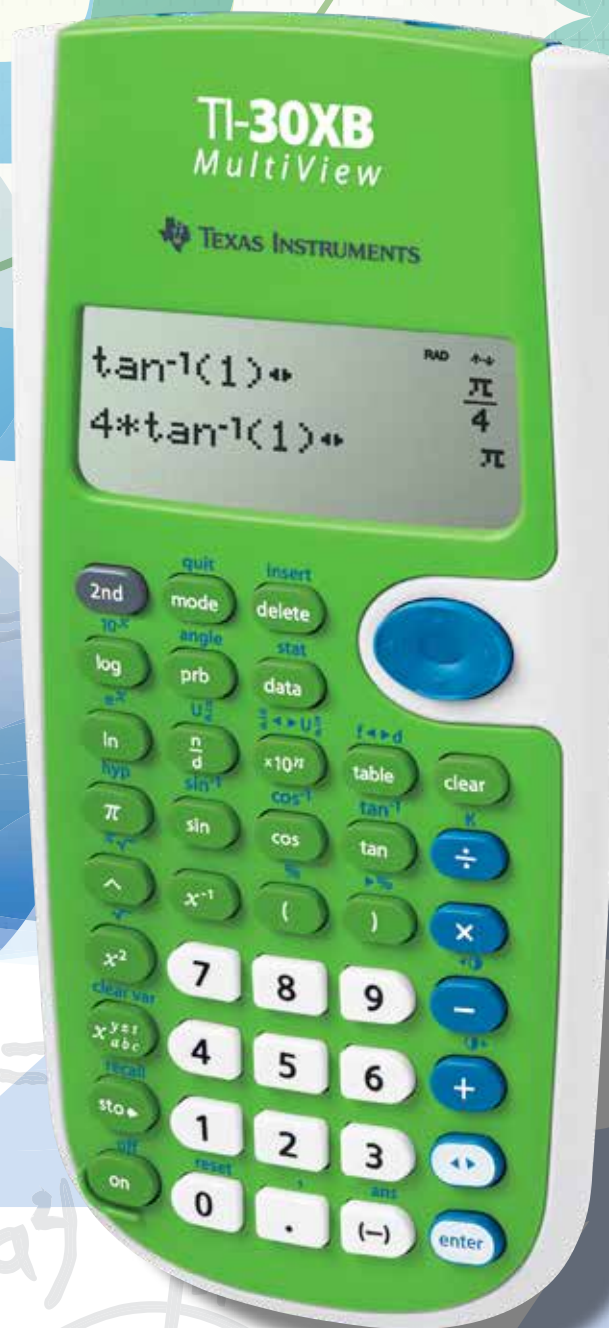


# TI-30XB Guidebook for NSW Stage 4 Mathematics

(Years 7 and 8)



# TI-30XB MultiView™ Scientific Calculator Guidebook

## NSW Stage 4 Mathematics

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## About this guidebook

This guidebook is designed to show ways in which the TI-30XB MultiView™ and TI-30XS MultiView™ scientific calculators can augment and enhance the teaching and learning of Stage 4 (Years 7 and 8) Mathematics in NSW.

All references in this guidebook refer to the TI-30XB MultiView™ calculator. However, they are also applicable to the TI-30XS MultiView™ calculator. The first section of the guidebook is a getting started section which provides an overview of features such as display settings, modes and menus. In addition, the getting started section gives some general guidance for navigating around the calculator, on calculator syntax and tips for efficient and accurate calculation when using the TI-30XB MultiView™.

Throughout the chapters on Number and Algebra, Measurement and Geometry and Statistics and Probability, TI-30XB MultiView™ features and menus relevant to the subject matter are introduced and explained. In terms of features, for example, the data editor and lists feature is introduced on page 17, the Constant feature is introduced on page 55 and function table is introduced on page 75. In terms of menus, for example, the probability (**PRB**) menu is introduced at the start of the section on Statistics and Probability (page 98).

The majority of examples showcased in this guidebook are relevant to Stage 4 (Years 7 and 8) Mathematics in NSW. A few extra examples have been included to enhance the user's knowledge of the TI-30XB MultiView™.

Each example includes a brief teaching note. Such teaching notes can provide a mathematical purpose for the example, highlight the mathematical concepts being developed in the example and how that example might fit in with the aims and outcomes of using calculators judiciously in Mathematics teaching and learning.

The examples showcased in this guidebook generally follow a two column format. In most examples, the left-hand column of the table contains step-by-step keystrokes that demonstrate TI-30XB MultiView™ (TI-30XS MultiView™) functionality accompanied by a solution outline and notes. Where applicable, the right-hand column of the table contains accompanying screenshots.

All examples in this guidebook assume the default settings as shown in Section 0.6 (page 6) on modes. Unless otherwise indicated, each section in this guidebook showcases the use of the TI-30XB MultiView™ in MathPrint™ mode (see page 6).

If desired, the TI-30XB MultiView™ can be reset so that all students start at the same point.

To do this, either press **on** and **clear** at the same time or press **2nd** **0** (reset) and then select **2** (Yes).

## 0 Getting started

This section provides an overview of features such as display settings, modes and menus. It also gives some general guidance on navigation around the calculator, on calculator syntax and tips for efficient and accurate calculation when using the TI-30XB MultiView™.

### 0.1 Turning on and off

Press **[on]** to turn the TI-30XB MultiView™ on.

Press **[2nd]** [off] to turn it off.

If no key is pressed for approximately five minutes, a power down feature automatically turns the TI-30XB MultiView™ off.

If after this time, the user presses **[on]**, the display, pending operations and memory are retained.

### 0.2 Changing display contrast

To adjust the contrast:

(1) Press and release **[2nd]**.

(2) Press **[+]** to darken the screen or press **[-]** to lighten the screen.

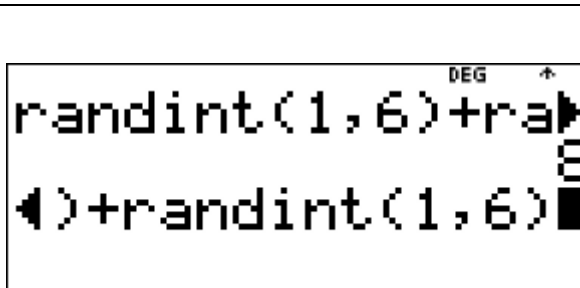
### 0.3 Home screen

The TI-30XB MultiView™ can display a maximum of four lines with a maximum of 16 characters per line.

#### Keystrokes description:








For entries and expressions of more than 16 characters, press **[←]** to scroll left and press **[→]** to scroll right to view the entire entry or expression.

When you calculate an entry on the Home screen, the answer is displayed either directly to the right of the entry or on the right side of the next line.



#### 0.4 Display indicators

Indicators may display on the screen to provide additional information concerning functions, results or mode.

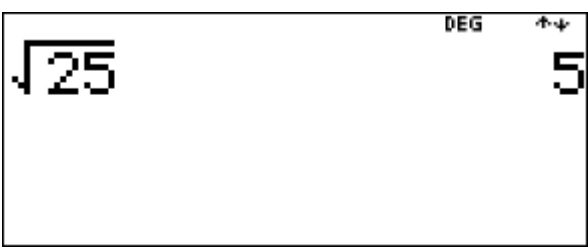
| Common examples include:  |  |
|---|--|
| <b>2nd</b>  | 2nd function   |
| <b>FIX</b>  | Fixed-decimal setting  |
| <b>DEG</b>  | Degrees  |
| <b>K</b>  | Constant feature on.   |
| <b>L1, L2, L3</b>   | Displays above the lists in data editor  |
|  | An operation is being performed  |
|  | An entry is stored in memory before and/or after the active screen. Press  and  to scroll. |
|  | An entry or menu displays beyond 16 digits. Press  or  to scroll.                          |

#### 0.5 2nd functions

Most keys can perform two functions. The primary function is indicated on the key and the secondary function is displayed above it. Press **2nd** to activate the secondary function.

##### Example

Use the TI-30XB MultiView™ to calculate  $\sqrt{25}$ .

|  |  |
|--|--|
| <p>Keystrokes and solution:</p> <p>Press <b>2nd</b> <b>x<sup>2</sup></b> (<math>\sqrt{\quad}</math>), <b>25</b> <b>enter</b>.</p> <p><math>\sqrt{25} = 5</math></p> <p>To cancel <b>2nd</b> before entering, press <b>2nd</b> again.</p> |  |
|--|--|

## 0.6 Modes

Press **[mode]** to choose modes.

Keystrokes description:

Press **[↑]** **[↓]** **[←]** **[→]** to choose a mode and press **[enter]** to select it.

Press **[clear]** or **[2nd] [mode]** (quit) to return to the Home screen.

Default mode settings are highlighted.

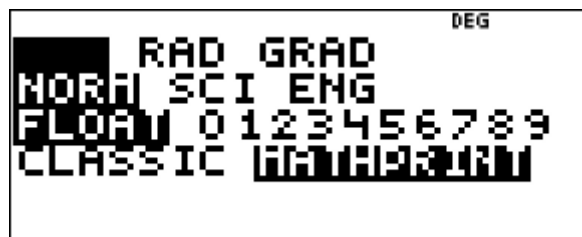
**DEG RAD GRAD** sets the angle mode.

**NORM SCI ENG** sets the numeric mode.

**FLOAT 0123456789** sets the decimal notation mode.

**FLOAT**, floating decimal point, displays up to 10 digits, plus the sign and decimal point.

**0123456789**, fixed decimal point, specifies the number of digits (0 through 9) to display to the right of the decimal point.

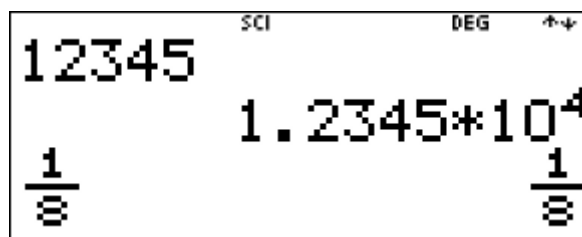
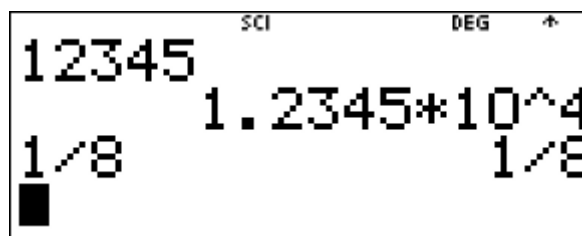


**Note:** In the function table, data editor and **[2nd] [sto→]** (recall) menu for example, the TI-30XB MultiView™ may display **E** instead of **\*10<sup>n</sup>**.

Keystrokes description:

**CLASSIC** mode displays inputs and outputs in a single line.

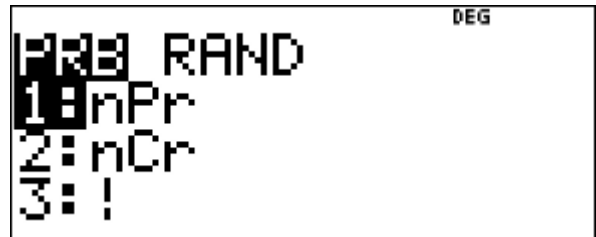
**MATHPRINT** mode displays most inputs and outputs in textbook format.



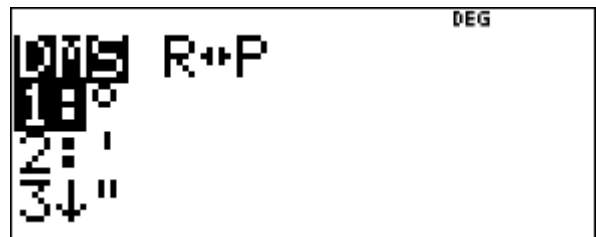
0.7 Menus

Keystrokes description:

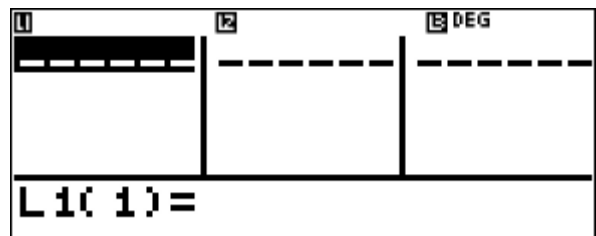
Press **[prb]** to access **PRB** and **RAND**.



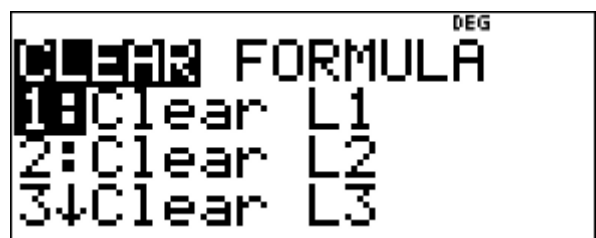
Press **[2nd] [prb]** (angle) to access **DMS** and **R <math>\leftrightarrow</math> P**.



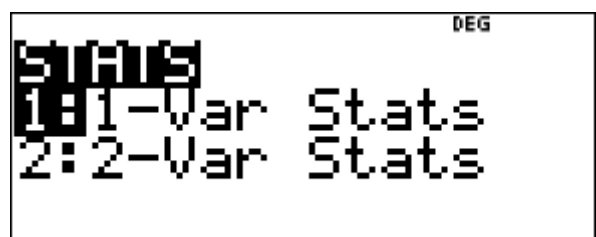
Press **[data]** to access **lists L1, L2, L3**.



Press **[data] [data]** to access **CLEAR** and **FORMULA**.



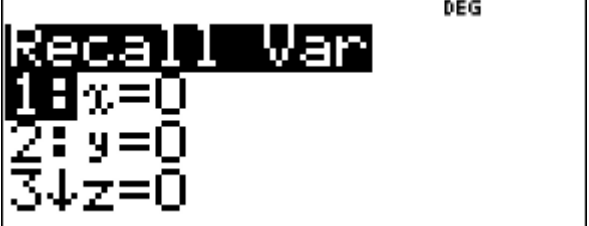
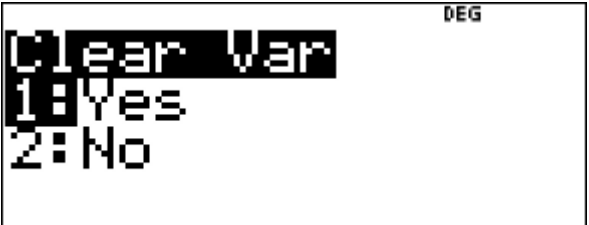
Press **[2nd] [data]** (stat) to access **STATS**.



Press **[2nd] [0]** (reset) to access **Reset**.





|  |  |
|--|--|
| <p>Press <b>2nd</b> <b>sto</b> (recall) to access <b>Recall Var.</b></p>   |  |
| <p>Press <b>2nd</b> <b>x<sup>yzt</sup></b> (clear var) to access <b>Clear Var.</b></p> <p>After accessing a menu, either press <b>⏏</b> and <b>⏏</b> to scroll and select a command or press the number next to the command.</p> <p>Press <b>clear</b> to return to the previous screen without selecting the item.</p> <p>Press <b>2nd</b> <b>mode</b> (quit) to exit a menu and return to the Home screen.</p> |  |

0.8 Scrolling

Press **⏏** or **⏏** to place the cursor horizontally over the expression entered.

Press **2nd** **⏏** to move the cursor directly to the beginning of the expression.

Press **2nd** **⏏** to move the cursor directly to the end of the expression.

After an expression is evaluated, press **⏏** or **⏏** to scroll through previous entries stored in memory.

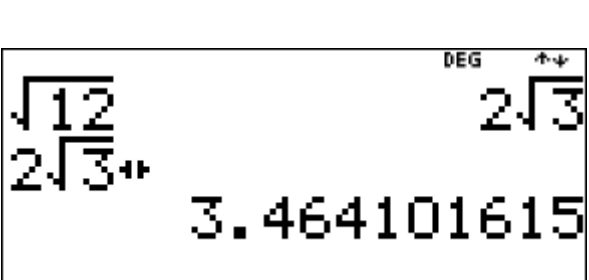
To reuse a previous entry, press **enter** to paste it on the bottom line and then evaluate a new expression.

0.9 Answer toggle


Press **↔** to toggle between fraction and decimal answers, surd and decimal answers and multiples of  $\pi$  and decimal answers.

Example

Use the TI-30XB MultiView™ to calculate  $\sqrt{12}$ , giving your answer in exact form and in decimal form.

|   |  |
|---|--|
| <p>Keystrokes and solution:</p> <p>Press <b>2nd</b> <b>x<sup>2</sup></b> (<math>\sqrt{\quad}</math>) and enter <b>12</b>.</p> <p>Press <b>enter</b>.</p> <p><math>\sqrt{12} = 2\sqrt{3}</math></p> <p>Press <b>↔</b> to toggle between exact form and decimal form.</p> <p><math>\sqrt{12} = 3.46\dots</math></p> |  |
|---|--|

## 0.10 Last answer

|   |  |
|---|--|
| <p><b>Keystrokes description:</b></p> <p>The most recently calculated result is stored to the variable <b>ans</b>.</p> <p>This is retained in memory even if the TI-30XB MultiView™ is turned off.</p> <p>To recall the value of <b>ans</b>:</p> <p>Press <b>2nd</b> <b>(←)</b> (<b>ans</b>) to display <b>ans</b>.</p> <p>Press any operation key as the first part of an entry.</p> <p><b>ans</b> and the operator are both displayed</p> |  |
|---|--|

## 0.11 Editing

### Clear:

Pressing **clear** performs the following actions:

Clears an error message.

Clears characters on an entry line.

Moves the cursor to the last entry in history once the display is clear.

Backs up one screen in applications.

### Delete:

Press **delete** to delete the character at the cursor.

### Insert:

Press **2nd** **delete** (**insert**) to insert a character at the cursor.

### Clear variable:

Press **2nd**  **$\frac{x^yzt}{abc}$**  (**clear var**) to clear variables *x, y, z, t, a, b, c*.

### Reset:

Press **2nd** **0** (**reset**) to reset the TI-30XB MultiView™. This action returns unit to default settings, clears memory variables, clears pending operations, clears all entries in history, clears statistical data, clears the constant feature, **K**, and **ans**.

## 0.12 Memory and stored variables

The TI-30XB MultiView™ has seven memory variables. These are  $x, y, z, t, a, b$  and  $c$ .

You can store a real number or an expression that results in a real number to a memory variable.

Press  $\boxed{\text{sto}} \rightarrow$  to store a variable and press  $\boxed{x \begin{smallmatrix} y \\ z \\ t \\ a \\ b \\ c \end{smallmatrix}}$  to select the variable to store. Press  $\boxed{\text{enter}}$  to store the value in the selected variable. If the selected variable already has a stored value, that value is replaced by the new one.

Press  $\boxed{x \begin{smallmatrix} y \\ z \\ t \\ a \\ b \\ c \end{smallmatrix}}$  to access the menu of variables. Press this key multiple times to choose  $x, y, z, t, a, b$  or  $c$ .

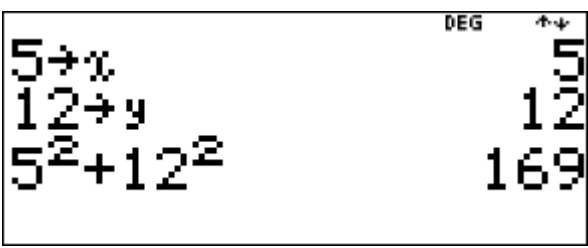
Press  $\boxed{x \begin{smallmatrix} y \\ z \\ t \\ a \\ b \\ c \end{smallmatrix}}$  to recall and use stored values. The variable, say  $y$ , is inserted into the current entry and the value assigned to  $y$  is used to evaluate the expression.

Press  $\boxed{2\text{nd}} \boxed{\text{sto}} \rightarrow$  (recall) to recall values of variables. A menu of variables and their stored values is then displayed. Select the variable you wish to recall and press  $\boxed{\text{enter}}$ . The value assigned to the variable is inserted into the current entry and used to evaluate the expression.

Press  $\boxed{2\text{nd}} \boxed{x \begin{smallmatrix} y \\ z \\ t \\ a \\ b \\ c \end{smallmatrix}}$  (clear var) and select **1: Yes** to clear all variable values.

### Example

Given that  $x = 5$  and  $y = 12$ , use the TI-30XB MultiView™ to find the value of  $x^2 + y^2$ .

|  |  |
|--|--|
| <p>Keystrokes and solution:</p> <p>Press <math>\boxed{2\text{nd}} \boxed{x \begin{smallmatrix} y \\ z \\ t \\ a \\ b \\ c \end{smallmatrix}}</math> (clear var) <math>\boxed{1}</math> to clear variables.</p> <p>Enter 5 and press <math>\boxed{\text{sto}} \rightarrow \boxed{x \begin{smallmatrix} y \\ z \\ t \\ a \\ b \\ c \end{smallmatrix}} \boxed{\text{enter}}</math>.</p> <p>Enter 12 and press <math>\boxed{\text{sto}} \rightarrow \boxed{x \begin{smallmatrix} y \\ z \\ t \\ a \\ b \\ c \end{smallmatrix}} \boxed{x \begin{smallmatrix} y \\ z \\ t \\ a \\ b \\ c \end{smallmatrix}} \boxed{\text{enter}}</math>.</p> <p>Press <math>\boxed{2\text{nd}} \boxed{\text{sto}} \rightarrow</math> (recall) <math>\boxed{1} \boxed{x^2} \boxed{+} \boxed{2\text{nd}} \boxed{\text{sto}} \rightarrow</math> (recall) <math>\boxed{2} \boxed{x^2} \boxed{\text{enter}}</math>.</p> <p><math>x^2 + y^2 = 169</math></p> |  <p>The calculator screen displays the following sequence of operations and results:</p> <ul style="list-style-type: none"><li>5 → x</li><li>12 → y</li><li>5<sup>2</sup> + 12<sup>2</sup> = 169</li></ul> <p>The screen also shows 'DEG' and a cursor at the top right.</p> |
|--|--|

## 1 Number and algebra

### 1.1 Order of operations

The following lists the order of operations used to evaluate expressions. The priority is evaluation from left to right and in the following order.

Order of operations hierarchy:

- (1) Expressions inside parentheses.
- (2) Functions that need a closing bracket and precede the argument.
- (3) Fractions.
- (4) Functions that are entered after the argument, such as  $x^2$  and angle unit modifiers.
- (5) Exponentiation (^) and roots.

In MathPrint™ mode, exponentiation using the  $\square$  key is evaluated from right to left. For example,  $2^3^2$  is evaluated as  $2^{\left(3^2\right)} = 512$ .

The TI-30XB MultiView™ evaluates expressions entered with  $\square$  and  $\square$  from left to right in both Classic mode and MathPrint™ mode.

For example, pressing  $\square \square \square$  calculates  $\left(2^2\right)^2 = 16$ .

- (6) Negation  $\square$ .
- (7) Permutations (**nPr**) and combinations (**nCr**).
- (8) Multiplication, implied multiplication and division.
- (9) Addition and subtraction.
- (10) Conversions.
- (11) Press **enter** to complete all operations and closes all open parentheses.

A TI-30XB MultiView calculator screen in MathPrint mode. The display shows the expression  $2^3^2$  on the left and the result  $512$  on the right. The top right corner of the screen displays "DEG" and a double arrow icon.

**Note:** In Classic mode, exponentiation using the  $\square$  key is evaluated from left to right. For example,  $2^3^2$  is evaluated as  $\left(2^3\right)^2 = 64$ .

A TI-30XB MultiView calculator screen in Classic mode. The display shows the expression  $(2^2)^2$  on the left and the result  $16$  on the right. The top right corner of the screen displays "DEG" and a double arrow icon.

## 1.2 Computation with integers

### Example

This example shows how to use a calculator and multiplication to calculate a quotient.

Use the TI-30XB MultiView™ and multiplication to calculate  $277 \div 51 = \square$ .

[**Teacher Note:** This skill is very important when performing mental computation.]

Keystrokes and solution:

$$272 \div 51 = \square \text{ becomes } 51 \times \square = 272$$

Try a whole number in place of  $\square$  in

$$51 \times \square = 272.$$

Try 6:

Using  $\times$ ,  $51 \times 6 = 306$  and so 6 is too large.

Try 5:

Using  $\times$ ,  $51 \times 5 = 255$  and so 5 is too small.

Using  $-$ ,  $272 - 255 = 17$ .

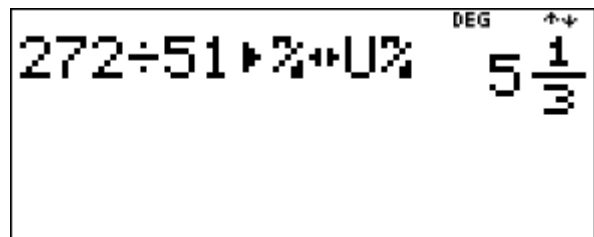
The answer is  $5 \frac{17}{51} = 5 \frac{1}{3}$ .

To confirm the answer  $5 \frac{1}{3}$ :

Enter **272** and press  $\div$ .

Enter **51** and press  $\text{2nd}$   $\times 10^n$  (converts to a mixed numeral).

Press **enter**.



### Example

This example shows how to use a calculator to illustrate the connection between division and multiplication.

Use the TI-30XB MultiView™ to

- (a) write  $437 \div 13$  as a mixed numeral.
- (b) calculate  $33 \times 13 + 8$ .

[**Teacher Note:** It is important to show this connection.]

Keystrokes and solution:

(a)

Enter **437** and press  $\div$ .

Enter **13** and press  $\text{2nd}$   $\text{x}10^n$  (converts to a mixed numeral).

Press **enter**.

$$437 \div 13 = 33 \frac{8}{13}$$

(b)

Enter **33** and press  $\times$ .

Enter **13** and press  $+$ .

Enter **8** and press **enter**.

$$33 \times 13 + 8 = 437$$

The calculator display shows the following sequence of operations and results:

- Top line:  $437 \div 13$  followed by a mixed numeral  $33 \frac{8}{13}$ .
- Bottom line:  $33 * 13 + 8$  followed by the result  $437$ .

### Example

This example shows how to use a calculator to illustrate associativity.

(a) Use the TI-30XB MultiView™ to calculate the following:

- (i)  $21+15+8$
- (ii)  $(21+15)+8$
- (iii)  $21+(15+8)$

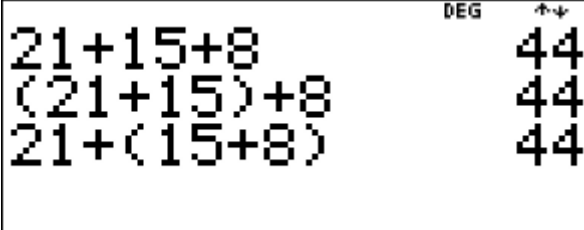
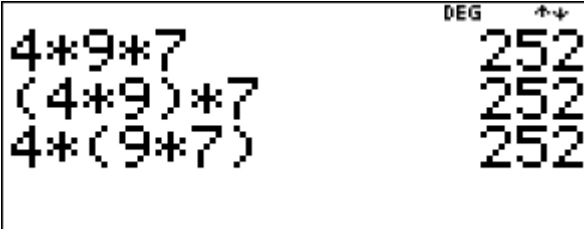
(b) What do you notice about each answer found in part (a)?

