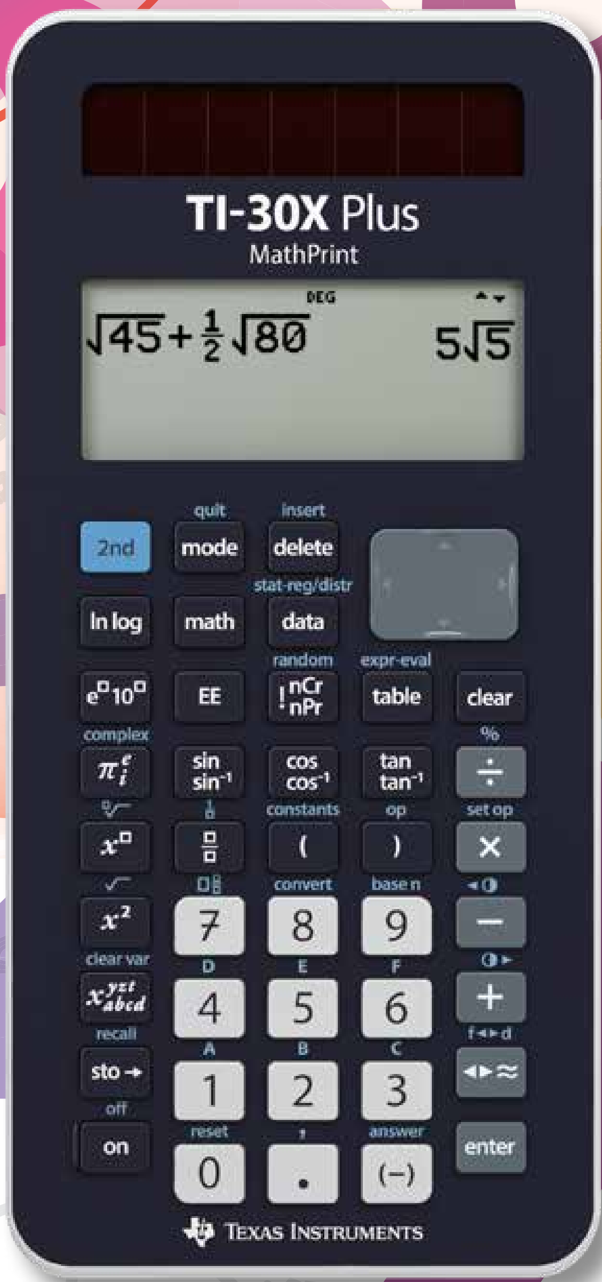
TI-30X Plus MathPrint™

Scientific Calculator

Guidebook for HSC Mathematics Standard



Texas Instruments

TI-30X Plus MathPrint™ Scientific Calculator Guidebook
NSW Stage 6 Mathematics Standard

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About this guidebook

This guidebook is designed to show ways in which the TI-30X Plus MathPrint™ scientific calculator can augment and enhance the teaching and learning of NSW Stage 6 Mathematics Standard. The Year 12 course featured in the guidebook is the Mathematics Standard 2 Year 12 course.

The first chapter of the guidebook is a getting started chapter which provides an overview of features such as display settings, modes and menus. In addition, the getting started chapter gives some general guidance for navigating around the calculator, on calculator syntax and tips for efficient and accurate calculation.

Throughout the chapters on Algebra, Measurement, Financial Mathematics and Statistical Analysis (note that Networks is not covered), TI-30X Plus MathPrint™ features and menus relevant to the subject matter are introduced and explained. In terms of features (math tools), for example, the conversions feature is introduced on page 14, the data editor and list formulas feature is introduced on page 21, the stored operation feature is introduced on page 22, the function feature is introduced on page 24, and the expression evaluation feature is introduced on page 26. In terms of menus, for example, the statistics – regressions (**STAT - REG**) menu is introduced at the start of the section on Statistical Analysis (page 70).

The examples showcased in this guidebook are relevant to NSW Stage 6 Mathematics Standard. Most examples include 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 describe how that example might fit in with the aims and outcomes of using calculators judiciously in Mathematics teaching and learning.

The examples generally follow a two-column table format. In most examples, the left-hand column displays step-by-step keystrokes that demonstrate TI-30X Plus MathPrint™ functionality accompanied by a solution outline and notes. Where applicable, the right-hand column displays accompanying screenshots.

All examples in this guidebook assume the default settings as shown in Section 0.5 (page 8) on modes. If desired, the TI-30X Plus MathPrint™ can be reset so that all students start at the same point.

To do this, press [2nd] [reset] [2].

0 Getting started

This chapter 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.

0.1 Switching the calculator on and off

Press [on] to turn the TI-30X Plus MathPrint™ on.

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

While the display is cleared, the history settings and memory are retained.

If no key is pressed for approximately 3 minutes, the APDTM (Automatic Power DownTM) feature turns off the TI-30X Plus MathPrint™ automatically.

Press [on] after APDTM and the display, pending operations, settings and memory are retained.

0.2 Display contrast

To adjust the contrast:

(1) Press and release the [2nd] key.

(2) Press [◑·] to darken the screen or press [·◑] to lighten the screen.

Note: This adjusts the contrast one level at a time. Repeat the above steps as needed.

0.3 Home screen

The TI-30X Plus MathPrint™ can display a maximum of 4 lines with a maximum of 16 characters per line.

Keystrokes description:

For entries and expressions longer than the visible screen area, scroll left and right (◄ and ►) to view the entire entry or expression.

Depending on space, the answer is displayed either directly to the right of the entry or on the right side of the next line.

In MathPrint™ mode, you can enter up to four levels of consecutive nested functions and expressions, which include fractions, square roots, exponents with ^, $\sqrt[x]{y}$, e^x and 10^x.

Special indicators and cursors may display on the screen to provide additional information concerning functions or results.

Indicator	Definition
2ND	2nd function.
FIX	Fixed-decimal setting.
SCI, **ENG**	Scientific or engineering notation.
DEG, **RAD**, **GRAD**	Angle mode (degrees, radians or gradians).
L1, **L2**, **L3**	Displays above the lists in data editor.
H, **B**, **O**	Indicates **HEX**, **BIN** or **OCT** number-base mode. No indicator is displayed for default **DEC** mode.
⌛	The calculator is performing an operation. Press [on] to break the calculation.
▲ ▼	An entry is stored in memory before and/or after the visible screen area. Press (▲) and (▼) to scroll.
▶	Indicates that the multi-tap key is active.
■	Normal cursor. Shows where the next item you type will appear. Replaces any current character.
▒	Entry-limit cursor. No additional characters can be entered.
▬	Insert cursor. A character is inserted in front of the cursor location.
⬚	Placeholder box for empty MathPrintTM template. Use arrow keys to move into the box.
◨	MathPrintTM cursor. Continue entering in the current MathPrintTM template or press (▶) to exit the template.

0.4 2nd functions

Press [2nd] to activate the secondary function of a given key. Note that **2ND** appears as an indicator on the screen. To cancel before pressing the next key, press [2nd] again.

Example: Activating a 2nd function

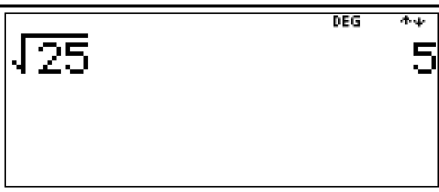
Press [2nd] [√] to calculate the square root of a non-negative value.

Use the TI-30X Plus MathPrint™ to calculate $\sqrt{25}$.

Keystrokes and solution:

Press [2nd] [√] and enter **25** [enter].

$\sqrt{25} = 5$



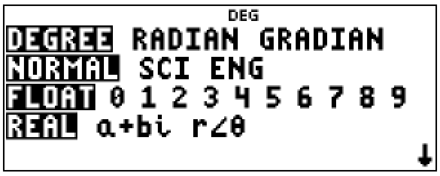
0.5 Modes

Press [mode] to choose modes.

Press ⊝ ⊜ ⊙ ⊙ to choose a mode and press [enter] to select it.

Press [clear] or [2nd] [quit] to return to the home screen and perform your calculations using the chosen mode settings.

Default mode settings are highlighted in the following two screenshots.



DEGREE RADIAN GRADIAN sets the angle mode.

NORMAL SCI ENG sets the numeric notation mode.

- **NORMAL** displays results with digits to the left and right of the decimal point. For example, 123456.78.
- **SCI** expresses numbers with one digit to the left of the decimal point and the appropriate power of 10. For example, $1.2345678\text{E}5$ which is equivalent to 1.2345678×10^5.
- **ENG** displays results as a number from $1 - 999$ times 10 to an integer power. The integer power is always a multiple of 3. For example, $123.45678\text{E}3$.

Note: [EE] is a shortcut key to enter a number in scientific notation format.

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.

REAL a+bi r∠θ sets the format of complex number results.

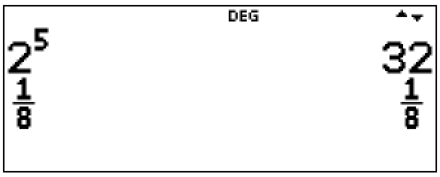
- **REAL** real results.
- **a+bi** rectangular results.
- **r∠θ** polar results.

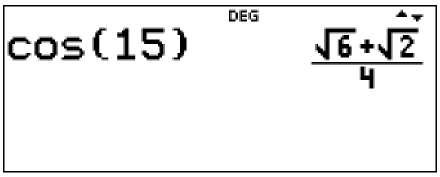
DEC HEX BIN OCT sets the number base.

- **DEC** decimal (base 10).
- **HEX** hexadecimal (base 16). To enter hex digits A through F, use [2nd] [A] etc.
- **BIN** binary (base 2).
- **OCT** octal (base 8).

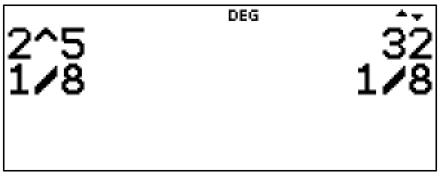
MATHPRINT CLASSIC

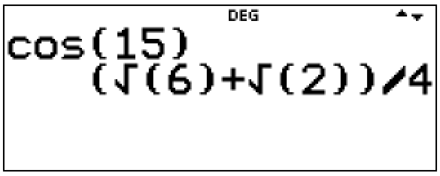
- **MATHPRINT** mode displays most inputs and outputs in textbook format.





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





0.6 Multi-tap keys

When pressed, a multi-tap key cycles through multiple functions.

Press ► to stop multi-tap.

For example, press [sin sin⁻¹] to access **sin**, $\mathbf{sin^{-1}}$, **sinh** and $\mathbf{sinh^{-1}}$.

Press the key repeatedly to display the function you wish to enter.

Multi-tap keys include [x yzt abcd], [sin sin⁻¹], [cos cos⁻¹], [tan tan⁻¹], [e□ 10□], [ln log], [! nCr nPr] and [π e i].

0.7 Menus

Menus provide access to a number of calculator functions.

Some menu keys, such as [2nd] [recall], display a single menu.

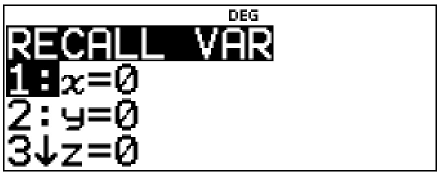
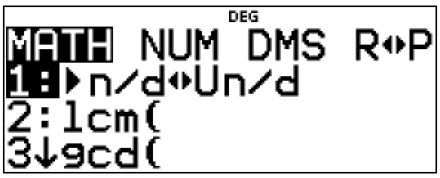
Others, such as [math], display multiple menus.

Press ► and ▼ to scroll and select a menu item or press the corresponding number next to the item.

To return to the previous screen without selecting the item, press [clear].

To exit a menu and return to the home screen, press [2nd] [quit].

Keystrokes description:

Press [2nd] [recall] (key with a single menu) to access **RECALL VAR**.	
Press [math] (key with multiple menus) to access **MATH**, **NUM**, **DMS** and **R◄► P**.	

0.8 Scrolling expressions and history

Press ◄ or ► to move the cursor within an expression that you are entering or editing.

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.

From an expression or edit, press ▲ or ▼ to move the cursor through previous entries in the history. Pressing [enter] from an input or output in history will paste that expression back to the cursor position on the edit line.

Press 2nd ▲ from the denominator of a fraction in the expressions edit to move the cursor to the history. Pressing enter from an input or output in the history will paste that expression to the denominator.

Example: Scrolling expressions and history

Press x^2 to calculate the square of a value.

Use the TI-30X Plus MathPrint™ to calculate

(a) $17^2 - 7^2$.

(b) $\sqrt{17^2 - 7^2}$, giving your answer in exact form.

Teacher Note: Students need sound mental computation strategies to determine the value of $17^2 - 7^2$ or sound estimation strategies to obtain a good estimate of its value.

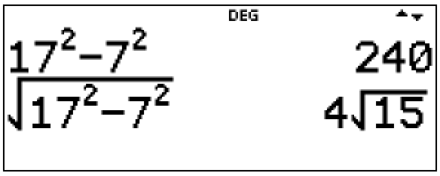
Keystrokes and solution:

(a) Enter **17** and press x^2 − **7** x^2 enter.

$17^2 - 7^2 = 240$

(b) Press 2nd [√‾] ▲ ▲ enter enter.

$\sqrt{17^2 - 7^2} = 4\sqrt{15}$



0.9 Answer toggle

Press ◂▸≈ to toggle the display result (when possible) between fraction and decimal answers, surd and decimal answers and multiples of π and decimal answers.

Example: Using answer toggle

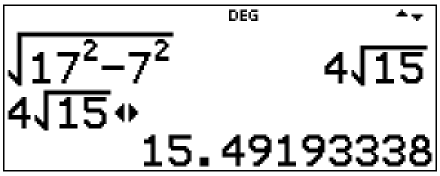
Use the TI-30X Plus MathPrint™ to express $4\sqrt{15}$ in decimal form.

Keystrokes and solution:

Enter $\mathbf{4\sqrt{15}}$ (or use the last output from the previous example by pressing ▲ enter).

Press ◂▸≈ to toggle between exact form and decimal form. Press enter.

$4\sqrt{15} = 15.49...$



Note: ◂▸≈ is also available to toggle number formats for values in cells in the Function table and in the Data Editor.

0.10 Last answer

Press 2nd [answer].

The last entry performed on the home screen is stored to the variable **ans**. This variable is retained in memory even after the TI-30X Plus MathPrint™ is turned off.

To recall the value of **ans**:

Press [2nd] [answer] (**ans** displays on the screen), or:

Press any operation key ([+], [−] etc.) in most edit lines as the first part of an entry.

The variable **ans** and the operator are both displayed.

The variable **ans** is stored and pastes in full precision which is 13 digits.

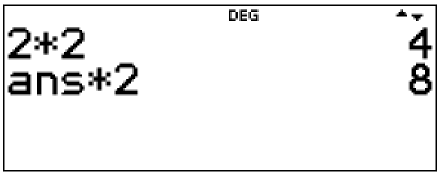
Example: Using last answer

The following example shows how the variable **ans** can preserve continuity in calculations.

Keystrokes description:

Enter **2** and press [×] **2** [enter].

$2 \times 2 = 4$

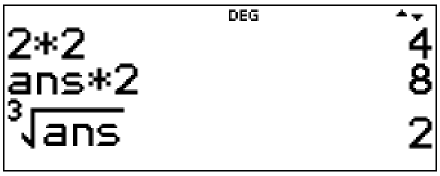


Press [×] and enter **2** [enter].

$2 \times 2 \times 2 = 8$

Enter **3** and press [2nd] [ⁿ√] [2nd] [answer] [enter].

$\sqrt[3]{2 \times 2 \times 2} = 2$

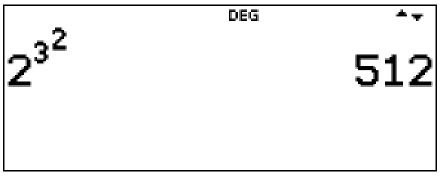


0.11 Order of operations

Order of operations hierarchy:

(1st) Expressions inside parentheses.

(2nd) Functions that need a closing bracket and precede the argument such as **sin, log** and all **R◄► P** menu items.

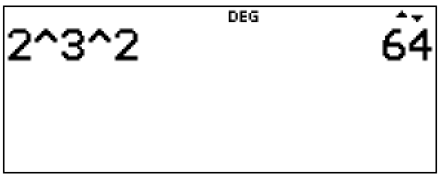


(3rd) Functions that are entered after the argument, such as x^2 and angle unit modifiers.

(4th) Exponentiation (**^**) and roots.

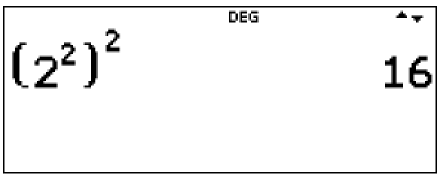
In MathPrint™ mode, exponentiation using the [$x^{\square}$] key is evaluated from right to left. For example, $\mathbf{2^{3^2}}$ is evaluated as $\mathbf{2^{(3^2)} = 512}$.

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



The TI-30X Plus MathPrint™ evaluates expressions entered with [x^2] and [$\frac{1}{\square}$] from left to right in both Classic and MathPrintTM modes.

For example, pressing [2] [x^2] [x^2] [enter] is calculated as $\mathbf{(2^2)^2 = 16}$.



(5th) Negation [(–)].

(6th) Fractions.

(7th) Permutations (**nPr**) and combinations (**nCr**).

(8th) Multiplication, implied multiplication, division and angle indicator ∠.

(9th) Addition and subtraction.

(10th) Logic operators **and**, **nand**.

(11th) Logic operators **or**, **xor**, **xnor**.

(12th) Conversions such as ► **n/d**◄► **Un/d**, **F**◄► **D**, ► **DMS**.

(13th) [sto→]

(14th) [enter] evaluates the input expression.

Note: End of expression operators and angle conversion ► **DMS**, for example, are only valid in the home screen. They are ignored in wizards, function table display and data editor features where the expression result, if valid, will display without a conversion.

Example: Order of operations

Use the TI-30X Plus MathPrint™ to calculate

(a) $42 + 3 \times -14$. (b) $2 + -6 + 9$. (c) $\sqrt{27+37}$.

(d) $5 \times (3 + 4)$. (e) $5\,(3 + 4)$. (f) $\sqrt{8^2+15^2}$.

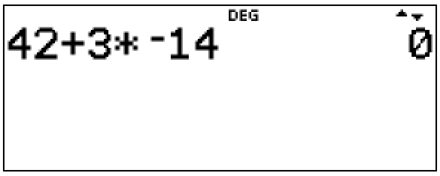
(g) $(-4)^2$ and -4^2.

Keystrokes and solution:

(a) × ÷ + –

Enter **42** and press [+] **3** [×] [(–)] **14** [enter].

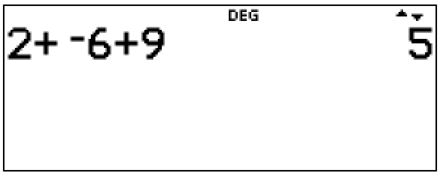
$42 + 3 \times -14 = 0$



(b) (–)

Enter **2** and press [+] [(–)] **6** [+] **9** [enter].

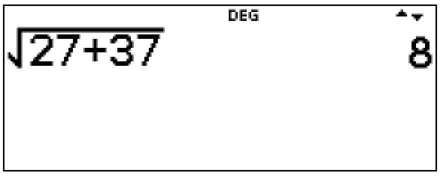
$2 + -6 + 9 = 5$



(c) √ and +

Press [2nd] [√] and enter **27** [+] **37** [enter].

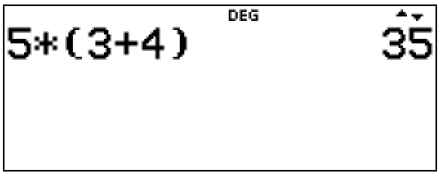
$\sqrt{27+37} = 8$



(d) ( )

Enter **5** and press [×] [(] **3** [+] **4** [)] [enter].

5 × (3 + 4) = 35



(e) ( ) and +

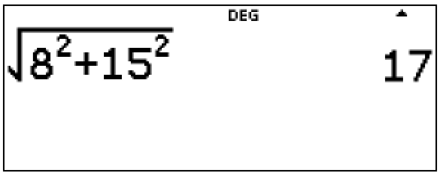
Enter **5** and press [(] **3** [+] **4** [)] [enter].

5 (3 + 4) = 35

(f) ^ and √

Press [2nd] [√] and enter **8** [x^2] [+] **15** [x^2] [enter].

$\sqrt{8^2+15^2}=17$



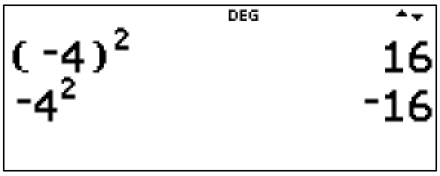
(g) ( ) and –

Press [(] [(–)] and enter **4** [)] [x^2] [enter].

$(-4)^2 = 16$

Press [(–)] and enter **4** [x^2] [enter].

$-4^2 = -16$



0.12 Clearing and correcting

Press [2nd] [quit] to return the cursor to the home screen.

Press [clear] to clear an error message. It also clears characters on an author line.

Press [delete] to delete the character at the cursor. When the cursor is at the end of an expression, it will backspace and delete.

Press [2nd] [insert] to insert (rather than replace) a character at the cursor.

Press [2nd] [clear var] [1] to clear variables ***x, y, z, t, a, b, c, d*** back to their default values of 0.

Press [2nd] [reset] [2] to return the TI-30X Plus MathPrint to default settings, clears memory variables, pending operations, all entries in history and statistical data; clears any stored operation and **ans**.

0.13 Memory and stored variables

The TI-30X Plus MathPrint has eight memory variables, ***x, y, z, t, a, b, c*** and ***d***.

The following can be stored to a memory variable:

- real (or complex) numbers.
- expression results.
- calculations from various menus such as **Distributions**.
- data editor cell values (stored from the edit line).

Features of the TI-30X Plus MathPrint that use variables will use stored values.

Press [sto→] to store a variable and press [x^{yzt}_{abcd}] (a multi-tap key that cycles through the variables ***x*, *y*, *z*, *t*, *a*, *b*, *c*** and ***d***) to select the variable to store.

Press [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 [x^{yzt}_{abc}] to recall and use the stored values for these variables. The variable, say ***y***, is inserted into the current entry and the value assigned to ***y*** is used to evaluate the expression. To enter two or more variables in succession, press ⊳ after each.

Press [2nd] [recall] to display a menu of variables and their stored values. Select the variable you wish to recall and press [enter]. The value assigned to the variable is inserted into the current entry and used to evaluate the expression.

Press [2nd] [clear var] and select **1: Yes** to clear all variable values. Any computed **Stat Vars** will no longer be available in the **Stat Vars** menu and would require recalculation.

Example: Using stored variables

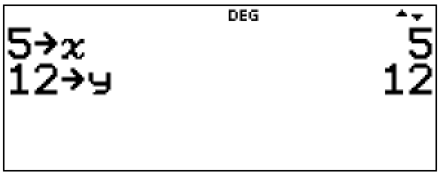
Given that $x = 5$ and $y = 12$, use the TI-30X Plus MathPrint to find the value of $x^2 + y^2$.

Keystrokes and solution:

Press [2nd] [clear var] [1] to clear variables.

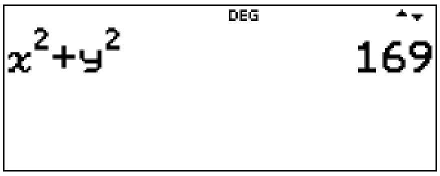
Enter **5** and press [sto→] [x^{yzt}_{abc}] [enter] **12** [sto→] [x^{yzt}_{abcd}] [x^{yzt}_{abcd}] [enter].

Two possible approaches:



Approach 1:

Press [x^{yzt}_{abcd}] [x^2] [+] [x^{yzt}_{abcd}] [x^{yzt}_{abcd}] [x^2] [enter].

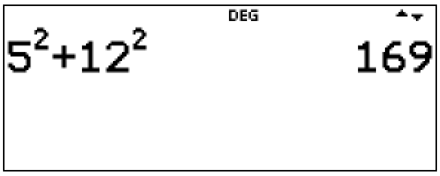


Approach 2:

Press [2nd] [recall] [1] [x^2] [+] [2nd] [recall] [2] [x^2] [enter].

$$x^2 + y^2 = 169$$

Note: This calculation can also be performed directly.



0.14 Unit conversions

The TI-30X Plus MathPrint™ has a conversions feature that allows a total of 20 conversions (or 40 if converting both ways).

The conversion occurs at the end of an expression and can be stored as a variable.

Press [2nd] [convert] to access the **CONVERSIONS** menu.

The five conversion categories are:

(1) English-Metric. (2) Temperature. (3) Speed, length.

(4) Pressure. (5) Power, Energy.

Example: Performing unit conversions

Use the TI-30X Plus MathPrint conversions feature to convert

(a) 100 degrees Fahrenheit to degrees Celsius, giving your answer correct to one decimal place.

(b) 20 m/s to km/h.

