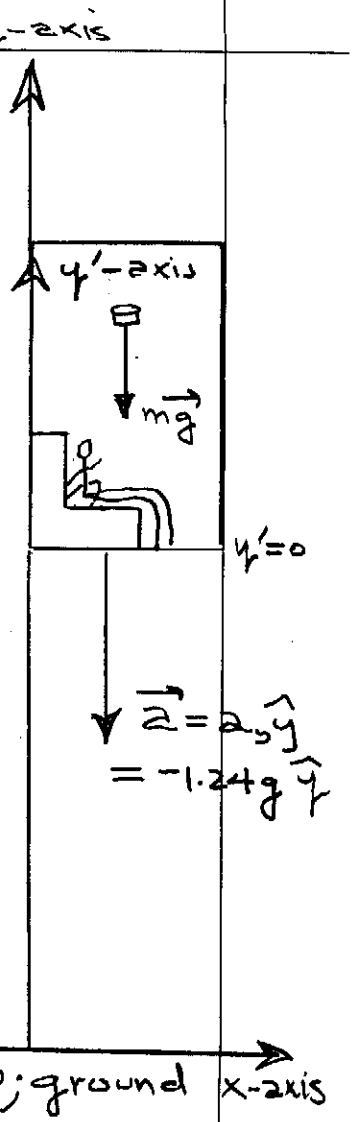
STAEDTLER® No. 937 811E Engineer's Computation Pad

•17 A customer sits in an amusement park ride in which the compartment is to be pulled downward in the negative direction of a $y$ axis with an acceleration magnitude of $1.24g$, with $g = 9.80\ m/s^2$. A 0.567 g coin rests on the customer's knee. Once the motion begins and in unit-vector notation, what is the coin's acceleration relative to (a) the ground and (b) the customer? (c) How long does the coin take to reach the compartment ceiling, 2.20 m above the knee? In unit-vector notation, what are (d) the actual force on the coin and (e) the apparent force according to the customer's measure of the coin's acceleration?

I assume the customer is strapped to the seat

Since the box accelerates at a rate greater than free fall it will accelerate away from the coin which only has gravity acting on it.




a) $\vec{F}_{net\ on\ coin} = m\vec{a}_{coin} \Rightarrow m\vec{g} = m\vec{a}_c \Rightarrow \vec{a}_c = \vec{g} = -g\hat{y}$

The person is forced to $\vec{a}_p = 1.24\vec{g}$

$\vec{a}_{cg} = \vec{a}_{cp} + \vec{a}_{pg} \Rightarrow \vec{a}_{cp} = \vec{a}_{cg} - \vec{a}_{pg}$

b) $\vec{a}_{cp} = \vec{g} - 1.24\vec{g} = -0.24\vec{g} = +0.24g\hat{y}$

Relative to the Box: $\vec{a}_c = \vec{a}_{cp} = 0.24g\hat{y}$

$\Rightarrow y' = y'_0 + v'_{0y}t + \frac{1}{2}(a_{cp})_y t^2$

$2.20 + y'_0 = y'_0 + 0\,t + \frac{1}{2}(0.24g)t^2$

c) $t^2 = 2(2.20)/[(0.24)\,9.80] \Rightarrow t = 1.37\ s$

d) $\vec{F}_{coin}$ = actual force on coin is that in an INERTIAL FRAME ≡ UNACCELERATED FRAME. (ONLY APPLY NEWTON'S LAWS IN INERTIAL FRAMES... IF YOU DON'T THEN YOU HAVE TO MAKE UP FICTICIOUS FORCES TO ACCOUNT FOR THE MOTION).

$= m\vec{g}$ = GRAVITY $= (0.567\times10^{-3}\ kg)\,9.80\ m/s^2\,(-\hat{y}) = 5.56\times10^{-3}$ NEWTONS

$= (0.567\ g)\,980\ cm/s^2 = 556\ dynes\,(-\hat{y})$

e) $\vec{F}'_{coin} = m\vec{a}'_c = m(0.24g\hat{y}) = 0.24(+5.56\times10^{-3}\hat{y}\ N)$

$= m\vec{g} + \vec{F}_{fic} = m(-0.24\vec{g})$

$\Rightarrow \vec{F}_{fic} = -m\vec{g} - 0.24m\vec{g} = -1.24m\vec{g}$