FACETS: FACETS Design Method
/public/TechnicalCommunication/

Engineering Logbook

Your Engineering Logbook is a very important tool for you to use throughout your engineering career. Your logbook serves several purposes, including, but not limited to:

- A critical aspect of documenting your inventive contributions to a product
- Very important for documenting your due diligence and care relative to developing safe products and protecting yourself from professional liability claims
- Must be timely, thorough, sustained, and fully detailed (detailed disclosure)
- Should show a chronology of your train of thought and investigation

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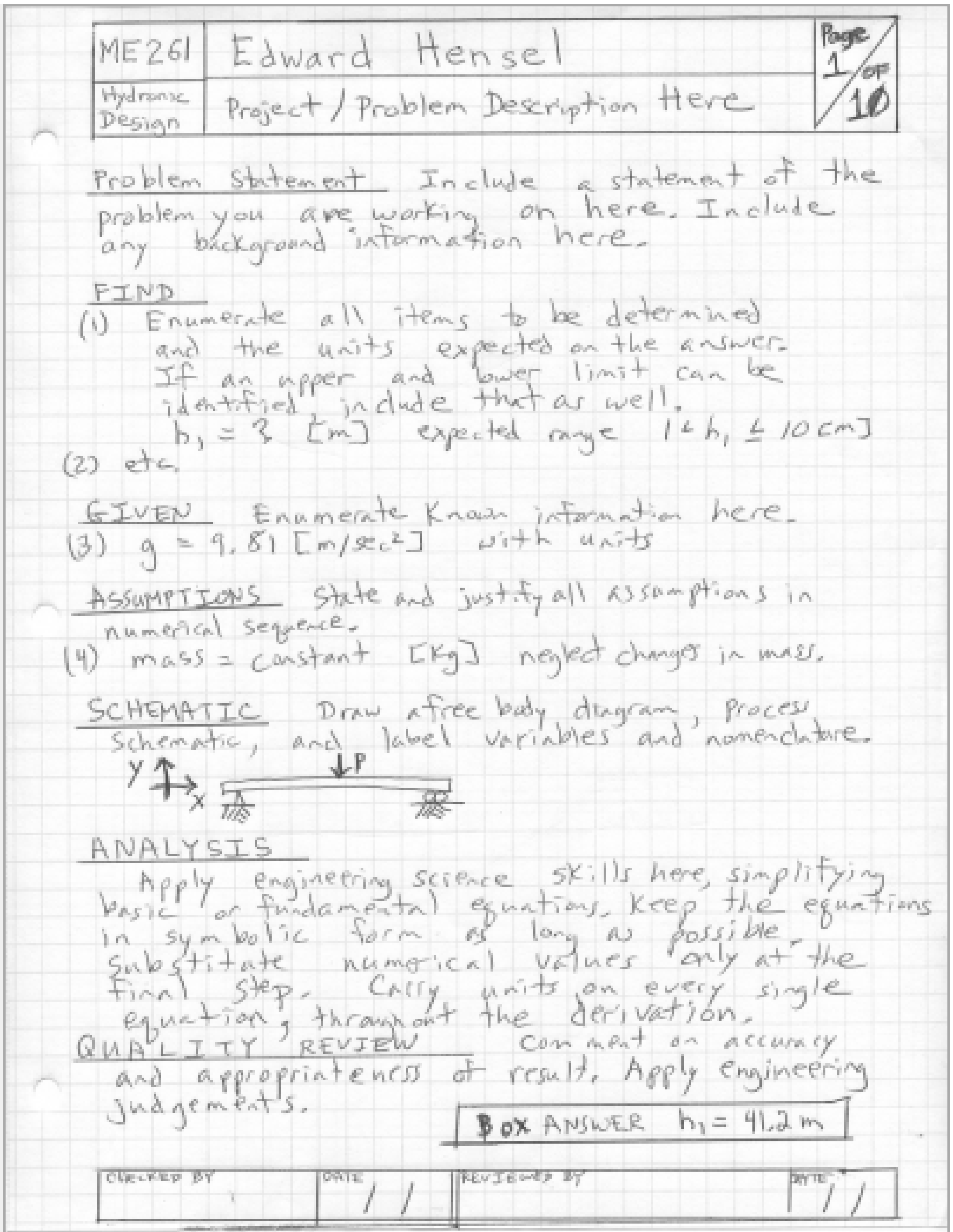
Sample Homework Engineering Logbook



ME261	Edward Hensel	Page 1 of 10
Hydronic Design	Project / Problem Description Here	

Problem Statement Include a statement of the problem you are working on here. Include any background information here.

