Dynamics

AT Dynamics(11)

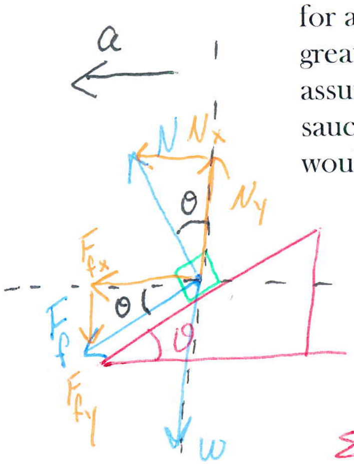
Solve the following problems showing ALL work and CIRCLING your answers. Each is worth 5 points.

1. Determine the weight of a 35 kg object

$W = mg$

$(35\,kg)(9.8\,m/s^2) = 343\,N$

2. One of the challenges with getting take-out pizza is the drive home. When well planned, the pizza is picked up piping hot as it comes out of the oven so that it can be driven home quickly so it is still good and hot upon arriving home. This activity always requires two people, a driver and a pizza holder. The holder must angle the pizza through the turns and during forward and backward accelerations to prevent the cheese and toppings from sliding on the pizza (What a mess when that happens!). In this case, we will figure that the greatest angle the "holder" can obtain for a forward acceleration is 20 degrees from the horizontal. Determine the greatest acceleration the car can have when the box is held at 20 degrees if we assume an effective coefficient of friction of 0.36 between the cheese layer and the sauce/crust. (The cheese on the pizza is complex situation. To simplify this, I would suggest considering the "Cheese" as a simple box.)

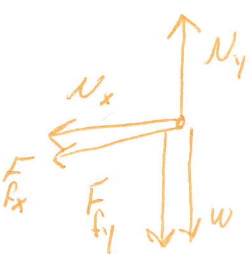


$\theta = 20°$

$\mu = .36$

$\Sigma F_y = N_y - W - F_{fy} = ma$

As Long As the Cheese Does Not Slide there Will Be No Acceleration In the y-Direction



$\Sigma F_y = N_y - W - F_{fy} = 0$

$N_y = W + F_{fy}$

$N \cos\theta = mg + F_f \sin\theta$

$N \cos\theta = mg + \mu N \sin\theta$

$N\cos\theta - \mu N \sin\theta = mg$

$N(\cos\theta - \mu \sin\theta) = mg$

$N = \frac{mg}{(\cos\theta - \mu\sin\theta)}$

$\Sigma F_x = -N_x - F_{fx} = -ma$

$N_x + F_{fx} = ma$

$N\sin\theta + \mu N \cos\theta = ma$

$N(\sin\theta + \mu\cos\theta) = ma$

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$\frac{mg}{(\cos\theta - \mu\sin\theta)}(\sin\theta + \mu\cos\theta) = ma$

(mass Cancels)

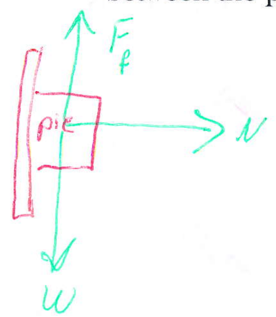
$\frac{g(\sin\theta + \mu\cos\theta)}{\cos\theta - \mu\sin\theta} = a$

$\frac{(9.8 m/s^2)[\sin(20°) + (.36)\cos(20°)]}{[\cos 20° - (.36)\sin(20°)]}$

~~$a = 7.09 m/s^2$~~ ?

$8.2 m/s^2$

3. Consider the old "pie in the face" routine. In order to throw a pie, you need to pick up the pie with the bottom of the pie pan resting on your horizontally oriented hand. You will then begin to accelerate the pie, and rotate your hand so the surface between the pie and your hand is vertical. Determine the minimal acceleration you must give the pie pan to prevent the pie from sliding down your hand when your hand is held vertically if the mass of the pie is 0.2 kg and the coefficient of friction between the pan and your hand is 0.42.



