# Inquiry Based Learning With CLASSWIZ


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## Preface

This booklet aims to demonstrate that the scientific calculator can support inquiry based learning (IBL) over and above its traditional use in basic computation and recall.

The approach adopted refers to *Casio fx-82EX (CLASSWIZ)* whose features and functions are considered adequate for facilitating such experiential learning activities as observation, recording, manipulation and analysis.

The booklet is intended not only for mathematics but the entire STEM education. Instructors are encouraged to expand on the ideas, within the curriculum, to supplement course books. There could not be a better opportunity to pioneer approaches to instruction that are consistent with the realities of the 21st Century.

It is advisable to take learners through Chapter 1 for them to attain proficiency with the calculator's functions before proceeding to Chapter 2. An emulator that is downloadable from www.casio.edu for use with a projector will be of great help.

The advanced models (*CASIO fx-991EX* and *fx-570EX*) mentioned in the last chapter are for teacher efficiency enhancement and will be found particularly useful in testing, assessment and evaluation exercises. They are also recommended for certain post-secondary education STEM courses.

## Acknowledgement

This booklet was conceived out of a synergy between ideas advanced by the Center for Mathematics, Science and Technology Education in Africa (CEMASTEA) and CASIO GAKUHAN PROJECT. Lots of thanks for your efforts towards 'modernizing' STEM education. Not forgetting CASIO TEAM at SANGYUG ENTERPRISES Ltd. for enabling the project.

## Contents

# 1. How to operate CLASSWIZ[1]

*"Technology is just a tool. In terms of getting the kids working together and motivating them, the teacher is most important."* – Bill Gates –

## 1.1. Some first steps

Slide off the cover, turn it and slide it back so that it forms the base.

Turn ON: 

And to turn   OFF, press:

Pressing SHIFT operates the function OFF above AC. The calculator turns OFF automatically after a few minutes of non-use. Press on to turn it back on.

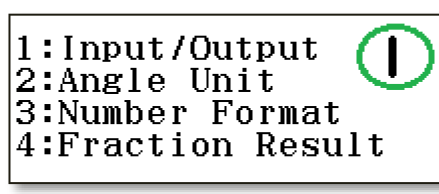
These four keys are used to move the menu icon highlighting, to move the cursor, to replay an input, to scroll the screen and to adjust screen contrast. From left clockwise they are represented by:

◀ ▲ ▶ ▼

Refer to them by the direction they indicate and the function being described, for example, as the: 'left cursor key', 'left icon highlighting key', 'right replay key', 'up scroll key', 'down scroll key', 'right screen contrast adjust key'….

Do not assume malfunctioning if the display is not readable. It could be no more than a contrast issue.

To adjust screen contrast: [SHIFT] [MENU]

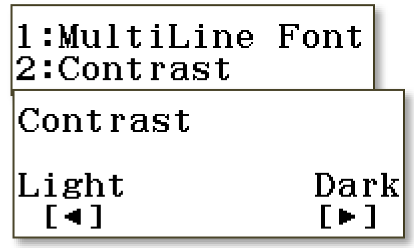



The vertical scroll bar indicates that the menu runs off the screen.

[1] fx-82EX, fx-85EX and fx-350EX are compatibles.

Continuing: ▼ ▼

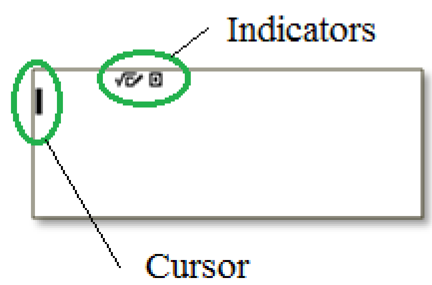
Continuing: [2]




Adjust to a darker contrast using ◄ or to a lighter contrast using ►

If adjusting display contrast does not improve display readability, it probably means that the battery power is low. Replace the battery.