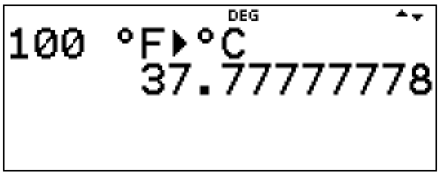
Keystrokes and solution:

(a) Enter **100** and press [2nd] [convert] [2] to select **Temperature**.

Select **°F ▶ °C** and press [enter] [enter].

100 degrees Fahrenheit converts to 37.8 degrees Celsius (correct to one decimal place).

Note: This conversion can also be made using the formula $C = \frac{5}{9}(F - 32)$.

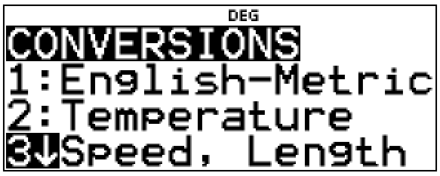


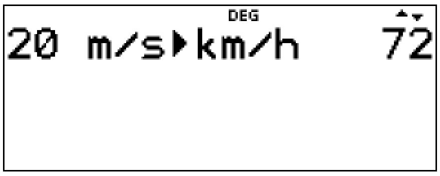
(b) Enter **20** and press [2nd] [convert] [3] to select **Speed, Length**.

Press [▶] to select **m/s ▶ km/h**. Press [enter] [enter].

20 m/s converts to 72 km/h

Note: This conversion can be made by multiplying by 3.6.





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1 Basic mathematical functions

1.1 Fractions

In MathPrint mode, press [□/□].

Fractions with [□/□] can include real (and complex numbers), operation keys ([+], [×] etc.) and most function keys ([x^2], [2nd] [%], etc.).

Press [▼] or [▲] to move the cursor between the numerator and denominator.

Fraction results are automatically simplified, and the output is in improper fraction form.

When a mixed number output is required, press [math] [1] to access the **▶ n/d ◀▶ Un/d** conversion feature.

Press [2nd] [□□/□] to enter a mixed number. Use the arrow keys to cycle through the unit, numerator and denominator.

Example: Adding fractions

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

Use the TI-30X Plus MathPrint to calculate $\frac{3}{4}+1\frac{7}{12}$.

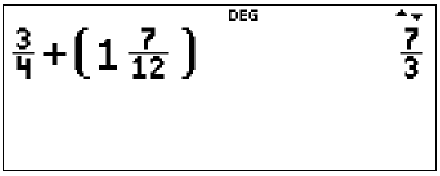
Give your answer as an improper fraction and as a mixed number.

Teacher Note: Students need to be able to convert an improper fraction to a mixed number and vice versa.

Keystrokes and solution:

Enter **3** and press [n/d] **4** [▶] [+] **1** [2nd] [□n/d] **7** [▼] **12** [enter].

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

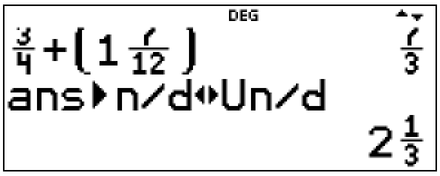


To give the answer as a mixed number:

Press [math] [1] [enter].

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

Note: Parentheses are added automatically.



If decimal numbers are used or calculated in a fraction's numerator or denominator, the result will display as a decimal.

Press [2nd] [f◀▶d] when wanting to convert a fraction to a decimal.

Example: Converting a decimal number to an improper fraction

This example shows how to convert a decimal number to an improper fraction.

Use the TI-30X Plus MathPrint to calculate $\frac{1.2+1.3}{4}$.

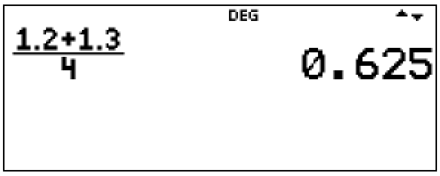
Give your answer as a decimal number and an improper fraction.

Teacher Note: Students need to be able to convert a decimal number to an improper fraction and vice versa.

Keystrokes and solution:

Press [n/d] and enter **1.2** [+] **1.3** [▼] **4** [enter].

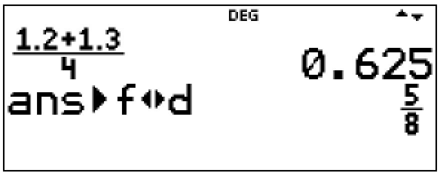
$$\frac{1.2+1.3}{4}=0.625$$



To express the answer as a fraction:

Approach 1:

Press [2nd] [f◂▸d] [enter].



Approach 2:

Press [math] [1] [enter].

$$0.625 = \frac{5}{8}$$

Pressing [▯/▯] before or after numbers or functions are entered may pre-populate the numerator with parts of your expression. Watch the screen as you press keys to ensure your expression is entered exactly as required.

To paste a previous entry from history in the numerator or mixed number unit, place the cursor in the numerator or unit, press ⏶ to scroll to the desired entry and press [enter] to paste the entry to the numerator or unit.

To paste a previous entry from history in the denominator, place the cursor in the denominator, press [2nd] ⏶ to jump into history. Press ⏶ to scroll to the desired entry and press [enter] to paste the entry to the denominator.

1.2 Percentages

To perform a calculation involving a percentage, press [2nd] [%] after entering the value of the percentage.

Example: Calculating the percentage of a quantity

This example shows how to use a calculator to calculate the percentage of a quantity.

Use the TI-30X Plus MathPrint to calculate 7.5% of 150.

Teacher Note: Students need to be able to estimate the magnitude of the resulting quantity. For example, 10% of 150 is 15.

Keystrokes and solution:

Enter **7.5** and press [2nd] [%] [×] **150** [enter].

7.5% of 150 is 11.25

1.3 Scientific notation

A number in scientific notation is made up of the following two parts multiplied together.

A number, a, where $1 \le a < 10$ and a power of 10. Hence numbers of the form a x 10^n where n is an integer.

Press [mode]. **NORMAL SCI ENG** sets the numeric notation mode. In **SCI** mode, numbers are expressed with one digit to the left of the decimal point and the appropriate power of 10.

[EE] is a shortcut key to enter a number in scientific notation format.

Example: Entering numbers in scientific notation format

This example shows how to use a calculator to enter a number in scientific notation format.

Use the TI-30X Plus MathPrint to enter $1.3\text{x}10^{-5}$ as 1.3E-5.

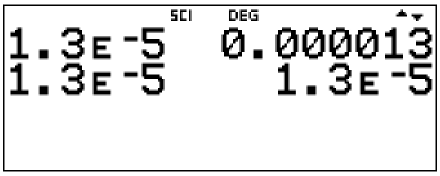
Keystrokes and solution:

Enter **1.3** and press [EE] [(–)] **5** [enter].

$1.3 \times 10^{-5} = 0.000013$

To change to **SCI** mode, press [mode] ⊙ ⊙ [enter].

Press [clear] [enter].



The [e□ 10□] key is a multi-tap key. Pressing [e□ 10□] [e□ 10□] pastes the base 10 to the power function.

Hence another way of entering a number in scientific notation format, is to press [e□ 10□] [e□ 10□]. The result obtained is displayed according to the numeric notation mode setting. Use parentheses to ensure correct order of operation.

Another way of entering a number in scientific notation format, is to enter **10** and press [$x^{\square}$].

Example

This example shows how to use a calculator to find the quotient of two numbers expressed in scientific notation.

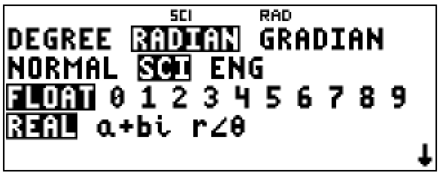
Use the TI-30X Plus MathPrint to calculate $\dfrac{5\times10^{3}}{8\times10^{-2}}$. Give your answer in scientific notation.

Teacher Note: Students need to be able to estimate the size of a quotient (or a product). This is an important skill when monitoring outputs from calculations performed with technology.

Keystrokes and solution:

Three approaches are shown.

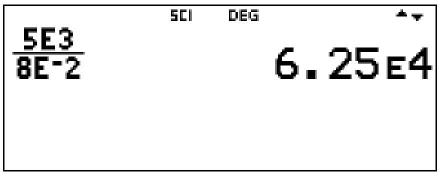
Press [mode], select **SCI** and press [enter].



Approach 1: Using [EE].

Press [fraction] and enter **5** [EE] **3** ⊙ **8** [EE] [(–)] **2** [enter].

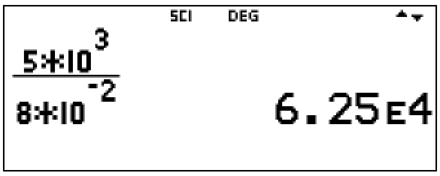
$$\frac{5\times10^{3}}{8\times10^{-2}}=6.25\times10^{4}$$



Approach 2: Using [e□ 10□] [e□ 10□].

Press [fraction] and enter **5** [×] [e□ 10□] [e□ 10□] **3** ⊙ **8** [×] [e□ 10□] [e□ 10□] [(–)] **2** [enter].

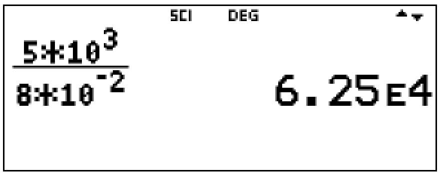
$$\frac{5\times10^{3}}{8\times10^{-2}}=6.25\times10^{4}$$



Approach 3:

Press [□/□] and enter **5** [×] **10** [$x^{\square}$] **3** ⊙ **8** [×] **10** [$x^{\square}$] [(−)] **2** [enter].

$$\frac{5\times10^{3}}{8\times10^{-2}}=6.25\times10^{4}$$



1.4 Powers, roots and reciprocals

Press [x^2] to calculate the square of a value.

Press [$x^{\square}$] to raise a value to the power indicated. Press ⊙ to move the cursor out of the power in MathPrint mode.

Example: Raising a value to a power

This example shows how to use a calculator to raise a value to the power indicated.

Use the TI-30X Plus MathPrint to calculate

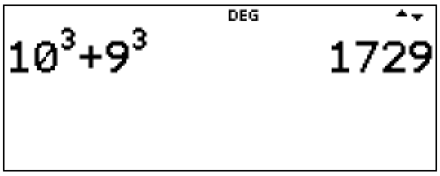
(a) $10^3 + 9^3$. (b) $12^3 + 1^3$.

Teacher Note: The Hardy-Ramanujan Number, 1729, is the smallest number which can be expressed as the sum of two different cubes in two different ways.

Keystrokes and solution:

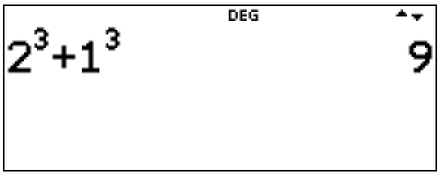
(a) Enter **10** and press [$x^{\square}$] **3** ⊙ [+] **9** [$x^{\square}$] **3** [enter].

$10^3 + 9^3 = 1729$



(b) Press ⊙ ⊙ [enter] to paste **10³ + 9³** onto a new author line, use ⊙ and ⊙ to edit the expression as required and press [enter].

$2^3 + 1^3 = 9$



Press [2nd] [√] to calculate the square root of a non-negative value. [In complex number modes, **a+bi** and **r∠θ** , press [2nd] [√] to calculate the square root of a negative real value.]

Press [2nd] [□√] to calculate the xth root of any non-negative value and any odd integer root of a negative value.

Example: Finding the xth root of a non-negative value

This example shows how to use a calculator to find the xth root of a non-negative value.

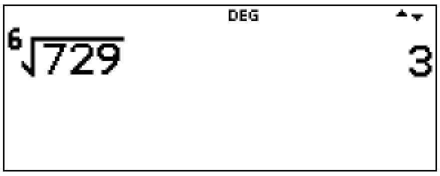
Use the TI-30X Plus MathPrint to calculate $\sqrt[6]{729}$.

Teacher Note: Students should recognise that 3 raised to the power of 6 gives 729.

Keystrokes and solution:

Enter **6** and press [2nd] [$\sqrt[x]{\ }$] **729** [enter].

$\sqrt[6]{729} = 3$



Press [$\frac{1}{\square}$] to calculate the reciprocal of a value.

Example: Finding the reciprocal of a fraction

This example shows how to use a calculator to verify numerically that $\left(\frac{a}{b}\right)^{-1} = \frac{b}{a}$ for $a = 5$ and $b = 7$.

Use the TI-30X Plus MathPrint to calculate the reciprocal of $\frac{5}{7}$. Give your answer as a

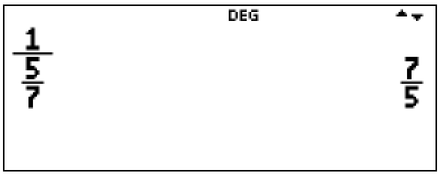
(a) fraction. (b) decimal.

Teacher Note: Students need to recognise that the reciprocal of $\frac{a}{b}$ is $\left(\frac{a}{b}\right)^{-1}$ or $\frac{1}{\frac{a}{b}} = \frac{b}{a}$.

Keystrokes and solution:

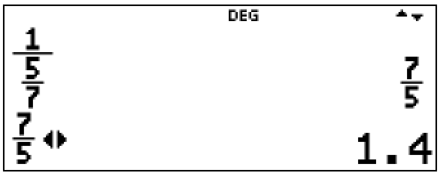
(a) Enter **5** and press [$\frac{\square}{\square}$] **7** and press [▶] [2nd] [$\frac{1}{\square}$] [enter].

$\frac{1}{\frac{5}{7}} = \left(\frac{5}{7}\right)^{-1} = \frac{7}{5}$



(b) Press [◂▸≈] to express as a decimal.

$\left(\frac{5}{7}\right)^{-1} = 1.4$



Alternatively, press [2nd] [f◂▸d] (convert fraction to decimal) [enter].

1.5 Pi (symbol pi)

The TI-30X Plus MathPrint can be used to perform calculations involving π.

To access π, press [$\pi\ \frac{e}{i}$] (a multi-tap key).

Note that $\pi \approx 3.14159265359$ for calculations and $\pi \approx 3.141592654$ for display in **Float** mode.

Example: Area of a circle

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-30X Plus MathPrint to find

(a) the area of a circle whose radius is 8 cm. Give your answer correct to one decimal place.

(b) the radius of a circle whose area is 60 m^2. Give your answer correct to one decimal place.

Teacher Note: When using technology, students need to have a sense of the magnitude of the expected answer. Hence students need to carefully monitor their calculations when using a calculator.

Keystrokes and solution:

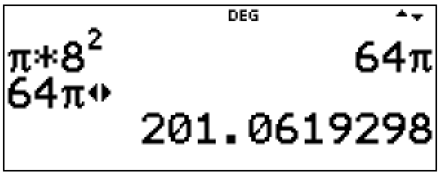
(a) $A = \pi r^2$

Press [π e/i] [×] and enter **8** [x^2] [enter].

$A = 64\pi$ (cm^2)

Press [◂▸≈] to convert to a decimal.

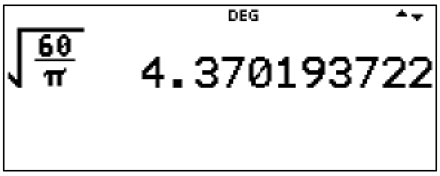
$A = 201.1$ (cm^2) correct to 1 decimal place.



(b) $60 = \pi r^2$ and so $r = \sqrt{\frac{60}{\pi}}$ $(r > 0)$

Press [2nd] [√] [fraction] and enter **60** [▾] [π e/i] [enter].

$r = 4.4$(m) correct to 1 decimal place.



2 Algebra

2.1 Formulae and equations (MS-A1)

We introduce two TI-30X Plus MathPrint™ features, namely, the data editor and list formulas feature and the stored operations feature.

TI-30X Plus MathPrint™ data editor and list formulas feature

Press [data] to access the data editor.

Data can be entered in up to three lists (**L1**, **L2** and **L3**). Each list can contain up to 50 items.

When editing a list, press [data] to access the **CLR**, **FORMULA** and **OPS** menus.

Use [◂] [▸] [▴] [▾] to select a cell in the data editor and then enter a value.

Mode settings affect the display of a cell value. Fractions, radicals and π values will display.

Press:

[sto→] to store the value of the cell to a variable.

[◂▸≈] to toggle the number format when a cell is highlighted.

[delete] to delete a cell.

[enter] [clear] to clear the edit line of a cell.

[2nd] [quit] to return to the home screen.

[2nd] ⏶ to go to the top of a list.

[2nd] ⏷ to go to the bottom of a list.

Use the **CLR** menu to clear the data from a list or lists.

FORMULA menu:

In the data editor, press [data] ⏵ to display the **FORMULA** menu. Select the appropriate menu item to add or edit a list formula in the highlighted column or clear formulas from a particular list.

When a data cell is highlighted, pressing [sto→] is a shortcut to open the formula edit state.

In the formula edit state, pressing [data] displays a menu to paste **L1**, **L2** or **L3** in the formula.

Formulas cannot contain a circular reference such as $\mathbf{L1} = \mathbf{L1}$.

When a list contains a formula, the edit line will display the reversed cell name. Cells will update if referenced lists are updated.

To clear a formula list, clear the formula first and then clear the list.

If [sto→] is used in a list formula, the last element of the computed list is stored to the variable. Lists cannot be stored.

List formulas accept all TI-30X Plus MathPrint™ functions and real numbers.

Options (OPS menu):

In the data editor, press [data] ⏴ to display the **OPS** menu.

This allows you to sort values from smallest to largest or largest to smallest, create a sequence of values to fill a list or sum the elements in a list which can then be stored to a variable for further use.

TI-30X Plus MathPrint™ stored operations feature

Press [2nd] [set op] to store an operation.

Press [2nd] [op] to paste an operation to the home screen.

To set an operation and then recall it:

Press [2nd] [set op].

Enter any combination of numbers, operations, and/or data values.

Press [enter] to store the operation.

Press [2nd] [op] to recall the stored operation and apply it to the last answer or the current entry.

If you apply [2nd] [op] directly to a [2nd] [op] result, a $\mathbf{n} = \mathbf{1}$ iteration counter is incremented.

Students are expected to:

- substitute numerical values into linear algebraic expressions and equations.
- evaluate the subject of a formula, given the value of other pronumerals in the formula.
- change the subject of a formula.
- develop and solve linear equations, including those derived from substituting values into a formula, or those developed from a word description.

Example: Solving a linear equation

The TI-30X Plus MathPrint™ data editor and list formulas feature, and the stored operations feature can both be used to solve problems involving linear expressions and equations. This example could also be solved using the function feature (see page 24) and, of course, the conversions feature (see page 14).

On a particular July day, a weather forecast listed the following predicted maximum temperatures.

Canberra 13°C

Sydney 18°C

Thredbo 2°C

The function $F(C)=\frac{9}{5}C+32$ can be used to convert degrees Celsius to degrees Fahrenheit.

(a) Convert these temperatures from degrees Celsius to degrees Fahrenheit using the TI-30X Plus MathPrint

 (i) data editor and list formulas feature.

 (ii) stored operations feature.

(b) If Katoomba is predicted to have a maximum temperature of 9°C, use the TI-30X Plus MathPrint to convert this temperature to degrees Fahrenheit.

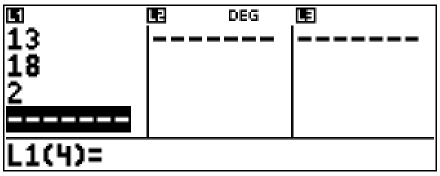
Teacher Note: This example showcases the different ways that the TI-30X Plus MathPrint can be used to solve these types of problems.

Keystrokes and solution:

(a) (i) Using the data editor and list formulas feature:

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

Enter **13** and press ⊙. Repeat for **18** and **2**.

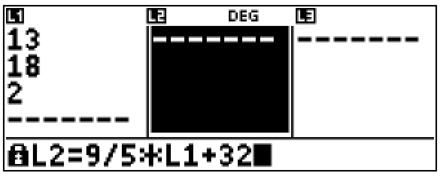


The three temperatures should now be displayed in **L1**.

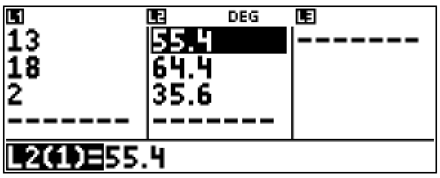
Press ⊙ to scroll across to the top of **L2**. Press [data] ⊙ to select **FORMULA** and press [1]. Enter the temperature conversion formula to **L2**.

Enter $\frac{9}{5}$ using the division key to ensure decimal outputs.

Enter **9** and press [÷] **5** [×]. Press [data] [enter] to paste **L1** into the author line. Press [+] and enter **32** [enter].



L2 should now display the converted temperatures 55.4°F, 64.4 °F and 35.6 °F.



(a) (ii) Using the stored operations feature:

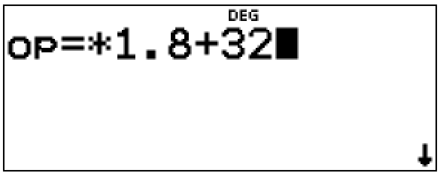
Press [2nd] [set op].

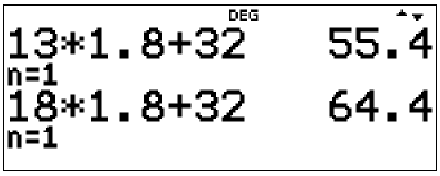
[If required, press [clear] to clear any previously stored operations.]

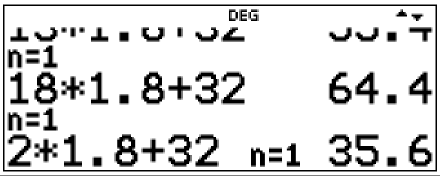
Press [×] and enter **1.8** [+] **32** [enter] **13** [2nd] [op].

Repeat for **18** and **2.**

The three converted temperatures are 55.4°F, 64.4 °F and 35.6 °F.







(b) Using the data editor and list formulas feature:

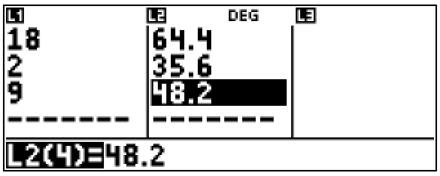
Press [data].

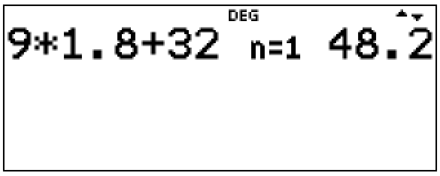
Move to **L1(4)** =, enter **9** and press [enter].

L2 should now display Katoomba's converted temperature of 48.2°F.

Using the stored operations feature:

Press [2nd] [quit]. Enter **9** and press [2nd] [op].





Students are expected to:

- substitute numerical values into non-linear algebraic expressions and equations.
- solve problems involving formulae.

Here we introduce the TI-30X Plus MathPrint™ function feature.

TI-30X Plus MathPrint™ function feature

Press [table] to access the function table.

The function table menu contains the following options:

1: Add/Edit Func

Lets you define a function $f(x)$ or $g(x)$ or both and generates a table of values.

2: f(

Pastes **f(** to an input area such as the home screen to evaluate the function at a point (for example, **f(5)**).

3: g(

Pastes **g(** to an input area such as the home screen to evaluate the function at a point (for example, **g(2)**).

Press ⏷ and ⏶ to move around the function table feature.

To set up a function table:

Press [table] [1] to select **Add/Edit Func**. [Press [clear] if required.]

Enter one or two functions as appropriate and press [enter].

TABLE SETUP contains the options **Start**, **Step**, **Auto**, or $x = ?$.

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

Step: Specifies the step value for the independent variable, x. The step can be positive or negative but cannot be zero. It is set at $\mathbf{1}$.

Auto: Automatically generates a series of values for the dependent variable, y, based on the table start and the table step values.

$x = ?$**:** Lets you build a table manually for the dependent variable, y, by allowing entry of specific values for the independent variable, x.

To display a table, input the desired settings, select **CALC** and press [enter].

In function table view, press [clear] to display and edit the **TABLE SETUP** wizard as needed.

Example: Solving a non-linear equation

This example shows how a calculator can be used to solve a question involving a non-linear equation (quadratic) derived from a likely unfamiliar context.

All people attending a party shook hands with each other as a way of exchanging a greeting. The number of handshakes, N, exchanged between x people at the party is given by $N = \frac{x}{2}(x-1)$ where $x \in \mathbb{Z}^{+}$.

(a) Use the TI-30X Plus MathPrint™ function feature to find the number of handshakes that would be exchanged between 5, 10 and 50 people respectively.

(b) Given that 136 handshakes were exchanged, use the TI-30X Plus MathPrint™ function feature to determine how many people at the party shook hands.

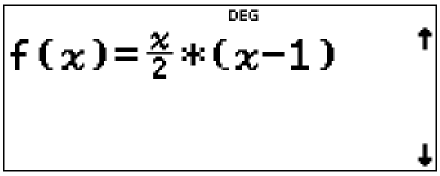
Teacher Note: In part (b), it is important for students to check their answer by substitution.

