The Curve Ball :

Ratios, Radians & The Unit Circle
Physics 204
John Jay College of Criminal Justice
Walters, Martens Yaverbaum and the Effervescent Ox, presiding

USING NOTHING OTHER THAN THE EQUIPMENT PROVIDED[*]

AND USING EACH INSTRUMENT IN NO MANNER
OTHER THAN THE BASIC FUNCTION FOR WHICH IT WAS DESIGNED,

PLEASE PERFORM EACH OF THE TASKS DESCRIBED ON THE PAGES TO FOLLOW.
The EQUIPMENT

1. Blank Paper
2. Compass,
   a. i.e.: Circle-Drawing Tool
   b. the compass has no 'memory'; if it were a perfect compass, it would collapse after every use
3. Straight Edge
   a. i.e.: NOT a ruler. No markings to be seen here.
   b. No markings to be made here

Please perform each of the following drawing tasks as precisely and reproducibly as possible – within reason.[†]

Specifically, you do your best to attack each next task in the attempt to make it really '***good***': to land as far as possible on the '***good***' end of the quality spectrum. '***Good***', here, is defined as follows:

1. Successful:

   a. Meets all criteria/constraints specified for a given task.

   b. Example: Imagine the instruction for a task is "Help a bent and crotchety professor across the street". In such a case, your lab partner might well invent a machine which cures cancer, feeds the hungry, speeds up john jay elevators and streams hip-hop music to underprivileged extra-terrerstrial cultures throughout the virgo supercluster, but that crotchety professor is still hobbling straight into traffic. In the context of this assignment, by definition, your lab partner **did not** *do **good***.

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[*] As well as your own writing implements, preferably pencil
[†] Do not say 'I am not a good artist'. Just please don't. Don't get me started.

2. Reliable:

    a. Involves an analytical or explicable reason for why anyone should believe that the task has been accomplished. There must be a basis for confidence beyond the pitch and volume at which your lab partner shouts, "Just look at it, dagnabbit!"

    b. Example: Imagine that the instructions for a task are "draw one ('*reference*') *point* somewhere on your page; now draw a small *curve* somewhere on your page – SUCH THAT no matter what tiny piece (point) of the curve you choose, you find it's the same distance from that single reference point." Then, it would not work to close your eyes, draw a random curve and hope to find out it's ok. You want, rather, to devise a persuasive method, such as: "I used one edge of a compass to make the reference point; I used the other edge of the same compass to draw the curve. I therefore know that my curve is a single arc cut from a single circle. A circle is just that: a closed curve of points – all equidistant from a given point."

3. Reproducible:

    a. Whatever you did which looks successful and which you might even be able to discuss convincingly as a success, must be capable of happening again – on demand, and without the eyes of a Newt, a prayer circle and/or a connection to anyone named Dumbledore. In other words, you need to know what you did and how.

    b. See Example from (2), above. Just make sure the compass was not made in Las Vegas.

4. Imperfect:

    a. Yes: **im**perfect. You are being asked to perform some tasks within a messy world of organic and inorganic bodies dwelling on a finite Earth amidst constraints and conditions established by the swirl of byproducts born from the marriage of time to space; specifically, this is W 59th Street, not the kingdom of heaven, no matter how eternally you might wait for an elevator.

    THEREFORE: If ever you claim to make a measurement, collect a data set or perform any of the following tasks with *literally perfect* execution, we are forced to claim that you are cheating. Off of the lord's paper. Or that you are very very troubled. Or that you did not read the directions. We might even go so far as to say that you **<u>did not</u>** do *good*.

    b. FURTHERMORE: If you, by any well intention or circumstance, ever find yourself striving for perfection or believing that it is required of you or of any physicist -- or that you will have failed if you achieve anything more than 0% uncertainty or 0% error, than please *immediately stop* what you are doing and walk away… leave the protractor and take the canoli. Create each of the following shapes with as much accuracy, reliability and reproducibility as possible and do even better the next time. But:

    <div align="center">

    always understand
    that it is always understood

    that when a physicist says,
    for example,

    'these two points are identically far away from that one point',

    s/he means:

    'these two points differ in distance by an amount
    which is smaller than my instruments can measure
    and/or smaller than I could possibly be bothered to care about in this context'.

    </div>

    So. The tasks. . .

<u>The TASKS</u>

I. Fully close your compass. Open it to a random size. Close it again. Open it to a new random size. Close it again. Let this important little hand-refreshing interlude activity herein be known as 'shuffling the compass'.

II. Draw a line segment of arbitrary length somewhere on your page. It should be long enough to see and work with, but short enough to leave lots of room for other things.

From here on in, let the length of that line segment be known as '1 UNIT'.

Shuffle your compass.

III. Somehow, somewhere else on the page, draw another line segment – one which, you will be quite confident to report, also has a length of 1 UNIT.

(Hint1: Use your compass. Hint2: Not that way. If it feels like cheating, it is. Hint3: Yes, that way.)

Shuffle your compass.

IV. Somehow, somewhere, create a line segment of length 2 UNITS.

Shuffle your compass.

V. Somehow, somewhere, create a line of length ½ UNITS.

Shuffle your compass.

VI. Draw a fresh new line segment which will be again, by decree (definition), 1 UNIT. Could be the same UNIT as before or not. Your party. Let's call this segment 'A' for clarity.

VII. Somehow, somewhere, draw a line segment, 'B' which you know to make a right angle to segment A.

Shuffle your compass.

VIII. Somehow, somewhere, draw a line segment which you confidently know to have a length $\sqrt{2}$ UNITS.

Shuffle your compass.

IX. Pause. Take a breath. Consider the implications.