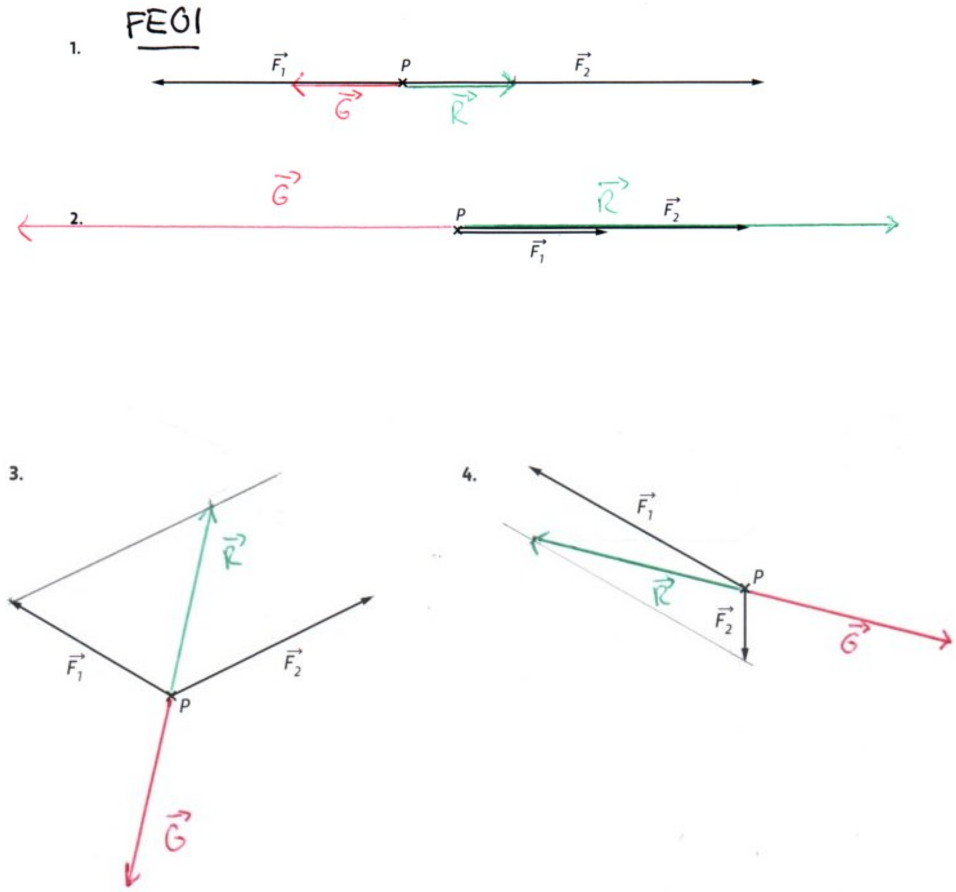
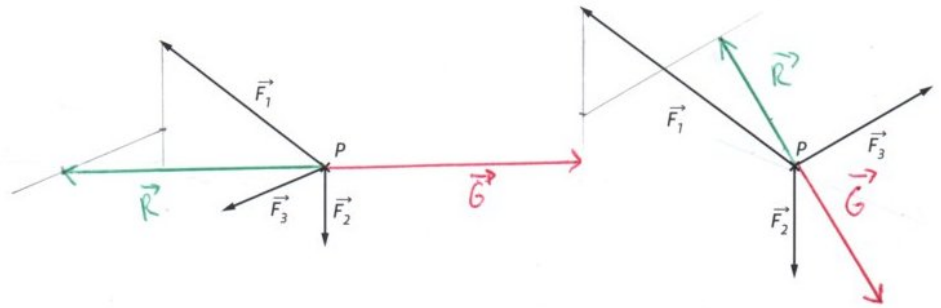
EURÊKA : Forces et équilibre
Corrigés

Y. Fracheboud

19 décembre 2023

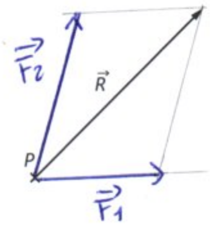




$\vec{F_1}$
P
$\vec{R}$
$\vec{G}$
$\vec{F_3}$
$\vec{F_2}$

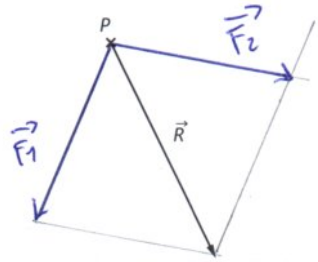
FE02

a. 1.



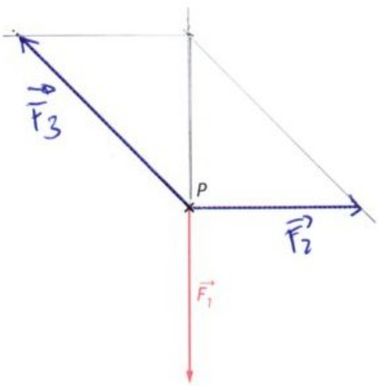
$\vec{F_2}$
$\vec{R}$
P
$\vec{F_1}$

2.



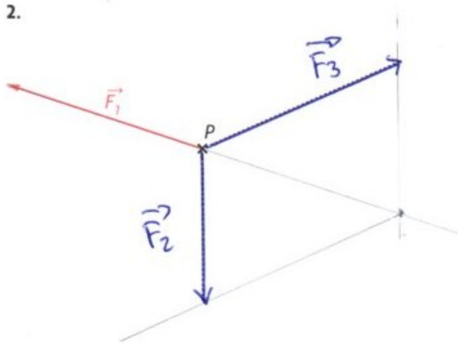
P
$\vec{F_2}$
$\vec{R}$
$\vec{F_1}$

b. 1.



