

The Checklist (Secrets of a Job Well Done)

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ABSTRACT: This is written from the POV of someone taking a team take-home exam. Most points are valid for in-class math essays, as well.

A pilot goes through a detailed checklist (*Fuel? Ailerons work?*) before taking off —this helps to prevent crashes. Here is a checklist that you should use for each of the Take-home exams.

You, speaking to me

I've carefully thought about what each of the following paragraphs mean. I, and each of my team-mates, have checked that the exam we are about to hand-in jibes with the paragraphs below.

Mechanics. **Ch₁** I've signed the honor code. (Each team member signs.) *Each member* of my team has a *complete copy* (paper) of the hand-in, including diagrams, computer data,...

Ch₂ Essays are typed, double-spaced, so that my prof. can write easily between the lines.

Ch₃ My hand-in is assembled as: PROBLEM SHEET, TYPOGRAPHY SHEET (if needed), 1st essay, 2nd essay,.... [Please do not put a cover on your exam; just securely staple it together, with the Problem Sheet first!]

When possible, pages —including diagram pages— should be numbered consecutively. However, this may not be possible if you are assembling different PDFs into a single PDF; do the best you can. [The problem sheet is page 1.]

Figures are interspersed with the text pages that refer to them, i.e, if Figure A is first referred to on page 3, then the figure should *be* page 2 or page 4 or should appear on page 3.

Ch₄ My hand-in is solidly *stapled* in such a way that my aging prof. with poor eyesight can easily read everything without taking the writeup apart. (Please put the staples vertically, in the upper lefthand corner.) Where I have written symbols by hand, they are large and clear.

Notation and Mathematics. **Ch₅** If I use notation which is *different* from that used in class, then I have included a TYPOGRAPHY SHEET explaining it. (However, notation which is specific to an essay, should be at the beginning of that essay.) For example, I might write:

“We use underbar to indicate subscripts e.g, ‘ \underline{x}_2 ’ and ‘ \underline{x}_{n+1} ’ for x_2 and x_{n+1} . Similarly, we use caret to indicate superscripts e.g, ‘ \hat{x}^2 ’ and ‘ \hat{x}^{n+1} ’ for x^2 and x^{n+1} . Analogously, we use ‘ $\text{int}_{a+1}^{2b} f(x) dx$ ’ to indicate $\int_{a+1}^{2b} f(x) dx$. For the gradient, ∇g , we type ‘ $\&g$ ’.”

Ch₆ I have written expressions **unambiguously**, e.g, for the expression “ $1/a + b$ ” I bracket it either $[1/a] + b$ or $1/[a + b]$, depending on my meaning. Similarly, I write function application using parentheses, e.g: $\sin(x)$, $\arctan(y)$, $\log(z)$, $\log_7(x)$, $\exp(x)$, $\text{Dom}(f)$, $\text{CoDom}(f)$, $\text{Range}(f)$, $\text{Area}(E)$. But I use brackets, for grouping. E.g

$$z[x + y]$$

means that I, Student, am *multiplying* z by $[x + y]$; which might be better written as $z \cdot [x + y]$. But

$$z(x + y)$$

means that z is a function and I am *evaluating* this fnc at $[x + y]$.

To avoid ambiguity, I, Student, write the evaluation symbol *with* the name of the variable.

I do *not* write $x \cdot \cos(z)|_5^7$, asking my poor prof. to guess whether I mean $x \cdot \cos(\beta)|_{\beta=5}^{\beta=7}$ or $x \cdot \cos(\beta)|_{x=5}^{x=7}$. Similarly, I have not forgotten to write the *infinitesimal* in integrals e.g, I write “ $\int x \cdot \cos(\beta) d\beta$ ” or “ $\int x \cdot \cos(\beta) dx$ ”, depending on what I mean, but I do not write “ $\int x \cdot \cos(\beta)$ ”.

Ch₇ I, Student, do not confound uppercase and lowercase letters; if I mean “ n ”, then I have not written “ N ”. When I use Greek letters, I write/type them so they are not confounded with Roman letters, e.g, “ a ” is not the Greek letter “ α ” (alpha).

Ch₈ Trigonometric functions are written using radian measure. Also, I have not written the oxymoron “ \sin^{-1} ” when I mean “arcsin”. (sin is not 1-to-1 and so

does not have an inverse function. The arcsin fnc is the inverse of a *restriction* of sin.)

Exposition. [Prof K.: Although much of what is said next seems obvious, please reflect upon it.]

Ch₉ Whenever *I*, Student, use a new symbol [a symbol already appearing in the problem statement is not new] in my essay, then I have defined it explicitly, e.g, “Let v denote the volume of the parallelepiped P ” or “Let $v(t)$ be the velocity of the spaceship at time t .”

Moreover, my sentence is specific: The sentence “Let d denote the distance from the centroid to the line.” is good, but I write the better sentence

“Let d denote the **perpendicular** distance from the centroid **of the region R_6** to the **line L_2** .”

In order to define quantities, when it is helpful (and it usually is...) I have used a *carefully drawn and labeled picture*, in addition to a clear sentence. The picture is **LARGE** (typically, a full page), as is all the writing on it. I include a detailed caption so that the reader knows *what this is a picture of* and what all of the labeled quantities *mean*. I realize that a careful and consistent use of colors may make my image more easily comprehended.

