# 3.4 – Newton's 3rd

p. 141 #1, 2, 3, 4, 8

① a) ∴ road pushes car <u>forward</u> (240 N)

b) ∴ desk pulls <u>back</u> on you with 25 N [S]

② a) Squid's <u>expelled</u> <u>water</u> pushes back on ocean water

∴ ocean water pushes <u>forward</u> on squid (∴ it moves forward)

b) You push wagon back as you step

∴ Wagon pushes you forward.

You are not used to "ground" moving as you walk ∴ you fall forward.

c) helicopter blades push air <u>down</u>

∴ air pushes helicopter Blades (and thus helicopter) <u>up</u>

③ a) She pulls handle back

∴ handle pulls her <u>forward</u> to ship

b) She pulls suit (herself) forward

∴ suit pulls hand (herself) back

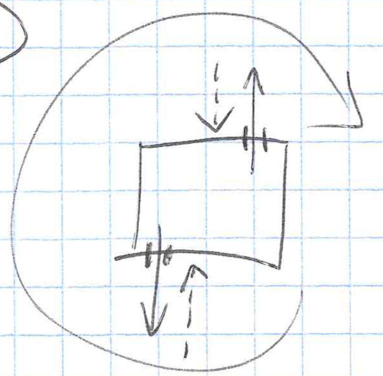
∴ $F_{net} = 0$

c) She throws tool backward with backward force

∴ tool pushes her <u>forward</u> to ship.

④ Cannon pushes cannonball <u>forward</u> ∴
Cannonball pushes cannon <u>back</u>ward
(rope holds it in place)

⑧



View from top

↑↓ water above pushes water below <u>out</u>

∴ ↑↓ water leaving pushes back on carton

∴ will spin ↻

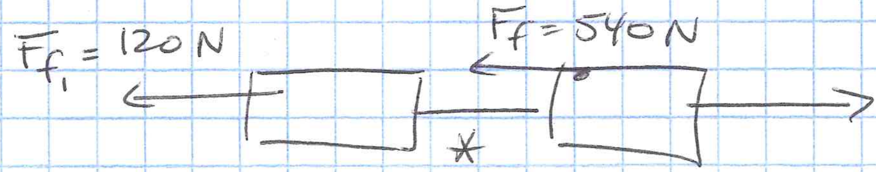
(like squid except 2 forces in opposite directions on opposite corners)

# 3.5 - Using Newton's Laws

(2)

$a = 2.0\ m/s^2$

P. 147 # 2, 5, 7, 8




→ fwd +

$t = 5.0\ s$

$m = 72$ kg

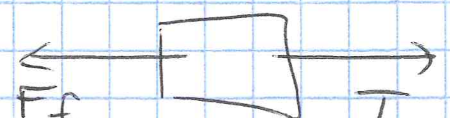
$m = 450$ kg

a) Tension = ?
*

the whole system accelerates at $2.0\ m/s^2$

$a = {}^{+}2.0\ m/s^2$
$F_{f_1} = {}^{-}120\ N$ [fwd]
$m = 72\ kg$

watch signs +/-



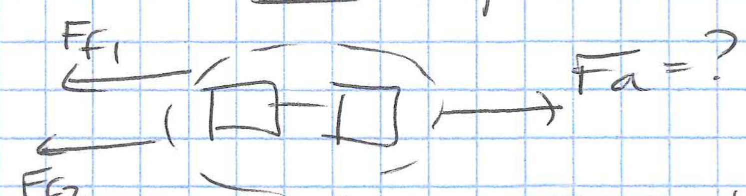

$F_{net} = ma$

$F_{f_1} + T = ma$

$-120 + (T) = (72)(2)$

$T = {}^{+}260\ N$ [fwd]

b) Let's look at whole "system"




$m = 72 + 450 = 522\ N$

$a = +2.0\ m/s$

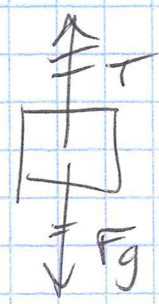
→ $F_{net} = ma$

$F_a + (-120) + (-540) = 522(2)$

$F_a = 1700\ N$ [fwd]

(5) "holds" 120 kg max ∴ can take $120\,kg \times 9.8\,N/kg$

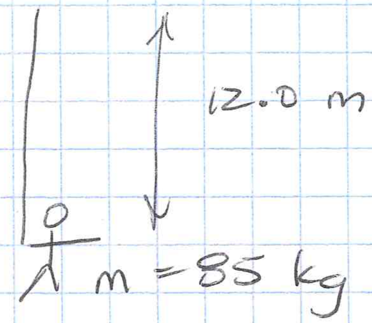
$= 1176\,N$ (Max)




