script	board
Introduction - myself - paula --No TA in CE3305-2014-2.2 - web server write url - why not the server - distribute syllabus -- Electronic distribute only - show required textbook - state: really will need to read the book! Use the e-book if possible, I did bring a physcial book - explain why roll sheet - distribute roll sheet - questions?	T.G. Cleveland P.A.---Monaco-- need this character! www.rtfmps.com/ce3305/ give the userid and password to class to get by the paywall Syllabus - objectives - schedule - grading - quizzes - exercises - exams - ABET PEO Roll sheet
- Exercise format - Solution Process - Explain purpose of format & process Summer class is really accelerated Need to do the exercises to be able to complete the quizzes. Quizzes are begin each meeting, 10 minutes -- no adjustments. They are part of the course letter grade, and are essentially an on-going exam. Two exams (if this were a normal semester would be in class) are take home. One exam in-class.	Exercises - Practice at problem solving - Format - Process Purpose: (1) Develop a systematic method to solve closed engineering/science problems. (2) Develop "muscle memory" to apply the process (3) Become accustomed to documenting effort.

Script	board
Process → Essentially the scientific method with hypothesis replaced by governing equations. → Usually works, worst case identifies things that need clarification	State the problem, sketch Identify "knowns" Identify governing equations, assumptions, and principles List "unknowns" Solve for "unknowns" Validate/discuss results · sensitivity — effect of relaxing an assumption

I have this out of order:
1) state problem
2) sketch, knowns
3) unknowns, find
4) solution -- identify governing equations in advance and as used.
5) validate/discuss results

Format
→ How we (i) want exercises to appear.

(1) Each problem starts on a new page!

Latex \clearpage

(2) Upper right hand every page!

Name Date
Sheet X of Y

(3) Use engineering grid paper for "final" submission

NAME DATE
1 OF X

1) PROBLEM STATEMENT

2) SKETCH OF SITUATION/ SYSTEM (FBD IF APPROPRIATE)

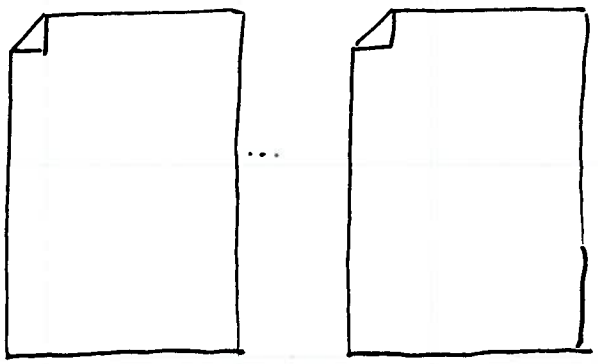
3) KNOWN
:

5) 4) GOVERNING EQUATION(S)
:

4) 5) UNKNOWNS/ FIND....

6) SOLUTION

7) DISCUSSION

Script	board
Example to illustrate format Remark as example proceeds: OK to make mistake – Use ~~strikethrough~~ and continue. OK to use guide arrows ## ## Remind to study notes	Follow EXAMPLE ~~ABOUT SHEET~~ ATTACHED AT END. DRAW AS:  INSERT EXAMPLE HERE Quiz 1 is essentially this problem.

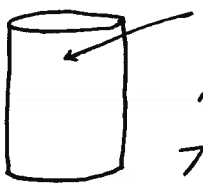
PROBLEM STATEMENT:

FIND THE TOTAL WEIGHT OF A $17 ft^3$ TANK OF NITROGEN AT 500 psia.

THE VESSEL ITSELF WEIGHS 50 lbf.

THE TEMPERATURE IS 20°C

SKETCH (FBD EQUIVALENT):



KNOWN

$\forall = 17 ft^3$

$p = 500 psia$

$T = 20°C$

$W_{TANK} = 50 lbf$

GOVERNING EQUATIONS;

IDEAL GAS LAW $p\forall = \frac{m}{M} RT$ (ASSUME IDEAL GAS LAW APPLIES)

$W_{TOTAL} = W_{TANK} + W_{GAS}$

UNKNOWN: (FIND)

W_{GAS}

SOLUTION

$W_{gas} = m_{gas} \cdot g$ WHERE R IS UNIVERSAL GAS CONSTANT

$m_{gas} = \frac{p \forall M}{RT}$ M IS MOLECULAR WEIGHT OF NITROGEN

$R = 0.0821 \frac{L \cdot atm}{K \cdot mol}$

$M_N = 14.007 g/mol \quad \therefore \quad M_{N_2} = 28.014 g/mol$

↖ GAS IS N_2; EVERY MOLE IS 28g!

