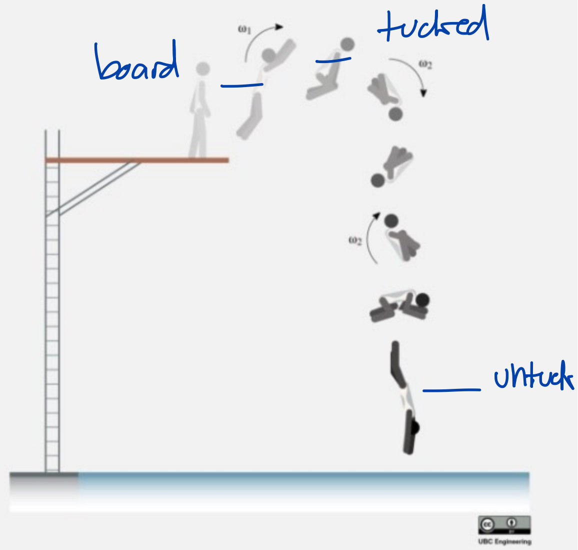
20-R-IM-PT-8

(1 point) **UBCDynamics/20-R-IM-PT-8.pg**



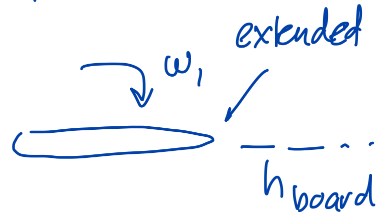
A high diver jumps from their diving board $h = 21\ m$ from the water. They start the dive fully extended with an angular momentum of $\omega_1 = 2.1\ rad/s$. Then they bring in their body to complete a several rotations before extending once again and landing in the water. If the person's center of mass is $h_{max} = 25.2\ m$ above the water when they start to tuck, and $1.75\ m$ above the water when they extend their body, how many full revolutions can they complete before they have to extend into the water?

Assume that, when fully extended, the divers body can be considered as a rod with a length of $l_{diver} = 1.6\ m$. When they tuck, their body can be considered as a rod of length $l_{diver_2} = 1.088\ m$, with a constant mass of $m = 85\ kg$.

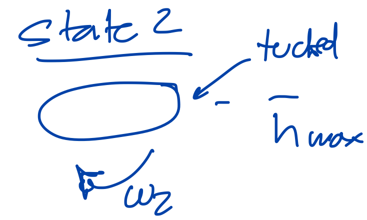
Number of rotations:

Enter your answers as a whole number.

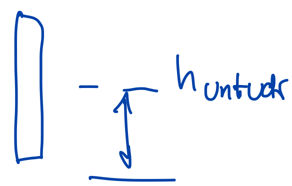
state 1



state 2



state 3



1→2 cons. of momentum

$$I_1\omega_1 = I_2\omega_2$$

$$\cancel{\tfrac{1}{2}m}\, l_1^2\omega_1 = \cancel{\tfrac{1}{2}m}\, l_2^2\omega_2$$

$$\omega_2 = \frac{\omega_1 l_1^2}{l_2^2} = \frac{2.1\ rad/s\,(1.6)^2}{(1.088)^2}$$

$$= 4.542\ rad/s^2$$

2→3 cons. of energy

$\omega_2 = \omega_3$ $\qquad V_2 = 0$

accel const.

mg

$$\Sigma F_y: -mg = ma_y \Rightarrow a_y = -g$$

$$d = d_0 + v_0 t + \tfrac{1}{2}a_y t^2$$

$$h_{untuck} = \overset{h_{max}}{h_{tucked}} + 0\cdot t - \tfrac{1}{2}g t^2$$

$$h_{max} - h_{untuck} = \tfrac{1}{2}g t^2$$

$$t = \sqrt{\frac{2(25.2m - 1.75m)}{9.81\ m/s}} = 2.187\ s$$

revolutions 2→3

$$\theta = \omega_2 \cdot t$$

$$= 9.932\ rad$$

total revs $= \dfrac{\theta}{2\pi} = 1.58$

round down to whole revs: 1