$F_g = (120)(9.8)$
$= 1176\,N$

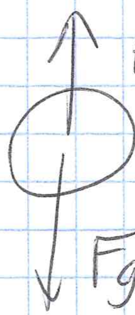
$\Delta d = 12.0\,m$

$t = ?$ minimum
∴ use max. $F_a$
($F_a = 1176\,N$)




person

(+) ↑



$F_a = 1176$ (climber pulls with 1176 ∴ rope pulls up on climber with 1176 N)

$F_g = (85)(9.8)$
$= 833\,N$

need $\vec{a}$

$F_{net} = ma$ ∴ $a = \frac{F_{net}}{m} = \frac{1176 + (-833)}{85}$

$= 4.04\,m/s^2$ [up]

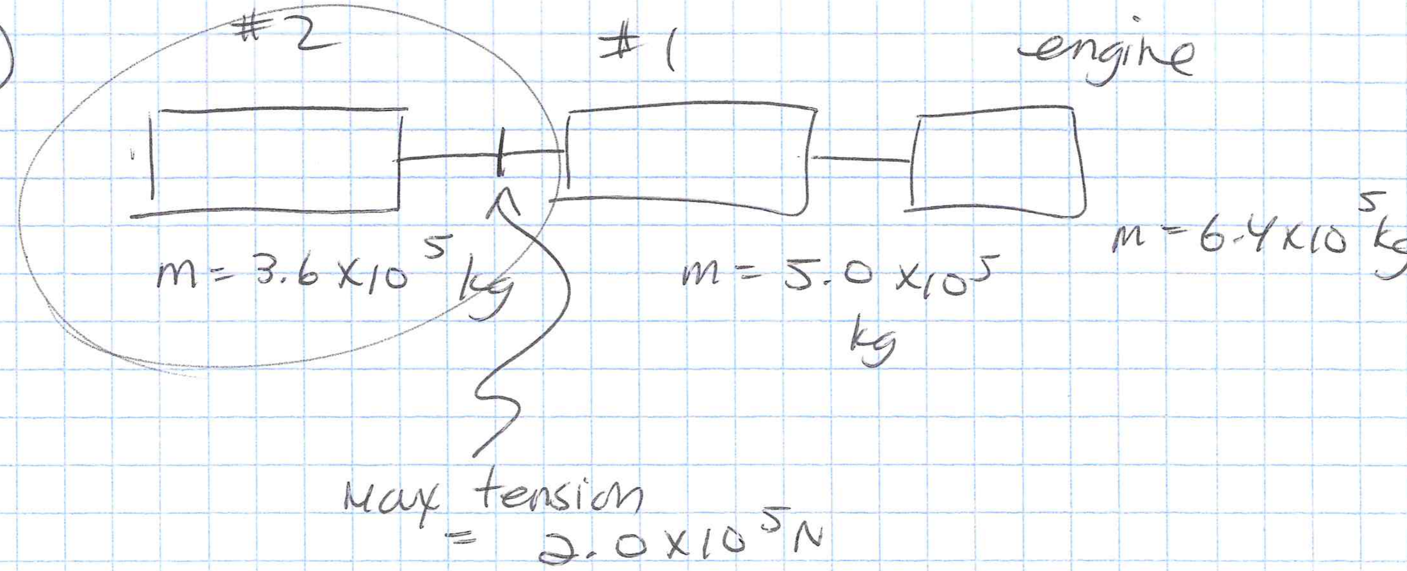
assume $v_1 = 0$

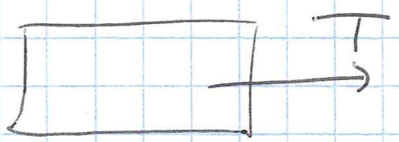
$d = v_1 t + \frac{1}{2}at^2$

$12.0 = \frac{1}{2}(4.04)\,t^2$

$t = 2.4\,s$ to climb up

(7)