In the default setting, the screen displays:




√□ Indicates that the calculator is in the Natural Textbook Display modes (MathI/MathO or MathI/DecimalO) and D that it is set to calculate in degrees.

Notice the blinking vertical cursor.

Other indicators will be explained in the course of the discussions. Unless otherwise stated, the explanations in this booklet assume that the calculator is in the default setting.

If not in the default setting initialize ALL by pressing [SHIFT] [9] [3] [=] [AC]

You will be doing this RESET operation quite often. No need memorizing it because from RESET, further directions are displayed in an interactive format. The operation initializes all settings except contrast.

## 1.2. Functions and menus.

CLASSWIZ is operated using functions and menus. The markings on or above the keys are called functions. Main or key cap functions are marked in white on the keys. Press a key to operate its key cap function.
Alternate functions are marked in yellow or red above the keys.

Pressing this key followed by a second key operates the alternate function marked in yellow of the second key. SHIFT

S at the top of the screen indicates that the calculator is currently in the SHIFT alternate function mode. The indicator disappears when you press the next key.

Pressing this key followed by a second key operates the alternate function marked in red of the second key. ALPHA

A at the top of the screen indicates that the calculator is currently in the ALPHA alternate function mode. The indicator disappears when you press the next key.

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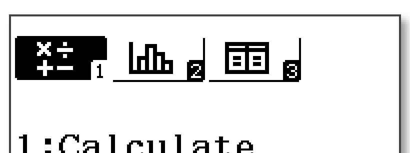
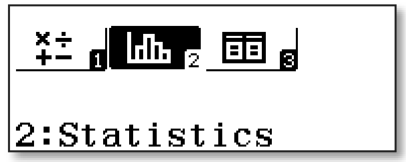
Of the menus, there are main menus, setup menus and sub-menus.

There are three main menus (calculation modes):
1: Calculate – for general calculations.
2: Statistics – for statistical calculations.
3: Table – for generating number tables each based on one or two functions especially for graph work.

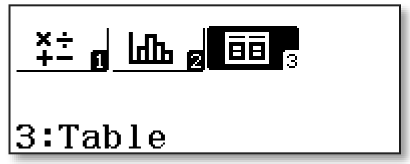
To display the icon highlighting for the Calculate mode: MENU



To move the highlighting to the Statistics mode: ▶




And once more to move it to the Table mode: ▶

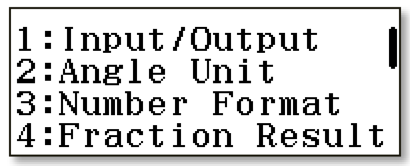



Press the number on the icon highlighting to select the mode.

Main menus are configured using sub-menus. To select a sub-menu, use a setup menu.

To display setup menus: SHIFT MENU

Scroll down for more.

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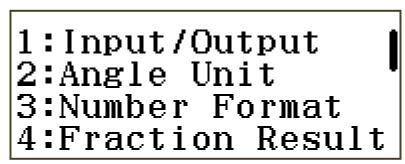
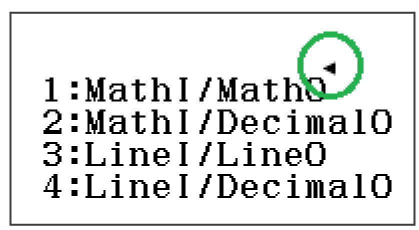
Examples:

1.To select **2: MathI/DecimalO** Sub-menu: SHIFT MENU 1

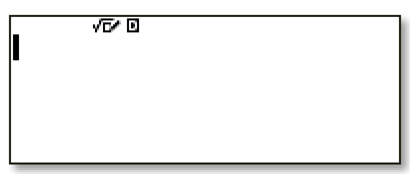



A second screen is displayed:




*The indicator means that the currently displayed menu is a sub-menu and that you press the left scroll key to return to the setup menu.*

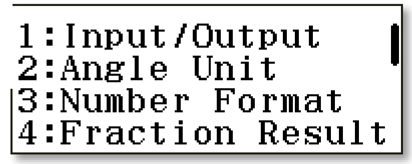
Let us continue…. 2



A blank screen is waiting for you to begin inputting…

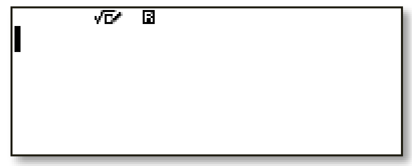
In this setting, results are displayed as decimals.