**[Teacher Note:** It is important that students are able to perform mental computation such as is required in part (a).]

(c) Use the TI-30XB MultiView™ to calculate the following:

- (i)  $4\times 9\times 7$
- (ii)  $(4\times 9)\times 7$
- (iii)  $4\times (9\times 7)$

(d) What do you notice about each answer found in part (c)?

|  |  |
|--|--|
| <p>Keystrokes and solution:</p> <p>(a)</p> <p>(i) Using <math>\boxed{+}</math>, <math>21+15+8=44</math>.</p> <p>(ii) Using <math>\boxed{+}</math>, <math>\boxed{()}</math> and <math>\boxed{+}</math>, <math>(21+15)+8=44</math>.</p> <p>(iii) Using <math>\boxed{+}</math>, <math>\boxed{()}</math> and <math>\boxed{+}</math>, <math>21+(15+8)=44</math>.</p> <p>(b)</p> <p>The answer is 44 (the same) in each case.</p> <p>(c)</p> <p>(i) Using <math>\boxed{\times}</math>, <math>4\times 9\times 7=252</math>.</p> <p>(ii) Using <math>\boxed{\times}</math>, <math>\boxed{()}</math> and <math>\boxed{\times}</math>, <math>(4\times 9)\times 7=252</math>.</p> <p>(iii) Using <math>\boxed{\times}</math>, <math>\boxed{()}</math> and <math>\boxed{\times}</math>, <math>4\times (9\times 7)=252</math>.</p> <p>(d)</p> <p>The answer is 252 (the same) in each case.</p> | <br> |
|--|--|

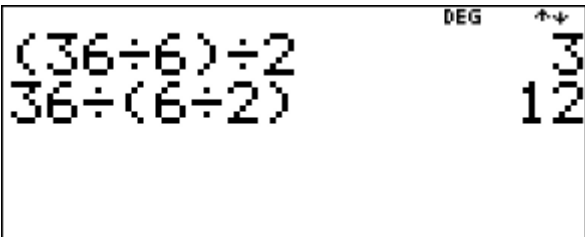
### Example

This example shows how to use a calculator to illustrate that associativity does not apply to calculations involving division.

Use the TI-30XB MultiView™ to calculate the following:

- (a)  $(36 \div 6) \div 2$
- (b)  $36 \div (6 \div 2)$
- (c) What do you notice about the answers found in part (a) and (b)?

**[Teacher Note:** It is important that students are able to perform mental computation such as is required in parts (a) and (b).]

|  |  |
|--|--|
| <p>Keystrokes and solution:</p> <p>(a)</p> <p>Using <math>\boxed{\div}</math>, <math>\boxed{}</math> and <math>\boxed{}</math>, <math>(36 \div 6) \div 2 = 3</math>.</p> <p>(b)</p> <p>Using <math>\boxed{\div}</math>, <math>\boxed{}</math> and <math>\boxed{}</math>, <math>36 \div (6 \div 2) = 12</math>.</p> <p>(c)</p> <p>The two answers (3 and 12) are different.</p> |  <p>The image shows a TI-30XB MultiView calculator display. The top line shows the expression <math>(36 \div 6) \div 2</math> and the result 3. The bottom line shows the expression <math>36 \div (6 \div 2)</math> and the result 12. The display also shows 'DEG' and a double arrow icon.</p> |
|--|--|

### Example

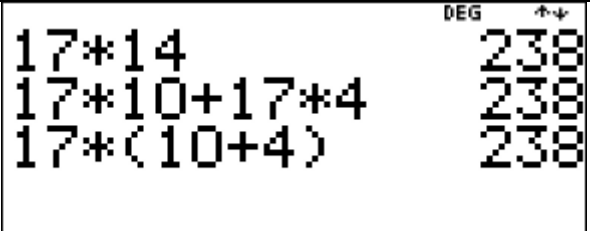
This example shows how to use a calculator to illustrate the distributive law.

- (a) Select a whole number between 11 and 20 .  
Use the TI-30XB MultiView™ to multiply the selected whole number
  - (i) by 14.
  - (ii) by 10 and then add the selected whole number multiplied by 4 .
- (b) What do you notice about the answers found in part (a) (i) and (ii)?

**[Teacher Note:** Compare the two answers in part (a) with the answer to  $17 \times (10 + 4)$ , for example.]

|  |  |
|--|--|
| <p>Keystrokes and solution:</p> <p>(a)</p> <p>Here the selected whole number is 17</p> <p>(i) Using <math>\boxed{\times}</math>, <math>17 \times 14 = 238</math>.</p> <p>(ii) Using <math>\boxed{\times}</math> and <math>\boxed{+}</math>, <math>17 \times 10 + 17 \times 4 = 238</math>.</p> |  |
|--|--|

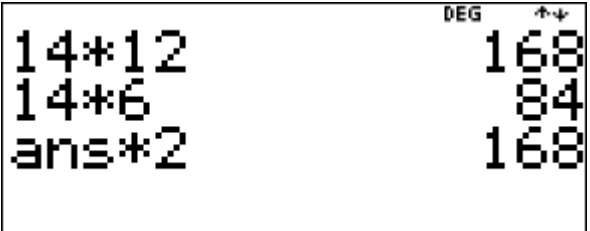


|  |   |
|--|---|
| <p>(b)<br/>The answer is 238 (the same) in each case.</p> <p>(c)<br/>All three answers are 238 (the same).</p> |  <p>DEG <math>\uparrow</math> <math>\downarrow</math></p> <p>17*14 238</p> <p>17*10+17*4 238</p> <p>17*(10+4) 238</p> |
|--|---|

### Example

This example shows how to use a calculator to illustrate the distributive law.

- (a) Select a whole number between 11 and 20 .
- Use the TI-30XB MultiView™ to multiply the selected whole number
- (i) by 12 .
- (ii) by 6 and then multiply the result by 2 .
- (b) What do you notice about the answers found in part (a) (i) and (ii)?

|   |  |
|---|--|
| <p>Keystrokes and solution:</p> <p>(a)<br/>Here the selected whole number is 14 .</p> <p>(i)<br/>Using <math>\times</math>, <math>14 \times 12 = 168</math> .</p> <p>(ii)<br/>Using <math>\times</math>, <math>14 \times 6 = 84</math> .</p> <p>Press <math>\square</math> (84 is then stored to the variable <b>ans</b>) and enter 2 .</p> <p>Press <b>enter</b> .</p> <p>(b)<br/>The answer is 168 (the same) in each case.</p> |  <p>DEG <math>\uparrow</math> <math>\downarrow</math></p> <p>14*12 168</p> <p>14*6 84</p> <p>ans*2 168</p> |
|---|--|

### TI-30XB MultiView™ data editor and list formulas

Press **[data]** to access the lists. Data can be entered in up to three lists. Each list can contain a maximum of 42 values. List formulas accept all TI-30XB MultiView™ functions. Numeric notation, decimal notation and angle modes affect the display of an element (except for fractional elements).

Press **[2nd]** **[↶]** to go to the top of a list.

Press **[2nd]** **[↷]** to go to the bottom of a list.

If required to clear the lists, press **[data]** **[4]**.

If required to add, edit or clear a formula, press **[data]** **[⏏]** and select as appropriate.

### Example

This example shows how to use a calculator to verify that subtracting a negative number is the same as adding a positive number.

(a) Use the TI-30XB MultiView™ lists feature to calculate the following:

(i)  $12 - (-19)$

(ii)  $18 - (-24)$

(iii)  $-28 - (-7)$

(b) Compare the answer to

(i) part (a) (i) with the answer to  $12 + 19$ .

(ii) part (a) (ii) with the answer to  $18 + 24$ .

(iii) part (a) (ii) with the answer to  $-28 + 7$ .

**[Teacher Note:** Such an activity can help to illustrate a fundamental property of arithmetic.]

Keystrokes and solution:

(a)

**Note:** Press **[(-)]** to enter a negative number.

Press **[data]** **[data]** **[4]** to clear all lists.

In **L1** enter **12** and press **[↶]**.

Repeat for **18** and **-28**.

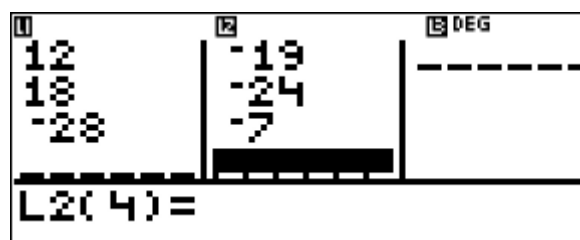
These three values should now be in **L1**.

Press **[⏏]** to scroll across to the top of **L2**.

In **L2** enter **-19** and press **[↶]**.

Repeat for **-24** and **-7**.

These three values should now be in **L2**.



Press  $\rightarrow$  to scroll across to the top of L3.

Press  $\text{data}$   $\rightarrow$  to highlight **FORMULA** and press  $\text{enter}$ .

Now enter the list formula **L1-L2** to L3.

Press  $\text{data}$   $\text{enter}$  to paste L1 into the author line.

Press  $\text{2nd}$   $\text{data}$   $\text{2}$   $\text{enter}$ .

L3 should now contain the required values.

(i)  $12 - (-19) = 31$

(ii)  $18 - (-24) = 42$

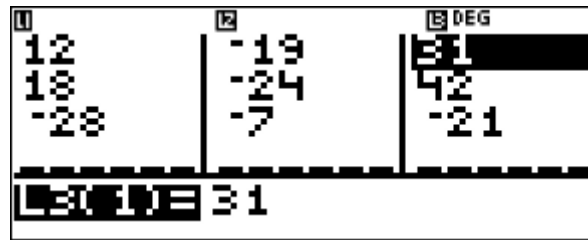
(iii)  $-28 - (-7) = -21$

(b)

(i)  $12 + 19 = 31$

(ii)  $18 + 24 = 42$

(iii)  $-28 + 7 = -21$



### Example

This example shows how to use a calculator to perform the four operations with integers.

(a) Use the TI-30XB MultiView™ to calculate  $9 \times (12 - 2) \div 5 + 1$ .

(b) Calculate  $9 \times (12 - 2) \div 5 + 1$  without using the TI-30XB MultiView™. List the order of operations used.

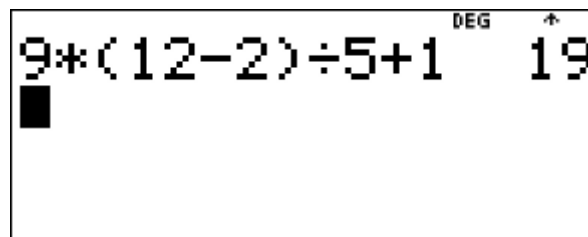
[**Teacher Note:** Students need to be able to make sense of calculator outputs.]

Keystrokes and solution:

(a)

Using  $\times$ ,  $-$ ,  $\div$ ,  $+$ ,  $( )$  and  $\square$ .

$$9 \times (12 - 2) \div 5 + 1 = 19$$



|  |  |
|--|--|
| <p>(b)</p> $9 \times (12 - 2) \div 5 + 1$ <p>perform within parentheses to obtain</p> $= 9 \times 10 \div 5 + 1$ <p>perform multiplication to obtain</p> $= 90 \div 5 + 1$ <p>perform division to obtain</p> $= 18 + 1$ <p>perform addition to obtain</p> $= 19$ |  |
|--|--|

**Example**

This example shows how to use a calculator to investigate patterns formed by multiplying integers.

- (a) Calculate  $(1 \times 9) + 2$ .
- (b) Use the TI-30XB MultiView™ to calculate the following:
  - (i)  $(12 \times 9) + 3$
  - (ii)  $(123 \times 9) + 4$
  - (iii)  $(1234 \times 9) + 5$
  - (iv)  $(12345 \times 9) + 6$
- (c) By observing the pattern, predict answers to the following:
  - (i)  $(123456 \times 9) + 7$
  - (ii)  $(1234567 \times 9) + 8$

Use the TI-30XB MultiView™ to check these predictions.
- (d) Test the pattern on  $(123456789 \times 9) + 10$  and use the TI-30XB MultiView™ to check the answer.

**[Teacher Note:** It is important that students work with large numbers and are given opportunities to look for patterns and form conjectures. Here the TI-30XB MultiView™ is used as a tool to obtain a number of answers efficiently.]

Keystrokes and solution:

(a)

$$(1 \times 9) + 2 = 11$$

(b)

(i) Using  $\square$ ,  $\times$ ,  $\square$  and  $+$ ,

$$(12 \times 9) + 3 = 111.$$

**Note:** After an expression is evaluated, press  $\uparrow$  or  $\downarrow$  to scroll through previous entries stored in memory.

**Note:** To reuse a previous entry, press **enter** to paste it on the bottom line and then evaluate a new expression.

[See the section on scrolling on page 20.]

(ii) Press  $\leftarrow \rightarrow$  to highlight  $(12 * 9) + 3$  and press **enter**.

Press  $\leftarrow$  until the cursor is flashing over  $*$ . Press **2nd** **delete** (insert) and insert  $3$ .

Press  $\rightarrow$  until the cursor is flashing over the  $3$  at the end of the expression.

Enter  $4$  to replace the  $3$  and press **enter**.

$$(123 \times 9) + 4 = 1111$$

Repeating this process of bringing the previous entry down and editing it we obtain the following results:

(iii)  $(1234 \times 9) + 5 = 11111$

(iv)  $(12345 \times 9) + 6 = 111111$

Calculator display showing a list of expressions and their results:

|                  |     |                       |       |
|------------------|-----|-----------------------|-------|
| $(12 * 9) + 3$   | DEG | $\uparrow \downarrow$ | 111   |
| $(123 * 9) + 4$  |     |                       | 1111  |
| $(1234 * 9) + 5$ |     |                       | 11111 |

Calculator display showing a list of expressions and their results:

|                   |     |                       |        |
|-------------------|-----|-----------------------|--------|
| $(1234 * 9) + 5$  | DEG | $\uparrow \downarrow$ | 11111  |
| $(12345 * 9) + 6$ |     |                       | 111111 |

(c)

Looking at the pattern, the answers always consist of ones digits.

There is the same number of ones as the number that is added to the product. So for

(i) we predict the answer to be 1 111 111 and for (ii) we predict the answer to be 11 111 111.

$$(i) (123456 \times 9) + 7 = 1\ 111\ 111$$

$$(ii) (1234567 \times 9) + 8 = 11\ 111\ 111$$

Hence the answer to (d) will consist of 10 ones digits, 1 111 111 111.

$$(d) (123456789 \times 9) + 10 = 1\ 111\ 111\ 111$$

DEG ↕

```
(123456*9)+7
      1111111
(1234567*9)+8
      1111111
```

DEG ↕

```
(1234567*9)+8
      11111111
(123456789*9)+10
      111111111
```

### 1.3 Fractions

Press  $\frac{\square}{\square}$  to enter a simple fraction.

In MathPrint™ mode, fractions involving use of the  $\frac{\square}{\square}$  key can include operation keys such as  $+$ ,  $\times$ , etc. and most function keys such as  $x^2$ ,  $2\text{nd}$   $\square$  (%), etc.

To enter fractions with operations in MathPrint™ mode, press  $\frac{\square}{\square}$  before entering a number.

Entering a number before pressing  $\frac{\square}{\square}$  causes that number to become the numerator.

Press  $\odot$  to move from the numerator to the denominator.

Calculations using fractions can display fraction or decimal results, depending on input.

The TI-30XB MultiView™ defaults output to improper fractions and results are automatically simplified.

#### Example


This example shows how to use a calculator to generate equivalent fractions and express fractions in simplest form.

Enter the following fractions into the TI-30XB MultiView™ and write down the answer given by the TI-30XB MultiView™:

(a)  $\frac{2}{4}$

(b)  $\frac{15}{30}$

**[Teacher Note:** It is important to show why these are equivalent fractions.]

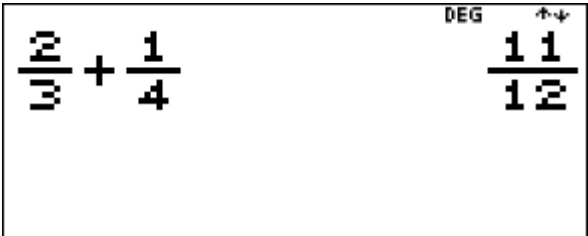
|   |  |
|---|--|
| <p>Keystrokes and solution:</p> <p>(a)</p> <p>Enter 2 and press <math>\frac{\square}{\square}</math>.</p> <p>Enter 4 in the denominator box.</p> <p>Press <b>enter</b>.</p> $\frac{2}{4} = \frac{1}{2}$ <p>The output is the fraction expressed in simplest form.</p> <p>(b)</p> <p>Repeating the above instructions:</p> $\frac{15}{30} = \frac{1}{2}$ |  |
|---|--|

### Example

This example shows how to use a calculator to illustrate incorrect operations with fractions.

Use the TI-30XB MultiView™ to confirm that  $\frac{2}{3} + \frac{1}{4} \neq \frac{3}{7}$ .

**[Teacher Note:** It is important to show students why  $\frac{2}{3} + \frac{1}{4} \neq \frac{3}{7}$ . At this point, you could also show that  $\frac{11}{12} \neq \frac{3}{7}$  by looking at the value of each fraction in decimal form.]

|  |   |
|--|---|
| <p>Keystrokes and solution:</p> <p>Enter 2 and press <math>\frac{\square}{\square}</math>.</p> <p>Enter 3 in the denominator box.</p> <p>Press <math>\rightarrow</math> to move the cursor out of the denominator and press <math>+</math>.</p> <p>Enter 1 and press <math>\frac{\square}{\square}</math>.</p> <p>Enter 4 in the denominator box.</p> <p>Press <b>enter</b>.</p> <p><math>\frac{2}{3} + \frac{1}{4} = \frac{11}{12}</math> and <math>\frac{11}{12} \neq \frac{3}{7}</math></p> |  |
|--|---|

Press **2nd**  $\times 10^{\square}$  to convert between mixed numerals and simple fraction form.

Press **2nd**  $\frac{\square}{\square}$  to enter a mixed numeral.

### Example

This example shows how to use a calculator to express improper fractions as mixed numerals and vice versa.

Use the TI-30XB MultiView™ to convert

- (a) the improper fraction  $\frac{19}{8}$  to a mixed numeral.
- (b) the mixed numeral  $4\frac{7}{12}$  to an improper fraction.

**[Teacher Note:** It is important that students are able to perform such calculations without a calculator.]



Keystrokes and solution:

(a)

Enter **19** and press  $\frac{\square}{\square}$ .

Enter **8** in the denominator box.

Press  $\rightarrow$  to move the cursor out of the denominator.

Press  $2^{nd}$   $\times 10^{\square}$  (converts to a mixed numeral)  $\text{enter}$ .

$$\frac{19}{8} = 2\frac{3}{8}$$

(b)

Enter **4** and press  $2^{nd}$   $\frac{\square}{\square}$ .

Enter **7** in the numerator box.

Press  $\ominus$  and enter **12** in the denominator box.

Press  $\text{enter}$ .

$$4\frac{7}{12} = \frac{55}{12}$$

The calculator display shows the fraction 19/8 on the left. On the right, it shows the mixed numeral 2 3/8. The mode indicator 'DEG' and the fraction template icon are visible at the top right.

The calculator display shows the mixed numeral 4 7/12 on the left. On the right, it shows the improper fraction 55/12. The mode indicator 'DEG' and the fraction template icon are visible at the top right.

### Example

This example shows how to use a calculator to add fractions, including mixed numerals and fractions with unrelated denominators.

(a) Use the TI-30XB MultiView™ to calculate  $\frac{3}{4} + 1\frac{7}{12}$ .

Give your answer as an improper fraction and as a mixed numeral.

(b) Interpret the two answers found in part (a).

**[Teacher Note:** It is important that students are able to interpret fractions and mixed numerals.]

Keystrokes and solution:

(a)

Enter **3** and press  $\frac{\square}{\square}$ .

Enter **4** in the denominator box.

Press  $\rightarrow$  to move the cursor out of the fraction.

Press  $+$  and enter **1**.

Press  $2^{nd}$   $\frac{\square}{\square}$  and enter **7** in the numerator box.

Press  $\leftarrow$  and enter **12** in the denominator box.

Press **enter**.

$$\frac{3}{4} + 1\frac{7}{12} = \frac{7}{3}$$

To give the answer as a mixed numeral:

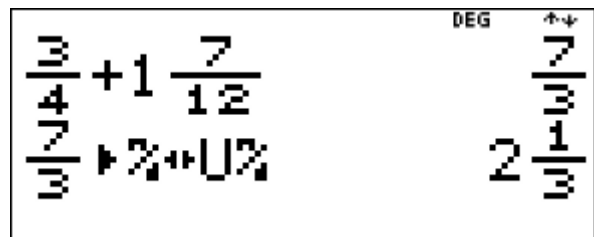
Press  $2^{nd}$   $\times 10^{th}$  (converts to a mixed numeral) **enter**.

$$\frac{3}{4} + 1\frac{7}{12} = 2\frac{1}{3}$$

(b)

As an improper fraction, we have 7 lots of 'one-third'.

As a mixed numeral, we have 2 'wholes' and a third of a 'whole'.



DEG  $\frac{3}{4} + 1\frac{7}{12} = 2\frac{1}{3}$

### Example

This example shows how to use a calculator to subtract fractions, including mixed numerals and fractions with unrelated denominators.

Use the TI-30XB MultiView™ to calculate  $2\frac{5}{9} - \frac{4}{3}$ .

Give your answer as an improper fraction and as a mixed numeral.

**[Teacher Note:** It is important that students are able to perform such calculations without a calculator.]

Keystrokes and solution:

Enter **2** and press  $\boxed{2nd} \boxed{\frac{a}{b}}$ .

Enter **5** in the numerator box.

Press  $\odot$  and enter **9** in the denominator box.

Press  $\rightarrow$  to move the cursor out of the denominator.

Press  $\boxed{-}$  and enter **4**.

Press  $\boxed{\frac{a}{b}}$  and enter **3** in the denominator box.

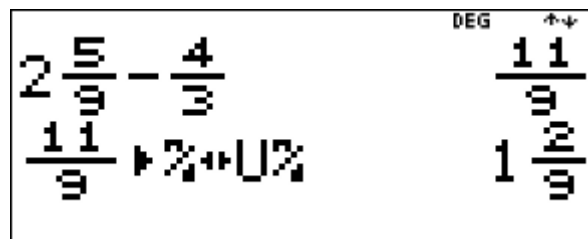
Press  $\boxed{enter}$ .

$$2\frac{5}{9} - \frac{4}{3} = \frac{11}{9}$$

To give the answer as a mixed numeral:

Press  $\boxed{2nd} \boxed{\times 10^n}$  (converts to a mixed numeral)  $\boxed{enter}$ .

$$2\frac{5}{9} - \frac{4}{3} = 1\frac{2}{9}$$



### Example

This example shows how to use a calculator to determine the effect of multiplying a positive number by a fraction between 0 and 1.

(a) Use the TI-30XB MultiView™ to calculate the following:

(i)  $200 \times \frac{1}{2}$

(ii)  $200 \times \frac{1}{4}$

(iii)  $200 \times \frac{1}{5}$

(iv)  $200 \times \frac{1}{8}$

(b) Determine the effect of multiplying a positive number by a fraction between 0 and 1.

(c) Describe what happens to the size of the answer (product) as the size of the fraction between 0 and 1 gets smaller?

**[Teacher Note:** It is important that students are able to anticipate such results when using a calculator.]

Keystrokes and solution:

(a)

(i) Enter **200** and press  $\boxed{\times}$ .

Enter **1** and press  $\boxed{\frac{n}{d}}$ .

Enter **2** in the denominator box.

Press **enter**.

$$200 \times \frac{1}{2} = 100$$

(ii) Press  $\leftarrow \rightarrow$  to highlight  $200 * \frac{1}{2}$  and press **enter**.

Press  $\uparrow \downarrow$  until the cursor is flashing over **2**.

Enter **4** and press **enter**.

$$200 \times \frac{1}{4} = 50$$

Repeating the above instructions:

(iii)  $200 \times \frac{1}{5} = 40$

(iv)  $200 \times \frac{1}{8} = 25$

(b)

Multiplying a positive number by a fraction between 0 and 1 results in a smaller positive number than the original positive number.

(c)

As the size of the fraction between 0 and 1 gets smaller, the size of the answer (product) gets smaller.

DEG  $\uparrow \downarrow$

|                     |     |
|---------------------|-----|
| $200 * \frac{1}{2}$ | 100 |
| $200 * \frac{1}{4}$ | 50  |

DEG  $\uparrow \downarrow$

|                     |    |
|---------------------|----|
| $200 * \frac{1}{5}$ | 40 |
| $200 * \frac{1}{8}$ | 25 |

The TI-30XB MultiView™ houses two more advanced features that could be used to complete the above example and examples similar to it.

The first advanced feature is the Constant feature. With this feature, the operation  $*200$  can be stored as the constant **K** and then each of the four products can be calculated using this stored operation. See page 55 for more detailed instructions on how to use the Constant feature.

The second advanced feature is use of the store feature to store **200** as variable  $x$ . Then each of the four products can be calculated using the stored variable  $x$ . See section 0.12 for more detailed instructions on how to store a value as a variable.

The following example, can be attempted using either of these more advanced TI-30XB MultiView™ features.

#### Example

This example shows how to use a calculator to determine the effect of dividing a positive number by a fraction between 0 and 1.

(a) Use the TI-30XB MultiView™ to calculate the following:

(i)  $10 \div \frac{1}{2}$

(ii)  $10 \div \frac{1}{4}$

(iii)  $10 \div \frac{1}{5}$

(iv)  $10 \div \frac{1}{10}$

(b) Determine the effect of dividing a positive number by a fraction between 0 and 1.

(c) Describe what happens to the size of the answer (quotient) as the size of the fraction between 0 and 1 gets smaller?

**[Teacher Note:** It is important that students are able to anticipate such results when using a calculator.]

|  |  |
|--|--|
| <p>Keystrokes and solution:</p> <p>(a)</p> <p>(i) Enter <b>10</b> and press <math>\boxed{\div}</math>.</p> <p>Enter <b>1</b> and press <math>\boxed{\frac{\square}{\square}}</math>.</p> <p>Enter <b>2</b> in the denominator box.</p> <p>Press <b>enter</b>.</p> $10 \div \frac{1}{2} = 20$ |  |
|--|--|

(ii) Press  $\leftarrow \rightarrow$  to highlight  $10 \div \frac{1}{2}$  and press **enter**.

Press  $\leftarrow \leftarrow$  until the cursor is flashing over 2.

Enter 4 and press **enter**.

$$10 \div \frac{1}{4} = 40$$

Repeating the above instructions:

(iii)  $10 \div \frac{1}{5} = 50$

(iv)  $10 \div \frac{1}{8} = 80$

(b)

Dividing a positive number by a fraction between 0 and 1 results in a bigger positive number than the original positive number.

