Thanks for looking at our
Appendix problem examples:
Units, graphs, and per problems

To the Right

Table of the units' conversion problems solved in Appendix A.

Below

Table of Per Problems Solved in Appendix B.

Below Right

Table of Graph Problems in Appendix C.

Page or Scroll down for specific samples

Units' Conversion problems solved in Appendix A.
Page or scroll down for a sample.

A.1 *Find the area of a rectangle whose length is 4 inches (in) and whose width is 6 centimeters (cm).*

A.2 *Express 60 mph in ft/sec:*

A.3 *Express* $10 \frac{ft}{(s)^2}$ *in inches per minute.*

(Note: ft/s^2 is acceleration with dimensions of length/time^2.)

A.4 *How many centimeters are there in a yard?*

A.5 *Express 62.4* lbm/ft^3 *in* gm/cm^3.
(Note: 62.4 lbm/ft^3 is the density of water.)

A.6 *The speed of sound is 680 mph (approximately -* depending on temperature and pressure conditions.) What is the approximate speed of sound in meters/sec?

A.7 *A student's mass is 120 lbm. What is his mass in* kilograms?

A.8 *A man wants to buy the gravel needed to fill a trench* that is 120 meters long by 20 inches wide by three feet deep. How many cubic yards of gravel should he buy?

A.9: *A fully charged battery has energy stored equal to* 100 kw-hr. How much energy is stored in ft-lbf?

A.10: *How many radians are there in 160 degrees?*

List of 'Per' Examples in Appendix B.
Page or Scroll down for an example

Problem Topic	Example #
Books Per Inch	B.2
Board Feet	B.3
Hours Per Gallon	B.4
Pounds Per Square Inch (psi)	B.5
An Old Trick	B.6
Fly on a Flywheel	B.7
A Per-Per Problem	B.8
Per Cent	B.9

List of Graph Examples in Appendix C

Graph Topic	Example #
Monitoring a Boy's Temperature	C.4
Find roots and features of $y = x^2 - 3x + 1$	C.5
Plot $y = 3^x$	C.6

A Units Conversion Example from Appendix A

Example A.3 Express $10 \frac{ft}{(s)^2}$ in inches per minute^2.

(Note: ft/s^2 is an acceleration with the dimensions of length/time^2.)

Solution:

Begin with the given information:

Numbers: 10

Units: $\frac{feet}{s^2}$

We must convert seconds^2 to minutes^2. We know there are 60 seconds per minute, so we square that conversion factor to get $3600 \frac{\sec^2}{\min^2}$.

Or we can just put into the equation twice, like this:

Numbers: 10 x 60 x 60

Units: $\frac{feet}{\cancel{s^2}} \times \frac{\cancel{s}}{min} \times \frac{\cancel{s}}{min}$

If we stopped right there, we'd have $36000 \frac{feet}{\min^2}$ but that's not the result we need. Converting feet to inches is easy using 12 in / ft for the conversion:

Numbers: 10 x 60 x 60 x 12 = 432,000

Units: $\frac{\cancel{feet}}{\cancel{s^2}} \times \frac{\cancel{s}}{min} \times \frac{\cancel{s}}{min} \times \frac{in}{\cancel{ft}} = \frac{in}{(min)^2}$

The result is $432{,}000 \quad \frac{in}{(min)^2}$

Example of Per Problem in Appendix B

Problem: A finished (nominal) one inch by 12 inch board that is one foot long is said to be a 'board-foot'. A finished (nominal) one inch by four inch board that is three feet long is also one board foot.[1] And so on.

What is the number of board feet per foot of length of a finished (nominal) two inch by eight inch board?

Solution:

Note that a board foot, despite its name, is really a volume. A nominal 1 x 12 x 12 inch piece is 144 cubic inches and is one board foot.

144 cubic inches = one board foot, or in the form of a conversion factor:

$$144 \frac{\text{inches}^3}{\text{board-foot}}$$

A 2 by 8 one foot long will have

$2 \cdot 8 \cdot 12$ cubic inches

So the board-feet per foot of length will be:

Numbers: $\frac{2 \cdot 8 \cdot 12}{144} = 1.25$

Units: $\frac{\cancel{\text{inches}^3}}{\frac{\cancel{\text{inches}^3}}{\text{brd-ft}}} = \text{board-feet}$

That is, a nominal 2 by 8 has 1.25 board feet per foot of length.

1. Lumber is generally sold by the board-foot.

Scroll or Page Down for Graph Example

A Graphing Example from Appendix C

<u>Example:</u> Show the approximate roots and the maximum or minimum of the function $y = x^2 - 3x + 1$ by plotting.

