

Note 6A • INOUTEXP Program

This program is similar to the INOUT program for linear rules. Here, however, the two lists are related by an exponential rule. You need to study the lists and determine the rule. The rule is in the form $A(1 + r)^x$, where x takes the values in the input list. Your job is to find the values for A and r . The program provides access to a “Calculator” screen as well as a “Hint” screen.

```

INOUT EXPONENTIAL
THERE WILL BE TWO LISTS
WITH AN EXPONENTIAL RULE.
GUESSES SHOULD USE THE
VARIABLE L1 IN THE RULE,
LIKE 20(1+.47)^L1
PRESS ENTER
    
```

```

INOUT EXPONENTIAL
PRESS X FOR L1
PRESS Y= FOR THIS SCREEN
PRESS WINDOW FOR HINT
PRESS ZOOM FOR CALCULATOR
PRESS TRACE TO GIVE UP
PRESS ENTER
    
```

```

INOUT EXP
1: EASY
2: MEDIUM
3: HARD
4: QUIT
    
```

```

IN   OUT
0    30
1    36
2    43.2
3    51.84
4    62.208
5    74.65
LAST GUESS:NONE
GUESS:
    
```

```

IN   OUT
0    30
1    36
2    43.2
3    51.84
4    62.208
5    74.65
LAST GUESS:NONE
GUESS: 30(1+30/36)^L1
    
```

```

IN   OUT   YOUR GUESS
0    30    30
1    36    55
2    43.2  100.833
3    51.84 184.861
4    62.208 338.912
5    74.65 621.339
LAST GUESS:30(1+30/36)^L1
GUESS:
    
```

```

ENTER R TO
RETURN
36/30-1      .2
    
```

```

IN   OUT   YOUR GUESS
0    30    30
1    36    55
2    43.2  100.833
3    51.84 184.861
4    62.208 338.912
5    74.65 621.339
LAST GUESS:30(1+30/36)^L1
GUESS: 30(1+.2)^L1
    
```

```

IN   OUT   YOUR GUESS
0    30    30
1    36    36
2    43.2  43.2
3    51.84 51.84
4    62.208 62.208
5    74.65 74.65
RIGHT!
    
```

PROGRAM:INOUTEXP

Lb1 0:FnoFF :PlotsOff

1→Xmin:2→Xmax

1→Ymin:2→Ymax

ClrDraw

```

"XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXX789*XXXXXXXX456-XXXXXXXX
123+XXXXXXXX0.-X"→Str2
    
```

```

Text(0,20,"INOUT EXPONENTIAL")
Text(13,0,"THERE WILL BE TWO LISTS")
Text(20,0,"WITH AN EXPONENTIAL
RULE.")
Text(27,0,"GUESSES SHOULD USE THE")
Text(34,0,"VARIABLE L1 IN THE
RULE,")
Text(41,0,"LIKE 20(1+.47)^L1")
Text(55,20,"PRESS ENTER"):Pause
ClrDraw
    
```

```

Text(0,20,"INOUT EXPONENTIAL")
Text(13,0,"PRESS X FOR L1")
Text(20,0,"PRESS Y= FOR THIS
SCREEN")
Text(27,0,"PRESS WINDOW FOR HINT")
Text(34,0,"PRESS ZOOM FOR CALCULATOR
MODE")
Text(41,0,"PRESS TRACE TO GIVE UP")
Text(55,20,"PRESS ENTER"):Pause
Menu("INOUT EXP","EASY",1,
"MEDIUM",2,"HARD",3,"QUIT",Q)
    
```

```

Lb1 1
{0,1,2,3,4,5}→L1
randInt(1,5)→A
10randInt(-5,5)→B
Goto 5
Lb1 2
seq(H,H,-3,8)→L1
rand(12)→L2
SortA(L2,L1)
6→dim(L1)
SortA(L1)
randInt(1,7)→A
5randInt(-10,10)→B
Goto 5
Lb1 3
seq(H,H,-9,9,.5)→L1
rand(37)→L2
SortA(L2,L1)
6→dim(L1)
randInt(1,9)→A
randInt(-50,50)→B
Lb1 5
1+B/100→B
10A→A
A*B^L1→L2
List►matr(L1,L2,[A])
"NONE"→Str4
ClrDraw
Text(0,0," IN OUT")
For(J,1,6):For(K,1,2)
    
```