Keystrokes and solution:

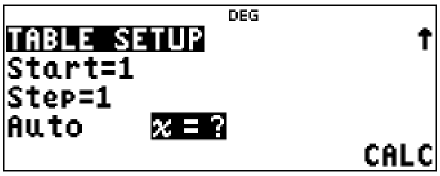
(a) Press [table] [1] to access the function table.

[If required, press [clear].]

Press [x^{yzt}_{abcd}] to paste x and press [fraction] **2** [▶] [×] [(] [x^{yzt}_{abcd}] [−] **1** [)] [▼] [▼].



Move the cursor to select x = ? and press [enter] (**CALC**) [enter].

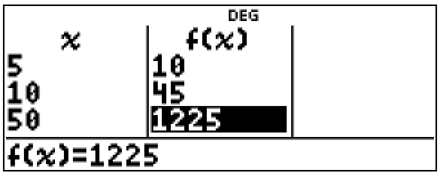


Enter **5** and press [enter] **10** [enter] **50** [enter].

With 5 people, there are 10 handshakes.

With 10 people, there are 45 handshakes.

With 50 people, there are 1225 handshakes.



Alternatively, press [2nd] [quit] to go to the home screen.

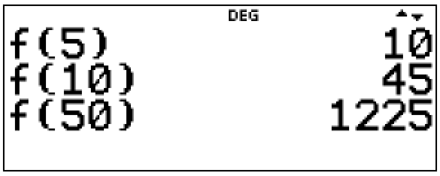
Press [table] [2] and enter **5** [)] [enter].

So f (5) is 10 as before.

Press [▲] [▲] to select **f (5)**. Press [enter].

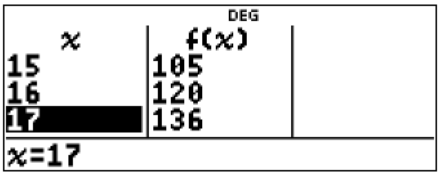
Change **f (5)** to **f (10)** and press [enter].

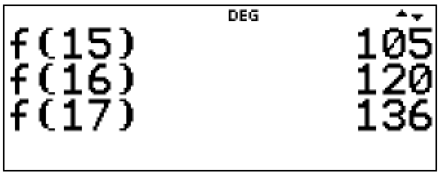
Change **f (10)** to **f (50)** and press [enter]. Thus, confirming our results.



(b) From part (a), we conclude that $x > 10$.

By entering values for x, starting with 15, for example, the last two screenshots show that 17 people exchanged 136 handshakes.





Here we introduce TI-30X Plus MathPrint™ expression evaluation feature.

2.2 TI-30X Plus MathPrint™ expression evaluation feature

Press [2nd] [expr-eval] to input and calculate an expression using numbers, functions and variables/parameters. Pressing [2nd] [expr-eval] from a populated home screen expression pastes the content to **Expr** =.

If variables ***x, y, z, t, a, b, c*** and ***d*** are used in the expression, you will be prompted for values or use the stored values displayed for each prompt. The number stored in the variables will update in TI-30X Plus MathPrint™.

Students are expected calculate stopping distances of vehicles using a suitable formula.

A vehicle's stopping distance is the distance it travels from the time the vehicle's driver sees an event occurring to the time the vehicle is brought to a stop.

The general formula for stopping distance is $d_S = d_R + d_B$, where d_S is the stopping distance, d_R is the reaction distance and d_B is the braking distance. All distances are measured in metres.

Example: Stopping distances

This example shows how to use a calculator to calculate the stopping distance of a vehicle.

Brian was driving at a speed of 110 km/h when he needed to apply the brakes and come to a stop.

His reaction time, t, is known to be 1.5 seconds.

The stopping distance, d_S metres, can be modelled by the formula $d_S = \frac{5vt}{18} + \frac{v^2}{150}$.

Use the formula for d_S and the TI-30X Plus MathPrint™ expression evaluation feature to find Brian's stopping distance, d_S. Give your answer correct to the nearest metre.

Teacher Note: When using the TI-30X Plus MathPrint™ expression evaluation feature, it is important for students to be clear that x is not representing a distance. In this context, it is representing the speed, v.

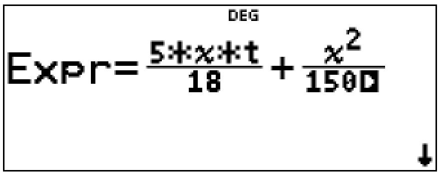
Keystrokes and solution:

$$d_S = \frac{5vt}{18} + \frac{v^2}{150}$$

As the TI-30X Plus MathPrint™ expression evaluation feature does not house the variable v, we will use the variable x instead.

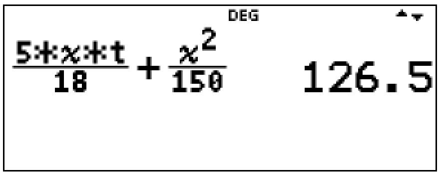
$$d_S = \frac{5xt}{18} + \frac{x^2}{150}$$

Press [2nd] [expr-eval]. [If required, press [clear].]

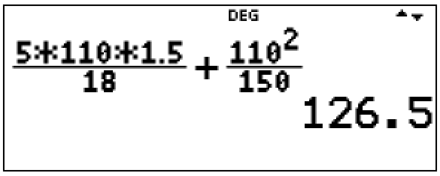


[x yzt abcd] is a multi-tap key that cycles through the variables ***x, y, z, t, a, b, c*** and ***d***.

Press [▭/▭] and enter **5** [×] and press [x yzt abcd] to paste ***x***. Press [×] and continue to press [x yzt abcd] until ***t*** appears.



Press [⏷] and enter **18** [⏵] [+] [▭/▭] [x yzt abcd] [x²] [⏷] **150** [⏵] [enter] [clear] **110** [enter] [clear] **1.5** [enter].



Substituting $x = 110$ and $t = 1.5$ into $d_S = \frac{5xt}{18} + \frac{x^2}{150}$ gives $d_S = 126.5$.

Brian's stopping distance, d_S, is 127 metres, correct to the nearest metre.

Alternatively, Brian's stopping distance can be calculated as shown at right.

Students are expected to:

- calculate and interpret blood alcohol content (BAC) based on drink consumption and body weight.
- determine the number of hours required for a person to stop consuming alcohol in order to reach zero BAC.

Blood alcohol content (BAC) is a measure of the amount of alcohol in your blood. The measurement is the number of grams of alcohol in 100 millilitres (mL) of blood.

For example, a BAC of 0.07 means 0.07 grams or 70 mg of alcohol in every 100 mL of blood.

A person's BAC is influenced by the number of standard drinks consumed in a given amount of time and the person's body weight.

Example: Blood alcohol content (BAC) (1)

This example shows how to use a calculator to calculate a person's blood alcohol content (BAC) based on their drink consumption and body weight.

A male's BAC can be estimated using the formula $BAC = \dfrac{10N - 7.5H}{6.8M}$ where N is the number of standard drinks consumed, H is the number of hours drinking and M is the body weight in kilograms.

Peter is 92 kg and has consumed nine standard drinks in three hours.

Use the BAC formula and the TI-30X Plus MathPrint™ expression evaluation feature to estimate Peter's BAC three hours after he started drinking. Give your answer correct to two decimal places.

Teacher Note: It is a good idea to discuss with students some of the limitations in estimating a person's BAC. A person's BAC is measured with a breathalyser or by analysing a blood sample. Factors such as gender, fitness and liver function can affect a person's BAC. It is also worth highlighting the various blood alcohol limits applied to drivers in NSW.

Keystrokes and solution:

$$BAC = \frac{10N - 7.5H}{6.8M}$$

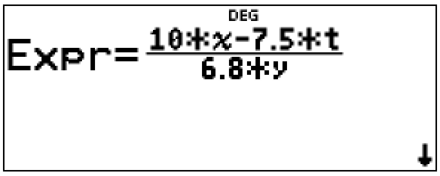
As the TI-30X Plus MathPrint™ expression evaluation feature does not house the variables N, H and M, we will use the variables x, t and y respectively instead.

$$BAC = \frac{10x - 7.5t}{6.8y}$$

Press [2nd] [expr-eval]. [If required, press [clear].]

[x yzt abcd] is a multi-tap key that cycles through the variables ***x, y, z, t, a, b, c*** and ***d***.

Press [fraction] and enter **10** [×] and press [x yzt abcd] to paste ***x***. Press [−] and enter **7.5** [×] and continue to press [x yzt abcd] until ***t*** appears.



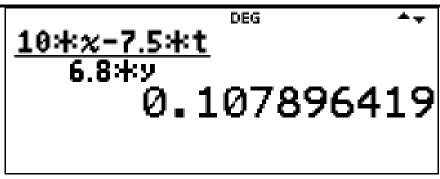
Press [⌄] and enter **6.8** [×] and press [x yzt abcd] twice to paste ***y***.

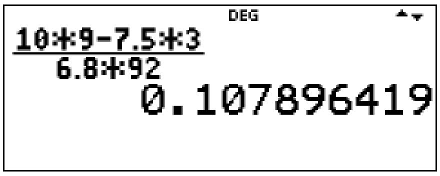
Press ⏵ ⏵ [enter] [clear] **9** [enter] [clear] **3** [enter] [clear] **92** [enter].

Substituting $x = 9$, $t = 3$ and $y = 92$ into $BAC = \dfrac{10x - 7.5t}{6.8y}$ gives $BAC = 0.107896$.

Peter's BAC is estimated to be 0.11, correct to two decimal places.

Alternatively, calculate the estimated BAC as shown at right.





Example: Blood alcohol content (BAC) (2)

This example shows how to use a calculator to determine the number of hours required for a person to stop consuming alcohol in order to reach zero BAC.

The number of hours a person should wait before driving can be estimated from the formula $t = \dfrac{BAC}{0.015}$ where t is the time in hours.

Tahlia's BAC is 0.140 and Toby's BAC is 0.091. The legal BAC limit for both drivers is 0.05.

Use the formula $t = \dfrac{BAC}{0.015}$ and the TI-30X Plus MathPrint™ stored operations feature to calculate the number of hours each should wait before they can drive. Give your answers correct to the nearest hour.

Teacher Note: Knowledge of this formula is very useful when making informed decisions as to when to drive after consuming alcohol.

Keystrokes and solution:

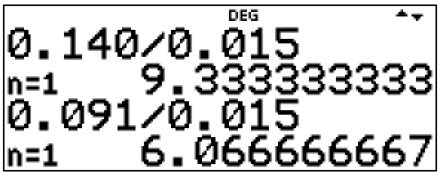
Using the stored operations feature:

Press [2nd] [set op]. [If required, press [clear] to clear any previously stored operations.]

Press [÷] and enter 0.015 [enter].

Enter **0.140** and press [2nd] [op] **0.091** [2nd] [op].

To the nearest hour, Tahlia should wait 10 hours before driving and Toby should wait 7 hours before driving.



2.3 Linear relationships (MS-A2)

Students are expected to:

- model, analyse and solve problems involving linear relationships.
- review the linear function $y = mx + c$ and understand the geometrical significance of m and c.
- construct and analyse a linear model, graphically or algebraically, to solve practical problems.

The TI-30X Plus MathPrint™ can be used to model, analyse and solve problems involving linear relationships.

Example: Linear relationships (1)

This example shows how to use a calculator to solve a problem involving a linear relationship.

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 L 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 an expression for L, in terms of x. Give your answer in the form $L = mx + c$.

(b) Interpret, in context, the value of m and the value of c found in part (a).

(c) Use the TI-30X Plus MathPrint™ function feature 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 to formulate a linear relationship from worded information. It is also important that students understand the meaning, in context, of m and c in the linear function $y = mx + c$.

Keystrokes and solution:

(a) $L = 54 - 6x$

(b) $m = -6$ represents 6 litres of fuel being used per 100 km.

$c = 54$ represents the initial amount of fuel in the car's petrol tank.

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

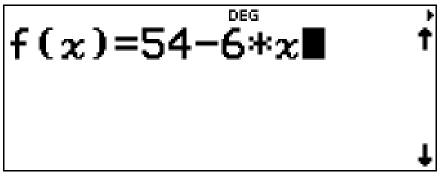
Press [table] [1] to access the function table.
[If required, press [clear].]

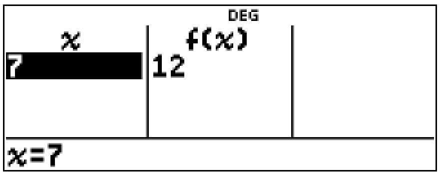
Enter **54** and press [−] **6** and press [×] [x^{yzt}_{abcd}] [▼] [▼].

Move the cursor to select $x = ?$,press [enter] (**CALC**) [enter].

Enter 7 and press [enter].

When $x = 7$, $L = 12$ and so Daisy had 12 litres in her petrol tank when she arrived at her friend's house.





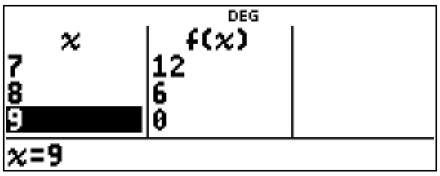
(c) (ii) Enter guess(es) for the value of x and press [enter].

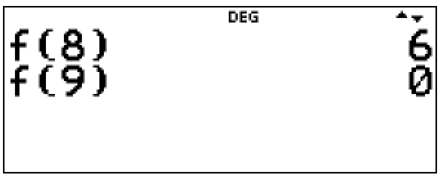
When $x = 8$, $L = 6$ and when $x = 9$, $L = 0$.

Alternatively, press [2nd] [quit] to go to the home screen.

Press [table] [2] and enter guess(es) for the value of x.

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





Students are expected to:

- recognise that a direct variation relationship produces a straight-line graph.
- determine a direct variation relationship from a written description, a straight-line graph or a linear function in the form $y = mx$.
- recognise the gradient of a direct variation graph as the constant of variation.

A variable y varies directly with a variable x if $y = mx$, where m is a non-zero constant of proportionality. The graph of $y = mx$ is a linear function that passes through the origin with a gradient m.

Example: Direct variation

This example shows how to use a calculator to help solve a problem involving direct variation.

A district nurse who often travels by car delivering medical supplies receives a travelling allowance. This travelling allowance, A dollars, varies directly with the number of kilometres, n, travelled in a week. During a particular week, the district nurse travelled 60 kilometres and received an allowance of $\$15$. The following week, the district nurse travelled a distance of 400 kilometres. Find the district nurse's travelling allowance for that week.

Teacher Note: This example illustrates how, given the constant of proportionality, to establish an equation which can be used to determine the value of an unknown quantity. When solving direct variation problems, it is important to link the given equation with a corresponding table of values or a corresponding graph.

Keystrokes and solution:

$A \propto n$ and so $A = kn$ where k is the constant of proportionality.

Substitute $n = 60$ and $A = 15$ into $A = kn$ and solve to find k.

$15 = 60k$

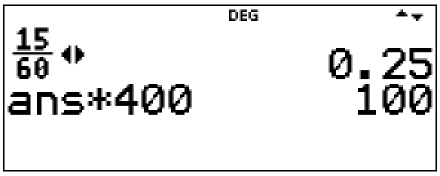
$k = 0.25$

Enter **15** and press [fraction] **60** [▶] [◂▸≈] [enter].

$k = 0.25$ and hence $A = 0.25n$.

Substitute $n = 400$ into $A = 0.25n$.

Press [2nd] [answer] [×] and enter **400** [enter].



$A = 0.25 \times 400$

$= 100$

The district nurse's travelling allowance for that week was $\$100$.

2.4 Types of relationships (MS-A4)

2.4.1 Simultaneous linear equations

Students are expected to:

- solve a pair of simultaneous linear equations by finding the point of intersection between two straight-line graphs.
- develop a pair of simultaneous linear equations to model a practical situation.
- solve practical problems that involve determining and interpreting the break-even point of a simple business problem where cost and revenue are represented by linear equations.

Example: Simultaneous linear equations

This example shows how to use a calculator to solve a practical problem that involves determining and interpreting the break-even point of a simple business problem where cost and revenue are represented by linear equations. This example could also be solved using the TI-30X Plus MathPrint™ function feature.

A company that manufactures and sells paper straws has fixed costs of $\$400$ per week.

It costs the company $\$2.50$ to make a carton of 500 straws.

The company sells a carton for $\$5.00$.

(a) If $\$C$ is the cost of producing S cartons of straws per week, express C in terms of S.

(b) If $\$I$ is the income received for selling S cartons of straws per week, express I in terms of S.

(c) Use the TI-30X Plus MathPrint™ data editor and list formulas feature to find the break-even point.

Teacher Note: Encourage students to sketch the two graphs on the same set of axes to determine the approximate location of the point of intersection. This helps to construct a table of values that contains the solution to the two equations. Students should relate the solution found to the intersection point of the two graphs and to the context of the problem being solved.

Keystrokes and solution:

(a) $C = 2.5S + 400$

(b) $I = 5S$

(c) Press [data]. Press [data] [4] to clear all lists.

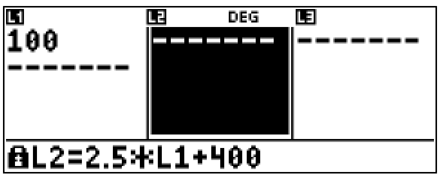
In **L1**, enter **100** as an initial guess and press [down].

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

Press [data] [right] to select **FORMULA** and press [enter].

Enter the list formula **2.5 * L1 + 400** to **L2**.

Enter **2.5** and press [×]. Press [data] [enter] to paste **L1** into the author line. Press [+] and enter **400** [enter].



650 should now be displayed in **L2**.

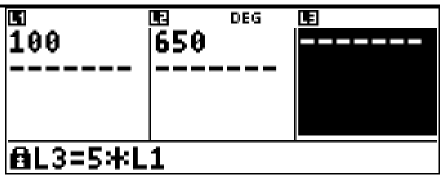
Press [right] to scroll across to the top of **L3**.

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

Enter the list formula **5 * L1** to **L3**.

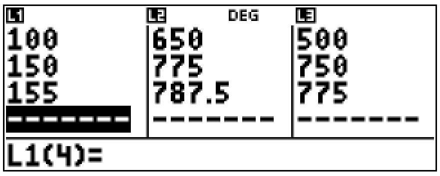
Enter **5** and press [×] [data] [enter] [enter].

500 should now be displayed in **L3**.



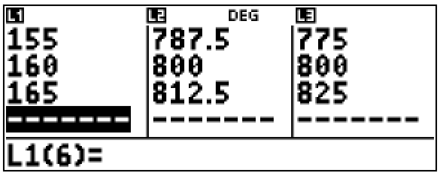
Move to **L1(2) =** and enter an appropriate guess for the S-value, for example, **150**. Press [enter].

Continue to enter S-values that (hopefully) approach the required solution.



After each S-value is entered, press [enter].

The two screenshots at right show a set of S-values used to determine the solution.



$S = 160$, $C = I = 800$, which is the break-even point.

2.4.2 Non-linear relationships

Students are expected to graph and recognise an exponential function in the form $y = a^x$ and $y = a^{-x}$ where y $a > 0$.

Example: Exponential models (1)

This example shows how to use a calculator to construct a table of values which can be used to help sketch the graph of a function of the form $y = a^x$.

Consider the function $y = 3^x$.

Use the TI-30X Plus MathPrint™ data editor and list formulas to complete the following table of values for $y = 3^x$.

x	–3	–2	–1	0	1	2	3
y							

Teacher Note: Students should recognise that the graph of $y = a^x$ always passes through the point $(0, 1)$ i.e. when $x = 0$, $y = a^0 = 1$. They should also recognise that the x-axis is an asymptote.

Keystrokes and solution:

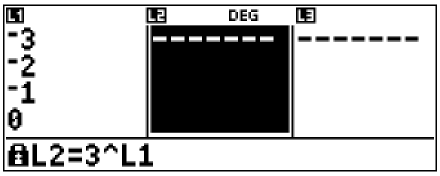
Press [data]. Press [data] [4] to clear all lists.

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

In **L1** enter **–3** and press ▼. Enter the values **–2, –1, 0, 1, 2,** and **3**.

These seven x-values should now be displayed in **L1**.

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

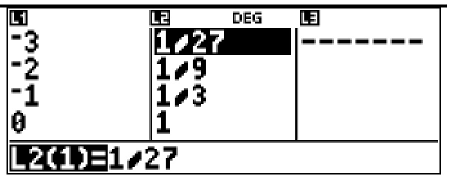


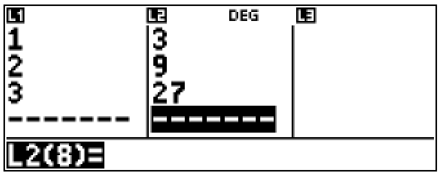
Press [data] ⊳ to select **FORMULA** and press [enter].

Enter the list formula **3 ^ L1** to **L2**.

Enter **3** and press [$x^{\square}$]. Press [data] [enter] to paste **L1** into the author line. Press [enter].

L2 should now display the function values $\frac{1}{27}, \frac{1}{9}, \frac{1}{3}, 1, 3, 9, 27$ and the table can be completed.





Students are expected to use an exponential (growth or decay) model to solve problems.

Example: Exponential models (2)

The number of flies, N, in a population at time, t days where $t \geq 0$, can be modelled by $N = 40\,(1.2)^t$.

Use the TI-30X Plus MathPrint™ to find, correct to the nearest whole number, the number of flies in the population after 3 days.

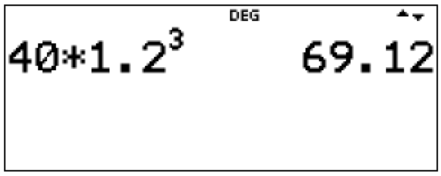
Teacher Note: The growth factor of 1.2 means that there are 1.2 times as many flies after each day passes. This is the same as saying that after each day there are 20% more flies (the population of flies grows at the rate of 20% per day).

Keystrokes and solution:

Substitute $t = 3$ into N.

Enter **40** and press [×] **1.2** [$x^{\square}$] **3** [enter].

$N = 69.12$ and so the number of flies after 3 days is 69, correct to the nearest whole number.



Students are expected to solve practical problems involving quadratic functions.

They are also expected to interpret the turning point of a quadratic in a practical context and consider the range of values for x and y for which the quadratic model makes sense in a practical context.

Example: Quadratic model

This example shows how to use a calculator to solve a practical problem involving a quadratic function.

A farmer has 500 metres of fencing with which to enclose a rectangular paddock.

Use the TI-30X Plus MathPrint™ function feature to find the maximum area that can be enclosed.

Teacher Note: The TI-30X Plus MathPrint™ data editor and list formulas feature can also be used here.

Keystrokes and solution:

Let xm be the length of the paddock, ym be the width of the paddock and Am^2 be the area of the paddock.

From the perimeter:

$$2x + 2y = 500$$

$$2y = 500 - 2x$$

$$y = 250 - x$$

$$A = x\,(250 - x)$$

As x is the length of the paddock, $x > 0$.

Also $250 - x > 0$ so $x < 250$.

The quadratic is valid for $0 < x < 250$.

Press [table] [1] to access the function table. [If required, press [clear].]

Press [x^{yzt}_{abcd}] to paste x.

Press [×] [(] and enter **250** [−] [x^{yzt}_{abcd}] [)] ⊙ ⊙.

Move the cursor to select x = **?** and press [enter] **(CALC)** [enter].

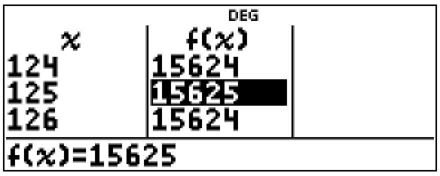
As we have a quadratic function in factorised form, the maximum value of A will occur when $x = 125$ (midpoint of 0 and 250).

When $x = 125$, $A = 125\,(250 - 125)$.

Enter **124** and press [enter] **125** [enter] **126** [enter].

The maximum area is 15625m^2 and the rectangle that gives this area has dimensions 125m by 125m.

Thus, the rectangle is a square.



Students are expected to recognise that $y = \dfrac{k}{x}$, where k is a constant, represents inverse variation.

A variable y varies inversely with a variable x if $y = \dfrac{k}{x}$, where k is a non-zero constant of proportionality.

The graph of y as a function of x is a rectangular hyperbola whose asymptotes are the x-axis and the y-axis.

Example: Inverse variation

This example shows how to use a calculator to help solve a problem involving inverse variation.

In electrical circuits, Ohm's law states that, for a given voltage, the current, I amperes, in an electrical component is inversely proportional to its resistance, R ohms.

An electrical component has a resistance of 2.4 ohms and passes a current of 5 amperes when connected to a battery.

If the same battery is used, use the TI-30X Plus MathPrint™ to find the current passing through an electrical component whose resistance is 1.5 ohms.

Teacher Note: It is important for students to recognise that if R increases then I decreases and if R decreases then I increases.

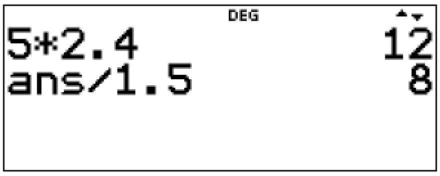
Keystrokes and solution:

$I \propto \dfrac{1}{R}$ and so $I = \dfrac{k}{R}$ where k is the constant of proportionality.