FIND
(1) Enumerate all items to be determined and the units expected on the answer. If an upper and lower limit can be identified, include that as well.
h1 = ? [m] expected range 1 < h1 ≤ 10 cm]
(2) etc.

GIVEN Enumerate Known information here.
(3) g = 9.81 [m/sec²] with units

ASSUMPTIONS State and justify all assumptions in numerical sequence.
(4) mass = constant [Kg] neglect changes in mass.

SCHEMATIC Draw a free body diagram, process schematic, and label variables and nomenclature.

ANALYSIS
Apply engineering science skills here, simplifying basic or fundamental equations. Keep the equations in symbolic form as long as possible. Substitute numerical values only at the final step. Carry units on every single equation, throughout the derivation.

QUALITY REVIEW Comment on accuracy and appropriateness of result. Apply engineering judgements.

BOX ANSWER h1 = 41.2 m

CHECKED BY	DATE / /	REVIEWED BY	DATE / /

Sample Page from a logbook

The Sample Page shown in the figure to the left illustrates a logbook typical of those used in engineering classes at the undergraduate level. Many times, your course instructor will require you to employ a standardized multi-step problem solving process. In the example page here, the top title block of the page indicates the course, the student's name, the problem set or assignment, and the page numbering for each page in the problem set. In this example case, we are looking at page number 1 of 10 pages.

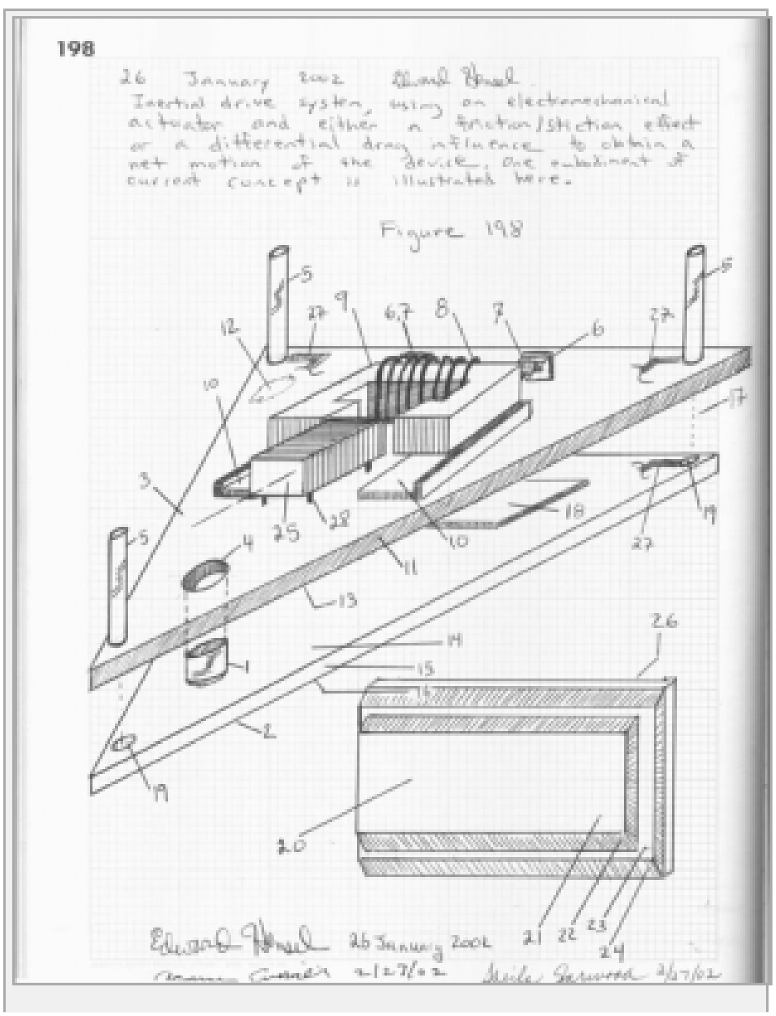
The course is ME261, and the chapter is Hydronic System design. The student (Edward Hensel) is working on a homework problem for a class. Each aspect of the homework problem is outlined in the formal problem solving method. Note that the student conducts the vast majority of the analysis in symbolic form, carrying units along on each equation. Near the very end of the problem, the student enters the numerical values, and identifies the final solution, with appropriate units, in a boxed result.