(c)

As the size of the fraction between 0 and 1 gets smaller, the size of the answer (quotient) gets bigger.

|                       |                             |
|-----------------------|-----------------------------|
|                       | DEG $\leftarrow \leftarrow$ |
| $10 \div \frac{1}{2}$ | 20                          |
| $10 \div \frac{1}{4}$ | 40                          |

|                       |                             |
|-----------------------|-----------------------------|
|                       | DEG $\leftarrow \leftarrow$ |
| $10 \div \frac{1}{5}$ | 50                          |
| $10 \div \frac{1}{8}$ | 80                          |

### Example

This numerical example can help explain why division by a fraction is equivalent to multiplication by its reciprocal.

- (a) (i) Use the TI-30XB MultiView™ to calculate  $3 \div \frac{1}{5}$ .
- (ii) Compare your answer to part (i) with the answer obtained from calculating  $3 \times 5$ .
- (b) (i) Use the TI-30XB MultiView™ to calculate  $\frac{1}{2} \div \frac{1}{3}$ .
- Give your answer as a mixed numeral.
- (ii) Compare your answer to part (i) with the answer obtained from calculating  $\frac{1}{2} \times 3$ , giving your answer as a mixed numeral.

**[Teacher Note:** It is important that students are able to understand the partition (sharing and grouping) model of division and the quotient ('how many') model of division. For example, with quotient, there are  $1\frac{1}{2}$  'one thirds' in a  $\frac{1}{2}$ .]

Keystrokes and solution:

(a)

(i) Using  $\frac{\square}{\square}$  and  $\frac{\square}{\square}$  we obtain  $3 \div \frac{1}{5} = 15$ .

(ii)  $3 \times 5 = 15$

The reciprocal of  $\frac{1}{5}$  is 5.

Division by a fraction is equivalent to multiplication by its reciprocal.

(b)

(i) Enter **1** and press  $\frac{\square}{\square}$ .

Enter **2** in the denominator box.

Press  $\rightarrow$  to move the cursor out of the denominator.

Press  $\frac{\square}{\square}$  and enter **1**.

Press  $\frac{\square}{\square}$  and enter **3** in the denominator box.

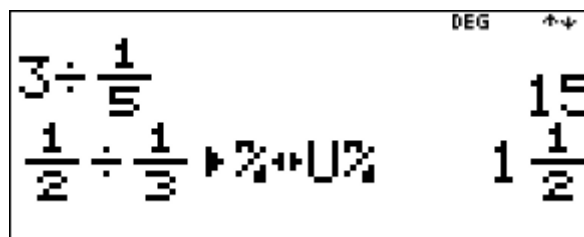
Press  $\rightarrow$  to move out of the denominator.

Press  $2^{nd}$   $\times 10^{x}$  to convert to a mixed numeral and press **enter**.

$$\frac{1}{2} \div \frac{1}{3} = 1\frac{1}{2}$$

(ii)  $\frac{1}{2} \times 3 = 1\frac{1}{2}$

So there are  $1\frac{1}{2}$  'one thirds' in a  $\frac{1}{2}$ .



### Example

This example shows how to use a calculator to multiply and divide fractions and mixed numerals.

Use the TI-30XB MultiView™ to calculate

(a)  $5\frac{1}{6} \times \frac{4}{5}$ .

(b)  $5\frac{1}{6} \div 1\frac{1}{4}$ .

In each case, give your answer as a mixed numeral.

(c) Give a reason why the answers to part (a) and part (b) are the same.

**[Teacher Note:** It is important that students are able to perform such calculations without a calculator and explain why these two answers are the same.]

Keystrokes and solution:

(a)

Enter **5** and press  $\boxed{2nd} \boxed{\frac{a}{a}}$ .

Enter **1** in the numerator box.

Press  $\ominus$  and enter **6** in the denominator box.

Press  $\rightarrow$  to move the cursor out of the denominator.

Press  $\times$  and enter **4**.

Press  $\frac{a}{a}$  and enter **5** in the denominator box.

Press  $\rightarrow$  to move the cursor out of the denominator.

To give the answer as a mixed numeral:

Press  $\boxed{2nd} \boxed{\times 10^n}$  (converts to a mixed numeral)  $\boxed{enter}$ .

$$5\frac{1}{6} \times \frac{4}{5} = 4\frac{2}{15}$$

The image shows a TI-30XB MultiView calculator display. The screen displays the calculation  $5\frac{1}{6} * \frac{4}{5}$  followed by a right arrow and the result  $4\frac{2}{15}$ . The display also shows "DEG" and a double arrow icon in the top right corner.



(b)

Press  $\leftarrow \rightarrow$  to highlight  $5\frac{1}{6} * \frac{4}{5}$  (and the conversion command) and press **enter**.

Press  $\leftarrow$  to move the cursor over  $*$  and press  $\frac{\square}{\square}$ .

Press **2nd**  $\frac{\square}{\square}$  and enter  $1\frac{1}{4}$ .

Press  $\rightarrow$  and then **delete** until  $\frac{4}{5}$  is deleted.

Press **enter**.

$$5\frac{1}{6} \div 1\frac{1}{4} = 4\frac{2}{15}$$

(c)

To find the quotient of two fractions, we convert division to multiplication and multiply the first fraction by the reciprocal of the second fraction.

$$1\frac{1}{4} = \frac{5}{4} \text{ and } 1\frac{1}{4} \div \frac{4}{5} = \frac{5}{4} \text{ so } \div \frac{5}{4} \text{ has the}$$

same effect (gives the same answer) as

$$\times \frac{4}{5}.$$

Hence the answers to part (a) and part (b) are the same

The image shows a calculator screen with the following display:  $5\frac{1}{6} \div 1\frac{1}{4} = 4\frac{2}{15}$ . The screen also shows 'DEG' and a cursor at the top right.

## 1.4 Decimals

Press **2nd** **table** **enter** to convert results between fractions and decimals.

Press **↔** to toggle an answer between a decimal and a fraction.

Press **2nd** **x10<sup>n</sup>** **enter** to convert a decimal to a mixed numeral.

### Example

This example shows how to use a calculator to express mixed numerals as decimals and vice versa.

Use the TI-30XB MultiView™ to convert

- (a) the mixed numeral  $6\frac{3}{8}$  to a decimal.
- (b) the decimal 1.6 to a mixed numeral.

**[Teacher Note:** It is important that students are able to perform such calculations without a calculator.]

Keystrokes and solution:

(a)

Enter **6** and press **2nd**  **$\frac{\square}{\square}$** .

Enter **3** in the numerator box.

Press **⌵** and enter **8** in the denominator box.

Press **⏪** to move the cursor out of the denominator.

Press **2nd** **table** **enter** to convert  $6\frac{3}{8}$  to a decimal.

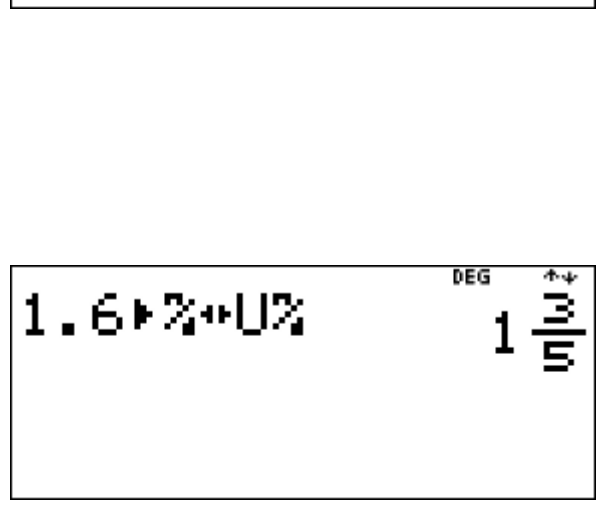
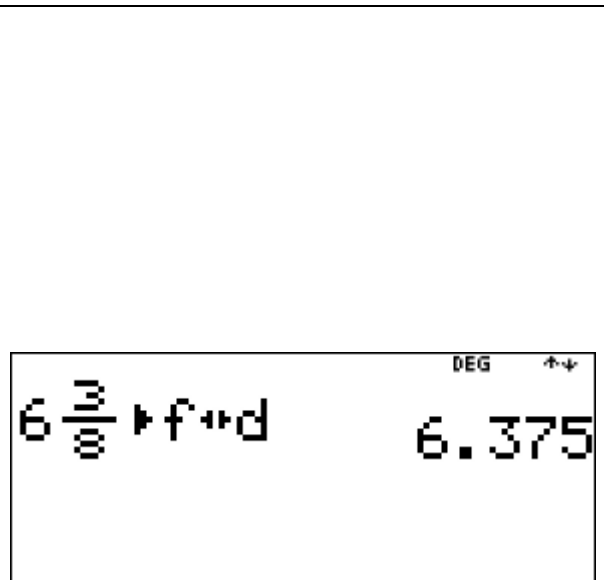
$$6\frac{3}{8} = 6.375$$

Note that pressing **↔** will convert an answer to a decimal.

(b)

Enter **1.6** and press **2nd** **x10<sup>n</sup>** **enter** to convert a decimal to a mixed numeral.

$$1.6 = 1\frac{3}{5}$$

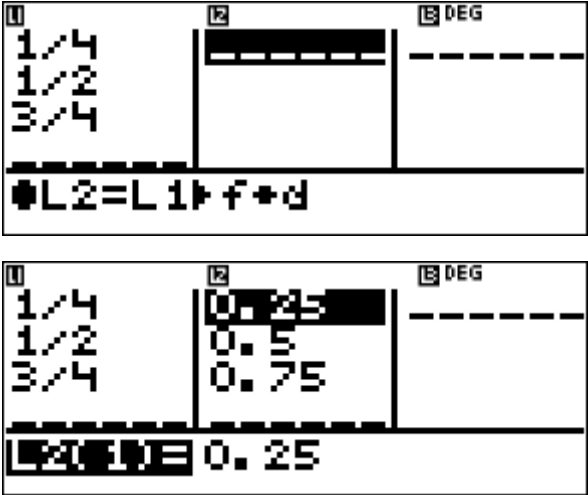


### Example

This example shows how to use a calculator to convert fractions to decimal form.

Use the TI-30XB MultiView™ lists feature to convert the fractions  $\frac{1}{4}$ ,  $\frac{1}{2}$  and  $\frac{3}{4}$  to decimal form.

[**Teacher Note:** It is important that students are able to perform such calculations without a calculator.]

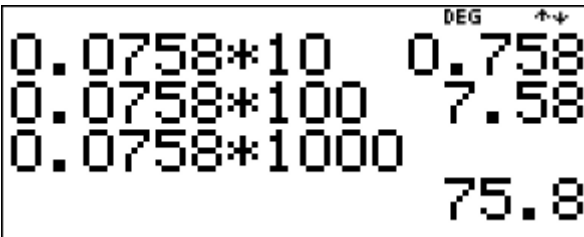
|   |  |
|---|--|
| <p>Keystrokes and solution:</p> <p>Press <b>data</b> <b>data</b> <b>4</b> to clear all lists.</p> <p>Enter <b>1</b> and press <b><math>\frac{n}{d}</math></b>.</p> <p>Press <b>⌵</b> and enter <b>4</b>.</p> <p>Press <b>⌵</b>.</p> <p>Repeat the above instruction to enter <math>\frac{1}{2}</math> and <math>\frac{3}{4}</math>. The three fractions should now be in <b>L1</b>.</p> <p>Press <b>⌶</b> to scroll across to the top of <b>L2</b>.</p> <p>Press <b>data</b> <b>⌶</b> to highlight <b>FORMULA</b> and press <b>enter</b>.</p> <p>Now we can enter a formula to generate decimals in <b>L2</b>.</p> <p>Press <b>data</b> <b>enter</b> to paste <b>L1</b> into the author line.</p> <p>Press <b>2nd</b> <b>table</b> (convert fraction to decimal).</p> <p>Press <b>enter</b>.</p> <p><b>L2</b> should now contain the decimals 0.25, 0.5 and 0.75.</p> <p>Note that <b>L2</b> is calculated as per the formula entered.</p> <p><b>L2(1) =</b> in the author line is highlighted to indicate the list is the result of a formula.</p> |  <p>The image shows two screenshots of a TI-30XB MultiView calculator screen. The top screenshot shows list L1 containing the fractions 1/4, 1/2, and 3/4. List L2 is empty. The formula editor shows the formula L2=L1 f-d. The bottom screenshot shows the same lists, but L2 now contains the decimal values 0.25, 0.5, and 0.75. The formula editor shows the formula L2=L1 f-d.</p> |
|---|--|

### Example

This example shows how to use a calculator to determine the effect of multiplying decimals by powers of 10.

- (a) Use the TI-30XB MultiView™ to calculate the following:
- (i)  $0.0758 \times 10$
  - (ii)  $0.0758 \times 100$
  - (iii)  $0.0758 \times 1000$
- (b) Without using the TI-30XB MultiView™, calculate the value of  $0.0758 \times 100\,000$ .

**[Teacher Note:** It is important for students to realise that the decimal point does not move under multiplication and division by powers of 10. It is the digits that move.]

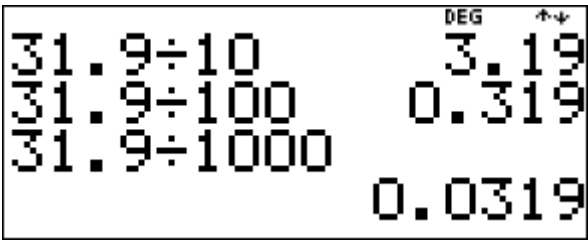
|   |  |
|---|--|
| <p>Keystrokes and solution:</p> <p>(a)</p> <p>(i) Enter <b>0.0758</b> and press <math>\boxed{\times}</math>.</p> <p>Enter <b>10</b> and press <b>enter</b>.</p> <p><math>0.0758 \times 10 = 0.758</math></p> <p>(ii) Press <math>\leftarrow \rightarrow</math> to highlight <b>0.0758 * 10</b> and press <b>enter</b>.</p> <p>Enter a <b>0</b> and press <b>enter</b>.</p> <p><math>0.0758 \times 100 = 7.58</math></p> <p>Repeating the above instruction:</p> <p>(iii) <math>0.0758 \times 1000 = 75.8</math></p> <p>(b)</p> <p><math>0.0758 \times 100\,000 = 7580</math></p> <p>The decimal point is no longer required (758) and a zero digit is then added to obtain 7580</p> |  |
|---|--|

### Example

This example shows how to use a calculator to determine the effect of dividing decimals by powers of 10.

- (a) Use the TI-30XB MultiView™ to calculate the following:
- (i)  $31.9 \div 10$
  - (ii)  $31.9 \div 100$
  - (iii)  $31.9 \div 1000$
- (b) Without using the TI-30XB MultiView™, calculate the value of  $31.9 \div 100\,000$ .

**[Teacher Note:** It is important for students to realise that the decimal point does not move under multiplication and division by powers of 10. It is the digits that move.]

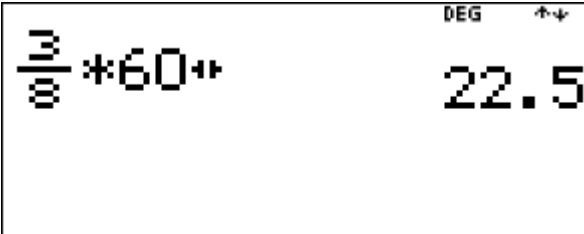
|  |  |
|--|--|
| <p>Keystrokes and solution:</p> <p>(a)</p> <p>(i) Enter <b>31.9</b> and press <math>\frac{\square}{\square}</math>.</p> <p>Enter <b>10</b> and press <b>enter</b>.</p> <p><math>31.9 \div 10 = 3.19</math></p> <p>(ii) Press <math>\leftarrow \rightarrow</math> to highlight <b>31.9 <math>\div</math> 10</b> and press <b>enter</b>.</p> <p>Enter a <b>0</b> and press <b>enter</b>.</p> <p><math>31.9 \div 100 = 0.319</math></p> <p>Repeating the above instruction:</p> <p>(iii) <math>31.9 \div 1000 = 0.0319</math></p> <p>(b)</p> <p><math>31.9 \div 100\,000 = 0.000319</math></p> <p>Two zeros digits are added after the decimal point to obtain 0.000319</p> |  |
|--|--|

### Example

This example shows how to use a calculator to calculate fractions and decimals of quantities.

Use the TI-30XB MultiView™ to calculate  $\frac{3}{8}$  of 60. Give your answer as a decimal.

[**Teacher Note:** Students need to understand the meaning of such 'of statements'. For example,  $\frac{1}{8}$  of 60 is equivalent to  $60 \div 8$ .]

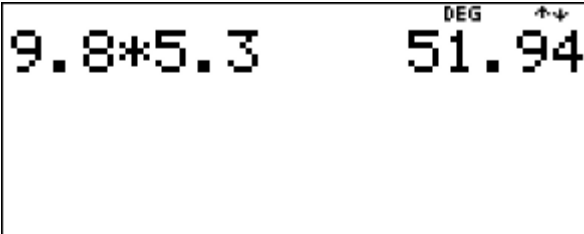
|  |  |
|--|--|
| <p>Keystrokes and solution:</p> <p>Enter <b>3</b> and press <math>\frac{\square}{\square}</math>.</p> <p>Enter <b>8</b> in the denominator box.</p> <p>Press <math>\rightarrow</math> to move the cursor out of the denominator.</p> <p>Press <math>\times</math> and enter <b>60</b>.</p> <p>Press <math>\rightarrow</math> <b>enter</b>.</p> <p><math>\frac{3}{8}</math> of 60 is 22.5</p> |  <p>The image shows a TI-30XB MultiView calculator screen. The display shows the fraction <math>\frac{3}{8}</math> followed by <math>*60</math> and an equals sign, with the result 22.5. The screen also shows 'DEG' and a double arrow icon in the top right corner.</p> |
|--|--|

### Example

This example shows how to compare initial estimates with answers obtained with a calculator.

- (a) Estimate the value of  $9.8 \times 5.3$ .
- (b) Use the TI-30XB MultiView™ to calculate  $9.8 \times 5.3$ .

[**Teacher Note:** Students need to be able to estimate the answers to such numerical calculations. It provides a use for mental computation and, when using a calculator, helps students to make sense of calculator outputs.]

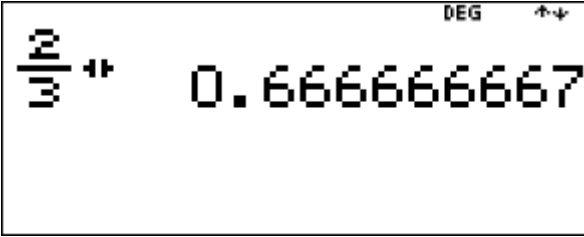
|  |  |
|--|--|
| <p>Keystrokes and solution:</p> <p>(a)</p> <p>Examples include<br/><math>10 \times 6 = 60, 10 \times 5 = 50, 10 \times 5.5 = 55</math> and<br/><math>9 \times 6 = 54</math>.</p> <p>(b)</p> <p>Using <math>\times</math>, <math>9.8 \times 5.3 = 51.94</math>.</p> |  <p>The image shows a TI-30XB MultiView calculator screen. The display shows the multiplication <math>9.8 * 5.3</math> followed by an equals sign and the result 51.94. The screen also shows 'DEG' and a double arrow icon in the top right corner.</p> |
|--|--|

### Example

This example shows how calculators deal with recurring decimals.

- (a) Express  $\frac{2}{3}$  as a recurring (repeating) decimal.
- (b) Use the TI-30XB MultiView™ to convert  $\frac{2}{3}$  to a decimal. Explain the calculator's output.

**[Teacher Note:** It is important for students to be able to reconcile/explain such calculator outputs.]

|   |   |
|---|---|
| <p>Keystrokes and solution:</p> <p>(a)</p> $\frac{2}{3} = 0.\dot{6}$ <p>(b)</p> $\frac{2}{3} = 0.666666667$ <p>As <math>\frac{2}{3} = 0.\dot{6}</math> the digit 6 repeats indefinitely.</p> <p>The TI-30XB MultiView™ cannot display all these repeating 6s. The last 6 that would be displayed on the Home screen is therefore rounded up to a 7. It is rounded up because <math>6 &gt; 5</math>.</p> |  <p>The image shows a TI-30XB MultiView calculator display. The screen displays the fraction <math>\frac{2}{3}</math> followed by an equals sign and the decimal <math>0.666666667</math>. The word "DEG" and a right arrow are visible in the top right corner of the display area.</p> |
|---|---|

### Short investigation

This is a short investigation involving terminating and recurring decimals. These decimals are rational numbers of the form  $\frac{a}{b}$  where  $a$  and  $b$  are integers and  $b \neq 0$ . The aim is to classify the number of terminating digits (T) and the number of repeating digits (R) in terminating decimals and recurring decimals.

(a) For each positive integer value of  $N$  in the following table:

- (i) Use the TI-30XB MultiView™ to write  $\frac{1}{N}$  in decimal form.
- (ii) Write each denominator of  $\frac{1}{N}$  as a product of its prime factors in index form.
- (iii) Write down the number of terminating digits (T) and the number of repeating digits (R) in each decimal.

The first three rows of the table have been filled in.

| $N$ | $\frac{1}{N}$ in decimal form | $\frac{1}{N}$ with prime factors | Number of T and R digits |
|-----|-------------------------------|----------------------------------|--------------------------|
| 2   | 0.5                           | $\frac{1}{2}$                    | 1 T and 0 R              |
| 3   | $0.\dot{3}$                   | $\frac{1}{3}$                    | 0 T and 1 R              |
| 4   | 0.25                          | $\frac{1}{2^2}$                  | 2 T and 0 R              |
| 5   |                               |                                  |                          |
| 6   |                               |                                  |                          |
| 7   |                               |                                  |                          |
| 8   |                               |                                  |                          |
| 9   |                               |                                  |                          |
| 10  |                               |                                  |                          |
| 11  |                               |                                  |                          |
| 12  |                               |                                  |                          |
| 13  |                               |                                  |                          |
| 14  |                               |                                  |                          |
| 15  |                               |                                  |                          |
| 16  |                               |                                  |                          |



- (b) Use the results from part (a) to state when a fraction  $\frac{1}{N}$ , when written as a decimal, results in
- a terminating decimal.
  - a repeating decimal.
- (c) Explain why  $\frac{1}{15}$ , when written as a decimal, has one T digit and one R digit.
- (d) Without using a calculator, show that  $\frac{1}{35}$ , when written as a decimal, has one T digit and six R digits. Use the TI-30XB MultiView™ to confirm this result.

Further rules regarding the number of T digits and R digits:

- If there are two prime factors with the same rule, for example 2 and 5, only apply the rule once to obtain one T digit instead of two T digits. For example,  $\frac{1}{10}$ , when written as a decimal, has one T digit only.
  - However, if there are higher powers of the same number, for example  $2^2$ , use the rule twice, so you would therefore have two T digits. The highest power of the factors 2 and 5 determines the number of T digits.
  - For a number such as 21, which has prime factors 3 and 7, the factor that generates the most R digits takes priority which in this case is 7. Hence  $\frac{1}{21}$ , when written as a decimal, has six R digits.
- (e) Find the number of T digits and R digits for the decimal form of each of the following fractions.
- $\frac{1}{50}$
  - $\frac{1}{33}$

**[Teacher Note:** Such investigations show how the TI-30XB MultiView™ can be used for good teaching and learning opportunities.]

**Answers:**

(a)

| $N$ | $\frac{1}{N}$ in decimal form                   | $\frac{1}{N}$ with prime factors | Number of T and R digits |
|-----|---|----------------------------------|--------------------------|
| 2   | 0.5   | $\frac{1}{2}$                    | 1 T and 0 R              |
| 3   | $0.\dot{3}$                                     | $\frac{1}{3}$                    | 0 T and 1 R              |
| 4   | 0.25  | $\frac{1}{2^2}$                  | 2 T and 0 R              |
| 5   | 0.2   | $\frac{1}{5}$                    | 1 T and 0 R              |
| 6   | $0.1\dot{6}$                                    | $\frac{1}{2 \times 3}$           | 1 T and 1 R              |
| 7   | $0.\dot{1}4\dot{2}\dot{8}\dot{5}\dot{7}$        | $\frac{1}{7}$                    | 0 T and 6 R              |
| 8   | 0.125   | $\frac{1}{2^3}$                  | 3 T and 0 R              |
| 9   | $0.\dot{1}$                                     | $\frac{1}{3^2}$                  | 0 T and 1 R              |
| 10  | 0.1   | $\frac{1}{2 \times 5}$           | 1 T and 0 R              |
| 11  | $0.\dot{0}\dot{9}$                              | $\frac{1}{11}$                   | 0 T and 2 R              |
| 12  | $0.08\dot{3}$                                   | $\frac{1}{2^2 \times 3}$         | 2 T and 1 R              |
| 13  | $0.\dot{0}\dot{7}\dot{6}\dot{9}\dot{2}\dot{3}$  | $\frac{1}{13}$                   | 0 T and 6 R              |
| 14  | $0.0\dot{7}\dot{1}\dot{4}\dot{2}\dot{8}\dot{5}$ | $\frac{1}{2 \times 7}$           | 1 T and 6 R              |
| 15  | $0.0\dot{6}$                                    | $\frac{1}{3 \times 5}$           | 1 T and 1 R              |
| 16  | 0.0625  | $\frac{1}{2^4}$                  | 4 T and 0 R              |

- (b) (i) A terminating decimal if the prime factors of the denominator are either 2 or 5 or both.
- (ii) A repeating decimal if a prime factor other than 2 or 5 appears in the prime factorisation of the denominator.

(c)  $\frac{1}{15} = \frac{1}{3 \times 5}$

$\frac{1}{3}$  has 0 T digits and 1 R digit and  $\frac{1}{5}$  has 1 T digit and 0 R digits

So  $\frac{1}{15}$  has 1 T digit and 1 R digit.

(d)  $\frac{1}{35} = \frac{1}{5 \times 7}$

$\frac{1}{5}$  has 1 T digit and 0 R digits and  $\frac{1}{7}$  has 0 T digits and 6 R digits

So  $\frac{1}{35}$  has 1 T digit and 6 R digits.  $\frac{1}{35} = 0.0\dot{2}\dot{8}\dot{5}\dot{7}\dot{1}\dot{4}$

(e) (i)  $\frac{1}{50} = \frac{1}{2 \times 5^2}$

The highest power of the factors 2 and 5 determines the number of T digits.

So  $\frac{1}{50}$  has 2 T digits and 0 R digits.

(ii)  $\frac{1}{33} = \frac{1}{3 \times 11}$

The factor that generates the most R digits takes priority.

$\frac{1}{3}$  has 1 R digit and  $\frac{1}{11}$  has 2 R digits

So  $\frac{1}{33}$  has 0 T digits and 2 R digits.

Real numbers that cannot be written in the form of a fraction  $\frac{a}{b}$ , where  $a$  and  $b$  are

integers and  $b \neq 0$ , are called irrational numbers. An important difference between rational and irrational numbers is that the decimal places of irrational numbers continue forever, without forming any repeating pattern.

The decimal places of  $\pi$  continue indefinitely without ever forming a repeating pattern. So  $\pi$  is an irrational number. As  $\pi$  is not a root of a number, it is not a surd (a number that cannot be simplified to remove a square root or cube root etc.).

A calculator can be used to describe informally, the properties of  $\pi$ .

Press  $\pi$  to enter  $\pi$ .