Substitute $R = 2.4$ and $I = 5$ into $I = \dfrac{k}{R}$ and solve to find k.

$$5 = \frac{k}{2.4}$$
$$k = 5 \times 2.4$$

Enter **5** and press [×] **2.4** and press [enter].



$k = 12$ and hence $I = \dfrac{12}{R}$.

Substitute $R = 1.5$ into $I = \dfrac{12}{R}$.

Press [2nd] [answer] [÷] and enter **1.5** [enter].

$$I = \frac{12}{1.5}$$
$$= 8$$

The current passing through the electrical component is 8 amperes.

---

3 Measurement

3.1 Applications of measurement (MS-M1)

3.1.1 Practicalities of measurement

Students are expected to calculate conversions between common units of measurement, for example kilometres to metres or litres to millilitres.

Example: Length conversion

This example shows how to use a calculator to perform a unit conversion.

Use the TI-30X Plus MathPrint™ stored operations feature to convert 4850 metres to kilometres.

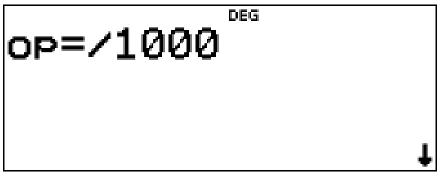
Teacher Note: Students should know that converting metres to kilometres involves dividing by 1000. The operation is division when converting from a smaller unit to a larger unit.

Keystrokes and solution:

Press [2nd] [set op]. [If required, press [clear] to clear any previously stored operations.]

Press [÷] and enter **1000** [enter] **4850** and press [2nd] [op].

4850 metres is 4.85 kilometres



Students are expected to calculate the percentage error of a reported measurement using:

$$\text{Percentage error} = \frac{\text{Absolute error}}{\text{Measurement}} \times 100\%$$

Example: Percentage error

This example shows how to use a calculator to calculate a percentage error.

It is known that the height of a tower is exactly 42 metres. Anne measured the height of the tower to 42.3 metres.

Use the TI-30X Plus MathPrint™ to calculate the percentage error of Anne's measurement. Give your answer correct to three decimal places.

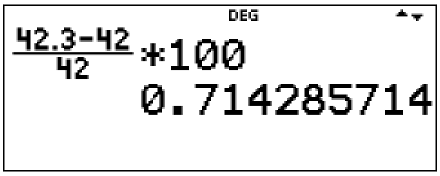
Teacher Note: Students should recognise that the relative error indicates how accurate a measurement is relative to the magnitude of the quantity being measured. The relative error is often expressed as a percentage error.

Keystrokes and solution:

Percentage error is $\frac{42.3-42}{42} \times 100\%$.

Press [fraction] and enter **42.3** [−] **42** [▼] **42** [▶] [×] **100** [enter].

The percentage error is 0.714%, correct to three decimal places.



3.1.2 Perimeter, area and volume

Students are expected to solve practical problems involving the calculation of perimeters and areas of various shapes including composite shapes.

Example: Area of an annulus

This example shows how to use a calculator to solve a problem involving an annulus.

The area, Am², of a circular path of outer radius Rm and inner radius rm is given by $A = \pi R^2 - \pi r^2$.

A particular circular path has an outer radius of 76 m and an inner radius of 60m.

Use the TI-30X Plus MathPrint™ expression evaluation feature to find the area of the circular path, giving your answer correct to one decimal place.

Teacher Note: A good activity would be to withhold the formula for the area of an annulus and ask students to derive it. An alternative form for the formula is $A = \pi\,(R^2 - r^2)$.

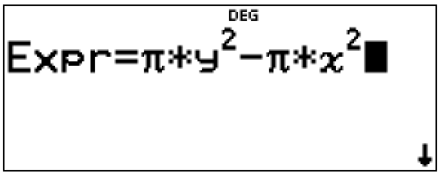
Keystrokes and solution:

$A = \pi R^2 - \pi r^2$

As the TI-30X Plus MathPrint™ expression evaluation feature does not house the variables R and r, we will use the variables y and x instead.

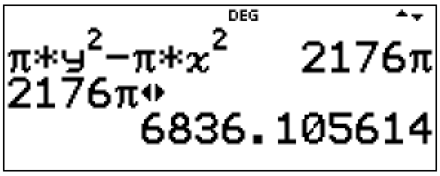
$A = \pi y^2 - \pi x^2$

Press [2nd] [expr-eval]. [If required, press [clear].]



[x^{yzt}_{abcd}] is a multi-tap key that cycles through the variables ***x***, ***y***, ***z***, ***t***, ***a***, ***b***, ***c*** and ***d***.

Press [π e i] [×] [x^{yzt}_{abcd}] [x^{yzt}_{abcd}] to paste ***y***. Press [x²] [−] [π e i] [×] [x^{yzt}_{abcd}] [x²].

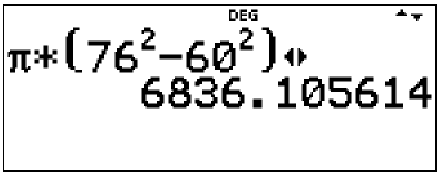


Press [enter] [clear] and enter **76** [enter] [clear] **60** [enter] [◂▸≈].

Substituting $y = 76$ and $x = 60$ into $A = \pi y^2 - \pi x^2$ gives $A = 6836.105...$(m2).

The area of the circular path is 6836m², correct to one decimal place.

Alternatively, the area of the circular path can be calculated as shown at right.



Students are expected to use:

- Pythagoras' theorem to solve problems involving right-angled triangles.
- a scale factor to find unknown lengths in similar figures.

Example: Pythagoras' theorem and a scale factor

This example shows how to use a calculator to solve a problem involving use of Pythagoras' theorem and a scale factor.

An 8 m ladder leans against a wall.

The foot of the ladder is 6.4 m from the base of the wall on level ground.

(a) How far up the wall is the ladder?

A person is one quarter of the way up the ladder.

(b) (i) How far above the ground is the person?

(ii) How far away from the wall is the person?

Teacher Note: It is important to stress to students the need to draw a labelled diagram(s) when attempting to solve such problems.

Keystrokes and solution:

(a) Let hm be the distance up the wall of the ladder.

Using Pythagoras' theorem:

$$8^2 = 6.4^2 + h^2$$

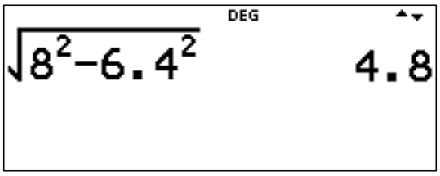
$$h^2 = 8^2 - 6.4^2$$

$$h = \sqrt{8^2 - 6.4^2} \quad (h > 0)$$

Press [2nd] [√] and enter **8** [x²] [−] **6.4** [x²] [enter].

$h = 4.8$

The ladder is 4.8m up the wall.



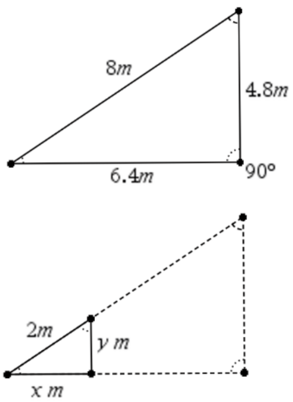
(b) (i) The triangles are similar (all corresponding angles equal).

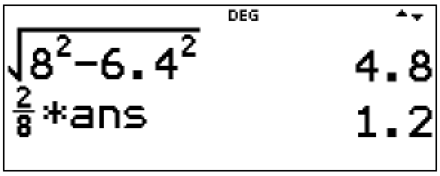
$$\frac{y}{4.8} = \frac{2}{8}$$

$$y = \frac{2}{8} \times 4.8$$

Enter **2** and press [n/d] **8** [▶] [×] [2nd] [answer] [enter].

$y = 1.2$. The person is 1.2m above the ground.

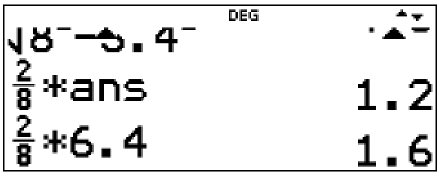




(b) (ii)

$$\frac{x}{6.4} = \frac{2}{8}$$

$$x = \frac{2}{8} \times 6.4$$



Edit the previous author line.

Press [▲] [▲] [enter] [◄] and enter **6.4** [enter].

$x = 1.6$

The distance from the person to the wall is:

$(6.4 – 1.6) = 4.8$(m)

Students are expected to solve practical problems involving the calculation of surface area of solids.

Example: Surface area of a cylinder

This example shows how to use a calculator to calculate the surface area of a cylinder.

The total surface area, S cm², of a cylinder with radius r cm and height h cm is given by $S = 2\pi r^2 + 2\pi rh$.

Use the TI-30X Plus MathPrint™ expression evaluation feature to find the surface area of a cylinder whose base radius is 4 cm and height is 6 cm.

Give your answer correct to one decimal place.

Teacher Note: An alternative form for the formula is $S = 2\pi r\,(r + h)$.

Keystrokes and solution:

$S = 2\pi r^2 + 2\pi rh$

As the TI-30X Plus MathPrint™ expression evaluation feature does not house the variables r and h, we will use the variables x and y instead.

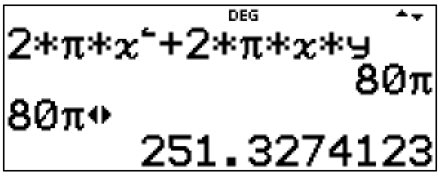
$S = 2\pi x^2 + 2\pi xy$

Press [2nd] [expr-eval]. [If required, press [clear].]

[x yzt abcd] is a multi-tap key that cycles through the variables ***x***, ***y***, ***z***, ***t***, ***a***, ***b***, ***c*** and ***d***.

Enter **2** and press [×] [π] [×]. Press [x yzt abcd] to paste ***x***.

Press [x²] [+] and enter **2** [×] [π] [×] [x yzt abcd] [×] and press [x yzt abcd] [x yzt abcd] to paste ***y***.

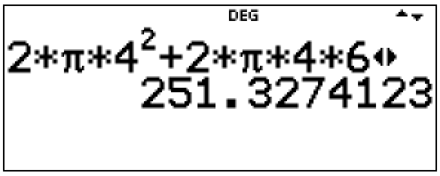


Press [enter] [clear] and enter **4** [enter] [clear] **6** [enter] [◂▸≈].

Substituting $x = 4$ and $y = 6$ into $S = 2\pi x^2 + 2\pi xy$ gives $A = 251.327...$ (cm²).

The surface area of the cylinder is 251.3 cm², correct to one decimal place.

Alternatively, the surface area of the cylinder can be calculated as shown at right.



Example: Surface area of a prism (problem solving)

This example requires the use of a calculator and problem-solving strategies to determine integer side lengths of a rectangular prism.

The surface area, S m², of a rectangular box with a lid has length l m, width w m and height h m is given by $S = 2\,(lw + hl + hw)$.

Given that $l < w < h$, determine the dimensions of a rectangular box of integer length, width and height measurements with a surface area between 120 m² and 130 m².

Teacher Note: This example is different to a standard textbook problem involving surface areas and dimensions of prisms. Students can use the TI-30X Plus MathPrint™ to undertake a systematic search for possible integer solutions.

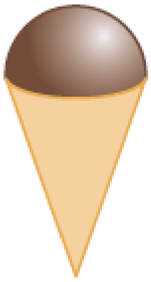
Answer: $l = 3$, $w = 5$ and $h = 6$

Students are expected to solve practical problems involving the calculation of volume and capacity of solids.

Example: Volume of a composite solid

This example shows how to use a calculator to find the volume of a composite solid.

An ice-cream cone is completely filled with ice-cream and is topped with a hemispherical scoop as shown.



The cone has a height of 12 cm and the diameter at the top of the cone is 5 cm.

Use the TI-30X Plus MathPrint™ expression evaluation feature to calculate the total volume of ice-cream, giving your answer correct to the nearest cubic centimetre.

Teacher Note: Students need be able to determine the solids that make up a composite solid and calculate the volume of each. In this instance, adding the two volumes together.

Keystrokes and solution:

$$V = \frac{1}{3}\pi r^2 h + \frac{2}{3}\pi r^3$$

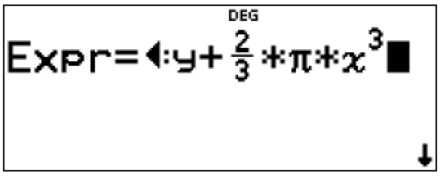
As the TI-30X Plus MathPrint™ expression evaluation feature does not house the variables r and h, we will use the variables x and y instead.

Let V_C be the volume of the cone and let V_H be the volume of the hemisphere.

The total volume, V, is given by $V = V_C + V_H$.

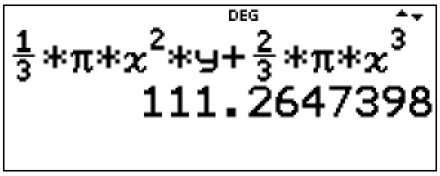
$$V = \frac{1}{3}\pi x^2 y + \frac{2}{3}\pi x^3$$

Press [2nd] [expr-eval]. [If required, press [clear].]



[x yzt abcd] is a multi-tap key that cycles through the variables ***x*, *y*, *z*, *t*, *a*, *b*, *c*** and ***d***.

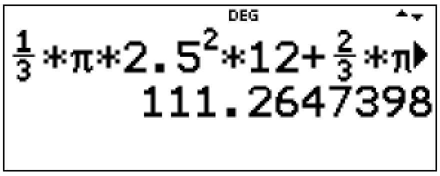
Enter **1** and press [n/d] **3** and press [▶] [×] [π e i] [×] and press [x yzt abcd] to paste ***x***. Press [x²] [×] and press [x yzt abcd] [x yzt abcd] to paste ***y***.



Press [+] and enter **2** [n/d] **3** [▶] [×] [π e i] [×] [x yzt abcd] [x□] **3** [▶].

If the diameter is 5 cm, then the radius is 2.5 cm.

Press [enter] [clear] and enter **2.5** [enter] [clear] **12** [enter].



Substituting $x = 2.5$ and $y = 12$ into $V = \frac{1}{3}\pi x^2 y + \frac{2}{3}\pi x^3$

gives $V = 111.264\ldots$ (cm³).

Correct to the nearest cubic centimetre, the total volume of ice-cream 111 cm³.

Alternatively, the surface area of the cylinder can be calculated as shown at right.

Students are expected to use the trapezoidal rule to solve a variety of practical problems.

$A = \frac{h}{2}\left(d_f + d_l\right)$ where h is the height or distance between the parallel sides and d_f and d_l are the distances of the first and last parallel sides.

Example: Using the trapezoidal rule to find an approximate area

This example shows how to use a calculator to help determine an approximate area with the trapezoidal rule.

The areas enclosed by contours in a lake are as follows:

Contour (m)	150	155	160	165	170
Area (m^2)	1550	7900	15800	24100	31000

Use the trapezoidal rule and the TI-30X Plus MathPrint™ to find an approximate volume of water in the lake between the contours 150 m and 170 m.

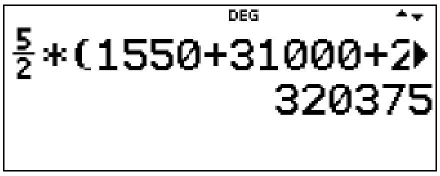
Teacher Note: Where possible, it is a good idea to explore the effect of increasing the number of trapezia used in an approximation.

Keystrokes and solution:

Let V be the volume.

$$V = \frac{5}{2}(1550 + 31000 + 2(7900 + 15800 + 24100))$$

Enter **5** and press [n/d] **2** [►] [×] [(] **1550** [+] **31000** [+] **2** [×] [(] **7900** [+] **15800** [+] **24100** [)] [)] [enter].



$V = 320375$ (m^3)

The approximate volume of water in the lake is 320375 m^3.

3.1.3 Units of energy and mass

Students are expected to use metric units of energy to solve problems, including calories, kilocalories, joules and kilojoules, their abbreviations and how to convert between them.

The common unit for food energy is the kilojoule (kJ). A kilojoule is an SI unit and is 1000 joules. The previous unit used was the calorie (Cal). 1 calorie is 4.184 kilojoules.

Example: Food energy unit conversions

This example shows how to use a calculator to perform food energy unit conversions.

Use the TI-30X Plus MathPrint™ conversions feature to convert

(a) 1060 calories to kilojoules.

(b) 284 kilojoules to calories.

Give each answer correct to the nearest whole number.

Teacher Note: Two definitions, a large calorie and a small calorie, are in wide use. In nutrition and food science, the term calorie almost always refers to the large calorie. It is used in food labels to express the energy value of foods in per serving or per mass. Give students opportunities to compare, contrast, interrogate and understand nutrition information displayed on food labels.

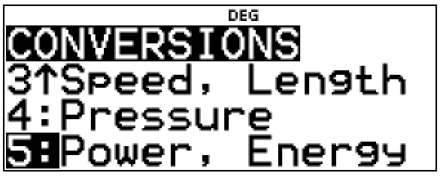
Keystrokes and solution:

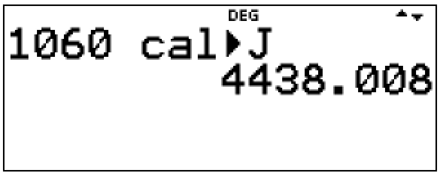
(a) Enter **1060** and press [2nd] [convert].

Press [5] to select **Power, Energy**. Select **cal ► J** and press [enter] [enter].

1060 calories converts to 4438 kilojoules (correct to the nearest whole number).

Note: This conversion can be made by multiplying by 4.184.



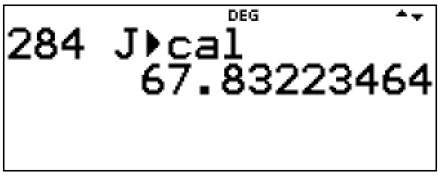


(b) Enter **284** and press [2nd] [convert].

Press [5] to select **Power, Energy**. Select **J ► cal** and press [enter] [enter].

284 kilojoules converts to 68 calories (correct to the nearest whole number).

Note: This conversion can be made by dividing by 4.184.



Students are expected to use units of energy to solve problems involving electricity consumption, for example kilowatt-hours (kWh), and investigate the energy consumption of common electrical appliances.

The kilowatt-hour (kWh) is a unit of energy equal to one kilowatt (1000 W) of power sustained for one hour and is commonly used to measure the electricity consumption of an electrical appliance.

Example: Calculating the cost of using an electrical appliance

This example shows how to use a calculator to calculate the cost of using an electrical appliance. A power provider charges $\$0.20$ per kWh for electricity.

Use the TI-30X Plus MathPrint™ to calculate the cost of running a 30 W LED light bulb for a week, giving your answer correct to the nearest cent.

Teacher Note: Give students opportunities to compare, contrast, interrogate and understand information displayed on electricity bills and on energy rating labels for electrical appliances. These labels display the amount of electricity (kWh) the appliance typically uses in a year.

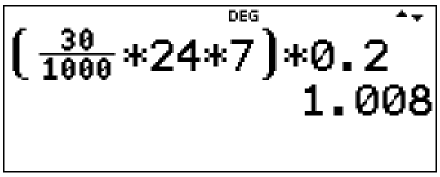
Keystrokes and solution:

The electricity consumed in kWh in a week is $\frac{30}{1000} \times 24 \times 7$.

The cost in a week is $\left(\frac{30}{1000} \times 24 \times 7\right) \times 0.2$.

Press [(] and enter **30** [fraction] and enter **1000** [▶] [×] **24** [×] **7** [)] [×] and enter **0.2** [enter].

The cost in a week is $\$1.01$ (correct to the nearest cent).



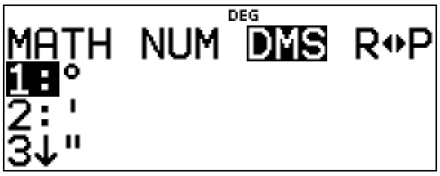
3.2 Working with time (MS-M2)

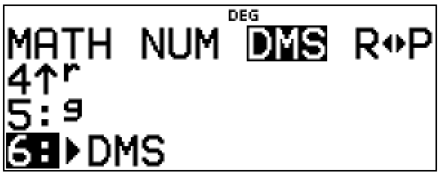
Students are expected to convert units of time, convert between 12-hour and 24-hour clocks and calculate time intervals.

The **DMS** menu is useful for converting units of time.

Press [mode] to choose an angle mode from the mode screen. Note that **DEG** is the default.

Press [math] ▶ ▶ to display the **DMS** menu.





In terms of units of time, the number of degrees displayed can be used to represent the number of hours.

The **DMS** menu enables you to specify the unit modifier as 'hours' (°), minutes ('), seconds (") or convert a time expressed as a decimal to a time expressed in hours, minutes and seconds using ►**DMS**.

Example: Time conversions

This example shows how to use a calculator to convert units of time.

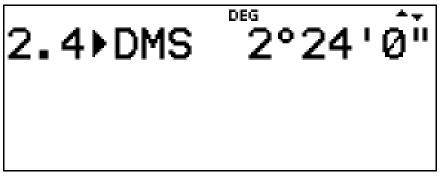
Use the TI-30X Plus MathPrint™ to convert a time of 2.4 hours to a time in hours and minutes.

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.

Keystrokes and solution:

Enter **2.4** and press [math] ▶ ▶ [6] [enter].

This time is 2 hours 24 minutes.



Example: Calculating a time interval

This example shows how to use a calculator to calculate a time interval.

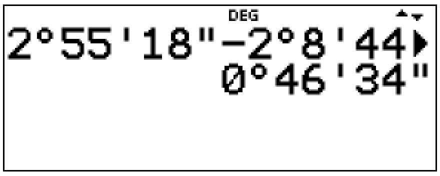
At the 1908 Olympic Games, John Hayes (USA) won the marathon in a time of 2:55:18. At the 2016 Olympic Games, Eluid Kipchoge (Kenya) won the marathon in a time of 2:08:44.

Use the TI-30X Plus MathPrint™ 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 [math] ▶ ▶ [1] **55** [math] ▶ ▶ [2] **18** [math] ▶ ▶ [3] [−] **2** [math] ▶ ▶ [1] **8** [math] ▶ ▶ [2] **44** [math] ▶ ▶ [3] [math] ▶ ▶ [6] [enter].



Kipchoge's winning time is 46 minutes and 34 seconds faster.

Example: 12-hour and 24-hour notation

This example shows how to use a calculator to solve a problem involving 12-hour and 24-hour notation as well as 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-30X Plus MathPrint™ to calculate 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.

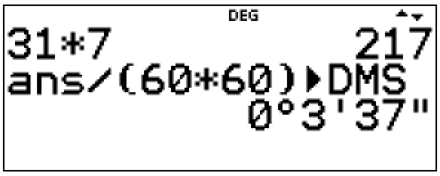
Keystrokes and solution:

There are 31 days in October so Anne's watch will have lost $31 \times 7 = 217$ seconds.

Enter **31** and press [×] **7** [enter].

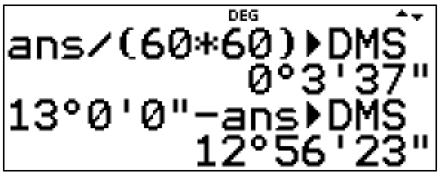
Convert 217 seconds into minutes and seconds:

Press [2nd] [answer] [÷] [(] and enter **60** [×] **60** [)] [math] ▶ ▶ [6] [enter].



217 seconds is 3 minutes and 37 seconds.

Enter **13** and press [math] ▶ ▶ [1] **0** and press [math] ▶ ▶ [2] **0** [math] ▶ ▶ [3] [−] [2nd] [answer] [math] ▶ ▶ [6] [enter].

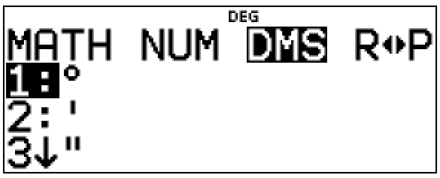


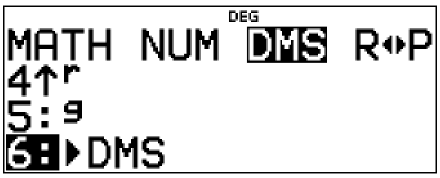
Subtracting 3 minutes and 37 seconds from 13:00:00 gives 12:56:23. This would be the time on Anne's watch.

3.3 Non-right-angled trigonometry

Press [mode] to choose an angle mode from the mode screen. Note that **DEG** is the default.

Press [math] ▶ ▶ to display the **DMS** menu.





This menu enables you to specify the angle unit modifier as degrees (°), minutes (‘), seconds (“); specify a radian angle (**r**); specify a gradian angle (**g**), or convert an angle from decimal degrees to degrees, minutes and seconds using **►DMS.**

Inputs are interpreted and results displayed according to the angle mode setting without the need to enter an angle unit modifier.

Example: Converting an angle from decimal degrees to degrees and minutes

This example shows how to use a calculator to convert an angle from a decimal to degrees and minutes.

