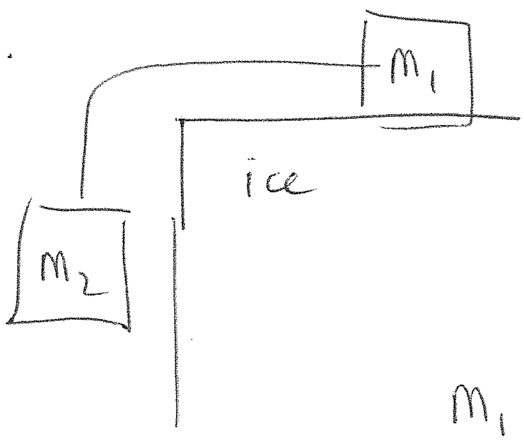
4.3 – Solving Frictional Problems

#2, 6, 7

#2.

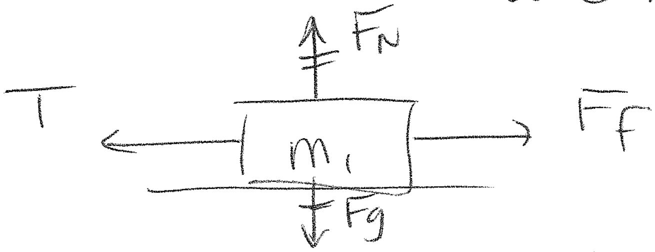


$m_1 = 55\ kg$

$m_2 = 78\ kg$

m_1 is not sliding.
It is @ rest + staying @ rest ∴ ⟷ forces are balanced

$m = 55\ kg$



I know $T = F_g$ acting on m_2

$F_g = m_2 g$
$= 78 \times 9.8$
$= 764.4\ N$ ∴ $T = 764.4$

∴ $F_f = 764.4\ N$ This is minimum F_s!

$\mu_s = \frac{F_s}{F_N}$ ⇒ $\mu_s = \frac{764.4}{(55)(9.8)} = 1.418$

on horizontal surface $F_N = F_g$

$\mu_s = 1.4$

b) a coefficient of friction of 1.4 is extremely high (normally < 1.0). And this is ice which is slippery. NOT Reasonable

c) The director should add gravel, rocks etc. to ice that actors can grab onto.

#6.

team A
6 players x 65 kg average

$\therefore m_A = 390\,kg$

team B
5 players x 84 kg

$m_B = 420\,kg$

dislodges (a.k.a. overcomes static friction)

A with 3.2 kN or 3200 N

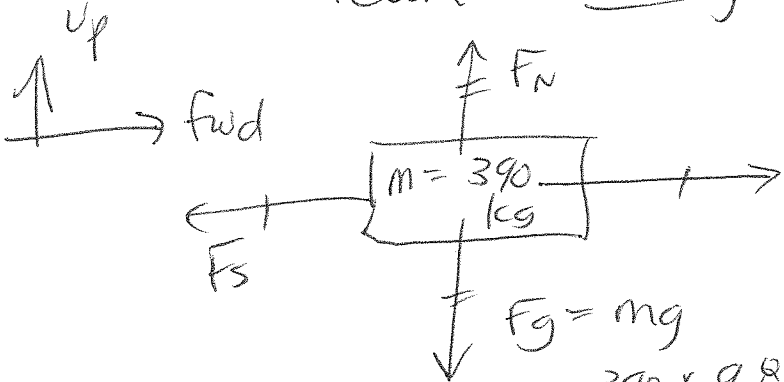
pulls with (a.k.a. kinetic friction now)