At the bottom of the page, the footer contains two review blocks and dates. The "Checked By" box on the left is used to confirm that the homework is being completed in the logbook in a timely fashion, without detailed review. The "Reviewed By" box on the right is used to indicate the a more through review has been completed by the evaluator, when the logbook is submitted for assessment. In this way, the timeliness of completion can be quickly verified by the instructor or TA and the logbook can be readily handed back to the student. Upon final submission of the logbook, a much more detailed review can be completed, to check for accuracy, completeness, and independent work by each student.

Sample Intellectual Property Protection Engineering Logbook

In this example, an engineer has maintained a logbook regarding the development of a three dimensional "Early Generation Chunxil" which was the subject of a series of senior design projects. The engineer used his logbook to record his independent thoughts about the concept design, and to share those thoughts with other members of the design team. The logbook has been witnessed by both a technical and a date witness periodically.

The Static Description



Consider Figure 198 shown to the left, where the engineer has created a sketch showing all of the elements of his design concept. The "Static Drawing" shows the components and subassemblies in relation to one another, but does *not* illustrate the the "Operation" of the device.

The engineer has taken care to label each component with a number. Note that identical components may be labeled with the same id number. The engineer signs and dates every single page of the log book each time an entry is made, to provide a timely record of all work completed as it is completed.

Periodically, and particularly when significant progress is made, you should have your logbook witnessed by a technical colleague and a date witness who can attest to the date on which your technical colleague reviewed the logbook.

Sample Page 198 from a logbook

After creating the static drawing of the device, you need to prepare a list of components, which describes each and every component appearing in the static drawing. This list, shown on Page 199 of the logbook, is cross-referenced to each number on preceding sketch, and contains a brief description of the component. It is very important that you do not make any assumptions that something is obvious. If your device requires a a screw, then assign it a number, and then label it as a "Screw", "Connector", or "Threaded Connector" etc.

You may cross reference the relationship between objects and components as illustrated here. As you fill in your logbook, do not leave any blank space at the bottom of any pages. You may draw a line across the bottom of the page to indicate that it was intentionally left blank. Remember to sign and date each page as you write it.


TITLE Proteus Gen 1 PROJECT NO. BOOK NO. 10 199

Work continued from Page 197

Static Description of Prototype /Concept Embodiment
Cross-Reference to Figure 198 on Book 10 Page 198

1 Sensor(s) facing outward (Photosensor, I/R, Acoustic, etc etc)
2 Upper cover for Prototype, could be Conformal Coating
3 Main Base of vehicle Body / Frame
4 Alignment / Receiver for sensor (1)
5 Standoff(s) to attach upper cover (2) above Base (3)
6 Electrical / Physical Contact and spring Retainer
7 Coil / Fan Fold spring and electrical conductor(s)
8 Magnet wire coil wrapping on armature (9)
9 Armature (alternatively fixed portion) Shown Sliding
10 Guides and low friction slider / bearing surface
11 Lateral edge of Main Base (3)
12 Inside surface of Main Base (3)
13 Outside surface of Main Base (3)
14 Inside surface of Top Cover (2) - Shown inverted
15 Lateral edge of upper cover (2)
16 Outside surface of upper cover (2)
17 Alignment Showing (inverted/mirror) alignment upper (2) bottom (3)
18 Power / Control Circuitry not necessarily mounted on (12)
19 Alignment detents / holes / features
20 Lateral face (one of four) to form hermetic seal
21 Inside surface of Lateral Face (20)
22 Beveled sealing surface of face (20)
23 Rabbit edge of face (20)
24 Outer Bevel of face (20)
25 Armature shown fixed, alternatively slide w/r/t (9)
26 Outside surface of face (20)
27 Printed circuit traces for conduction thru standoffs (5)
28 Secure connection between (25) and (3)

