Easy Ways to Get Points on the Final

READ AND ANSWER THE ENTIRE QUESTION. A lot of points have been lost on homeworks for not completely answering the question. For instance, if we ask for a comparison, explicitly make the comparison; there will be points assigned for it!

ANSWER LEGIBLY AND CLEARLY. If we can't find or can't read your answer, you won't get points for it. And the easier it is for us to read, the happier we are, and the more points you get!

ANSWER SUCCINCTLY. We will not ask for a long essay. Short answers are easier for you to write, and leave you more time for the rest of the exam, and are easier for us to read and grade. Include all the information necessary to answer the question, but not too much more.

CONVINCE US YOU UNDERSTAND THE MATERIAL. If you just use the buzzwords, we may not believe you understand what they mean – for example, don't just say "protein denaturation and coagulation" to explain a cooked egg, but explain that this means proteins unfolding, and then binding to other proteins through hydrophobic interactions to form a large network.

Math Tips

PAY ATTENTION TO UNITS. This will save you in two ways. First, we will take off points if you have missing or incorrect units. Second, if your units don't work out to what you expect (e.g. you're calculating a time but somehow your units work out to meters), it means you've done something wrong in the equations.

PAY ATTENTION TO SIGNIFICANT FIGURES. If you haven't figured it out from the homeworks yet, we do take off points for having too many significant figures! If you're not comfortable with significant figures, take a look at the math review worksheets from the beginning of term, or ask in office hours. But remember, **do not round during calculations, only when you report your final answer.**

SHOW YOUR WORK. You will not get many points for the right answer if you don't show work. Furthermore, if you show your work but make a mistake, you can still get most of the points in partial credit even if you get the wrong answer.

REALITY CHECK. Make sure your answer makes sense! For instance, if we ask how long it takes to cook a turkey, and you get an answer of 2 seconds, you probably messed up somewhere; likewise if you get an answer of 2 years. Points will be taken off for ridiculous answers.

Math Tips

SUGGESTED PROCESS FOR A MATH PROBLEM:

- Identify what quantity we are asking for.
- Identify the equation that involves that quantity, and in which you know the other variables.
- Rearrange the equation to isolate the unknown quantity.
- Plug in your numbers for the known variables.

The Equations of the Week

Weeks 5-9

$$U_{hydrophobicity} = Nk_BT + U_{electrostatics}$$

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units: **J** or **kJ/mol**

Meaning: the energy required to break the hydrophobic 'bonds' within one folded protein

To get an estimate of the total U_hydrophobicity, multiply 10 kJ/mol by N_hydrophobic, the number of hydrophobic amino acids in the protein.

$$U_{hydrophobicity} = N k_B T + \ U_{electrostatics}$$

units: none or **mol**

Meaning: total number of amino acids on the protein

$$U_{hydrophobicity} = N k_B T + U_{electrostatics}$$

units: **J/K**

Meaning: constant, relates temperature and energy

$$U_{hydrophobicity} = Nk_BT + U_{electrostatics}$$

units: **K**

Meaning: temperature of denaturation

Note it *is* important to use K, *not* C or F.

$$U_{hydrophobicity} = Nk_BT + \ U_{electrostatics}$$

units: **J** or **kJ/mol**

Meaning: thermal energy; measure of entropy which wants the protein to unfold

$$U_{hydrophobicity} = Nk_BT + U_{electrostatics}$$

units: **J** or **kJ/mol**

Meaning: energy due to charges on the protein pushing it apart.

Note: you will not be expected to compute U_electrostatics, but should be able to argue qualitatively about whether and why it increases or decreases by, for example, adding an acid, base, or salt.

$$U_{surface} = \sigma \times 4\pi R^2$$

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units: **J**

Meaning: the energy required to create a single droplet or bubble.

