, Work and Power, and Momentum

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| Force: **F = ma****Fg = mg (g = 9.8 N/kg on earth)****Ff = μFN ( = μmg)***Fg**m**g**F*μmg*F**m**a* | Symbols and units:*F* - force (N)*m* - mass (kg) (g/1000 = kg)*a* - acceleration (m/s/s)*μ* - coefficient of friction  |
| Work and Power:*W**F**d***W = Fd = Fd(cosθ)****F = mg (lifting)****or****F = μmg (dragging)***W**P**t***P = Fv** | Symbols and units:P - Power (W)W - Work (J)F - Force (N)d - distance (m)t - time (s)m - mass (kg)μ - coefficient of friction1 HP = 745.7 W |
| Kinetic Energy:**KE = ½mv2**Potential Energy:**PE = mgh**Elastic (Spring) Potential Energy:**PEelastic = ½kx2***o**e**i* **Fd + mgh + ½mv2 = Fd + mgh + ½mv2** | KE - Kinetic Energy (J)m - Mass (kg)v - Velocity (m/s)PE - Potential Energy (J)m - Mass (kg)g - 9.8 N/kgh - Elevation (m)PE - Potential Energy (J) (Stored in a spring)k - Spring Constant (N/m)x - Stretch/Compression Distance (m) |
| Momentum:**p = mv****FΔt = impulse****FΔt = mΔv**  | Symbols and units:*p* - momentum (kg m/s)m - mass (kg)*v* - velocity (m/s)*Δv* - change in velocity (m/s)*Δt* - elapsed time (s) |

**Chapter 7 - Circular Motion and Gravity**

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| **Circular Motion:**       | Symbols and units:*F* - force (N)*m* - mass (kg) (g/1000 = kg)*a* - acceleration (m/s/s)*μ* - coefficient of friction *v* - tangential velocity (m/s)*T* - period (s)   |
| **Vertical Circle:**Top: 1g – ride Bottom: 1g + ride(m/s/s) ÷ 9.8 = (“g”s)(“g”s ) x 9.8 = (m/s/s) | Inverted “g”s are negative1 “g” = 9.8 m/s/sa > 9.8 for water to stay in the bucket etc. |
| **Gravity:***G* - Universal Gravitation Constant  (6.67x10-11 Nm2/kg2) | Symbols and units:*F* - force (N)*m1* - the first mass (kg) *m2* - the second mass (kg) *r* - distance separating the centers (m)*G* - Universal Gravitation Constant  (6.67x10-11 Nm2/kg2) |
| **Orbit: (r, m, v): Orbit: (r, m, T):** Note: - the satellite mass cancels if ms << mc.    | Symbols and units:*mc* - central body mass (kg) *ms* - satellite mass (kg) *v* - orbital velocity (m/s)*r* - orbital radius (m)*T* - period (s) *G* - Universal Gravitation Constant  (6.67x10-11 Nm2/kg2) |

**Chapter 12 - Waves**

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| **Basic Waves:**     | Symbols and units:λ - Wavelength (m)f - Frequency (Hz)v - Wave speed (m/s)T - Period (s) |
| **Standing Waves** 4Antinodes = 1 λ 4Antinodes or 4Antinodes  | Symbols and units:*L* - Length of standing wave (m)λ - Wavelength (m)n - Number of quarter wavelengths |
| **Doppler:**Moving Source: Moving Observer:  | Symbols and units:f' - Shifted Frequency (Hz)f - Original Frequency (Hz)v - Speed of sound (m/s) us - Speed of source (m/s)uo - Speed of observer (m/s) |