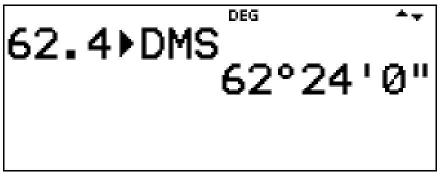
Use the TI-30X Plus MathPrint™ to convert $62.4°$ to an angle expressed in degrees and minutes.

Teacher Note: It is useful for students to know that $0.1°$ corresponds to $6‘$.

Keystrokes and solution:

Enter **62.4** and press [math] ► ► [6] [enter].

$62.4° = 62°24‘$



Students are expected to know the sign of $\sin A$ and $\cos A$ for $0° \le A \le 180$.

To create a sequence of values to fill a list in the data editor, press [data] ◄ to display the Options (**OPS**) menu. Press [3] and complete the required fields.

Example: Investigating the sign of cos *A* for 0°≤*A*≤180°

This example shows how to use a calculator to investigate the sign of $\cos A$ for $0° \le A \le 180$.

Use the TI-30X Plus MathPrint™ data editor and list formulas feature to complete the following table of values for $\cos A$.

Where appropriate, give each value of $\cos A$ correct to two decimal places.

A	$0°$	$30°$	$60°$	$90°$	$120°$	$150°$	$180°$
$\cos A$							

Teacher Note: The same approach can be used to investigate the sign of $\sin A$ for $0° \le A \le 180$.

Keystrokes and solution:

The angle mode is **DEG.**

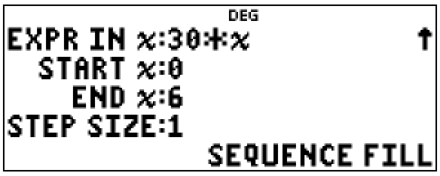
Press [data]. Press [data] [4] to clear all lists.

Press [data] ◄ [3].

Select **L1** and press [enter].

Enter **30** and press [×].

Press [x^{yzt}_{abcd}] to paste x, complete the sequence set-up as shown, scroll down to select **SEQUENCE FILL** and press [enter].



These seven A -values should now be displayed in **L1**.

Press ⏵ to scroll across to the top of **L2**.

Press data ⏵ to select **FORMULA** and press enter.

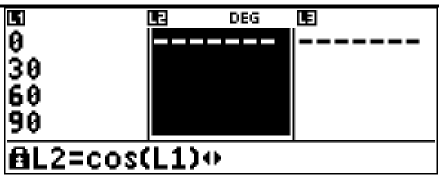
Enter the list formula $\cos(L1)$ to **L2**.

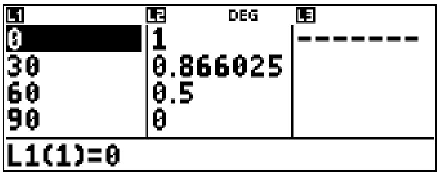
Press cos/cos⁻¹ and press data enter to paste **L1** into the author line. Press) ◂▸≈ enter.

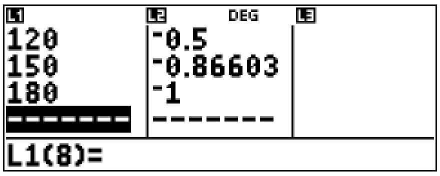
L2 should now display the $\cos A$ values and the table can be completed.

For $0° \leq A \leq 90°$, $0 \leq \cos A \leq 1$.

For $90° \leq A \leq 180°$, $-1 \leq \cos A \leq 0$.







Students are expected to use trigonometric ratios to find the length of an unknown side or the size of an unknown angle in a right-angled triangle. This includes solving practical problems involving Pythagoras' theorem, right-angled and non-right-angled triangle trigonometry, angles of elevation and depression and the use of true and compass bearings.

Students are expected to work with angles correct to the nearest degree and/or minute.

The trigonometry keys, sin/sin⁻¹, cos/cos⁻¹ and tan/tan⁻¹, are multi-tap keys. In the following examples, the angle mode is set prior to the calculation.

Example: Trigonometric ratios (1)

This example shows how to use a calculator to solve a problem involving right-angled triangle trigonometry.

The angle of depression from a drone flying horizontally 100 metres above the water to a buoy at sea is $23°18'$.

Find the horizontal distance, x metres, from the drone to the buoy.

Give your answer correct to one decimal place.

Teacher Note: It is important to reinforce the following five steps when solving a right-angled triangle trigonometry problem.

Keystrokes and solution:

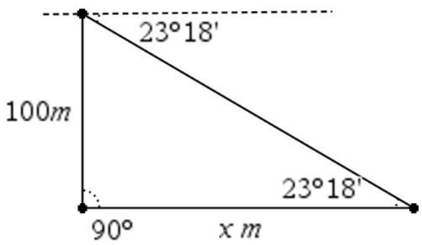
The angle msode is **DEG**.

Step (1): Draw a diagram.

Step (2): Label all given and required information where x represents the horizontal distance.

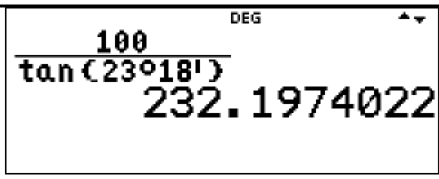
Step (3): From TOA, the required trigonometric ratio is $\tan$.

Step (4):



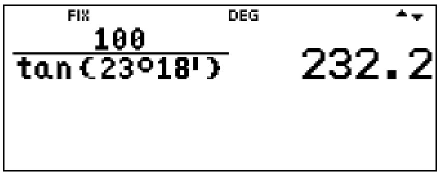
$$\tan 23°18' = \frac{100}{x} \text{ and so } x = \frac{100}{\tan 23°18'}$$

Enter **100** and press [÷] [tan tan⁻¹] **23** [math] ▶ ▶ [1] **18** [math] ▶ ▶ [2] [)] [enter].



$x = 232.197...$

The horizontal distance is 232.2 metres, correct to one decimal place.

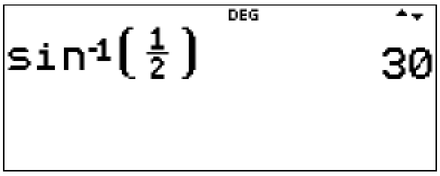


Note: Press [mode] ▼ ▼ ▶ ▶ [enter] to set the decimal notation mode to a one decimal place output.

Given two sides of a right-angled triangle, we can use trigonometric ratios to find unknown angles. For example, if $\sin\theta = \frac{1}{2}$, we can find the angle θ whose sine is equal to $\frac{1}{2}$.

To do this on the TI-30X Plus MathPrintTM, we use the inverse of sine.

Press [sin sin⁻¹] [sin sin⁻¹] (a multi-tap key) to access $\mathbf{sin^{-1}}$. Enter $\mathbf{\frac{1}{2}}$ and press [)] [enter].



So $\sin^{-1}\frac{1}{2}$ is the 'angle whose sine is $\frac{1}{2}$'.

Inverse trigonometric ratios can be thought of as 'angle finders'.

Example: Trigonometric ratios (2)

This example shows how to use a calculator to find the magnitude of an angle, in degrees and minutes, given a trigonometric ratio for the angle.

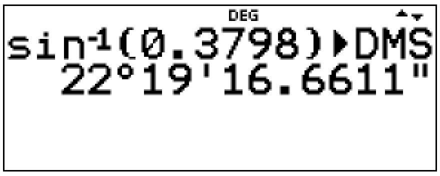
Use the TI-30X Plus MathPrint™ to find the value of θ for $\sin\theta = 0.3798$. Give your answer in degrees and minutes.

Teacher Note: It is important to reinforce that $\sin^{-1}(0.3798)$ means the angle whose sine is 0.3798.

Keystrokes and solution:

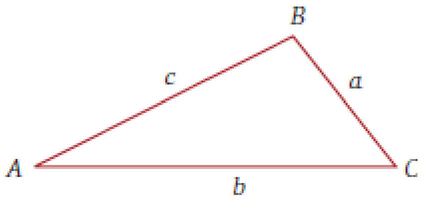
The angle mode is **DEG**.

Press [sin sin⁻¹] [sin sin⁻¹] and enter **0.3798** [)] [math] ▶ ▶ [6] [enter].



In degrees and minutes, $\theta = 22°19'$.

Students are expected to use the sine rule, cosine rule and area of a triangle formula for solving problems. This can include finding the size of an obtuse angle. The ambiguous case of the sine rule is excluded.



For a triangle ABC, the sine rule is given by $\dfrac{a}{\sin A}=\dfrac{b}{\sin B}=\dfrac{c}{\sin C}$.

It is used to find unknown lengths and angles when given:

(1) two angles and one side length.

(2) two side lengths and an angle opposite one of the sides.

For a triangle ABC, the cosine rule is given by $a^2 = b^2 + c^2 - 2bc \cos A$.

It is used to find unknown lengths and angles when given:

(1) all three side lengths.

(2) two side lengths and the included angle.

The above formula can be rearranged to find the unknown angle A where $\cos A = \dfrac{b^2+c^2-a^2}{2bc}$.

If two sides of a triangle and the included angle are given then $\text{Area} = \dfrac{1}{2}ab\sin C$.

Example: Sine and cosine rule

This example shows how to solve a problem using the cosine rule and the sine rule.,

Use the TI-30X Plus MathPrint™ to find all the unknown angles and side lengths in triangle ABC for which $a = 5$, $b = 4$ and $C = 46°24'$. Give your answer for c correct to two decimal places and your answers for A and B correct to the nearest minute.

Teacher Note: When performing such multi-stage calculations, do not round intermediate answers as this is likely to lead to inaccurate final answers.

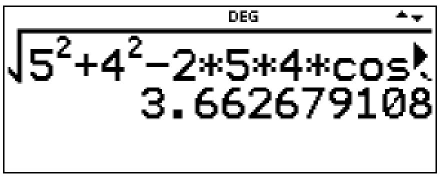
Keystrokes and solution:

The angle mode is **DEG**.

Using the cosine rule:

$$c = \sqrt{5^2+4^2-2\times5\times4\times\cos 46°24'}$$

Press [2nd] [√] and enter **5** [x^2] [+] **4** [x^2] [−] **2** [×] **5** [×] **4** [×] [cos] **46** [math] ▶ ▶ [1] **24** [math] ▶ ▶ [2] [)] [enter].



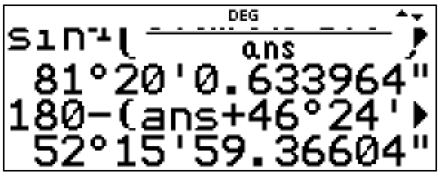
Correct to 2 decimal places, $c = 3.66$.

Using the sine rule:

$$\frac{5}{\sin A}=\frac{3.662...}{\sin 46°24'}\Rightarrow \sin A=\frac{5\sin 46°24'}{3.662...}$$

$$A=\sin^{-1}\left(\frac{5\sin 46°24'}{3.662...}\right)$$

Press [sin⁻¹] [sin⁻¹] [frac] and enter **5** [×] [sin] **46** [math] ▶ ▶ [1] **24** [math] ▶ ▶ [2] [)] ▼ [2nd] [answer] ▶ [)] [math] ▶ ▶ [6] [enter].



Correct to the nearest minute, A = 81°20‘.

Note that careful use of the expression evaluation feature could be used in solving this problem (the pronumerals are a,b,c,A,B,C).

B = 180° – (81°20‘+ 46°24‘)

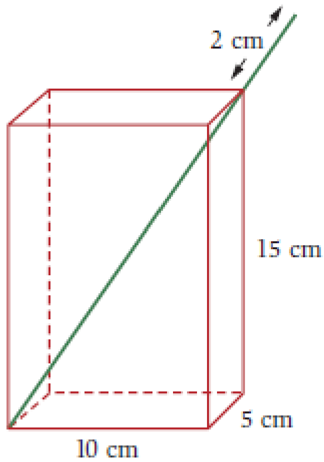
Enter **180** and press [−] [(] [2nd] [answer] [+] **46** [math] ▶ ▶ [1] **24** [math] ▶ ▶ [2] [)] [math] ▶ ▶ [6] [enter].

Correct to the nearest minute, B = 52°16‘.

Example: Trigonometry and Pythagoras' theorem

This example shows how to use Pythagoras' theorem to solve a three-dimensional problem involving right-angled triangles. In particular, solving a problem involving the lengths of the edges and diagonals of a rectangular prism.

Find the length of a straw which will fit diagonally into a child's fruit juice box (a rectangular prism) and extend out of the box by 2 cm. Give your answer correct to one decimal place.



Teacher Note: When solving three-dimensional problems involving Pythagoras' theorem, it is important to draw carefully labelled diagrams identifying the right-angled triangles, where the theorem can be applied to find unknown lengths.

Keystrokes and solution:

$x^2 = 10^2 + 5^2$

$= 125$

$y^2 = x^2 + 15^2$

$= 125 + 225$

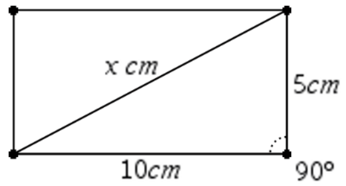
$= 350$

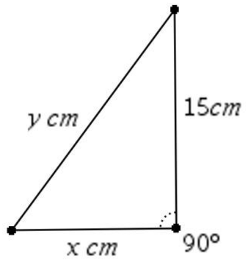
$y = \sqrt{350}$ (cm)

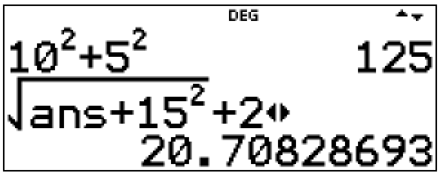
The length of the straw is $(y + 2)$ (cm).

Enter **10** and press [x^2] [+] **5** [x^2] [enter] [2nd] [√] [2nd] [answer] [+] **15** [x^2] [▶] [+] **2** [◂▸≈] [enter].

Correct to one decimal place, the length of the straw is 20.7 cm.







3.4 Rates and ratios (MS-M7)

Students are expected to use rates to solve and describe practical problems, for example, to compare 'best buys', by comparing price per unit or quantity per monetary unit.

Example: Calculating the 'best buy'

This example shows how to use a calculator to determine a 'best buy'.

Use the TI-30X Plus MathPrint™ to determine 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 solved using the unitary method.

Keystrokes and solution:

500 grams of butter for $\$4.50$

What is 1 gram worth?

Press [(] and enter **4.5** [÷] **500** [)] [×] **100** [enter].

1 gram is worth 0.9 cents.

300 grams of butter for $\$2.75$

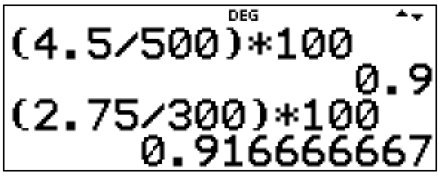
What is 1 gram worth?

Press ⏶ ⏶ [enter] to bring the previous entry to a new author line.

Press [2nd] ⏴ to move to the beginning of the previous entry and press [2nd] [insert] to edit as shown at right. Press [enter].

1 gram is worth 0.92 cents (correct to two decimal places).

$0.9 < 0.92$ and so 500 grams of butter for $4.50 is the 'best buy'.



Students are expected to solve practical problems involving speed.

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

Example: Calculating travel time

This example shows how to solve a real-life problem involving speed and travel time.

A truck is travelling at a constant speed of 90 km per hour.

Use the TI-30X Plus MathPrint™ 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-30X Plus MathPrint™ 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.

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

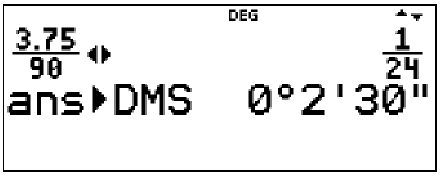
Enter **3.75** and press [n/d] **90** ⏵ [◂▸≈] [enter].

This gives $\frac{1}{24}$ hours.

Press [2nd] [answer] [math] ⏵ ⏵ [6] [enter].

This gives an output in minutes and seconds.

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



Students are expected to calculate the amount of fuel used on a trip, given the consumption rate and to compare fuel consumption statistics for various vehicles.

A motor vehicle's fuel consumption is the number of litres of fuel it uses to travel 100 kilometres.

The formula for fuel consumption, FC, in L/100 km, can be expressed as $FC = \frac{A}{d} \times 100$ where A is the amount of fuel in litres and d is the distance travelled in kilometres.

Example: Comparing fuel consumption

This example shows how to use a calculator to compare fuel consumption statistics for various vehicles.

Consider the following fuel consumption statistics for three vehicles.

Vehicle A uses 29.4 L of fuel to travel 350 km.

Vehicle B uses 77.3 L of fuel to travel 840 km.

Vehicle C uses 45.0 L of fuel to travel 490 km.

Use the TI-30X Plus MathPrint™ data editor and list formulas feature to determine which of the three vehicles has the most economical fuel consumption.

Teacher Note: When comparing fuel consumption, in L/100 km, for different vehicles, students should recognise that the most economical (best) fuel consumption corresponds to the smallest value.

Keystrokes and solution:

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

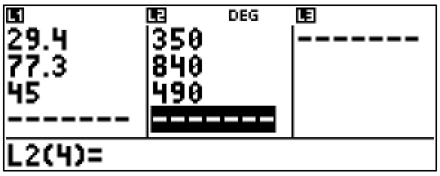
Enter **29.4** and press [▼]. Repeat for **77.3** and **45.0.**

The three fuel amounts should now be displayed in **L1**.

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

Enter **350** and press [▼]. Repeat for **840** and **490**.

The three distances should now be displayed in **L2**.



Press [▶] to scroll across to the top of **L3**.

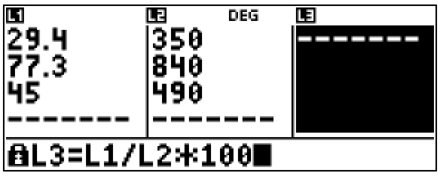
Press [data] [▶] to select **FORMULA** and press [1].

Enter the list formula **L1 / L2 * 100** to **L3**.

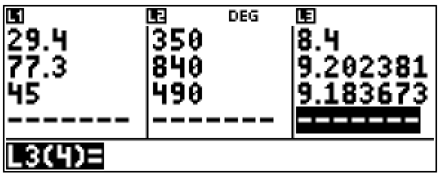
Press [data] [enter] to paste **L1** into the author line.

Press [÷] and press [data] [2] to paste **L2** into the author line.

Press [×] and enter **100** [enter].



L3 should now display the fuel consumption statistics for the three vehicles.



Vehicle A is 8.4 L/100 km.

Vehicle B is $9.20\ldots$ L/100 km.

Vehicle C is $9.18\ldots$ L/100 km.

As $8.4 < 9.18\ldots < 9.20\ldots$, vehicle A is the most fuel efficient of the three vehicles.

Students are expected to solve practical problems involving ratio, for example, measurements from scale drawings.

Example: Interpreting a scale in a house plan

This example shows how to use a calculator to help interpret a scale in a house plan.

Using an architect's house plans, a builder measured the width of the house to be 350 mm. If the house has an actual width of 14.5 m, use the TI-30X Plus MathPrint™ to find the scale diagram ratio of the house plans.

Teacher Note: Choosing the most appropriate unit of measurement is important. Afford students opportunities to interpret and use scales in photographs, plans and drawings used in everyday life.

Keystrokes and solution:

350 mm on the house plan represents an actual width of 14.5 m.

Convert the units so that the scale measurement and actual measurement are expressed in the same unit.

Here, change the larger unit to the smaller unit. Hence convert 14.5 m to mm.

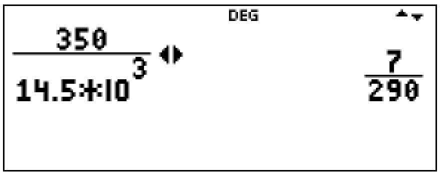
The ratio is 350 (mm): 14.5 (m).

As 1 m is 10^3 mm and considering the above ratio as a part-to-whole ratio we obtain:

350 (mm): 14.5×10^3 (mm)

Enter **350** and press [fraction] **14.5** [×] [e□ 10□] [e□ 10□] **3** [▶] [▶] [◂▸≈] [enter].

The scale diagram ratio is $7 : 290$.



4 Financial mathematics

4.1 Money matters (MS-F1)

4.1.1 Interest and depreciation

Students are expected to apply percentage increase or decrease in various contexts, for example, calculating GST payable on a range of goods and services.

Percentage change involves increasing or decreasing a quantity as a percentage of the original amount of the quantity.

For example, percentage decrease involves the following two steps:

(1) Subtract the percentage decrease from 100%.

(2) Multiply the percentage determined in (1) by the amount.

Example: Applying a percentage decrease

This example shows how to use a calculator to decrease a quantity by a given percentage.

A shop has a sale where there is a 30% discount on sporting equipment.

Use the TI-30X Plus MathPrint™ 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 $\$250$.

Keystrokes and solution:

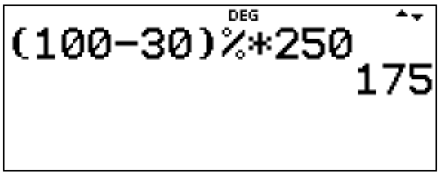
Determine the percentage to be paid by subtracting the percentage discount from 100%.

$(100 - 30)\ \% = 70\%$

To find the discounted price, calculate 70% of the marked price.

Press [(] and enter **100** [−] **30** [)] [2nd] [%] [×] **250** [enter].

The discounted price of the tennis racquet is $\$175$



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: Calculating a price including GST

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-30X Plus MathPrint™ 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 last answer feature when using the TI-30X Plus MathPrint™.

Keystrokes and solution:

GST is 10% of $\$760$.

Enter **10** and press [2nd] [%] [×] **760** [enter].

GST is $\$76$.

Price including GST:

Enter **760** and press [+] [2nd] [answer] [enter].

The price including GST is $\$836$

$(\$760 + \$76)$

Students are expected to use technology to calculate simple interest for different rates and periods.

Simple interest is calculated only on the original amount borrowed or invested.

The simple interest earned or owed can be calculated using the formula $I = Prn$ where:

I is the interest earned or paid (in dollars);

P is the principal (initial amount borrowed or invested) (in dollars);

r is the interest rate per time period (usually expressed as a decimal);

n is the number of time periods.

$A = P + I$ where A is the amount owed or total to be paid.

Example: Exploring a simple interest investment

This example shows how to use a calculator to explore a simple interest investment.

$\$5000$ is invested at a simple interest rate of 8.25% per annum for a ten-year period.

Use the TI-30X Plus MathPrint™ data editor and list formula feature to explore the growth in interest earned over this period.

Teacher Note: This example could be extended to explore simple interest graphs for different rates and periods.

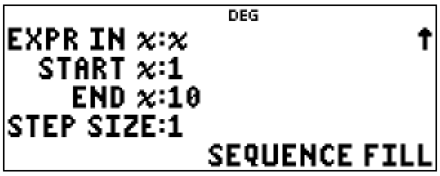
Keystrokes and solution:

$I = 5000 \times 8.25\% \times n$

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

Press [data] ◀ [3]. Select **L1** and press [enter].

Press [x^{yzt}_{abcd}] to paste x, complete the sequence set-up as shown, scroll down to select **SEQUENCE FILL** and press [enter].

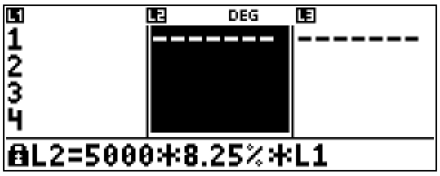


These ten time period values should now be displayed in **L1**.

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

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

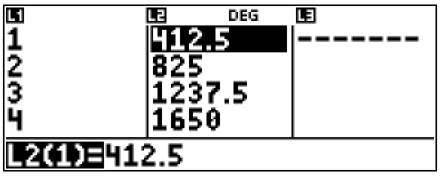
Enter the list formula **5000 * 8.25% * L1** to **L2**.



Enter **5000** and press [×] **8.25** [2nd] [%] [×].

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

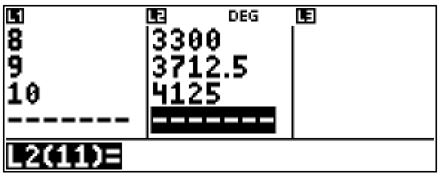
L2 should now display the required interest amounts.



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

Interest of $\$4125$ will be earned after 10 years.

The graph of the amount of simple interest earned is linear with slope (interest added each year) equal to $\$412.50$.



Students are expected to calculate the depreciation of an asset using the straight-line method.

Straight-line depreciation occurs when the value of an asset decreases by the same amount each time period.

The salvage value (current value) of the asset, S, is given by the formula $S = V_0 - Dn$ where

V_0 is the initial value of the asset.

D is the depreciated amount per time period.

n is the number of time periods.

Example: Exploring the straight-line depreciation of an asset

This example shows how to use a calculator to explore the straight-line depreciation of an asset.

Serena paid $\$23500$ for a used car.

It is thought that the car will depreciate in value by an average amount of $\$1950$ each year for a period of four years.

Use the TI-30X Plus MathPrint™ data editor and list formulas feature to complete the following depreciation table for the first four years.

