AP Physics Chap 10 C.Q (4, 7, 8, 10-14)

(4) $3v \rightarrow$ (9KE)

(7) ($v_A = v_B = v_C$)
All begin with same K & U_g
so all end w/ same K.

(8) ($v_A = v_B = v_C$)
All begin with same K so
all end with same U_g & K.

(10) The spring stretches same distance, 20cm,
Carlos acts just as wall did
w/ Bob, so now stretch
Split between Bob & Carlos
(10cm)

(11) ($U_{s_D} \geq U_{s_C} > U_{s_B} = U_{s_A}$)

(12) $U = \frac{1}{2} k (\Delta s)^2$
$\frac{1}{2} k (1m)^2 = \frac{1}{2} 2k (\Delta s)^2$
$1 = 2 (\Delta s)^2$
$\frac{1}{2} = (\Delta s)^2$
(.71 cm)

(13) (4X) 2X distance → 4X Energy

(14) K = TE − PE — Reread Section 10.7
a) so at ($x = 6m$) K_{max}

b) ($x = 2m$ & $x = 8m$)
turning points

c) at 3m & 6m stable equilibrium
at 1m & 4m unstable equilibrium

AP Physics Chapter 10 (6, 8, 13, 16, 17, 21)

(6) $m = 0.100kg$
$y_i = 1.5m$
$y_f = 10m$

a) $K = \Delta U_g$
$\frac{1}{2}mv^2 = mg(\Delta y)$
$\frac{1}{2}v^2 = g(8.5m)$
$v = 12.9m/s$

b) $K = \Delta U_g$
$\frac{1}{2}mv^2 = mgh$
$v^2 = 2gh$
$v^2 = 2(9.8)(10)$
$v = 14m/s$

(8) $U_{g_i} = U_{g_f}$

$mgh = mgh$
$mgy = mgy$
$y = 1.0m$
if $y = \frac{1}{4}x^2$
$1.0m = \frac{1}{4}x^2$
$4 = x^2$
$x = 2.0m$ along parabolic arc
but still 1.0m up from base

(13) $\Delta K = -\Delta U_g$ — loss in K = gain in U_g (opposite sign)
$K_f - K_i = -(U_f - U_i)$
$\frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 = -(mgy_i - mgy_f)$
$\frac{1}{2}v_f^2 - \frac{1}{2}(10)^2 = -(9.8(10) - 9.8(15))$
$\frac{1}{2}v_f^2 - 50 = -49$
$\frac{1}{2}v_f^2 = 1$
$v_f^2 = 2$
$v_f = 1.4m/s$

(16) $F = -k\Delta s$
$-(2.0)(9.8) = -k(.05m)$
a) $k = 392 N/m$

b) $-3.0(9.8) = -392N/m(\Delta s)$
$\Delta s = .075m$
$+ s_i = .10m$
$.175m$

(17) a) 49N

b) $F = -k\Delta s$
$(49-20) = k(.02)$
$k = 1450 N/m$

c) $49 = 1450(\Delta s)$
$\Delta s = 3.38cm$

(21) $m = 0.500kg$
$\Delta s = 0.040m$
$k = 1250 N/m$
$U_s = K$
$\frac{1}{2}k(\Delta x)^2 = \frac{1}{2}mv^2$
$1250(.04)^2 = (.5)(v^2)$
$v = 2.0m/s$

AP Physics Chapter 10 (23-25, 28-30)

(23) $K = U_s$

$\frac{1}{2}mv^2 = \frac{1}{2}k(\Delta x)^2$

$(10)(v)^2 = 250(.6)^2$

$v = 3.0 m/s$

(24) $K = U_s$

$\frac{1}{2}mv^2 = \frac{1}{2}k(\Delta s)^2$

$(15000)v^2 = 60,000(30)^2$

$v = 60 m/s$

(25) $\vec{p}$: $50(2) + 20(0) = 50v_5 + 20v_2$ (conserve)

K: $\frac{1}{2}50(2)^2 + 0 = \frac{1}{2}50v_5^2 + \frac{1}{2}20v_2^2$ (conserve)

$100 = 50v_5 + 20v_2$

$100 = 25v_5^2 + 10v_2^2$

(2 solutions v_i & v_f. If you solve for v_{20} then it will be factorable.)