(continued)

(PROGRAM: INOUTEXP continued)

```
Text(7J,30K-20,round([A](J,K),3))
End:End
Repeat abs(sum(L3-L2)<.01 or K=14
Text(50,0,"LAST GUESS:"+Str4)
Text(57,0," GUESS:          ")
"0+"→Str1
Repeat K=105 or K=14
Repeat K≠0
getKey→K:End
sub(Str2,K+1,1)→Str3
If K=11:Goto 8
If K=12:Goto 6
If K=13:Goto 9
Lb1 7
If Str3≠"H":Str1+Str3→Str1
If K=21 or K=32:Str1+"L1"→Str1
length(Str1)→L
If K=24 and L>2:Then
L-1→L:sub(Str1,1,L)→Str1
End:If L>2:Then
Text(57,28,sub(Str1,3,L-2)+" ")
Else:Text(57,28," ")
End:End:If L>2:Then
String▶Equ(Str1,r1)
sub(Str1,3,L-2)→Str4
r1+L1-L1→L3
List▶matr(L1,L2,L3,[A])
FnOff :ClrDraw
Text(0,0," IN OUT YOUR GUESS")
For(J,1,6):For(K,1,3)
Text(7J,7K2,round([A](J,K),3))
End:End:End:End
If K=14:Then
Text(57,0," Ans:          ")
Text(57,16,A)
Text(57,24,"(1+")
Text(57,36,B-1)
```

```
Text(57,46+4(B<1),")^L1")
Else
Text(50,10,"RIGHT!")
End:Pause
Goto 0
Lb1 6
ClrHome
Disp "A*(1+R)^L1","", "A WILL BE A
MUL-","", "TIPLE OF 10 FROM", "10 TO 90
AND R","", "WILL BE BETWEEN","", "0.99
AND 0.99"
Pause :DispGraph
Goto 7
Lb1 8:ClrHome
Disp "PRESS..."
Disp "H FOR L1"
Disp "Y= FOR HERE"
Disp "WINDOW FOR HINT"
Disp "ZOOM FOR CALC."
Disp "TRACE TO GIVE UP"
Output(8,3,"PRESS ENTER"):Pause
Goto 7
Lb1 9
ClrHome
Disp "ENTER R TO RETURN"
47→R
Repeat H=47
Input "",H
Disp H
End:DispGraph
Goto 7
Lb1 Q
ClrHome
Disp " PRESS ENTER","", " TO
REPLAY","", ""," PRESS","", " 1 AND
ENTER","", " TO QUIT"
```

Note 6B • Equivalent Expressions

Two expressions are equivalent if they always have the same value regardless of the value of the variables. You can use your calculator to check whether two expressions are equivalent or not. The procedure is different depending on whether your expressions have one variable or more than one variable.

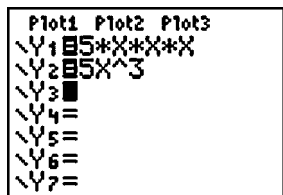
(continued)

Expressions with One Variable

To check whether or not $5 \cdot b \cdot b \cdot b$ is equivalent to $5b^3$:

- Enter the expressions into Y_1 and Y_2 in the $Y=$ screen, replacing the variable, in this case b , with x .
- Press $\boxed{2nd}$ [TABLE] and look at the calculator table to see if both expressions give the same result for each value of x .
- Press $\boxed{2nd}$ [TBLSET] and change TblStart and ΔTbl to make the table show any set of variable values you like.

This example shows that $5 \cdot b \cdot b \cdot b$ is equivalent to $5b^3$.



