Daniel W. Galef, QED
65 Edgemont Road
Montclair, NJ 07042-2304

phone/fax (973) 746-0848
e-mail DWG314159@earthlink.net

Speaking Mathish

[C. P. Snow] says, quite rightly, he says it's no good going up to a scientist and saying to him as you would to anybody else, you know, "good morning, how are you, lend me a quid" and so on, I mean he'll just glare at you or make a rude retort or something. No, you have to speak to him in language that he'll understand. I mean you go up to him and say something like, "Ah, H_2SO_4 Professor! Don't synthesize anything I wouldn't synthesize. Oh, and the reciprocal of pi to your good wife." Now, this he will understand.

--- *Michael Flanders*

Mathematics, as it has often been noted, is its own language. It may be said to be the language of truth, or even the language of beauty, but many people still irrationally (even transcendentally) fear it. As anyone who has gotten past the tricky bit around fifth grade when they start swapping out letters for numbers knows, the alphabet of math is by no means limited to numerals and alien symbols. Sometime between when numbers were first discovered and when calculators were, mathematicians started using letters. And not just silly useless ones, like Greek, but real, decent English characters like a and b. Sometimes even c. In fact, because math has been around for quite a while, they've used all of them, and gone on to capitals and lowercase, diacritical marks, other languages, and made-up quasi-letters. A few years back, I read a *Foxtrot* comic strip by Bill Amend, who often deals with weighty topics like physics and mathematics in his writing, in which a character writes out a Christmas message using mathematical phrases, as such:

$$M(2.71828)\,r^2\,y$$

$$\sqrt{x^2}\,\frac{\text{force (physical quantity)}}{\text{acceleration (physical quantity)}}$$

The M, the rr, the x, and the y are self-evident, in that, while some of them may require some little mathematical reasoning to decipher, they only solve for themselves, as hidden in a slight rephrasing. More interesting is the substitution of 2.71828[...] for e, a universal constant associated with the letter purely by dint of being documented by Euler. Finally, the phrase "mass" in "x-mass" for "Christmas" is written as the division of force by acceleration. Similarly, several, if not all, English letters are, simply by tradition or abbreviation, commonly associated with mathematical formulae, and thus, if one wished to express, in a phrase, the letter c, one could write $\surd(a^2 + b^2)$, relying on the reader's knowledge of the Pythagorean Theorem to connect the meaningless letters with the known equation "$a^2 + b^2 = c^2$," even though the letters themselves may stand for anything at all and bear no necessary relation to the sides of a right triangle with no context. It is simply common association and the structure of the phrase that suggests this solution. Any letter at all (almost) may be thus encoded with common and not-so-common mathematical formulae. Below is a brief list of a few possible rephrasings for each letter of the alphabet, with an explanation of the mathematical or scientific equation or formula referenced. All are real, most are rational, and some are quite complex.

A

(c^2-b^2)^(½)	Length of one leg of a right triangle [c=hypotenuse; b=leg]
F/m	Acceleration [F=force; m=mass]
v’	Acceleration [v=velocity]
s’’	Acceleration [s=position]
r’’	Acceleration [r=position]
(b*sin(A))/(sin(B))=(c*sin(A))/(sin(C))	Length of one side of a triangle [b=adjacent side; B=angle opposite side b; A=angle opposite side a; c=adjacent side; C=angle opposite side c]
(b^2+c^2-2bc*cos(A))^(½)	Length of one side of a triangle [b=adjacent side; A=angle opposite side a; c=adjacent side]
L/F	Area [L=luminosity; F=flux density]
∫(a,b)f(x)dx	Area from x=a to x=b under a function in the form: y=f(x)
$\int(a_x,b_x)\int(a_y,b_y)((1+(f_x(x,y))^\wedge 2+(f_y(x,y))^\wedge 2)^\wedge(1/2))dydx$	Area from $x=a_x$ to $x=b_x$ and from $y=a_y$ to $y=b_y$ of a three-dimensional surface function in the form: z=f(x,y)

B

(c^2-a^2)^(½)	Length of one leg of a right triangle [c=hypotenuse; a=leg]
y-mx	Y-intercept of a line [y=linear function of independent variable “x”; m=slope]
(2A(▲))/h	Base of a triangle [A=area; h=altitude]
(a*sin(B))/(sin(A))=(c*sin(B))/(sin(C))	Length of one side of a triangle [a=adjacent side; B=angle opposite side b; A=angle opposite side a; c=adjacent side; C=angle opposite side c]
(a^2+c^2-2ac*cos(B))^(½)	Length of one side of a triangle [a=adjacent side; B=angle opposite side b; c=adjacent side]