$10 = 5v_5 + 2v_2$ $\qquad \frac{10 - 2v_2}{5} = v_5$

$20 = 5v_5^2 + 2v_2^2$

$20 = 5\left(\frac{10-2v_2}{5}\right)^2 + 2v_2^2$

$20 = \frac{5}{25}\left(100 - 40v_2 + 4v_2^2\right) + 2v_2^2$

$20 = 20 - 8v_2 + \frac{4}{5}v_2^2 + 2v_2^2$

$0 = \frac{14}{5}v_2^2 - 8v_2$

$0 = v_2\left(\frac{14}{5}v_2 - 8\right)$

$v_2 = 0$ or $v_2 = 2.86 m/s$ → 2.9 m/s

$v_5 = .857 m/s$ → 0.86 m/s

(28) b) inelastic first

$\vec{p}$: $(.1)(10 m/s) + 0 = (.4)(v)$

b) $v = 2.5 m/s$

a) elastic

$\vec{p}$: $(.1)(10) + 0 = .1(v_1) + .3(v_2)$

K: $\frac{1}{2}(.1)(10)^2 + 0 = \frac{1}{2}(.1)(v_1)^2 + \frac{1}{2}(.3)(v_2)^2$

$\vec{p}$: $10 = v_1 + 3v_2$ $\qquad v_1 = 10 - 3v_2$

K: $100 = v_1^2 + 3v_2^2$

$100 = (10 - 3v_2)^2 + 3v_2^2$

$100 = 100 - 60v_2 + 9v_2^2 + 3v_2^2$

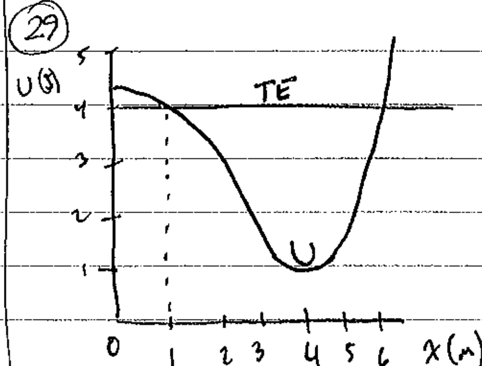
$0 = 12v_2^2 - 60v_2$

$0 = v_2(12v_2 - 60)$

a) $v_2 = 0$ or $v_2 = 5.0 m/s$

$v_1 = -5.0 m/s$

(29)



at $x = 1.0m$, $v = 0$, so at $x = 1.0m$ all (total) energy is U (no K)

$m = 0.020kg$

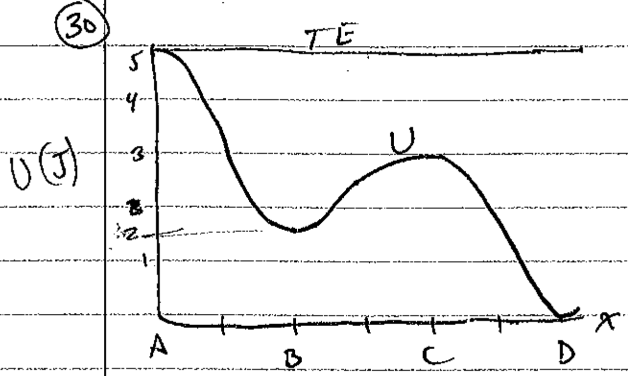
a) $TE = K + U = 4J$

$K = 4J - U$ moving left would mean $U > K$ and neg. K, but this cannot happen so particle moves to the right.

b) v_{max} at $x = 4m$ $\qquad 3J = \frac{1}{2}(.020kg)v^2$ $\quad v = 17.3 m/s$

c) $x = 1m$ & $6m$

(30)



$m = .500 kg$ $v_A = 0$

v_B : $3J = \frac{1}{2}(.5)(v_B)^2$

$v_B = 3.5 m/s$

v_C : $2J = \frac{1}{2}(.5)(v_C)^2$

$v_C = 2.8 m/s$

v_D : $5J = \frac{1}{2}(.5)(v_D)^2$

$v_D = 4.5 m/s$

AP Physics Chap 10 EP (31, 32, 34, 37, 42, 49, 61 ^{uc}) 56 ^{B}

(31) TE = 5J if oscillating btw 2 & 8mm

$\Delta E = 5J - 1J = 4J = K_{max}$

$4J = \frac{1}{2}(.002kg)(v^2)$

$v = 63m/s$

(32) if no K at x=A then would not move "uphill". Must be able to get to 5J at top of hill so needs $K_{min} = 3J$ since starts at 2J. i.e. TE must be 5J (zero v. at top)