2. To select **2: Radian** sub-menu: [SHIFT] [MENU] [2]




A second screen is displayed:

Continuing: [2]



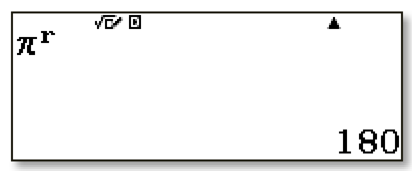
A blank screen awaits you…
Note that R has replaced D!

Calculations are done with the radian as the angle unit.

You can also use [OPTN] to input an angle in radians.
Let us first initialize ALL: [SHIFT] [9] [3] [=] [AC]

The degree is the default angle unit i.e. selected on initializing ALL.

To enter $\pi^r$: [SHIFT] [×10ˣ] [OPTN] [2] [2] [=]




Note that this converts the input angle into the currently indicated angle unit (degrees).

So you can convert degrees into radians by entering degrees when the radian is the selected (displayed) angle unit.

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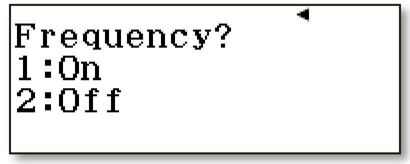
And to select from a different main menu: 2: Statistics or 3: Table?

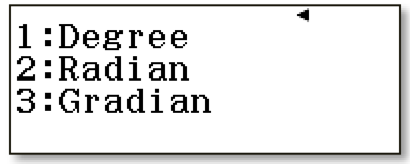
3.To select **Frequency? 1: On**sub-menu of the **2: Statistics** main menu:

This is for performing statistical calculations for data with frequency distribution: [SHIFT] [MENU] [▼]

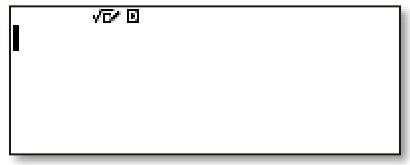
Continuing: [1]




Continuing: [1]

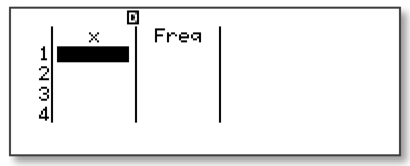



A blank screen…



Continuing: [MENU] [▶] [2] [1]

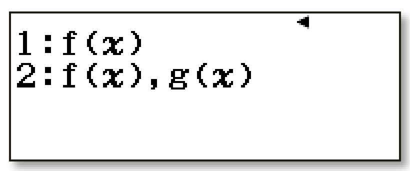
From here you can enter your statistical data and their frequencies.



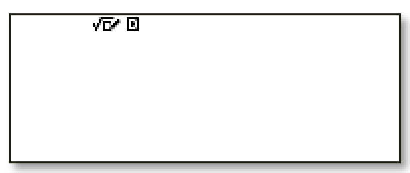

We will come back to this later on.
4.To select **1: f(x)**sub-menu for configuring the **3: Table** main menu:

This is for generating a table of values for a single function: [SHIFT] [MENU] [▼]


Continuing: [2]