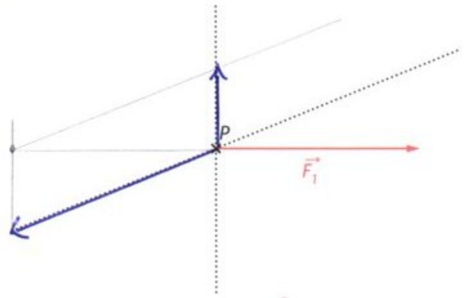
$\vec{F_3}$
P
$\vec{F_2}$
$\vec{F_1}$

2.

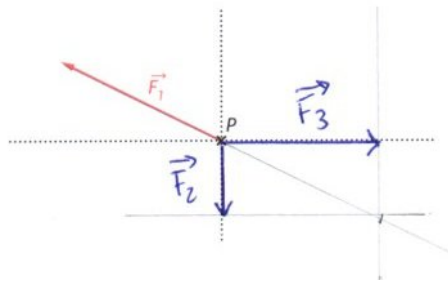


$\vec{F_3}$
$\vec{F_1}$
P
$\vec{F_2}$

3.



4.



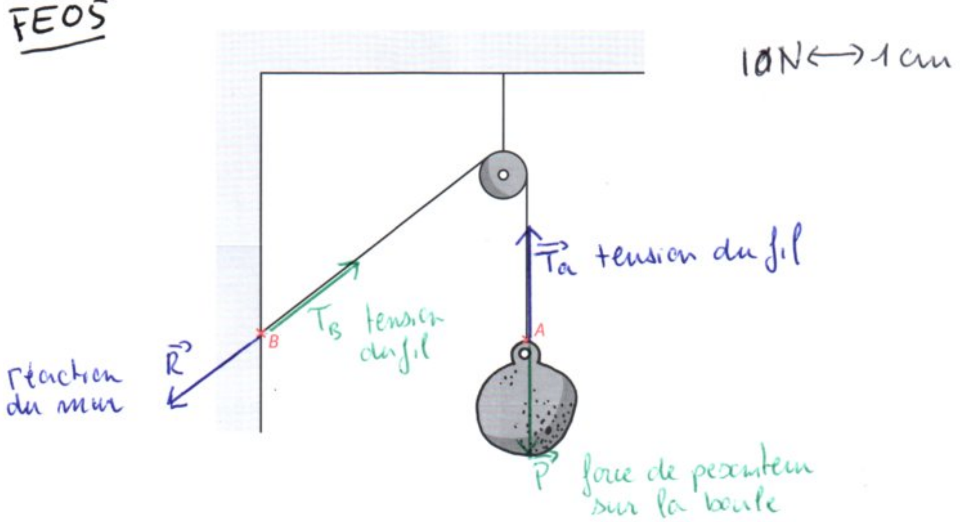
FE03

Par exemple soulever 50 kg sur Terre : oui

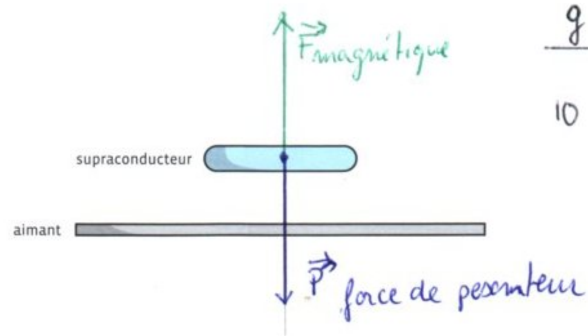
FE04

1 N

FE05



FE06



g	N	cm
	0,04	1
10	0,1	2,5

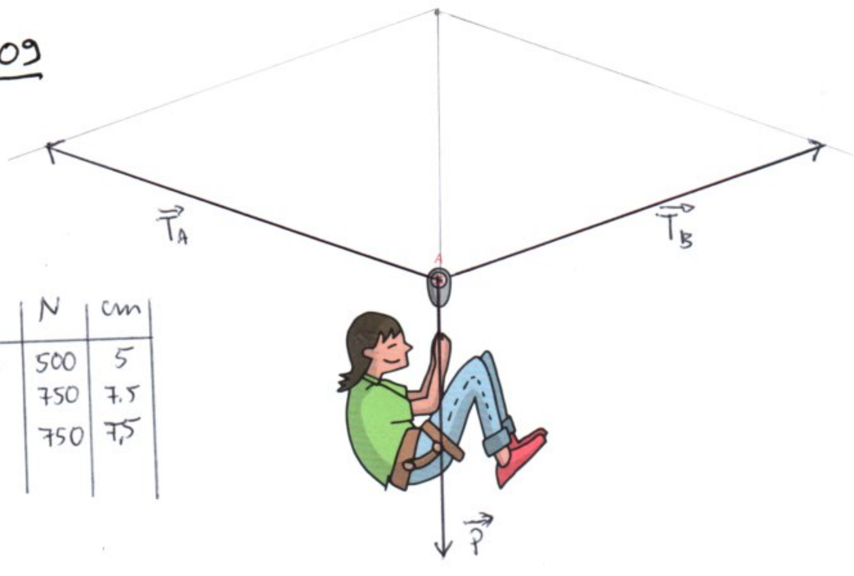
FE07

$T_d < T_e = T_f < T_a < T_c < T_b$

FE08

L'intensité des forces de tension sur chaque corde est égale à la moitié de la force de pesanteur d'Amélie