C

(a^2+b^2)^(½)	Length of the hypotenuse of a right triangle [a=leg; b=leg]
(E/m)^(½)	Speed of light [E=energy; m=mass]
λν	Speed of light [λ=wavelength; ν=frequency]
λf	Speed of light [λ=wavelength; f=frequency]
3.00*(10^8)(m/s)	Speed of light in a vacuum

∫f'(x)dx-f(x)	Constant of integration
(a*sin(C))/(sin(A))=(b*sin(C))/(sin(B))	Length of one side of a triangle [a=adjacent side; A=angle opposite side a; B=angle opposite side b; b=adjacent side; C=angle opposite side c]
(a^2+b^2-2ab*cos(C))^(½)	Length of one side of a triangle [a=adjacent side; C=angle opposite side a; b=adjacent side]
D	
rt	Distance [r=rate; t=time]
2r	Diameter of a circle [r=radius]
2(((A(●))/π)^(½))	Diameter of a circle [A=area]
μ/q	Distance between polar molecules [μ=dipole moment; q=charge]
(nλ)/(2sin(θ))	Distance between planes in crystal lattice [n=integral order of diffraction; λ=wavelength; θ=angle of reflected parallel beams]
m/V	Density [m=mass; V=volume]
Π/(gh)=(MRT)/(gh)	Density [Π=osmotic pressure; g=gravitational constant; h=height; M=concentration (molarity) of solution; R=ideal gas constant; T=temperature in Kelvins]
E	
m(c^2)	Energy [m=mass; c=speed of light]
H-PV	Energy [H=enthalpy; P=pressure; V=volume]
hν	Energy [h=Planck's constant; ν=frequency]
hf	Energy [h=Planck's constant; f=frequency]
(hc)/λ	Energy [h=Planck's constant; c=speed of light; λ=wavelength]
q+w	Energy [q=heat; w=work]
2.718281828...	Euler's constant
1/(lim(x-->infinity)((1-(1/x))^x))	Euler's constant
W^(k/S)	Euler's constant [W=number of microstates; k=Boltzmann constant; S=entropy]
F/N_A	Elementary charge [F=Faraday constant; N_A=Avogadro constant]
1.6022*(10^-19)(C)	Elementary charge
F	
ma	Force [m=mass; a=acceleration]
ν	Frequency of a wave [ν=frequency]
v/λ	Frequency of a wave [v=velocity; λ=wavelength]

	c/λ	Frequency of a wave in a vacuum [c=speed of light; λ=wavelength]
	E/h	Frequency of a wave [E=energy; h=Planck's constant]
	eN_A	Faraday constant [N_A=Avogadro constant; e=elementary charge]
	96485.3365...(C/mol)	Faraday constant
	L/A	Flux density [L=luminosity; A=area]
G		
	-9.81(m/(s^2))	Gravitational constant
	-32 (ft/(s^2))	Gravitational constant
	$\Pi/(dh)=(MRT)/(dh)$	Gravitational constant [Π=osmotic pressure; d=density; h=height; M=concentration (molarity) of solution; R=ideal gas constant; T=temperature in Kelvins]
	w/m	Gravitational constant [w=weight; m=mass]
H		
	$E+PV$	Enthalpy [E=energy; P=pressure; V=volume]
	E/ν	Planck's constant [E=energy; ν=frequency]
	E/f	Planck's constant [E=energy; f=frequency]
	$(E\lambda)/c$	Planck's constant [E=energy; λ=wavelength; c=speed of light]
	$mv\lambda$	Planck's constant [m=mass; v=velocity; λ=wavelength]
	$\lambda\rho$	Planck's constant [λ=wavelength; ρ=momentum]
	6.62607...(s*J)	Planck's constant
	$(2A(\blacktriangle))/b$	Altitude of a triangle [A=area; b=base]
	$\Pi/(dg)=(MRT)/(dg)$	Height [Π=osmotic pressure; d=density; g=gravitational constant; M=concentration (molarity) of solution; R=ideal gas constant; T=temperature in Kelvins]
I		
	(-1)^(½)	Imaginary unit
	<1,0,0>	Identity vector parallel to the x-axis
	ĵ×(k^)	Identity vector parallel to the x-axis [ĵ=identity vector parallel to the y-axis; k^=identity vector parallel to the z-axis]
	-((k^)×ĵ	Identity vector parallel to the x-axis [ĵ=identity vector parallel to the y-axis; k^=identity vector parallel to the z-axis]
	<0,1,0>×<0,0,1>	Identity vector parallel to the x-axis
	-(<0,0,1>×<0,1,0>)	Identity vector parallel to the x-axis
J		

