TP frottements 2

Mesures

La distance est notée “d”.
Les dimensions des billes sont notées au dessus.

In[50]:=
```
di = Quantity[Around[8.5,0.1],"Centimeters"];
d = UnitConvert[di, "Meters"]

bille1diam = Quantity[1,"Millimeters"];
bille2diam = Quantity[1.5,"Millimeters"];
bille3diam = Quantity[2,"Millimeters"];

b1r = N[UnitConvert[bille1diam/2, "Meters"]]
b2r = N[UnitConvert[bille2diam/2, "Meters"]]
b3r = N[UnitConvert[bille3diam/2, "Meters"]]

t1l = Quantity[Around[{4.07,4.15,4.11,4.05,4.18},0.005], "Seconds"]
t2l = Quantity[Around[{1.63,1.83,1.74,1.88,1.77},0.005], "Seconds"]
t3l = Quantity[Around[{1.15,1.14,1.17,1.18,1.14},0.005], "Seconds"]
```

Out[51]= (0.0850 ± 0.0010) m

Out[55]= 0.0005 m

Out[56]= 0.00075 m

Out[57]= 0.001 m

Out[58]= $\{(4.070 \pm 0.005)$ s , (4.150 ± 0.005) s , (4.110 ± 0.005) s , (4.050 ± 0.005) s , (4.180 ± 0.005) s $\}$

Out[59]= $\{(1.630 \pm 0.005)$ s , (1.830 ± 0.005) s , (1.740 ± 0.005) s , (1.880 ± 0.005) s , (1.770 ± 0.005) s $\}$

Out[60]= $\{(1.150 \pm 0.005)$ s , (1.140 ± 0.005) s , (1.170 ± 0.005) s , (1.180 ± 0.005) s , (1.140 ± 0.005) s $\}$

Calculs 1

La moyenne des temps a été prise afin de calculer la vitesse.

In[61]:=
```
t1 = Mean[t1l]
t2 = Mean[t2l]
t3 = Mean[t3l]
```

Out[61]= (4.1120 ± 0.0022) s

Out[62]= (1.7700 ± 0.0022) s

Out[63]= (1.1560 ± 0.0022) s

In[64]:=
```
v1 = d/t1
v2 = d/t2
v3 = d/t3
```

Out[64]= (0.02067 ± 0.00024) m/s

Out[65]= (0.0480 ± 0.0006) m/s

Out[66]= (0.0735 ± 0.0009) m/s

Calculs 2

Le travail de formules pour les forces :

In[67]:=
```
volsp = 4/3 π * R^3;
m = ρacier * volsp;

fp = m * g;
fa = ρglyc * volsp * g;
ff = 6 * π * R * η * vlim;

Factor[Solve[Expand[ff + fa == fp], η]]
```
factorise résous développe

Out[72]= $\left\{\left\{\eta \to \frac{2\, g\, R^2\, (\rho acier - \rho glyc)}{9\, vlim}\right\}\right\}$

Calculs 3

Application numérique pour calculer η :

In[73]:=
```
gc = Quantity[9.81,"Meters"/"Seconds"^2];
ρacierc = Quantity[7850,"Kilograms"/"Meters"^3];
ρglycc = Quantity[1260,"Kilograms"/"Meters"^3];

R1 = b1r;
vlim1 = v1;
η1i = (2 gc R1^2 (ρacierc-ρglycc))/(9 vlim1);
η1 =UnitConvert[η1i, "Millipascals"*"Seconds"]

R2 = b2r;
vlim2 = v2;
η2i = (2 gc R2^2 (ρacierc-ρglycc))/(9 vlim2);
η2 =UnitConvert[η2i, "Millipascals"*"Seconds"]

R3 = b3r;
vlim3 = v3;
η3i = (2 gc R3^2 (ρacierc-ρglycc))/(9 vlim3);
η3 = UnitConvert[η3i, "Millipascals"*"Seconds"]
```

Out[79]= (173.7 ± 2.0) s mPa

Out[83]= (168.3 ± 2.0) s mPa

Out[87]= (195.4 ± 2.3) s mPa

Vu que η est une constante pour un liquide à une température donnée, on prend la moyenne pour la suite :

In[88]:=
```
ηf = Mean[{η1,η2,η3}]
inηre = UnitConvert[ηf[[1]]["Uncertainty"]/ηf[[1]]["Value"],"Percent"]
```

Out[88]= (179.1 ± 1.2) s mPa

Out[89]= 0.685675%

Modèle 1

Calcul de formule pour le modèle.