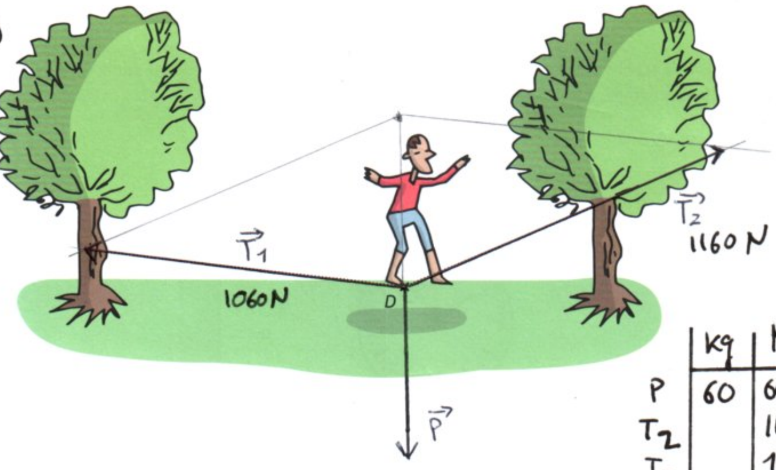
FE09



	kg	N	cm
P	50	500	5
T_A		750	7,5
T_B		750	7,5

FE10

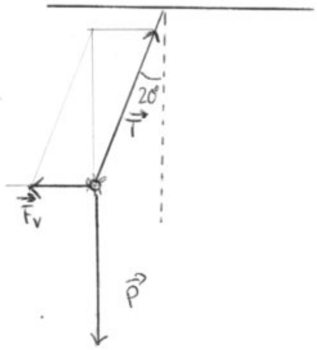
a)



	kg	N	cm
P	60	600	3
T_2		1160	5.8
T_2		1060	5.3

b) Non.

FE 11



	mg	N	cm
P	100	0.001	3
F_v		0,0004	1.2

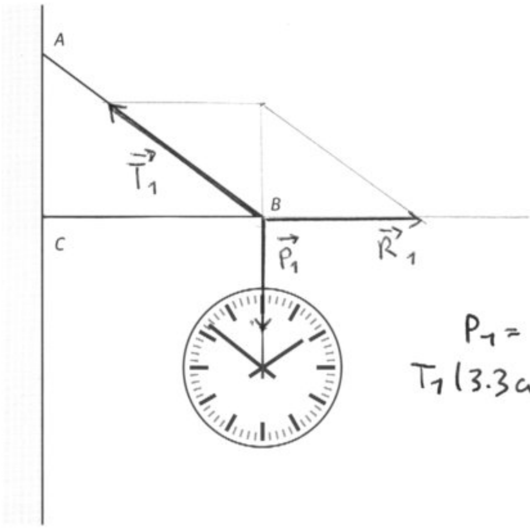
La force du vent est de 0.0004 N

FE12

	kg	N	cm
P	70	700	3.5
T		700	3.5

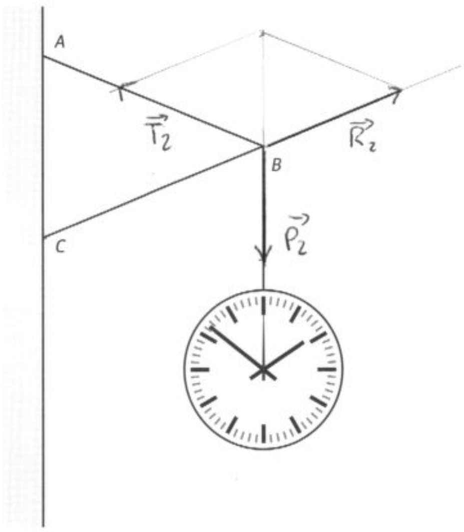
La tension sur la corde est d'environ 700 N

FE13



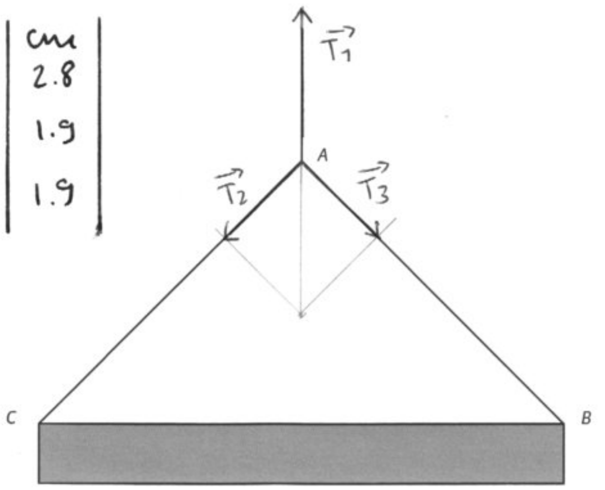
$P_1 = P_2$

T_1 (3.3 cm) > T_2 (2.7 cm)

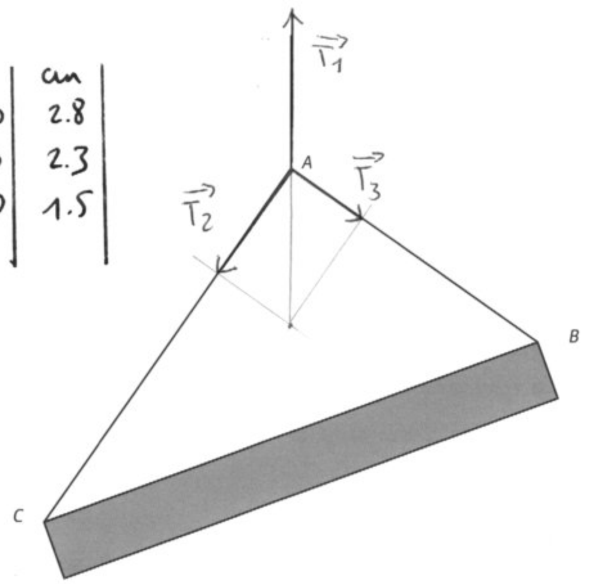


FE14

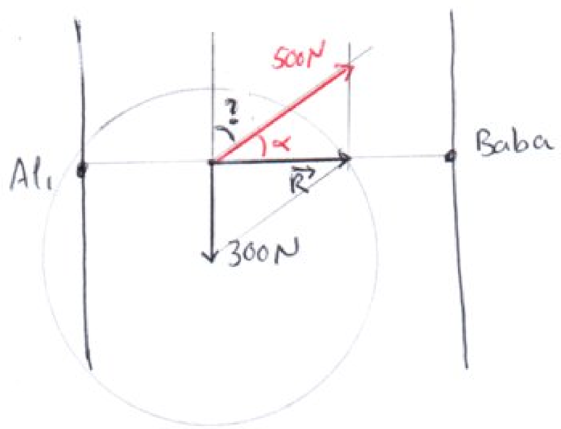
a.	N	cm
T_1	1400	2.8
T_2	950	1.9
T_3	950	1.9