X	Y1	Y2
0	0	0
1	5	5
2	40	40
3	135	135
4	320	320
5	625	625
6	1080	1080



X	Y1	Y2
-4	-320	-320
-3.5	-214.4	-214.4
-3	-135	-135
-2.5	-78.13	-78.13
-2	-40	-40
-1.5	-16.88	-16.88
-1	-5	-5

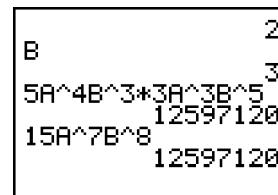
Expressions with More Than One Variable

Follow these steps to check whether or not $5a^4b^3 \cdot 3a^3b^5$ is equivalent to $15a^7b^8$:

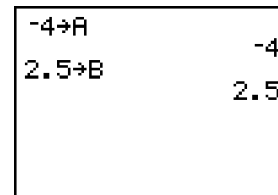
- Your calculator has a stored value for each variable a and b in its current memory. To see your variable values, enter a into the Home screen by pressing \boxed{ALPHA} [A] \boxed{ENTER} . Next, enter b into the Home screen and press \boxed{ENTER} . (The values in your calculator will probably be different than those shown on the screen here.)
- Compare the values of the two expressions. Enter each of the two expressions into the Home screen, pressing \boxed{ENTER} after each.



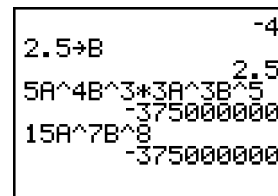
For the current variable values, the expressions are equal. But for the expressions to be equivalent, their values must be equal for any variable values. To be sure that the expressions are equivalent and not just equal for the one pair of variable values you tried, you need to evaluate the expressions for at least several other variable values. Note: If your expressions involve division by a variable, be sure not to use 0 as a variable value because you will get an ERR: DIVIDE BY 0 message. Division by 0 is undefined.



- To change the currently stored value for a to -4 , press $\boxed{(-)}$ $\boxed{4}$ \boxed{STO} \boxed{ALPHA} [A] \boxed{ENTER} . Follow similar steps to change b . In the screen here, a has been changed to value -4 and b to value 2.5 .
- Again, enter both expressions into the Home screen, pressing \boxed{ENTER} after each to see if they have the same value.
- Repeat **steps c** and **d** for other variable values.



This example shows that $5a^4b^3 \cdot 3a^3b^5$ is equivalent to $15a^7b^8$.



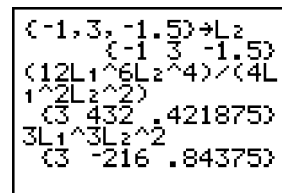
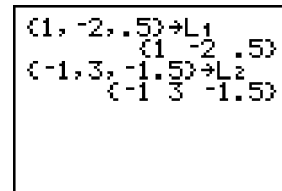
(continued)

Using Lists to Compare Expressions with More Than One Variable

Using list names as your variables allows you to check many variable values at the same time.

For example, follow these steps to check whether $\frac{12p^6q^8}{4p^2q^4}$ is equivalent to $3p^3q^2$:

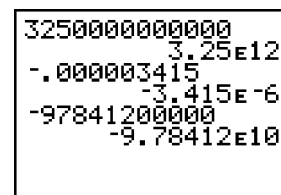
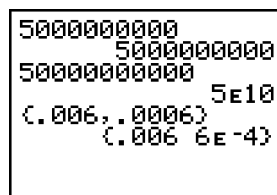
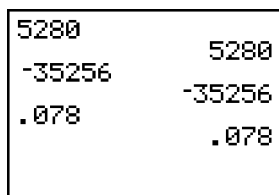
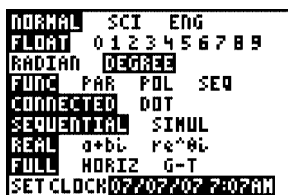
- Enter a sequence, of say three values, into list L1 (see Note 1B). Then enter a sequence of three values into list L2. The number of elements in each list must be the same. Do not use 0 in either list. Since this expression involves division by both variables, you will get an error message if either variable is 0.
- Enter each expression into the Home screen, substituting list L1 for p and list L2 for q . Press **ENTER** after each expression. Compare the two sequences of expression values to see if they are the same.



