Physics Formula Sheet

Kinematics

1. $v = v_o + at$
   (Final velocity = initial velocity + acceleration × time)
2. $x = v_o t + \frac{1}{2} a t^2$
   (Displacement = initial velocity × time + ½ × acceleration × time^2)
3. $v^2 = v_o^2 + 2ax$
   (Final velocity^2 = initial velocity^2 + 2 × acceleration × displacement)

Free Fall Motion

1. $v = v_o - gt$
   (Final velocity = initial velocity − acceleration × time)
2. $y = v_o t - \frac{1}{2} g t^2$
   (Displacement = initial velocity × time − ½ × acceleration × time^2)
3. $v^2 = v_o^2 - 2gy$
   (Final velocity^2 = initial velocity^2 − 2 × acceleration × displacement)

Projectile Motion

Horizontal Motion

1. $v_{ox} = v_o cos\theta$
   (Initial horizontal velocity = initial velocity x cos of launch angle)
2. $\mathrm{v_x} = \mathrm{v_{ox}} = \text{constant}$
   (Final hor. velocity = initial hor. velocity = constant)
3. $\mathrm{x} = \mathrm{v_{ox}} t$
   (Horizontal velocity = initial hor. velocity x time)
4. $a_x = 0$
   (Horizontal Acceleration = 0)
5. $\mathrm{R} = \frac{v_o^2 \sin 2\theta}{g}$
   (Range = (Initial velocity^2 x sin of twice launch angle ÷ gravitational accel)

Vertical Motion

1. $v_{oy} = v_o sin\theta$
   (Initial vertical velocity = initial velocity × sin of launch angle)

2. $v_y = v_{oy} - gt$
   (Final vertical velocity = Initial vertical velocity − gravitational accel x time)
3. $y = v_{oy}t - \frac{1}{2}gt^2$
   (Final vertical displacement = initial velocity × time − ½ × acceleration × time^2)
4. $v_y^2 = v_{oy}^2 - 2gy$
   (Final vertical velocity^2 = initial vertical velocity^2 − 2 × grav. acceleration × displ)

Dynamics (Newton's Laws)

1. Force: $F = ma$
   (Force = mass × acceleration)
2. Weight: $W = mg$

   (Weight = mass x gravitational acceleration)
3. For Incline surface: $W_x = Wsin\theta$
   (Component of weight down incline = weight x sin of angle of incline)
   $W_y = Wsin\theta$
   (Component of weight perp. to incline = weight x sin of angle of incline)
4. $f_{s\,max} = \mu_s n$
   (Maximum static friction = coefficient of static friction x normal force)
5. $f_{k\,max} = \mu_k n$
   (Maximum kinetic friction = coefficient of kinetic friction x normal force)

6. Centripetal force: $F = \frac{mv^2}{r}$
   (Force = mass × velocity^2 / radius)

Work, Energy & Power

1. Work: $W = Fd$
   (Work = force × displacement, assuming parallel)
2. Work: W = Fdcosθ
   (Work = force × displacement × cos of angle between force and displacement)
3. Kinetic energy: $KE = \frac{1}{2}mv^2$
   (KE = ½ × mass × velocity^2)
4. Work-Kinetic energy equation: W = $\Delta KE = KE_f - KE_i$
   (Work = change in kinetic energy = final KE – initial KE)
5. Potential energy: $PE = mgy$
   (PE = mass × gravity × height)
6. Power: $P = \frac{W}{t}$
   (Power = work / time)

Momentum

1. $p = mv$
   (Momentum = mass × velocity)
2. Impulse: Impulse: J $= F \times t$
   (Impulse = force × time)
3. Impulse J = $\Delta p = p_f - p_i$
   (Impulse = change in momentum = Final momentum – Initial momentum)
4. Conservation of momentum:
   Total momentum before = total momentum after (for collisions or explosions)
5. Force: F = $\frac{\Delta p}{\Delta t}$

   (Force = rate of change of momentum / time)