Year	Depreciated value
1	
2	
3	
4	

Teacher Note: It is a good idea to graph $S = V_0 - Dn$ and interpret the meaning of V_0 and D in the context of straight-line depreciation.

Keystrokes and solution:

$S = 23500 - 1950n$

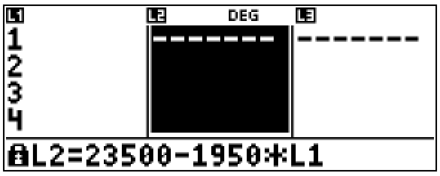
Press [data]. Press [data] [4] to clear all lists.

In **L1**, enter **1** and press ▼.

Repeat for **2**, **3** and **4**.

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

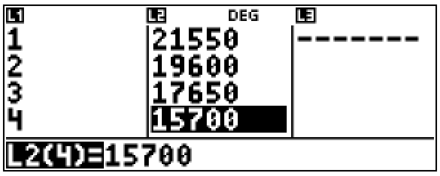
Press [data] ▶ to select **FORMULA** and press [enter].



Enter the list formula **23500 – 1950 * L1** to **L2**.

Enter **23500** and press [−] **1950** [×].

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



The depreciated values should now be displayed in **L2**.

Year	Depreciated value
1	\$21550
2	\$19600
3	\$17650
4	\$15700

Students are expected to use a spreadsheet to calculate and graph compound interest as a recurrence relation involving repeated applications of simple interest.

Compound interest calculates the interest on the original amount plus any interest that is earned to that time.

Example: Exploring compound interest by repeated application of simple interest (1)

This example shows how to use a calculator to explore compound interest through repeated use of the simple interest formula.

\$200 is invested at 5% per annum, where the interest earned is added to the account each year.

Use the TI-30X Plus MathPrint™ last answer feature to calculate how much money, A, is in the account after three years.

Teacher Note: Such an example shows how the TI-30X Plus MathPrint™ last answer feature can be used to explore compound interest through repeated use of the simple interest formula.

Keystrokes and solution:

After one year: $I = 200 \times 5\% \times 1$

Enter **200** and press [×] **5** [2nd] [%] [×] **1** [enter].

The interest earned is \$10.

After one year, the amount of money, A, in the account is \$200 + \$10.

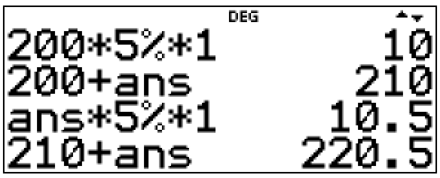
Enter **200** and press [+] [2nd] [answer] [enter].

After one year, $A = \$210$.

After two years: $I = 210 \times 5\% \times 1$

Repeat the calculation with $P = \$210$ to find the value of I.

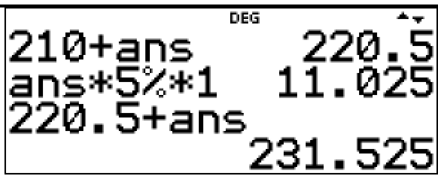
Note the use of the last answer feature (third author line in the screenshot at right).



The interest earned is \$10.50.

After two years, the amount of money, A, in the account is \$210 + \$10.50.

Enter **210** and press [+] [2nd] [answer] [enter].



After two years, A = $220.50.

After three years: $I = 220.50 \times 5\% \times 1$

Repeat the calculation with P = $220.50 to find the value of I.

The interest earned is $11.03.

After three years, the amount of money, A, in the account is $220.50 + $11.03.

After three years, A = $231.53.

Example: Exploring compound interest by repeated application of simple interest (2)

This example, following on from the previous example, shows how to use a calculator to help see a pattern to compound interest calculations thus leading towards developing a formula for compound interest.

$200 is invested at 5% per annum, where the interest earned is added to the account each year.

(a) Use the TI-30X Plus MathPrint™ stored operations feature to calculate how much money, A, is in the account after three years.

(b) Develop a formula for A, the amount of money in the account, after n years.

Teacher Note: This example shows how to connect the calculation of the total value of a compound interest investment to repeated multiplication. Example: a rate of 5% per annum leads to repeated multiplication by 1.05.

Keystrokes and solution:

(a) Increasing a quantity by 5% is equivalent to multiplying that quantity by 1.05.

Press [2nd] [set op].

[If required, press [clear] to clear any previously stored operations.]

Press [×] and enter **1.05** [enter].

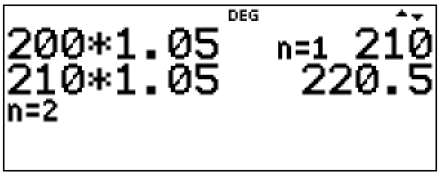
After one year:

Enter **200** and press [2nd] [op].

$A = \$200 \times 1.05 = \$210$

After two years:

Press [2nd] [op].



$A = \$200 \times 1.05 \times 1.05$

$= \$200 \times 1.05^2$

$= \$220.50$

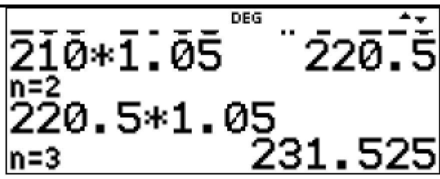
After three years:

Press [2nd] [op].

$A = \$200 \times 1.05 \times 1.05 \times 1.05$

$= \$200 \times 1.05^3$

$= \$231.53$



(b) $A = \$200 \times (1.05)^n$

4.1.2 Earning and managing money

Students are expected to calculate earnings based on commission.

A commission payment is an amount paid to a person based on how much they sell.

Often, a commission payment is calculated as a percentage of the total sales.

Example: Calculating a commission

This example shows how to use a calculator to calculate a commission.

A real estate agent sold a house for $900000.

Her rate of commission on the sale was 1.5%.

Use the TI-30X Plus MathPrint™ to find the commission from the sale.

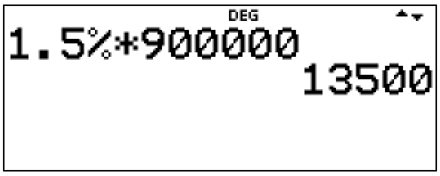
Teacher Note: When using a calculator to answer such questions, it is important that students anticipate the order of magnitude of the answer. For example, 1%. of $900000 is $9000.

Keystrokes and solution:

Commission is 1.5% of $900000.

Enter **1.5** and press [2nd] [%] [×] **900000** [enter].

The commission earned is $13500.



Students are expected to calculate the amount of tax payable.

The tax payable is the amount of money owed in taxes.

Example: Calculating the tax payable

Ari has a taxable income of $39600.

Use the TI-30X Plus MathPrint™ to find the amount of tax he will have to pay.

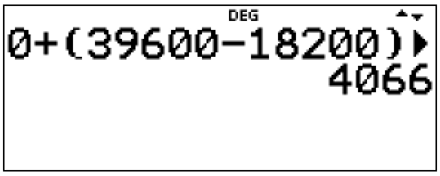
Teacher Note: The Australian resident tax rates can be sourced from the Australian Tax Office website. The address is https://www.ato.gov.au/rates/individual-income-tax-rates/.

Keystrokes and solution:

The tax payable on this income is
Nil + (\$39600 – \$18200) × 0.19.

Enter **0** and press [+] [(] **39600** [−] **18200** [)] [×] **0.19** [enter].

The tax payable is \$4066.



4.1.3 Budgeting and household expenses

Students are expected to plan for the purchase of a car, including sale price and loan repayments.

When buying a car with a car dealers' finance, the purchaser usually pays a deposit and then makes a number of monthly repayments.

The total cost of using car dealers' finance is greater than the cash price.

Example: Purchasing a car

Hannah wishes to buy a car for \$30000.

Finance is available at \$6000 deposit and monthly repayments of \$750 for 5 years.

Use the TI-30X Plus MathPrint™ last answer feature to find the amount of interest Hannah would pay.

Teacher Note: Students should understand that the amount of interest paid is the deposit plus the total repayments minus the sale price.

Keystrokes and solution:

Total repayment is \$750 × 12 × 5 = \$45000.

Enter **750** and press [×] **12** [×] **5** [enter].

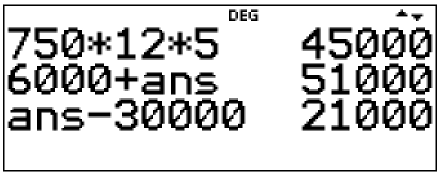
Add the deposit to the total repayments.

Enter **6000** and press [+] [2nd] [answer] [enter].

\$6000 + \$45000 = \$51000

Press [2nd] [answer] [−] and enter **30000** [enter].

Interest paid is $\$51000 - \$30\,000 = \$21000$.



4.2 Investments and loans (MS-F4)

4.2.1 Investments

Students are expected to calculate the future value, FV, or present value, PV, and the interest rate, r, of a compound interest investment using the formula $FV = PV(1 + r)^n$.

Compound interest is calculated on the initial amount borrowed or invested plus any interest that has been charged or earned.

The future value, FV, of a compound interest investment (or loan) can be calculated using the formula $FV = PV(1 + r)^n$ where:

FV is the future value of the loan or amount (in dollars).

PV is the present value of the loan or principal (in dollars).

r is the interest rate per compounding time period expressed as a decimal.

n is the number of compounding time periods.

Note that the present value of an investment, PV, can be calculated using the formula $PV = \dfrac{FV}{(1+r)^n}$.

The compound interest, I, earned or owed is given by the formula $I = FV - PV$.

Example: Exploring a compound interest investment

This example shows how to use a calculator to explore a compound interest investment.

Use the TI-30X Plus MathPrint™ data editor and list formulas feature to

(a) show the future value, FV, accumulating over 5 years if $\$1000$ is invested at an interest rate of 6% per annum, compounded annually.

(b) calculate, to the nearest cent, the future value, FV, of the investment accumulated after 5 years.

(c) show the amount of interest, I, accumulating over the 5 years.

(d) calculate the amount of interest, I, earned after 5 years.

Teacher Note: Such an example shows how the TI-30X Plus MathPrint™ can be used to explore a compound interest investment for teaching and learning purposes. In the formula, the future value, FV, is the same as the amount, A, and the present value, PV, is the same as the principal, P.

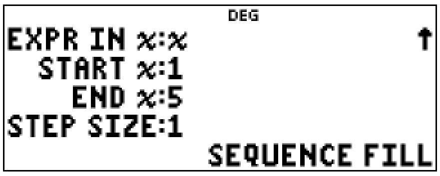
Keystrokes and solution:

(a) $FV = 1000\ (1 + 6\%)^n$

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

Press [data] [◄] [3]. Select **L1** and press [enter].

Press [x^{yzt}_{abcd}] to paste x, complete the sequence set-up as shown, scroll down to select **SEQUENCE FILL** and press [enter].

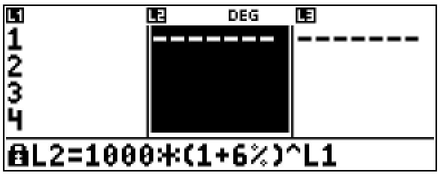


These five time period values should now be displayed in **L1**.

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

Press [data] [►] to select **FORMULA** and press [enter].

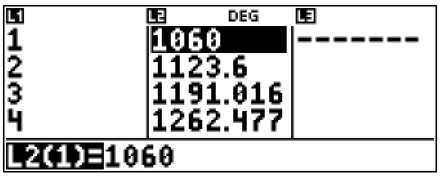
Enter the list formula **1000 * (1 +6%) ^ L1** to **L2**.



Enter **1000** and press [×] [(] **1** [+] **6** [2nd] [%] [)] [$x^{\square}$].

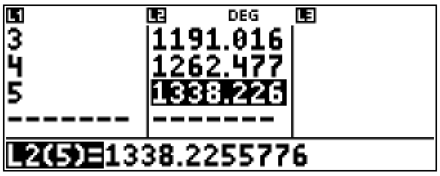
Press [data] [enter] to paste **L1** into the author line. Press [enter].

L2 should now display the future value, FV, of the investment at the end of each year.



(b) Press [2nd] ⊙ to go to the bottom of a list and press ⊙.

The future value, FV after 5 years is $\$1338.23$.



(c) Press ⊙ to scroll across to the top of **L3**.

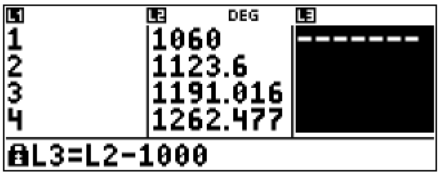
Press [data] ⊙ to select **FORMULA** and press [enter].

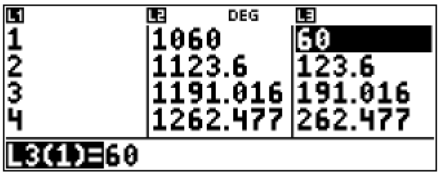
Enter the list formula **L2 – 1000** to **L3**.

Press [data] [2] to paste **L2** into the author line.

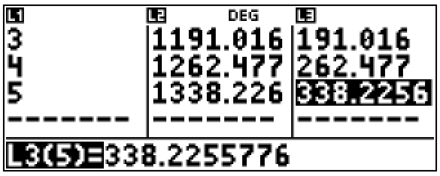
Press [–] and enter **1000**. [enter].

L3 should now display the interest accumulating over the 5 years





(d) The total amount of interest, I, earned after 5 years is $\$1338.23 - \$1000 = \$338.23$.



Students are expected to use technology to:

- compare the growth of simple interest investments (linear growth) and compound interest investments (exponential growth) numerically and graphically.
- investigate the effect of varying the interest rate, the term or the compounding period on the future value, FV, of an investment.
- compare and contrast different investment strategies.

Example: Comparing the growth of a simple interest investment and a compound interest investment

This example shows how to use a calculator to compare the growth of a simple interest investment and a compound interest investment.

Use the TI-30X Plus MathPrint™ data editor and list formulas feature to compare a simple interest investment and a compound interest investment of $\$5000$ at 4% per annum over a period of 6 years.

Teacher Note: Simple interest increases by a constant amount each time period, resulting in a straight-line graph. Compound interest increases by a different amount each time period, resulting in an exponential curve.

Keystrokes and solution:

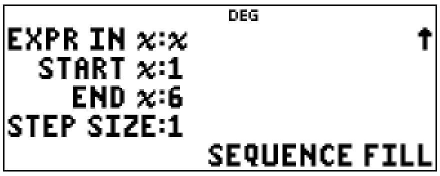
Simple interest investment:

$FV = 5000 + (5000 \times 4\% \times n)$

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

Press [data] ◀ [3]. Select **L1** and press [enter].

Press [x^{yzt}_{abcd}] to paste x, complete the sequence set-up as shown, scroll down to select **SEQUENCE FILL** and press [enter].

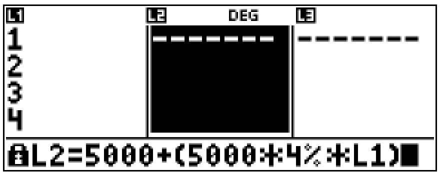


These six time period values should now be displayed in **L1**.

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

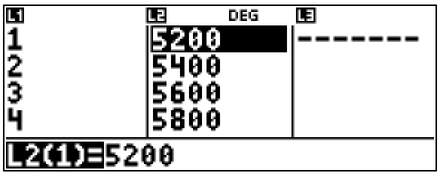
Press [data] ▶ to select **FORMULA** and press [enter].

Enter the list formula **5000 + (5000 × 4% × L1)** to **L2**.

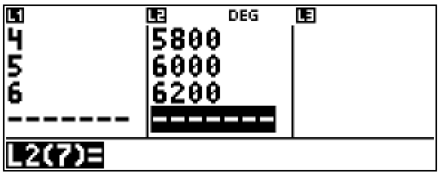


Enter **5000** and press [+] [(] **5000** [×] **4** [2nd] [%] [×].

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



L2 should now display the future value, FV, of the simple interest investment at the end of each year.



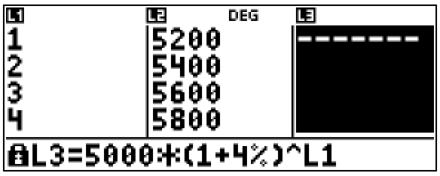
Compound interest investment:

$FV = 5000\,(1 + 4\%)^n$

Press ▶ to scroll across to the top of **L3**.

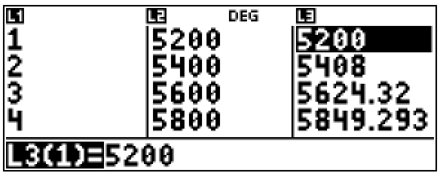
Press [data] ▶ to select **FORMULA** and press [enter].

Enter the list formula **5000 * (1 + 4%) ^ L1** to **L3**.



Enter **5000** and press [×] [(] **1** [+] **4** [2nd] [%] [)] [$x^{\square}$].

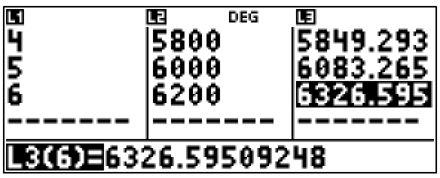
Press [data] [enter] to paste **L1** into the author line. Press [enter].



L3 should now display the future value, FV, of the compound investment at the end of each year.

After the first year the value of the compound interest investment is greater and the difference between the two investments increases over time.

After six years, the difference is $126.60.



Tables of values can be used to solve certain problems involving compound interest.

Example: Calculating the number of time periods for a compound interest investment

This example shows how to use a calculator to determine the number of time periods required to obtain a particular total amount for a compound interest investment.

Use the TI-30X Plus MathPrint™ function feature to find the number of time periods required for an initial investment of $\$20000$ to increase to at least $\$25000$ given that it has an interest rate of 7% per annum compounding monthly.

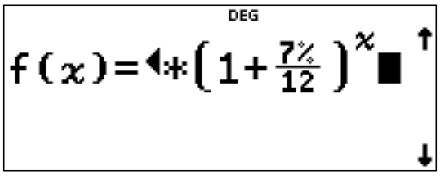
Teacher Note: Such an example shows how the TI-30X Plus MathPrint™ can be used to automate a 'guess and refine' numerical solution strategy. This example could also be solved using the TI-30X Plus MathPrint™ function feature.

Keystrokes and solution:

$$FV = 20\,000\left(1+\frac{7\%}{12}\right)^n$$

Press [table] [1] to access the function table. [If required, press [clear].

Enter **20000** and press [×] [(] **1** [+] [fraction] **7** [2nd] [%] ⊝ **12** ⊳ [)] [$x^{□}$].



Press [$x\frac{yzt}{abcd}$] to paste x and press [enter] ⊝.

Move the cursor to select x = **?** and press [enter] **(CALC)** [enter].

Enter **30**, for example, and press [enter].

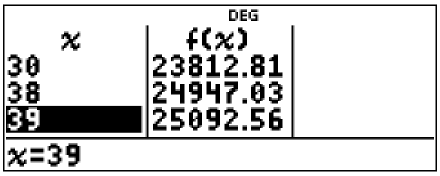
Column two of the table should show the output **23812.81**.

Enter **38**, for example, and press [enter].

Column two of the table should show the output **24947.03**.

Enter **39**, for example, and press [enter].

Column two of the table should show the output **25092.56**.



It would take 39 months for the investment to become at least $\$25000$.

4.2.2 Depreciation and loans

Students are expected to:

- calculate the depreciation of an asset using the declining balance method.
- solve practical problems involving reducing balance loans, for example determining the total loan amount and monthly repayments.

Declining-balance depreciation occurs when the value of the asset decreases by a fixed percentage each time period.

The salvage value (current value) of the asset, S, is given by the formula $S = V_0(1-r)^n$ where

V_0 is the initial value of the asset (purchase price).

r is the rate of depreciation per time period.

n is the number of time periods.

Example: Exploring the declining-balance depreciation of an asset

This example shows how to use a calculator to calculate the declining-balance depreciation of an asset.

Coco paid $\$24000$ for a used car. It is thought that the car will depreciate in value by 15% each year for a period of four years.

Use the TI-30X Plus MathPrint™ data editor and list formulas feature to complete the following depreciation table for the first four years.

Year	Depreciated value
1	
2	
3	
4	

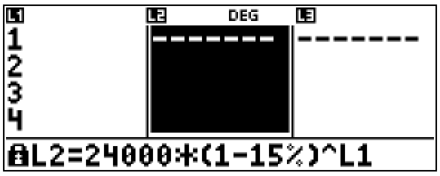
Teacher Note: It is a good idea to graph $S = V_0(1 - r)^n$ and interpret the meaning of V_0 and r in the context of declining-balance depreciation.

Keystrokes and solution:

$S = 24000\,(1 - 0.15)^n$

$\quad = 24000\,(0.85)^n$

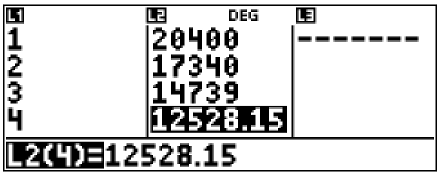
Press [data]. Press [data] [4] to clear all lists.



In **L1**, enter **1** and press [⌄]. Repeat for **2, 3** and **4**.

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

Press [data] [›] to select **FORMULA** and press [enter].



Enter the list formula **24000 * (1 – 15%) ^ L1** to **L2**.

Enter **24000** and press [×] [(] **1** [−] **15** [2nd] [%] [)] [$x^{\square}$].

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

The depreciated values should now be displayed in **L2**.

Year	Depreciated value
1	\$20400
2	\$17340
3	\$14739
4	\$12528.15

Example: Calculating the percentage rate of declining-balance depreciation of an asset

Hideki bought a 4WD vehicle four years ago for $\$36000$.

Using declining-balance depreciation, a car dealer estimates the vehicle's present value to be $\$14750$.

Use the formula $S = V_0(1 - r)^n$ and the TI-30X Plus MathPrint™ to find the annual depreciation rate. Give your answer correct to the nearest whole number.

Teacher Note: The TI-30X Plus MathPrint™ expression evaluation feature could be used here. However, the feature does not house the variables S, V_0 and n.

Keystrokes and solution:

$$S = V_0(1-r)^n$$

$$(1-r)^n = \frac{S}{V_0}$$

$$1-r = \sqrt[n]{\frac{S}{V_0}}$$

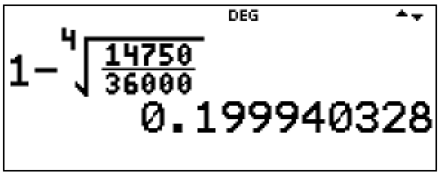
$$r = 1-\sqrt[n]{\frac{S}{V_0}}$$

Substituting $n = 4$, $S = 14750$ and $V_0 = 36000$ gives $r = 1-\sqrt[4]{\frac{14750}{36000}}$.

Enter **1** and press [−] **4** [2nd] [ⁿ√] **14750** [fraction] **36000** [enter].

$r = 0.199940\ldots$

The rate of depreciation is 20%, correct to the nearest whole number.



4.3 Annuities (MS-F5)

Students are expected to:

- solve compound interest problems involving financial decisions, for example a home loan, a savings account, a car loan or an annuity.
- use technology to model an annuity as a recurrence relation and investigate numerically (or graphically) the effect of varying the amount and frequency of each contribution, the interest rate or the payment amount on the duration and/or future value of the annuity.

An annuity is a type of investment involving the regular contribution of money.

A familiar example of an annuity is a monthly loan repayment.

A recurrence relation uses the previous result (value) to generate the next result (value).

Annuities can be modelled as recurrence relations where a future value at the end of a year becomes the present value for the next year.

A loan can be modelled by the recurrence relation $A_{n+1} = A_n(1 + r) - D$ where

A_{n+1} is the value of the loan after $(n + 1)$ payments.

A_n is the value of the loan after n payments.

r is the rate of interest per compounding period expressed as a decimal.

D is the payment made per compounding period.

Note that the recurrence relation for an investment is $A_{n+1} = A_n(1 + r) + D$

Example: Modelling a loan expressed as a recurrence relation

This example shows how to use a calculator to model a loan using a recurrence relation.

Tamara and Paul have borrowed $\$100000$ at an interest rate of 7.5% per annum reducing balance with monthly repayments of $\$1200$ over approximately 10 years.

Use the TI-30X Plus MathPrint™ stored operations feature to calculate the amount owing after two years. Give your answer correct to the nearest dollar.

Teacher Note: A similar approach can be employed to model the growth of an investment expressed as a recurrence relation.

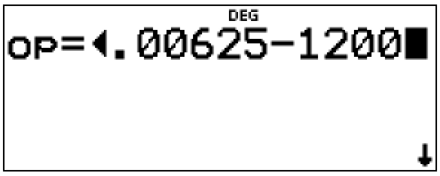
Keystrokes and solution:

$$A_0 = 100\,000,\ r = \frac{0.075}{12} = 0.0625,\ D = 1200$$

Using $A_{n+1} = A_n(1 + r) - D$:

$A_1 = 100000(1 + 0.00625) - 1200 = 99425$

$A_2 = A_1(1 + 0.00625) - 1200 = 98846.41$

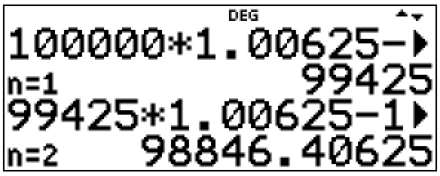


Press [2nd] [set op].

