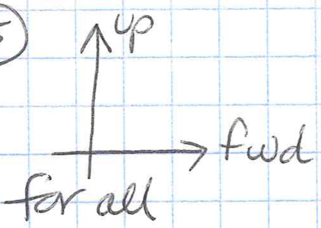
Forces

3.1 - Types of Forces p. 122 # 2, 3, 5, 7, 13, 15

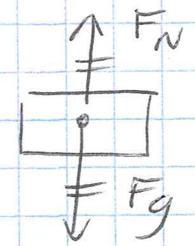
(2) a) gravity b) tension (through cable)
c) friction (in brake pads)

(3) The reading on spring scale will not be accurate if the scale is not zeroed 1st

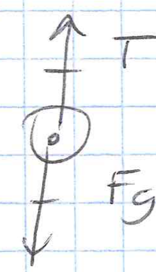
(5)



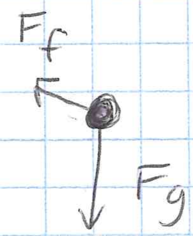
a)



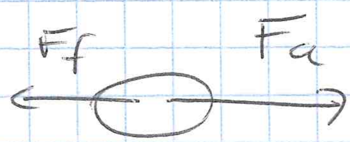
b)



c)



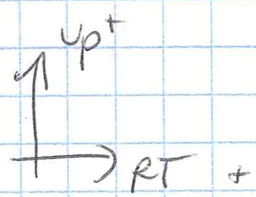
d)

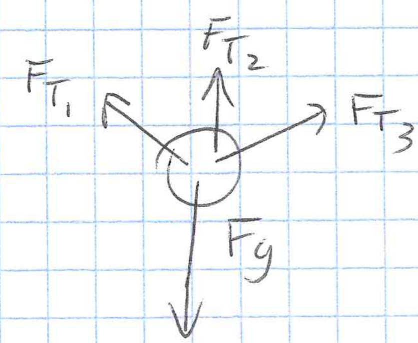


(7) a) $F_g = mg$ $\therefore F_g = (2\,kg)(9.8\,\frac{N}{kg}) = 19.6\,N$ [down]

b) $F_g = mg$ $\therefore F_g = (62\,kg)(9.8\,N/kg) = 608\,N$ [down]

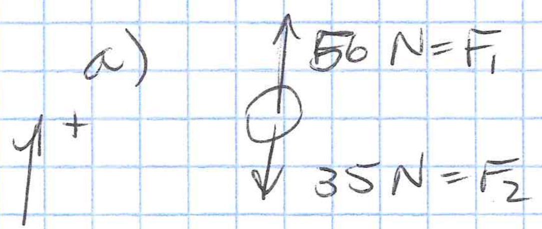
(13)





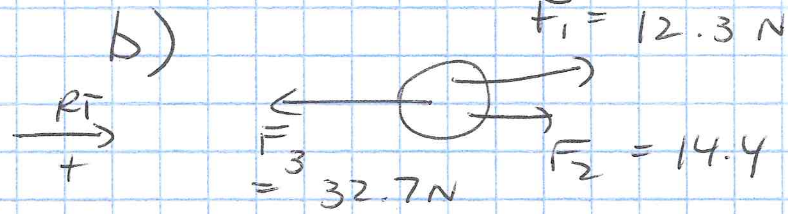
(15) F_{net} = sum of all forces.

a)



$F_{net} = F_1 + F_2$
$= (+56) + (-35)$
$= +21$ N [up]
∴ $F_{net} = 21$ N [up]

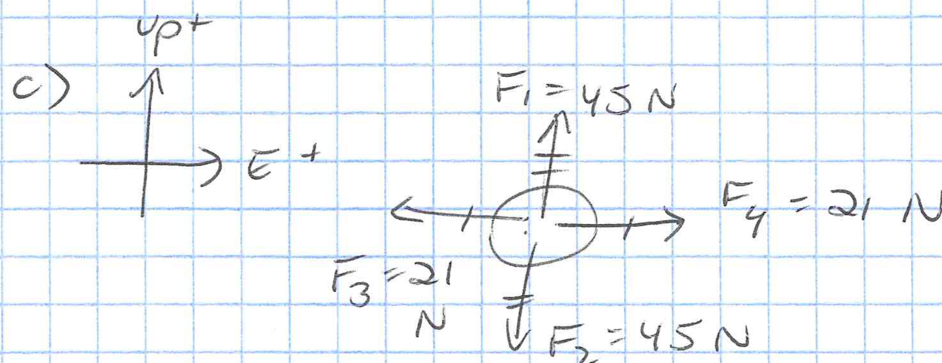
b)



