

Lecture 25

11/23

\* Final Exam: Dec 9, 12:10-2:00 PM

10%

Closed book.

time is different  
from regular class time

(No reference material, computer)

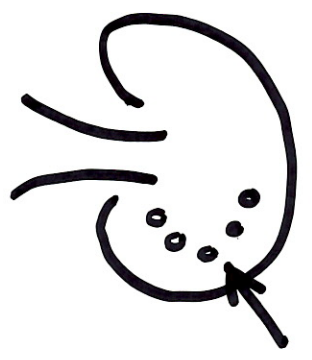
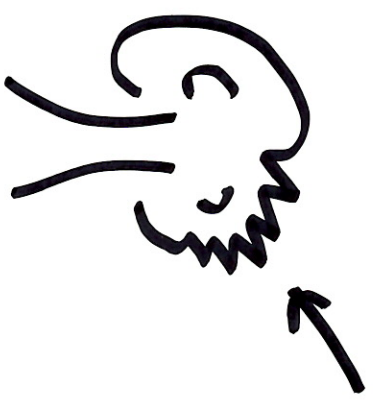
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Comprehensive

All content from Lecture 1-27

{ Homework 1  
Project 1-3

Proj 2  
Task 1

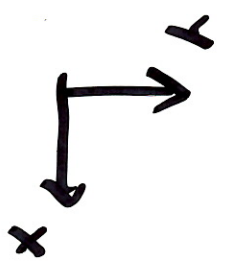
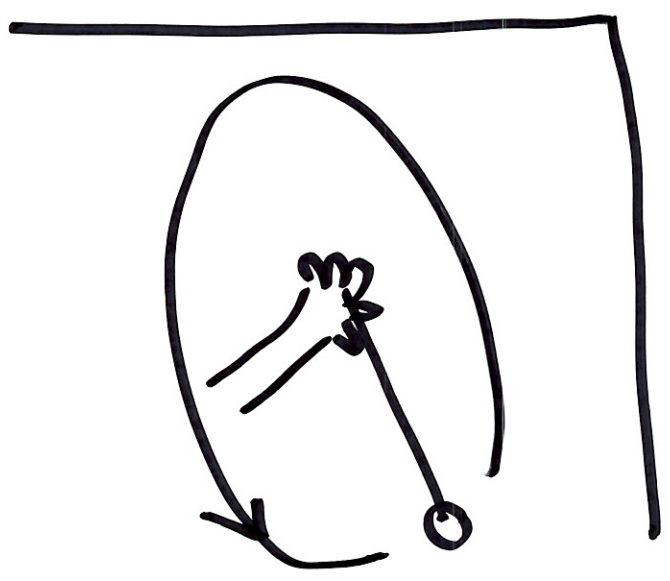
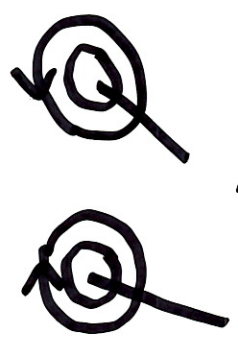