<0,1,0>	Identity vector parallel to the y-axis
(k^)×î	Identity vector parallel to the y-axis [î=identity vector parallel to the x-axis; k^=identity vector parallel to the z-axis]
-(î ×(k^))	Identity vector parallel to the y-axis [î=identity vector parallel to the x-axis; k^=identity vector parallel to the z-axis]
<0,0,1>×<1,0,0>	Identity vector parallel to the y-axis
-(<1,0,0>×<0,0,1>)	Identity vector parallel to the y-axis

K

<0,0,1>	Identity vector parallel to the z-axis
î ×ĵ	Identity vector parallel to the z-axis [î=identity vector parallel to the x-axis; ĵ=identity vector parallel to the y-axis]
-(ĵ ×î)	Identity vector parallel to the z-axis [î=identity vector parallel to the x-axis; ĵ=identity vector parallel to the y-axis]
<1,0,0>×<0,1,0>	Identity vector parallel to the z-axis
-(<0,1,0>×<1,0,0>)	Identity vector parallel to the z-axis
R/N_A	Boltzmann constant [R=ideal gas constant; N_A=Avogadro constant]
S/(ln(W))	Boltzmann constant [S=entropy; W=number of microstates]
1.38065*(10^-23)(J/K)	Boltzmann constant
||T'||/||r'(t)||	Curvature [T=unit tangent vector; r(t)=position vector in terms of time]
||r'(t)×r''(t)||/(||r'(t)||^3)	Curvature [r(t)=position vector in terms of time]
|y''|/((1+(y')^2)^(3/2))	Curvature [y=function of independent variable "x"]

L

(A(▬))/w	Length of a rectangle [A=area; w=width]
FA	Luminosity [F=flux density; A=area]

M

E/(c^2)	Mass [E=energy; c=speed of light]
F/a	Mass [F=force; a=acceleration]
h/(λv)	Mass [h=Planck's constant; λ=wavelength; v=velocity]
ρ/v	Mass [ρ=momentum; v=velocity]
p/v	Mass [p=momentum; v=velocity]
w/g	Mass [w=weight; g=gravitational constant]
dV	Mass [d=density; V=volume]
ρV	Mass [ρ=density; V=volume]
(y-b)/x	Slope of a line [y=linear function of independent variable "x"; b=y-intercept]

$(dy)/(dx)$	Slope (instantaneous) [y=function of independent variable “x”]
$(y_2-y_1)/(x_2-x_1)$	Slope (non-instantaneous) [y=function of independent variable “x”]
$(\Delta y)/(\Delta x)$	Slope (non-instantaneous) [y=function of independent variable “x”]
mol/L	Concentration (molarity) of a solution
$\Pi/(RT)=(dgh)/(RT)$	Concentration (molarity) of a solution [Π=osmotic pressure; R=ideal gas constant; T=temperature in Kelvins; d=density; g=gravitational constant; h=height]
g/L	Concentration (molality) of a solution
$\Delta T_b/K_b$	Concentration (molality) of a solution [ΔT_b=change in boiling point of solution; K_b=boiling point constant of solution]
$\Delta T_f/K_f$	Concentration (molality) of a solution [ΔT_f=change in freezing point of solution; K_f=freezing point constant of solution]

N

$(PV)/(RT)$	Amount in moles [P=pressure; V=volume; R=ideal gas constant; T=temperature in Kelvins]
$T'/\|\|T'\|\|$	Unit normal vector [T=unit tangent vector]

O

16.00(g/mol)	Elemental oxygen

P

$(nRT)/V$	Pressure [n=amount; R=ideal gas constant; T=temperature in Kelvins; V=volume]
$(H-E)/V$	Pressure [H=enthalpy; E=energy; V=volume]
mv	Momentum [m=mass; v=velocity]