For calculations, the TI-30XB MultiView™ uses  $\pi = 3.141592653590$ .

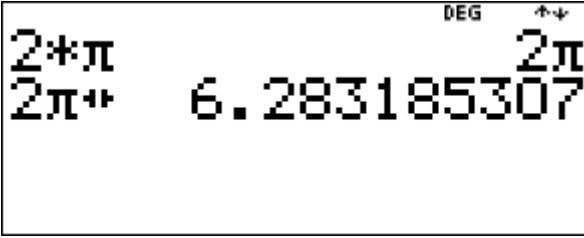
For display, the TI-30XB MultiView™ displays  $\pi = 3.141592654$ .

Press  $\leftrightarrow$  to toggle between exact and approximate values.

### Example

Use the TI-30XB MultiView™ to convert  $2\pi$  to a decimal.

**[Teacher Note:** Such an example helps students to become familiar with the properties of irrational numbers and the magnitude of frequently used irrational numbers.]

|  |   |
|--|---|
| <p>Keystrokes and solution:</p> <p>Enter 2 and press <math>\times</math> <math>\pi</math> enter .</p> <p>The output is <math>2\pi</math>.</p> <p>To convert to a decimal, press <math>\leftrightarrow</math>.</p> <p>The output is <b>6.283185307</b>.</p> |  <p>The calculator display shows the expression <math>2 * \pi</math> on the top line and <math>2\pi</math> on the second line. To the right of <math>2\pi</math>, the decimal value <b>6.283185307</b> is displayed. The mode indicator 'DEG' and the toggle symbol <math>\leftrightarrow</math> are visible in the top right corner.</p> |
|--|---|

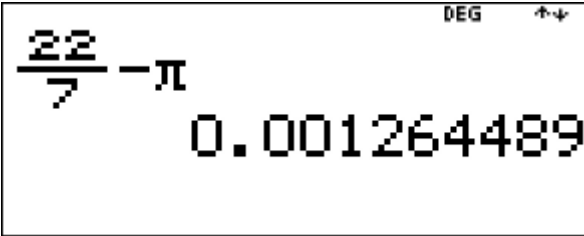
### Example

This example shows how a calculator can be used to establish the order of fractions, decimals (and percentages).

The fraction  $\frac{22}{7}$  is sometimes used as a rational approximation for  $\pi$ . There is no fraction that is equal to  $\pi$ .

Use the TI-30XB MultiView™ to determine whether  $\frac{22}{7}$  is bigger or smaller than the calculator's decimal value for  $\pi$ .

**[Teacher Note:** This example helps to illustrate that if  $a - b > 0$  then  $a > b$ .]

|   |   |
|---|---|
| <p>Keystrokes and solution:</p> <p>For example, attempt to calculate <math>\frac{22}{7} - \pi</math>.</p> <p>Enter 22 and press <math>\frac{\square}{\square}</math>.</p> <p>Enter 7 and press <math>\rightarrow</math> to move the cursor out of the denominator.</p> <p>Press <math>=</math> <math>\pi</math> enter .</p> <p>The output is <b>0.001264489</b> which is <math>&gt; 0</math>.</p> <p>So <math>\frac{22}{7} &gt; \pi</math>.</p> |  <p>The calculator display shows the expression <math>\frac{22}{7} - \pi</math> on the top line and the decimal value <b>0.001264489</b> on the second line. The mode indicator 'DEG' and the toggle symbol <math>\leftrightarrow</math> are visible in the top right corner.</p> |
|---|---|

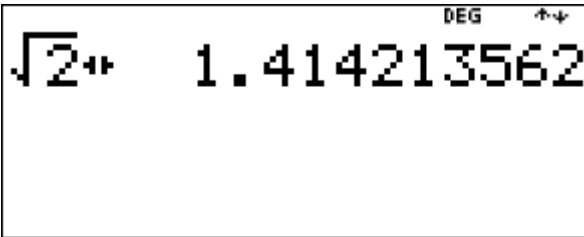
The square roots of many numbers are irrational. An irrational number that is the root of a rational number is called a surd. Examples of surds are  $\sqrt{2}$ ,  $\sqrt{3}$ ,  $\sqrt{5}$  and  $\sqrt[3]{2}$ .

A calculator can be used to describe informally, the properties of irrational numbers such as  $\sqrt{2}$ .

### Example

Use the TI-30XB MultiView™ to write  $\sqrt{2}$  in decimal form.

**[Teacher Note:** Such an example helps students to become familiar with the magnitude of frequently used irrational numbers.]

|   |   |
|---|---|
| <p>Keystrokes and solution:</p> <p>Press <b>2nd</b> <b>x<sup>2</sup></b> (<math>\sqrt{\quad}</math>) and enter 2 .</p> <p>Press <b>⏏</b> to move the cursor out from under the square root sign.</p> <p>Press <b>▶</b> <b>enter</b> to obtain the answer in decimal form.</p> <p><math>\sqrt{2} = 1.414213562\dots</math></p> <p>No matter how many decimal places we give, we can never express <math>\sqrt{2}</math> exactly. It is always possible to calculate more decimal places.</p> |  <p>The image shows a TI-30XB MultiView calculator display. The screen shows the square root symbol followed by a small '2' and a decimal point followed by the digits 414213562. The mode indicator 'DEG' and a cursor are visible in the top right corner.</p> |
|---|---|

### Short investigation

A calculator can be used to explore decimal approximations of surds and help students recognise that surds can be represented by decimals that are neither terminating nor have a repeating pattern.

For each positive integer value of  $N$  in the following table:

- Use the TI-30XB MultiView™ to write  $\sqrt{N}$  either as a positive integer or as a decimal.
- Hence determine whether each  $\sqrt{N}$  is irrational or rational.

The first two rows of the table have been filled in.

**[Teacher Note:** Such investigations show how the TI-30XB MultiView™ can be used for good teaching and learning opportunities.]

| $N$ | $\sqrt{N}$ | $\sqrt{N}$ in exact or decimal form | Rational or irrational |
|-----|------------|-------------------------------------|------------------------|
| 1   | $\sqrt{1}$ | 1                                   | rational               |
| 2   | $\sqrt{2}$ | 1.414213562                         | irrational             |
| 3   |            |                                     |                        |
| 4   |            |                                     |                        |
| 5   |            |                                     |                        |
| 6   |            |                                     |                        |
| 7   |            |                                     |                        |
| 8   |            |                                     |                        |
| 9   |            |                                     |                        |

**Answers:**

(a) and (b)

| $N$ | $\sqrt{N}$ | $\sqrt{N}$ in exact or decimal form | Rational or irrational |
|-----|------------|-------------------------------------|------------------------|
| 1   | $\sqrt{1}$ | 1                                   | rational               |
| 2   | $\sqrt{2}$ | 1.414213562                         | irrational             |
| 3   | $\sqrt{3}$ | 1.732050808                         | irrational             |
| 4   | $\sqrt{4}$ | 2                                   | rational               |
| 5   | $\sqrt{5}$ | 2.236067978                         | irrational             |
| 6   | $\sqrt{6}$ | 2.449489743                         | irrational             |
| 7   | $\sqrt{7}$ | 2.645751311                         | irrational             |
| 8   | $\sqrt{8}$ | 2.828427125                         | irrational             |
| 9   | $\sqrt{9}$ | 3                                   | rational               |

## 1.5 Percentages

Percentages are fractions where the denominator is 100. 'Per cent' means 'out of 100' or 'for every 100'. The symbol % has a one and two zeros hidden in it. The whole amount is 100%. Because percentages all have a denominator of 100, it is easier to compare percentages than it is to compare fractions with different denominators.

To express a value as a percentage, press  $\boxed{2\text{nd}} \boxed{)} (>\%)$  after the value.

To perform a calculation involving a percentage, press  $\boxed{2\text{nd}} \boxed{(} (\%)$  after entering the value of the percentage.

### Example

This example shows how to use a calculator to convert fractions to percentages. To change a fraction or a decimal to a percentage, find that fraction or decimal 'of' 100% where 'of' is calculated by multiplying.

Use the TI-30XB MultiView™ to convert  $\frac{1}{40}$  to a percentage.

**[Teacher Note:** It is important for students to make such conversions with and without a calculator.]

|   |  |
|---|--|
| <p>Keystrokes and solution:</p> <p>Enter <b>1</b> and press <math>\boxed{\frac{\square}{\square}}</math>.</p> <p>Enter <b>40</b> in the denominator box.</p> <p>Press <math>\boxed{\rightarrow}</math> to move the cursor out of the denominator.</p> <p>Press <math>\boxed{2\text{nd}} \boxed{)} (&gt;\%) \boxed{\text{enter}}</math>.</p> <p>As a percentage, <math>\frac{1}{40}</math> is 2.5% .</p> | <p>The calculator display shows the fraction <math>\frac{1}{40}</math> followed by a right arrow and a percent sign. To the right, the result 2.5% is displayed. The mode indicator 'DEG' and a double arrow are visible at the top right of the screen.</p> |
|---|--|

### Example

This example shows how to use a calculator to convert terminating decimals to percentages.

Use the TI-30XB MultiView™ to convert 0.7652 to a percentage.

**[Teacher Note:** It is important for students to realise that the decimal point does not move. It is the digits that move. Students need to understand this is multiplication by 100.]

|  |  |
|--|--|
| <p>Keystrokes and solution:</p> <p>Enter <b>0.7652</b> and press <math>\boxed{2\text{nd}} \boxed{)} (&gt;\%) \boxed{\text{enter}}</math>.</p> <p>As a percentage, 0.7652 is 76.52% .</p> | <p>The calculator display shows the decimal 0.7652 followed by a right arrow and a percent sign. To the right, the result 76.52% is displayed. The mode indicator 'DEG' and a double arrow are visible at the top right of the screen.</p> |
|--|--|

To change a percentage to a fraction, write it over 100 then simplify if possible.

To change a percentage to a decimal, write it over 100 then do the division by 100.

### Example

This example shows how to use a calculator to convert percentages to fractions and decimals (terminating and recurring).

Use the TI-30XB MultiView™ to express  $9\frac{1}{2}\%$  as

(a) a fraction.

(b) a decimal.

[**Teacher Note:** It is important for students to make such conversions with and without a calculator.]

Keystrokes and solution:

(a)

Enter 9 and press  $\boxed{2nd} \boxed{\frac{\square}{\square}}$ .

Enter 1 in the numerator box.

Press  $\odot$  and enter 2 in the denominator box.

Press  $\odot$  to move the cursor out of the denominator box.

Press  $\boxed{2nd} \boxed{\square} (\%)$ .

Press  $\boxed{2nd} \boxed{\times 10^n}$  (convert a decimal to a fraction).

Press  $\boxed{enter}$ .

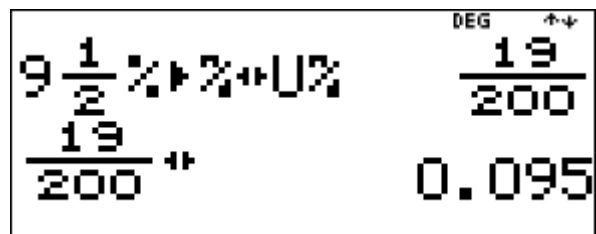
So  $9\frac{1}{2}\%$  as a fraction is  $\frac{19}{200}$ .

(b)

To now express  $9\frac{1}{2}\%$  as a decimal, press

$\boxed{\rightarrow}$ .

So  $9\frac{1}{2}\%$  as a decimal is 0.095.



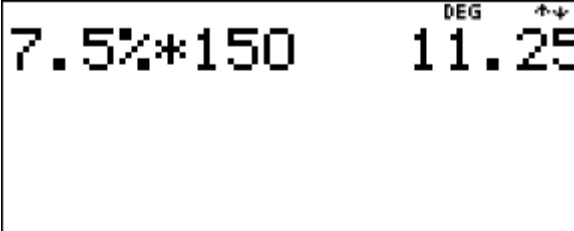


### Example

This example shows how to use a calculator to calculate percentages of quantities.

Use the TI-30XB MultiView™ to calculate 7.5% of 150.

**[Teacher Note:** It is important for students to be able estimate the magnitude of the resulting quantity. For example, 10% of 150 is 15.]

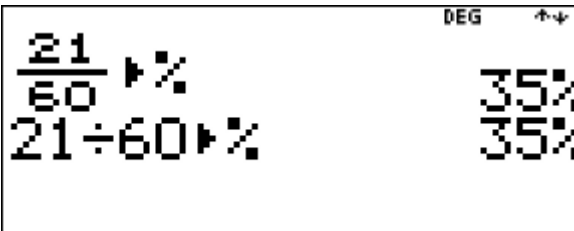
|  |   |
|--|---|
| <p>Keystrokes and solution:</p> <p>Enter <b>7.5</b> and press <b>2nd</b> <b>(</b> <b>(%)</b> <b>)</b>.</p> <p>Enter <b>150</b> and press <b>enter</b>.</p> <p>So 7.5% of 150 is 11.25.</p> |  <p>The calculator display shows the calculation 7.5%*150 resulting in 11.25. The mode indicator 'DEG' and the arrow keys are visible at the top right of the screen.</p> |
|--|---|

### Example

This example shows how to use a calculator to express one quantity as a percentage of another.

Using the TI-30XB MultiView™, what percentage of one hour is 21 minutes?

**[Teacher Note:** Students need to know there are 60 minutes in 1 hour.]

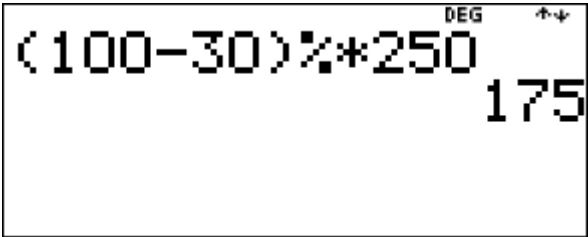
|   |   |
|---|---|
| <p>Keystrokes and solution:</p> <p>Enter <b>21</b> and press <b><math>\frac{\square}{\square}</math></b>.</p> <p>Enter <b>60</b> and press <b>⤵</b> to move the cursor out of the denominator box.</p> <p>Press <b>2nd</b> <b>)</b> (<b>&gt;%</b>) <b>enter</b>.</p> <p>As a percentage this is 35%.</p> <p>Alternatively:</p> <p>Enter <b>21</b> and press <b><math>\div</math></b>.</p> <p>Enter <b>60</b> and press <b>2nd</b> <b>)</b> (<b>&gt;%</b>) <b>enter</b>.</p> |  <p>The calculator display shows two calculations: 21/60 = 35% and 21 ÷ 60 = 35%. The mode indicator 'DEG' and the arrow keys are visible at the top right of the screen.</p> |
|---|---|

### Example

This example shows how to use a calculator to decrease a quantity by a given percentage. It also illustrates the importance of recognising equivalences when calculating percentage decreases.

A shop has a sale where there is a 30% discount on sporting equipment. Use the TI-30XB MultiView™ to find the discounted price on a tennis racquet that normally costs \$250.

**[Teacher Note:** When using a calculator to answer such questions, it is important that students anticipate an answer less than \$250.]

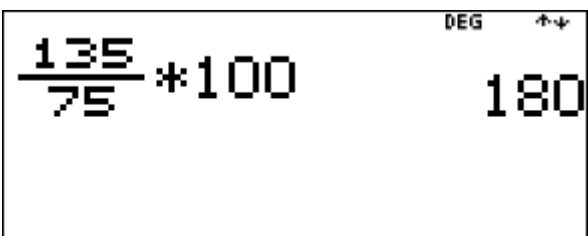
|   |   |
|---|---|
| <p>Keystrokes and solution:</p> <p>First work out the percentage to be paid by subtracting the percentage discount from 100% .</p> <p>Then to find the discounted price, calculate that percentage of the marked price.</p> <p>Press <math>\square</math> and enter <b>100</b> .</p> <p>Press <math>\square</math> and enter <b>30</b> .</p> <p>Press <math>\square</math> <math>\square</math> <math>\square</math> (<math>\square</math> (%) <math>\square</math>).</p> <p>Enter <b>250</b> and press <b>enter</b> .</p> <p>The discounted price of the tennis racquet is \$175</p> |  <p>The calculator display shows the calculation: <math>(100-30)\% * 250 = 175</math>. The display also shows 'DEG' and a double arrow icon.</p> |
|---|---|

### Example

This example shows how to use a calculator to solve percentage problems involving use of the unitary method.

A shop has a sale where all items are reduced by 25% . If a pair of shoes costs \$135 in the sale, use the TI-30XB MultiView™ to find the original price of the shoes.

**[Teacher Note:** When using a calculator to answer such questions, it is important that students anticipate an answer more than \$135.]

|  |  |
|--|--|
| <p>Keystrokes and solution:</p> <p>If the shoes have been reduced by 25% , \$135 is 75% of the original price.</p> <p>1% of the original price is <math>\frac{\\$135}{75}</math></p> <p>100% of the original price is <math>\frac{\\$135}{75} \times \frac{100}{1}</math></p> <p>The original price of the shoes is \$180.</p> |  <p>The calculator display shows the calculation: <math>\frac{135}{75} * 100 = 180</math>. The display also shows 'DEG' and a double arrow icon.</p> |
|--|--|

## 1.6 Financial mathematics

The GST is a federal tax applied to most goods and services in Australia. It is calculated at the rate of 10% of the purchase price of the goods or services.

The price including the GST (the price after the GST is added) is described as 'price including GST'.

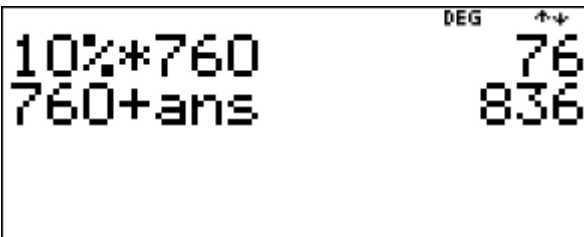
The price excluding the GST (the price before the GST is added) is described as 'price excluding GST'.

### Example

This example shows how to use a calculator to calculate the GST and GST inclusive prices for goods purchased in Australia, given the pre-GST price.

Use the TI-30XB MultiView™ to calculate the GST and the price including GST of a coffee machine whose listed price excluding GST is \$760.

**[Teacher Note:** Remind students of the usefulness of the answer feature when using the TI-30XB MultiView™.]

|  |   |
|--|---|
| <p>Keystrokes and solution:</p> <p>GST is 10% of \$760.</p> <p>Enter <b>10</b> and press <b>2nd</b> <b>( )</b> (%).</p> <p>Press <b>(x)</b> and enter <b>760</b>.</p> <p>Press <b>enter</b>.</p> <p>GST is \$76.</p> <p>Price including GST:</p> <p>Enter <b>760</b> and press <b>+</b> <b>2nd</b> <b>(-)</b> (<b>ans</b>) <b>enter</b>.</p> <p>The price including GST is \$836<br/>(\$760 + \$76).</p> |  <p>The image shows a TI-30XB MultiView calculator display. The screen is divided into two columns. The left column shows the calculation steps: '10%*760' followed by '760+ans'. The right column shows the results: '76' and '836'. At the top right of the display, 'DEG' and a double-headed arrow are visible.</p> |
|--|---|

### Example

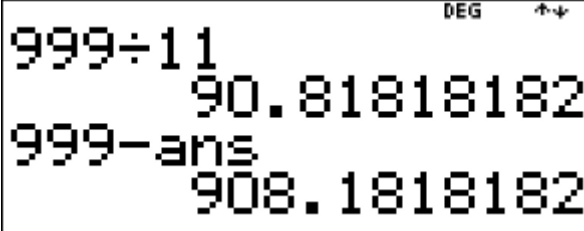
This example shows how to use a calculator to calculate the pre-GST price for goods, given the GST-inclusive price.

A TV is advertised with a listed price of \$999 including GST.

Use the TI-30XB MultiView™ to calculate

- (a) the GST included on the price.
- (b) the pre-GST price.

**[Teacher Note:** Remind students of the usefulness of the answer feature when using the TI-30XB MultiView™.]

|  |   |
|--|---|
| <p>Keystrokes and solution:</p> <p>(a)</p> <p>The working formula for calculating the GST in these situations is:</p> $\text{GST} = \text{price including GST} \div 11$ <p>GST is <math>\frac{\\$999}{11}</math>.</p> <p>Enter <b>999</b> and press <math>\div</math>.</p> <p>Enter <b>11</b> and press <b>enter</b>.</p> <p>GST is \$90.82 to the nearest cent.</p> <p>(b)</p> <p>Pre-GST price:</p> <p>Enter <b>999</b> and press <math>\square</math> <b>2nd</b> <math>\square</math> <b>(ans)</b> <b>enter</b>.</p> <p>Pre-GST price is \$908.18</p> <p>(\$999 – \$90.82).</p> |  <p>The calculator display shows the following sequence of operations and results:</p> <ul style="list-style-type: none"><li>999 ÷ 11 = 90.81818182</li><li>999 - ans = 908.1818182</li></ul> <p>The display also shows 'DEG' and a right arrow icon in the top right corner.</p> |
|--|---|

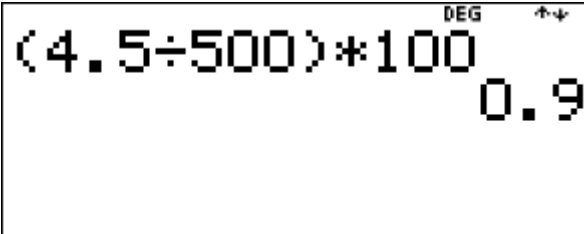
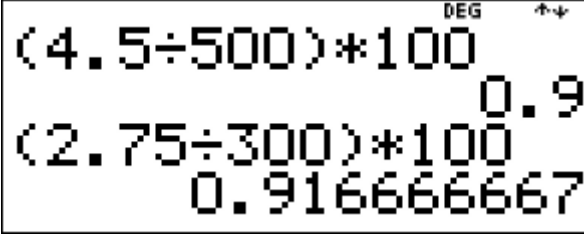
### Example

This example shows how to use a calculator to calculate 'best buys' by comparing price per unit, or quantity per monetary unit.

Use the TI-30XB MultiView™ to calculate which of the following options is the 'best buy'.

500 grams of butter for \$4.50 or 300 grams of butter for \$2.75

[**Teacher Note:** This problem can be analysed in a number of different ways.]

|   |   |
|---|---|
| <p>Keystrokes and solution:</p> <p>500 grams of butter for \$4.50</p> <p>What is 1 gram worth?</p> <p>Press <math>\left[ \frac{\square}{\square} \right]</math> and enter <b>4.5</b> .</p> <p>Press <math>\left[ \frac{\square}{\square} \right]</math> and enter <b>500</b> .</p> <p>Press <math>\left[ \square \right] \left[ \times \right]</math> and enter <b>100</b> .</p> <p>Press <b>enter</b> .</p> <p>1 gram is worth 0.9 cents.</p> <p>300 grams of butter for \$2.75</p> <p>What is 1 gram worth?</p> <p>Press <math>\left[ \leftarrow \right] \left[ \rightarrow \right] \left[ \text{enter} \right]</math> to bring the previous entry to a new author line.</p> <p>Press <math>\left[ 2\text{nd} \right] \left[ \text{delete} \right]</math> (insert) to edit this expression.</p> <p>Form <math>(2.75 \div 300) * 100</math> and press <b>enter</b> .</p> <p>1 gram is worth 0.917 cents (correct to three decimal places).</p> <p><math>0.9 &lt; 0.917</math> and so 500 grams of butter for \$4.50 is the 'best buy'.</p> |  <p>DEG <math>\uparrow \downarrow</math></p> $(4.5 \div 500) * 100$ $0.9$<br> <p>DEG <math>\uparrow \downarrow</math></p> $(4.5 \div 500) * 100$ $0.9$ $(2.75 \div 300) * 100$ $0.916666667$ |
|---|---|

## 1.7 Ratios and rates

The scale on a map is a ratio. It compares the distance on the map with the actual distance on the ground. Map scales normally compare 1 cm on the map with the distance on the ground.

A scale of 1:100, for example, means that 1 cm on the map represents 100 cm on the ground.

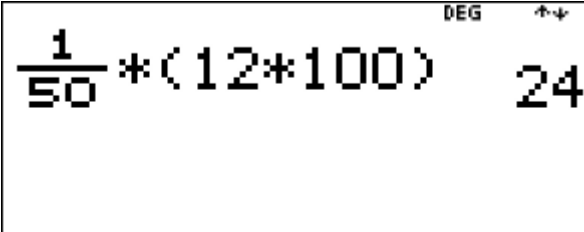
Converting this to a more appropriate unit, 1 cm on the map represents 1 m because 100 cm = 1 m. The distance on the map is  $\frac{1}{100}$  of the distance on the ground.

### Example

This example shows how to solve a real-life problem involving ratios.

A plan for a shed is drawn using a scale of 1 : 50 . If the shed is 12 metres long, use the TI-30XB MultiView™ to calculate how long this would be on the plan.

**[Teacher Note:** Correct conversion of units is important here.]

|   |  |
|---|--|
| <p>Keystrokes and solution:</p> <p>Actual length of shed is 1200 cm.</p> <p>The plan is <math>\frac{1}{50}</math> of the actual size.</p> <p>Enter <b>1</b> and press <math>\frac{n}{d}</math>.</p> <p>Enter <b>50</b> and press <math>\rightarrow</math> to move the cursor out of the denominator.</p> <p>Press <math>\times</math> <math>(</math> and enter <b>12</b>.</p> <p>Press <math>\times</math> and enter <b>100</b>.</p> <p>Press <math>)</math> <b>enter</b>.</p> <p>The length of the shed on the plan is <math>\frac{1}{50}</math> of 1200 cm. Which is 24 cm.</p> |  |
|---|--|

The speed of an object is a rate because it is the distance travelled in a certain time.

### Example

This example shows how to solve a real-life problem involving rates.

A truck is travelling at a constant speed of 90 km per hour. Use the TI-30XB MultiView™ to find how long it would take the truck to travel 3.75 km. Give your answer in minutes and seconds.

**[Teacher Note:** This example illustrates how to use the TI-30XB MultiView™ to convert a time into minutes and seconds.]

Keystrokes and solution:

In one hour, the truck would travel 90 km.

It would take  $\frac{1}{90}$  of an hour to travel 1 km.

So it would take  $\frac{3.75}{90}$  of an hour to travel 3.75 km.

Enter **3.75** and press  $\div$ .

Enter **90** and press  $\leftarrow$  **enter**.

This gives an output of  $\frac{1}{24}$  hours.

Press **2nd** **prb** (angle) **6** **enter**.

This gives an output in minutes and seconds.

The truck would take 2 minutes and 30 seconds to travel 3.75 km.

The calculator display shows the following sequence of operations and results:

- Input:  $3.75 \div 90$
- Output:  $\frac{1}{24}$
- Conversion mode: **DMS** (Degrees, Minutes, Seconds)
- Final output:  $0^\circ 2' 30''$

## 1.8 Algebraic techniques

It is important to develop the concept that pronumerals (letters) can be used to represent numerical values. The TI-30XB MultiView™ has a Constant feature which can be used to help achieve this aim. It also has a data editor and list formulas feature which can also be used to help achieve this aim. See page 17 for more details on the lists feature.

