1 Equation Sheet 202A (Physics)

1. $v_f = v_0 + at$

2. $x_f = x_0 + (v_0)t + \frac{1}{2}at^2$

3. $v_f^2 = v_0^2 + 2a(\Delta x)$ where $\Delta x = x_f - x_0$
   $x_0 =$ initial displacement
   $x_f =$ final displacement
   $v_0 =$ inital velocity
   $v_f =$ final velocity
   $a =$ acceleration
   $t =$ time interval for initial & final positions

4. velocity$(v) = \frac{\Delta x}{\Delta t}$
   $\Delta x =$ displacement change
   $\Delta t =$ time interval

5. acceleration$(a) = \frac{\Delta v}{\Delta t}$ $\Delta v = velocitychange$ $\Delta t = timeinterval$

Equation of straight line:
$y = mx + b$
$b =$ y-intercept
$m = slope = \frac{\Delta x}{\Delta y}$

1. Trigonometric Cheet-Sheet
   $h =$ hypotenuse
   $p =$ opposite
   $b =$ adjacent

   (a) $\sin\theta = \frac{p}{h}$
   (b) $\cos\theta = \frac{b}{h}$
   (c) $\tan\theta = \frac{p}{b}$
   (d) $h^2 = p^2 + b^2$
   (e) $\sin^2\theta + \cos^2\theta = 1$
   (f) $180° = \pi \cdot radian$

2. Area of triangle $= \frac{1}{2} \cdot base \cdot height$

3. Area of rectangle $= length \cdot width$
   $Perimeter = 2(length + width)$

4. Quadratic Equation
   $ax^2 + bx + c = 0$
   $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

5. 12 inch = 1 foot
   3 foot = 1 yard
   1 mile = 1.61 km
   1 km = 1000 m
   100 cm = 1 m
   10 mm = 1 cm
   1 hr = 3600 sec
   1 inch = 2.54 cm

6. x-component of $\overrightarrow{A}$:
   $A_x = A\cos\theta$ y-component of $\overrightarrow{A}$:
   $A_y = A\sin\theta$
   $A_x^2 + A_x^2 = A^2$
   $\tan\theta = \frac{A_y}{A_x}$, $\sin\theta = \frac{A_y}{A}$, $\cos\theta = \frac{A_x}{A}$

7. Acceleration due to gravity (g)
   $g = 9.8m/s^2 = 10m/s^2$

8. Weight of mass ḿ´
   $= mg =$ force of Earth on mass($\overrightarrow{F}_{\text{E on o}}$)

9. $\mu_{max} = \frac{f_{s,max}}{F^{\perp}}$
   $F^{\perp} =$ normal force
   $f_{s,max} =$ limiting static friction
   $\mu_{s,max} =$ coefficient of limiting static friction

10. $\mu_k = \frac{f_k}{F^{\perp}}$
    $f_k =$ kinetic friction
    $\mu_k =$ coefficient of kinetic friction

11. If the net force acting on an object is zero,
    $\sum F_x = 0$ (net force along x-axis)
    $\sum F_y = 0$ (net force along y-axis)

12. Newton's 2^{nd} law of motion
    $a = \frac{\sum F}{m}$
    $m =$ mass
    $a =$ acceleration
    $\sum F =$ net force

13. For a projectile motion:
    $a_x = 0$(acceleration along the x-axis)
    $a_y = -g$(acceleration along y-axis)
    If 'upward' is considered as 'positive' and 'downward' is considered as 'negative'.

14. Newton's 3^{rd} law of Motion
    $\overrightarrow{F}_{12} =$ force exerted by object 2 on object 1
    $\overrightarrow{F}_{21} =$ force exerted by object 1 on object 2

