

# Reference Guide & Formula Sheet for Physics

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- 40 Components of a Vector  
 $v_x = v \cos \theta$      $v_y = v \sin \theta$   
 $\theta$  = angle between  $v$  and  $v_x$   
 $v_x$  = horizontal component,  $v_y$  = vertical component
- 41 Weight =  $mg$   
 $g = 9.8 \text{ m/s}^2$  near the surface of the Earth  
 $g = 9.80665 \text{ m/s}^2$  in Fort Worth, TX  
 Density = mass/volume  
 $\rho = \frac{m}{V}$  (units:  $\text{kg/m}^3$ )
- 42 Area speed = distance / time =  $v = d/t$   
 Area velocity = displacement / time =  $v = d/t$   
 Area acceleration = change in velocity / time
- 43 Friction Force  
 $F_f = \mu F_N$   
If the object is not moving, you are dealing with static friction and it can have any value from zero up to  $\mu_s F_N$ .  
If the object is sliding, then you are dealing with kinetic friction and it will be constant (dependent on  $\mu_k F_N$ ).
- 44 Range  
 $R = \frac{v^2 \sin 2\theta}{g}$   
Where  $\theta$  is the angle between  $v$  and  $R$ , and  $R$  is the range.
- 45 Newton's Second Law  
 $F_{\text{net}} = \Delta p_{\text{net}} / \Delta t$
- 46 Work =  $F \cdot d \cos \theta$   
Where  $d$  is the distance traveled and  $\theta$  is the angle between  $F$  and the direction of motion.  
units: J
- 47 Power = rate of work done  
 $P_{\text{average}} = \frac{\text{Work}}{\text{time}}$     units: watt  
 Efficiency =  $\frac{\text{Work}_{\text{out}}}{\text{Energy}_{\text{in}}}$   
 Mechanical Advantage = force out / force in  
 $M.A. = F_{\text{out}} / F_{\text{in}}$
- 48 Constant Acceleration (Linear Motion)
- |                                       |     |
|---------------------------------------|-----|
| $v = v_0 + at$                        | (1) |
| $\Delta x = v_0 t + \frac{1}{2} at^2$ | (2) |
| $v^2 = v_0^2 + 2a\Delta x$            | (3) |
| $\Delta x = \frac{v_0 + v}{2} t$      | (4) |
| $\Delta x = \frac{v^2 - v_0^2}{2a}$   | (5) |

- 49 Heating a Matter, Liquid or Gas  
 $Q = mc\Delta T$     (no phase change)  
 $Q$  = the heat added  
 $c$  = specific heat  
 $\Delta T$  = temperature change, K
- 50 Linear Momentum  
 momentum =  $p = mv$  = mass  $\times$  velocity  
 momentum is conserved in collisions
- 51 System of Masses - joint masses on a line  
 $M_{\text{tot}} = M_1 + M_2 + \dots$
- 52 Angular Speed vs. Linear Speed  
Linear speed =  $v = \omega r$  =  $r$   $\times$  angular speed
- 53 Pressure under Water  
 $P = \rho gh$   
 $h$  = depth of water  
 $\rho$  = density of water
- 54 Universal Gravitation  
 $F = G \frac{m_1 m_2}{r^2}$   
 $G = 6.67 \times 10^{-11} \text{ N}\cdot\text{m}^2/\text{kg}^2$
- 55 Mechanical Energy  
 $PE_{\text{grav}} = mgh$   
 $KE_{\text{trans}} = \frac{1}{2} mv^2$
- 56 Impulse = Change in Momentum  
Impulse =  $\Delta p$
- 57 Snell's Law  
 $n_1 \sin \theta_1 = n_2 \sin \theta_2$   
 Index of Refraction  
 $n = c/v$   
 $c$  = speed of light =  $3.0 \times 10^8 \text{ m/s}$
- 58 Ideal Gas Law  
 $PV = nRT$   
 $n$  = # of moles of gas  
 $R$  = gas law constant  
 =  $8.31 \text{ J/K}\cdot\text{mole}$
- 59 Parallel Waves  
 $v = f\lambda$   
 $f = 1/T$      $T$  = period of wave
- 60 Constant Acceleration Circular Motion
- |                                    |     |
|------------------------------------|-----|
| $v = r\omega$                      | (1) |
| $a_c = v^2/r = \omega^2 r$         | (2) |
| $\omega = \frac{2\pi}{T} = 2\pi f$ | (3) |
| $\omega = \frac{2\pi}{T} = 2\pi f$ | (4) |
| $\omega = \frac{2\pi}{T} = 2\pi f$ | (5) |