Lecture 18

10/26

* **Project 2** released (key **demos** in Lec 16, 17)

Hw 1	5
Proj 1	25
Proj 2	30
* Proj 3	30
* Final Exam	10
	100

Proj 2 : Two-phase flow

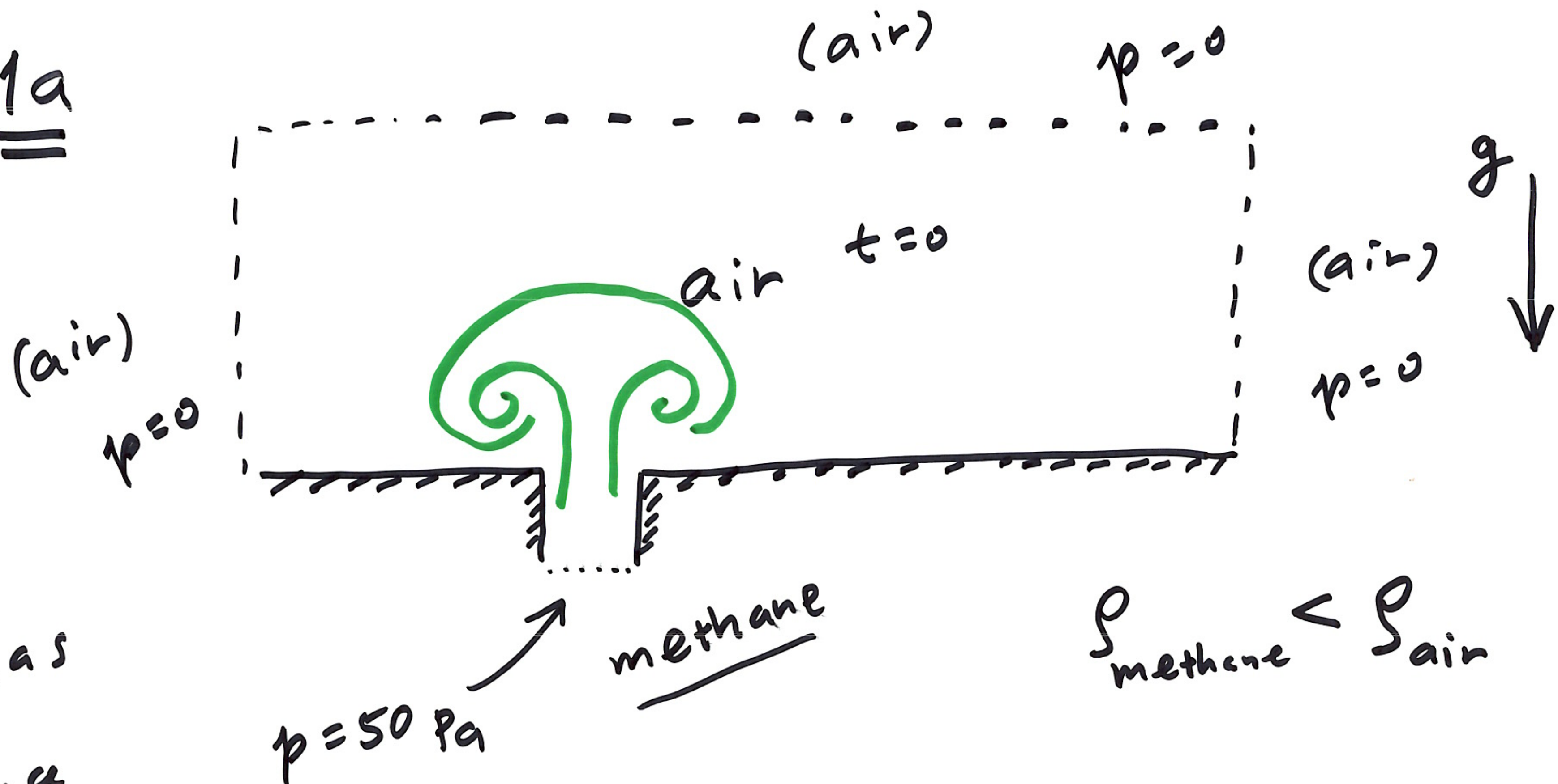
* **VOF** method, * Δx, Δt **transient**