$F_{net} = (12.3) + (14.4) + (-32.7)$
$= -6$ N [right]

∴ $F_{net} = 6$ N [left]

c)



Add forces along x axis: $(+21) + (-21) = 0$ N [right]
Add forces along y-axis: $(+45) + (-45) = 0$ N [up]

∴ <u>F_{net} = 0 Newtons</u>

(16) a) weakest: F_g < electromag < ~~strong~~ weak nuclear < strong nuclear
b) Gravity is <u>only</u> attract, other 3 are attract/repel
c) Tension - created by humans ∴ not natural or fundamental
Friction - exists because of gravity pulling 2 objects together ∴ fundamental

4.2 - Friction

p. 172 # 1, 3, 4, 6, 7, 11

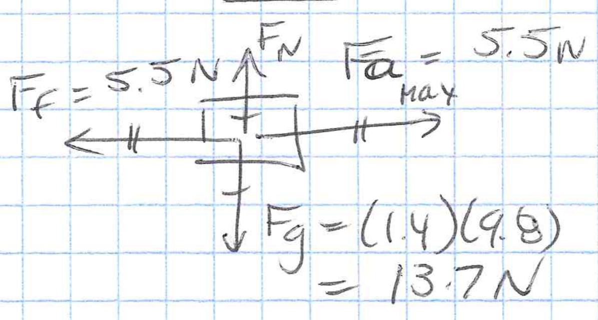
(1) Turning doorknob - friction helpful so I can grib + turn knob.

Pushing box - friction is not helpful - it opposes motion & makes it harder to push.

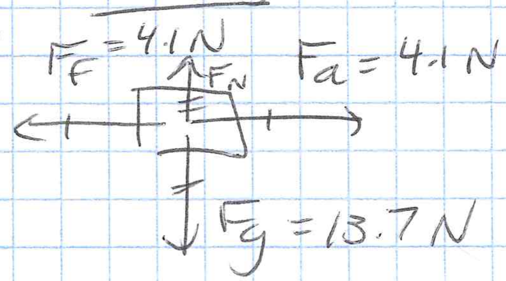
Gliding on ice - friction would not be helpful. Gliding a long ways happens with very little friction; the more friction there is, the less gliding.

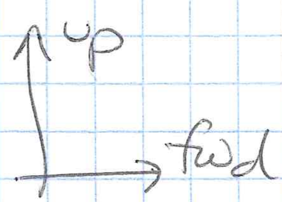
Tying a knot - Friction helps
Friction between ropes holds the ~~notes~~ knots - otherwise rope will slip + knot wouldn't hold.

(3) Start



Sliding





$m = 1.4 kg$

$$\mu_s = \frac{F_{s_{max}}}{F_N} = \frac{F_{a_{max}}}{F_g}$$

$$= \frac{5.5 \cancel{N}}{13.7 \cancel{N}}$$

$$\mu_s = 0.40$$

$$\mu_k = \frac{F_k}{F_N} = \frac{F_a}{F_N}$$

$$= \frac{4.1 \cancel{N}}{13.7 \cancel{N}}$$

$$= 0.30$$

$$\mu_k = 0.30$$

④ Roads typically made of asphalt

a) (407 made of concrete I believe)

Concrete + asphalt are similar in <u>dry</u> conditions.

in wet conditions, asphalt is more slippery (0.25 is minimum value vs 0.45 for concrete).