Work continued to Page 201

SIGNATURE Edward Hensel DATE 26 Jan 2002

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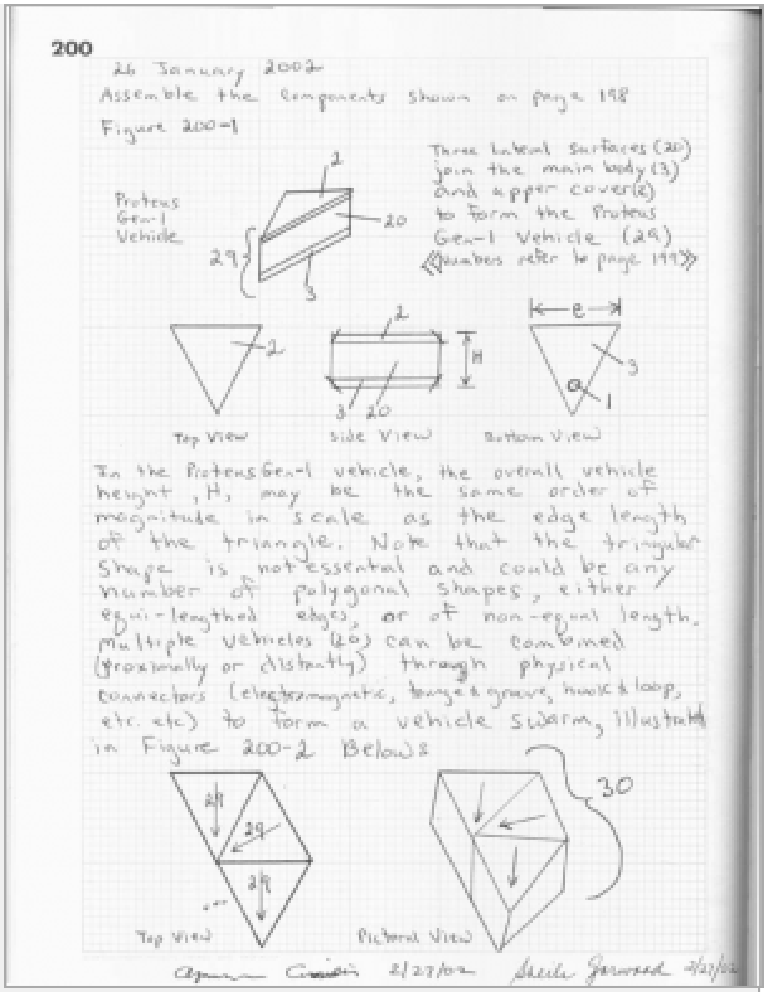
Sample Page 199 from a logbook