<u>Solution:</u> *Remember: don't draw those axes yet! A graph must be planned.* First do the planning:

- Identify the variables to be represented

  y and x

- Define the Symbols and Units to be Used

  y and x No units.

- Decide which will be the independent and dependent variables

  x is independent and will be the abscissa; y is dependent and will be the ordinate.

- Specify the range is to be covered for each variable

Not so easy, but we don't want to guess and then have to redraw our graph several times.

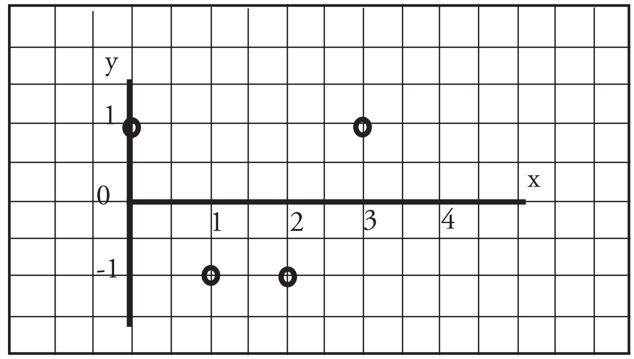
In order to find the range of x our graph must cover, we'll have to determine at least approximately where the roots are. (Note: The roots are the values of x that make y = 0.)

We make a table of values — which we can use later to plot points:

We'll start with x = 0 because that's easy:

x	y
0	1
1	-1
2	-1
3	1

A rough, informal sketch (on 1/4" paper — but still using a straight edge for the axes) of just this much data looks like:



Note that we have used a scale that gives us a good sized rough graph. We don't want it scooched up into a tiny square in the left hand corner of the paper!

We can already see that there is minimum at about x = 1.5 (in fact, it's at exactly 1.5) and that there are roots at approximately x = .3 and x = 2.7, give or take.

In order to get a little more accuracy and a better idea of what this function looks like, we compute a few more points. (By the way, we were lucky that starting with x = 0, etc. gave us useful data. Maybe the optimum would have been at x = 10; then we'd have had to hunt longer for it.)

x	y
0	1
1	-1
2	-1
3	1
4	5
-1	5
1.5	-1.25

That should be enough. Now back to the issue of the ranges to be covered by each variable on our graph

The table shows the answer: x will go from minus 1 to plus 4. And y will go from about minus 1.25 to plus 5. That's a total range of 5 for x, and a total range of 6.25 for y - but we'll use 7....

- What kind of graph paper will be used?

Scroll or Page Down for Continuation of Graph Example

We could use either the 1/4’ or 1/10” grid, but we’ll we’ll use the 1/4” grid this time.

- Approximately how large is the graph to be and where will it be located?

On a separate sheet of the 1/4” paper. And we’ll make a nice, big graph. (Most student graphs are too small.)

- How long will each axis will be? Answering will involve considering the range of data and possibly the scale to be used.

If we let one inch on the paper (four grid lines) for one unit of y, then the y-axis (ordinate) will require seven inches (from y=-2 to y = 5. Seven is a good length for the 11” dimension of the paper.

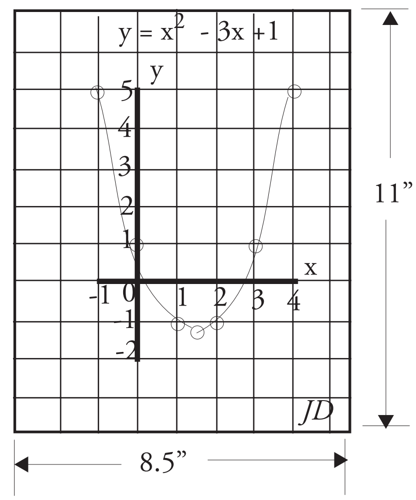
If we also use one inch for one unit of x, then the x-axis (abscissa) will require five inches - which seems very convenient for the 8.5” dimension of the paper.

- What will the scales be?

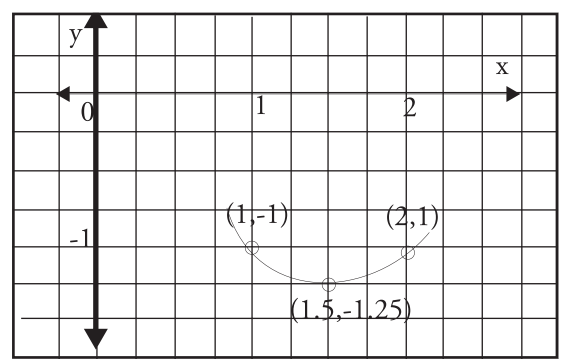
We’ve just answered that: one inch (that’s four 1/4’ spaces on the paper) will equal one unit for both x and y.