b) The μ_k values are higher for <u>dry</u> condition

∴ more grip when it's <u>dry</u>

∴ more slippery when wet

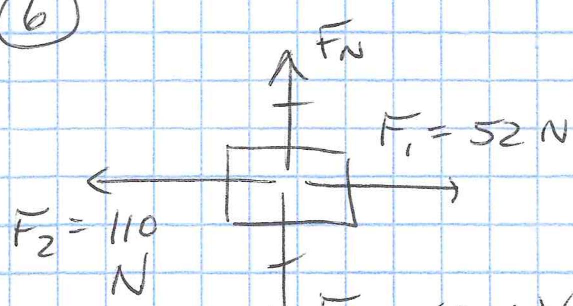
∴ should slow down when wet because you will slide more

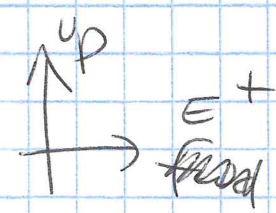
c) Salt melts the ice.

∴ road is not icy (<u>very</u> slippery) but just wet (not as slippery)

∴ safer for cars when they have more <u>traction</u> (friction)

⑥





$F_g = (26\text{ kg})(9.8\text{ N/kg})$
$= 254.8$ N

$\mu_s = 0.25$

- There is no net ↕ vertical force. So focus on ↔ horizontal
- $F_{net} = F_1 + F_2$
  $= 52 + (-110) = -58$ N [E] $=$ <u>58 N [W]</u>

$F_{s\,max} = \mu_s F_N = (0.25)(254.8)$ (b/c $F_N = F_g$)

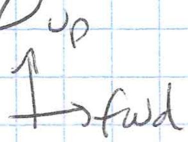
$= 63.7\,N$

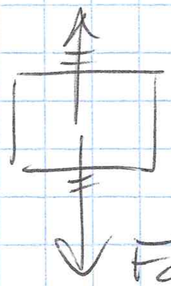
It takes 63.7 N to make desk begin to move

The net Force is only 58 N

The desk won't move.

(7)





$\mu_s = 0.50$

$\mu_k = 0.40$

$F_g = (12{,}000)(9.8) = 117600\,N$ also $= F_N$

a) F to start movement. (must $= F_{s\,max}$)

$F_{s\,max} = \mu F_N$

$= (0.50)(117{,}600)$

$= 58{,}800\,N$ to start movement

b) F to keep moving at constant velocity

$F_k = \mu F_N = (0.40)(117600) = 47{,}040\,N$

or 47000 N to keep moving

(11)

Running shoe → goal of such a shoe is to run fast + be able to turn, speed up, slow down, etc. TRACTION/Friction + no slip is key

Dress shoe → goal is looks. No so focussed on traction/friction.

3.2 - Newton's 1st Law

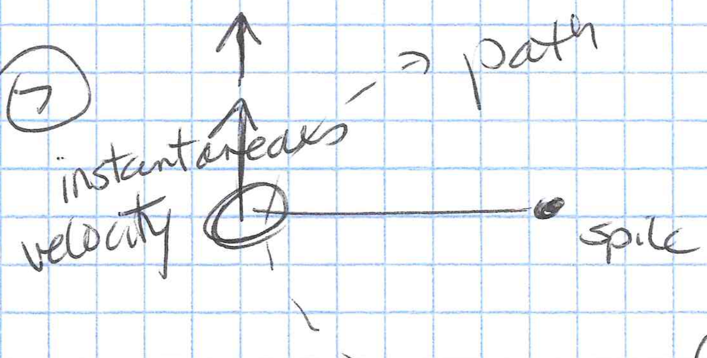
p. 129
2, 5, 7, 9, 12, 13

(2) Galileo + Newton
did not have an air hockey table! They did not have access to something that had very little friction like such a table. We all know that when you hit a puck on a good air hockey table, it will go for a very long time! Only the air friction slows it down, eventually. It is easier for us to imagine Newton's 1st Law of inertia.