Q

E-w	Heat [E=energy; w=work]
μ/d	Charge of a polar molecule [μ=dipole moment; d=distance]

R

$(PV)/(nT)$	Ideal gas constant [P=pressure; V=volume; n=amount; T=temperature in Kelvins]
kN_A	Ideal gas constant [k=Boltzmann constant; N_A=Avogadro constant]
$\Pi/(MT)=(dgh)/(MT)$	Ideal gas constant [Π=osmotic pressure; M=concentration (molarity) of solution; T=temperature in Kelvins; d=density; g=gravitational constant; h=height]
0.082058((atm*L)/(mol*K))	Ideal gas constant

8.3145(J/(mol*K))	Ideal gas constant
d/t	Rate [d=distance; t=time]
((A(●))/π)^(½)	Radius of a circle [A=area]
d/2	Radius of a circle [d=diameter]
∫vdt	Position vector [v=velocity]

S

(A(■))^(½)	Side of a square [A=area]
∫(a,b)(((x'(t))^2+(y'(t))^2)^(1/2))dt	Arc length from time "a" to time "b" of a parametric curve in vector format: x=x(t),y=y(t)
∫(a,b)((1+(f'(x))^2)^(1/2))dx	Arc length from point (a,f(a)) to point (b,f(b)) of a function in the format: y=f(x)
∫vdt	Position [v=velocity]
k*ln(W)	Entropy [k=Boltzmann constant; W=number of microstates]

T

(PV)/(nR)	Temperature (in Kelvins) [P=pressure; V=volume; n=amount; R=ideal gas constant]
Π/(MR)=(dgh)/(MR)	Temperature (in Kelvins) [Π=osmotic pressure; M=concentration (molarity) of solution; R=ideal gas constant; d=density; g=gravitational constant; h=height]
d/r	Time [d=distance; r=rate]
(r'(t))/||r'(t)||	Unit tangent vector [r(t)=position vector in terms of time]

U

238.03(g/mol)	Elemental uranium

V

(nRT)/P	Volume [n=amount; R=ideal gas constant; T=temperature in Kelvins; P=pressure]
(H-E)/P	Volume [H=enthalpy; E=energy; P=pressure]
∫(a_x,b_x)∫(a_y,b_y)f(x,y)dydx	Volume from x=a_x to x=b_x and from y=a_y to y=b_y under a three-dimensional curve function in the form: z=f(x,y)
m/d	Volume [m=mass; d=density]
m/ρ	Volume [m=mass; ρ=density]
s'	Velocity [s=position]
r'	Velocity [r=position]
∫adt	Velocity [a=acceleration]
ρ/m	Velocity [ρ=momentum; m=mass]
p/m	Velocity [p=momentum; m=mass]
λν	Velocity of a wave [λ=wavelength; ν=frequency]

	λf	Velocity of a wave [λ=wavelength; f=frequency]
	$h/(\lambda m)$	Velocity of a wave [h=Planck's constant; λ=wavelength; m=mass]
W		
	E-q	Work [E=energy; q=heat]
	(A(■))/l	Width of a rectangle [A=area; l=length]
	e^(S/k)	Number of microstates [e=Euler's constant; S=entropy; k=Boltzmann constant]
	mg	Weight [m=mass; g=gravitational constant]
X		
	(y-b)/m	X-value of a line at a given height "y" [y=linear function of independent variable "x"; b=y-intercept; m=slope]
	mol/mol	Concentration (mole fraction) of a solution
Y		
	f(x)	Function of independent variable "x"
	mx+b	Function of a line [x=independent variable; m=slope; b=y-intercept]
Z		
	f(x,y)	Function of independent variables "x" and "y"

NOTE: I have not happened upon adequate representations for the letters: L, O, U, X, Y, or Z. L is often associated with length, but, without resorting to the childishly simple A/w, or "area over width," which assumes a parallelogram, this is difficult to indicate. X, Y, and Z are usually reserved for variables and axes, which makes any actual description at all almost impossible, beyond using Y and Z merely as dependent variables of the others. The description above, of a line, is often taught as $y = mx + b$, but may not be as reliable as some other phrases. O seems to be generally avoided due to its graphic similarity with zero, and U I could find so little on, I threw in what may seem a cop-out to chemists: referring to the atomic symbol of uranium by its properties. I use molar mass, but atomic number, weight, etc. may also be used. ■