Note that this is a pure number function so there are no physical units for the variables.

The little drawing below is a scale drawing of the layout we have planned for 8 1/2 by 11 inch paper. The points have been plotted, too. Note how we located the x and y axes so as to more less balance the space on the paper.



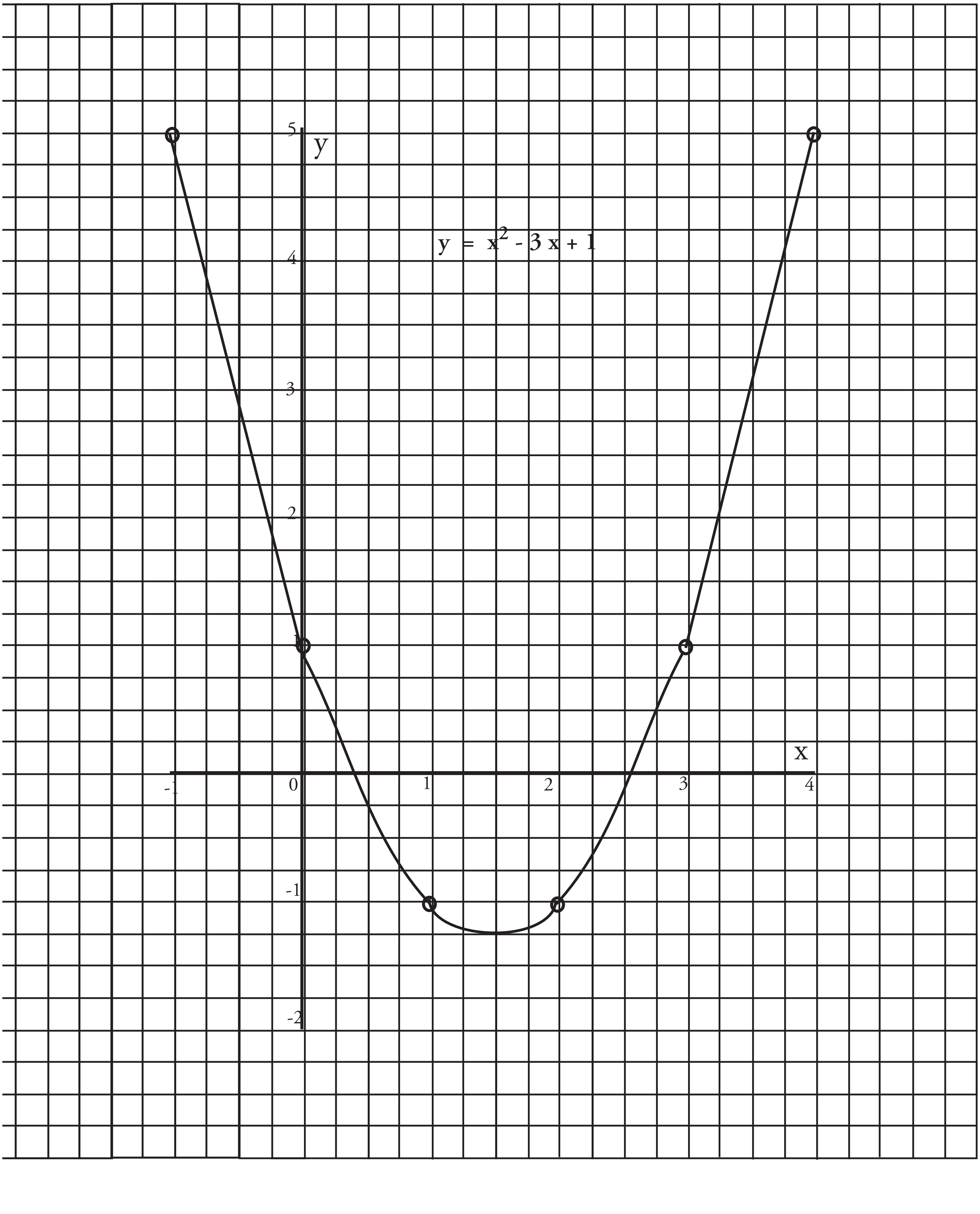
The drawing below is actual size of the part of the graph that shows the minimum. The freehand line through the points shows that the minimum point is not a pointed ‘V’, as many students like to draw. The graph runs smoothly through the minimum.



A full size graph enables one to estimate the roots as 0.38 and 2.60. Solving for them algebraically gives 0.382 and 2.618. The graph produced good accuracy.

A full size view of this graph is presented on the next page.

 Scroll or Page Down for Full Sized Graph


y = x^2 - 3 x + 1
y
x
5
4
3
2
-1
-2
-1
0
1
2
3
4