A. P. PHYSICS 1

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1 SUBJECT

COLLEGE RULED

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FORMULA

$V = V_0 + at$

$x = V_0 t + \frac{at^2}{2}$

$V^2 = V_0^2 + 2ax$

$\Sigma F = ma$

$a_R = \frac{V^2}{r}$

$E_0 + W_{NC} = E_1$

$F_{fr} = F_N \mu$

$F_G = \frac{G m_1 m_2}{r^2}$

$P_0 + J = P_1$

$m_1 v_{01} + m_2 v_{02} = m_1 v_1 + m_2 v_2$

$T = 2\pi \sqrt{\frac{m}{k}}$ $\quad T = 2\pi \sqrt{\frac{L}{g}}$

$\omega = \omega_0 + \alpha t$

$\theta = \omega_0 t + \frac{\alpha t^2}{2}$

$\omega^2 = \omega_0^2 + 2\alpha\theta$

$\Sigma \tau = I\alpha$ or $Fr\sin\theta$

$TME = K + U$

$U_e = \frac{kx^2}{2}$

$F_e = -kx$*

$L_0 + \tau t = L_1$

DEFINE CO-ORDINATE SYSTEM

KINEMATICS.

- Displacement → Change in position (Δs) $\int v = \Delta s$ $\int a = v$

  $\frac{d}{dt}\Delta s = v$ $\frac{d}{dt} v = a$

- $\bar{v} = \frac{\Delta s}{\Delta t}$ $\bar{a} = \frac{\Delta v}{\Delta t}$
  - a and v in different direction ⇒ speed decreasing
  - x and y motion independent of each other
  - For $\vec{v}$ $v_x = v\cos\theta$ $v = \sqrt{v_x^2 + v_y^2}$ $\tan\theta = \frac{v_y}{v_x}$

    $v_y = v\sin\theta$
  - $v = v_0 + at$; $\Delta s = v_0 t + \frac{at^2}{2}$; $v^2 = v_0^2 + 2a\Delta s$

UNITS
- Δs – meters (m)
- v – meters/sec (m/s)
- a – meters/sec^2 (m/s^2)
- t – sec (s)

DYNAMICS.

- Newtons Laws
  - Law of Inertia – An object will continue in it's state of motion unless acted upon by an outside force
  - $\Sigma\vec{F} = m\vec{a}$
  - Action/Reaction – For every action there is an equal and opp. reaction
- Weight = mg

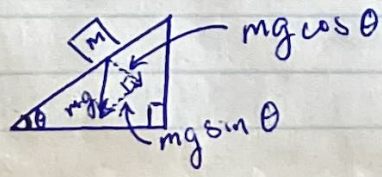
  $\boxed{\text{Is a force}}$
- Normal Force – support force

  $F_{AB} = F_{BA}$

  F_T → pulls toward center of cord

  Pulleys change direction of F_T
- Contact Force – Perpendicular to surface
- FRICTION : $F_{frs} = F_N \mu_s$ – Max – Not moving (static)

  $F_{frk} = F_N \mu_k$ – Moving (kinetic)
- $\boxed{\text{Draw free body diagram / Force sketch}}$



UNITS
- F – Newtons (N)
- M – kilograms (kg)

CIRCULAR MOTION & GRAVITATION

- $a_{tan} = \emptyset \Rightarrow$ uniform $a_{tan} \neq \emptyset \Rightarrow$ non-uniform
- acceleration towards center (a_R or a_c)
- $a_R = \frac{v^2}{r}$ $F_R = ma_R$
- $F_G = \frac{G m_1 m_2}{r^2}$ r = difference between CMs
- $v = \frac{2\pi r}{T}$

gravitational field strength halfway between two objects is $\emptyset$

ENERGY

- $W = F \cos\theta \, d$ d = distance θ = angle between F and d
- $K_{tr} = \frac{mv^2}{2}$
- $W_{subtotal} = \Delta K_{tr}$
- $U_g = mgh$
- $TME = E = \Sigma K + \Sigma U$
- $E_0 + W_{NC} = E_1$
- $P = \frac{W}{\Delta t} = \frac{\Delta E}{\Delta t} = \frac{Fd}{\Delta t} = Fv$
- $W_{net} = \Delta K$

FORCES

CONSERVATIVE	NON-CONSERVATIVE
· TME conserved	· TME not conserved
· work done by force doesn't depend on path	· work done by force depends on path
· Gravitational force	· Frictional force
· Elastic force	· Applied force

· Total Energy of closed system remains constant

UNITS:

· Work and Energy = Joules (J)

MOMENTUM

- $\vec{p} = m\vec{v}$
- $F = \frac{\Delta p}{\Delta t}$

$J = F\Delta t = \Delta p$

$p_0 + J = p_1$

Total momentum of closed system remains constant

COLLISIONS

ELASTIC
- objects bounce perfectly off each other in opposite directions (head on)
- K conserved; p conserved
- $m_a v_{a_0} + m_b v_{b_0} = m_a v_a' + m_b v_b'$
- If $m_a = m_b$ $v_{a_0} + v_{b_0} = v_b' + v_a'$

INELASTIC
- objects travel in same direction after collision
- K not conserved; p conserved
- $m_a v_{a_0} + m_b v_{b_0} = m_a v'_a + m_b v'_b$

COMPLETELY INELASTIC
- objects stick together and travel in same direction
- K not conserved p conserved
- $m_a v_{a_0} + m_b v_{b_0} = v'(m_a + m_b)$

UNITS

Momentum and Impulse = kilogram meters/sec (kg m/sec)

SIMPLE HARMONIC

- $F_E = -kx$
- SHM – Restoring force propotional to displacement (x) from equilibrium point
- $x_{max} = A$
- $U = \frac{kx^2}{2}$
- At max extension/compression $a = max$
- $T = \frac{1}{f}$
- SHO – $T = 2\pi\sqrt{\frac{m}{k}}$

Pendulum $F_{restoring} = mg \sin\theta$

$\sin\theta \approx \theta$ for $\theta \leq 15°$

$T = 2\pi\sqrt{\frac{L}{g}}$

UNITS

k – Newtons/meter (N/m)

T = seconds

Per cycle

f = cycles/sec (Hz)

θ = radians (rad)

ROTATIONAL MOTION

- $F \sim \tau$
- $M \sim I$
- $a \sim \alpha$
- $v \sim \omega$
- $p \sim L$
- $\Delta s \sim \Delta\theta$
- $K_{rot} = \frac{I\omega^2}{2}$

$\boxed{\text{• } K_{rot} + \text{Friction} \Rightarrow K_{tr}}$

- $\omega = \frac{\Delta\theta}{\Delta t}$
- $\omega = 2\pi r f$
- $\alpha = \frac{\Delta\omega}{\Delta t}$
- $\tau = I\alpha$
- $\tau = Fr\sin\theta$
- $L = I\omega$
- $\Delta L = \tau\Delta t$
- $I = cmr^2$

- $\Delta\theta r = \Delta s$
- $\omega r = v$
- $\alpha r = a$

$\boxed{\text{RIGHT HAND RULE}}$

UNITS

θ = radians (rad)
ω = radians/sec (rad/sec)
α = radians/sec^2 (rad/sec^2)
I = Kilograms meter^2 (kgm^2)
τ = meter Newtons ($m \cdot N$)
L = meter Newton/sec $\left(\frac{m.N}{s}\right)$

- Equilibrium $\Sigma\tau = \phi$ and $\Sigma F = \phi$