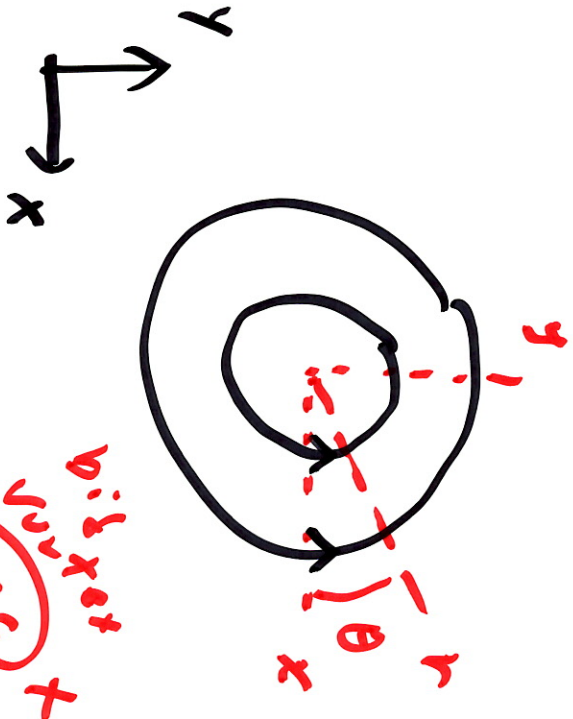
numerical artifacts

pressure



flow

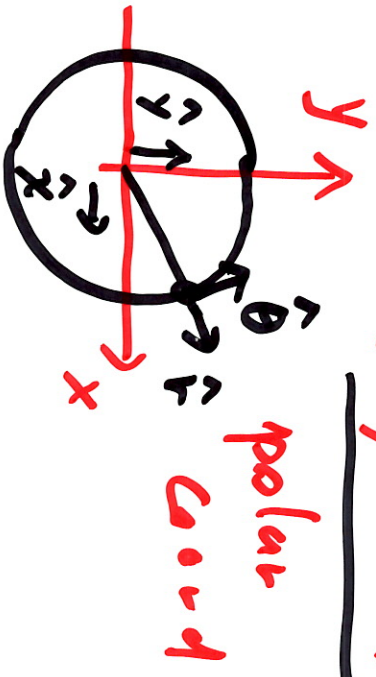




visc  
visc +  
visc

Steady  
vortex

$(x, y) \rightarrow (r, \theta)$



polar  
Coord

$(u, v)$   $\hat{x}, \hat{y}$   
 $(u_r, u_\theta)$   $\hat{r}, \hat{\theta}$

N-S.  $(2-D)$   $\rho = \text{const}$

$$\cancel{\frac{\partial u}{\partial t}} = -u \frac{\partial u}{\partial x} - v \frac{\partial u}{\partial y} - \frac{1}{\rho} \frac{\partial p}{\partial x} + \cancel{\text{visc.}}$$

$$\cancel{\frac{\partial v}{\partial t}} = -u \frac{\partial v}{\partial x} - v \frac{\partial v}{\partial y} - \frac{1}{\rho} \frac{\partial p}{\partial y} + \cancel{\text{visc.}}$$

↓ polar coord.

axially sym.  $\frac{\partial}{\partial \theta} = 0$   $x = r \cos \theta$   
 $y = r \sin \theta$

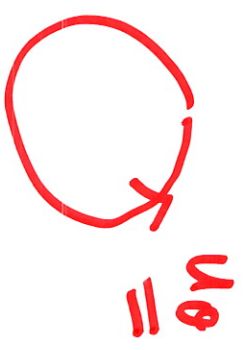
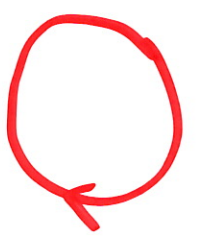
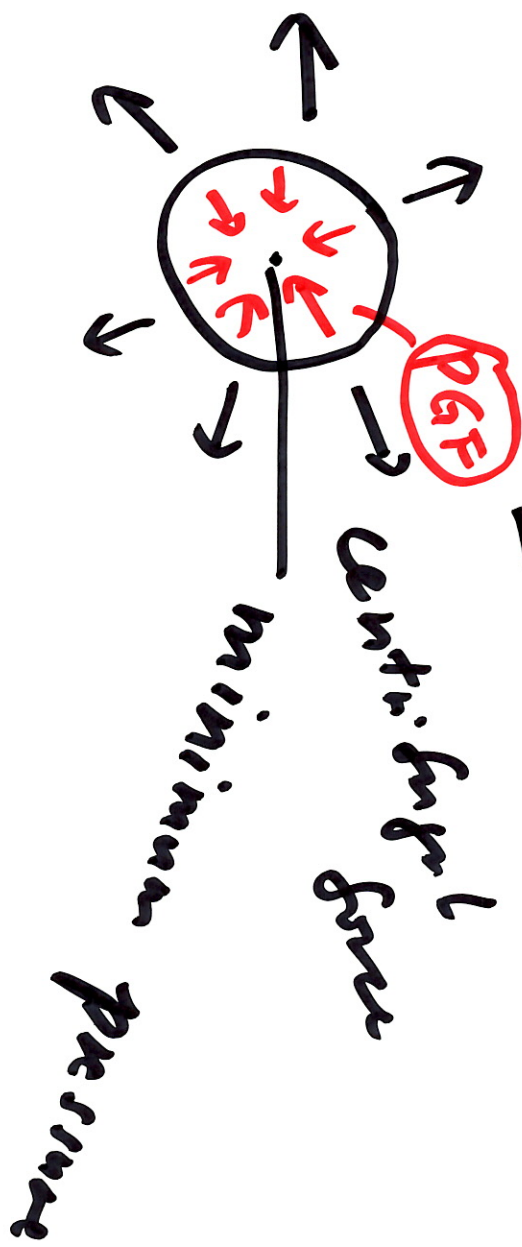
$u_r = 0$

$$\frac{\partial u_r}{\partial t} = -u_r \frac{\partial u_r}{\partial r} - \frac{u_\theta}{r} \frac{\partial u_r}{\partial \theta} + \frac{u_\theta^2}{r} - \frac{1}{\rho} \frac{\partial p}{\partial r} + \text{visc}$$

$$\frac{\partial u_\theta}{\partial t} = -u_r \frac{\partial u_\theta}{\partial r} - \frac{u_\theta}{r} \frac{\partial u_\theta}{\partial \theta} - \frac{u_\theta u_r}{r} - \frac{1}{\rho} \frac{\partial p}{\partial \theta} + \text{visc}$$