In[90]:=

```
volspm = 4/3 π * rm^3;
mm = ρacierm * volspm;

fpm = mm * gm;
fam = ρglycm * volspm * gm;
ffm = 6 * π * rm * ηm * vm;

Solve[Expand[atot mm == fpm - fam - ffm], atot]
```

résous développe

Out[95]=

$$\left\{\left\{\text{atot} \to \frac{-9\ \text{vm}\ \eta\text{m} + 2\ \text{gm}\ \text{rm}^2\ \rho\text{acierm} - 2\ \text{gm}\ \text{rm}^2\ \rho\text{glycm}}{2\ \text{rm}^2\ \rho\text{acierm}}\right\}\right\}$$

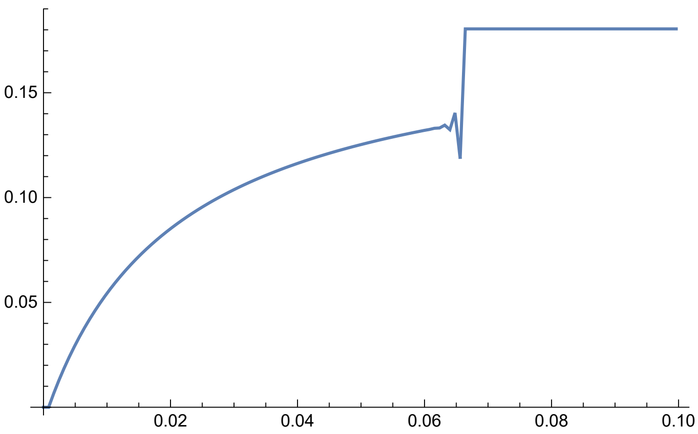
Modèle 2

In[2092]:=

```
gmp = 9.81;
ρaciermp = 7850;
ρglycmp = 1260;
ηmp = UnitConvert[ηf,"Pascals"*"Seconds"][[1]]["Value"];

rmp = 0.0015;
vop = 0;

const1 = 2 gmp rmp^2 ρaciermp-2 gmp rmp^2 ρglycmp;
const2 = 2 rmp^2 ρaciermp;

Afun[v_] := ((-9 v ηmp + const1)/const2);
Calcfun[v_,t_] := vop+t*Afun[v];

Solve[Afun[vlimtest] == 0,vlimtest]

vlimfun = 0.18044580728859538;
vlist = {vop};
tlist = {0};
Δtfun = 0.00081;
tfun = 0;
vfun = vop;
isfinish = False;
Do[{vfun = Calcfun[vfun, tfun],tfun = tfun+Δtfun, If[vfun ≤ vlimfun && isfinish == False, Appe

ListLinePlot[Transpose[{tlist,vlist}]]
```

Out[2102]= `{{vlimtest → 0.180446}}`

Out[2111]=



Modèle 3

Ne marche pas encore !!!

In[2130]:=

```
Afunm[v_] := ((-9 v ηmp + const1)/const2);
Calcfunm[v_,t_,i_] := i+t*Afunm[v];

Manipulate[{tlistm={0},vlistm={vom},isfinishm = False,vfunm=vom,tfunm=0,
Do[{vfun = Calcfun[vfunm, tfunm, vom],tfunm = tfunm+0.1/tmax, If[vfunm ≤ vlimfun && isfinishm
ListLinePlot[Transpose[{tlistm,vlistm}]]},
{vom, 0, 1, 0.1},{tmax,0,10000, 100}]
```

Out[2132]=