Math 696 – Spring 2004
Document Preparation

Your assignment is to duplicate this page. You need not duplicate the marginal notes (unless you want to do so for extra credit). In Topic 1 you must integrate a picture with text. This can be accomplished using various boxes.

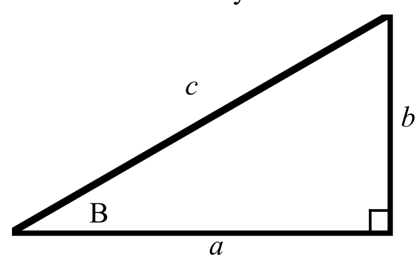
1 Topic 1 - inserting pictures

Marie-Sophie Germain (1776 - 1831) was born in Paris and lived there her entire life. She was the middle daughter of Ambroise-Francois, a prosperous silk-merchant, and Marie-Madelaine Gruguelin. At the age of thirteen, Sophie read an account of the death of Archimedes at the hands of a Roman soldier. She was moved by this story and decided that she too must become a mathematician. Sophie pursued her studies, teaching herself Latin and Greek. She read Newton and Euler at night,wrapped in blankets, as her parents slept. Not at all encouraging her talent and in an effort to turn her away from books, they had taken away her fire, her light and her clothes. Sophie obtained lecture notes for many courses from Ecole Polytechnique. Ultimately, she was a mathematical correspondent with the great Karl Gauss, who knew her as Monsieur LeBlanc.

In this topic, you will make a table of values.

2 Topic 2 - Making a table.

Interpreting Plimpton 322. As we have seen there is solid evidence that the ancient Chinese were aware of the Pythagorean theorem, even though they may not have had anything near to a proof. The Babylonians, too, had such an awareness. Indeed, the evidence her is very much stronger, for an entire tablet of Pythagorean triples has been discovered. The events surrounding them reads much like a modern detective story, with the sleuth being archaeologist Otto Neugebauer. We begin in about 1945 with the **Plimpton 322 tablet**, which is now the Primpton collection at Yale University, and dates from about 1700 BCE. It appears to have the left section broken away. Indeed , the presence of glue on the broken edge indicates that it was broken after excavation. To see what it means, we need a model right triangle. Write the Pythagorean triples, the edge b in the column thought to be severed from the tablet. Note that they are listed decreasing cosecant.



Right Triangle

b	$(c/b)^2$	a	c	
120	$(169/120)^2$	119	169	1
3456	$(4825/3456)^2$	3367	4825	2
⋮				
90	$(106/90)^2$	56	106	15

Here we insert some extra space. The next table uses a different layout. Don't worry about inserting the characters: koppa, sampi, and digamma. Those are not in any standard font set.

Greek Enumeration and Basic Number Formation First, we note that the number symbols were the same as the letters of the Greek alphabet.

symbol	value	symbol	value	symbol	value
α	1		10	ρ	100
β	2		20	σ	200
γ	3	λ	30	τ	300
δ	4	μ	40	υ	400
ε	5	ν	50	ϕ	500
⋮	⋮	⋮	⋮	⋮	⋮

3 The Transport equation

We write the monoenergetic two-dimensional transport equation in the form

This is a partial differential equation of the first order. Can you place this 6pt note right here and still have the equation centered and numbered?

$$\mu \frac{\partial \psi}{\partial x} + \eta \frac{\partial \psi}{\partial y} + \sigma \psi = Q. \tag{1}$$

Here ψ is the angular flux in the directions having direction cosines $\mu, \eta,$ and $\zeta := \pm\sqrt{1 - \mu^2 - \eta^2}$, or more briefly in the direction (μ, η). Further, σ is the total cross section, and Q is the total source function in the direction (μ, η). In the present work the focus is upon the *monodirectional* version of this equation, as appropriate to execution of the ray-tracing calculatons that constitute the computations inside the innermost loops of any solution of the discrete-ordinates approximation to (1). This means that μ and η will be taken as fixed, usually as nonnegative in order to fix the ideas, subject to $\mu^2 + \eta^2 \leq 1$, and Q will be treated as known.

The transverse integral appearing in Eq. (2.3) can be expressed as

$$\begin{aligned}
\frac{1}{\tilde{\eta}} T_{n_y} &= \int_{-1}^{1} \frac{\partial \psi}{\partial y} P_{n_y}(y) dy \\
&= \psi(x,y) P_{n_y}(y) \Big|_{-1}^{1} - \int_{-1}^{1} \psi(x,y) \frac{d}{dy} P_{n_y}(y)\, dy \\
&= \psi(x,1) - \psi(x,-1)(-1)^{n_y} \\
&\qquad - \int_{-1}^{1} \psi(x,y)[(2n_y - 1)P_{n_y-1}(y) + P'_{n_y-2}(y)]dy \\
&= \psi(x,1) - \psi(x,-1)(-1)^{n_y} - (2n_y - 1)\psi_{n_y-1}(x) - \cdots \\
&= \psi(x,1) - \psi(x,-1)(-1)^{n_y} \\
&\qquad - \sum_{\ell=o}^{\lfloor (n_y-1)/2 \rfloor} [2(n_y - 2\ell) - 1]\tilde{\psi}_{n_{y-2\ell-1}}(x),
\end{aligned} \tag{2}$$

where $\lfloor z \rfloor$ is the greatest integer not exceeding z. Similarly that appearing in (2.4) is given by ...