15. Circular Motion
    (a) Angular Velocity$(\omega) = \frac{\Delta\theta}{\Delta t} = \frac{3\pi}{T}$rad/s
        (T = time period)
    (b) frequency (f) = $\frac{1}{T}$
    (c) $v = r\omega$
        r = radius
        v = velocity
    (d) circumference of a circle = $2\pi r$
    (e) centripetal acceleration $(a_c) = \frac{v^2}{r}$
    (f) centripetal force $(F_c) = ma_c = \frac{mv^2}{r}$
16. Static Equilibrium
    (a) $\sum F = 0 \Rightarrow \sum F_x = 0$(net force along x-axis)
        $\sum F_y = 0$(net force along the y-axis)
    (b) Torque = $Fd\sin\theta$
        F = force
        d = distance
        θ = angle between $\overrightarrow{F}$ & $\overrightarrow{d}$
17. (a) linear momentum$(\overrightarrow{p}) = mass \cdot velocity$
        $= m\overrightarrow{v}$
    (b) Impulse = $force \cdot timeinterval$
        $= \overrightarrow{F}(\Delta t)$
        $= m\overrightarrow{v}_f - m\overrightarrow{v}_0$
        $\overrightarrow{v}_f$ = final velocity
        $\overrightarrow{v}_0$ = initial velocity
    (c) conservation of linear momentum
        $m_1v_{0,1} + m_2v_{0,2} = m_1v_{f,1} + m_2v_{f,2}$
        $v_{0,1}$ = Inital Velocity of mass m_1
        $v_{0,2}$ = Initial velocity of mass m_2
        $v_{f,1}$ = Final velocity of mass m_1
        $v_{f,2}$ = Final Velocity of mass v_2
        $\sum_{initial} mv = \sum_{final} mv$
    (d) Momentum-impulse relation $I = p_f - p_0$
        p_f = final momentum
        p_0 = Initial momentum
18. Work and Energy
    (a) Work (w) = $Fd\cos\theta$
        F = force
        d = displacement
        θ = angle between $\overrightarrow{F}$&$\overrightarrow{d}$

(b) Kinetic Energy (K) $= \frac{1}{2}mv^2 = \frac{p^2}{2m}$
$m =$ mass
$v =$ velocity
$p = mv =$ momentum

(c) Gravitational potential energy$(U_g) = mgh$
$m =$ mass
$g =$ acceleration due to gravity
$h =$ height from a reference level

(d) power (P) $= \frac{Work}{time} = \frac{W}{t}$

(e) Elastic potential energy$(v_e) = \frac{1}{2}kx^2$
$k =$ spring constant (or force constant)
$x =$ extension (i.e., change in length)

(f) Generalised work-energy principle
$K_0 + v_0 + W = K_f + v_f + \Delta v_{int}$
$K_0 =$ Initial kinetic energy
$v_0 =$ Initial potential energy
$K_f =$ Final kinetic energy
$v_f =$ Final potential energy
$W =$ Work done by external force
$\Delta v_{int} =$ change in internal energy

(g) Hooke's law
$\overrightarrow{F_s} = -K\overrightarrow{x}$
$\overrightarrow{F_s} =$ force due to spring
$\overrightarrow{x} =$ extension or change in length
$K =$ Spring constant or force constant

19. Total energy of a vibrating body (v)
$v = \frac{1}{2}mv^2 + \frac{1}{2}Kx^2$
($m =$ mass, $v =$ velocity when displacement is x from equibrium position, $K =$ Spring constant)

20. For simple pendulum,
$T = 2\pi\sqrt{\frac{l}{g}}$
($T =$ time period, $l =$ length of pendulum, $g = 9.81m/s^2$)

21. Angular velocity $(\omega) = \frac{\Delta\theta}{\Delta t} = \frac{2\pi}{T} = 2\pi f$
($T =$ Time period, $\Delta\theta =$ angle in angle, $\Delta t =$ time interval, $f =$ frequency $= \frac{1}{T}$)

22. Simple Harmonic motion:
$x = A\cos\omega t$
$= Acos(\frac{2\pi}{T}t)$
($x =$ displacement from equilibrium position, $A =$ amplitude, $\omega =$ angular velocity, $T =$ time period)

$v = -v_{max} \sin \omega t$
$v = -\omega A \sin \omega t$
(v = velocity at a time $t, v_{max} = \omega A$ = maximum velocity)

$a = -a_{max} \cos \omega t$
$a = \omega^2 A \cos \omega t$
$a = -\omega^2 x$
($a_{max} = \omega^2 A$ = maximum acceleration, a = acceleration at time t)

23. $T = 2\pi \sqrt{\frac{m}{K}}$
    (T = time period for horizontal/vertical spring-mass system, m = mass attached to the spring, K = spring constant)

24. Wave motion: $v : f\lambda$
    (v = velocity, f = frequency, λ = wavelength)
    $f = \frac{1}{T}$ (T = time period)

25. waves in string fixed at both ends:
    $v = \sqrt{\frac{T}{\mu}}$
    (v = velocity, T = tension, $\mu = mass/length$)

26. v = velocity of sound wave in air $= 332m/s$

27. Intensity of a wave (J)
    $I = \frac{P}{A}$
    P = power emitted by source $= \frac{\Delta E}{\Delta t}$ = energy emitted per unit time
    A = area $= 4\pi r^2$
    r = radius(with the source at the center)

28. Intensity level (β)
    $\beta = 10log_{10} \frac{J}{J_0}$
    I = Intensity at a point from the source of sound
    $I_0 = 10^{-2} W/m^2$ = reference intensity level