### TI-30XB MultiView™ Constant feature

Press  $\boxed{2\text{nd}} \boxed{\div} (\mathbf{K})$  to turn the Constant feature on and define a constant.

Follow these instructions to store an operation to  $\mathbf{K}$  and recall it.

Press  $\boxed{2\text{nd}} \boxed{\div} (\mathbf{K})$ .

$\mathbf{K} =$  will now be displayed.

Enter any combination of numbers, operators, and/or values, up to 44 characters.

Press  $\boxed{\text{enter}}$  to save the operation.  $\mathbf{K}$  will now display in the indicator line.

Each subsequent time  $\boxed{\text{enter}}$  is pressed, the TI-30XB MultiView™ recalls the stored operation and applies it to the last answer or the current entry.

Press  $\boxed{2\text{nd}} \boxed{\div} (\mathbf{K})$  again to turn Constant feature off.

### Example

This example shows how to use a calculator to help students recognise that pronumerals can represent one or more numerical values.

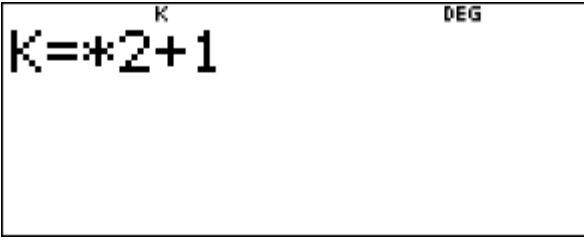
Use the TI-30XB MultiView™ Constant feature to find the value of the expression  $2k + 1$  when

(a)  $k = 3$

(b)  $k = 4$

(c)  $k = 5$

[**Teacher Note:** It is very important that students see pronumeral as variable.]

|   |   |
|---|---|
| <p>Keystrokes and solution:</p> <p>Press <math>\boxed{2\text{nd}} \boxed{\div} (\mathbf{K})</math> to turn the Constant feature on.</p> <p>If needed, press <math>\boxed{\text{delete}}</math> to delete a previously defined operation.</p> <p>Press <math>\boxed{\times}</math> and enter 2.</p> <p>Press <math>\boxed{+}</math> and enter 1.</p> <p>Press <math>\boxed{\text{enter}}</math>.</p> |  <p>The image shows a TI-30XB MultiView™ calculator display. The indicator line at the top shows 'K' on the left and 'DEG' on the right. The main display area shows the expression 'K=*2+1'.</p> |
|---|---|



Enter 3 and press **enter**.

When  $k = 3$ ,  $2k + 1 = 7$ .

Enter 4 and press **enter**.

When  $k = 4$ ,  $2k + 1 = 9$ .

Enter 5 and press **enter**.

When  $k = 5$ ,  $2k + 1 = 11$ .

Press **2nd** **÷** (**K**) to turn the Constant feature off.

The calculator display shows a list of three expressions and their corresponding results. The expressions are  $3*2+1$ ,  $4*2+1$ , and  $5*2+1$ . The results are 7, 9, and 11. The display also shows the 'K' (Constant) feature is turned off and the 'DEG' mode is selected.

| Expression | Result |
|------------|--------|
| $3*2+1$    | 7      |
| $4*2+1$    | 9      |
| $5*2+1$    | 11     |

### Example

This example shows how to use a calculator to verify whether a simplified expression is correct by substituting numbers for pronumerals and to recognise algebraic equivalence.

- (a) Use the TI-30XB MultiView™ lists feature to find the value of the expression  $2k + 1$  when
- $k = 3$
  - $k = 4$
  - $k = 5$
- (b) Use the TI-30XB MultiView™ lists feature to find the value of the expression  $2(k + 1)$  when
- $k = 3$
  - $k = 4$
  - $k = 5$
- (c) Make a change to the expression given in part (a) so that it is equivalent to  $2(k + 1)$ . Use the TI-30XB MultiView™ lists feature to test the change to your expression.

**[Teacher Note:** The TI-30XB MultiView™ can be used in conjunction with concrete materials and digital technologies to introduce algebraic equivalence, simplifying expressions and extending and applying the laws and properties of arithmetic to algebraic terms and expressions.]

Keystrokes and solution:

(a)

Press **data** **data** **4** to clear all lists.

In **L1** enter 3 and press  $\odot$ .

Repeat for 4 and 5.

These three values should now be in **L1**.

Press  $\rightarrow$  to scroll across to the top of **L2**.

Press **data**  $\rightarrow$  to highlight **FORMULA** and press **enter**.

Now enter the expression  $2k+1$  as  $2L1+1$  to **L2**.

Enter 2 and press **data** **enter** to paste **L1** into the author line.

Press **+** and enter 1 and press **enter**.

**L2** should now contain the values of the expression  $2k+1$  when  $k=3,4,5$ .

(i) when  $k=3$ ,  $2k+1=7$

(ii) when  $k=4$ ,  $2k+1=9$

(iii) when  $k=5$ ,  $2k+1=11$

(b)

Press  $\rightarrow$  to scroll across to the top of **L3**.

Press **data**  $\rightarrow$  to highlight **FORMULA** and press **enter**.

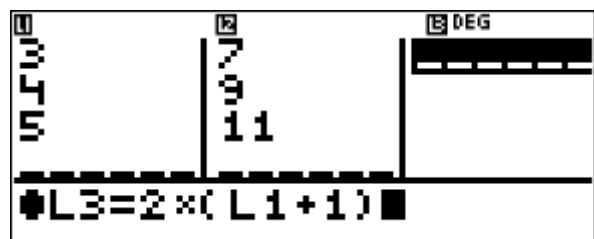
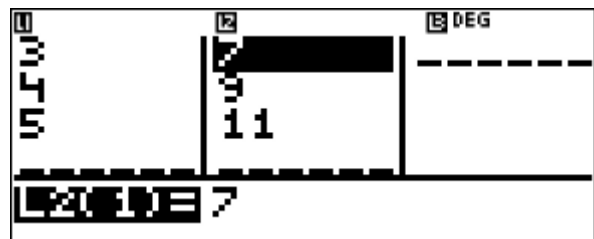
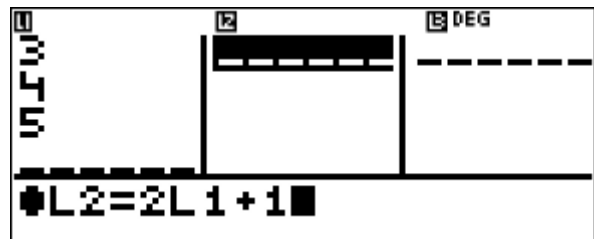
Now enter the expression  $2(k+1)$  as  $2(L1+1)$  to **L3**.

Enter 2 and press  $\times$   $($ .

Press **data** **enter** to paste **L1** into the author line.

Press **+** and enter 1.

Press  $)$  **enter**.



**L3** should now contain the values of the expression  $2(k+1)$  when  $k = 3, 4, 5$ .

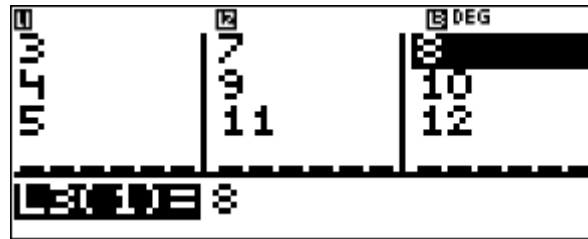
(i) when  $k = 3$ ,  $2(k+1) = 8$

(ii) when  $k = 4$ ,  $2(k+1) = 10$

(iii) when  $k = 5$ ,  $2(k+1) = 12$

(c)

From the entries in **L2** and **L3**, it appears that we need to form the expression  $2k+1+1 = 2k+2$ . The expression  $2k+2$  is equivalent to  $2(k+1)$ .



The TI-30XB MultiView™ lists feature can be used to verify numerically the application of the distributive law to the expansion of algebraic expressions. For example:

Enter integer values of  $a$  into **L1**.

Enter the expression  $3(a+2)$  with the list formula  $3(\mathbf{L1}+2)$  into **L2**.

Enter the expression  $3a+6$  with the list formula  $3\mathbf{L1}+6$  into **L3**.

The values generated in **L2** and in **L3** for a particular value in **L1** should be the same.

Such an approach could also be used to show that  $-5(x+2) = -5x-10$ . The idea here being to connect algebra with the distributive property of arithmetic to help determine that  $a(b+c) = ab+ac$ .

Similarly, the TI-30XB MultiView™ lists feature can be used to verify numerically the factorisation of algebraic expressions either by finding a common numerical factor or finding a common algebraic factor. For example:

Enter integer values of  $a$  into **L1**.

Enter the expression  $6a+12$  with the list formula  $6\mathbf{L1}+12$  into **L2**.

Enter the expression  $6(a+2)$  with the list formula  $6(\mathbf{L1}+2)$  into **L3**.

The values generated in **L2** and in **L3** for a particular value in **L1** should be the same.

Such an approach could be used to show that  $x^2 - 5x = x(x-5)$ .

### Example

This example shows how to use a calculator to substitute into algebraic expressions and evaluate the result., in particular, to calculate and compare the values of  $x^2$  for values of  $x$  with the same magnitude but opposite sign.

- (a) Use the TI-30XB MultiView™ lists feature to find the value of the expression  $x^2$  when
- (i)  $x = -1$
  - (ii)  $x = 1$
  - (iii)  $x = -5$
  - (iv)  $x = 5$
  - (v)  $x = -16$
  - (vi)  $x = 16$
- (b) What do you notice about the values of  $x^2$  for values of  $x$  with the same magnitude but opposite sign? Give a brief reason why.

**[Teacher Note:** The TI-30XB MultiView™ lists feature is particularly useful in such small investigations where the emphasis is more on students explaining calculator outputs rather than in the actual mechanics of calculating such outputs. Note that the TI-30XB MultiView™ Constant feature (see page 55) and function table feature (see page 75) could also be used here. The advantage of using the function table is the more direct link to  $x^2$ .]

Keystrokes and solution:

(a)

Press **[data]** **[data]** **[4]** to clear all lists.

**Note:** Press **[(-)]** to enter a negative number.

In **L1** enter **-1** and press **[↵]**.

Repeat for **1, -5, 5, -16** and **16**.

These six values should now be in **L1**.

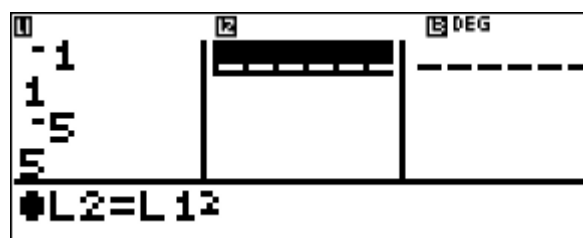
Press **[▶]** to scroll across to the top of **L2**.

Press **[data]** **[▶]** to highlight **FORMULA** and press **[enter]**.

Now enter the expression  $x^2$  as **L1<sup>2</sup>** to **L2**.

Press **[data]** **[enter]** to paste **L1** into the author line.

Press **[x<sup>2</sup>]** **[enter]**.



**L2** should now contain the values of the expression  $x^2$  when  $x = -1, 1, -5, 5, -16, 16$

(i) when  $x = -1$ ,  $x^2 = 1$

(ii) when  $x = 1$ ,  $x^2 = 1$

(iii) when  $x = -5$ ,  $x^2 = 25$

(iv) when  $x = 5$ ,  $x^2 = 25$

(v) when  $x = -16$ ,  $x^2 = 256$

(vi) when  $x = 16$ ,  $x^2 = 256$

(b)

The values of  $x^2$  for values of  $x$  with the same magnitude but opposite sign are the same.

It is because a negative multiplied by a negative is a positive.

| $x$ | $x^2$ |
|-----|-------|
| -1  | 1     |
| 1   | 1     |
| -5  | 25    |
| 5   | 25    |
| -16 | 256   |
| 16  | 256   |

## 1.9 Indices

Before showcasing how the TI-30XB MultiView™ can be used in the teaching and learning of indices, we offer a brief review of divisibility tests. The link between divisibility and indices lies in being able to express a number as a product of its prime factors using index notation where appropriate.

Divisibility tests for 2,3,4,5,6 and 10.

A number is divisible by 2 if the last digit of the number is 0,2,4,6 or 8.

A number is divisible by 3 if the sum of the digits of the number is divisible by 3.

A number is divisible by 4 if the last two digits of the number are divisible by 4.

A number is divisible by 5 if the last digit of the number is 0 or 5.

A number is divisible by 6 if the number is divisible by both 2 and 3.

A number is divisible by 10 if the last digit of the number is 0.

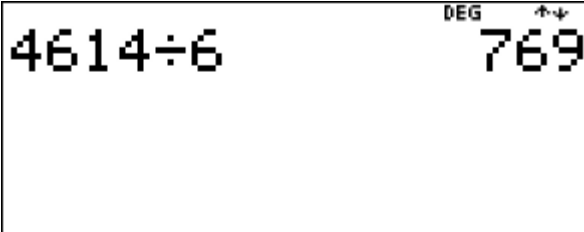
### Example

This example shows how to use a calculator to apply the test for divisibility by 6.

(a) Without a calculator, show that 4614 is divisible by 6.

(b) Use the TI-30XB MultiView™ to verify that 4614 is divisible by 6.

**[Teacher Note:** The TI-30XB MultiView™ can be used to apply and verify the tests of divisibility for 2,3,4,5,6 and 10. It is important for students to recognise that if a given number is divisible by a composite number, then it is also divisible by the factors of that number.]

|  |  |
|--|--|
| <p>Keystrokes and solution:</p> <p>(a)</p> <p>4614 is an even number so it is divisible by 2.</p> <p>Adding the digits of 4614 :</p> <p><math>4+6+1+4=15</math> and the sum of the digits is divisible by 3 because <math>15 \div 3 = 5</math>.</p> <p>Since 4614 is both divisible by 2 and 3 then it must also be divisible by 6.</p> <p>(b)</p> <p>Using <math>\boxed{\div}</math>, <math>4614 \div 6 = 769</math>.</p> |  <p>The image shows a TI-30XB MultiView calculator display. The screen displays the calculation <math>4614 \div 6 = 769</math>. The number 4614 is on the left, followed by a division symbol, then 6, an equals sign, and finally 769. In the top right corner of the display, the word 'DEG' and a double-headed arrow symbol are visible.</p> |
|--|--|

As a product of prime factors in index notation,  $4614 = 2^1 \times 3^1 \times 769^1$  and so 4614 is divisible by 6.

Press  $\wedge$  to raise a number to a power. If the exponent is an expression, it must be placed inside parentheses.

### Short investigation

This short investigation shows how a calculator can be used to evaluate numbers expressed as powers of integers.

Use the TI-30XB MultiView™ to determine what effect the raising of a negative number to an odd or even power has on the sign of the result.

[**Teacher Note:** Such investigations show how the TI-30XB MultiView™ can be used for good teaching and learning opportunities.]

Keystrokes and solution:

(a)

Press  $\text{data}$   $\text{data}$   $4$  to clear all lists.

**Note:** Press  $(-)$  to enter a negative number.

In **L1** enter  $-2$  and press  $\odot$ .

Repeat so that **L1** has  $-2, -2, -2, -2, -2, -2$ .

In other words,  $-2$  entered six times.

These six values should now be in **L1**.

In **L2** enter  $1$  and press  $\odot$ .

Now enter  $2, 3, 4, 5$  and  $6$ .

These six values should now be in **L2**.

Press  $\rightarrow$  to scroll across to the top of **L3**.

Press  $\text{data}$   $\rightarrow$  to highlight **FORMULA** and press  $\text{enter}$ .

Now enter the list formula  $L1^{L2}$  to **L3**.

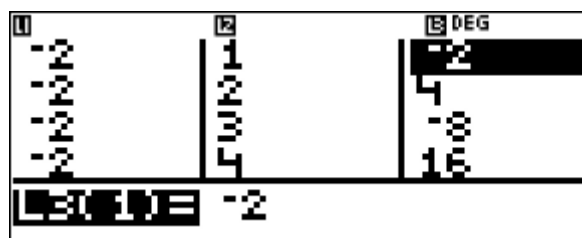
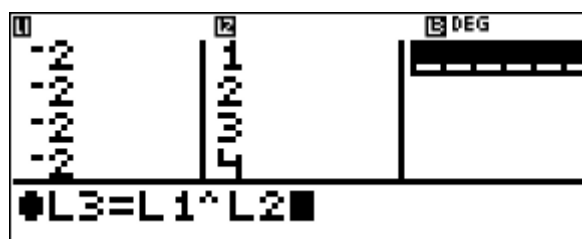
Press  $\text{data}$   $\text{enter}$  to paste **L1** into the author line.

Press  $\wedge$   $\text{data}$   $2$   $\text{enter}$ .

**L3** should now contain the values  $-2, 4, -8, 16, -32, 64$ .

Raising a negative number to an odd power results in a negative number.

Raising a negative number to an even power results in a positive number.




### Example

This example shows how to use a calculator to express a number of the form  $a^{-n}$  as a fraction.

Use the TI-30XB MultiView™ to write  $6^{-3}$  as a fraction.

[**Teacher Note:** It is important that students understand that  $6^{-3} = \frac{1}{6^3}$ .]

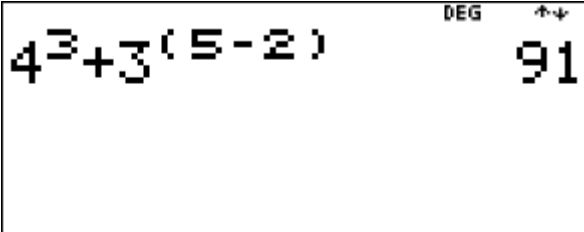
|   |   |
|---|---|
| <p>Keystrokes and solution:</p> <p>Enter 6 and press <math>\square</math> <math>\square</math>.</p> <p>Enter 3 and press <b>enter</b>.</p> $6^{-3} = \frac{1}{216}$ |  <p>The calculator display shows the expression <math>6^{-3}</math> on the left and the fraction <math>\frac{1}{216}</math> on the right. The mode is set to DEG and the display is in fraction mode.</p> |
|---|---|

### Example

This example shows how to use a calculator and order of operations to evaluate expressions involving indices.

Use the TI-30XB MultiView™ to calculate  $4^3 + 3^{(5-2)}$ .

[**Teacher Note:** It is important that students are able to use their calculator to evaluate expressions involving various operations.]

|  |   |
|--|---|
| <p>Keystrokes and solution:</p> <p>Enter 4 and press <math>\square</math>.</p> <p>Enter 3 and press <math>\rightarrow</math> <math>\square</math>.</p> <p>Enter 3 and press <math>\square</math> <math>\square</math>.</p> <p>Enter 5 and press <math>\square</math>.</p> <p>Enter 2 and press <math>\square</math> <b>enter</b>.</p> $4^3 + 3^{(5-2)} = 91$ |  <p>The calculator display shows the expression <math>4^3 + 3^{(5-2)}</math> on the left and the result 91 on the right. The mode is set to DEG and the display is in decimal mode.</p> |
|--|---|




Press  $\boxed{2\text{nd}} \boxed{x^2}$  ( $\sqrt{\phantom{x}}$ ) to calculate the square root of a positive number.

#### Example

This example shows how to use a calculator to calculate the square root of a perfect square number.

Use the TI-30XB MultiView™ to calculate  $\sqrt{196}$ .

**[Teacher Note:** It is important that students link  $\sqrt{196} = 14$  to  $14^2 = 196$ .]

|  |  |
|--|--|
| <p>Keystrokes and solution:</p> <p>Press <math>\boxed{2\text{nd}} \boxed{x^2}</math> (<math>\sqrt{\phantom{x}}</math>).</p> <p>Enter <b>196</b> and press <math>\boxed{\text{enter}}</math>.</p> <p><math>\sqrt{196} = 14</math></p> |  <p>The calculator display shows the square root function being applied to 196. The screen displays <math>\sqrt{196}</math> on the left and the result 14 on the right. The mode is set to DEG and the cursor is at the top right.</p> |
|--|--|


Press  $\boxed{2\text{nd}} \boxed{\wedge}$  ( $\sqrt[n]{\phantom{x}}$ ) to calculate the  $n$ th root of any positive number and any odd integer root of a negative number.

#### Example

This example shows how to use a calculator to calculate the cube root of a perfect cubed number.

Use the TI-30XB MultiView™ to calculate  $\sqrt[3]{729}$ .

**[Teacher Note:** It is important that students link  $\sqrt[3]{729} = 9$  to  $9^3 = 729$ .]


|   |  |
|---|--|
| <p>Keystrokes and solution:</p> <p>Enter <b>3</b> and press <math>\boxed{2\text{nd}} \boxed{\wedge}</math> (<math>\sqrt[n]{\phantom{x}}</math>).</p> <p>Enter <b>729</b> and press <math>\boxed{\text{enter}}</math>.</p> <p><math>\sqrt[3]{729} = 9</math></p> |  <p>The calculator display shows the cube root function being applied to 729. The screen displays <math>\sqrt[3]{729}</math> on the left and the result 9 on the right. The mode is set to DEG and the cursor is at the top right.</p> |
|---|--|

### Example

This example shows how to use a calculator to establish the link between squares and square roots.

- (a) Use the TI-30XB MultiView™ to calculate the following:
- (i)  $7^2$  and  $\sqrt{49}$ .
  - (ii)  $20^2$  and  $\sqrt{400}$ .
  - (iii)  $32^2$  and  $\sqrt{1024}$ .
- (b) Take a positive whole number  $N$ . Square that number and then take the positive square root of the result. What is the resulting number?

[**Teacher Note:** It is important that students understand the link between squares and square roots.]


|   |  |
|---|--|
| <p>Keystrokes and solution:</p> <p>(a)</p> <p>(i) Enter <b>7</b> and press <math>x^2</math> <b>enter</b>.</p> <p>Press <math>2^{nd}</math> <math>x^2</math> (<math>\sqrt{\quad}</math>) <math>2^{nd}</math> (<math>\leftarrow</math>) (<b>ans</b>) <b>enter</b>.</p> <p><math>7^2 = 49</math> and <math>\sqrt{49} = 7</math></p> <p>(ii) Enter <b>20</b> and repeat the above instructions.</p> <p><math>20^2 = 400</math> and <math>\sqrt{400} = 20</math></p> <p>(iii) Enter <b>32</b> and repeat the above instructions.</p> <p><math>32^2 = 1024</math> and <math>\sqrt{1024} = 32</math></p> <p>(b)</p> <p>The result is <math>N</math>.</p> |  <p>The image shows a TI-30XB MultiView calculator display. The screen is split into two sections. The top section shows the calculation <math>7^2 = 49</math>. The bottom section shows the calculation <math>\sqrt{ans} = 7</math>. The display also shows the DEG mode indicator and the ans register indicator.</p> |
|---|--|

### Example

This example shows how to use a calculator to establish the link between cubes and cube roots.

- (a) Use the TI-30XB MultiView™ to calculate the following:
- (i)  $5^3$  and  $\sqrt[3]{125}$ .
  - (ii)  $11^3$  and  $\sqrt[3]{1331}$ .
  - (iii)  $20^3$  and  $\sqrt[3]{8000}$ .
- (b) Take a positive whole number  $N$ . Cube that number and then take the cube root of the result. What is the resulting number?

[**Teacher Note:** It is important that students understand the link between cubes and cube roots.]

|   |  |
|---|--|
| <p>Keystrokes and solution:</p> <p>(a)</p> <p>(i) Enter <b>5</b> and press <math>\square</math>.</p> <p>Enter <b>3</b> and press <b>enter</b>.</p> <p>Enter <b>3</b> and press <b>2nd</b> <math>\square</math> (<math>\sqrt[3]{\phantom{x}}</math>) <b>2nd</b> <math>\square</math> (<b>ans</b>) <b>enter</b>.</p> <p><math>5^3 = 125</math> and <math>\sqrt[3]{125} = 5</math></p> <p>(ii) Enter <b>11</b> and repeat the above instructions.</p> <p><math>11^3 = 1331</math> and <math>\sqrt[3]{1331} = 11</math></p> <p>(iii) Enter <b>20</b> and repeat the above instructions.</p> <p><math>20^3 = 8000</math> and <math>\sqrt[3]{8000} = 20</math></p> <p>(b)</p> <p>The result is <math>N</math></p> |  <p>The image shows a TI-30XB MultiView calculator display. The screen is split into two sections. The top section shows the calculation <math>5^3 = 125</math>. The bottom section shows the calculation <math>\sqrt[3]{125} = 5</math>. The display is in DEG mode and shows 'ans' for the second result.</p> |
|---|--|

### Example

This example shows how to use a calculator to determine through numerical examples that  $(ab)^2 = a^2b^2$  and  $\sqrt{ab} = \sqrt{a} \times \sqrt{b}$ .

(a) Use the TI-30XB MultiView™ to calculate the following:

- (i)  $(2 \times 3)^2$  and  $2^2 \times 3^2$ .
- (ii)  $(-3 \times 5)^2$  and  $(-3)^2 \times 5^2$ .
- (iii)  $(-5 \times -6)^2$  and  $(-5)^2 \times (-6)^2$ .

(b) Use the results from part (a) to complete the following formula  $(ab)^2 = \underline{\hspace{2cm}}$ .

(c) Use the TI-30XB MultiView™ to calculate the following:

- (i)  $\sqrt{9 \times 4}$  and  $\sqrt{9} \times \sqrt{4}$ .
- (ii)  $\sqrt{4 \times 16}$  and  $\sqrt{4} \times \sqrt{16}$ .
- (iii)  $\sqrt{49 \times 25}$  and  $\sqrt{49} \times \sqrt{25}$ .

(d) Use the results from part (c) to complete the following formula  $\sqrt{ab} = \underline{\hspace{2cm}}$ .

**[Teacher Note:** It is important to showcase the link between generalised arithmetic and algebra. And to showcase numerical and algebraic equivalence of expressions.]

Keystrokes and solution:

(a)

(i) Press  $($  and enter 2.

Press  $\times$  and enter 3.

Press  $)$   $x^2$  **enter**.

$$(2 \times 3)^2 = 36$$

Enter 2 and press  $x^2$   $\times$ .

Enter 3 and press  $x^2$  **enter**.

$$2^2 \times 3^2 = 36$$

For (ii) and (iii), repeat the above instructions and using  $(-)$  for negative numbers.

|             |     |    |
|-------------|-----|----|
|             | DEG | ↕  |
| $(2 * 3)^2$ |     | 36 |
| $2^2 * 3^2$ |     | 36 |

(ii)  $(-3 \times 5)^2 = 225$  and  $(-3)^2 \times 5^2 = 225$

(iii)  $(-5 \times -6)^2 = 900$  and

$(-5)^2 \times (-6)^2 = 900$

(b)  $(ab)^2 = a^2b^2$

(c)

(i) Press **2nd** **x<sup>2</sup>** ( $\sqrt{\quad}$ ).

Enter **9** and press **x**.

Enter **4** and press **enter**.

$$\sqrt{9 \times 4} = 6$$

Press **2nd** **x<sup>2</sup>** ( $\sqrt{\quad}$ ) and enter **9**.

Press **right arrow** to move the cursor out from underneath the square root sign.

Press **x** **2nd** **x<sup>2</sup>** ( $\sqrt{\quad}$ ).