car #2

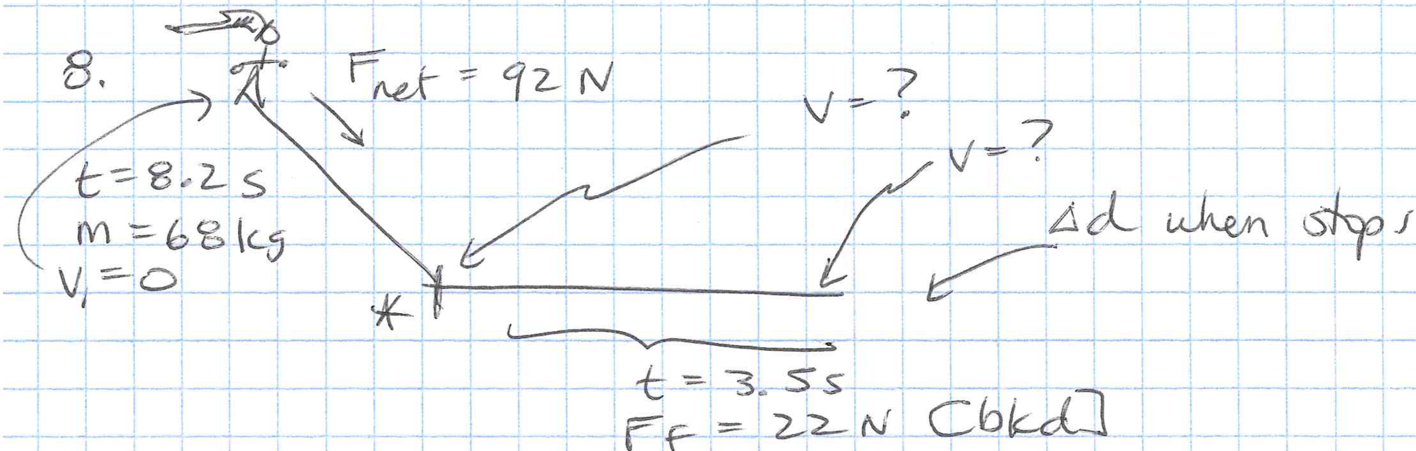
$F_{net} = ma$

$T = ma$

$(2.0 \times 10^5) = 3.6 \times 10^5\, a$

$a = 0.56\ m/s^2$ [fwd]

8.

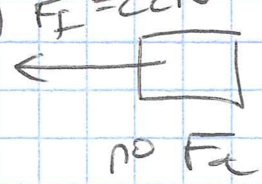



a) speed* Find $\vec{a}$, then use kinematics for $\underline{v}$

$a = \frac{F_{net}}{m} = \frac{92}{68} = 1.353\ m/s^2$ [down]

$v_2 = \cancel{v_1}^{0} + at = (1.353)(8.2) = 11.09 = \underline{\underline{11\ m/s}}$

b)




$a = \frac{F_{net}}{m} = \frac{-22}{68} = -0.324\ m/s^2$

(sign)

$V_2 = V_1 + at$ but now $V_1 = 11.09$ m/s
$V_2 = ?$

$V_2 = 11.09 + (-0.324)(3.5)$

$V_2 = 9.956 = \underline{10 \text{ m/s}}$

c) $\Delta d$ to stop?
$V_1 = 11.09$ m/s $V_2 = 0$ $a = -0.324$ m/s$^2$

$\cancel{V_2^2}^{\,0} = V_1^2 + 2ad$

$0 = (11.09)(11.09) + 2(-0.324)d$

$0 = 122.988 - 0.648d$

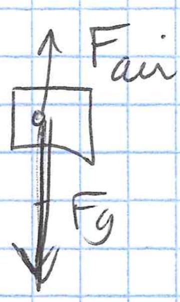
$190 \text{ m} = d$

$\therefore$ 190 m before stopping on flat ground

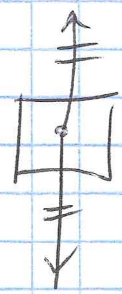
# 4.1 Gravity Near Earth    p. 167 #2, 4, 5

(2) Fig 3 on page 163 explains this very well. Remember: air resistance increases as speed increases. That is key.

(4)




$F_g > F_{air}$



$F_g = F_{air}$

} box will speed up as it falls (accelerates) until terminal velocity

Basically a) b) + c) of Fig 3 p. 163 again

(5) $\vec{g} = 8.6$ N/kg now $\neq$ 9.8 N/kg

m = 74 kg

a) Mass of astronaut is still 74 kg on ISS

b) $F_g(\text{earth}) = (9.8)(74) = 725$ N

$F_g(\text{ISS}) = (8.6)(74) = 636$ N

} 89 N of weight less on ISS

$(F_g = m\vec{g})$

c) gravity less intense on ISS ∴ $F_g \downarrow$ ∴ "weight" is less

d) Objects in orbit are continually falling towards earth + appear weightless. They are not.