NEED $\forall$ IN L

NEET T IN °K

NEED p IN ATM

$\forall = 17 ft^3 \cdot \frac{1m}{3.28ft} \cdot \frac{1m}{3.28ft} \cdot \frac{1m}{3.28ft} \cdot \frac{1000 L}{1 m^3} = \underline{481.76 L}$ ← Volume

$°C + 273 = °K$

$T = 20°C + 273 = \underline{293 °K}$ ← TEMP.

$p = 500 psia \frac{1 atm}{14.7 psi} = \underline{34.01 atm}$ ← PRESSURE

NOW SOLVE FOR MASS OF GAS

$* m_{gas} = \frac{(34.01 atm)(481.76 L)(28.014 g/mol)}{(0.0821 \frac{L \cdot atm}{K \cdot mol})(293 K)} = \underline{19071.5 g\ N_2}$ ← MASS GAS

NOW APPLY W_{gas} TO FIND WEIGHT OF GAS

$$W_{gas} = 19071.5\,g \cdot \frac{kg}{1000\,g} \cdot 9.81\,m/s^2 = \underline{187.09\ N} \leftarrow \text{WEIGHT GAS}$$

NOW CONVERT VESSEL WEIGHT TO NEWTONS

$$W_{TANK} = 50\,lbf \cdot \frac{1\,kg}{2.2\,lbf} \cdot 9.8\,m/s^2 = \underline{222.72\,N} \leftarrow \text{WEIGHT TANK}$$

TOTAL WEIGHT

$$W_T = W_{gas} + W_{tank}$$

$$= 187.09N + 222.72N = \underline{409.81N} \leftarrow \text{TOTAL WEIGHT IN NEWTONS}$$

PROBABLY MAKES SENSE TO CONVERT TO LBS

$$409.8N = 409.8\,\frac{kg \cdot m}{s^2} \cdot \frac{1}{9.8\,m/s^2} \cdot \frac{2.2\,lbf}{1\,kg} = \underline{91.99\,lbf} \leftarrow \text{TOTAL WEIGHT IN LBS.}$$

Discussion

SEVERAL INTERMEDIATE VALUES ARE REQUIRED, ESP. R AND M.

NEED TO RECOGNIZE THAT N_2 HAS TWO ATOMS PER MOLE, THUS M_{N_2} IS TWICE M_N

NEED TABLE OF ELEMENTS TO LOOK UP MOLECULAR WEIGHT NITROGEN (ATTACHED AS EXHIBIT I)