(5) a) suddenly slows down ⇒ seatbelts are key here. Without something to restrain us, we would continue to travel at the speed of the car when the car suddenly stops. Our bodies obey Newton's 1st Law. Without a seatbelt, we fly through the windshield when the car stops suddenly.

b) If the car suddenly speeds up (we "floor it" or we get rear-ended) our body prefers to keep moving at the slow (or still) speed it was + the car moves ahead. This causes "whiplash"

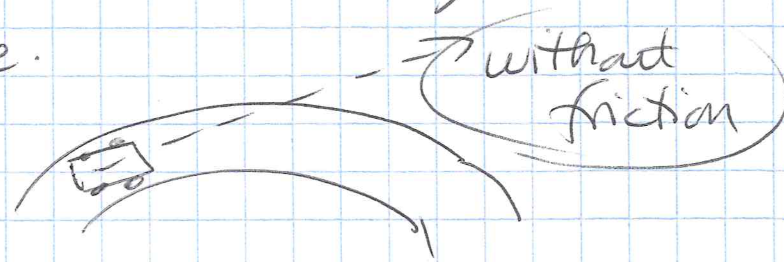
(7)



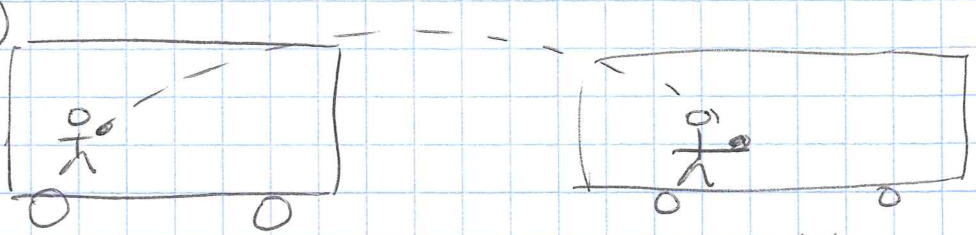
See p. 125

The puck will move forward tangentally to curved path of string cut. The puck only circles because the string exerts an inward force.

(9) <u>Friction</u> between the road + tires helps you navigate the turn. Without friction (say road is icy or wet), you car continues in a straight line tangental to curve.



(12)

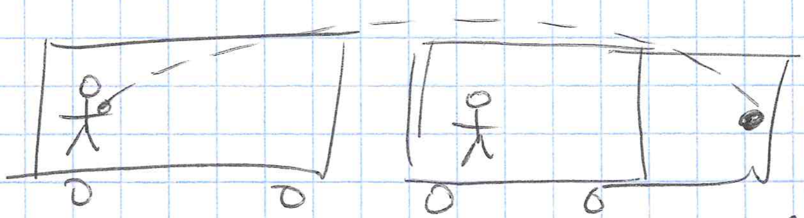


a)

V constant

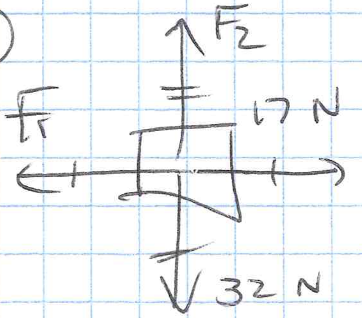
You catch apple since <u>you</u> + <u>apple</u> moving at same speed

b)



Apples moves forward at speed it was released. You slow down with bus + apple lands in <u>front</u> of you. In this case near front of bus.

(13)

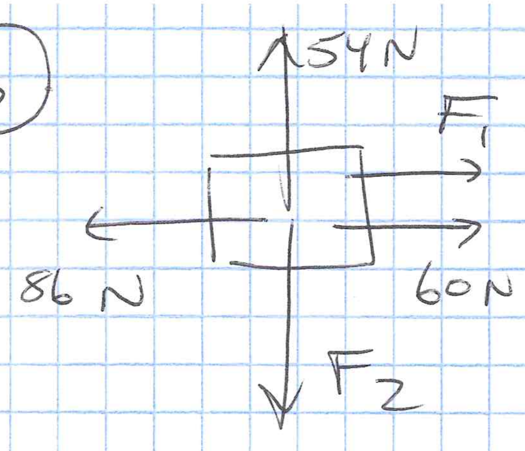


$F_1 = 17$ N [opposite way]

$F_2 = 32$ N (opposite way)

@ rest ∴ ↕ balanced + ↔ balanced

(13)



Moving @ constant velocity

∴ ↔ balanced

∴ ↕ balanced

∴ $F_2 = 54\,N$

∴ $86\,N = 60\,N + F_1$ ∴ $F_1 = 26\,N$

(15)