* Surface tension : { ON —, OFF — }

* Operating density method : { 2 different settings for (Task 1) . (Task 2, 3, 4)

Task 1a

2-D



$\rho_{methane} < \rho_{air}$

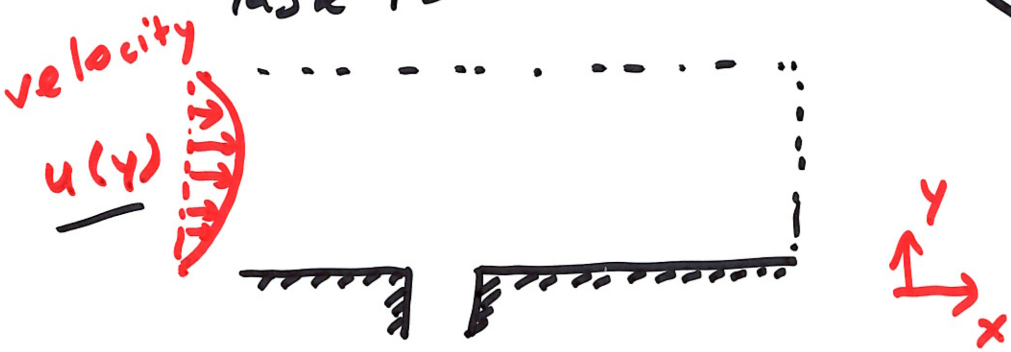
gas-gas

X surface tension

Operating density method:

mixture-averaged

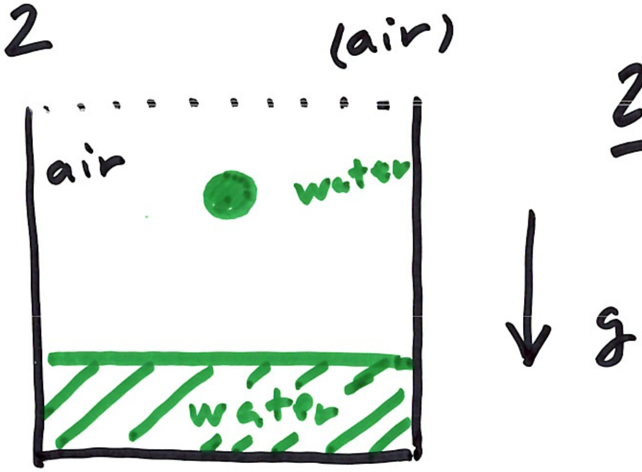
Task 1b



$u(y) = 0.8y - 0.032y^2$?

↳ Constant Expression

Task 2



2-D

surface tension (water | air) ON

σ : default value

"animation"

Lec 17

operating density method

Task 2, 3, 4

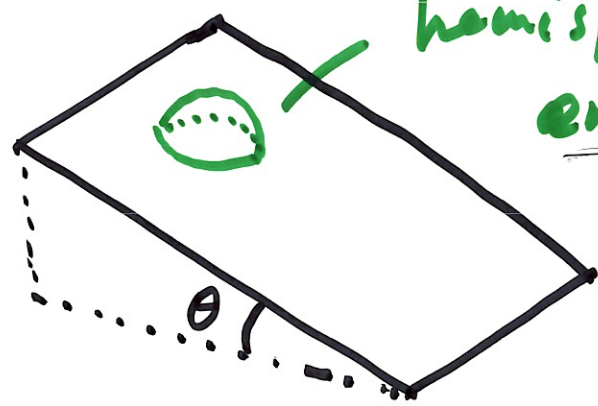
air water

$\rho_{air} \sim 1$ $\rho_{water} \sim 1000$

minimum-phase-averaged (default)

↑ > 2020 version

Task 3 (3-D)



