AP Physics - Unit 4

wkst - Unit 4 workBook

① B Conservation of Energy

$$U_{si} + \cancel{KE_i}^{\,0} = \cancel{U_{sf}}^{\,0} + KE_f$$

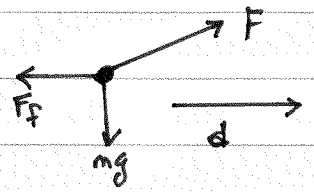
$$\cancel{\tfrac{1}{2}} Kx^2 = \cancel{\tfrac{1}{2}} mV^2$$

$x = A$

$$KA^2 = mV^2$$

$$V = A\sqrt{\frac{K}{m}}$$

② A



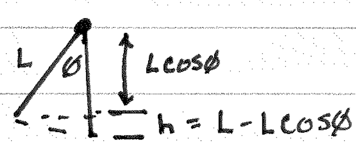
V = constant $\therefore a = 0$

$$W = -F_k d + F\cos\phi\, d$$

$$F_k d = F\cos\phi\, d$$

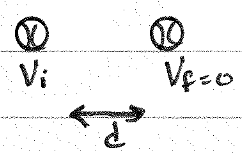
③ D In a circle moving at a constant speed, the work done is zero, since the force is Always perpendicular to the distance moved as you move incrementally around the circle

④ A



$$U_g = mgh$$
$$= mg(L - L\cos\phi)$$

⑤ A



- a constant

$$W = \Delta KE$$

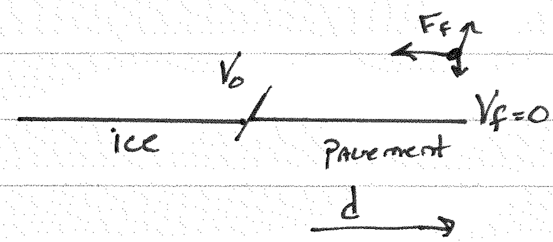
$$-Fd = -\tfrac{1}{2} m V_i^2$$

$$F = \frac{mV_i^2}{2d}$$

⑥ C This is a conservative situation so the Total Energy should stay the same the whole time.

It should Also start w/ max U + min KE

(7) B



mass = 2m
d = ?

$W = \Delta KE$

$-F_f d = \frac{1}{2} m \cancel{V_f^2}^{0} - \frac{1}{2} m V_i^2$

$F_f = u_f F_N = u_f mg$

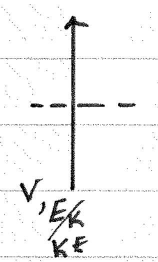
$d u_f \cancel{m} g = \frac{1}{2} \cancel{m} v_i^2$

$d = \frac{V_i^2}{u_f g}$

mass cancels out so 2m doesn't Affect ∴ d is still stopping distance

(8) D   Same Relationship as above
double the V give 2^2, 4x the distance

(9) B



?v, ?KE $+\frac{1}{2} Ug + -\frac{1}{2} KE = \frac{KE}{2}$

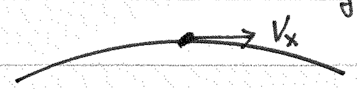
$KE_i = \frac{KE_{midpoint}}{2}$

$\frac{1}{2} \cancel{m} V_i^2 = \frac{\cancel{\frac{1}{2}} \cancel{m} V_2^2}{2}$

$V_i = \sqrt{\frac{V_2^2}{2}} = \frac{V_2}{\sqrt{2}}$

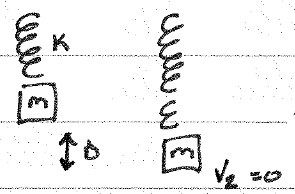
(10) A

At the Top, the Ball is still moving (V_x) so would still posses some KE



(11) B

$V_E = ?$ Equilibrium



0 At Equilibrium no spring tension

$$\cancel{Ug_{Equil}} + KE_{Equil} = Ug_2 + \cancel{KE_2}$$

$$\cancel{\tfrac{1}{2}} m V_E^2 = \cancel{\tfrac{1}{2}} K D^2$$

$$V_E^2 = \frac{KD^2}{m}$$

$$V = D\sqrt{\frac{K}{m}}$$

(12) C Total Energy is Always conserved, so as the Air molecules slow and lose their KE, there is heat flow which increases internal (or thermal) Energy

(13) A Eliminating obviously wrong choices only leaves A as an option. The answer is A because since the first ball has a head start on the second ball it is moving at a faster rate of speed at all times. When both are moving in the air together for equal time periods the first faster rock will gain more distance than the slower one which will widen the gap between them.

(14) C For a mass on a spring, the max U occurs when the mass stops and has no K while the max K occurs when the mass is moving fast and has no U. Since energy is conserved it is transferred from one to the other so both maximums are equal

(15) D Since the Ball is thrown ~~w~~ initial V_i, it must start w/ some Initial KE. As it falls $\frac{1}{2}mv^2$ which gives a parabolic relationship to how KE Changes over time

(16) D only conservative forces are Acting which means Mechanical Energy must Be conserved so it stays Constant as the mass oscillates

(17) C The box momentarily stops at x(min) and x(max) so must have zero K at these points. The box accelerates the most at the ends of the oscillation since the force is the greatest there. This changing acceleration means that the box gains speed quickly at first but not as quickly as it approaches equilibrium. This means that the K gain starts of rapidly from the endpoints and gets less rapid as you approach equilibrium where there would be a maximum speed and maximum K, but zero force so less gain in speed. This results in the curved graph.