b.	N	cm
T_1	1400	2.8
T_2	1150	2.3
T_3	750	1.5



FE15

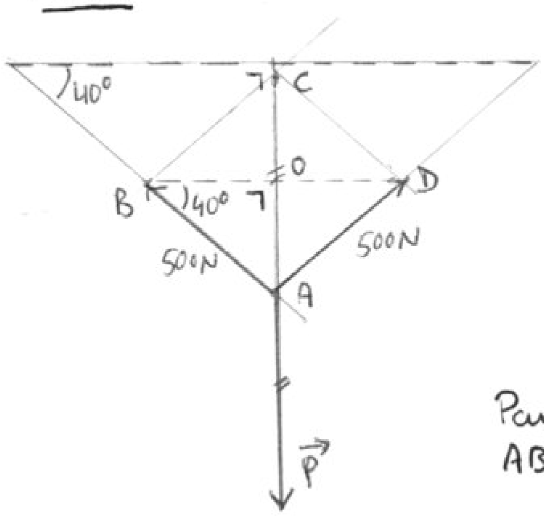


$$\sin\alpha = \frac{300}{500} \Rightarrow \alpha = 36.87°$$

⇒ angle avec la berge :

$90 - 36.87 = \underline{\underline{53.13°}}$

FE16



Par géométrie

	N	cm
	500	2.5
P	$\underline{\underline{640}}$	3.2

Sacha's mass is

$$\frac{640}{10} = \underline{\underline{64\ \text{Kg}}}$$

Par trigonométrie :

ABCD est un losange ⇒ $AO = \frac{1}{2} P$

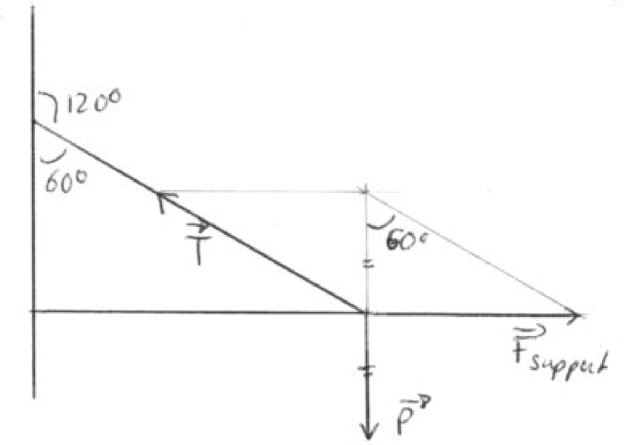
$$\sin(40) = \frac{\frac{1}{2}P}{T} \Rightarrow \frac{1}{2}P = T\sin(40)$$

$$\Rightarrow P = 2 \cdot T(\sin 40) = 2 \cdot 500 \cdot \sin(40)$$

$= 642,8\ N$

⇒ Sacha's mass = $\underline{\underline{64,28}}$ Kg

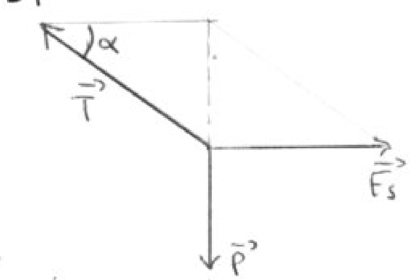
FE17



a) $P = m \cdot g = 8 \cdot 10 = 80\,N$

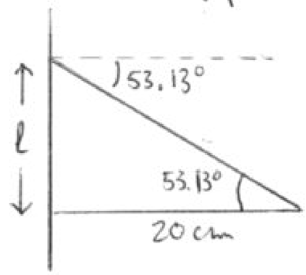
$\cos 60° = \frac{P}{T} \Rightarrow T = \frac{P}{\cos 60} = \frac{80}{\cos 60°} = \underline{\underline{160\,N}}$

b)



$T_{max} = 100\,N$

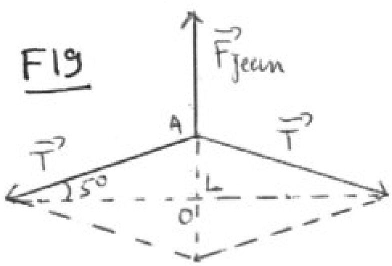
$\sin \alpha = \frac{P}{T} = \frac{80}{100} \Rightarrow \alpha = 53.13°$



$\tan(53.13) = \frac{\ell}{20} \Rightarrow \ell = 20 \tan(53.13)$

$= \underline{\underline{26.67\,cm}}$

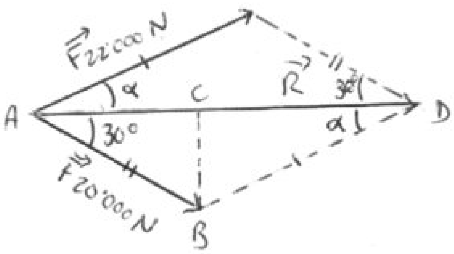
F19



$OA = \frac{1}{2} F_{jean} = 150$

$\sin(5°) = \frac{OA}{T} \Rightarrow T = \frac{OA}{\sin(5)} = \underline{\underline{1721\,N}}$