The Operation of the Device



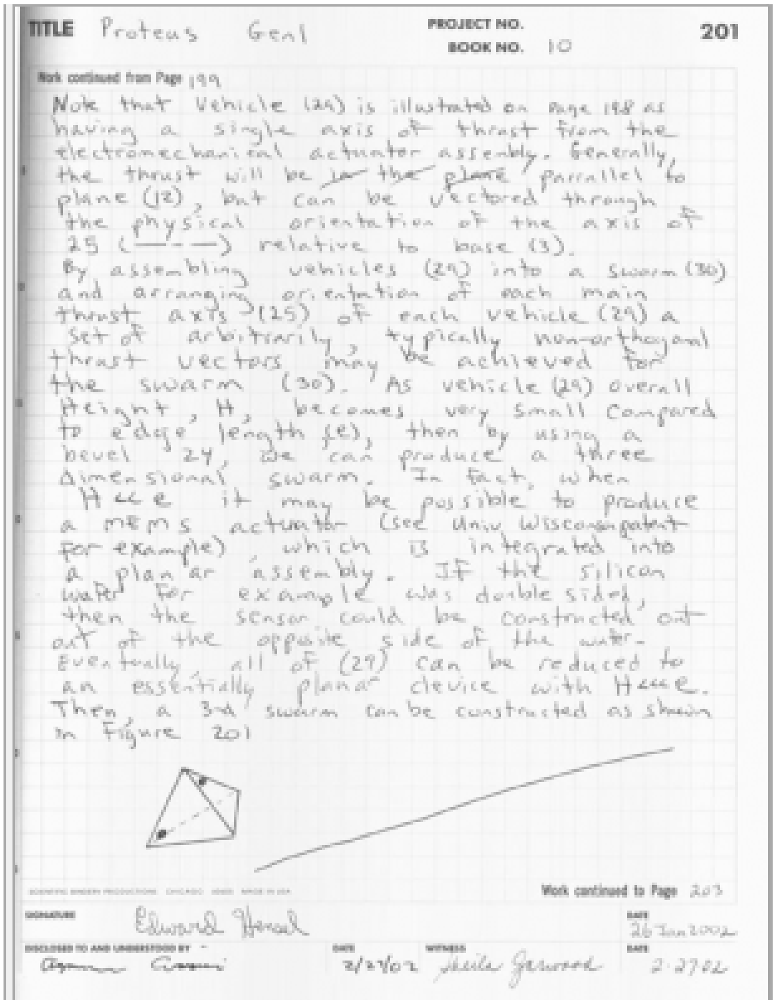
Sample Page 200 from a logbook

Illustrate various ways in which your device can be used or assembled Cross-reference the numbers from these figures to the same numbers from the earlier figures Show how forces can be superimposed, for example, to achieve a vector result of forces from components Add text/verbage to clarify anything that is not OBVIOUS by the drawing itself Label the views

Description of the Preferred Embodiment

- Describe in great detail the static configuration of your device
- Describe in great detail the dynamic operation of your device
- Explain by example why your solution is better that somebody else's idea or solution
- What is unique about your approach?

- What do your drawings TEACH?
- What are natural extensions of the work you have done?



TITLE Proteus Gen1 PROJECT NO. BOOK NO. 10 201

Work continued from Page 199

Note that Vehicle (29) is illustrated on page 198 as having a single axis of thrust from the electromechanical actuator assembly. Generally, the thrust will be ~~in the plane~~ parallel to plane (12), but can be vectored through the physical orientation of the axis of 25 (—·—) relative to base (3). By assembling vehicles (29) into a swarm (30) and arranging orientation of each main thrust axis (25) of each vehicle (29) a set of arbitrarily, typically non-orthogonal thrust vectors may be achieved for the swarm (30). As vehicle (29) overall height, H, becomes very small compared to edge length (e), then by using a bevel 24, we can produce a three dimensional swarm. In fact, when H << e it may be possible to produce a MEMS actuator (see Univ Wisconsin patent for example) which is integrated into a planar assembly. If the silicon wafer for example was double sided, then the sensor could be constructed out of the opposite side of the wafer. Eventually all of (29) can be reduced to an essentially planar device with H << e. Then, a 3rd swarm can be constructed as shown in Figure 201