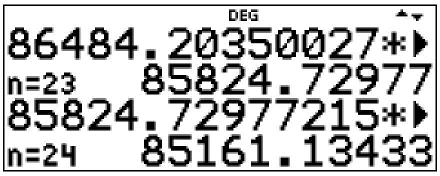
[If required, press [clear] to clear any previously stored operations.]

Press [×] and enter **1.00625** [−] **1200** [enter].

Enter **100000** and press [2nd] [op].



Press [2nd] [op] until the iteration counter shows **n = 24** (corresponding to the end of two years).



The amount owing after two years is $\$85161$ (correct to the nearest dollar).

5 Statistical analysis

Press [data] to enter and edit lists (see page 21 for the data editor and list formulas feature).

Press [2nd] [stat-reg/distr] to access the **STAT-REG** (statistics-regressions) menu.

The **STAT-REG** menu contains the following useful options for NSW Stage 6 Mathematics Standard.

StatVars displays a secondary menu of the last calculated statistical result variables. Use ⏷ and ⏶ to locate the desired variable and press [enter] to select it.

The statistical variables are defined in the following table.

Variables	Definition
n	Number of x or (x, y) data points.
$\bar{\mathbf{x}}$ or $\bar{\mathbf{y}}$	Mean of all x or y values.
$\mathbf{s_x}$ or $\mathbf{s_y}$	Sample standard deviation of x or y.
$\boldsymbol{\sigma_x}$ or $\boldsymbol{\sigma_y}$	Population standard deviation of x or y
$\sum \mathbf{x}$ or $\sum \mathbf{x}^2$	Sum of all x or x^2 values.
$\sum \mathbf{y}$ or $\sum \mathbf{y}^2$	Sum of all y or y^2 values.
$\sum \mathbf{xy}$	Sum of $(x \times y)$ 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.
MinX or **MaxX**	Minimum or maximum of x-values.
Q1	Lower quartile (median of the elements between **MinX** and **Med**).
Med	Median of all data points.
Q3	Upper quartile (median of the elements between **Med** and **MaxX**).
MinY or **MaxY**	Minimum or maximum of y-values.

1-VAR STATS analyses statistical data from one dataset with one measured variable, x. Frequency data may be included.

2-VAR STATS analyses paired statistical data from two datasets with two measured variables, the independent variable, x and the dependent variable, y. Frequency data may be included. **2-VAR STATS** also calculates a least-squares regression equation, displaying values for $\mathbf{a}$ (slope), $\mathbf{b}$ (y-intercept), $\mathbf{r}^2$ (if needed) and $\mathbf{r}$ (Pearson's correlation coefficient).

LinReg ax+b calculates a least-squares regression equation, $y = ax + b$. It displays values for $\mathbf{a}$ (slope), $\mathbf{b}$ (y-intercept), $\mathbf{r}^2$ (if needed) and $\mathbf{r}$ (Pearson's correlation coefficient).

Regressions store the regression information, along with the two-variable statistics for the data in **StatVars**.

A regression equation can be stored to $f\,(x)$ or $g\,(x)$.

To obtain one-variable or two-variable statistics for a dataset entered into **L1**, **L2** or **L3**:

Press [2nd] [stat-reg/distr].

Select **1-VAR STATS** or **2-VAR STATS** and press [enter].

Select **L1**, **L2** or **L3** and the frequency (**FREQ**).

Press [enter] to display the menu of statistical variables with their values.

5.1 Data analysis (MS-S1)

5.1.1 Classifying and representing data (grouped and ungrouped)

Students are expected to describe and use appropriate data collection methods for populations or samples. One such sampling method is simple random sampling.

A random sample occurs when all members of a given population have an equal chance of being selected.

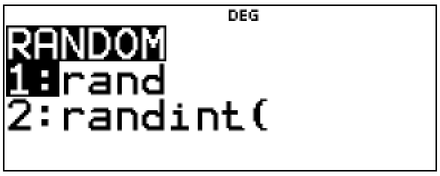
For any given population, a sample that is selected free of bias, using random numbers is called a simple random sample.

For example, a simple random sample (SRS) of 10 students (the sample) from a HSC Mathematics Standard 2 class of 28 students (the population) can be made by assigning each student a number, placing all 28 numbers in a hat and then selecting 10 numbers from the hat 'at random'.

Random number generators can help in generating sets of suitable random numbers.

The TI-30X Plus MathPrint™ can be used to obtain data by sampling using a pseudo-random number generator.

Press [2nd] [random] to access **rand** and **randint**.



The command **rand** generates a pseudo-random number between 0 and 1. These pseudo-random numbers are generated by a formula.

To initiate this formula, the TI-30X Plus MathPrint™ uses a starting value called a seed and then generates 'random' numbers based upon this seed. This process is known as seeding the calculator.

If two or more TI-30X Plus MathPrint™ 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 numbers, store an integer (seed value) ≥ 0 to **rand**. The seed value changes every time a number is generated.

Example: Seeding the TI-30X Plus MathPrint™

This example shows how to seed the TI-30X Plus MathPrint™.

By using the integer 4, seed the TI-30X Plus MathPrint™ to generate a 'random' number between 0 and 1.

Teacher Note: It is important to decide whether you want students generating the same set of 'random' numbers or different sets of 'random' numbers. It is mostly desirable to have each student generating a different set of 'random' numbers. To achieve this, assign each student a different seed value and follow the instructions below. For example, students could enter their mobile phone number as a seed value. Note that the leading zero is not required.

Keystrokes and solution:

Enter **4** and press [sto→] [2nd] [random] [1] [enter].

To generate a 'random' number between 0 and 1:

Press [2nd] [random] [1] [enter].

Press [enter] to generate further 'random' numbers between 0 and 1.

The command **randint(** generates a 'random' integer between two integers, a and b, where $a \leq \text{randint} \leq b$. The syntax involves the use of a comma (press [2nd] [,]) to separate the two integers. For example, **randint (1,6)** will generate a 'random' integer between 1 and 6 inclusive.

Example: Generating 'random' integers between 1 and 6 inclusive

This example shows how to use a calculator to generate 'random' integers between 1 and 6 inclusive.

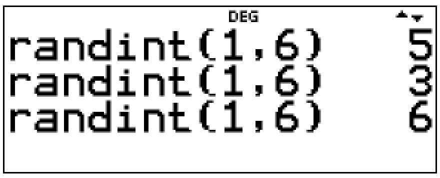
Generate some 'random' integers on the TI-30X Plus MathPrint™ between 1 and 6 inclusive.

Teacher Note: Generating 'random' integers between 1 and 6 inclusive simulates the rolling of an unbiased six-sided die and can be used to play games such as Greedy Pig.

Keystrokes and solution:

Press [2nd] [random] [2] and enter **1** [2nd] [,] **6** [)] [enter].

Press [enter] to generate further 'random' integers between 1 and 6.



Example: Generating a simple random sample (SRS)

This example shows how to use a calculator to generate a simple random sample.

Rachael wishes to determine the opinion of her year level's 80 students about whether they should have the valedictory dinner before or after the end-of-year exams.

Describe how Rachael could select a simple random sample (SRS) of 20 students with a TI-30X Plus MathPrintTM to obtain results which are likely to represent the views of the entire year level.

Teacher Note: In the event of obtaining repeat 'random' integers in the sample, 25 'random' integers can be generated with any repeat 'random' integers discarded. In this example, 25 'random' integers are generated.

Keystrokes and solution:

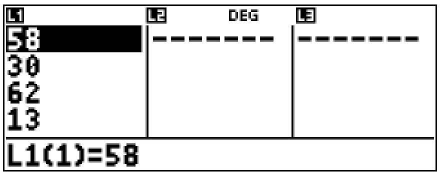
Press [data]. Press [data] [4] to clear all lists.

Press [data] [◄] [3]. Select **L1** and press [enter].

Press [2nd] [random] [2] and enter **1** [2nd] [,] **80** [)].

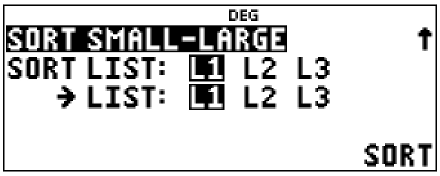
Complete the sequence set-up as shown, scroll down to select **SEQUENCE FILL** and press [enter].

The generated random sample should now be displayed in **L1**.

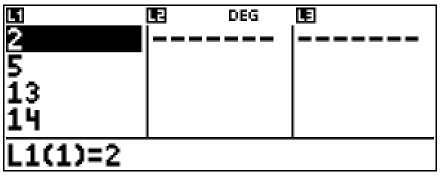


To help detect the presence of any repeat values, the 'random' integers in **L1** can be ordered from smallest to largest (or largest to smallest).

Press [data] [◄] [1] to select **SORT Sm-Lg**.



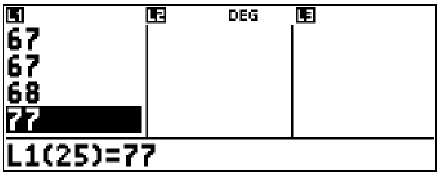
Complete the sorting set-up as shown, scroll down to select **SORT** and press [enter].



The following students were selected in the sample:

2, 5, 13, 14, 18, 19, 22, 24, 25, 28,
30, 43, 46, 47, 58, 62, 64, 66, 67, 68

Considering repeats, 77 was not required.



Students are expected to organise and display data into appropriate tabular representations, for example, cumulative frequency distribution tables.

Example: Calculating cumulative frequencies

This example shows how to use a calculator to generate cumulative frequencies from a frequency table.

A researcher interviewed commuters, asking how often they caught a bus in the last week.

The following table shows the results of the survey.

Number of days	Number of commuters (frequency)	Cumulative frequency
0	8	
1	16	
2	22	
3	14	
4	20	
5	32	
6	8	
7	4	

(a) Use the TI-30X Plus MathPrint™ last answer feature to calculate the cumulative frequencies.

(b) How many people caught a bus on four days or less?

Teacher Note: Students should realise that for the first data value, the cumulative frequency is the same as the frequency. For subsequent values, they should realise to add the frequency for that value to the previous total. This example shows how the last answer feature preserves continuity in calculations.

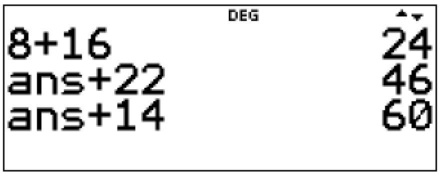
Keystrokes and solution:

Enter **8** and press [+] **16** [enter].

8 + 16 = 24

Press [+] and enter **22** [enter].

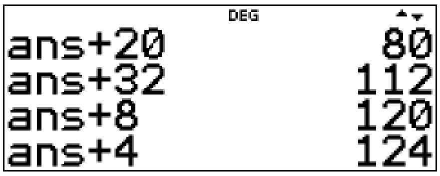
24 + 22 = 46



Continuing the same process:

46 +16 = 60

60 + 20 = 80



80 + 32 = 112

112 + 8 = 120

120 + 4 = 124

The cumulative frequency column can now be filled in.

(b) The relevant row from the table is:

4	20	60 + 20 = 80

80 commuters caught the bus on four days or less.

5.1.2 Summary statistics

Students are expected to:

- calculate measures of central tendency, including the arithmetic mean and the median and use them to compare datasets in real-world contexts.
- calculate measures of spread including the range, interquartile range (IQR) and standard deviation
- investigate and describe the effect of outliers on summary statistics (for example, use of $Q_1 - 1.5 \times IQR$ and $Q_3 + 1.5 \times IQR$ as criteria), on the mean and median.
- complete a five-number summary for different datasets.

Example: Comparing the central tendency and spread of two datasets

This example shows how to use a calculator to compare data displays using mean and median to describe and interpret centre (location) and quartiles, interquartile range and standard deviation to describe and interpret spread.

Two companies, A and B, produce packets of chips which are labelled as having a weight of 50 grams. A random sample of 10 packets is taken from each company. Each packet is weighed and the results, in grams, are as follows.

Company A: 50.0, 50.6, 50.0, 50.4, 49.2, 49.0, 51.4, 50.1, 47.4, 51.9

Company B: 51.0, 50.9, 51.1, 51.5, 51.3, 50.2, 50.6, 50.0, 50.5, 50.9

(a) For each company's data, use the TI-30X Plus MathPrint™ to calculate the

(i) sample mean weight.

(ii) sample standard deviation. Give your answer correct to two decimal places.

(iii) five-number summary ([minimum, Q1, median, Q3, maximum]).

(b) For Company A, are the weights of any of the packets in the sample considered outliers by the '$1.5 \times IQR$' rule?

(c) What, if anything, can be concluded about the manufacturing processes of the two companies?

Teacher Note: Numerical comparisons should be made in conjunction with graphical comparisons of two datasets, for example, with parallel box plots.

Keystrokes and solution:

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

Enter the Company A data in **L1**. Start by entering **50.0** and pressing [▼] (or [enter]).

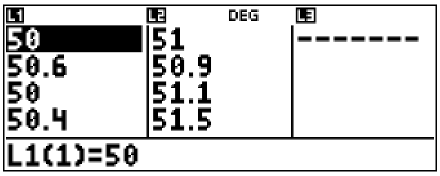
Press [►] to scroll across to the top of **L2**.

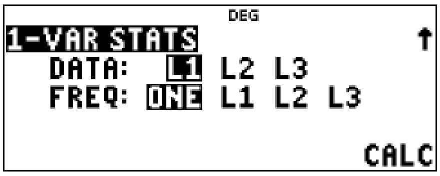
Enter the Company B data in **L2**. Start by entering **51.0** and pressing [▼] (or [enter]).

Press [2nd] [stat-reg/distr] to access the statistics menu.

Press [2] to access **1-VAR STATS**. Select **L1** and press [enter].

Press [▼] [enter] (**CALC**) to calculate the results for Company A.





(a) (i) Company A

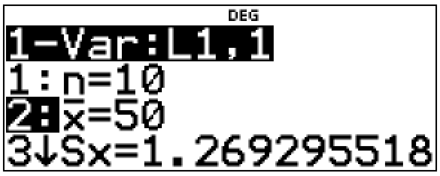
$\bar{x} = 50$ (grams)

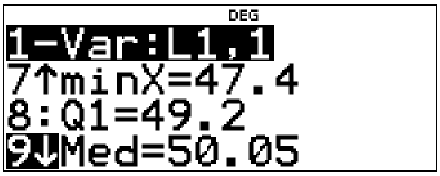
(a) (ii) Company A

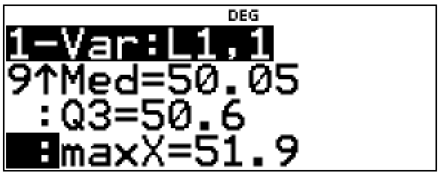
$s = 1.27$ (grams) (correct to two decimal places)

(a) (iii) Company A

The five-number summary is $[47.4, 49.2, 50.05, 50.6, 51.9]$.



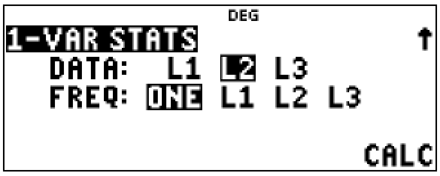




Press [2nd] [stat-reg/distr] to access the statistics menu.

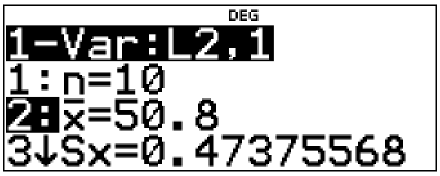
Press [2] to access **1-VAR STATS**. Select **L2** and press [enter].

Press [▼] [enter] (**CALC**) to calculate the results for Company B.



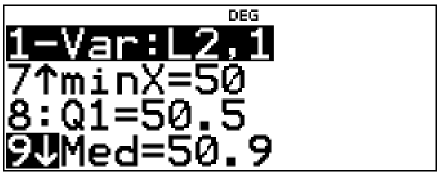
(a) (i) Company B

$\bar{x} = 50.8$ (grams)



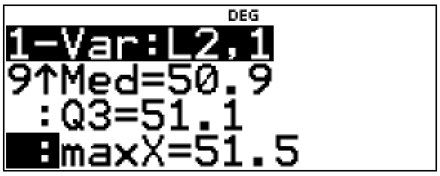
(a) (ii) Company B

s = 0.47 (grams) (correct to two decimal places)

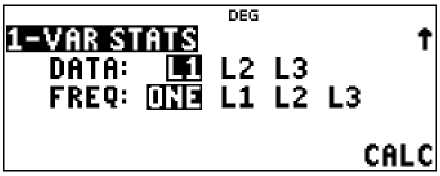


(a) (iii) Company B

The five-number summary is [50, 50.5, 50.9, 51.1, 51.5].



Press [2nd] [stat-reg/distr] [2] to access **1-VAR STATS**.



Ensure **L1** is selected and press [enter].

Press [▼] [enter] (**CALC**) to again access the results for Company A.

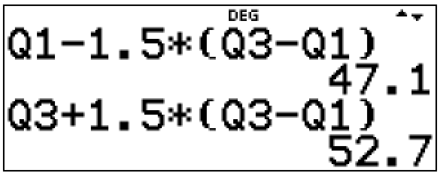
Press [8] (or scroll up or down and select **Q1**) and press [enter] [−] **1.5** [×] [(] [2nd] [stat-reg/distr] [1].

Scroll up or down to select **Q3** and press [enter] [−] [2nd] [stat-reg/distr] [1] [8] [)] [enter].

The home screen should show **Q1 – 1.5 * (Q3 – Q1).**

Press [▲] [▲] to select **Q1 – 1.5 * (Q3 – Q1)** and press [enter]. Press [2nd] [◄], edit the new author line to form **Q3 + 1.5 * (Q3 – Q1)** and press [enter].

(b) Company A



$Q_1 - 1.5 \times IQR = 47.1$ (grams)

$Q_3 + 1.5 \times IQR = 52.7$ (grams)

None of the packets in the sample are considered outliers by the '$1.5 \times IQR$' rule.

(c) Company A produces packets of chips with a weight centred closer to 50 grams than Company B, but with greater variation (using the sample standard deviation and/or the IQR) in the weights. Company B produces packets of chips with a weight centred slightly greater than 50 grams whereas some of the packets produced by Company A are less than 50 grams.

Example: Effect of outliers on the mean and median

This example shows how to use a calculator to investigate and recognise the effect of outliers on the mean and median.

A group of 10 students had their hand span measured and recorded to the nearest cm.

The measurements are as follows: $16, 15, 18, 20, 15, 15, 14, 17, 23, 17$

(a) Use the TI-30X Plus MathPrint™ to calculate the mean and the median.

(b) Confirm that 23 is an outlier.

Remove 23 from the dataset.

(c) Use the TI-30X Plus MathPrint™ to calculate the new mean and new median of the dataset. Give the new mean correct to two decimal places.

(d) Describe the effect the outlier had on the

(i) mean.

(ii) median.

Teacher Note: It is important that students understand how the mean and median are calculated when examining the effects of outliers.

Keystrokes and solution:

(a) Press [data]. Press [data] [4] to clear all lists.

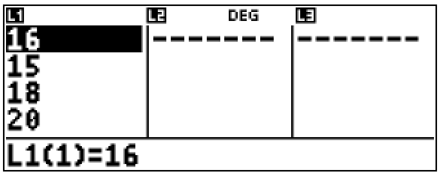
Enter the hand span data in **L1**. Start by entering **16** and pressing ⊝ (or [enter]).

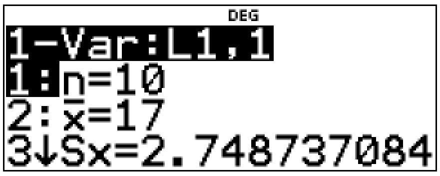
Press [2nd] [stat-reg/distr] to access the statistics menu.

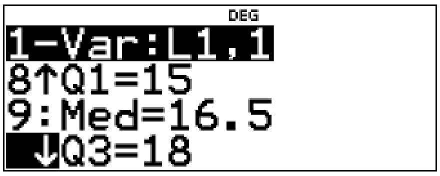
Press [2] to access **1-VAR STATS**. Select **L1** and press [enter].

Press ⊝ [enter] (**CALC**) to calculate the results.

$\bar{x} = 17$ (cm) and the median is 16.5 (cm).







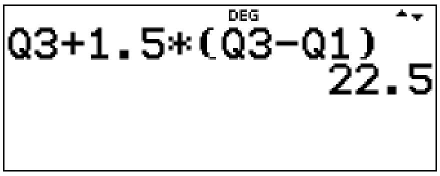
(b) Scroll up or down to select **Q3** and press [enter].

Press [+] and enter **1.5** [×] [(] [2nd] [stat-reg/distr] [1].

Scroll up or down to select **Q3** and press [enter].

Press [−] [2nd] [stat-reg/distr] [1] [8] [)] [enter].

The home screen should show **Q3 + 1.5 * (Q3 – Q1).**



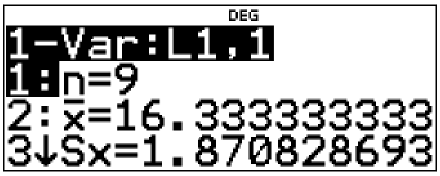
$Q_3 + 1.5 \times IQR = 22.5$ (cm)

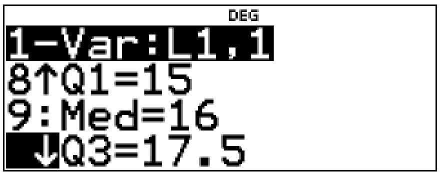
$23 > 22.5$ and hence 23 is an outlier by this definition.

(c) Press [data], scroll down **L1** to select 23 and press [delete].

Press [2nd] [stat-reg/distr] [2], ensure **L1** is selected and press [enter] [⊖] [enter] (**CALC**) to calculate the new results.

$\bar{x} = 16.33$ (cm) and the median is 16 (cm).





(d) (i) Removing the outlier had a small effect on the mean, decreasing it from 17 to 16.33.

A decrease of 0.67.

(d) (ii) Removing the outlier had a small effect on the median, decreasing it from 16.5 to 16.

A decrease of 0.5 (a smaller decrease than on the mean).

5.2 Relative frequency and probability (MS-S2)

Students are expected to:

- solve problems involving simulations or trials of experiments in a variety of contexts.
- perform simulations of experiments using technology.
- use relative frequency as an estimate of probability.
- recognise that an increasing number of trials produces relative frequencies that gradually become closer in value to the theoretical probability.

Example: Simulating 50 trials of rolling two unbiased six-sided dice

This example shows how to use a calculator to simulate 50 trials of rolling two unbiased six-sided dice.

Use the TI-30X Plus MathPrint™ data editor and list formulas feature to

(a) simulate 50 trials of rolling two unbiased six-sided dice, taking the result from each die in each trial and adding the two results together to obtain a score.

(b) find the sample mean score, $\bar{x}$, for these 50 trials.

Teacher Note: Such simulations encourage comparison of experimental probabilities and results with theoretical probabilities and considerations. Entering the formula **randint(1,6)** + **randint(1,6)** on the TI-30X Plus MathPrint™ home screen simulates the rolling of two unbiased six-sided dice. Press [enter] to perform further trials.

Keystrokes and solution:

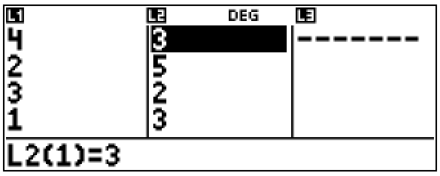
(a) Press [data]. Press [data] [4] to clear all lists.

Press [data] [◄] [3]. Select **L1** and press [enter].

Press [2nd] [random] [2] and enter **1** [2nd] [,] **6** [)].

Complete the sequence set-up as shown, scroll down to select **SEQUENCE FILL** and press [enter].

The results for the first die should now be displayed in **L1**.

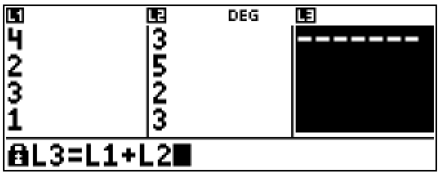


Press [►] to scroll across to the top of **L2**.

Press [data] [◄] [3]. Select **L2** and press [enter].

Scroll down to select **SEQUENCE FILL** and press [enter].

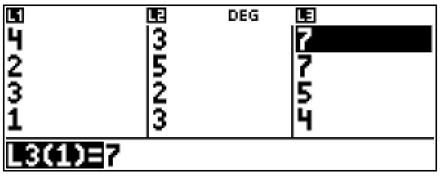
The results for the second die should now be displayed in **L2**.



Press [►] to scroll across to the top of **L3**.

Press [data] [►] to select **FORMULA** and press [enter].

Enter the list formula **L1 + L2** to **L3**.

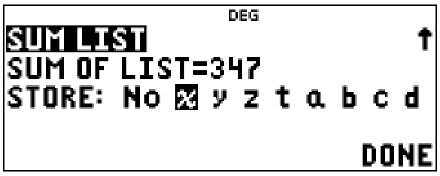


Press [data] [enter] to paste **L1** into the author line.