FE20



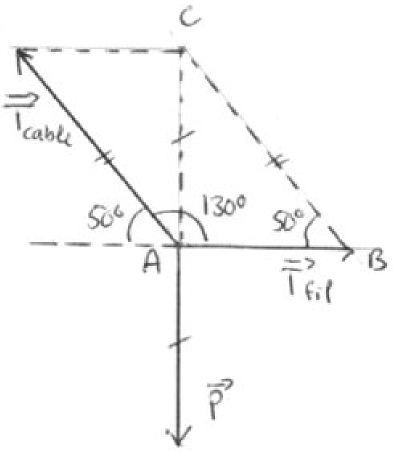
$$\sin(30°) = \frac{BC}{AB} \Rightarrow BC = \sin(30°) \cdot AB$$

$$\sin(\alpha) = \frac{BC}{BD} = \frac{\sin(30°) \cdot AB}{BD}$$

$$= \frac{\sin 30 \cdot 20'000}{22'000} \cong 0{,}\overline{45}$$

$$\Rightarrow \alpha = \underline{\underline{27{,}04°}}$$

FE21

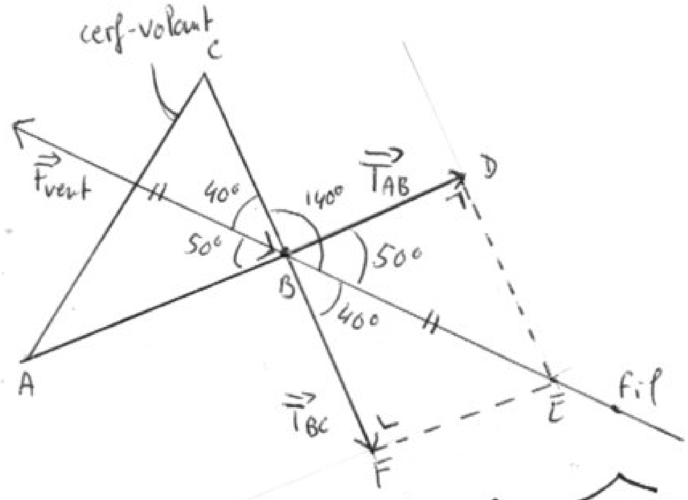


$$\tan(50) = \frac{P}{T_{fil}} \Rightarrow T_{fil} = \frac{P}{\tan(50)} = \underline{\underline{4.20}}\,N$$

$$\sin(50) = \frac{AC}{BC} = \frac{P}{T_{cable}} \Rightarrow$$

$$T_{cable} = \frac{P}{\sin(50)} = \frac{5}{\sin(50)} = \underline{\underline{6.53}}\,N$$

FE22

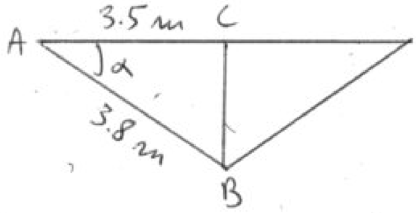


BDEF est un rectangle $\Rightarrow \widehat{BFE} = \widehat{BDE} = 90°$

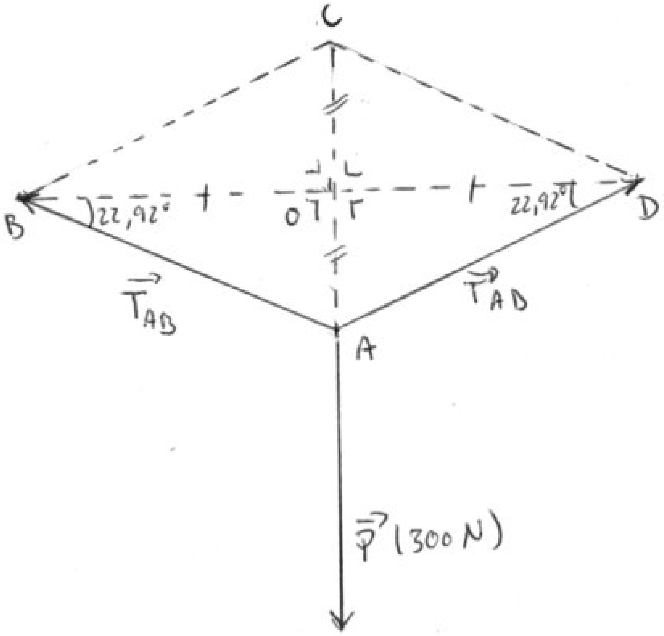
$\cos(40) = \dfrac{T_{BC}}{F_{vent}} \Rightarrow T_{BC} = F_{vent} \cdot \cos(40) = 12 \cdot \cos(40) = \underline{\underline{9.19\ N}}$

$\cos(50) = \dfrac{T_{AB}}{F_{vent}} \Rightarrow T_{AB} = F_{vent} \cdot \cos(50) = 12 \cdot \cos(50) = \underline{\underline{7.71\ N}}$

FE23



$$\cos\alpha = \frac{AC}{AB} = \frac{3.5}{3.8} \Rightarrow \alpha \cong 22.92°$$



ABCD est un losange $\Rightarrow OA = \frac{P}{2} = 150$

et ABO et ACO triangles rectangles isométriques.

$$\sin(22.92) = \frac{AO}{T_{AB}} \Rightarrow T_{AB} = T_{AD} = \frac{AO}{\sin(22.92)} = \frac{150}{\sin(22.92)} = \underline{\underline{385.2\ N}}$$

On peut utiliser ces cables.