$\Sigma F_x = N = ma$

$\Sigma F_y = F_f - W = 0$

[accel must Be Zero, or It would Fall]

$\mu N - mg = 0$

$\mu N = mg$

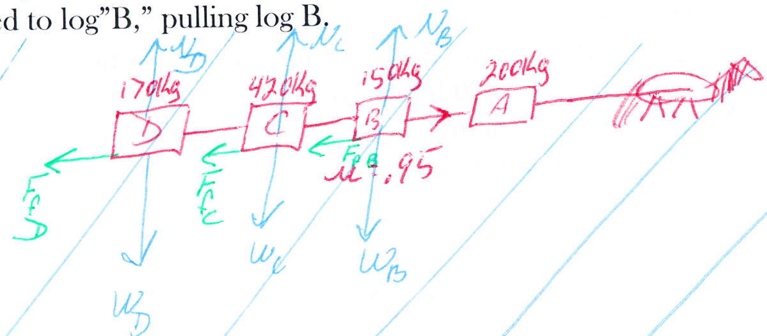
$N = \frac{mg}{\mu}$

$\frac{mg}{\mu} = ma$

$\frac{g}{\mu} = a = \frac{9.8\,m/s^2}{.42} = 23.3\,m/s^2$

$a = \text{Zero}$

4. A horse is dragging logs up a hill. There are 4 logs being pulled in tandem. The 4 logs are attached with separate ropes. The first log (call it "A") has a mass of 200 kg, the second log (call it "B") has a mass of 150kg, the third log (call it "C") has a mass of 420 kg, and the final log (Call it "D") has a mass of 170kg. There is a rope running from log "A" to the horse's harness. There is an effective coefficient of friction on each log of 0.95, and the horse is pulling the logs up a hill with an angle of 22 degrees above the horizontal. Determine the tension in the rope that is attached to log"B," pulling log B.



$\Sigma F_{y_D} = N_D - W_D = ma$ $\quad N_D = W_D$

$\Sigma F_{y_C} = N_C - W_C = ma$ $\quad N_C = W_C$

$\Sigma F_{y_B} = N_B = W_B$ (opps... I short cutted by mistake)