$\theta = 45°$

surface tension ON

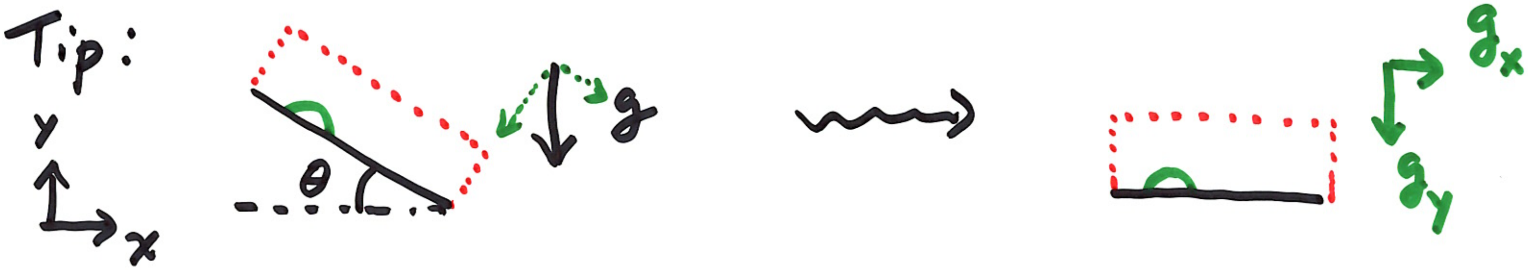
$\sigma = 0.03$ N/m

Your choice of computational domain ✓

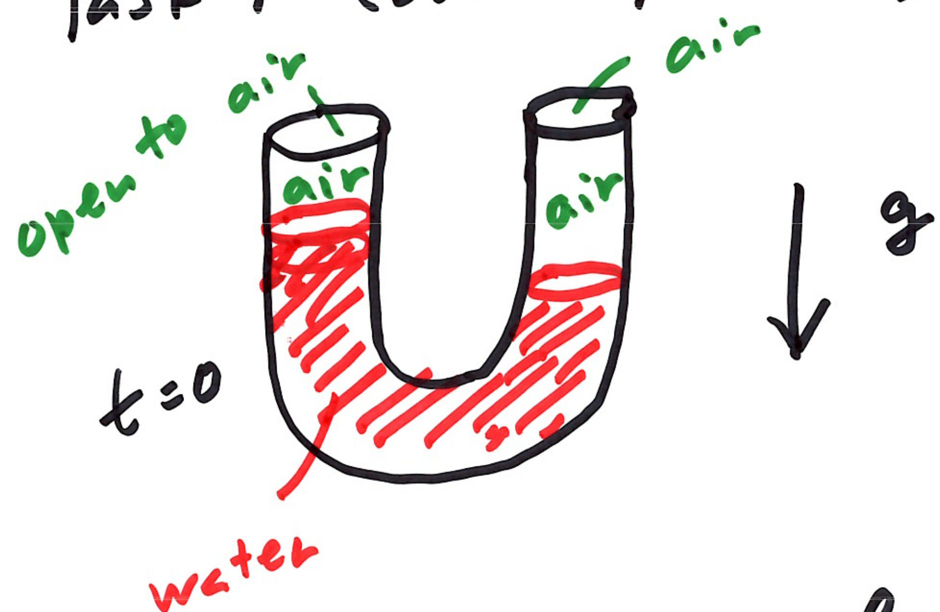
" boundary conditions ✓

" mesh ✓

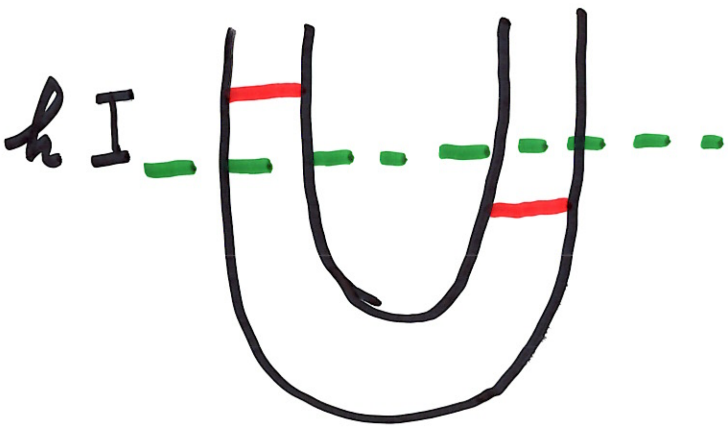
Tip:

