Victoria L Physics 54

1) const a → 3 eqn (kinematics) a= v= x= $V_2^2 - V_1^2 =$ $\vec{A}\cdot\vec{B}$ $|A||B|\cos\theta$

2) vectors
3) projectile x-dir, y-dir
4) uniform circular motion
5) Newton's laws → FBD, coord, eqn, conditions, solve
6) forces → friction, spring, tension, normal ↑

not moving = $\mu_s N$ moving = $\mu_k N$ $\mu_s N > \mu_k N$

7) W, E, P $\Delta E = 0$ $V = \Delta E$ $W = E_f - E_N$ $E_f = E_N + W$

KE + PE + Q = TE

$KE = \frac{1}{2}mv^2$

$PE_{grav} = mgh$ $P = \frac{dW}{dt}$

$PE_{spring} = \frac{1}{2}kx^2$

$v = \frac{dx}{dt}$ $a = \frac{dv}{dt}$ $x(t) = x_0 + v_0 t + \frac{1}{2}at^2$

$v(t) = v_0 + at$ $v^2(x) = v_0^2 + 2a(\Delta x)$ $d = \frac{v_i + v_f}{2} t$

$V = \frac{v_0 + v}{2}$ $\Delta y = \frac{1}{2}gt^2$ $V_y = V_0 + at$

$W = F\,dx$ $F = ma$ $a = \frac{v^2}{R}$ $(+ v_{0y} t) = 0$

centripetal: $v = \frac{d}{t} = \frac{2\pi r}{t}$ $a = \frac{v^2}{r} = \frac{4\pi^2 r}{T^2}$

$F_{net} = m \frac{v^2}{R}$ $F_{net} = m \times \frac{4\pi^2 R}{T^2}$

spring: $F = kx$ satellite $F_{net} = \frac{M_{sat} \cdot v^2}{R}$

$F_{grav} = \frac{G \cdot M_{sat} \cdot M_{central}}{R^2}$) =

Units

$V = m/s$

$a = m/s^2$

$F = N = kg \cdot \frac{m}{s^2} = F = \frac{ML}{T^2}$

$k = \frac{N}{m} \Rightarrow \frac{kg}{s^2}$

energy/work $= J = \frac{kg \cdot r^2}{s^2} = N \cdot m = \cancel{Pa \cdot m^3} = W \cdot s = \cancel{C \cdot V}$

$P = W = \frac{J}{s}$

w/o friction: $E_0 = E_f \pm \cancel{work}^0$
spring mgh/kinetic

straight: $y(t) = \frac{1}{2} g t^2$

$v^2 = \frac{G \cdot M_{central}}{R}$ $a = \frac{G \cdot M_{central}}{r^2}$

$\frac{T^2}{R^3} = \frac{4\pi^2}{G \times M_{central}}$ Earth mass $= 5.972 \times 10^{24}$

$T = \sqrt{\frac{4\pi^2 r^3}{GM}}$

Tension: $T = mg\cos\theta + ma + m\frac{v^2}{r} + \mu mg$
$= T_g + F + F_c + f_{friction}/N$

$T = \frac{2 m_1 m_2 g}{m_2 + m_1}$

check your signs esp for gravity + work

direction of acceleration + velocity can be different

$1 \frac{m}{s} = 2.24$ mph

w/ friction: $\cancel{m}gh - \mu \cancel{m} g\cos\theta\, D = \frac{1}{2}\cancel{m}v^2$

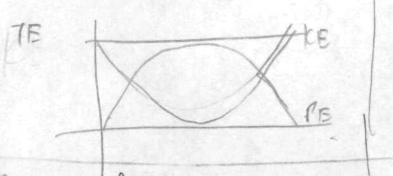
write equations / FBD

angular motion $= \frac{\Delta x}{\Delta t} = \frac{\text{fraction} \times 2\pi r}{\Delta t}$

time = kinematics

no time = energy

$W_{net} = \Delta KE = \frac{1}{2}mv_B^2 - \frac{1}{2}mv_A^2 = (F_g)\Delta y$



$e = \frac{W}{Q_h} = \frac{Q_h - Q_c}{Q_h} = 1 - \frac{Q_c}{Q_h} = 1 - \frac{T_c}{T_h}$ (max)

$W = Q_h - Q_c$ $Q = mL$

$P = W/\Delta t$ K

$\Delta S = mc\ln\frac{high}{low}$ $\frac{Q_c}{T_c} = \frac{Q_H}{T_H}$

$= \frac{Q}{T}$

adiabatic: $PV^\gamma = const$ $\gamma = \frac{C_p}{C_V}$

$W = \frac{P_2V_2 - P_1V_1}{1 - \gamma}$ $C_p = C_V + 1$

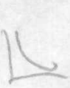
$P_A V_A^\gamma = P_B V_B^\gamma$

AB - iso thermal $(T_H) = Q_h = W = nRT_h \ln\left(\frac{V_B}{V_A}\right)$
BC - Adiabatic
CD - Isothermal $(T_C) = Q_c = W = nRT \ln\left(\frac{V_D}{V_C}\right)$
DA - adiabatic

$O = C_V = \frac{3}{2}R$

$O\!-\!O = C_V = \frac{5}{2}R$

fluids: $Q = \frac{m^3}{s}$ = area × velocity

Isothermal

T = const
Q = -W
$W = -nRT\ln\left(\frac{V_2}{V_1}\right)$
PV = const


Const vol.
V = const
Q = ΔU
W = 0
$Q = nC_V\Delta T$

Isobaric

P = const
Q = ΔU + W
$W = -P(V_2 - V_1)$
$Q = nC\Delta T$

$C_p = C_V + R$

Adiabatic

Q = 0
ΔU = W
$W = \frac{P_2V_2 - P_1V_1}{\gamma - 1}$