

## Biology 427 Problem Set 1 Spring 2011

### General Comments About Problem Sets.

This and all future problem sets are designed to lubricate your numerical neurons. Turn them in at your discussion section.

Feel free to work in groups, but be sure the work you turn in is your own.

Feel free to abuse your instructor and TA. We will have office hours for you to invade with your questions.

Please -- always explain your answers and show all your work. By doing so you can often get credit for numerically incorrect answers.

Every problem set comes bundled with a paper for you to review. These are extracted from the primary literature and we ask that you read these critically and comment on them. Be prepared to come to section with comments you will share with your colleagues.

### 1) Mathematica warm up --

a. Plot  $\sin(x)$  for  $x$  between 0 and  $2\pi$  -- do so by using the following command typed exactly as follows:

```
Plot[Sin[x],{x,0,2*Pi}]
```

b. Symbolically solve the quadratic equation  $ax^2 + bx + c = 0$ . Do so by typing the following

```
Solve[a*x^2 + b*x + c == 0,x]
```

c. Make up a function of time  $t$  and find its derivative and integral.

```
D[function,t]
```

```
Integrate[function,t]
```

2) Ballistic motion and a soccer game. A soccer player earned a free goal kick. Sadly, an evil competitor substituted the normal soccer ball with one partially filled with lead, weighing 30 kg. With adrenaline pumping, the soccer player somehow managed to kick the ball 20 m having launched it at 45 degrees ( $\pi/4$  radians).

(a) What is the initial take-off velocity of the ball?

(b) What is the kinetic energy associated with this take-off velocity?

(c) The parameter that is hardest to measure is the take-off angle. Plot the predicted kinetic energy as a function of take off angle. You can do so with *Mathematica* or on your own.

3) Two biomechanics students competed in a ballistic walking race. One was a female whose leg length was 0.8 m and the other was a male whose leg length was 1.2 m. For a 5 m distance they both scored an identical time of 2.4 s (these by the way are real data!).

(a) Is this greater or less than the maximum predicted speed for rigid limb (ballistic, inverted pendulum) walking.

(b) Explain what factors could contribute to the proportionately greater speed attained by the female biomechanics student.

Attached is an original research article from the prestigious journal Nature. This paper represents what is considered to be a major contribution to a broad set of scientific disciplines. It is important that you read both the paper and the instructions for contributors.

Journals of this sort (Nature and Science) have a board of editors whose job is to decide whether such original research contributions are worthy of publication. Since no editor can be an expert in all fields of science, they must rely on the expert opinion of colleagues for a careful evaluation of the scientific merit of submitted papers. All professional scientists serve in this role of providing reviews of submitted papers. This peer review process is the most crucial form of quality control in modern science. Not only does it attempt to regulate the quality of publications, it is also the dominant mechanism by which funding and promotions are regulated. While it seems to be a reasonable and working mechanism, it is not infallible. As such, all that is published is not necessarily without flaw.

Your TA will act as an editor of the prestigious journal Biomechs@UW. He is seeking your professional opinion of the enclosed manuscript. Please give your frank and candid opinion of the paper using the form enclosed. We have also attached a copy of the instructions for contributors that you should read before you evaluate the paper. In preparing your evaluation please use the following guidelines.

What are the specific strengths and weaknesses of the paper?

Is this paper of interest to a broad sector of the scientific community?

Does this paper potentially open up new directions and, if so, which?

Extra things to keep in mind when reviewing a paper:

Read the paper through entirely. If you did not fully understand the paper, do not assume it is your fault. Ask how the author could have improved the paper to make it clearer. After you have considered these issues, next ask how novel and broad are the findings. Does future work seem warranted? Is it exciting or does it seem like a dead end program?

The format of the paper is rather constrained by the style of the journals Science and Nature. It is helpful if you read the instructions to contributors first to understand why the paper in the form you have read.

#### How to Prepare your review

These should be written in essay form with complete sentences. In this way we can give you substantive feedback on your writing. Please try to stick to the forms we provide -- these, after all, are the ones the journals ask reviewers to use.

Begin your review with a summary of the major findings of the paper and follow this by indicating both the strengths and weaknesses in the paper (presentation, logic, experimental design, statistical methods are all fair game for comment).

End your review with a paragraph in which you make a clear decision about publishing this manuscript. Is it convincing, novel and noteworthy? Should it be sent to a more specialized journal, or should it be summarily rejected? Do the

authors convince you that this paper constitutes a contribution of general interest to the scientific community?