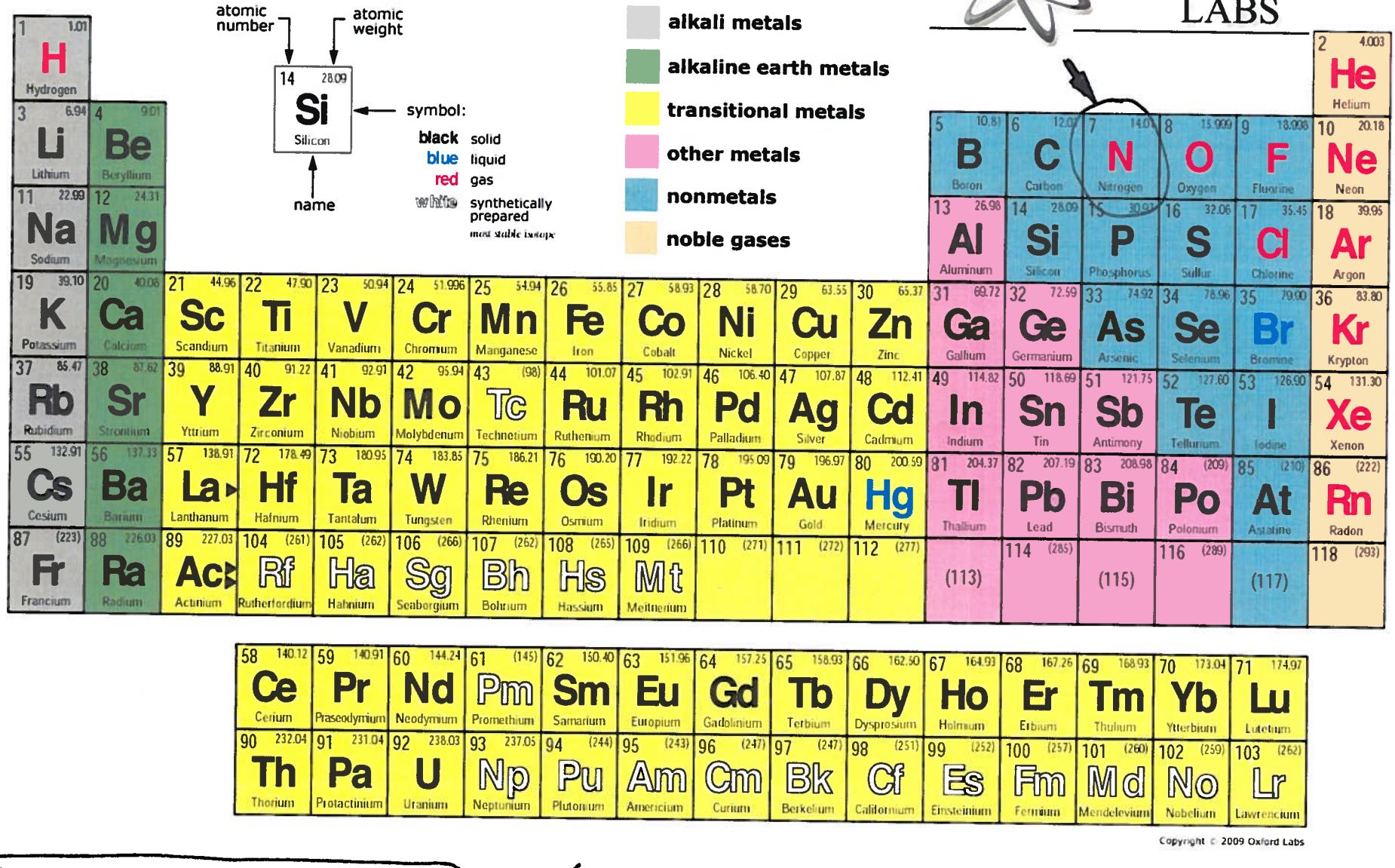
FINAL ANSWER TOO MANY SIGNIFICANT FIGURES; 409N AND 92lbf WOULD BE MORE MEANINGFUL.

REMEMBER TO REPORT UNITS WITH ANSWER!

15 JAN 14 4 of 4

Cleveland CE3305

Periodic Table of the Elements



Page 7

EXAMPLE PAGE FORMAT

http://oxford-labs.com/wp-content/uploads/2009/04/periodic-table.jpg URL

DO THE EXAMPLE BEFORE START THIS SECTION

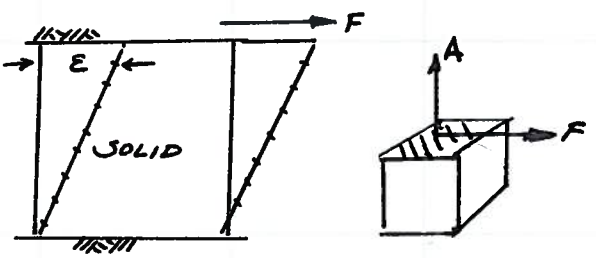
What is fluid mechanics?

A solid deforms, but not continuously.

When stress is applied, deformation is proportional to stress

Deformation (strain) is some function of stress (τ).

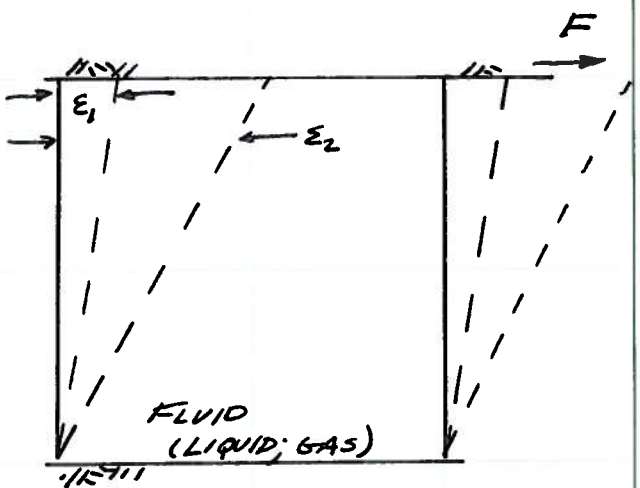
Assuming solid does not fail, then deformation is largely time invariant
(ε does not change with time)