Ch₁₀ I have used the right word for each concept. An example:

France’s greatest lexicographer, Emile Littré, was once found by his wife *in flagrante delicto* –and in the conjugal bedroom no less– with their housemaid.

“Emile”, cried Mrs. Littré, “I am surprised!”

“No, my dear,” replied the erring lexicographer calmly.

“You are astonished. It is we who are surprised.”

I do not confound these words: **function**, **equation**, **graph**, **formula**, **coefficient**, **inequality** —I realize that these mean different things and I take the time to choose the correct word.

Ch₁₁ I have not used a comma to mean “then”! Instead of writing “If $x = 0$, $y = 5$, $z = 2$ ” I make the correct choice between “If $x = 0$ and $y = 5$, then $z = 2$ ” and “If $x = 0$ then $y = 5$ and $z = 2$ ”. Similarly, instead of “When $a > 0$, $b < 5$.” I write (something like) “Whenever $a > 0$, then $b < 5$.”

Ch₁₂ I have not written “Thus x would be 3” when I mean “Thus x is 3” or (probably better) “Thus x

equals 3”. I have used the conditional mode only when I am doing an *argument by contradiction*, e.g, “Suppose, for the sake of contradiction, that the cannonball doesn’t have sufficient energy to hit the wall. Then θ would exceed $\pi/4$ and so x would be 3. But x is negative. Thus the cannonball did indeed hit the wall.”

Ch₁₃ Each of my essays starts with an announcement of my results, stated specifically, and with units. For example, suppose the problem-sheet describes the flight of a baseball and then asks “How high did the baseball go and does it clear a 14 foot fence which is 300 feet from home plate?” Then I will start my writeup by: “I will show that the baseball reaches a maximum height of 74 feet, and fails to clear the fence by 2 feet. Thus Joe does NOT make a home run.”

Ch₁₄ I have *announced my methods*, before applying them. Theorems are cited *by name* (preferred), or by theorem-number and page number. Rather than just blunder into a computation, I say “By L’Hôpital’s Rule applied to the ratio f'/h'' ...” or, “By theorem 12, on page 786...”

Ch₁₅ Most importantly, I have done a quality job. I have done *much more* than what was asked of me. And –by the way– *I worked even harder than my teammates!* (But don’t tell them please –I don’t want to hurt their feelings...)

Phrases used in grading

Below, the professor is speaking to the team. I may number long comments that I write on your exam as “*1:”, “*2:”, etc. In contrast, I use “(*1)” to refer to comment “*1:”.

TSNV “*This sentence no verb.*” For example, suppose you write “ $\int_2^5 x^2 dx$ ” on one line and you write “ $\int_2^5 x dx$ ” on the next. What you *probably* mean is that the first number [the definite integral] is bigger than the second, because $x^2 > x$ for all $x \in [2, 5]$. However, you failed to write “ $>$ ” between the integrals and so I have no idea what relation you intended to assert between the two numbers.

Remember that relations such as “=”, “ \neq ”, “ $>$ ”, “ \in ”, “ \ni ”, “ \supset ”, “ \supset ”, “*is prettier than*”, are verbs [or rather, are phrases which play the role of a verb].

CR “*Can’t read*” —I can’t make out what you’ve written here. Also: **SP**, “*SPelling error*”. Also: **TINE**, “*This Is Not English*” —your paragraph is seriously ungrammatical and/or is incoherent. This often happens when **Ch₁₀** or **Ch₁₁** is violated, or when “*it*” or “*the function*” is written several times, sometimes meaning g , sometimes f , sometimes f^{-1} , sometimes f' , sometimes f'' ... —you get the idea.

DYMean “*Do you mean...*” Also: **MW?**, “*Means what?*” —I can’t figure out the meaning of something that you have written.

MI⁵WGA The famous “*Maybe If I Ignore It, It Will Go Away*” error. The student ignores unpleasant cases, e.g, he divides both sides of an equation by $[y - 3]$, conveniently forgetting to analyze the case when $y = 3$. Or he has proven that $\sqrt{x^2} = 5$ and then blithely concludes that $x = 5$ —cheerfully overlooking that x might have been negative.

Y $\not\approx$ Y Also written **YCY**: “*You contradict yourself*” —usually written with arrows pointing at two assertions you’ve written that contradict each other. I use a tilted $\not\approx$ for “*contradiction*”.

Magic? Where is the justification for the step you just did? A related error is **HDYTKYC?** —“*How do you know that you can?*” The student has used the conclusion of a theorem, but has not verified the hypotheses.

OY $\not\approx$ YOWTOP! “*Oops, You’ve Assumed What YOu Wanted TO Prove!*” [I may just abbreviate this as *Oy!*] If you are trying to show that “*A implies B*” then you may assume *A*. However, you must not assume *B* —*that* is what you are trying to prove.

WFFW? “*What Follows From What?*” The student lists a sequence of assertions, but without employing useful connective phrases such as: But, ... which implies ..., In contrast to the preceding inequality, Nonetheless, Consequently from eqn. 6, ... which, together with the Chain Rule applied to $\sin(\cos(x))$, shows ...

One particular way a student might commit a **WFFW?** is the dreaded **SS**, the “*Semicolon Soup*”. Here, the student *could* have carefully structured a paragraph clearly showing his reasoning. Instead he

chose to toss together a bunch of fragments, placing a semicolon between each pair, thinking that this will fool his benighted professor into believing that what he has written is English. He is wrong; it won’t, and it isn’t.

Cheers, Prof. K