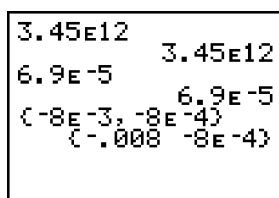
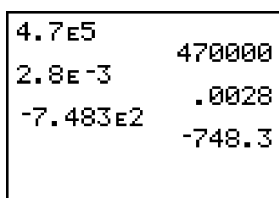
Even though the first expression value of each sequence is 3, the other two pairs of expression values do not match. Therefore, $\frac{12p^6q^8}{4p^2q^4}$ is not equivalent to $3p^3q^2$.

Note 6C • Scientific Notation

When your calculator is in normal mode (as it usually is), it displays some numbers in expanded notation and some numbers in scientific notation. Any number between 0.0001 ($1 \cdot 10^{-4}$) and 10,000,000,000 ($1 \cdot 10^{10}$) or between -0.0001 ($-1 \cdot 10^{-4}$) and $-10,000,000,000$ ($-1 \cdot 10^{10}$) is displayed in expanded form. A number greater than $1 \cdot 10^{10}$ or less than $-1 \cdot 10^{10}$ and a number within $1 \cdot 10^{-4}$ of zero is displayed in scientific notation. There is no way to set the calculator to display these numbers in expanded notation.

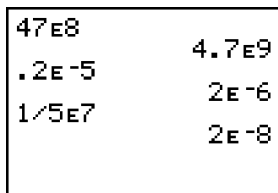
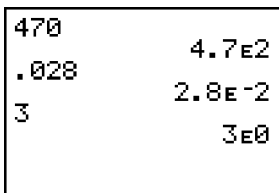
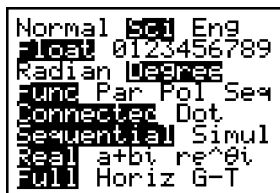


With your calculator in normal mode, any number can be entered in scientific notation form. To enter a number in scientific notation, locate the EE command above the comma key. Enter a number, press **2nd** [EE], and then enter the power of ten.



(continued)

To have your calculator display *all* numbers in standard scientific notation, press **[MODE]**, arrow to Sci, and press **[ENTER]**. Now any number, regardless of size or form, will appear in scientific notation.



Note 6D • BOUNCE and PENDULUM Programs

Attach the motion sensor to the calculator and run either the BOUNCE or the PENDULUM program. The data will be collected in lists L1 and L2, and when the data collection is complete, a stat plot will be displayed on the calculator screen.

PROGRAM:BOUNCE

```
50→N
Disp "HOLD BALL 1 M OR","LESS FROM
  FLOOR.,""HOLD PROBE 0.5 M","ABOVE
  THE BALL.,""RELEASE BALL
  THE","SAME TIME YOU","PRESS
  TRIGGER."
Send({1,11,2,0,0,0})
Send({3,.06,N,1,0,0,0,0,1})
For(H,1,1000):End
Disp "PRESS ENTER","WHEN DONE."
Pause
Get(L2)
Get(L1)
max(L2)-L2→L2
Plot1(Scatter,L1,L2,.)
FnOff :ZoomStat
```

PROGRAM:PENDULUM

```
31→N:CirHome
Send({0})
Send({1,11,2,0,0,0})
Disp "GIVE CAN A SMALL","SWING,
  ALIGN THE","PROBE. PRESS","ENTER
  TO START"
ClrList L2
Pause
Disp "COLLECTION WILL","TAKE 3
  MINUTES"
For(J,1,N)
Send({3,.04,99,0})
Get(L1)
min(L1)→L2(J)
End
1-Var Stats L2
Q1-(Med-Q1)2/(Q3-2Med+Q1)→K
K-L2→L2
seq(H,H,0,N-1)→L1
Plot1(Scatter,L1,L2,.)
ZoomStat
```

You can also use the EasyData App to collect these data. See **Note 3B/App** for help.