Work continued to Page 203

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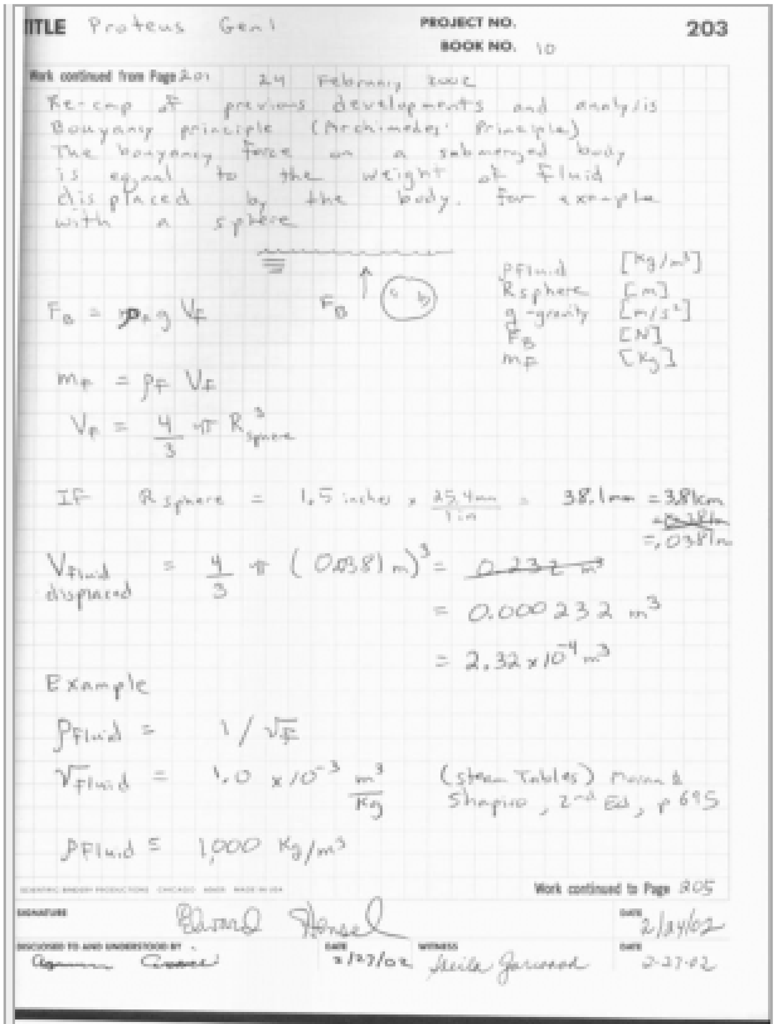
Sample Page 201 from a logbook

Analysis

Use your background in engineering, science, and mathematics to show that you have a sound basis for your design You do not have to demonstrate that you understand the theory of operation if you can demonstrate an actual working device A complete technical disclosure may be considered as a reduction to practice Introduce terminology, carry units, do symbolic math and then substitute numbers

Show the examiner that you know your stuff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Work continued from Page 201 24 February 2002

Re-cap of previous developments and analysis

Bouyancy principle (Archimedes' Principle)

The bouyancy force on a submerged body is equal to the weight of fluid displaced by the body. for example with a sphere

$F_B = \rho_F g V_F$

ρ_{Fluid} [Kg/m³], R_{sphere} [m], g - gravity [m/s²], F_B [N], m_F [Kg]

$m_F = \rho_F V_F$

$V_F = \frac{4}{3}\pi R_{sphere}^3$

IF R_{sphere} = 1.5 inches × 25.4mm/1in = 38.1mm = 3.81cm = .0381m

$V_{Fluid\ displaced} = \frac{4}{3}\pi (0.0381\ m)^3$ = ~~0.232 m³~~ = 0.000232 m³ = 2.32×10^{-4} m³

Example

$\rho_{Fluid} = 1/v_F$

$v_{Fluid} = 1.0 \times 10^{-3}$ m³/Kg (steam Tables) Moran & Shapiro, 2nd Ed, p 695