Enter **4** and press **enter**.

$$\sqrt{9} \times \sqrt{4} = 6$$

For (ii) and (iii), repeat the above instructions and using **(-)** for negative numbers.

(ii)  $\sqrt{4 \times 16} = 8$  and  $\sqrt{4} \times \sqrt{16} = 8$

(iii)  $\sqrt{49 \times 25} = 35$  and  $\sqrt{49} \times \sqrt{25} = 35$

(d)  $\sqrt{ab} = \sqrt{a} \times \sqrt{b}$



### Example

This example shows how to use a calculator to find square roots and cube roots of any non-square whole number after first estimating the answer.

- (a) By determining the two integers between each of the following square roots and cube roots, estimate the value of each of these square roots and cube roots.

(i)  $\sqrt{48}$

(ii)  $\sqrt{84}$

(iii)  $\sqrt[3]{6}$

(iv)  $\sqrt[3]{41}$

- (b) Use the TI-30XB MultiView™ to check each estimate from part (a). Give each answer as a decimal correct to two decimal places.

**[Teacher Note:** It is important for students to determine the two integers between which the square root of a non-square whole number lies.

Keystrokes and solution:

Press   to obtain a decimal answer.

Note that estimates will vary.

(a) and (b)

(i)  $\sqrt{36} = 6$  and  $\sqrt{49} = 7$  and 48 is less than 49 so  $\sqrt{48}$  is a number between 6 and 7.

$$\sqrt{48} = 6.93 \text{ (correct to two decimal places)}$$

(ii)  $\sqrt{81} = 9$  and  $\sqrt{100} = 10$  and 84 is more than 81 so  $\sqrt{84}$  is a number between 9 and 10.

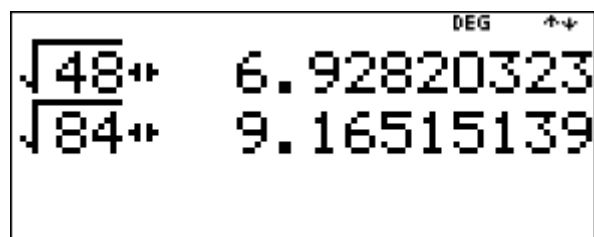
$$\sqrt{84} = 9.17 \text{ (correct to two decimal places)}$$

(iii)  $\sqrt[3]{1} = 1$  and  $\sqrt[3]{8} = 2$  and 6 is less than 8 so  $\sqrt[3]{6}$  is a number between 1 and 2.

$$\sqrt[3]{6} = 1.82 \text{ (correct to two decimal places)}$$

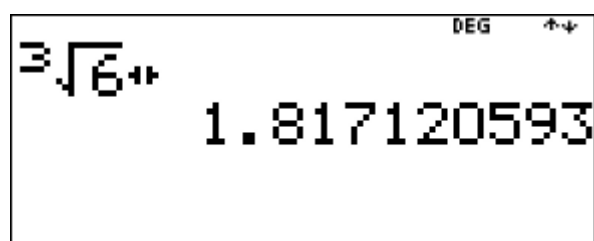
(iv)  $\sqrt[3]{27} = 3$  and  $\sqrt[3]{64} = 4$  and 41 is less than 64 so  $\sqrt[3]{41}$  is a number between 3 and 4.

$$\sqrt[3]{41} = 3.45 \text{ (correct to two decimal places)}$$



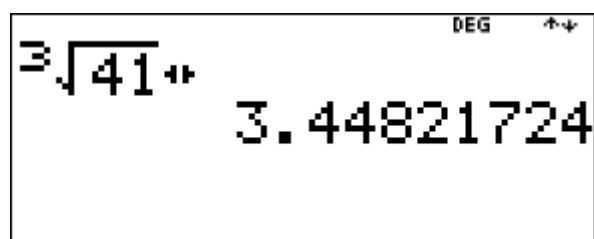
DEG  $\uparrow\downarrow$

$$\sqrt{48} \rightarrow 6.92820323$$
$$\sqrt{84} \rightarrow 9.16515139$$



DEG  $\uparrow\downarrow$

$$\sqrt[3]{6} \rightarrow 1.817120593$$



DEG  $\uparrow\downarrow$

$$\sqrt[3]{41} \rightarrow 3.44821724$$

### Example

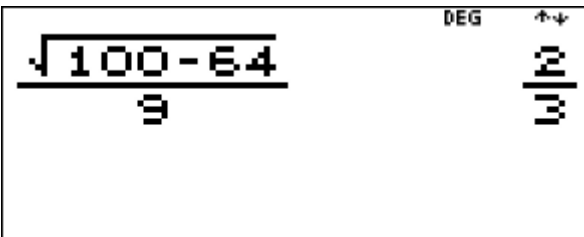
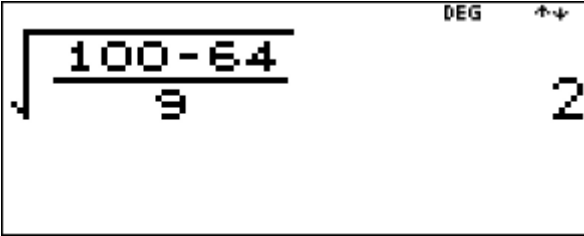
This example shows how to use a calculator and order of operations to evaluate expressions involving square roots and cube roots.

Use the TI-30XB MultiView™ to calculate the following:

(a)  $\frac{\sqrt{100-64}}{9}$

(b)  $\sqrt{\frac{100-64}{9}}$

[**Teacher Note:** Students can be asked to explain the difference between pairs of numerical expressions that appear similar.]

|  |   |
|--|---|
| <p>Keystrokes and solution:</p> <p>(a)</p> <p>Press <b>2nd</b> <b>x<sup>2</sup></b> (<b>√</b>).</p> <p>Enter <b>100</b> and press <b>□</b>.</p> <p>Enter <b>64</b> and press <b>⤵</b> to move the cursor out from underneath the square root sign.</p> <p>Press <b>⌵</b> and enter <b>9</b>.</p> <p>Press <b>enter</b>.</p> $\frac{\sqrt{100-64}}{9} = \frac{2}{3}$ <p>(b)</p> <p>Press <b>2nd</b> <b>x<sup>2</sup></b> (<b>√</b>) <b>⌵</b>.</p> <p>In the numerator, enter <b>100</b> and press <b>□</b>.</p> <p>Enter <b>64</b> and press <b>⤵</b> to move the cursor down to the denominator.</p> <p>Enter <b>9</b> and press <b>enter</b>.</p> $\sqrt{\frac{100-64}{9}} = 2$ |  <p>The calculator display shows the fraction <math>\frac{\sqrt{100-64}}{9}</math> on the left and the result <math>\frac{2}{3}</math> on the right. The mode is set to DEG.</p>  <p>The calculator display shows the expression <math>\sqrt{\frac{100-64}{9}}</math> on the left and the result <math>2</math> on the right. The mode is set to DEG.</p> |
|--|---|

### Short investigation

This short investigation shows how to use a calculator to help establish and verify the index laws with numerical bases and positive-integer indices.

(a) Use the TI-30XB MultiView™ to calculate the following:

(i)  $2^3 \times 2^4$

(ii)  $(2 \times 2 \times 2) \times (2 \times 2 \times 2 \times 2)$

(iii)  $2^{3+4}$

(iv)  $2^7$

(b) Use the TI-30XB MultiView™ to calculate the following:

(i)  $3^6 \div 3^2$

(ii)  $\frac{3 \times 3 \times 3 \times 3 \times 3 \times 3}{3 \times 3}$

(iii)  $3^{6-2}$

(iv)  $3^4$

(c) Use the TI-30XB MultiView™ to calculate the following:

(i)  $(5^2)^3$

(ii)  $(5 \times 5) \times (5 \times 5) \times (5 \times 5)$

(iii)  $5^{2 \times 3}$

(iv)  $5^6$

(d) Use the results from parts (a), (b) and (c) to complete the following formulas:

(i)  $a^m \times a^n = \underline{\hspace{2cm}}$

(ii)  $a^m \div a^n = \underline{\hspace{2cm}}$

(iii)  $(a^m)^n = \underline{\hspace{2cm}}$

**[Teacher Note:** The TI-30XB MultiView™ can be used to help illustrate incorrect use of index laws. For example, to assist in explaining why  $2^3 \times 2^4 \neq 4^7$ .]



Keystrokes and solution:

(a)

(i), (ii), (iii) and (iv) all equal 128

DEG  $\leftrightarrow$

$$2^3 * 2^4 = 128$$
$$(2 * 2 * 2) * (2 * 2 * 2) = 128$$

(b)

(i), (ii), (iii) and (iv) all equal 81

DEG  $\leftrightarrow$

$$2^3 + 4 = 128$$
$$2^7 = 128$$

(c)

(i), (ii), (iii) and (iv) all equal 15 625

DEG  $\leftrightarrow$

$$(5^2)^3 = 15625$$
$$5^2 * 3 = 15625$$

(d)

(i)  $a^m \times a^n = a^{m+n}$

(ii)  $a^m \div a^n = a^{m-n}$

(iii)  $(a^m)^n = a^{m \times n} = a^{mn}$

Note the screenshots at right show the results to parts (a), (c) (iii) and (c) (iv) only.

### Short investigation

This short investigation shows how to use a calculator to help establish the meaning of the zero index and verify the zero index law.

What does an index of 0 mean?

Use the TI-30XB MultiView™ lists feature to investigate and generalise the result that any number raised to the power of 0 is equal to 1.

**[Teacher Note:** The TI-30XB MultiView™ lists feature can be used to illustrate patterns that lead to a generalisation. It is very important to try and develop the skill of generalisation.]

Keystrokes and solution:

(a)

Press **data** **data** **4** to clear all lists.

In **L1** enter **5** and press  $\odot$ .

Now enter the values **4,3,2,1** and **0**.

These six values should now be in **L1**.

Press  $\rightarrow$  to scroll across to the top of **L2**.

Press **data**  $\rightarrow$  to highlight **FORMULA** and press **enter**.

Now enter the list formula  $2^{L1}$  to **L2**.

Enter **2** and press  $\wedge$ .

Press **data** **enter** to paste **L1** into the author line.

Press **enter**.

**L2** should now contain the values **32,16,8,4,2,1**.

In **L2**, each number is half the previous number.  $2^2 = 4, 2^1 = 2$  and so  $2^0 = 1$ .

Press  $\rightarrow$  to scroll across to the top of **L3**.

Press **data**  $\rightarrow$  to highlight **FORMULA** and press **enter**.

Now enter the list formula  $3^{L1}$  to **L3**.

Enter **3** and press  $\wedge$ .

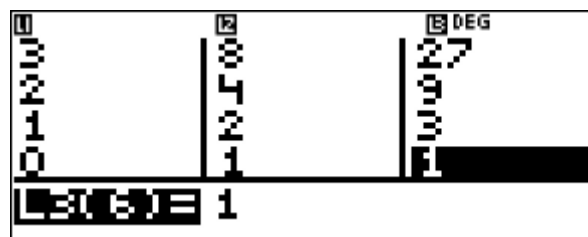
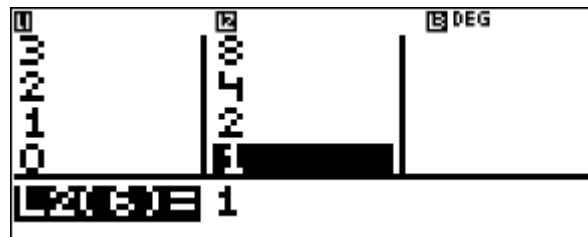
Press **data** **enter** to paste **L1** into the author line.

Press **enter**.

**L3** should now contain the values **243,81,27,9,3,1**.

Similarly looking at the powers of 3 in **L3**, each number in the sequence 243,81,27,9,3 is one-third of the previous number. So the next number in the sequence is 1. So  $3^0 = 1$ .

Similarly,  $4^0 = 1$  and  $5^0 = 1$  etc. and so  $a^0 = 1$ .



Press  $x^{-1}$  to calculate the reciprocal of a number.

### Example


This example shows how to use a calculator to calculate the reciprocal of a number.

Use the TI-30XB MultiView™ to calculate the reciprocal of 25 .

Give your answer as a

- (a) fraction.
- (b) decimal.

[**Teacher Note:** Students need to understand that the reciprocal of  $x$  is  $x^{-1}$  or  $\frac{1}{x}$  .]

|   |  |
|---|--|
| <p>Keystrokes and solution:</p> <p>(a)<br/>Enter <b>25</b> and press <math>x^{-1}</math> <b>enter</b> .</p> $25^{-1} = \frac{1}{25}$ <p>(b)<br/>Press <b>2nd</b> <b>table</b> (convert fraction to decimal) <b>enter</b> .</p> $25^{-1} = 0.04$ <p>Alternatively, press <b>↔</b> to express as a decimal.</p> |  <p>The image shows a TI-30XB MultiView calculator display. The top line shows <math>25^{-1}</math> and the DEG mode indicator. The second line shows the fraction <math>\frac{1}{25}</math>. The third line shows the decimal <math>0.04</math> after pressing the fraction-to-decimal key (f<math>\leftrightarrow</math>d).</p> |
|---|--|

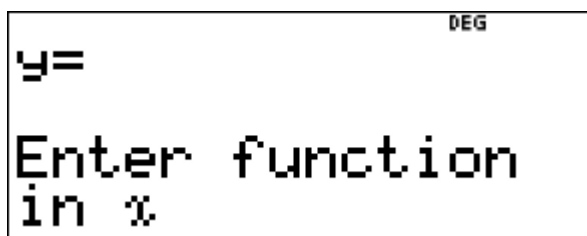
## 1.10 Equations

Tables of values can be used to solve some linear equations and answer certain question types relating to linear models.

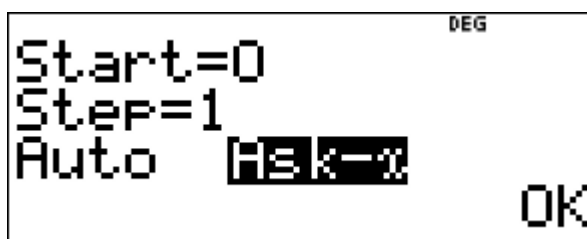
### TI-30XB MultiView™ Function table

Press **table** to access the function table. The function table allows a user to display a defined function in table form. To set up a function table:

Press **table**.



Enter a function remembering to press  **$x^y z / abc$**  to paste  $x$  and press **enter**.



The user then sees a menu with options table start, table step, auto, or ask - $x$ .

Select an option(s), make the required change(s) and press **enter**.

**Start:** Specifies the starting value for the independent variable,  $x$ . It is set to start at **0**.

**Step:** Specifies the incremental value for the independent variable,  $x$ . The step can be positive or negative, but cannot be zero. It is set at **1**, which means the values for the independent variable increase by **1**.

**Auto:** The TI-30XB MultiView™ automatically generates a series of values for the dependent variable,  $y$ , based on the table start value and the table step value.

**Ask - $x$ :** Lets the user build a table manually for the dependent variable,  $y$ , by entering specific values for the independent variable,  $x$ .

### Example

This example shows how to use a calculator's table feature to solve a linear equation.

Daisy's car has a petrol tank with a capacity of 54 litres. Her car's average fuel consumption is 6 litres/100 km. She fills the petrol tank to capacity and drives 700 km to stay with friends. Let  $y$  litres be the amount of petrol remaining in the car's petrol tank after travelling  $x$  hundred kilometres. For example,  $x = 1$  denotes a travel distance of 100 km.

- (a) Find a formula for  $y$  in terms of  $x$ .
- (b) Use the TI-30XB MultiView™ function table to calculate
  - (i) how much petrol was left in the tank when Daisy arrived at her friend's house.
  - (ii) the maximum distance Daisy's car can travel before running out of petrol.

[**Teacher Note:** Students need to be able solve equations numerically and graphically as well as algebraically.]

Keystrokes and solution:

(a)

$$y = 54 - 6x$$

(b)

(i) A distance of 700 km corresponds to  $x = 7$ .

Press **table** to access the function table.

If required, press **clear**.

Enter **54** and press **[-]**.

Enter **6** and press  **$x \frac{y}{z} \frac{1}{abc}$**  to paste  $x$  into the author line.

Press **enter**.

Move the cursor to highlight **Ask -x** and press **enter** (**OK**) **enter**.

Enter **7** and press **enter**.

Column two of the table should now show the output **12**.

So Daisy had 12 litres in her petrol tank when she arrived at her friend's house.

(ii) Enter guess(es) for  $x$  and press **enter**.

When  $x = 9$ ,  $y = 0$  and so Daisy's car can travel 900 km before running out of petrol.

| $x$ | $y$ |
|-----|-----|
| 7   | 12  |

x=

| $x$ | $y$ |
|-----|-----|
| 7   | 12  |
| 8   | 6   |
| 9   | 0   |

x=9

### Example

This example shows how to use a calculator to check solutions to linear equations by substitution.

(a) Solve the equation  $\frac{2x+5}{3} = 10$ .

(b) Use the TI-30XB MultiView™ to check the solution found in part (a).

[**Teacher Note:** It is important that students check their solution to any equation they solve.]

Keystrokes and solution:

(a)

$$2x + 5 = 30$$

$$2x = 25$$

$$x = \frac{25}{2}$$

(b)

For example:

Press  $\boxed{1}$  and enter **2**.

Press  $\boxed{\times}$  and enter **25**.

Press  $\boxed{\frac{\square}{\square}}$  and enter **2**.

Press  $\rightarrow$  to move the cursor out of the denominator and press  $\boxed{+}$ .

Enter **5** and press  $\boxed{)}$   $\boxed{\frac{\square}{\square}}$  and enter **3**.

Press **enter**.

The output **10** shows that  $x = \frac{25}{2}$  satisfies

the equation  $\frac{2x+5}{3} = 10$ .

The calculator display shows the expression  $(2 \times \frac{25}{2} + 5)$  over  $3$  resulting in **10**. The display also shows "DEG" and a right arrow icon in the top right corner.

### 1.11 Linear relationships

Here we concentrate briefly on the algebraic and numerical representations of a linear function. These two representations should be linked to the graphical representation.

#### Example

This example shows how to use objects to build a geometric pattern, record the results in a table of values and describe the pattern in words and with the use of algebraic symbols. It also shows how to use a calculator to check pattern descriptions by substituting further values, calculate the corresponding value for a larger number and determine whether a particular number pattern forms a linear or non-linear relationship.

Consider the following matchstick pattern.

Shape 1



Shape 2



Shape 3



This matchstick pattern has two operations.

- Identify the first operation which is the repeating element of the pattern.
- Identify the second operation which is what is being added each time to the previous shape to form the new shape.
- Copy and complete the following table.

|                               |   |   |    |   |   |
|-------------------------------|---|---|----|---|---|
| Shape number ( $s$ )          | 1   | 2 | 3  | 4 | 5 |
| Number of matchsticks ( $m$ ) | 4   | 7 | 10 |   |   |
| Function rule                 | Number of matchsticks = Shape number $\times$ ___ + ___ |   |    |   |   |

- Write the function rule found in part (c) as an equation involving  $s$  and  $m$ .
- Use the TI-30XB MultiView™ function table to find the number of matchsticks needed for
  - Shape 20.
  - Shape 55.
  - Shape 227.

**[Teacher Note:** Alternatively, the base shape is Shape 1 (the square) and what is added each time to the previous shape is three more matches in the shape of a ‘backwards C’. From this viewpoint, we obtain  $m = 4 + 3(s - 1)$  which is algebraically equivalent to  $m = 3s + 1$ . These alternative ways of seeing how each shape in the sequence is formed offers an excellent teaching and learning opportunity to highlight algebraic equivalence.]

Keystrokes and solution:

(a)



(b)



(c)

When  $s = 4$ ,  $m = 13$ .

When  $s = 5$ ,  $m = 16$ .

Number of matchsticks

= Shape number  $\times 3 + 1$ .

(d)

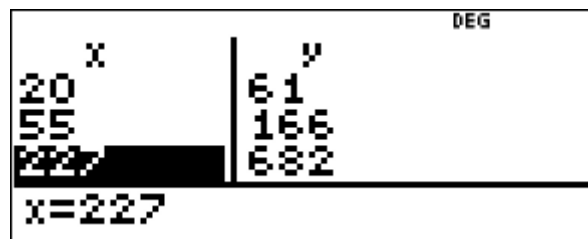
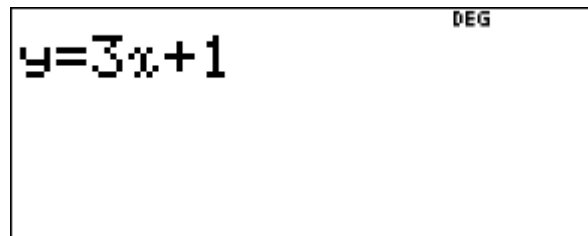
$$m = 3s + 1$$

(e)

(i) When  $s = 20$ ,  $m = 61$ .

(ii) When  $s = 55$ ,  $m = 166$ .

(iii) When  $s = 227$ ,  $m = 682$ .



### Example

This example shows how to use a calculator to substitute values for the independent variable to calculate values for the dependent variable.

Given the linear function  $y = 4x + 3$ , use the TI-30XB MultiView™ Constant feature to calculate the value of  $y$  for  $x = -5$  and  $x = -1$ .

**[Teacher Note:** While this example is best done using the TI-30XB MultiView™ function table, it shows how it can be done using the Constant feature which highlights the operations that make up a linear function.]



Keystrokes and solution:

Press  $\boxed{2nd} \boxed{\div}$  (K) to turn the Constant feature on.

If needed, press  $\boxed{delete}$  to delete a previously defined operation.

Press  $\boxed{\times}$  and enter 4 .

Press  $\boxed{+}$  and enter 3.

Press  $\boxed{enter}$  .

Press  $\boxed{-}$  and enter -5 .

Press  $\boxed{enter}$  .

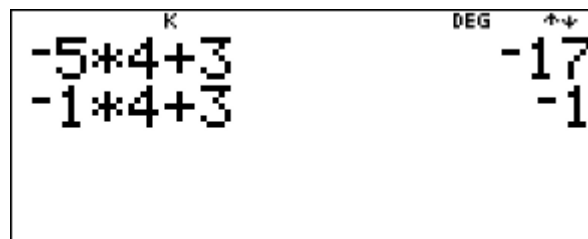
Press  $\boxed{-}$  and enter -1 .

Press  $\boxed{enter}$  .

$$y = 4 \times -5 + 3 = -17$$

$$y = 4 \times -1 + 3 = -1$$

Press  $\boxed{2nd} \boxed{\div}$  (K) to turn the Constant feature off.



### Example

This example shows how to use a calculator to perform linear model conversions.

On a particular July day, a weather forecast listed the following predicted maximum temperatures.

Canberra 13°C

Sydney 18°C

Thredbo 2°C

The formula to convert from degrees Celsius to degrees Fahrenheit is given by the linear relationship  $F = \frac{9}{5}C + 32$ .

Convert these temperatures from degrees Celsius to degrees Fahrenheit using

- the TI-30XB MultiView™ list tool.
- the TI-30XB MultiView™ function table.
- If Katoomba is predicted to have a maximum temperature of 9°C, use either the TI-30XB MultiView™ list tool or the TI-30XB MultiView™ function table to convert this temperature to degrees Fahrenheit.

**[Teacher Note:** This example showcases how the TI-30XB MultiView™ can be used in more than one way to perform such linear model conversions.]

Keystrokes and solution:

(a)

Using lists.

Press **data** **data** **4** to clear all lists.

Enter **13** and press **↵**.

Repeat for **18** and **2**.

The three values should now be in **L1**.

Press **↵** to scroll across to the top of **L2**.

Press **data** **↵** to highlight **FORMULA** and press **enter**.

Now we can enter the temperature conversion formula to **L2**.

Enter **9** and press **÷**.

Enter **5** and press **×**.

Press **data** **enter** to paste **L1** into the author line.

Press **+** and enter **32**.

Press **enter**.

**L2** should now contain the converted temperatures 55.4°F, 64.4°F and 35.6°F.

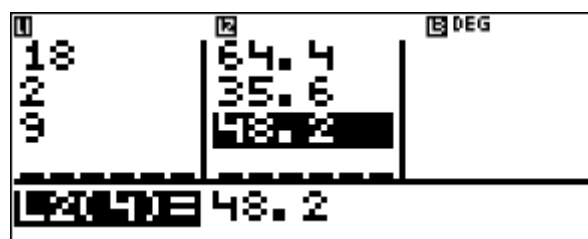
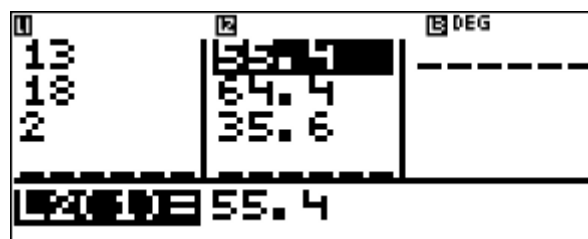
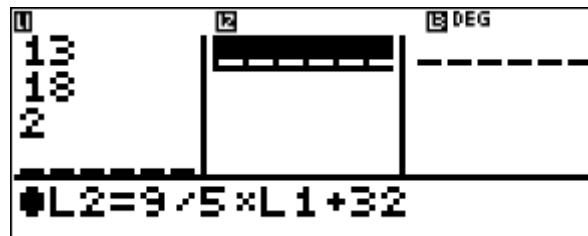
(c)

Using lists.

Use the cursor to move to **L1(4) =**, enter **9** and press **enter**.

**L2** should now contain the converted temperature 48.2°F.

So Katoomba's temperature is 48.2°F.



Keystrokes and solution:

(b)

Using the function table.

Press **table** to access the function table.

Now we can enter the temperature conversion formula into  $y =$ .

Enter 9 and press **÷**.

Enter 5 and press **×**.

Press **x<sub>abc</sub>** to paste  $x$  into the author line.

Press **+** and enter 32.

Press **enter**.

Move the cursor to highlight **Ask -x** and press **enter** (OK) **enter**.

Enter 13 and press **enter**.

Repeat for 18 and 2.

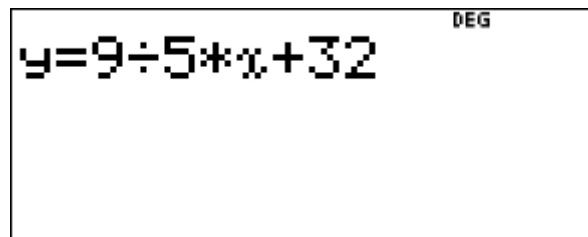
Column two of the table should now contain the converted temperatures 55.4°F, 64.4°F and 35.6°F.

(c) Using the function table.

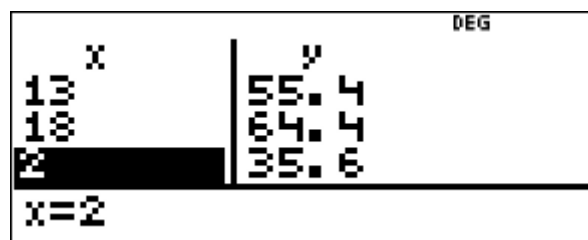
Enter 9 and press **enter**.

Column two of the table should now contain the converted temperature 48.2°F.