Continuing: [1]
A blank screen…

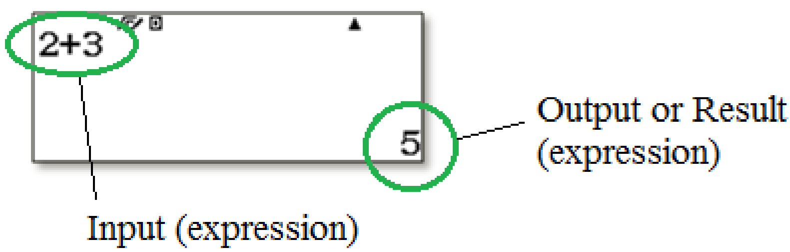


## 1.3. Calculate mode

This sub-chapter discusses how to operate CLASSWIZ for basic calculation and recall in the Calculate mode. This is the default mode; it is automatically selected when you initialize ALL: [SHIFT] [9] [3] [=] [AC]

You can also return to it from the other modes by [MENU] pressing and using [◄] to return the icon highlighting to **1: Calculate** and pressing: [1]
This however does not necessarily reset the calculator to the default mode.

In the context of this booklet, to 'enter'means to input (key in) then press [=] to prompt the calculator to display an output or result (expression).




### <u>1.3.1Number keys</u>

The calculator assumes a positive sign for an input value.
To affix a negative sign press [(−)]
before inputting the value.
The negative sign is not to be confused with [−] which is an operator.


*The subtraction operator may function as a negative sign but the negative sign cannot function as a subtraction operator.*

### <u>1.3.2. Operator keys:</u> [×] [÷] [+] [−]

…and the opening and closing brackets: [(] [)]

…are used to input expressions.
Always clear the screen before you start a new operation: [AC]

## 1.3.3.Values and expressions with integers

Initialize ALL: [SHIFT] [9] [3] [=] [AC]

Observe the screen…

Do 1(a) to 2(b) without pressing [ON]

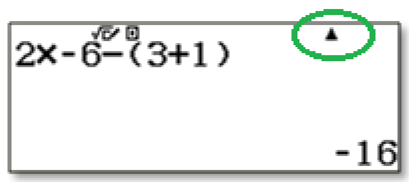
1(a) 576 — [5] [7] [6] [=]

(b) -179 — [(−)] [1] [7] [9] [=]

2(a) 4 + 12 — [4] [+] [1] [2] [=]

(b) 2 x -6 – (3 +1) — [2] [×] [(−)] [6] [−] [(] [3] [+] [1] [)] [=]

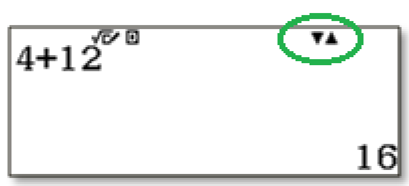
Now observe the screen:




The indicator means that calculation history content is stored and you can scroll through it using [▲]

Observe the screen. You have gone back to a previous operation and the indicator has changed:

It means that you can scroll back and forth through the calculation history using the up and down scroll keys: [▲] [▼]




The calculation history is deleted when you press [ON] or when you change settings.

### 1.3.4.Editing input values and expressions

Have you made a mistake while inputting? 256 instead of 265 for example…?
It is easy to press [AC] to clear the screen and start afresh.

But that might be inefficient after you have input a long expression or function.

If you notice the mistake before entering, use the scroll keysto position the cursor and insert an omitted value or symbol or [DEL] pressonce to delete the value or symbol immediately to the left of the cursor.

If you notice the mistake after entering, while the calculation result is on the display, replay by pressing the left [◀] or the right [▶] scroll keys.

The cursor returns to the input (expression)and you can edit it as described above.