ρ_{Fluid} = 1,000 Kg/m³

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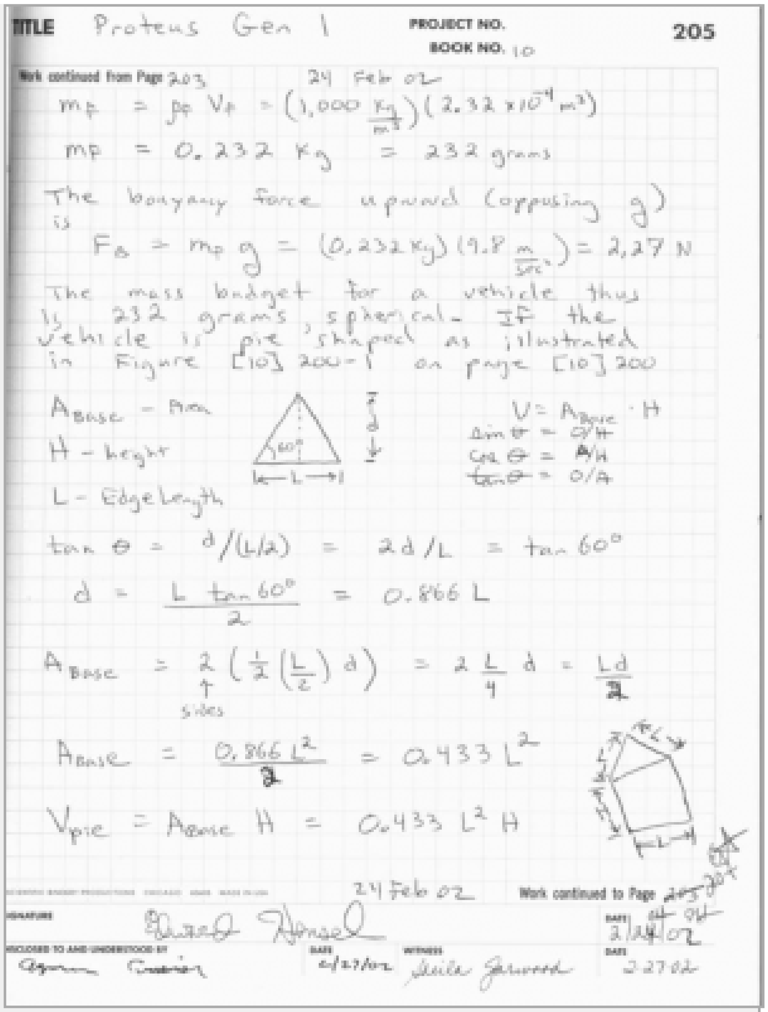
Sample Page 203 from a logbook

Pretend you are writing a lecture to explain your idea to a class, with the same level of detail that you would like a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Work continued from Page 203 24 Feb 02

$m_p = \rho_p V_p = (1{,}000 \frac{Kg}{m^3})(2.32 \times 10^{-4} m^3)$

$m_p = 0.232\ Kg = 232\ grams$

The bouyancy force upward (opposing g) is

$F_B = m_p g = (0.232 Kg)(9.8 \frac{m}{sec^2}) = 2.27\ N$

The mass budget for a vehicle thus is 232 grams, spherical. If the vehicle is pie shaped as illustrated in Figure [10] 200-1 on page [10] 200

A_{Base} - Area

H - height

L - Edge Length

V = $A_{Base} \cdot H$

$\sin\theta = O/H$

$\cos\theta = A/H$

$\tan\theta = O/A$

$\tan\theta = d/(L/2) = 2d/L = \tan 60°$

$d = \frac{L \tan 60°}{2} = 0.866 L$

$A_{Base} = 2\left(\frac{1}{2}\left(\frac{L}{2}\right) d\right) = 2 \frac{L}{4} d = \frac{Ld}{2}$ (2 sides)