FE26

a) $\frac{96}{200} \cdot 10 = 4.8\ N$

b) $\frac{7.5}{10} \cdot 200 = 150\ mm$

FE27

$F_R = k \cdot \Delta l \quad ; \quad \Delta l = 30\ cm = 0.3\ m$

$P = m \cdot g$

$P = F_R \Rightarrow m \cdot g = k \cdot \Delta l \Rightarrow m = \dfrac{k \cdot \Delta l}{g} = \dfrac{20 \cdot 0.3}{10} = \underline{\underline{0.6}}\ kg.$

FE28

a) $F_R = k\Delta l \Rightarrow \Delta l = \dfrac{F_R}{k}$

$F_R = P = m \cdot g \Rightarrow \Delta l = \dfrac{m \cdot g}{k} = \dfrac{0.05 \cdot 10}{20} = \underline{\underline{0,025}}\ m$

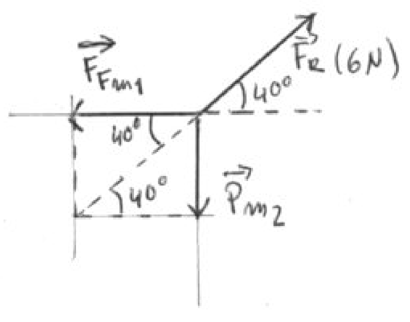
b) $0.025\ m$

c) $0.025\ m$

d) $0,0125\ m$

FE29

$F_{ressort} = k \cdot \Delta l = 20 \cdot 0.3 = 6\ N$



$\cos(40°) = \dfrac{F_{Fm1}}{F_R} \Rightarrow F_{Fm1} = \cos(40) \cdot 6 =$ $4,60\ N$

$\sin(40°) = \dfrac{P_{m2}}{F_R} \Rightarrow P_{m2} = \sin(40°) \cdot 6 =$ $3,86\ N$

$\Rightarrow m_2 = 3.86 : 10 = \underline{\underline{0,386}}\ kg.$

FE32

a) $k = 10 + 20 = 30\,N \cdot m^{-1}$

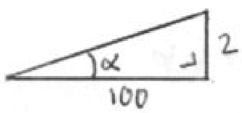
b) $k = \dfrac{1}{\frac{1}{k_1} + \frac{1}{k_2}} = \dfrac{1}{\frac{1}{10} + \frac{1}{20}} = \dfrac{1}{\frac{3}{20}} = \dfrac{20}{3} = 6.67\,N \cdot m^{-1}$

c) $k = k_1 + k_2 + k_3 = 10 + 20 + 30 = 60\,N \cdot m^{-1}$

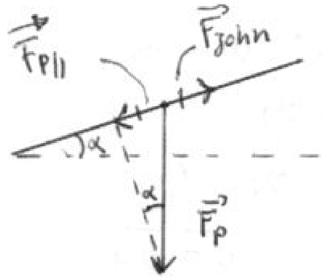
d) $\dfrac{1}{\frac{1}{k_3 + k_3} + \frac{1}{k_3}} = \dfrac{1}{\frac{1}{60} + \frac{1}{30}} = \dfrac{1}{\frac{1}{20}} = 20\,N \cdot m^{-1}$

$\dfrac{1}{\frac{1}{k_1 + k_2} + \frac{1}{k_3}} = \dfrac{1}{\frac{1}{30} + \frac{1}{30}} = \dfrac{1}{\frac{1}{15}} = 15\,N \cdot m^{-1}$

FE34



$\tan \alpha = \dfrac{2}{100} \Rightarrow \alpha = 1{,}1458°$



$F_P = 1120 \cdot 10 = 11'200\,N$

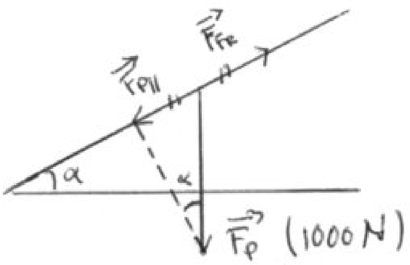
$F_{John} = F_{P//}$

$\sin \alpha = \dfrac{F_{P//}}{F_P} \Rightarrow F_{P//} = \sin(1{,}1458) \cdot 11200$

$= \underline{\underline{224.0\,N}}$

FE 36

$\tan \alpha = \frac{15}{100} \Rightarrow \alpha = 8{,}531°$



a) $F_P = 100 \cdot 10 = 1000\ N$

$F_{FR} = F_{P//}$

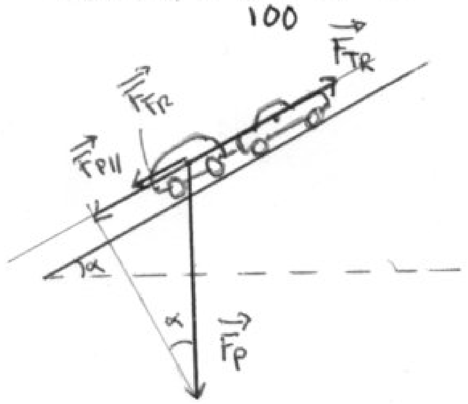
$\sin \alpha = \frac{F_{P//}}{F_P} \Rightarrow F_{P//} = \sin \alpha \cdot F_P$

$= \sin(8.531) \cdot 1000 = \underline{\underline{148.3}}\ N$

b) Si la force de frottement était plus faible le skieur accélérerait.
Si elle était plus forte il ralentirait.

FE37

$\tan \alpha = \frac{10}{100} \Rightarrow \alpha = 5{,}711°$



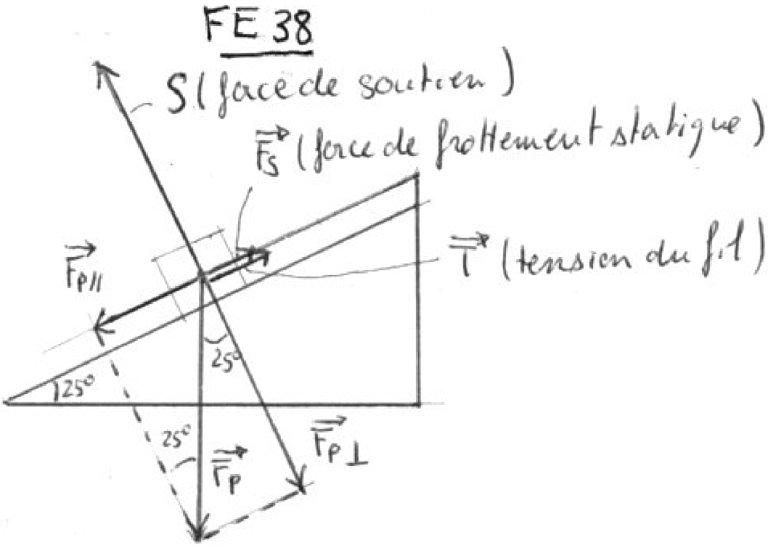
$\sin \alpha = \frac{F_{P//}}{F_P} \Rightarrow F_{P//} = \sin \alpha \cdot F_P =$

