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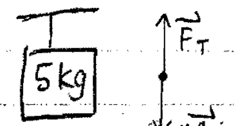
(C) - Mechanics Review Solutions

1. 

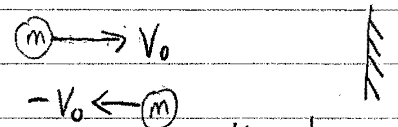
Find tension.

$\sum F_y = m a_y$

$F_T - mg = 0$

$F_T = mg = 5\,kg\,(10\,m/s^2) = \underline{50\,N}$ $\boxed{C}$

Define coordinates
$- \longleftrightarrow +$

2. 

Kinetic Energy $= \frac{1}{2} m v^2$

$K_i = \frac{1}{2} m v_0^2,\ K_f = \frac{1}{2} m (-v_0)^2 = \frac{1}{2} m v_0^2$

$\Delta K = K_f - K_i = \frac{1}{2} m v_0^2 - \frac{1}{2} m v_0^2 = \underline{0}$ $\boxed{C}$

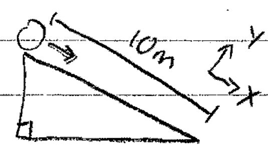
Define coordinates
$- \longleftrightarrow +$

3. Same situation as #2. Momentum: $p = mv$

$p_i = m v_0,\ p_f = m(-v_0)$

$\Delta p = p_f - p_i = -m v_0 - m v_0 = -2 m v_0$

negative means <u>to the left</u> $\boxed{A}$

4. Kinematics. 

$x - x_0 = v_0 t + \frac{1}{2} a t^2$ ($v_0 t = 0$ since the ball is initially at rest)

First 2 seconds: $1 = \frac{1}{2} a (2)^2 = 2a$

$a = 1/2\ m/s^2$

First 4 seconds: $d = \frac{1}{2} (\frac{1}{2} m/s^2)(4s)^2 = \underline{4\,m}$ $\boxed{C}$

5. Since gravity (a conservative force) is the only force acting on the box, we can use energy conservation.

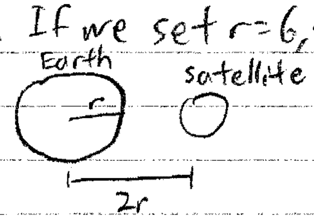
Set $U=0$ at position 2

$K_i + U_i = K_f + U_f$

$0 + U_i = K_f + 0$

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

6. If we set $r = 6{,}400\,km$:



$F \propto \frac{1}{r^2}$

<u>On Earth vs. In orbit</u>

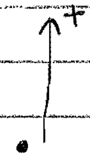
$\frac{100\,kN}{1/r^2} = \frac{x\ kN}{1/(2r)^2}$

$x = \underline{25\,kN}$ $\boxed{B}$

7. Period of a pendulum: $T = 2\pi\sqrt{\frac{l}{g}}$

Quadrupling l yields: $T_{new} = 2\pi\sqrt{\frac{4l}{g}} = 2\left[2\pi\sqrt{\frac{l}{g}}\right] = 2T$. $\boxed{E}$

8.



During ascent:

Position: +, chalk is above initial height

Velocity: +, chalk is moving up

Acceleration: −, gravity pulls on the chalk

+, +, − $\boxed{B}$