(1) **Fruit drying**

Réponses intégrées | pénalité 0.10

A spherical fruit of diameter D, whose surface is wet, is dried by an airflow at temperature T_∞, relative humidity ψ, and velocity U_∞.

We want to compute the evaporation rate of the water film at the fruit surface.

You will use the following data

Diameter $D = 4.0\,\mathrm{cm}$

Temperature $T = 34.0\,^\circ\mathrm{C}$

Relative humidity $\psi = 35.\,\%$

Velocity $U_\infty = 9.2\,\mathrm{m\,s^{-1}}$

Atmospheric pressure $p_{\mathrm{atm}} = 101300.\,\mathrm{Pa}$

Water saturation pressure at given temperature $p_{\mathrm{sat}}(T) = 5324.\,\mathrm{SI}$

Diffusion coefficient $D_{AV} = 2.65\,10^{-5}\,\mathrm{m^2\,s^{-1}}$

Kinematic viscosity of air $\nu = 1.63\,10^{-5}\,\mathrm{m^2\,s^{-1}}$

These data are personal

Compute the quantities below. The correlation used must **involve the Schmidt number**.

In your answers, use scientific notations if needed. ($6.34\,10^{-5}$ writes 6.34e-5 and 10^3 writes 1e3).

Your answer is considered correct within a relative error of $5.0\,\%$

Indicative ranges are proposed in front of each answer. This are orders of magnitude to help you to check your results.

Reynolds number : Re =

Numérique | noté sur 1

2.2519226199e+04 ± 1.1259613099e+03 ✓	

(22510. → 41650.)

Schmidt number : Sc =

NUMÉRIQUE noté sur 1

6.1577028085e-01 ± 3.0788514043e-02 ✓	

$(6.13\,10^{-1} \rightarrow 6.16\,10^{-1})$

Sherwood number : Sh =

NUMÉRIQUE noté sur 2

9.0854257730e+01 ± 4.5427128865e+00 ✓	

$(90. \rightarrow 128.)$

Mass transfer coefficient : k_m =

NUMÉRIQUE noté sur 1

6.0278290072e-02 ± 3.0139145036e-03 ✓	

$\mathrm{m\,s^{-1}}$ $(4.52\,10^{-2} \rightarrow 6.03\,10^{-2})$

Vapor concentration at the fruit surface : $C_{V,\mathrm{surface}}$ =

NUMÉRIQUE noté sur 2

2.0851412530e+00 ± 1.0425706265e-01 ✓	

$\mathrm{mol\,m^{-3}}$ $(2.08 \rightarrow 3.45)$

Incident vapor concentration : $C_{V,\infty}$ =

NUMÉRIQUE noté sur 2

7.2979943855e-01 ± 3.6489971927e-02 ✓	

$\mathrm{mol\,m^{-3}}$ $(0.72 \rightarrow 1.14)$

Incident vapor concentration :

NUMÉRIQUE noté sur 2

7.2979943855e-01 ± 3.6489971927e-02 ✓	

$\mathrm{mol\,m^{-3}}$ $(0.72 \rightarrow 1.14)$

Massic evaporation rate : $\dot{m}_V =$

NUMÉRIQUE noté sur 1

7.3918325783e-06 ± 3.6959162891e-07 ✓	

$\mathrm{kg\,s^{-1}}$ $(7.39\,10^{-6} \rightarrow 3.79\,10^{-5})$

The initial film thickness at the fruit surface is assumed to be $e = 1.0\,\mathrm{mm}$

Compute the total evaporation time :

NUMÉRIQUE noté sur 2

6.8001381153e+02 ± 3.4000690576e+01 ✓	

s (530. → 680.)

(2) **Fruit drying**

RÉPONSES INTÉGRÉES pénalité 0.10

A spherical fruit of diameter D, whose surface is wet, is dried by an airflow at temperature T_∞, relative humidity ψ, and velocity U_∞.

We want to compute the evaporation rate of the water film at the fruit surface.

You will use the following data

Diameter $D = 8.0\,\mathrm{cm}$

Temperature $T = 44.0\,^\circ\mathrm{C}$

Relative humidity $\psi = 33.\,\%$

Velocity $U_\infty = 9.0\,\mathrm{m\,s^{-1}}$

Atmospheric pressure $p_{\mathrm{atm}} = 101300.\,\mathrm{Pa}$

Water saturation pressure at given temperature $p_{\mathrm{sat}}(T) = 9111.\,\mathrm{SI}$

Diffusion coefficient $D_{AV} = 2.82\,10^{-5}\,\mathrm{m^2\,s^{-1}}$

Kinematic viscosity of air $\nu = 1.73\,10^{-5}\,\mathrm{m^2\,s^{-1}}$

These data are personal

Compute the quantities below. The correlation used must **involve the Schmidt number**.

In your answers, use scientific notations if needed. ($6.34\,10^{-5}$ writes 6.34e-5 and 10^{3} writes 1e3).

Your answer is considered correct within a relative error of 5.0 %

Indicative ranges are proposed in front of each answer. This are orders of magnitude to help you to check your results.

Reynolds number : Re =

NUMÉRIQUE noté sur 1

4.1654043359e+04 ± 2.0827021680e+03 ✓	

(22510. → 41650.)

Schmidt number : Sc =

NUMÉRIQUE noté sur 1

6.1330096894e-01 ± 3.0665048447e-02 ✓	

($6.13\,10^{-1}$ → $6.16\,10^{-1}$)

Sherwood number : Sh =

NUMÉRIQUE noté sur 2

1.2842785885e+02 ± 6.4213929423e+00 ✓	

(90. → 128.)

Mass transfer coefficient : k_m =

NUMÉRIQUE noté sur 1

4.5245035769e-02 ± 2.2622517885e-03 ✓	

$\mathrm{m\,s^{-1}}$ ($4.52\,10^{-2}$ → $6.03\,10^{-2}$)

Vapor concentration at the fruit surface : $C_{V,\mathrm{surface}}$ =

NUMÉRIQUE noté sur 2

3.4556189867e+00 ± 1.7278094934e-01 ✓	

$\mathrm{mol\,m^{-3}}$ (2.08 → 3.45)

Incident vapor concentration : $C_{V,\infty} =$

NUMÉRIQUE noté sur 2

1.1403542656e+00 ± 5.7017713281e-02 ✓	

$\mathrm{mol\,m^{-3}}$ (0.72 → 1.14)

Incident vapor concentration :

NUMÉRIQUE noté sur 2

1.1403542656e+00 ± 5.7017713281e-02 ✓	

$\mathrm{mol\,m^{-3}}$ (0.72 → 1.14)

Massic evaporation rate : $\dot{m}_V =$

NUMÉRIQUE noté sur 1

3.7911759608e-05 ± 1.8955879804e-06 ✓	

$\mathrm{kg\,s^{-1}}$ ($7.39\,10^{-6}$ → $3.79\,10^{-5}$)

The initial film thickness at the fruit surface is assumed to be $e = 1.0\,\mathrm{mm}$

Compute the total evaporation time :

NUMÉRIQUE noté sur 2

5.3034185674e+02 ± 2.6517092837e+01 ✓	

s (530. → 680.)

Total des points : 28