**WHAT YOU SHOULD REVIEW FOR THE MIDTERM**

**KINEMATICS**

**Scalar and Vector Quantities**

**Scalar quantities have only magnitude**

**Vector quantities have magnitude and direction**

**Distance versus Displacement**

**Distance refers to how much ground was covered - scalar quantity**

**Displacement is determined by the start and end points (path does not matter) - vector quantity**

**When using formulas, we account for the different directions with + or –**

**North, up, right is +**

**South, down, left is –**

**Speed versus Velocity**

**Speed is the distance that an objects moves in a unit of time - scalar quantity**

**Velocity of an object is the time rate of change of its displacement - vector quantity**

**Average Velocity versus Instantaneous Velocity**

**Average Velocity refers to **

**Instantaneous Velocity refers to the velocity at any particular instant of time vf**

**Uniform Motion** **means constant velocity**

**To solve for constant velocity we use the formula** 

**Uniformly accelerated motion** **means constant acceleration**

**The formulas used are**



**If the problem is asking to calculate average velocity or speed then, we could use**

 or 

**Projectile motion**

**Projectile Motion 1D = Free fall**

**Free Fall: We neglect air resistance the acceleration acting on the object is the acceleration due to gravity a = g = 9.81m/s2 down for calculations we use - 9.81m/s2**

**If the object is dropped, then the initial velocity is 0 m/s**

**At the maximum height the object has a velocity of 0 m/s**

**Projectile Motion 2D Air resistance is neglected; therefore, the only force acting on the object is the force of gravity**

**ax = 0m/s2 ay = - 9.81m/s2**

**vx remains constant throughout the trajectory of the projectile**

**Launched horizontally: viy = 0 m/s**

**Launched at an Angle: vytop = 0m/s**

|  |  |  |
| --- | --- | --- |
| **To calculate the initial horizontal and vertical components**  **Vix = vi cos θ**  **Viy = vi sin θ** |  | **If the projectile launches at the same height it was ejected, then the total time this projectile spends in the air is calculated t total = 2 t up** |

**Graphical Analysis**

**Position or Displacement versus Time Graph Slope = velocity**

**Displacement covered by the object is read directly from the graph!**

**Velocity versus Time Graph Slope = acceleration**

**Area under Curve = displacement**

**The instantaneous velocity of the object is read directly from the graph!**

**STATICS**

**To add vectors graphically we use the technique Head to Tail**

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**Resultant is the vector that produces the same effect as the original vectors**

**In the example above, it is the sum graphical of F1 and F2**

**Equilibrant** **refers to the force that counteracts the effect of the resultant force. It has the same magnitude of the resultant, but the opposite direction**

**Range of Possible Resultants:**

**Minimum resultant when the angle between the forces is 180 degrees**

**Maximum resultant when the angle is 0 degrees**

**Components of a Vector**

**A vector can be broken down into an infinite number of components!**

**The most used and convenient components a vector can be broken down are:**

**The horizontal and vertical components**

|  |  |
| --- | --- |
|  |  |

**DYNAMICS**

**Inertia** **is the tendency of an object to resist motion. It directly related to the mass and only depends on the mass of the object**

**Newton’s First Law** – **An object at rest tends to stay at rest unless an unbalanced force acts on it. Also called the law of inertia**

**Newton’s Second Law – The acceleration of an object is directly related to the net force and indirectly related to its mass**



**Newton’s Third Law – For every action there is an equal and opposite reaction**

**FBD** **The free body diagram shows all the forces acting on an object**

**Friction Types – Static friction Fs and Kinetic friction Fk**

**Static friction acts on the object until is about to move.**

**All forces are balanced a = 0, Fnet = 0 prior to the motion of the object.**

**The static friction changes from 0 to the maximum value that can be calculated using the formula Fs = μFn**

**Kinetic friction acts when there is a relative motion between the object and the surface**

**Kinetic friction can be calculated using the formula Fk = μFn**

**Selected coefficient of frictions are found on page 1 of Physics Reference Tables**

**Momentum** Symbol **p**  Formula **p= m v** Units **kg m/s**

**Conservation of Momentum Law**

**For a collision occurring between object 1 and object 2 in an isolated system, the total momentum of the two objects before the collision is equal to the total momentum of the two objects after the collision.**

**Total p initial = Total p final m1v1i + m2v2i = m1v1f + m2v2f**

**Impulse** Symbol **J** Formula **J = Fnet t** Units **N s**

**Impulse Momentum Theorem** **J = Fnet t = Δp**

**Δp = pfinal – pinitial = m Δv**

**The area under the curve of a Force versus Time Graph represents** **the impulse imparted on the object**

**Work** Symbol **W** Formula **W = F d cosθ** Units **N m** or **Joules**

**Power** Symbol **P** Formulas **** Units **Watts** or **J/s**

**The area under the curve of a Force versus Displacement Graph represents** **work done on an object**

**Types of Energy: Kinetic, Potential, Internal Energy**

**Kinetic Energy: 1/2mv2 if the velocity is constant there is no change in KE (ΔKE = 0)**

2 types of Potential Energy: Potential Gravitational Energy and Potential Elastic Energy

**Change in potential gravitational energy: ΔPE = mg Δh**

**Potential Elastic Energy: PEs = 1/2kx2**

**Hooke’s Law: The force applied to a spring is directly related to its elongation**

**Fs = kx** k: spring constant Units: **N/m** means Newton per meter

**Mechanical Energy = PE + KE**

**Conservation of Energy**

**If energy is conserved in a system, then its total mechanical energy remains constant**

**Work Energy Theorem: W = ΔEt Et = PE + KE + Q**

**Work against Gravity is the same as ΔPE, so it can be calculated:**

**W = F d where F has the same magnitude as Fg or ΔPE = mg Δh**

**Work against Force of Friction is the same as ΔQ, so it can be calculated:**

**W = ΔPE + ΔKE + ΔQ or W = F d where F has the same magnitude as Ff**