Physics 112 Course Review #4 Newtons Laws

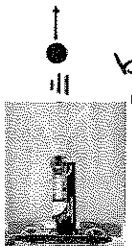
1. What is an inertial and non-inertial frame of reference? Give an example of each and be sure to clearly indicate what the frame of reference is.

Inertial frame of reference - frame of reference for objects at rest or moving at a constant velocity ie/ a person watching a car going by or a person in a car driving @ a constant velocity

non-inertial frame of reference - an accelerating frame of reference ie/ you are driving and the driver abruptly put on the breaks

Newtons Laws do not apply to non-inertial frames of reference

2. Is the ball in the image below likely to land in the funnel if the cart is maintaining a constant velocity? What about if the cart has a constant acceleration? Provide an explanation for your answers.

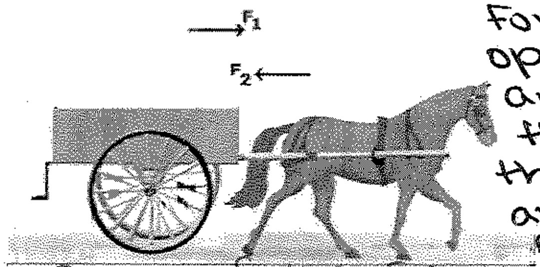


If the cart is maintaining a constant velocity the ball will land in the funnel. If the cart has a constant acceleration the ball will not land in the funnel. The reason with a constant velocity that the ball goes in the funnel is because the ball and cart have the same velocity in this scenario. Newtons 1st law can be applied. If the cart is accelerating the velocity is changing so the ball cannot go back in the funnel. It has a non inertial frame of reference.

3. Using Newton's 3rd law describe how the floor pushes you forward and that you do not push the floor.

According to Newtons 3rd law every action has an equal and opposite reaction. Because of this when we step down on the floor the floor exerts the same force upwards on our foot. Therefore the floor propels us forward.

4. Considering Newton's 3rd Law, how is the horse able to move the cart?



For every action there is an equal and opposite reaction. If the horse and cart is considered as one unit then the horse exerts a force on the cart and the cart exerts the same and opposite force on the cart. The force of the horse is greater than the force of the friction acting on the cart and therefore the cart will begin moving as the horse pulls it.

5. A 3.5 kg ball is accelerated from rest to a velocity of 18 m/s over a distance of 10 m. What force is exerted on the ball during this time? (F = 57 N)

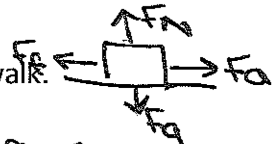
$m = 3.5 kg$
$v_o = 0$
$v_f = 18 m/s$
$d_f = 10 m$
$d_o = 0 m$

② $F_{net} = ma$ — need to find a 1st
$= (3.5 kg)(a)$

$F_{net} = (3.5)(16.2)$

$F_{net} = 57 N$

① $v_f^2 = v_o^2 + 2a(d_f - d_o)$
$(18)^2 = (0)^2 + 2(a)(10-0)$
$324 = 0 + 2a(10)$
$324 = 0 + 20a$
$\frac{324}{20} = \frac{20a}{20}$
$16.2 = a$



6. An applied force of 35 N is needed to accelerate a 12 kg wagon at 1.5 m/s^2 along a sidewalk.

   a. How large is the frictional force? ($|F_f|$ = 17 N)

$F_a = 35N$
$m = 12kg$
$a = 1.5 m/s^2$
$F_f = ?$

① $F_{net} = ma$
$F_{net} = (12)(1.5)$
$F_{net} = 18$

$F_{net} = \Sigma Forces$
$F_{net} = F_a + F_f$ need to find F_{net} 1st

② $F_{net} = F_a + F_f$
$18 = 35 + F_f$ -35
$18 - 35 = F_f$
$-17 = F_f$

   b. What is the coefficient of friction? (μ = 0.14)

$F_f = \mu F_N$ need to find F_N 1st
$\frac{-17}{118} = \frac{\mu\, 118}{118}$
$0.14 = \mu$

① $|F_N| = |F_g|$
$F_g = mg$
$= (12)(9.81)$
$F_g = 118N$
$F_N = 118N$

7. An elevator with a mass of 750 kg is accelerated upward at 2.4 m/s^2. What force does the cable apply to give this acceleration? (F_a = 9160 N)

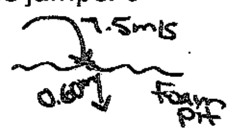
$m = 750kg$
$a = 2.4 m/s^2$
$F_a = ?$

① $F_{net} = ma$
$= (750)(2.4)$
$F_{net} = 1800$

② $F_g = mg$
$F_g = (750)(9.81)$
$F_g = 7358$

③ $F_{net} = F_a + F_g$
$+7358 + 1800 = F_a + (-7358)$ $+7358$
$9158 = F_a$

8. A high jumper falling at a 7.5 m/s lands on foam pit and comes to rest compressing the pit 0.60 m. If the pit is able to exert an average force of 1700 N on the high jumper breaking the fall, what is the jumper's mass? (m = 36 kg)

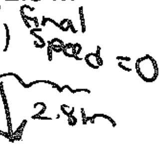


$v_o = 7.5 m/s$ down $(-7.5 m/s)$
$v_f = 0 m/s$
$F_a = 1700N$
$d_f = -0.60m$
$d_o = 0$

① $v_f^2 = v_o^2 + 2a(d_f - d_o)$
$(0)^2 = (-7.5)^2 + 2a(-0.60 - 0)$
$0 = 56.25 + -1.2a$
$\frac{1.2a}{1.2} = \frac{56.25}{1.2}$
$a = 46.9$

② $F_{net} = ma$
$\frac{1700}{46.9} = \frac{m(46.9)}{46.9}$
$36kg = m$

10. A 45 kg diver steps off a 13 m high platform (initial velocity is zero). The swimmer comes to a stop 2.8 m below the surface of the water. Calculate the net stopping force exerted by the water. (F = 2050 N)



need to find velocity he hits the water & then find stopping force

$m = 45kg$
$v_o = 0 m/s$
$d_o = 13m$
$d_f = 2.8m$
$v_f =$

① $v_f^2 = v_o^2 + 2a(d_f - d_o)$
$0^2 = v_o^2 + 2(-9.81)(0 - 13)$
$0 = v_o^2 + (19.62)(-13)$
$0 = v_o^2 + -225.06$ $+225.06$
$225.06 = v_o^2$
$\sqrt{225.06} = v_o$
$-15 m/s = v_o$

② $v_f^2 = v_o^2 + 2a(d_f - d_o)$
$(0) = (-15)^2 + 2a(2.8)$
$0 = 225 + 5.6a$
$\frac{-225}{5.6} = \frac{5.6a}{5.6}$
$40 m/s^2 = a$

③ $F_{net} = ma$
$F_{net} = (45)(40)$
$F_{net} = 1800N$