2.9 kN OR 2900 N

@ constant velocity

FIND $\mu_s = ?$
$\mu_K = ?$

Team is moving. They are the object



F_a to dislodge = max f_s *
= 3200 N

$F_g = mg$
$= 390 \times 9.8$
$= 3822\ N$
$\therefore F_n = 3822\ N$

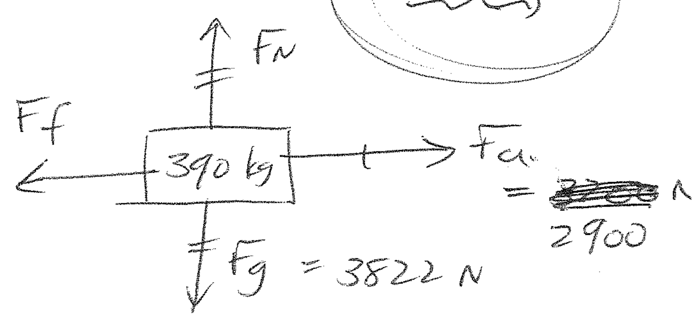
$\mu_s = ?$

$$\mu_s = \frac{F_f}{F_N} = \frac{F_s}{F_N} \qquad F_{s\,max} = F_a$$

$$= \frac{3200}{3822} = 0.837$$

$\therefore \mu_s = 0.84$

$V_{const.}$ *



$\mu_k = ?$

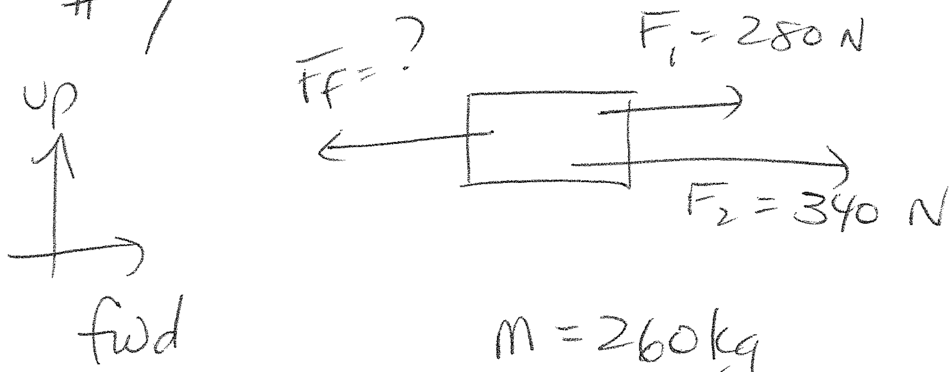
$$\mu_k = \frac{F_f}{F_N} = \frac{F_a}{F_N}$$

$$\mu_k = \frac{2900}{3822}$$

$\mu_K = 0.759$

$\therefore \mu s = 0.76$

#7



$a = 0.30\ m/s^2$

$m = 260\ kg$

$\mu_k = ?$

$$\mu_k = \frac{F_f}{F_N}$$? ok

$$F_N = F_g = mg = 260\ kg \times 9.8\ \frac{N}{kg} = \frac{2548}{N}$$

need to calculate F_f.

$$F_{net} = ma$$

$$F_1 + F_2 + F_f = ma.$$

$$280 + 340 + F_f = (260)(0.30)$$

$$F_f = 78 - 620$$

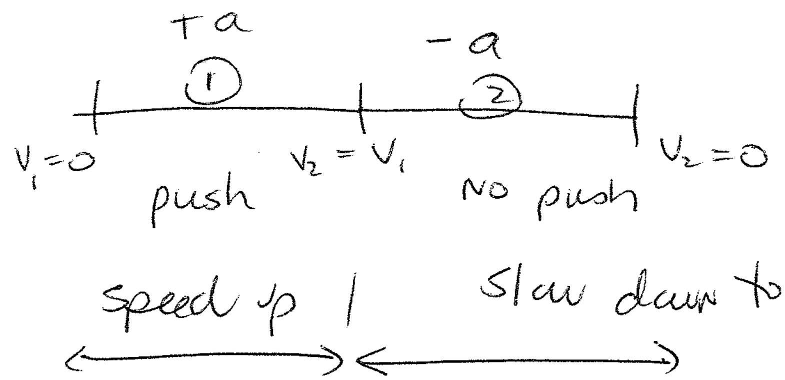
$$F_f = -542\ N$$

now:

$$\mu_k = \frac{F_f}{F_N} = \frac{542}{2548} = 0.2127$$

$$\mu_k = 0.21$$

b) $t = ?$ after pushing for $\underline{6.2s}$ from rest *



① $v_1 = 0$

$v_2 = ?$

$a = 0.30\ m/s^2$ *

$t = 6.2s$

$v_2 = v_1 + at$

$= 0 + (0.30)(6.2)$

$= 1.86\ m/s = v_1$ for part ②

② $\underline{\text{Now}}$ $v_1 = 1.86\ m/s$

$v_2 = 0$

$t = ?$

$a = ?$

But $F_{net} = ma$

$F_f = ma$

(already solved for!) $-542 = 260\ a$

$a = -2.08\ m/s^2$

now $a = \frac{v_2 - v_1}{t}$

$-2.08 = \frac{0 - 1.86}{t}$

$\underline{t = 0.89s}$

Takes 0.89 s to coast to stop