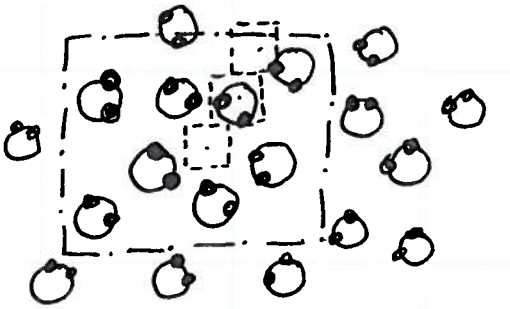
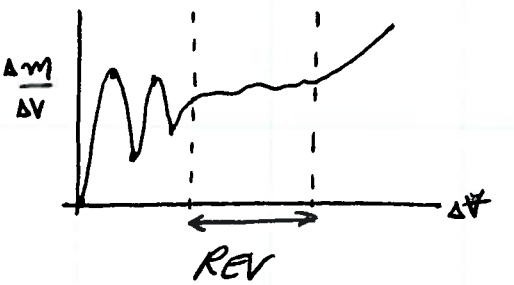
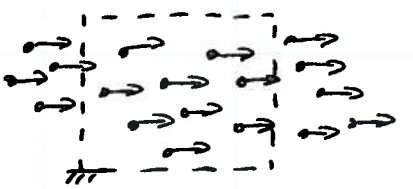


$\varepsilon \propto \frac{F}{A} = \tau$ "SHEAR STRESS"

$\varepsilon = f(\tau)$ $\frac{d\varepsilon}{dt} = 0$

Time

script	board
A fluid (liquid or gas) deforms continously; as long as stress is applied, the fluid will continue to deform. Deformation (strain) is proportional to stress. Strain is time variant. (look ahead pg 36 – note similarity of sketches)	 $\varepsilon \propto \frac{F}{A} = \gamma$ $\varepsilon \propto t \Rightarrow \varepsilon = g(\gamma, t)$ $\frac{d\varepsilon}{dt} \neq 0$
What is fluid mechanics? Compare to pg 3 definition What kind of things are fluids? · water (eT & P = ??) · air · gasoline · paraffin at (60°F?, 190°F)? · window glass? · ice cream? · paint?	Fluid mechanics is the study of motion, deformation, momentum, energy, and related properties of materials that cannot resist shear stress liquids or gasses.

script	board
Calculus of fluid mechanics uses continuously differentiable functions (usually) and implicitly assumes a fluid is a continuum Usual definition is that a mass density can be defined – and is usually assumed to be controlled by the sampling volume $\Delta\forall$. The lowest usable value $\Delta\forall$ is called a representative elementary volume (REV)	Continuum  $\rho = \frac{\Delta m}{\Delta \forall}$ 
Concept of fluid parcel[2] is useful especially when studying motion in a Lagrangian coordinate system. A fluid parcel is a quantity of fluid with fixed ~~mass~~ identity (usually mass) The volume of parcel can remain finite[3] or be infinitesmal. When infinitesmal, they are called fluid particles [2] Fluid parcels used in air quality models where parcels represent cubic kilometers. [3] Some models represent parcels as "drops" (i.e. $1 \cdot 10^6$ drops = 1 watershed inch) – these are particles	Fluid parcel (particle)  Eulerian  Lagrangian Fixed identity (usually mass)

~~Demo~~ Script	board
Dimensions are things that can be measured, a unit is how much of that thing. Most "things" are reduced or expressed in a set of primary dimensions, defined either by length-mass-acceleration or length-weight-acceleration Primary dimensions are used to construct secondary dimensions. Secondary dimensions are often more practical in engineering.	Dimensions - Things that can be measured · length · weight · temperature · speed Units - How much of a dimension is measured or counted A foot is a unit of length. ↑ unit ↑ dimension
Consistent units, when possible, reduce errors because of fewer arithmetic operations. The SI system is promoted as superior to US customary (also called imperial) system. The superiority is a fallacy, although SI units are reasonably consistent, and scales by multiples of 10 (nice!) and is the result of international treaty signed decades ago. kg-m, kg-f — just as stupid as lbf and lbm.	Consistent Units A set of units with conversion factors equal to unity. U.S. customary (imperial) SI SI is equivalent, useful, and international standard. ~~Try to buy 4'x8'~~ ~~sheet of plywood in France~~ ~~good luck~~ ~~120cm x 240cm~~ ~~plausible.~~