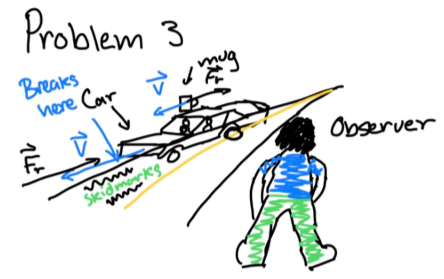
PHY 303K - Midterm II Corrections
Abdon Morales

Part A: In whose reference frame does the coffee mug accelerate forward

Part B: In whose reference frame does the coffee mug move at a constant velocity

Problem 3



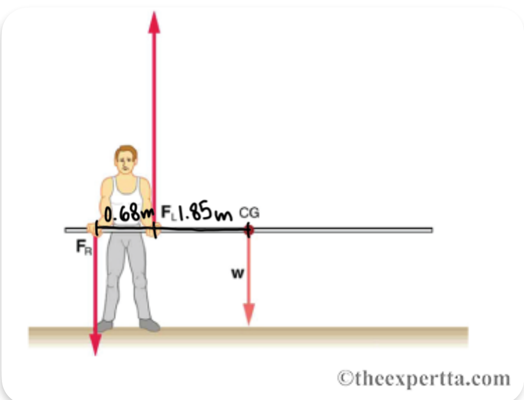
Part A: The car "decelerates" when the brakes are applied, causing the mug to slide backward relative to the car. In the car's reference frame, the mug appears to accelerate foward relative to the car; as it slows down.

∴ The mug accelerates foward in the driver's reference frame.

Part B: Relative to the roadside observer, the coffee mug maintains a constant velocity until the brakes cause it to fall. Relative to the driver, the mug appears accelerate backwards due to de-acceleration of the car

∴ The roadside observer's reference frame.

Problem #5



We know that torque:

$\tau = F \cdot r \sin\theta$ $\sum \tau = 0$

$= F \cdot r$

$= I\alpha$ [Rot.] $\sum F = 0$

$\vec{W} = m \cdot g$ [Center of Gravity]

Solve symbolically

$\vec{F}_L - \vec{F}_R - \vec{W} = 0$
$+\vec{W}$ $+\vec{W}$

$\vec{F}_L - \vec{F}_R = \vec{W}$

→ $\vec{F}_L = \vec{W} + \vec{F}_R$

→ $\vec{F}_R = \vec{F}_L - \vec{W}$

Solve numerically

$\vec{W} = m \cdot g = 5.0\,kg \cdot 9.81\,m/s^2$

$= 49.05\,\frac{kg \cdot m}{s^2}$

$\vec{F}_L = 49.05N + \vec{F}_R$

$\vec{F}_R = \frac{m \cdot g \cdot d_{CG}}{d_{hands}} = \frac{49.05 \cdot 1.85m}{0.68m}$

$= \boxed{133.31\,\frac{kg \cdot m}{s^2}}$

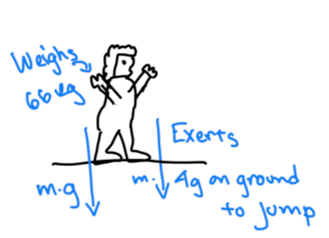
$\vec{F}_L = 49.05N + 133.31 = \boxed{182.36N}$

∴ The magnitudes of

$\vec{F}_R = 133.3N$

$F_L = 182.36N$

Problem 6:



$F_{Exert} = F_{Total} = (m \cdot g) + (m \cdot 4g)$

$= m(g + 4g)$

$\boxed{F = m(5g)}$

Let $m = 66\,kg$

$g = 9.81\,m/s^2$

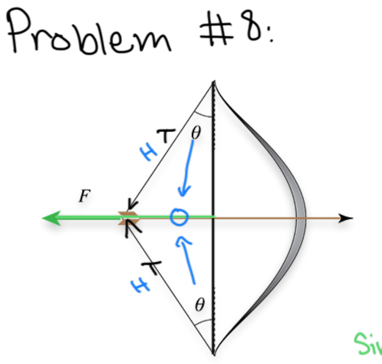
$F = 66kg \cdot (5 \cdot (9.81\,m/s^2))$

$= 66kg \cdot (49.05\,m/s^2)$

$= \boxed{(3234\,kg \cdot m)/s^2}$

∴ The magnitude of the force the jumper must exert on the ground to produce an upward acceleration 4times the gravitational acceleration is $3234\,\frac{kg \cdot m}{s^2}$.

Problem #8:



SOH
CAH
TOA

Let $F = 2T \sin\theta$

T = Tension

Find for T

$F = \frac{2T \sin\theta}{2 \sin\theta}$

$\boxed{\frac{F}{2\sin\theta} = T}$

Since this is an isosceles triangle and the force relative to the tension via the string/rubberband being pulled we have two equivalent angles and tension ∴ the final result via symbolic math and logic resulted in the final correct answer being:

$\boxed{F/(2\sin\theta) = T}$

Problem 10:

We can use the following kinematics equation to solve for the velocity final given the initial:

Let $a = g = 9.81$

$v_0 = v_i = 6.6$

$h = (\Delta x) = 29 - 0 = 29$

Sym solve for v_f:

$v_f^2 = v_i^2 + 2a\Delta x$

$\sqrt{v_f^2} = \sqrt{v_i^2 + 2gh}$

$\boxed{v_f = \sqrt{v_i^2 + 2gh}}$

Conservation of Energy Theorem

or $\frac{m\left(\frac{1}{2}mv_0^2 + mgh\right)}{m} = \frac{\frac{1}{2}mv_f^2}{m}$

$2 \cdot \frac{1}{2}v_0^2 + gh = \frac{1}{2}v_f^2 \cdot 2$

$\sqrt{v_0^2 + 2gh} = \sqrt{v_f^2}$

$\sqrt{v_0^2 + 2gh} = v_f$

Solve numerically:

$v_f = \sqrt{(6.6)^2 + 2(9.81)(29)}$

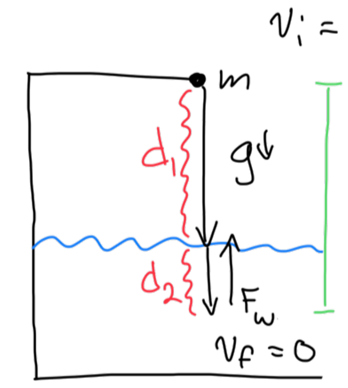
$= \sqrt{43.56 + 568.98}$

$= \sqrt{612.54}$

$= \boxed{24.7495\,m/s}$

Problem #11

$v_i = 0$ $\Delta KE = 0$



Solve symbolically

$-mgh + F_w \cdot d = 0$

$(mg)h = F_w \cdot d$

$\therefore h = \frac{F_w}{m \cdot g} \cdot d$

∴ The total distance between the diving board and diver's stopping point is 12.8673 meters.

Let F_w = force of water resistance = 1520N

$F_g = m \cdot g$ = Force of gravity

$m = 57.8kg$ = mass of diver

d = distance #2 = 9.8m

Now solve num. → $h = \frac{1520\,\frac{kg \cdot m}{s^2} \cdot 9.8m}{57.8kg \cdot 9.81\,m/s^2}$

total distance $= \frac{7296}{567.018} = \boxed{12.8673m}$