So Katoomba's temperature is 48.2°F.

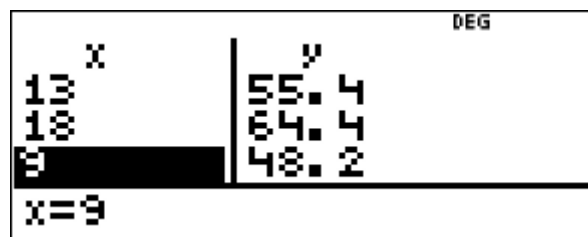


Calculator screen showing the formula  $y=9\div 5*x+32$  entered. The screen also displays "DEG" in the top right corner.



Calculator function table showing the results of the conversion formula for x=2. The table has two columns: x and y. The values are 13, 18, and 2 in the x column, and 55.4, 64.4, and 35.6 in the y column. The screen also displays "DEG" in the top right corner.

| x  | y    |
|----|------|
| 13 | 55.4 |
| 18 | 64.4 |
| 2  | 35.6 |



Calculator function table showing the results of the conversion formula for x=9. The table has two columns: x and y. The values are 13, 18, and 9 in the x column, and 55.4, 64.4, and 48.2 in the y column. The screen also displays "DEG" in the top right corner.

| x  | y    |
|----|------|
| 13 | 55.4 |
| 18 | 64.4 |
| 9  | 48.2 |

### Example

This activity (game), called Guess My Rule, requires the use of the TI-30XB MultiView™.

Two students (players) A and B.

Student A enters a linear function into the TI-30XB MultiView™. For example,  $y = 5x - 2$ .

In the options menu, Student A selects **Ask -x**. This allows a table to be built manually for the dependent variable,  $y$  by entering a value for the independent variable,  $x$ .

Student A presses **enter** and, if needed, presses **delete** to ensure a blank function table.

Student A hands the TI-30XB MultiView™ over to Student B.

Student B enters a value for  $x$  and then presses **enter**. The TI-30XB MultiView™ will display a value for  $y$ .

Student B continues entering values for  $x$  until they think they know the linear function entered by Student A and can successfully predict the value of  $y$  for any value of  $x$ .

Student B then confirms that Student A has correctly identified the linear function and they switch roles.

[**Teacher Note:** This game helps to show the usefulness of choosing  $x = 0, 1$  and  $2$  when attempting to identify a linear function. For example, why is  $x = 0$  a good choice?]

Keystrokes and solution:

Press **table** to access the function table.

Student A enters  $y = 5x - 2$ , for example.

Enter 5 and press **x**  **$x^{y^z}$**  **=**.

Enter 2 and press **enter**.

Highlight **Ask -x** and press **enter** (**OK**) **enter**.

Student B enters 0 for  $x$  and presses **enter**. So when  $x = 0, y = -2$ .

Student B then enters 1 and presses **enter**.

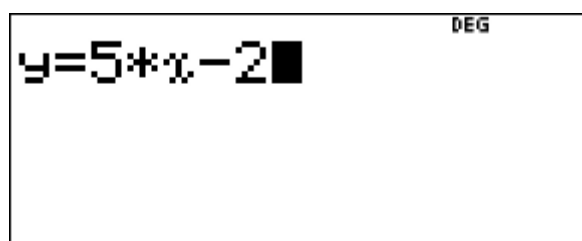
So when  $x = 1, y = 3$ .

Student B then enters 2 and presses **enter**.

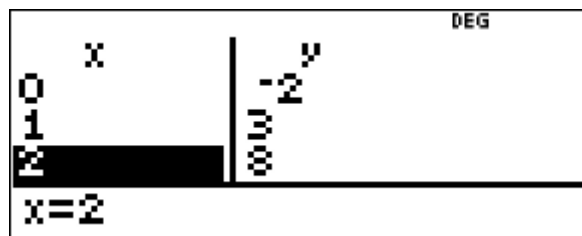
So when  $x = 2, y = 8$ .

As the value of  $x$  increases by 1, the value of  $y$  increases by 5.

And as  $y = -2$  when  $x = 0$ , Student B should conclude that  $y = 5x - 2$ .



TI-30XB MultiView™ display showing the equation  $y = 5 * x - 2$  and the DEG mode indicator.



TI-30XB MultiView™ display showing a table with  $x$  values 0, 1, 2 and corresponding  $y$  values -2, 3, 8. The  $x = 2$  row is highlighted.

| $x$ | $y$ |
|-----|-----|
| 0   | -2  |
| 1   | 3   |
| 2   | 8   |

## 2 Measurement and geometry

The TI-30XB MultiView™ can be used to calculate the perimeters of various shapes and simple composite figures.

For example, the perimeters of rectangles, parallelograms, trapeziums, rhombuses and kites. It can be used to solve a variety of problems involving the perimeters of plane shapes.

The TI-30XB MultiView™ can also be used to investigate the circumference, radius and diameter of a circle.

And it can be used to solve problems involving these features of a circle.

In addition, the TI-30XB MultiView™ can be used to calculate the perimeters of quadrants and semicircles, the perimeters of simple composite shapes, arc lengths and the perimeters of sectors.

And it can be used to solve a variety of problems involving circles and parts of circles.

### 2.1 Length

The number  $\pi$  is irrational and is defined as the ratio of the circumference to the diameter of any circle.

Press  $\pi$  to enter  $\pi$ .

For calculations, the TI-30XB MultiView™ uses  $\pi = 3.141592653590$ .

For display, the TI-30XB MultiView™ displays  $\pi = 3.141592654$ .

For example, enter 2 and then press  $\times$   $\pi$  **enter**.

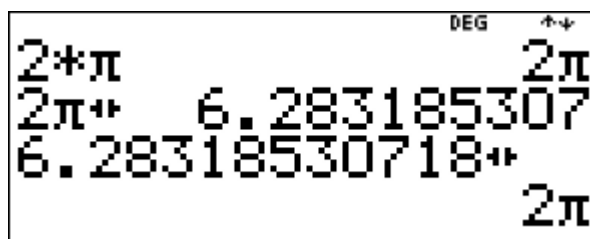
The output is  $2\pi$ .

Note that pressing  $\times$  is optional here.

To convert the output  $2\pi$  to a decimal, press  $\leftrightarrow$ .

The output is **6.283185307**.

Press  $\leftrightarrow$  and the output **6.283185307** returns to  $2\pi$ .



### Short investigation

This short investigation shows, with the assistance of a calculator, how to demonstrate by practical means that the ratio of the circumference,  $C$ , to the diameter,  $d$ , of a circle is constant.

Instructions:

- (1) Measure the diameter of five circles.
- (2) Use a piece of string to measure the circumference of each of these circles. Use a ruler to measure the length of each piece of string.
- (3) Copy the table below and complete columns 2 and 3.
- (4) Enter each measured diameter and each measured circumference into the TI-30XB MultiView™ lists feature.
- (5) For each circle, use the TI-30XB MultiView™ lists feature to calculate the ratio of the circumference,  $C$ , to the diameter,  $d$ . Add each calculated ratio to column 4 of the table.
- (6) Calculate the average value of  $\frac{C}{d}$  for these five circles.

| Circle number | Diameter ( $d$ ) | Circumference ( $C$ ) | $\frac{C}{d}$ |
|---------------|------------------|-----------------------|---------------|
|               |                  |                       |               |
|               |                  |                       |               |
|               |                  |                       |               |
|               |                  |                       |               |
|               |                  |                       |               |

**[Teacher Note:** Extensions to this activity include calculating a class average ratio of circumference to diameter and analysing how close the various average values obtained were to the calculator value of  $\pi$ . Students should be asked questions such as why it is important to measure circles of different sizes and should calculating the class average provide a better approximation of  $\pi$ ?]

Keystrokes and solution:

Press **[data]** **[data]** **[4]** to clear all lists.

In **L1** enter the diameter of the first circle and press **[↵]**.

Repeat this process so that **L1** contains the five diameter measurements.

Press **[↵]** to scroll across to the top of **L2**.

In **L2** enter the circumference of the first circle and press **[↵]**.

Repeat this process so that **L2** contains the five circumference measurements.

Press **[↵]** to scroll across to the top of **L3**.

Press **[data]** **[↵]** to highlight **FORMULA** and press **[enter]**.

Now enter the expression  $\frac{C}{d}$  as  $\frac{L2}{L1}$  to **L3**

so **L3** =  $\frac{L2}{L1}$ .

Press **[data]** **[2]** to paste **L2** into the author line.

Press **[÷]** **[data]** **[enter]** **[enter]**.

**L3** should now contain the values of the expression  $\frac{C}{d}$  for each of the five circles.

To calculate the average value of  $\frac{C}{d}$  for these five circles:

Press **[2nd]** **[data]** (stat) to access the statistics menu. Press **[enter]** or **[1]** to access **1-Var Stats**.

Press **[↵]** **[↵]** **[enter]** to select **L3**.

Press **[↵]** **[↵]** **[enter]** to access the statistical results.

The average value of  $\frac{C}{d}$  is given by  $\bar{x}$ . In

this example, the average value of  $\frac{C}{d}$  is

3.1 correct to one decimal place.

| L1   | L2   | L3      |
|------|------|---------|
| 5.2  | 16.1 |         |
| 8.8  | 28.2 |         |
| 7.1  | 21.7 |         |
| 12.4 | 39.3 |         |
|      |      | L3(1) = |

| L1   | L2   | L3                    |
|------|------|-----------------------|
| 5.2  | 16.1 | 3.096153846           |
| 8.8  | 28.2 | 3.204545455           |
| 7.1  | 21.7 | 3.056338028           |
| 12.4 | 39.3 | 3.169354839           |
|      |      | L3(1) = 3.096153846.. |

```

1-VAR STATS
DATA: L1 L2 L3
FREQ: ONE L1 L2 L3
  
```

```

1-VAR: L3, 1
1: n=5
2: x̄=3.135184976
3: s=0.059001236
  
```

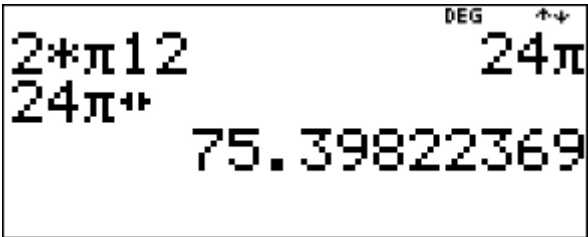
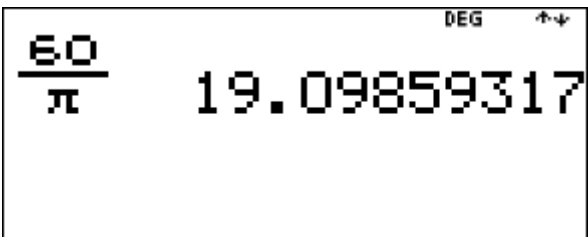
### Example

This example shows how to use a calculator to find the circumference of a circle given its radius and the diameter of a circle given its circumference.

Use the TI-30XB MultiView™ to

- (a) find the circumference of a circle whose radius is 12 cm. Give your answer correct to one decimal place.
- (b) find the diameter of a circle whose circumference is 60 cm. Give your answer correct to one decimal place.

**[Teacher Note:** Students need be able to perform such calculations efficiently and accurately. It is also an important skill to have a sense of the magnitude of the expected answer. In other words, students need to carefully monitor their calculations when using a calculator.]

|   |  |
|---|--|
| <p>Keystrokes and solution:</p> <p>(a)</p> $C = 2\pi r$ <p>Enter <b>2</b> and press <math>\pi</math> <math>\times</math>.</p> <p>Enter <b>12</b> and press <b>enter</b>.</p> <p>This gives <math>C = 24\pi</math>.</p> <p>Press <math>\rightarrow</math> to convert to a decimal.</p> $C = 75.4 \text{ (cm) correct to 1 decimal place.}$ <p>(b)</p> $C = \pi d \text{ and so } d = \frac{C}{\pi}$ <p>Enter <b>60</b> and press <math>\frac{\square}{\square}</math>.</p> <p>Press <math>\pi</math> <b>enter</b>.</p> $d = 19.1 \text{ (cm)}$ |   |
|---|--|



## 2.2 Area

The TI-30XB MultiView™ can be used to find the area of various shapes and simple composite figures and solve a variety of practical problems relating to unknown side lengths.

It can also be used to investigate the area and radius of a circle and to solve problems involving features of a circle. In addition, it can be used to calculate the areas of quadrants, semicircles and sectors and solve a variety of problems involving circles and parts of circles.


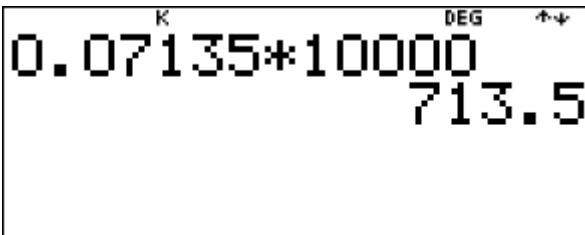

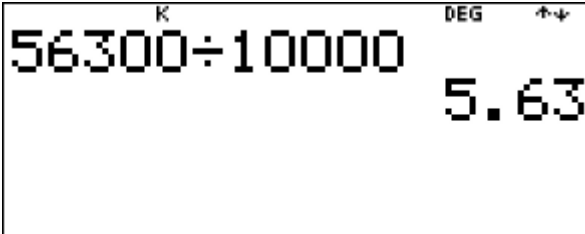
### Example

This example shows how to use a calculator to convert metric units of area.

Use the TI-30XB MultiView™ Constant feature to

- (a) convert 0.07135 ha to m<sup>2</sup>.
- (b) convert 56300 m<sup>2</sup> to ha.

[**Teacher Note:** When converting units, students need to anticipate what happens to the size of the number when converting from a bigger unit to a smaller unit and vice versa.]

|   |   |
|---|---|
| <p>Keystrokes and solution:</p> <p>(a)</p> <p>Press <b>2nd</b> <b>⏏</b> (<b>K</b>) to turn the Constant feature on.</p> <p>If needed, press <b>delete</b> to delete a previously defined operation.</p> <p>1 ha is 10000 m<sup>2</sup></p> <p>Press <b>⊗</b> and enter <b>10000</b>.</p> <p>Press <b>enter</b>.</p> <p>Enter <b>0.07135</b> and press <b>enter</b>.</p> <p>So 0.07135 ha is 713.5 m<sup>2</sup>.</p> <p>Press <b>2nd</b> <b>⏏</b> (<b>K</b>) to turn the Constant feature off.</p> <p>(b)</p> <p>Press <b>2nd</b> <b>⏏</b> (<b>K</b>) to turn the Constant feature on.</p> <p>Press <b>⊘</b> to change <math>\times</math> to <math>\div</math>.</p> <p>Press <b>enter</b>.</p> <p>Enter <b>56300</b> and press <b>enter</b>.</p> <p>So 56300 m<sup>2</sup> is 5.63 ha.</p> <p>Press <b>2nd</b> <b>⏏</b> (<b>K</b>) to turn the Constant feature off.</p> |  <p>K=*10000</p>  <p>0.07135*10000<br/>713.5</p>  <p>K=÷10000</p>  <p>56300÷10000<br/>5.63</p> |
|---|---|


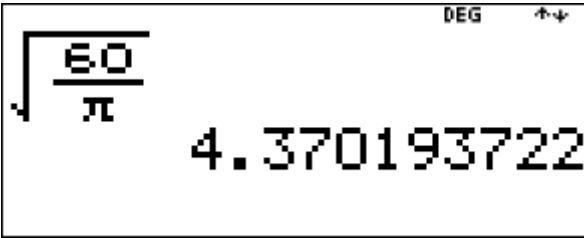
### Example

This example shows how to use a calculator to find the area of a circle given its radius and the radius of a circle given its area.

Use the TI-30XB MultiView™ to

- (a) find the area of a circle whose radius is 8 cm. Give your answer correct to one decimal place.
- (b) find the radius of a circle whose area is 60 m<sup>2</sup>. Give your answer correct to one decimal place.

**[Teacher Note:** Students need be able to perform such calculations efficiently and accurately. It is also an important skill to have a sense of the magnitude of the expected answer. In other words, students need to carefully monitor their calculations when using a calculator.]

|   |  |
|---|--|
| <p>Keystrokes and solution:</p> <p>(a)</p> $A = \pi r^2$ <p>Press <math>\pi</math> <math>\times</math> and enter 8.</p> <p>Press <math>x^2</math> <b>enter</b>.</p> <p>This gives <math>A = 64\pi</math>.</p> <p>Press <math>\rightarrow</math> to convert to a decimal.</p> <p><math>A = 201.1</math> (cm<sup>2</sup>) correct to 1 decimal place.</p> <p>(b)</p> $A = \pi r^2 \text{ and so } r = \sqrt{\frac{60}{\pi}} \text{ (} r > 0 \text{)}$ <p>Press <b>2nd</b> <math>x^2</math> (<math>\sqrt{\quad}</math>) <math>\frac{\square}{\square}</math> and enter 60 in the numerator.</p> <p>Press <math>\odot</math> <math>\pi</math> <b>enter</b>.</p> <p><math>r = 4.4</math> (m<sup>2</sup>) correct to 1 decimal place.</p> |   |
|---|--|

## 2.3 Volume

The TI-30XB MultiView™ can be used to find the volume of various (including rectangular and triangular) prisms and solve a variety of practical problems involving the volumes and capacities of right prisms. It can also be used to investigate the volume, height and radius of a cylinder and to solve problems involving these features of a cylinder.


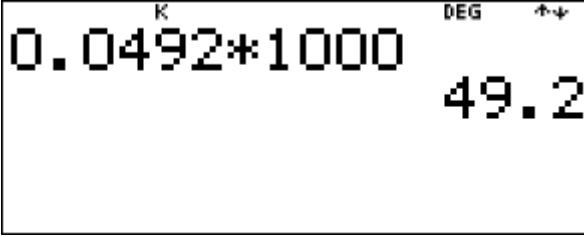

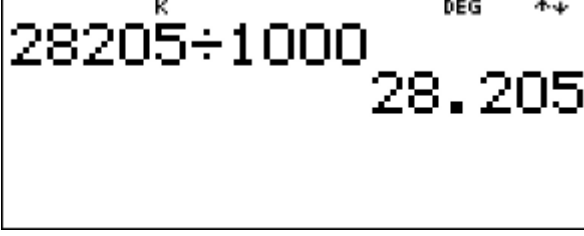
### Example

This example shows how to use a calculator to convert metric units of volume and capacity.

Use the TI-30XB MultiView™ Constant feature to

- (a) convert 0.0492 L to cm<sup>3</sup>.
- (b) convert 28205 kL to ML.

**[Teacher Note:** When converting units, students need to anticipate what happens to the size of the number when converting from a bigger unit to a smaller unit and vice versa.]

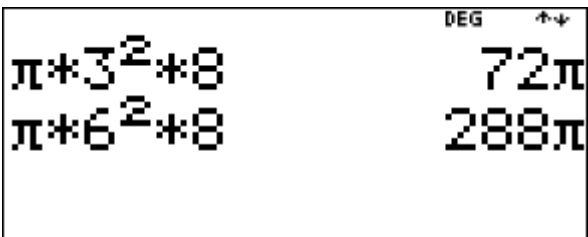
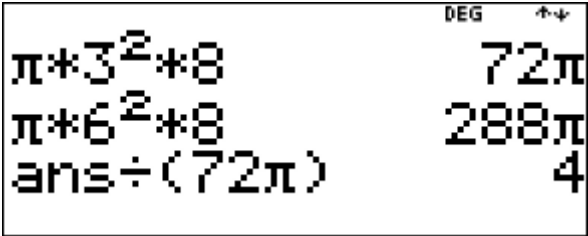
|  |   |
|--|---|
| <p>Keystrokes and solution:</p> <p>(a)</p> <p>Press <b>2nd</b> <b>⏏</b> (<b>K</b>) to turn the Constant feature on.</p> <p>If needed, press <b>delete</b> to delete a previously defined operation.</p> <p>1 L is 1000 cm<sup>3</sup></p> <p>Press <b>⊗</b> and enter <b>1000</b>.</p> <p>Press <b>enter</b>.</p> <p>Enter <b>0.0492</b> and press <b>enter</b>.</p> <p>So 0.0492 L is 49.2 cm<sup>3</sup>.</p> <p>Press <b>2nd</b> <b>⏏</b> (<b>K</b>) to turn the Constant feature off.</p> <p>(b)</p> <p>1000 kL is 1 ML</p> <p>Press <b>2nd</b> <b>⏏</b> (<b>K</b>) to turn the Constant feature on.</p> <p>Press <b>⏏</b> to change <math>\times</math> to <math>\div</math>.</p> <p>Press <b>enter</b>.</p> <p>Enter <b>28205</b> and press <b>enter</b>.</p> <p>So 28205 kL is 28.205 ML.</p> <p>Press <b>2nd</b> <b>⏏</b> (<b>K</b>) to turn the Constant feature off.</p> |  <p>K=*1000</p>  <p>0.0492*1000<br/>49.2</p>  <p>K=÷1000</p>  <p>28205÷1000<br/>28.205</p> |
|--|---|

### Example

This example shows how to use a calculator to find the volume of a cylinder given its radius and height and shows how to compare the volume of two cylinders.

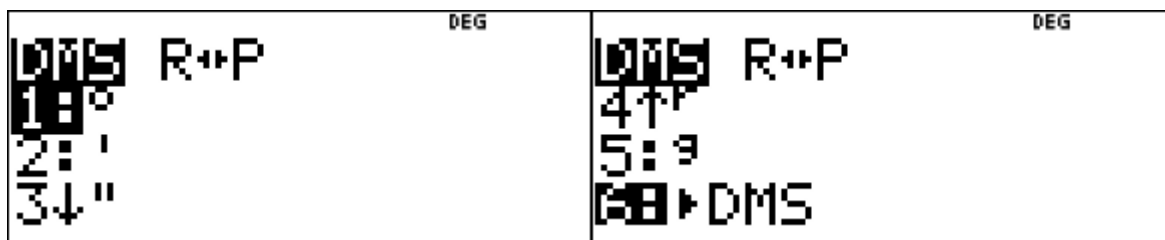
- (a) Use the TI-30XB MultiView™ to find the exact volume of a cylinder
- whose radius is 3 cm and height is 8 cm.
  - whose radius is 6 cm and height is 8 cm.
- (b) Find how much larger the volume of the second cylinder is compared to the volume of the first cylinder.

**[Teacher Note:** Students need be able to determine what effect changing the radius (keeping height constant) or the height (keeping radius constant) has on the volume of a cylinder.]

|   |  |
|---|--|
| <p>Keystrokes and solution:</p> <p>(a)</p> <p>(i) <math>V = \pi r^2 h</math></p> <p>Press <math>\pi</math> <math>\times</math> and enter 3 .</p> <p>Press <math>x^2</math> <math>\times</math> and enter 8 .</p> <p>Press <b>enter</b> .</p> <p>This gives <math>V = 72\pi</math> .</p> <p>(ii) <math>V = \pi r^2 h</math></p> <p>Press <math>\uparrow</math> <math>\downarrow</math> <b>enter</b> to bring the previous calculation down to a new author line.</p> <p>Change the 3 to a 6 and press <b>enter</b> .</p> <p>This gives <math>V = 288\pi</math> .</p> <p>(b)</p> <p>Press <b>2nd</b> <math>(\leftarrow)</math> (<b>ans</b>) <math>\div</math> .</p> <p>Press <math>\square</math> and then press <math>\uparrow</math> until <math>72\pi</math> is highlighted.</p> <p>Press <b>enter</b> <math>\square</math> <b>enter</b> .</p> $\frac{288\pi}{72\pi} = 4$ <p>The volume of the second cylinder is four times larger than the volume of the first cylinder.</p> | <br><br> |
|---|--|

## 2.4 Time

Press  $\boxed{2\text{nd}}$   $\boxed{\text{prb}}$  (angle) to access angle. This displays the choice of two submenus. The first submenu, **DMS**, enables the user to specify the angle unit modifier as degrees ( $^\circ$ ), minutes ( $'$ ), seconds ( $''$ ); radian (**r**); gradian (**g**), or convert units using convert **DMS**.



For Stage 4 (Years 7 and 8) Mathematics in NSW, the TI-30XB MultiView™ should be set in **DEG** (default) mode.

### Example

This example shows to use a calculator to perform calculations involving time.

Use the TI-30XB MultiView™ to convert a time of 2.4 hours to a time in hours and minutes.

[**Teacher Note:** Students need to understand that 3.25 hours, for example, on a calculator display converts to  $3\frac{1}{4}$  hours or 3 hours 15 minutes.]

|   |  |
|---|--|
| <p>Keystrokes and solution:</p> <p>Enter <b>2.4</b> and press <math>\boxed{2\text{nd}}</math> <math>\boxed{\text{prb}}</math> (angle) <math>\boxed{6}</math> <math>\boxed{\text{enter}}</math>.</p> <p>This time is 2 hours 24 minutes.</p> |  |
|---|--|

### Example

This example shows how to use a calculator to add and subtract time including by using the 'degrees, minutes and seconds' button.

At the 1908 Olympic Games, John Hayes (USA) won the marathon in a time of 2:55:18. At the 2016 Olympic Games, Eluid Kipchoge (Kenya) won the marathon in a time of 2:08:44.

Use the TI-30XB MultiView™ to calculate how much faster Kipchoge's winning time was compared to Hayes' winning time.

[**Teacher Note:** Such calculations can be problematic without the use of a calculator. However, encourage students to attempt questions of this type using mental computation and written methods.]

Keystrokes and solution:

Enter **2** and press **2nd** **prb** (angle) **1**.

Enter **55** and press **2nd** **prb** (angle) **2**.

Enter **18** and press **2nd** **prb** (angle) **3**.

Press **[-]**.

Enter **2** and press **2nd** **prb** (angle) **1**.

Enter **8** and press **2nd** **prb** (angle) **2**.

Enter **44** and press **2nd** **prb** (angle) **3**.

Press **2nd** **prb** (angle) **6** **enter**.

Kipchoge's winning time is 46 minutes and 34 seconds faster.

2°55'18" - 2°8'44" = 0°46'34"

### Example

This example shows how to use a calculator to solve a problem involving 12-hour and 24-hour notation and the use of mixed units (years, months, days, hours and seconds).

On September 30, Anne set her digital watch at 13:00:00. During October, Anne notices that the watch loses 7 seconds per day. Use the TI-30XB MultiView™ to find what time would be showing on Anne's watch when it is 13:00:00 on October 31.

**[Teacher Note:** Students need to know the number of days in each month, that there are 60 minutes in an hour and there are 60 seconds in a minute.]

Keystrokes and solution:

There are 31 days in October so Anne's watch will have lost  $31 \times 7 = 217$  seconds.

Using **[x]**,  $31 \times 7 = 217$ .

Convert 217 seconds into minutes and seconds:

Press **2nd** **[(-)]** (**ans**) **÷** and enter **60**.

Press **2nd** **prb** (angle) **6** **enter**.

Hence 217 seconds is 3 minutes and 37 seconds.

Enter **13** and press **2nd** **prb** (angle) **1**.

Enter **0** and press **2nd** **prb** (angle) **2**.

Enter **0** and press **2nd** **prb** (angle) **3**.