To find the total energy needed for an emulsion or foam, multiply the U_surface *per droplet* by the number of droplets.

$$U_{surface} = \sigma \times 4\pi R^2$$

units: **J/m^2 or N/m**

Meaning: the energy *per unit surface area* required to create new liquid-liquid or liquid-gas interface

σ is a property of the system: which liquid or gas is on each side of the interface, and if there are any surfactant molecules or particles at the interface.

$$U_{surface} = \sigma \times 4\pi R^2$$

units: **m**

Meaning: the radius of a droplet or bubble.

$$\Delta P = \frac{2\sigma}{R}$$

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units: **Pa or N/m^2**

Meaning: the pressure difference between the outside and the inside of a droplet or bubble. The pressure inside is higher.

Note that to get the total pressure inside a droplet or bubble, you must add this pressure difference to the ambient (outside) pressure, usually atmospheric pressure.

$$\Delta P = \frac{2\sigma}{R}$$

units: **J/m^2 or N/m**

Meaning: the energy *per unit surface area* required to create new liquid-liquid or liquid-gas interface.

Also the force per unit length with which the interface pulls to try to become smaller.

$$\Delta P = \frac{2\sigma}{R}$$

units: **m**

Meaning: the radius of a droplet or bubble.

$$E = \frac{k_B T}{l^3}$$

$$E = \frac{k_B T}{l^3}$$

units: **Pa** or **N/m^2**

Meaning: the *elastic modulus*, a measure of how stiff a solid is, or how much weight it will support. A larger value of E indicates a stiffer object, while a smaller value indicates a softer object.

$$E = \frac{k_B T}{l^3}$$

units: **J/K**

Meaning: constant, relates temperature and energy

$$E = \frac{k_B T}{l^3}$$

units: **K**

Meaning: temperature; almost always room temperature

$$E = \frac{k_B T}{l^3}$$

units: **m**

Meaning: average distance between cross-links in a gel.

Note this is *not* the same as the size of the molecules forming the gel.

$$L_{shell} = \sqrt{\pi D_{Ca} t}$$

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units: **m**

Meaning: thickness of an alginate shell, in either basic or reverse spherification.

$$L_{shell} = \sqrt{\pi D_{Ca} t}$$

units: **m^2/s** or **cm^2/s**

Meaning: the diffusion *constant* of calcium ions through water; a measure of how quickly calcium ions move.

$$L_{shell} = \sqrt{\pi D_{Ca} t}$$

units: **s** or **min**

Meaning: the time for which a sphere has been in the bath.

$$T(t) = (T_{initial} - T_{external})e^{-t/\tau} + T_{external}$$

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units: **K** or **C** or **F**

Meaning: the temperature in a dish being cooked at time *t*.

$$T(t) = (T_{initial} - T_{external})e^{-t/\tau} + T_{external}$$

units: **K** or **C** or **F**

Meaning: the starting temperature of the dish at time t=0; usually room temperature.

$$T(t) = (T_{initial} - T_{external})e^{-t/\tau} + T_{external}$$

units: **K** or **C** or **F**

Meaning: the external temperature, e.g. of the oven, pan, or boiling water.

Note that you may use Kelvin, Celsius, or Fahrenheit for the temperatures as long as you use the same scale for all three.

$$T(t) = (T_{initial} - T_{external})e^{-t/\tau} + T_{external}$$

units: **s** or **min** or **hours**

Meaning: the time for which the dish has been cooking

$$T(t) = (T_{initial} - T_{external})e^{-t/\tau} + T_{external}$$

units: **s** or **min** or **hours**

Meaning: the characteristic time constant of the dish; this depends primarily on the geometry and size of the dish, as discussed in week 4.

$$N(t) = N_0 e^{kt}$$

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units: **none**

Meaning: the number of organisms (e.g. microbes) present after time *t.*

$$N(t) = N_0 e^{kt}$$

units: **none**

Meaning: the initial number of organisms (e.g. microbes) present at time t=0.

$$N(t) = N_0 e^{kt}$$

units: **1/s** or **1/min**

Meaning: the *rate constant* of reproduction of an organism; a small value of k indicates that the organism reproduces slowly, while a large value of k indicates that the organism reproduces quickly.

Given by k = ln(2)/T where T is the doubling time.

$$N(t) = N_0 e^{kt}$$

units: **s** or **min**

Meaning: the time for which a population of organisms has been growing.