(*Note*) I Failed To Include the hill

$\Sigma F_{x_{BCD}} = -F_{f_B} - F_{f_C} - F_{f_D} + T_B = ma$

$-\mu N_B - \mu N_C - \mu N_D + T_B = 0$

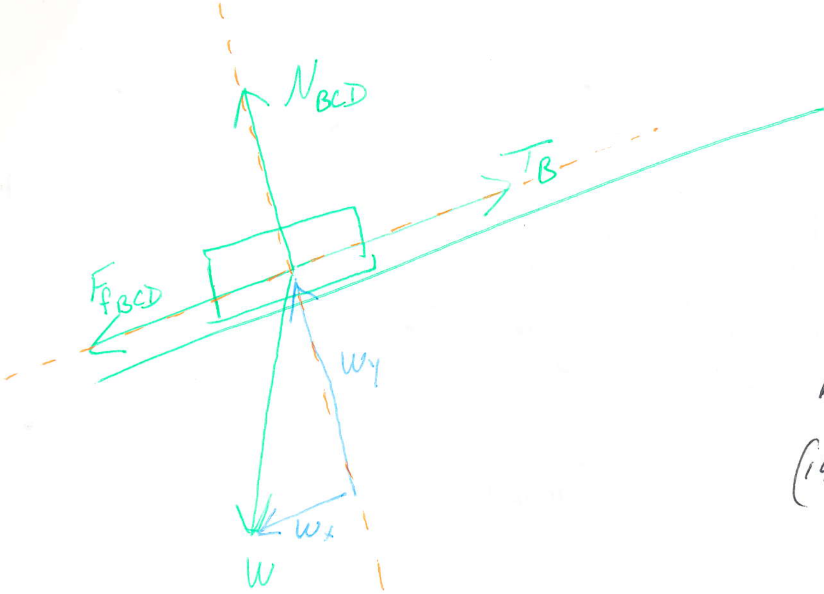
$T_B = \mu N_B + \mu N_C + \mu N_D$

$T_B = \mu [W_B + W_C + W_D]$

$T_B = \mu [m_B g + m_C g + m_D g]$

$T_B = \mu g [m_B + m_C + m_D]$

$T_B = (.95)(9.8\,m/s^2)[150kg + 420kg + 170kg] = 6{,}890\,N$



$m_B + m_L + m_D = m$

$(150kg + 420kg + 170kg)$

$\Sigma F_y = N_{BCD} - W_{Y_{BCD}} = ma$

$N_{BCD} - mg\,Cos\theta = ma = 0$

$N_{BCD} = mg\,Cos\theta$

$\Sigma F_x = T_B - F_{f_{BCD}} - W_{x_{BCD}} = 0$

$T_B = F_{f_{BCD}} + W_{BCD}\,Sin\theta$

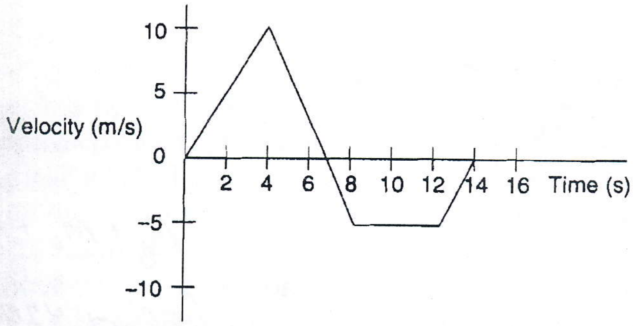
$T_B = \mu N + mg\,Sin\theta$

$T_B = \mu mg\,Cos\theta + mg\,Sin\theta$

$T_B = mg[\mu\,Cos\theta + Sin\theta)$

$T_B = (150kg + 420kg + 170kg)(9.8\,m/s^2)[.95\,Cos(22°) + Sin(22°)] = 9100\,N$

Questions 5–7 refer to the velocity versus time graph shown below.

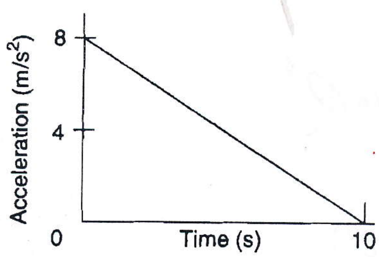


5. The total distance traveled by the object during the indicated 14 s is
   (A) 7.5 m
   (B) 25 m
   (C) 62.5 m
   (D) 77.5 m
   (E) 82.1 m

6. The total displacement of the object during the 14 s indicated is
   (A) 7.5 m
   (B) 25 m
   (C) 62.5 m
   (D) 77.5 m
   (E) 82.1 m

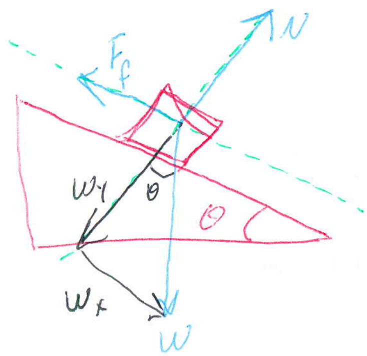
7. The average velocity, in meters per second, of the object is
   (A) 0
   (B) 0.5
   (C) 2.5
   (D) 4.5
   (E) 5.6

8. What is the total change in velocity for the object whose acceleration versus time graph is given below?



   (A) 40 m/s
   (B) −40 m/s
   (C) 80 m/s
   (D) −80 m/s
   (E) 0 m/s

5. A box is released on an incline that makes an incline of 33 degrees. The coefficient of the box on the incline is .52. Determine the acceleration of the box.



$\theta = 33°$

$\mu = .52$

$\Sigma F_x = W_x - F_f = ma$

$W \sin\theta - \mu N = ma$

$W \sin\theta - \mu W \cos\theta = ma$

$mg \sin\theta - \mu mg \cos\theta = ma$

$g \sin\theta - \mu g \cos\theta = a$

$g(\sin\theta - \mu \cos\theta) = a$

$9.8\,m/s^2[\sin 33° - (.52)(\cos 33°)]$ $a = 1.06\,m/s^2$

$\Sigma F_y = N - W_y = ma$

$N - W_y = 0$

$N = W_y$

$N = W\cos\theta$

6. Determine the mass of a 55 kg object.

55 kg

Wayne
Connie
Leonard
Donald
Shirley
Dale
Floyd
Queen
Hazel
Kathleen

Doris - Betty
Jake Bertha