Press [+] and press [data] [2] to paste **L2** into the author line. Press [enter].

L3 should now show the scores in each of the 50 trials.

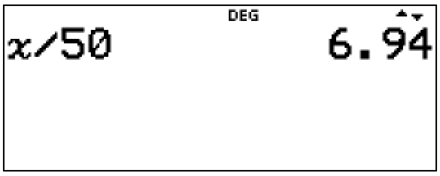
(b) To find the sum of **L3**, press [data] ◄ [4]. Select **L3** and press [enter]. Press [enter] (**CALC**).



The sum is 347.

Store the sum as x, select **DONE** and press [enter].

Press [2nd] [quit] to return to the home screen.



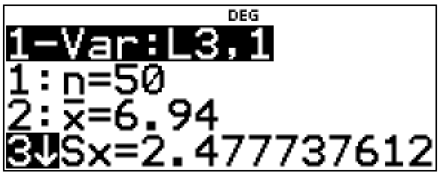
Press [x^{yzt}_{abcd}] to paste x. Press [÷] and enter **50**.

$\overline{x} = 6.94$

Note: Use of [$\frac{\square}{\square}$] gives $\overline{x} = \dfrac{347}{50}$.

Alternatively:

Press [2nd] [stat-reg/distr] to access the statistics menu.



Press [2] to access **1-VAR STATS.** Select **L3** and press [enter]. Press ▼ [enter] (**CALC**).

$\overline{x} = 6.94$

Example: Theoretical outcome of an experiment

This example shows how to use a calculator to find the theoretical outcome (for example, mean score) of an experiment.

Consider the following experiment.

Two unbiased six-sided dice are rolled, the result from each die noted and the two results added together to obtain a score.

(a) By listing the sample space, verify the theoretical probabilities shown in the following table.

Score	2	3	4	5	6	7	8	9	10	11	12
Probability	$\frac{1}{36}$	$\frac{2}{36}$	$\frac{3}{36}$	$\frac{4}{36}$	$\frac{5}{36}$	$\frac{6}{36}$	$\frac{5}{36}$	$\frac{4}{36}$	$\frac{3}{36}$	$\frac{2}{36}$	$\frac{1}{36}$

(b) Use the TI-30X Plus MathPrint™ data editor and list formulas feature and one-variable statistics feature to find the theoretical mean score of the experiment.

(c) Compare your part (b) answer with the sample mean score, $\overline{x}$, obtained from simulating 50 trials of rolling two unbiased six-sided dice, taking the result from each die in each trial and adding the two results together to obtain a score.

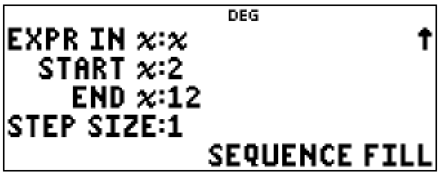
Teacher Note: Activities like the simulation conducted in the previous example and the theoretical situation considered in this example should help students recognise the difference between relative frequencies and theoretical probabilities. It is also important to conduct activities that demonstrate that increasing the number of trials produces relative frequencies that gradually become closer in value to the theoretical probability.

Keystrokes and solution:

(a) For example, a score a 3 can be obtained by rolling $\{1,2\}$ or $\{2,1\}$.

There are 36 total possible outcomes so the probability of obtaining a 3 is $\frac{2}{36}\left(=\frac{1}{18}\right)$.

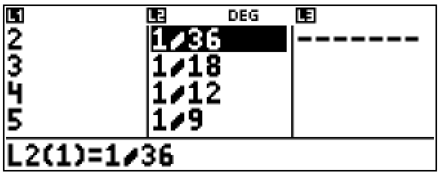
(b) Press [data]. Press [data] [4] to clear all lists.



Press [data] [◄] [3]. Select **L1** and press [enter].

Press [x^{yzt}_{abcd}] to paste x, complete the sequence set-up as shown, scroll down to select **SEQUENCE FILL** and press [enter].

These eleven scores should now be displayed in **L1**.



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

Enter the probabilities to **L2**.

To enter the first probability, enter **1** and press [▭/▭].

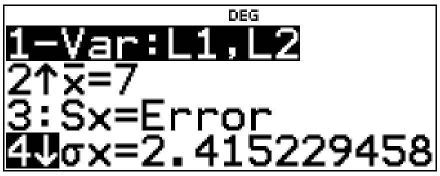
Note: If [÷] is used in this example, all probabilities will be in decimal form.

Enter **36** and press [enter]. Repeat this for the other ten probabilities.

L2 should now display the eleven probabilities.

Press [2nd] [stat-reg/distr] to access the statistics menu.

Press [2] to access **1-VAR STATS**.



Select **L1** for **DATA**, select **L2** for **FREQ** and press [enter].

Press [enter] (**CALC**).

The theoretical mean score is 7.

(c) Answers for $\overline{x}$ may vary.

For example, $E(X) = 7$ and $\overline{x} = 6.94$ are similar values.

Students are expected to calculate the expected frequency of an event occurring using np where n represents the number of times an experiment is repeated, and on each of those times the probability that the event occurs is p.

Expected frequency is the number of times that a particular event should occur.

Example: Expected frequencies

This example shows how to use a calculator to calculate the expected frequency of an event occurring.

Consider the following experiment.

Two unbiased six-sided dice are rolled, the result from each die noted and the two results added together to obtain a score.

The sample space and associated probabilities are shown in the following table.

Score	2	3	4	5	6	7	8	9	10	11	12
Probability	$\frac{1}{36}$	$\frac{2}{36}$	$\frac{3}{36}$	$\frac{4}{36}$	$\frac{5}{36}$	$\frac{6}{36}$	$\frac{5}{36}$	$\frac{4}{36}$	$\frac{3}{36}$	$\frac{2}{36}$	$\frac{1}{36}$

900 trials of this experiment are to be conducted.

Use the TI-30X Plus MathPrint™ data editor and list formulas feature to calculate the expected frequency of each event in the sample space occurring.

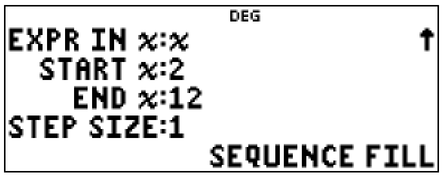
Teacher Note: Remind students that the expected frequency may not match the results from an experiment (simulation). For example, if a coin is tossed 200 times, the expected number of tails is 100. However, tossing a coin 200 times may not result in obtaining exactly 100 tails. The larger the number of trials, the closer the experimental frequency should be to the expected frequency. Also remind students that the expected frequency may not be a whole number.

Keystrokes and solution:

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

Press [data] ◄ [3]. Select **L1** and press [enter].

Press [x^{yzt}_{abcd}] to paste x, complete the sequence set-up as shown, scroll down to select **SEQUENCE FILL** and press [enter].



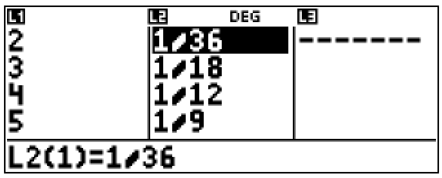
These eleven scores should now be displayed in **L1**.

Press ► to scroll across to the top of **L2**.

Enter the probabilities to **L2**.

To enter the first probability, enter **1** and press [n/d].

Note: If [÷] is used in this example, all probabilities will be in decimal form.

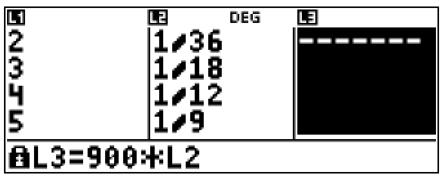


Enter **36** and press [enter]. Repeat this for the other ten probabilities.

L2 should now display the eleven probabilities.

Press ► to scroll across to the top of **L3**.

Press [data] ► to select **FORMULA** and press [1].

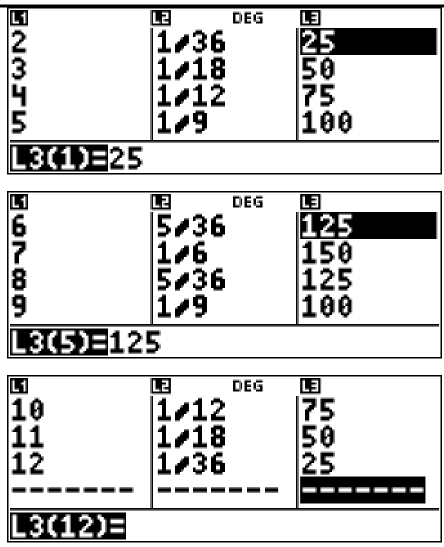


Enter the list formula **900 * L2** to **L3**.

Enter **900** and press [×]. Press [data] [2] to paste **L2** into the author line. Press [enter].

L3 should now display the expected frequencies.

Score	Expected frequency
2	25
3	50
4	75
5	100
6	125
7	150
8	125
9	100
10	75
11	50
12	25



5.3 Bivariate data analysis (MS-S4)

Students are expected to:

- calculate and interpret Pearson's correlation coefficient (r) using technology to quantify the strength of a linear association of a sample.
- fit a least -squares regression line to a dataset using technology and to interpret the intercept and gradient of the fitted line.
- make predictions by either interpolation or extrapolation and to recognise the limitations of interpolation and extrapolation.

Example: Pearson's correlation coefficient and least-squares regression

This example shows how to use a calculator to calculate Pearson's correlation coefficient and to interpret its value. It also shows how to calculate and use a least-squares regression line.

The length measurements (correct to the nearest cm) of the femur bone and humerus bone of a particular species of fossil are shown in the following table.

Femur length (x)	60	57	65	39	75
Humerus length (y)	71	64	73	42	85

(a) Use the TI-30X Plus MathPrint™ to determine Pearson's correlation coefficient, giving your answer correct to two decimal places. Comment on the direction and strength of association.

(b) Use the TI-30X Plus MathPrint™ to determine the least-squares regression line. Give your answer in the form $y = ax + b$, where a,b are expressed correct to two decimal places.

(c) Interpret the gradient of the least-squares regression line found in part (b).

(d) Use the least-squares regression line found in part (b) to estimate the length of a humerus bone of this species of fossil whose femur length is 48 cm. Give your answer correct to the nearest centimetre.

Teacher Note: Given reliable (unbiased) data, a line of best fit can reasonably be used for interpolation. Students should be made aware of the dangers of using a line of best fit for extrapolation.

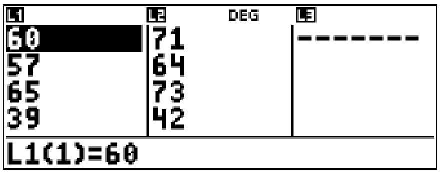
Keystrokes and solution:

(a) Press [data]. Press [data] [4] to clear all lists.

Enter the femur bone lengths in **L1**. Start by entering **60** and pressing ⊝ ([enter]).

Press ⊕ to scroll across to the top of **L2**.

Enter the humerus bone lengths in **L2**. Start by entering **71** and pressing ⊝ (or [enter]).



METHOD 1:

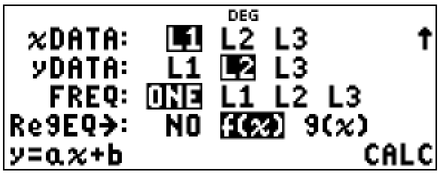
Press [2nd] [stat-reg/distr] to access the statistics menu.

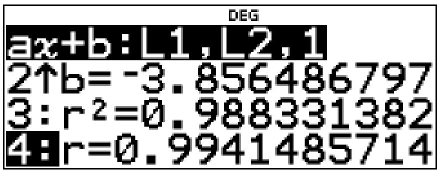
Press [4] to access **LinReg a*x*+b**.

Select the options as shown at right and press [enter] (**CALC).**

$r = 0.99$ (correct to two decimal places)

This reflects a (very) strong positive association.





METHOD 2:

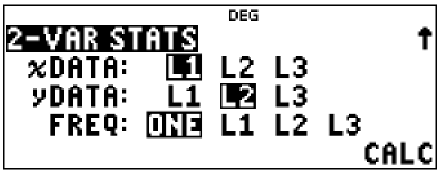
Press [2nd] [stat-reg/distr] to access the statistics menu.

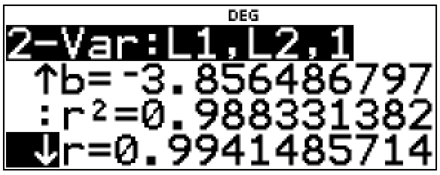
Press [3] to access **2-VAR STATS**.

Select **L1** for ***x*DATA** and select **L2** for ***y*DATA**.

Press ⊝ to select **CALC** and press [enter]. Scroll up or down.

$r = 0.99$ (correct to two decimal places)



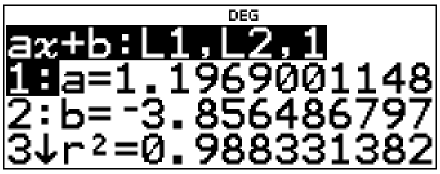


(b) Press [2nd] [stat-reg/distr] to access the statistics menu.

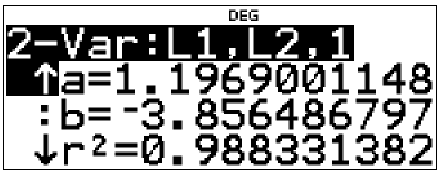
Either by using **LinReg a*x*+b** or **2-VAR STATS**, we obtain:

$a = 1.196\ldots$ and $b = -3.856\ldots$

The least-squares regression line is $y = 1.20x - 3.86$ (correct to two decimal places).



(c) The humerus length increases by 1.2 cm (correct to one decimal place) for each increase of 1 cm in femur length.v

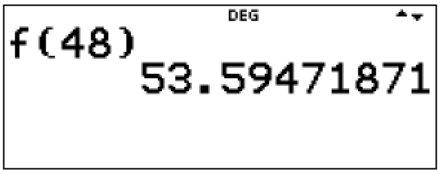


(d)

METHOD 1:

With the least-squares regression equation stored as $f(x)$, press [table] [2] and enter **48**. Press [)] [enter].

Correct to the nearest centimetre, the humerus bone length is estimated to be 54 cm.

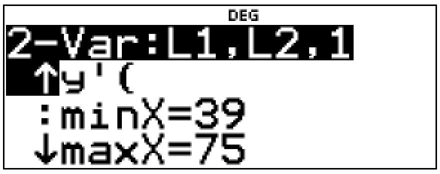


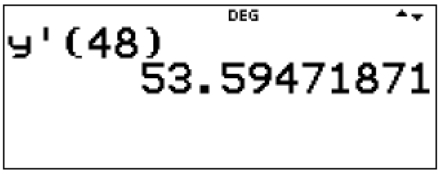
METHOD 2:

Press [2nd] [stat-reg/distr] to access the statistics menu.

In **StatVars**, scroll up or down to locate **y' (** and press [enter]. Enter **48** and press [)] [enter].

Correct to the nearest centimetre, the humerus bone length is estimated to be 54 cm.





5.4 The normal distribution (MS-S5)

Students are expected to calculate the z-score corresponding to a particular value in a dataset and use calculated z-scores to compare scores from different datasets.

If a dataset has a mean $\bar{x}$ and a standard deviation s, then any score x has a z-score given by $z = \frac{x - \bar{x}}{s}$.

A z-score provides a measure of how extreme a particular score is relative to the mean.

It is the number of standard deviations a score lies above or below the mean.

The set of z-scores for data arising from a random variable that is normally distributed has a mean of 0 and a standard deviation of 1.

Example: Calculating *z*-scores from a dataset

This example shows how to use a calculator to calculate z-scores from a dataset.

The weights of strawberries are known to have a mean of 14.3 grams and a standard deviation of 0.8 grams.

Five strawberries were randomly sampled (labelled S1 to S5) from a batch.

Their weights (in grams) are shown in the following table.

S1	S2	S3	S4	S5
12.9	15.1	16.2	13.7	14.5

(a) Use the TI-30X Plus MathPrint™ data editor and list formulas feature to convert each of the sample weights to z-scores.

(b) Relative to the mean weight, rank the strawberries from the most extreme to the least extreme.

Teacher Note: Remind students that the larger the z-score (ignoring the positive or negative), the further away it is from the centre of the data. This makes comparisons easier to make.

Keystrokes and solution:

(a) Store the mean as a.

Enter **14.3** and press [sto→] and press [x^{yzt}_{abcd}] until a appears, then press [enter]

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

Enter **12.9** and press ⊖. Repeat for **15.1, 16.2, 13.7** and **14.5.**

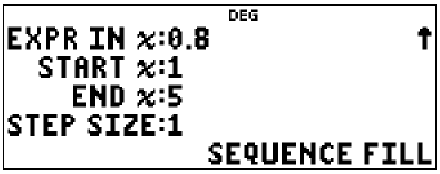
The five weights should now be displayed in **L1**.

Press ⊳ to scroll across to the top of **L2**. Press [data] ⊲ [3].

Select **L2** and press [enter].

Use the sequence feature to enter **0.8** five times in **L2**.

Complete the sequence set-up as shown at right, scroll down to select **SEQUENCE FILL** and press [enter].

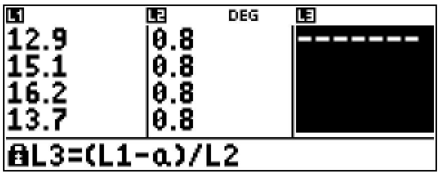


These five values should now be displayed in **L2**.

Press ⊳ to scroll across to the top of **L3**.

Press [data] ⊳ to select **FORMULA** and press [1].

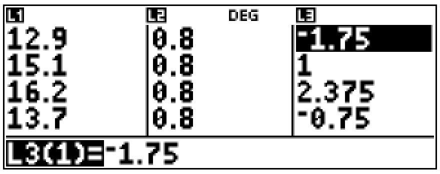
Enter the list formula **(L1 – a) / L2** to **L3**.



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

Press [−] and press [x^{yzt}_{abcd}] until a appears.

Press [)] [÷] and press [data] [2] to paste **L2** into the author line. Press [enter].

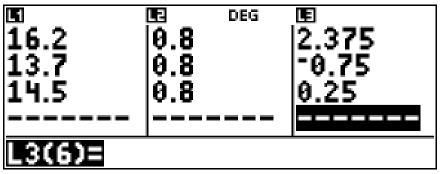


L3 should now display the five z-scores.

S1 is $z = -1.75$. S2 is $z = 1$.

S3 is $z = 2.375$. S4 is $z = -0.75$.

S5 is $z = 0.25$.



b) Ranking from most to least extreme: S3, S1, S2, S4, S5

Students are expected to use z-scores to identify probabilities of events less or more extreme than a given event and to use technology to determine probabilities.

In a normal distribution:

68% of scores have a z-score between -1 and 1.

95% of scores have a z-score between -2 and 2.

99.7% of scores have a z-score between –3 and 3.

Press [2nd] [stat-reg/distr] ▶ to display the **DISTR** (distributions) menu which has the following distribution functions for NSW Stage 6 Mathematics Standard 2:

Normalcdf

Calculates the normal distribution probability between **LOWERbnd** and **UPPERbnd** for a given mean **mu** and standard deviation **sigma**. The defaults are **mu = 0** and **sigma = 1** with **LOWERbnd = -1E99** and **UPPERbnd = 1E99**. These bounds represent $-\infty$ to ∞.

Example: Normal distribution

This example shows how to use a calculator to calculate a normal distribution probability.

Random variable X has a normal distribution with mean $\mu = 28$ and standard deviation $\sigma = 1.7$.

Use the TI-30X Plus MathPrint™ to find $P\,(24.6 \le X \le 31.4)$.

Give your answer correct to four decimal places.

Teacher Note: A rough sketch of a normal curve can be extremely useful. The symmetry of the normal distribution can be used to simplify, clarify or visualise the question.

Keystrokes and solution:

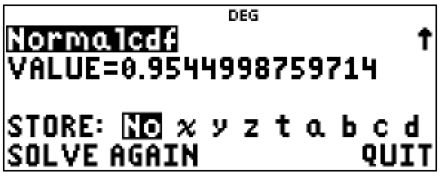
X has a normal distribution with mean $\mu = 28$ and standard deviation $\sigma = 1.7$.

Press [2nd] [stat-reg/distr] ▶ to access the probability distributions menu.

Press [2] to select **Normalcdf**.

Enter the required values for μ and σ and press ▼. Enter **24.6** for the lower bound and enter **31.4** for the upper bound.

Press ▼ to select **CALC** and press [enter].



So $P\,(24.6 \le X \le 31.4) = 0.9545$ (correct to two decimal places).

Press ▼ ▶ to select **QUIT** and press [enter].

6 Error and messages

When the TI-30X Plus MathPrint™ detects an error, the screen will display the error type or a message. To correct an error, press [clear] to clear the error screen. The cursor will display at or near the error where it can be corrected.

To close the error screen without correcting the expression, press [2nd] [quit] to return to the home screen. Examples of errors and messages that you may encounter are outlined below.

Argument

This error is returned when:

- a function does not have the correct number of arguments.
- the lower limit is greater than the upper limit in a summation or a product function.

Bounds: Enter LOWER ≤ UPPER

This error is returned when the input for the lower bound is greater than the upper bound for the **Normalcdf** distribution.

Break

This error is returned when the [on] key is pressed to stop the evaluation of an expression.

Calculate 1-Var, 2-Var Stat or a regression

This message is returned when no statistics or regression calculation has been stored.

Change mode to DEC

This error is returned when the mode is set to **BIN**, **HEX** or **OCT** and the following applications are accessed.

[expr-eval] [table] [convert] [stat-reg/distr] [data]

These applications are available in **DEC** mode only.

Dimension mismatch

This error is returned if:

- the dimensions of the lists used in a data formula are not the same length for the operation.
- a calculation of **2-VAR STATS** is attempted when the data lists are not of equal length.

Domain

This error is returned when an argument is not in the function domain.

- For $x\sqrt{y}$: $x = 0$ or $y < 0$ and x is not an odd integer.
- For y^x: $x, y = 0$.
- For $\sqrt{x}$: $x < 0$.
- For $\log$, $\ln$ or **logBASE**: $x \le 0$.
- For tan: $x = 90°, –90°, 270°, –270°, 450°$ etc. and equivalent for radian mode.
- For $\sin^{-1}$ or $\cos^{-1}$: $|x| > 1$.
- For ${}^nC_r$ and ${}^nP_r$: n or r are not integers ≥ 0.
- For $x!$:x is not an integer between 0 and 69.

Enter 0 ≤ area ≤ 1

This error is returned when you enter an invalid area value in **invNormal** for a distribution.

Enter sigma > 0

This error is returned when the input for sigma in a distribution is required.

Expression is too long

This error is returned when an entry exceeds the digits limits. For example, pasting an expression entry with a constant that exceeds the limit. A checkerboard cursor may display when limits are reached in each MathPrint™ feature.

Formula

This error is returned in [data] when the formula:

- does not contain a list name (**L1**, **L2** or **L3**).
- for a list contains its own list name. For example, a formula for **L1** contains **L1**.

Frequency: Enter FREQ ≥ 0

This error is returned when at least one element in a list selected for **FREQ** is a negative real number in **1-VAR** or **2-VAR STATS**.

Input must be non-negative integer

This error is returned when an input is not the expected number type. For example, in the distribution argument **TRIALS** and x in **Binomialpdf**.

Input must be Real

This error is returned when an input requires a real number.

Invalid data type

This error is returned when the argument of a command or function is the incorrect data type. For example, the error will be displayed for $\sin(i)$ where the argument(s) must be real number(s).

List Dimension 1 ≤ dim(list) ≤ 50

This error is returned when, in [data]:

- the **SUM LIST** function is executed on an empty list.
- a sequence is created with a length of 0 or >50.

Mean: Enter mu > 0

This error is returned when an invalid value is input for the mean in **Poissonpdf** or **Poissoncdf**.

Memory limit reached

This error is returned when a calculation contains a circular reference such as two functions referencing each other, or a very long calculation.

[2nd] [set op]: Operation is not defined

This error is returned when an operation has not been defined in [2nd] [set op] and [2nd] [op] is pressed.

Operation set! [2nd] [op] pastes to home screen

This message is returned when an operation is stored (set) from [2nd] [set op] editor. Press any key to continue.

Overflow

This error is returned when a calculation or value is beyond the range of the TI-30X Plus MathPrint™.

Probability: Enter 0 ≤ *p* ≤ 1

This error is returned when an input for the probability in distributions is invalid.

Statistics

This error is returned when a statistical or regression function is invalid. For example, when a calculation in **1-VAR** or **2-VAR STATS** is attempted with no defined data points.

Step size must not be 0

This error is returned when, in [data], the **STEP SIZE** input is set to 0 in the **SEQUENCE FILL** function.

Syntax

This error is returned when an expression contains misplaced functions, arguments, parentheses or commas.

TRIALS: Enter 0 ≤ *n* ≤49

This error is returned in **Binompdf** and **Binomcdf** when the number of trials is out of range, $0 \leq n \leq 49$ in the case of **ALL**.