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 sec  1 day = 86400 sec  1 km = 1000 m ≈ 0.6214 mile  1 mile = 5280 ft = 1760 yards ≈ 1609 m  1 foot = 12 inches ≈ 30.48 cm  1 cm = 2.54 cm (defined)  1 m ≈ 3.281 ft  1 yard = 3 feet | Shortcuts: (mph = miles/hour)  1 m/s = 3.6 km/hr ≈ 2.237 mph ≈ 3.281 ft/s  1 mph ≈ 1.467 f/s (1.46666666…) ≈ 1.609 km/hr ≈ 0.4470 m/s  1 f/s = 0.3048 m/s ≈ 0.6818 mph (.6818181818…) ≈ 1.0973 km/hr  1 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 top  Total time in air = 2x time to top  vf = -vi |  |

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

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| **Vectors:**  **Finding Components:**  1. Draw components from tail to tip  Use arrows for components  2. Find the length of the sides:  θ  hyp  opp  adj  opp = hyp Sin(θ)  adj = hyp Cos(θ)  3. Decide x or y, + or -  (+, +)  (+, -)  (-, +)  (-, -)  4. Write it as units + units  **Adding two component vectors:**  A = 1 m x + 2 m y  B = 2 m x + 3 m y  A+B = 3 m x + 5 m y  (Add x to x and y to y)  **Converting Components to Angle Magnitude:**  1. Draw the vector  Draw x, and from there draw y as arrows  The vector goes from the tail of the x to the tip of the y  4.0 m  3.0 m  θ  mag.  e.g. 3.0 m x + -4.0 m y:      2. Find the angle using Tan-1  3. 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 components  2. Fill in H/V table  3. For level range remember vertical Vf = -Vi  4. 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*  μ  m  g  *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 friction  1 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/kg  h - 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 negative  1 “g” = 9.8 m/s/s  a > 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) |