~~3J~~

$3J = \frac{1}{2}(.100kg)(v^2)$

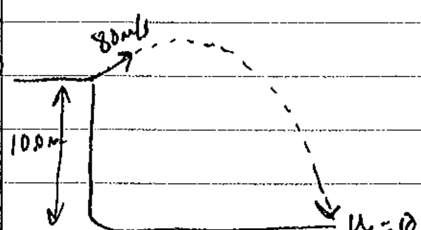
a) $v = 7.7m/s$

b) From B, $K_{min} = 5J$

$5J = \frac{1}{2}(.100kg)\,v^2$

$v = 10m/s$

(34)



$K_i + U_{g_i} = K_f + U_{g_f}$

$\frac{1}{2}mv_i^2 + mgy_i = \frac{1}{2}mv_f^2 + mgy_f \to 0$

$\frac{1}{2}(80)^2 + 9.8(10) = \frac{1}{2}v_f^2$

$v_f = 81.2m/s$

(37) a) ~~[crossed out]~~ Left → force opposite direction of stretch : $F = -k\Delta s$ & force on graph is (+).

b) Yes linear relationship with force & displacement

c) $k = 2N/cm$ or $200N/m$

d) $U_s = K$

$\frac{1}{2}k(\Delta s)^2 = \frac{1}{2}mv^2$

$200N/m(.30m)^2 = (.050kg)(v)^2$

$v = 19m/s$

(42) 1st block speed upon impact

$U_g = K$

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

$(9.8)(3) = \frac{1}{2}(v)^2$

$v = 7.668115805m/s$

$m(\ \ ) + 2m(\emptyset) = 3m(v_c)$

$v_c = 2.556\ m/s$

a) $\approx 2.56m/s$

b) p: $m(7.668...) + 0 = m(v_1) + 2m(v_2)$

$(7.668...) = v_1 + 2v_2$

K: $\frac{1}{2}m(7.668...)^2 + \emptyset = \frac{1}{2}m(v_1)^2 + \frac{1}{2}(2m)(v_2)^2$

$(7.668...)^2 = v_1^2 + 2v_2^2$

$58.8 = v_1^2 + 2v_2^2$ $\quad \left(\frac{7.668... - v_1}{2}\right) = v_2$

$58.8 = v_1^2 + 2\left(\frac{7.668... - v_1}{2}\right)^2$

$58.8 = v_1^2 + \frac{2}{4}\left(58.8 - 15.336..v_1 + v_1^2\right)$

$58.8 = v_1^2 + 29.4 - 7.668115805v_1 + \frac{1}{2}v_1^2$

$0 = \frac{3}{2}v_1^2 - 7.668115805v_1 - 29.4$

$v_1 = {}^{-}2.55603...m/s$ ⟶

42 cont.

$v_1 = -2.55603\ldots m/s$

$K = U$

$\frac{1}{2} m v^2 = mgh$

$\frac{\frac{1}{2}(-2.55603\ldots m/s)^2}{9.8} = h$

$h = .3333\ m$

(33cm) $= y_f$

(49) Conserve energy to get speed off end of ramp then proj. mot. to get range.

$-\Delta U = K$

$-mg\Delta h = \frac{1}{2} m v^2$

$-g(-22m) = \frac{1}{2} v^2$

$v = 20.76535578\,m/s$

Launch angle = 30° by geometry

H	
$v = 20.76 \cos 30°$	$v_i = 20.76\ldots \sin 30°$
$t = ?$	$\Delta y = -3m$
$\Delta x = ?$	$a = -9.8 m/s^2$
	$t = ?$

$\Delta y = v_i t + \frac{1}{2} a t^2$

$-3 = (20.76\ldots \sin 30°)t + \frac{1}{2}(-9.8)t^2$

$t = 2.376534706$ sec

$\Delta x = (20.76\ldots \cos 30°)(t)$

$\Delta x = 42.7m$

(43m)

(61) $U(x) = x + \sin(2\,rad/m\ x)$

over $0 \le x \le \pi\ m$

Graph in TI-89 - Radian mode

$y = x + \sin(2x)$

Window $x_{min} = 0,\ x_{max} = \pi$

$y_{min} = 0 \quad y_{max} = \pi + 1$

a) unstable equilibrium at $\frac{dU}{dx} = 0$ — Maximum at $x = 1.05m$ ($y = 1.91m$)

b) Stable equilibrium at $\frac{dU}{dx} = 0$ — min at $x = 2.09m$ ($y = 1.23m$)

[$U(x) = x + \sin(2x)$

$\frac{dU}{dx} = 1 + 2\cos 2x$

$0 = 1 + 2\cos(2x)$

$\frac{-1}{2} = \cos(2x) \quad x = \pi/3,\ 2\pi/3, \ldots$]

b)