$\sin(5.711) \cdot 11'000 = 1094.6\ N$

$F_{TR} = F_{P//} + F_{FR} = 1094.6 + 2500$

$= \underline{\underline{3594.6}}\ N$

FE 38



a) $F_P = 2 \cdot 10 = 20\ N$

$\sin(25°) = \frac{F_{P//}}{F_P} \Rightarrow F_{P//} = \sin(25) \cdot F_P = 8.452\ N$

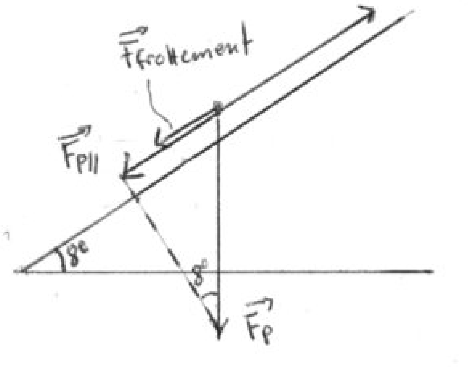
$F_S + T = F_{P//} \Rightarrow F_S = F_{P//} - T = 8.452 - 4.8 = 3.652\ N$

$S = F_{P\perp}$.

$\cos(25) = \frac{F_{P\perp}}{F_P} \Rightarrow F_{P\perp} = \cos 25 \cdot F_P = 18.126\ N$

$F_S = \mu_s \cdot S \Rightarrow \mu_s = \frac{F_S}{S} = \frac{3.652}{18.126} \cong \underline{\underline{0.20}}$

FE39



$F_P = 28'000 \cdot 10 = 280'000\ N$

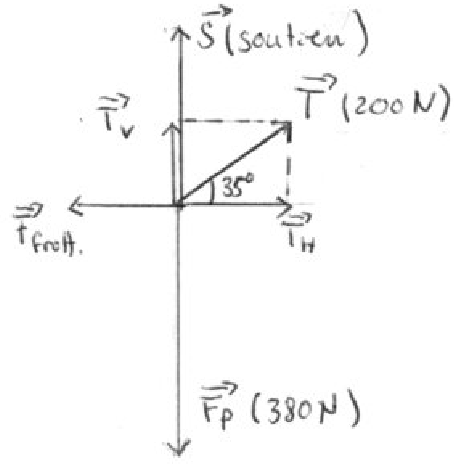
$F_{frottement} = 1/12 \cdot 280'000 = 23'333\ N$

$F_{P//} = \sin(8°) \cdot F_P = 38'968\ N$

$T_{traction} = F_{P//} + F_{frottement} =$

$38'968 + 23'333 \cong \underline{\underline{62'300\ N}}$

FE41



$F_p = (35+3) \cdot 10 = 380\ N$

$F_{froll.} = T_H = \cos(35) \cdot T = \underline{\underline{163.83}}\ N$

$F_p = S + T_V \Rightarrow S = F_p - T_V$

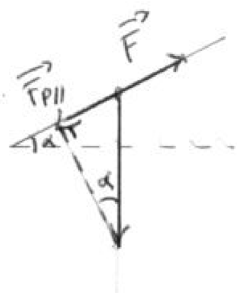
$T_V = \sin(35°) \cdot T = 114.72\ N$

$S = 380 - 114.72 = 265.28 N$

$F_{frott} = \mu \cdot S \Rightarrow \mu = \dfrac{F_{frott}}{S} =$

$\dfrac{163.83}{265.28} \cong \underline{\underline{0.62}}$

FE42



$F_p = 1200 \cdot 10 = 12'000\ N$

$\tan\alpha = \dfrac{5}{100} \Rightarrow \alpha = 2.862°$

$F = F_{p//}$

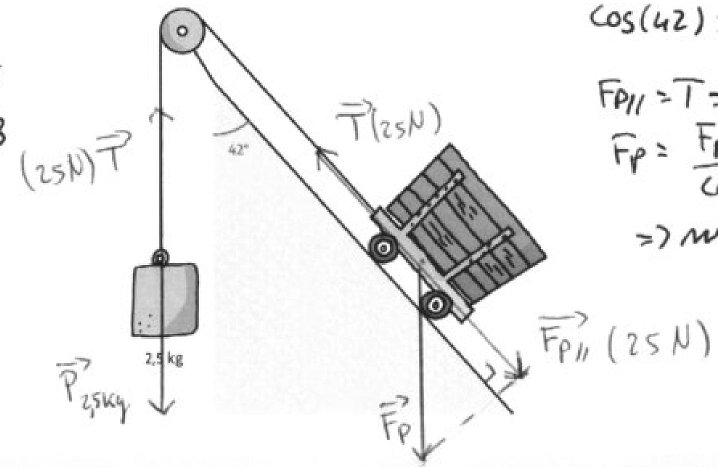
$\sin(\alpha) = \dfrac{F_{p//}}{F_p} \Rightarrow F_{p//} = \sin(\alpha) \cdot F_p \cong \underline{\underline{599\ N}}$

FE 43 — Deux masses pour un plan

Dans chaque cas, détermine graphiquement la valeur demandée puis vérifie ton résultat par calcul.

a. Quelle est la masse du chariot, sachant que le système est à l'équilibre sans frottement.

	kg	N	cm
	2.5	25	2.5
Fp	3.3	33	3.3



$\cos(42) = \frac{F_{P//}}{F_P}$

$F_{P//} = T = 25N$

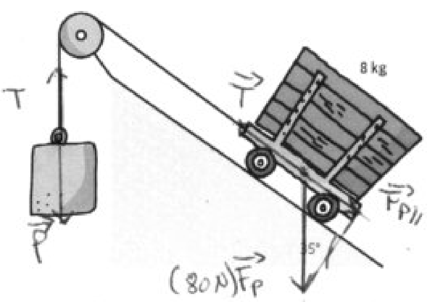
$F_P = \frac{F_{P//}}{\cos(42)} = 33.64N$

$\Rightarrow m_{chariot} = 3{,}364\ kg$

b. Quelle est la force de pesanteur du bloc suspendu, sachant que le système est à l'équilibre sans frottement?