31\*7 = 217  
ans ÷ 60 DMS 3°37'0"

Press  $\square$ .

Enter 0 and press  $\square$   $\square$  (angle)  $\square$ .

Enter 3 and press  $\square$   $\square$  (angle)  $\square$ .

Enter 37 and press  $\square$   $\square$  (angle)  $\square$ .

Press  $\square$   $\square$  (angle)  $\square$  **enter**.

Subtracting 3 minutes and 37 seconds from 13:00:00 gives 12:56:23. This would be the time on Anne's watch.

The calculator display shows the following sequence of operations and results:

- ans  $\div$  60  $\rightarrow$  DMS
- DEG  $\leftrightarrow$
- 3° 37' 0"
- 13° 0' 0" - 0° 3' 37"  $\rightarrow$
- 12° 56' 23"

## 2.5 Right-angled triangles (Pythagoras)

This example shows how to use a calculator and Pythagoras' theorem to find the length of an unknown side in a right-angled triangle.

### Example

Use the TI-30XB MultiView™ to find the length of the hypotenuse of a right-angled triangle where the two shortest sides measure 6 cm and 3 cm. Give your answer

(a) exactly, in simplest surd form.

(b) correct to one decimal place.

**[Teacher Note:** It is important for students to identify the hypotenuse as the longest side in any right-angled triangle and also as the side opposite the right angle. Students need to write answers to a specified or sensible level of accuracy, using an 'approximately equals' sign where appropriate or give exact answers (i.e. as surds) where appropriate.]

Keystrokes and solution:

(a)

The hypotenuse is the longest side and so we expect an answer  $> 6$  (cm).

$$\begin{aligned}c^2 &= 6^2 + 3^2 \\ &= 45\end{aligned}$$

$$c = \sqrt{45} \quad (c > 0) \text{ side lengths are positive}$$

The length of the hypotenuse is  $3\sqrt{5}$  cm.

Press  $\boxed{2\text{nd}} \boxed{x^2} (\sqrt{\phantom{x}})$ .

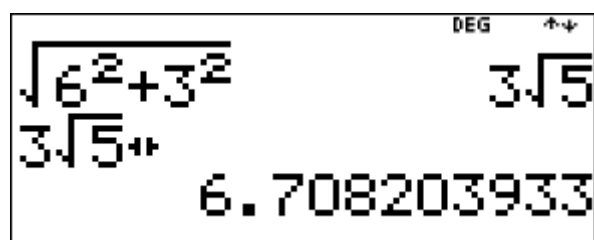
Enter 6 and press  $\boxed{x^2} \boxed{+}$ .

Enter 3 and press  $\boxed{x^2} \boxed{\text{enter}}$ .

(b)

To convert to a decimal, press  $\boxed{\rightarrow}$ .

Correct to one decimal place, the length of the hypotenuse is 6.7 cm.





A Pythagorean triad is a set of three whole numbers in which the sum of the squares of the two smaller numbers is equal to the square of the third number.

**Example**

This example shows how to use a calculator to determine whether a set of three numbers is a Pythagorean triad.

Use the TI-30XB MultiView™ to determine whether each set of three numbers is a Pythagorean triad.

(a) 11,13,17.

(b) 8,15,17.

[**Teacher Note:** The triad 11,13,17 satisfies the equation  $x^2 + y^2 = z^2 + 1$  and is known as an almost Pythagorean triad.]

Keystrokes and solution:

(a)

Press **[data]** **[data]** **[4]** to clear all lists.

In **L1**, enter **11** and press **[x<sup>2</sup>]** **[+]**.

Enter **13** and press **[x<sup>2</sup>]** **[enter]**.

$$11^2 + 13^2 = 290$$

Press **[right arrow]** to scroll across to the top of **L2**.

In **L2**, enter **17** and press **[x<sup>2</sup>]** **[enter]**.

$$17^2 = 289$$

$11^2 + 13^2 \neq 17^2$  and so 11,13,17 is not a Pythagorean triad.

(b)

Press **[left arrow]** to move to **L1**.

In **L1**, enter **8** and press **[x<sup>2</sup>]** **[+]**.

Enter **15** and press **[x<sup>2</sup>]** **[enter]**.

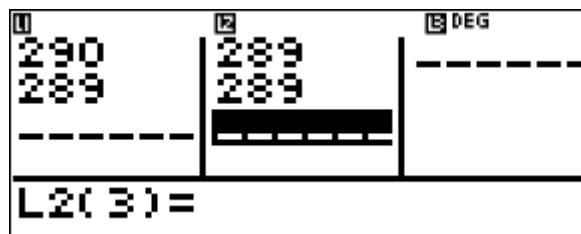
$$8^2 + 15^2 = 289$$

Press **[right arrow]** to scroll across to the top of **L2**.

In **L2**, enter **17** and press **[x<sup>2</sup>]** **[enter]**.

$$17^2 = 289$$

$8^2 + 15^2 = 17^2$  and so 8,15,17 is a Pythagorean triad.



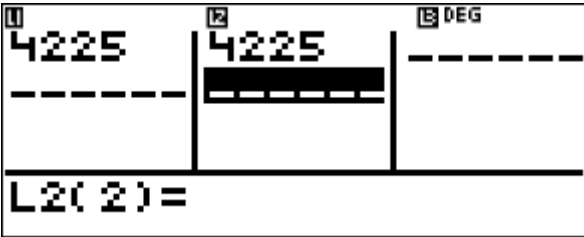
The converse of Pythagoras' theorem is if the square of the length of the longest side of a triangle is equal to the sum of the squares of the other two sides, then the triangle is a right-angled triangle.

### Example

This example shows how to use a calculator and the converse of Pythagoras' theorem to establish whether a triangle has a right angle.

Use the TI-30XB MultiView™ to check whether a triangle with side lengths 33 cm, 56 cm and 65 cm is a right-angled triangle.

[**Teacher Note:** In a triangle with side lengths  $a, b$  and  $c$  where  $c$  is the length of the longest side: If  $c^2 < a^2 + b^2$  then the triangle is acute. If  $c^2 > a^2 + b^2$  then the triangle is obtuse.]

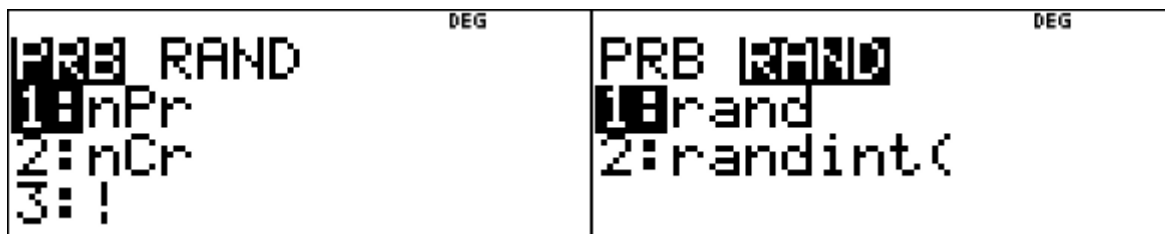
|   |  |
|---|--|
| <p>Keystrokes and solution:</p> <p>Press <b>data</b> <b>data</b> <b>4</b> to clear all lists.</p> <p>In <b>L1</b>, enter <b>65</b> and press <b>x<sup>2</sup></b> <b>enter</b>.</p> <p><math>65^2 = 4225</math></p> <p>Press <b>⤵</b> to scroll across to the top of <b>L2</b>.</p> <p>In <b>L2</b>:</p> <p>Enter <b>33</b> and press <b>x<sup>2</sup></b> <b>+</b>.</p> <p>Enter <b>56</b> and press <b>x<sup>2</sup></b> <b>enter</b>.</p> <p><math>33^2 + 56^2 = 4225</math></p> <p>Apply the converse of Pythagoras' theorem.</p> <p>Since the square of the longest side is the sum of the squares of the other two sides, by the converse of Pythagoras' theorem, the triangle is right-angled.</p> |  <p>The image shows a TI-30XB MultiView calculator screen. At the top, there are three list headers: L1, L2, and DEG. L1 contains the value 4225. L2 contains the value 4225. Below the lists, the expression L2(2) = is displayed on the screen.</p> |
|---|--|

### 3 Statistics and probability

#### 3.1 Data collection and representation

Obtaining data by sampling can involve using a random process, for example, from a random number generator.

The TI-30XB MultiView™ has two menus that can be accessed by pressing  $\boxed{\text{prb}}$ . These two menus are **PRB** and **RAND**.



The menu **RAND** houses the command **rand** which generates a pseudo-random number between 0 and 1.

Calculators such as the TI-30XB MultiView™ do not generate truly random numbers. Instead they generate pseudo-random numbers which means they use a formula to generate the values. To initiate this formula, the TI-30XB MultiView™ uses a starting value called a seed and then generates random numbers based upon this seed.

If two or more TI-30XB MultiView™ calculators start with the same seed value, they will generate the same sequence of random values. Hence, if you wish, you can control the starting seed value.

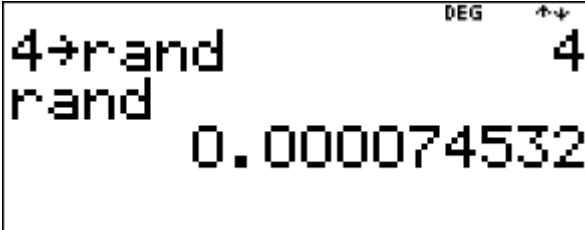
To control a sequence of random numbers, store an integer (seed value)  $\geq 0$  to **rand**. The seed value changes randomly every time a random number is generated.

#### Example

This example shows how to seed the TI-30XB MultiView™.

Seed the TI-30XB MultiView™ to generate a random number between 0 and 1.

[**Teacher Note:** It is important to determine whether you want students generating the same set of random numbers or different sets of random numbers.]

|   |  |
|---|--|
| <p>Keystrokes and solution:</p> <p>Here we choose to use the integer 4 to store a seed value to <b>rand</b>.</p> <p>Enter 4 and press <math>\boxed{\text{sto}}</math> <math>\boxed{\text{prb}}</math> <math>\downarrow</math> <math>\boxed{\text{enter}}</math> <math>\boxed{\text{enter}}</math>.</p> <p>To generate a random number between 0 and 1:</p> <p>Press <math>\boxed{\text{prb}}</math> <math>\downarrow</math> <math>\boxed{\text{enter}}</math>.</p> <p>Press <math>\boxed{\text{enter}}</math> to generate further random numbers between 0 and 1.</p> |  |
|---|--|

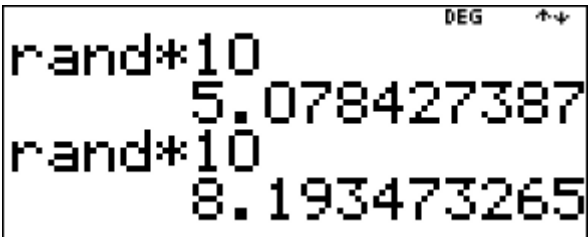
When performing simulations with the **rand** command, it is mostly desirable to have each student in the class generating a different set of random numbers. To achieve this, assign each student a different seed value and follow the instructions in the above example. For example, students could enter their mobile phone number as a seed value. Note that when using a mobile phone number, the leading zero is not required.

Example

This example shows how to use a calculator to generate random numbers between 0 and 10.

- (a) Construct a formula that will generate random numbers between 0 and 10 on the TI-30XB MultiView™.
- (b) Use this formula to generate some random numbers on the TI-30XB MultiView™ between 0 and 10.

[**Teacher Note:** It is an important skill to be able to construct formulas that will generate sets of random numbers. Students should be given opportunities to build and apply such formulas.]

|   |  |
|---|--|
| <p>Keystrokes and solution:</p> <p>(a)</p> <p>The required formula is <b>rand * 10</b>.</p> <p>(b)</p> <p>To generate a random number between 0 and 10:</p> <p>Press <b>prb</b> <b>▶</b> <b>enter</b> <b>⊗</b> and enter <b>10</b>.</p> <p>Press <b>enter</b>.</p> <p>Press <b>enter</b> to generate further random numbers between 0 and 10.</p> |  |
|---|--|

Example

This example shows how to use a calculator to generate random numbers between 1 and 12.

- (a) Construct a formula that will generate random numbers between 1 and 12 on the TI-30XB MultiView™.
- (b) Use this formula to generate some random numbers on the TI-30XB MultiView™ between 1 and 12.

[**Teacher Note:** It is an important skill to be able to construct formulas that will generate sets of random numbers. Students should be given opportunities to build and apply such formulas.]

Keystrokes and solution:

(a)

**rand** generates a random number between 0 and 1.

**rand\*11** generates a random number between 0 and 11.

**rand\*11+1** generates a random number between 1 and 12.

(b)

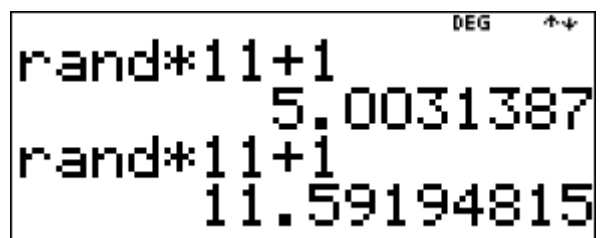
To generate a random number between 1 and 12:

Press **prb** **↓** **enter** **×**.

Enter **11** and press **+**.

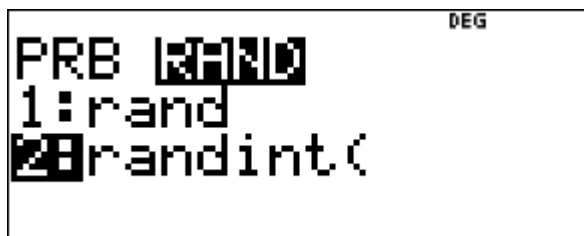
Enter **1** and press **enter**.

Press **enter** to generate further random numbers between 1 and 12.



```
DEG ↑↓
rand*11+1
5.0031387
rand*11+1
11.59194815
```

**RAND** also houses the command **randint**(.



```
DEG
PRB 1:rand
2:randint(.
```

The command **randint**( generates a random integer between two integers,  $a$  and  $b$ , where  $a \leq \text{randint} \leq b$ . In other words, between two given integers  $a$  and  $b$  inclusive. The syntax is to use a comma to separate the two integers. For example, the command **randint**(1,6) will generate a random integer between 1 and 6 inclusive.

[**Note:** To enter the comma symbol, press **2nd** **.** (,).]

### Example

This example shows how to use a calculator to generate random integers between 1 and 6 inclusive.

Generate a random integer on the TI-30XB MultiView™ between 1 and 6 inclusive.

**[Teacher Note:** Generating random integers between 1 and 6 inclusive simulates the rolling of a six-sided die and can be used to play games such as Greedy Pig.]

|   |  |
|---|--|
| <p>Keystrokes and solution:</p> <p>Press <b>prb</b> <b>▸</b> <b>2</b>.</p> <p>Enter <b>1</b> and press <b>2nd</b> <b>.</b> (,).</p> <p>Enter <b>6</b> and press <b>)</b> <b>enter</b>.</p> <p>Press <b>enter</b> to generate further random integers between 1 and 6.</p> |  <p>The calculator screen displays the DEG mode indicator and a list of three random integers generated by the randint(1,6) function. The results are 4, 2, and 3, each on a new line.</p> |
|---|--|

### Example

This example shows how to use a calculator to generate random integers between 7 and 12 inclusive.

Generate random integers on the TI-30XB MultiView™ between 7 and 12 inclusive.

**[Teacher Note:** Generating random integers between 7 and 12 inclusive can be used for example to simulate the months of a calendar year from July (7) to December (12).]

|   |  |
|---|--|
| <p>Press <b>prb</b> <b>▸</b> <b>2</b>.</p> <p>Enter <b>7</b> and press <b>2nd</b> <b>.</b> (,).</p> <p>Enter <b>12</b> and press <b>)</b> <b>enter</b>.</p> <p>Press <b>enter</b> to generate further random integers between 7 and 12.</p> |  <p>The calculator screen displays the DEG mode indicator and a list of three random integers generated by the randint(7,12) function. The results are 7, 10, and 7, each on a new line.</p> |
|---|--|

### Example

This example shows how to use a calculator to simulate the rolling of two six-sided dice and find the sum of the two results.

Use the TI-30XB MultiView™ lists feature to simulate the rolling of two six-sided dice and find the sum of the two results.

**[Teacher Note:** It is important to conduct simulations such as this and to encourage students to compare experimental probabilities and results with theoretical probabilities and considerations.]

Keystrokes and solution:

Press **[data]** **[data]** **[4]** to clear all lists.

In **L1**, press **[prb]** **[2]**.

Enter **1** and press **[2nd]** **[,]**.

Enter **6** and press **[ ]** **[enter]**.

Press **[right arrow]** to scroll across to the top of **L2**.

In **L2**, press **[prb]** **[2]**.

Enter **1** and press **[2nd]** **[,]**.

Enter **6** and press **[ ]** **[enter]**.

Press **[right arrow]** to scroll across to the top of **L3**.

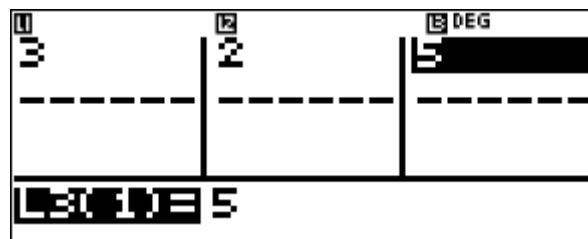
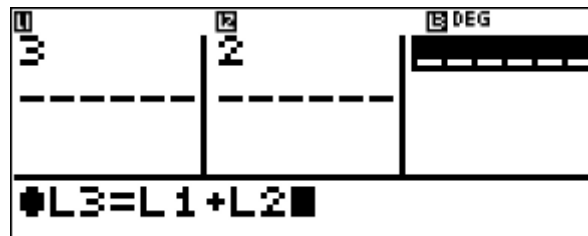
Press **[data]** **[right arrow]** to highlight **FORMULA** and press **[enter]**.

Now enter the list formula **L1 + L2** to **L3**.

Press **[data]** **[enter]** to paste **L1** into the author line.

Press **[+]** **[data]** **[2]** **[enter]** to complete entering the list formula.

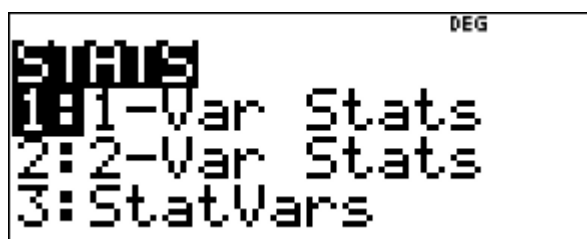
**L3** should now show the sum of the two results.



Note that entering the formula **randint(1,6) + randint(1,6)** on the Home screen of the TI-30XB MultiView™ will simulate the experiment of rolling two six-sided dice. Press **[enter]** to repeat the experiment. To simulate the experiment of rolling of two four-sided dice for example, use the formula **randint(1,4) + randint(1,4)**.

### 3.2 Single variable data analysis

Press **[data]** to access the lists. Press **[2nd] [data]** (stat) to access the statistics menu.



The statistics menu displays the following options.

**1-Var Stats** analyses the statistics from a data set described by a measured variable,  $x$ .

**2-Var Stats** analyses the statistics from a paired data set described by two measured variables, the independent variable,  $x$  and the dependent variable,  $y$ .

**StatVars** displays a secondary menu of statistical variables. This menu only appears after a **1-Var Stats** or **2-Var Stats** calculation has been performed. Press **[down arrow]** and **[left arrow]** to locate the desired variable and press **[enter]** to select it.

The following table defines all the statistical variables. Some of these variables will not be required for Stage 4 Mathematics in NSW. However, they are listed here for completeness.

| Variables                | Definition   |
|--------------------------|--|
| $n$                      | Number of $x$ or $(x, y)$ data points.   |
| $\bar{x}$ or $\bar{y}$   | Mean of all $x$ or $y$ values.   |
| $s_x$ or $s_y$           | Sample standard deviation of $x$ or $y$ .  |
| $\sigma_x$ or $\sigma_y$ | Population standard deviation of $x$ or $y$ .                                      |
| $\sum x$ or $\sum y$     | Sum of all $x$ or $y$ values.  |
| $\sum x^2$ or $\sum y^2$ | Sum of all $x^2$ or $y^2$ values.  |
| $\sum xy$                | Sum of $(x \dots y)$ for all $xy$ pairs.   |
| $a$                      | Linear regression slope.   |
| $b$                      | Linear regression $y$ - intercept.   |
| $r$                      | Correlation coefficient.   |
| $x'$                     | Uses $a$ and $b$ to calculate a predicted $x$ - value for an inputted $y$ - value. |
| $y'$                     | Uses $a$ and $b$ to calculate a predicted $y$ - value for an inputted $x$ - value. |
| <b>MinX</b>              | Minimum of $x$ - values.   |
| <b>Q1</b>                | Median (lower quartile) of the elements between <b>MinX</b> and <b>Med</b> .       |
| <b>Med</b>               | Median of all data points.   |
| <b>Q3</b>                | Median (upper quartile) of the elements between <b>Med</b> and <b>MaxX</b> .       |
| <b>MaxX</b>              | Maximum of $x$ - values.   |



To obtain one-variable or two-variable statistics:

With a data set entered into **L1**, **L2** or **L3** (see the introduction to the data editor and list formulas on page 17).

Press **2nd** **data** (stat). Select **1-Var Stats** or **2-Var Stats** and press **enter**.

Select **L1**, **L2** or **L3** and the frequency.

Press **enter** to display the menu of variables.

To clear data, press **data** **data**, select a particular list or all lists and press **enter**.

### Example

This example shows how to use the statistical functions of a calculator to determine the mean, median and range for a set of data.

Consider the following data set  $\{144, 142, 92, 211, 82, 80, 23\}$ .

- (a) Use the TI-30XB MultiView™ to calculate the
- (i) mean, correct to two decimal places.
  - (ii) median.
  - (iii) range.
- (b) If the data value 211 is replaced by the data value 0, describe without calculation what happens to the value of the
- (i) mean.
  - (ii) median.
- (c) Given that the data value 211 is replaced by the data value 0, calculate the new
- (i) mean, correct to two decimal places.
  - (ii) median

**[Teacher Note:** It is important for students to be able to interpret in context, the statistics obtained from calculators.]

Keystrokes and solution:

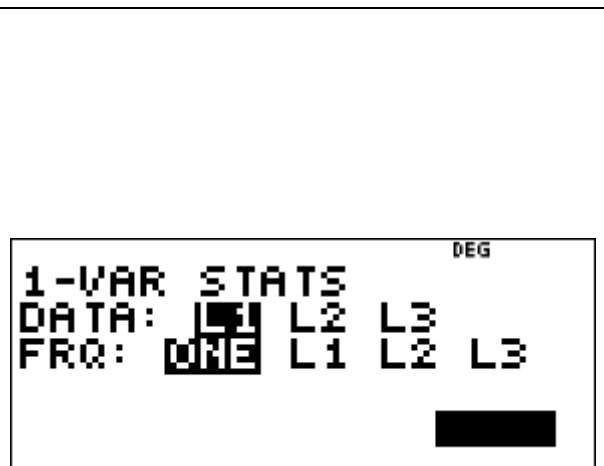
To clear all data, press **data** **data** **4**.

Enter the data in **L1**. Start by entering **144** and pressing **↵**. Enter all the data and press **enter**.

Press **2nd** **data** (stat) to access the statistics menu.

Press **enter** or **1** to access **1-Var Stats**.

Press **↵** **↵** **enter** to access the statistical results for part (a) (i) and part (a) (ii).



Scrolling down:

(a)

(i)  $\bar{x} = 110.57$

(ii) median = 92

Press **2nd** **mode** (quit) to return to the Home screen.

(iii) range = max. value – min. value

Press **2nd** **data** (stat) **3** to access **StatVars**.

Press **⇐**, select **MaxX** and press **enter**.

Press **□**.

Press **2nd** **data** (stat) and press **3** for **StatVars**.

Press **7** (or scroll down until **MinX** is selected and press **enter**).

The Home screen should display **MaxX – MinX**.

Press **enter**.

range = 188 (= 211 – 23)

(b)

(i)  $\sum x$  decreases and so  $\bar{x}$  decreases.

(ii) The maximum value (211) has been replaced by a value (0) which is now the minimum value. So the median decreases.

DEG  
1-Var: L1,1  
1:n=7  
2:  $\bar{x} = 110.5714286$   
3:  $Sx = 60.49203017$

DEG  
1-Var: L1,1  
9: Med=92  
H: Q3=144  
B: MaxX=211

DEG ↑↓  
MaxX-minX 188

(c)

Press **[data]** to go back to **L1**.

Press **⏴** to scroll down **L1** to highlight **211**.

Enter **0** and press **⏴**. This replaces **211** with **0**.

Press **[2nd]** **[data]** (stat) to access the statistics menu.

Press **[enter]** or **[1]** to access **1-Var Stats**.

Press **⏴** **⏴** **[enter]** to access the statistical results for part (c) (i) and part (c) (ii).

Scrolling down:

(i)  $\bar{x} = 80.43$

(ii) median = 82

```
DEG
1-Var:L1,1
1:n=7
2:Σx=80.42857143
3:Σx²=54.36867095
```

```
DEG
1-Var:L1,1
0:Med=82
A:Q3=142
B:maxX=144
```

The statistical functionality of a TI-30XB MultiView™ can be used to explore the means and proportions of random samples drawn from the same population.

In addition, the calculator can be used to calculate and compare summary statistics (mean, median, mode and range) of at least three different random samples drawn from the same population.

For three different random samples on a TI-30XB MultiView™, this is best organised by having each of **L1**, **L2** and **L3** housing a random sample drawn from the same population.

This will facilitate the calculation and comparison of summary statistics of different random samples drawn from the same population.

Such an analysis will help demonstrate that summary statistics vary from sample to sample.

## 4 Error messages

Press **clear** to clear an error message. This takes you back to the previous screen with the cursor at or near where the error occurred. Some examples of error messages are shown below.

### Argument

A function does not have the correct number of arguments.

### Divide by 0

In statistics this is equivalent to  $n = 1$ .

### Domain

An argument to a function is outside the valid range. For example,  $\sqrt{x}$  with  $x < 0$ .

### Equation length error

An entry that exceeds the digit limits.

### Frq domain

A **FRQ** value in **1-Var** stats that is either  $< 0$  or  $> 99$ .

### Overflow

You attempted to enter, or you have calculated, a number that is too big for the TI-30XB MultiView™.

### Stat

Either attempting to calculate **1-Var** or **2-Var** stats with no defined data points or attempting to calculate **2-Var** stats when the data lists are unequal in length.

### Dim mismatch

Attempting to create a formula when the lists are unequal in length.

### Formula

The formula does not contain a list name, e.g., **L1**, or the formula for a list contains its own list name. For example, a formula for **L2** contains **L2**.

### Syntax

The entry contains a syntax error. Often this will be misplaced arguments, parentheses or commas.

### Invalid function

An invalid function is entered in the function table.

### Memory limit

The calculation contains too many pending operations.

### Low battery

This message displays briefly and then disappears. Pressing **clear** does not clear this message.