

# USING THE TI-83 SOLVER WITH SCIENCE PROBLEMS

John F. Mahoney

The major law in chemistry related to gasses is the Ideal Gas Law:  $PV=NRT$ . If the volume is in liters, the temperature in degrees Kelvin, and the pressure is in atmospheres, R has a value of 0.0821 and units of  $\frac{\text{liter-atm}}{\text{mole-Kelvin}}$ . One can use the Solver on the TI-83 to simplify the solution to problems involving the ideal gas law. The Solver is accessed from the **MATH** menu by selecting 0:Solver (see Figure 1).

(If an equation had previously been entered, the screen in Figure 1 can be displayed by pressing the up arrow.) The calculator requires that the equation be written in the form  $0 =$  . So, type in the equation in the form  $0 = PV - NRT$  (see Figure 2).

Pressing **ENTER** produces a chart of variables similar to the screen in Figure 3. Here's a typical chemistry problem: If 3.00 g of Freon gas is introduced into an evacuated 500.0 mL container at 10°C, what pressure in atmospheres is developed? First the quantities are converted to the proper units:

$$V = 500.0 \text{ mL} = 0.500 \text{ L}$$

$$T = 10 + 273 = 283 \text{ K}$$

Since the molar mass of Freon ( $\text{CF}_2\text{Cl}_2$ ) is 120.91 g/mol, then  $n = 3.00 \text{ g CF}_2\text{Cl}_2 \times 1 \text{ mol}/120.91 \text{ g} = 0.0248 \text{ mol}$ . Enter the values into the Solver screen (see Figure 4).

Each variable needs a value. The 0 in  $P=0$  is an initial guess. Move the cursor up to the 0 in the equation  $P=0$ , press the buttons **ALPHA**, Solve (**2nd** **ENTER**) and the calculator will produce the correct value:  $P=1.15 \text{ atm}$  (see Figure 5).

One can make changes in the problem with ease, to explore, for example how much volume this same quantity of gas would have if the pressure were 2 atm. Change the value of P to 2 (see Figure 6).

Move the cursor to the .5 in  $V = .5$ , then press **ALPHA** Solve and the calculator will compute the new volume of .288 liters. (see Figure 7).

Each of the sciences has its stock equations. The TI-83 can be of significant help to those who work with particular equations frequently.

Notes: 1) The  $\{-1E99, 1E99\}$  range for bound can be modified so that the calculator solves for the variable more quickly. 2) The "left-rt = 0" statement indicates that the value obtained (for P) makes the difference between the left and right sides of the equation equal 0. 3) Students planning on doing lots of different problems can store an equation using the **Y =** menu. For example  $Y5=PV-NRT$  and then that equation can be pasted into the Solver equation by typing **2nd** **RCL** **VAR5**, **Y-VARS**, 1:Function, 5:Y5. Further hints on using the Solver can be found in the TI-83 manual, pages 2-8 through 2-12.

*Example from p. 110, William L. Masterton, Cecile N. Hurley, Chemistry Principles and Reactions, Saunders College Publishing, 1993*

```
EQUATION SOLVER
eqn: 0=PV-NRT
```

Figure 1

```
EQUATION SOLVER
eqn: 0=
```

Figure 2

```
PV-NRT=0
P=0
V=0
N=0
R=0
T=0
bound=(-1E99,1E99)
```

Figure 3

```
PV-NRT=0
P=0
V=.5
N=.0248
R=.0821
T=283
bound=(-1E99,1E99)
```

Figure 4

```
PV-NRT=0
P=1.15242128
V=.5
N=.0248
R=.0821
T=283
bound=(-1E99,1E99)
left-rt=0
```

Figure 5

```
PV-NRT=0
P=2
V=.5
N=.0248
R=.0821
T=283
bound=(-1E99,1E99)
```

Figure 6

```
PV-NRT=0
P=2
V=.28810532
N=.0248
R=.0821
T=283
bound=(-1E99,1E99)
left-rt=0
```

Figure 7