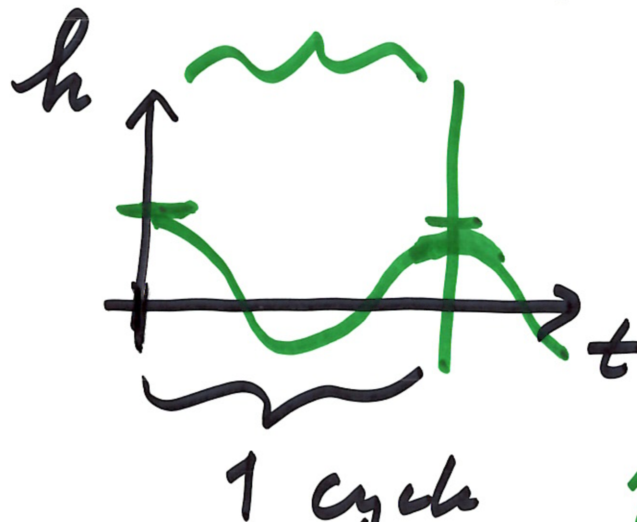


Task 4 (MAE 560 only) 3-D U-shaped pipe



transient solution up to at least 1 full cycle of oscillation





monitor

report file }
" plot }

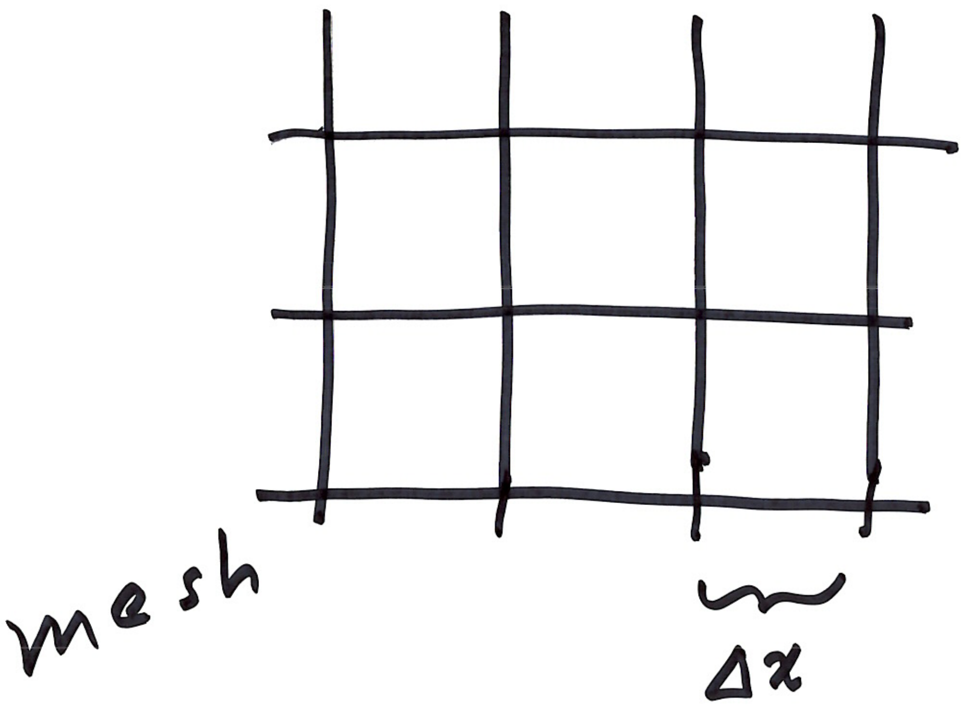
period of oscillation = ?

* For simplicity, <u>turn off</u> surface tension.

<u>mesh resolution</u> , <u>time step size</u>

Δx Δt

element size



VOF

$$\frac{\partial C_2}{\partial t} = -\vec{V} \cdot \nabla C_2$$

- [ ] Explicit
- [x] Implicit

} Both are OK

But: Explicit:

Constraint on numerical stability

U max velocity

CFL stability criterion

Courant-~~Fr~~ Friedricks-Lewy

Courant number

$$C \equiv \frac{U \Delta t}{\Delta x}$$

$C > 1$ numerically unstable

If **<u>Explicit</u>** simulation blows up

/ error: C too large

choose $\Delta t, \Delta x$

adjustment: lower C

by either refine Δt

or coarsen $\underline{\Delta x}$

only concerned with stability

otherwise, smaller C does NOT necessarily imply higher degree of accuracy of simulation!

to be continued...