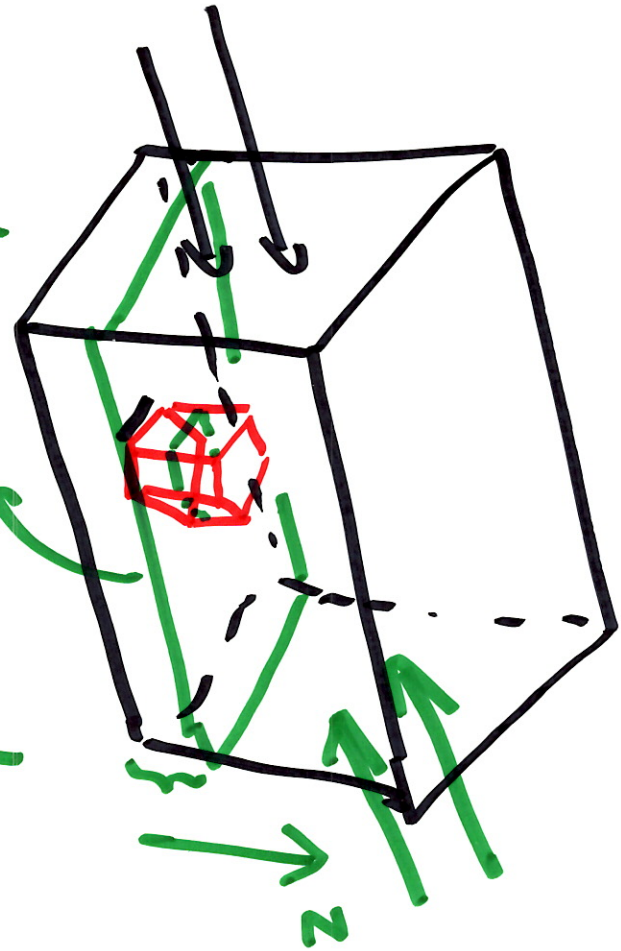
Eq. 1

$$0 = \frac{u_\theta^2}{r} - \frac{1}{\rho} \frac{\partial p}{\partial r}$$



Proj 3

Task 3

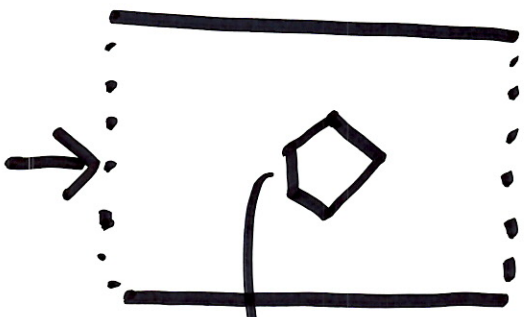
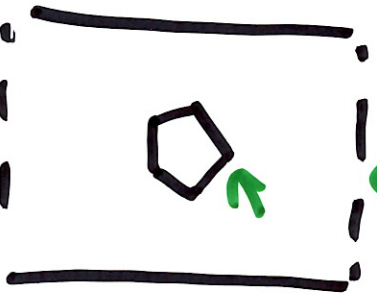


Geometry

Same strategy

as

Task 2



flat

Fig 7b

Fig 7c

Fig 7c



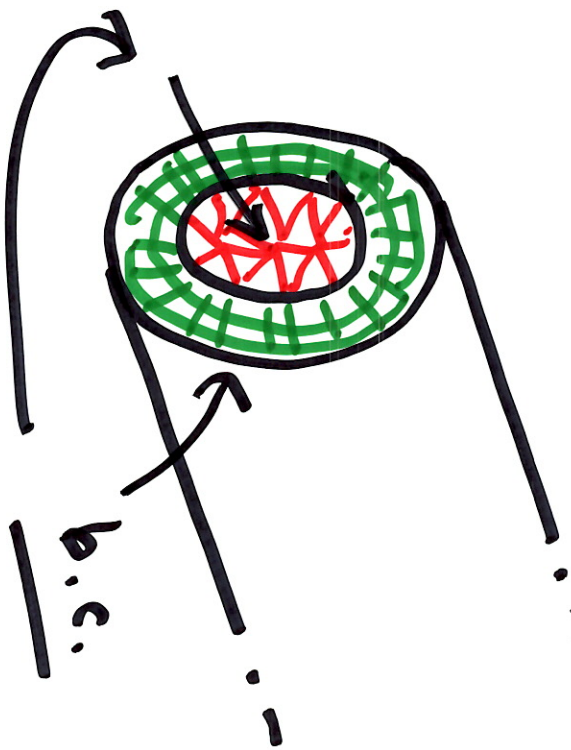
Other subjects (beyond Proj 1-3)