$A_{Base} = \frac{0.866 L^2}{2} = 0.433 L^2$

$V_{pie} = A_{Base} H = 0.433 L^2 H$

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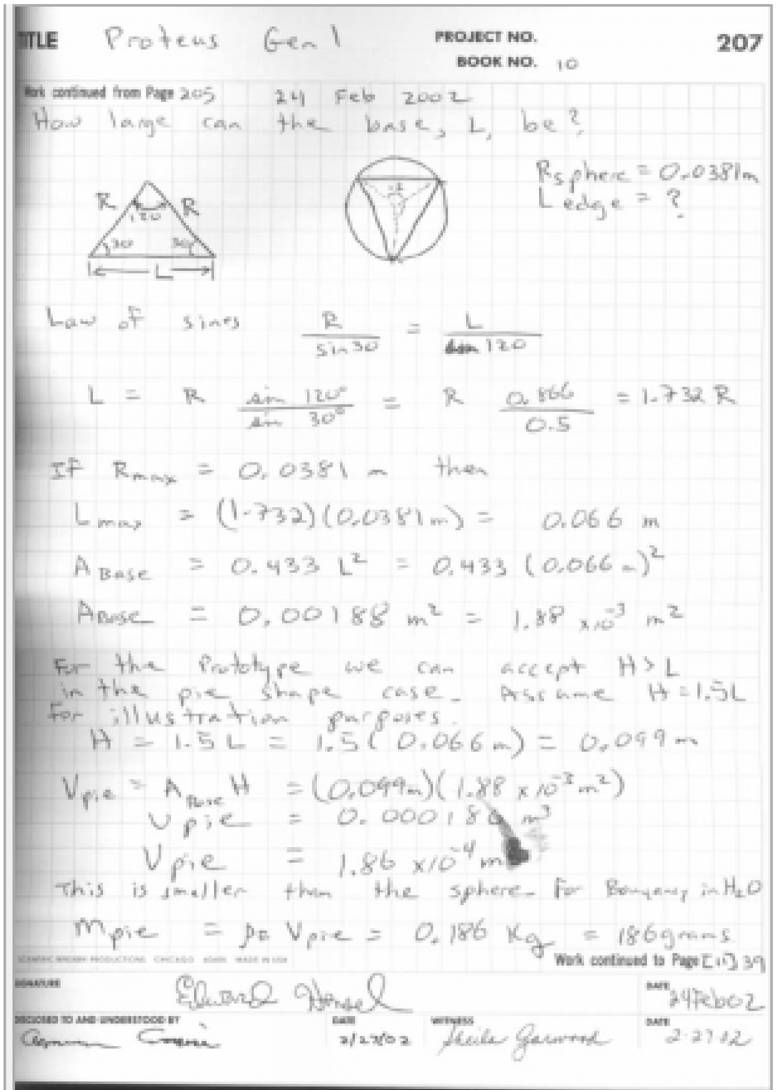
Sample Page 205 from a logbook

professor to show you in your notes! Explain multiplicative factors that may not be obvious to the reader Cross reference your analysis to drawings, figures, and previous results Do not erase incorrect results (you actually should write everything in INK anyways) If you make a mistake draw a single line through your error, but do not obscure the writing, since you may later find out you were correct after all!

Extend and Predict

Show how the foundation of your analysis can be extended to a more general application

Try to expand the breadth of your disclosure to encompass more technology than what is explicitly described in your drawings and description to date. Don't lose heart! Stick with it! Be persistent! Keep your logbooks forever! Your employer may require you to turn in your logbooks periodically, or when you leave the firm.



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Work continued from Page 205 24 Feb 2002

How large can the base, L, be?

$R_{sphere} = 0.0381 m$

$L_{edge} = ?$

Law of sines $\frac{R}{\sin 30} = \frac{L}{\sin 120}$

$L = R \frac{\sin 120°}{\sin 30°} = R \frac{0.866}{0.5} = 1.732 R$

If $R_{max} = 0.0381 m$ then

$L_{max} = (1.732)(0.0381 m) = 0.066 m$

$A_{Base} = 0.433 L^2 = 0.433 (0.066 m)^2$

$A_{Base} = 0.00188 m^2 = 1.88 \times 10^{-3} m^2$

For the Prototype we can accept H > L in the pie shape case. Assume H = 1.5L for illustration purposes.

$H = 1.5 L = 1.5 (0.066 m) = 0.099 m$

$V_{pie} = A_{Base} H = (0.099 m)(1.88 \times 10^{-3} m^2)$

$V_{pie} = 0.000186 m^3$

$V_{pie} = 1.86 \times 10^{-4} m^3$

This is smaller than the sphere. For Bouyancy in H_2O

$m_{pie} = \rho_{w} V_{pie} = 0.186 Kg = 186 grams$

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Sample Page 207 from a logbook