(18) C Point IV is the endpoint where the ball would stop and have all U and no K. Point II is the minimum height where the ball has all K and no U. Since point III is halfway to the max U point half the energy would be U and half would be K

(19) B Conservation of Energy IV + II

$$U_g^{IV} + \cancel{KE}^{0} = \cancel{U_g}^{0\,II} + KE$$

$$\cancel{m}gh = \frac{1}{2}\cancel{m}v^2$$

$$v^2 = 2gh$$

$$v = \sqrt{2(9.8\,m/s^2)(1\,m)}$$

$$v = 4.5\,m/s^2$$

(20) D

Since the track is rough there is friction and some mechanical energy will be lost as the block slides which means it cannot reach the same height on the other side. The extent of energy lost depends on the surface factors and cannot be determined without more information

(21) D As the object oscillates its Total Mechanical Energy is Conserved + Transfers from U to KE Back + forth. The only graph that makes sense to have an equal swith thoughout is D.

(22) A To Push the Box at a constant speed, the Child would need to use a force equal to friction. The Rate of work $\left(\frac{W}{t}\right)$ is <u>Power</u>

$F = f_K$ $\quad\quad$ $P = FV$

$\quad = U_K m g$ $\quad\quad$ $P = U_K m g V$

$\therefore A$

(23) C

1st what is K?

$F = Kx$

$mg = kx$

$K = \frac{mg}{x}$

$\left(\frac{12cm}{1}\right)\left(\frac{1m}{100cm}\right) = .12m$

$= \frac{(3kg)(9.8m/s^2)}{(.12m)}$

$K = 245 N \cdot m$

$U_g + \cancel{KE_i}^{0} = U_{sp} + \cancel{KE_f}^{0}$

$mgh = -\frac{1}{2}Kx^2 \quad x = h$

$mgh = -\frac{1}{2}Kh^2$

$h = \frac{-2mg}{K}$

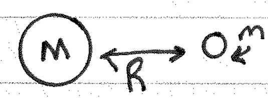
$= \frac{-2(4kg)(9.8m/s^2)}{245 N \cdot m}$

$h = -.32m$

or 32cm down

(24) A

$F_c = F_{net}$



KE of satellite?

$\frac{\cancel{m} V_T^2}{\cancel{r}} = \frac{GM\cancel{m}}{r^2}$

$V_T = \sqrt{\frac{GM}{r}}$

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

$= \frac{1}{2}m\left(\sqrt{\frac{GM}{r}}\right)^2$

$V = \frac{mGM}{2r}$

(25) A Both will Be moving the fastest when they move through Equilibrium

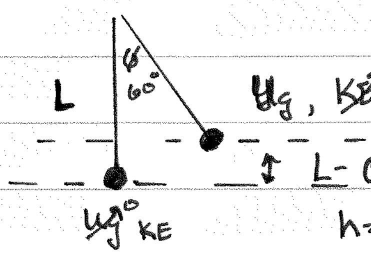
(26) B X and Y directions are independent and both start with the same velocity of zero in each direction. The same force is applied in each direction for the same amount of time so each should gain the same velocity in each respective direction.

(27) B Kinetic energy is not a vector and the total resultant velocity should be used to determine the KE. For the 1st second the object gains speed at a uniform rate in the x direction and since KE is proportional to v^2 we should get a parabola. However, when the 2nd second starts the new gains in velocity occur only in the y direction and are at smaller values so the gains essentially start over their parabolic trend as shown in graph B

(28) A As the system moves, m_2 loses energy over distance h and m_1 gains energy over the same distance h but some of this energy is converted to KE so there is a net loss of U. Simply subtract the $U_2 - U_1$ to find this loss

(29) D In a force vs. displacement graph, the area under the line gives the work done by the force and the work done will be the change in the K so the largest area is the most K change

(30) A



$L - \cos\theta L = h$

$h = L(1-\cos\theta)$

$= L(1-\cos 60°)$

$= L(1-.5)$

$h = \frac{1}{2}L$

$V = ?$ at Equilibrium or Low Point

$U_g = KE$

$U_g = mgh$

$= mg\frac{1}{2}L$

$\frac{1}{2}\cancel{m}gL = \frac{1}{2}\cancel{m}v^2$

$V^2 = gL$

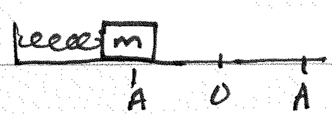
$V = \sqrt{gL}$

$\therefore A$

(31) A $W_{net} = \Delta KE$

(32) A There is No U_{spring} at position $x=0$. So there is NO $\Delta X = 0$ $\therefore$ this is the minimum U_{spring} $\frac{1}{2}K\Delta x^2$ at location $x=0$

(33) C



MAX Speed occurs @ Equilibrium, Not used

$KE = U_{spring}$

$\frac{1}{2}mV_m^2 = \frac{1}{2}Kx^2$ Velocity is equal to spring K stored

$x = a$

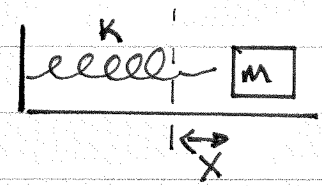
$V_m^2 = \frac{Ka^2}{m}$

$K = \frac{mV_m^2}{a^2}$ $\therefore C$

34 A $W_{net} = \Delta K$ since this has constant speed

$\Delta KE = 0 \quad \therefore W_{net} = 0$

35 C



$U_K = ?$

Work friction = initial

$F_{net} D = \frac{1}{2} K x^2$

$F_{net} = U_K mg \qquad D = X$

$U_K mg \cancel{D} = \frac{1}{2} K x^2 \qquad D$

$U_K = \frac{Kx}{2mg}$

36 B

. Energy is conserved so the term mgh + ½ mv^2 must remain constant. As the object rises it loses K and gains U. Since the height is H/2 it has gained half of the total potential energy it will end up with which means it must have lost half of its kinetic energy, so its K is half of what it was when it was first shot.