✓  
✓  
Fluid + solid ✓

heat transfer

fluid only

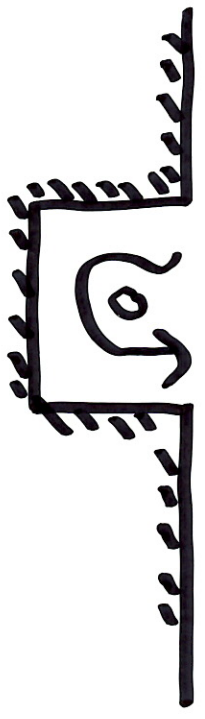
1 body



Energy eq.

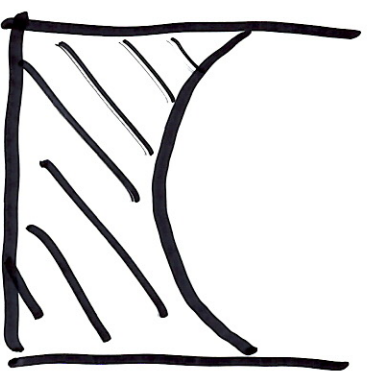
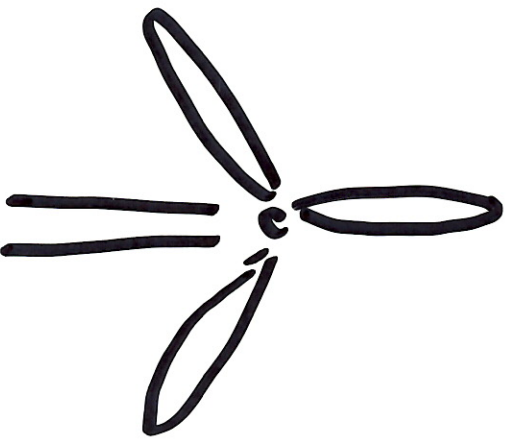
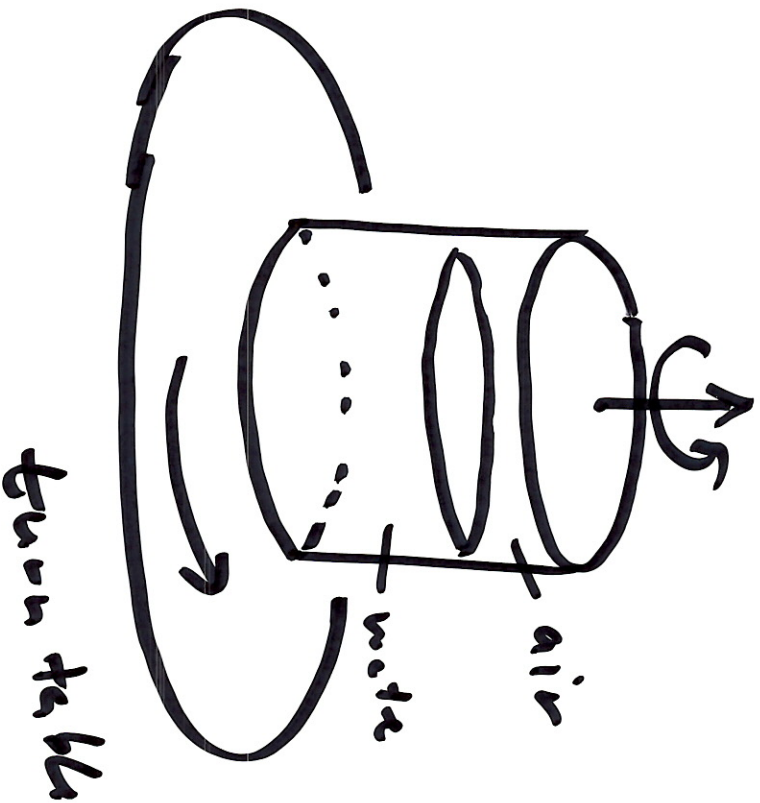
Heat exchanger

# \* Dynamic boundary / Dynamic mesh



default: Stationary  
 b.c. of wall

dynamic boundary:  
moving coordinate



Fluent:

abs. coord  $\rightarrow$  rotating  
coord.

adding Coriolis &  
Centrifugal force  
to N-S. eq.