$\vec{P} = T = F_{P//}$

	kg	N	cm
	8	80	2
Fp	4.4	44	1.1



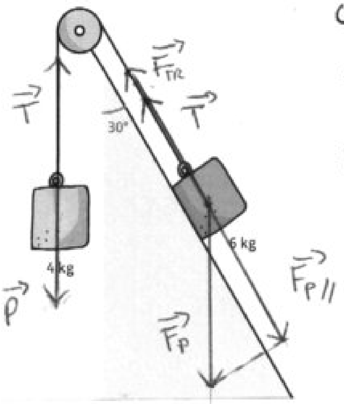
$\sin(35) = \frac{F_{P//}}{F_P} \Rightarrow$

$F_{P//} = \sin(35) \cdot F_P = 45.88\ N = P$

c. Quelle est l'intensité de la force de frottement s'exerçant sur le bloc de bois, sachant que le système suivant est à l'équilibre?

Dans quel sens est dirigée cette force de frottement?

	kg	N	cm
P	4	40	2
Fp	6	60	3
Fp//			2.6
T		40	2
FFR		12	0.6



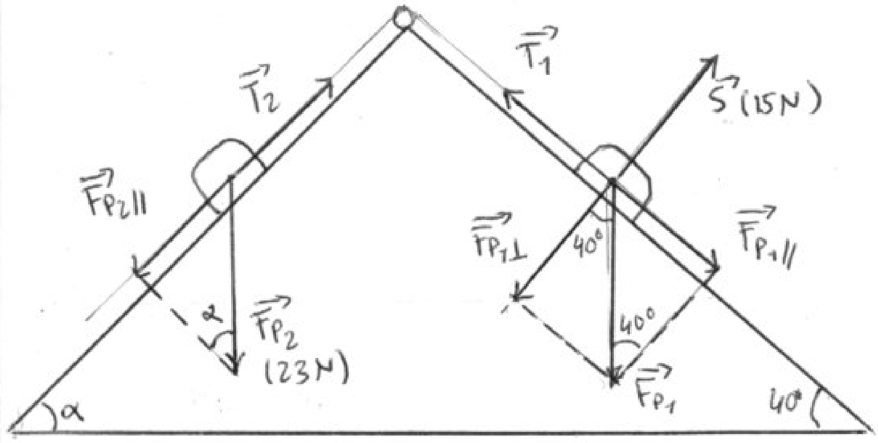
$\cos(30°) = \frac{F_{P//}}{F_P} \Rightarrow$

$F_{P//} = \cos(30) \cdot F_P = 51.96\ N$

$F_{P//} = T + F_{FR} \Rightarrow F_{FR} = T - F_{P//}$

$= 51.96 - 40 = 11.96\ N$

FE44



$F_{P_1\perp} = S$

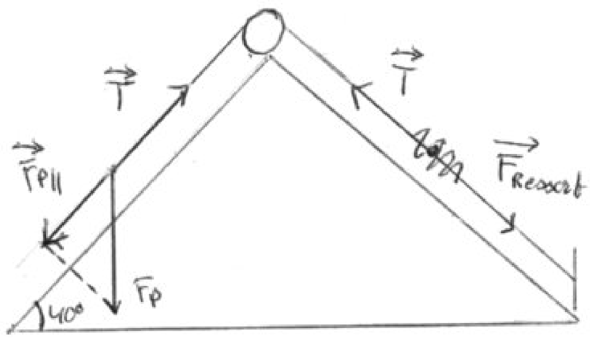
$\cos(40) = \frac{F_{P_1\perp}}{F_{P_1}} \Rightarrow F_{P_1} = \frac{F_{P_1\perp}}{\cos(40)} = 19.581\ N$

$\sin(40) = \frac{F_{P_1//}}{F_{P_1}} \Rightarrow F_{P_1//} = F_{P_1} \cdot \sin(40) = 12,586\ N.$

$F_{P_1//} = T_1 = T_2 = F_{P_2//}$

$\Rightarrow \sin(\alpha) = \frac{F_{P_2//}}{F_{P_2}} = \frac{12.586}{23} = 0.547 \Rightarrow \alpha \cong \underline{\underline{33.2°}}$

FE45



$F_{Ressort} = k \cdot \Delta l$

$= 10 \cdot 0.25 = 2.5\ N$

$\sin(40) = \frac{F_{P//}}{F_P} \Rightarrow F_P = \frac{F_{P//}}{\sin 40}$

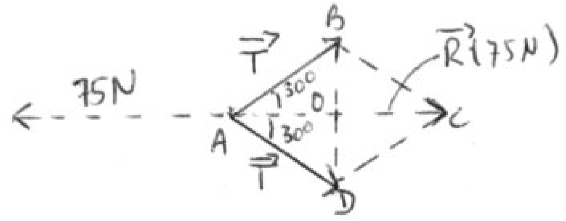
$F_{Ressort} = T = F_{P//} \Rightarrow$

$F_P = \frac{25}{\sin(40)} = 3.89\ N$

$\Rightarrow m = \frac{3.89}{10} = \underline{\underline{0.389}}\ kg$

FE47

$F_{Frott} = \mu \cdot S = 0.05 \cdot 1500 = 75\,N$



ABCD est un losange $\Rightarrow AO = \frac{75}{2} = 37.5$

et $\cos(30) = \frac{AO}{T} \Rightarrow T = \frac{AO}{\cos(30)} \cong \underline{43,3}\ N$