Examples:

1.Input 6789 [6] [7] [8] [9]
Edit the input value to 67489
Continuing: [◀] [◀] [4]

2.Enter 4 x 6 + 10 [4] [×] [6] [+] [1] [0] [=]

Edit the input expression to 4 x 16 + 10 and enter it.
Continuing: [◀] [◀] [◀] [◀] [1] [=]

3.Enter 13 + 49 + 4 [1] [3] [+] [4] [9] [+] [4] [=]

Edit the input expression to 13 + $\sqrt{49}$ + 4

Continuing: [◀] [◀] [◀] [◀] [SHIFT] [DEL] [√■]

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4.Enter 13+49 + 4 and edit it to 13 + $\sqrt{49 + 4}$
[1] [3] [+] [4] [9] [+] [4] [=] [◀] [)] [◀] [◀] [◀] [◀] [◀] [(] [◀] [SHIFT] [DEL] [√■]

While still inputting (and before entering) you can undo the last key operation by pressing [ALPHA] [DEL]

Notice that this operates UNDO.
This only works in the MathI/MathO or MathI/DecimalOsettings.

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5.Input 2 x 6 – (-3 + 1 [2] [×] [6] [−] [(] [(−)] [3] [+] [1]

Now undo the last key operation of inputting 1.
Continuing: [ALPHA] [DEL]

You remain with 2 x 6 – (-3 +
Now undo the last key operation again. Does it undo the last key operation?

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In the LineI/LineO or LineI/DecimalO settings the vertical cursor changes to a horizontal one for overwriting.
Select LineI/LineO: [SHIFT] [MENU] [1] [3]

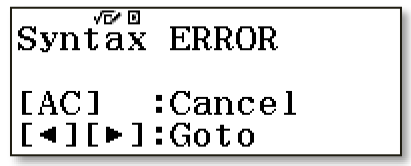
6. Enter 368.9 in the LineI/LineOand edit it to 358.9:
[3] [6] [8] [·] [9] [=] [◀] [SHIFT] [DEL]

## 1.3.5.Error message

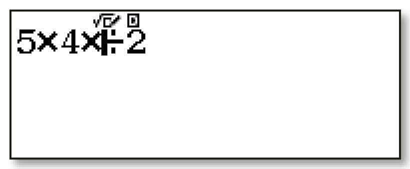
If on entering an expression the calculator displays an ERROR message, press the left or right replay key to return to the calculation screen. The cursor will be positioned at the location of the error ready for correction.

Alternatively, clear the error message by pressing [AC] to return to the calculation screen. This also clears the calculation that contained the error.

(a)Syntax ERROR – there is a problem with the format e.g. subsequent multiplication and division operations.
Enter 5 x 4 x ÷ 2
[5] [×] [4] [×] [÷] [2] [=]




Now to correct the error: Continuing: [◄]



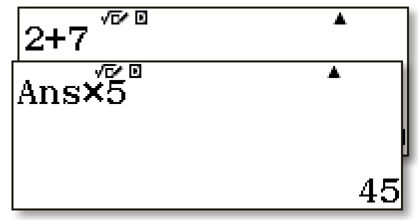

(b)Math ERROR – the intermediate or final result exceeds the allowable calculation range; the input exceeds the allowable input range; or the calculation contains an illegal mathematical operation such as division by zero. This is the message you will receive for operations that are usually represented by the infinity symbol: ∞
(c) Stack ERROR – the capacity of the numeric stack or the command stack has been exceeded.
(d) Argument ERROR – there is a problem with the argument e.g. Ran(a,b) where b ≤ a.
(e)Range ERROR – the conditions to generate a number table in the Table Mode exceed the maximum number of allowable rows.

## 1.3.6. Answer memory: [Ans]

The last calculation result obtained is stored in [Ans] memory and can be recalled for use in subsequent calculations.

To multiply the result by 5: [2] [+] [7] [=]

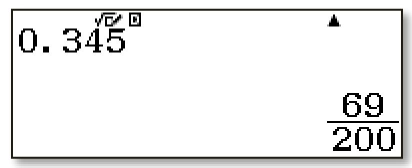
Continuing : [Ans] [×] [5] [=]




## 1.3.7.Decimals: [•]

1.Enter:

(a) 0.345 [0] [•] [3] [4] [5] [=]




An output may be displayed as a fraction. To toggle the result expression between the fraction and decimal forms, press [S⇔D]

(b).345 [•] [3] [4] [5]

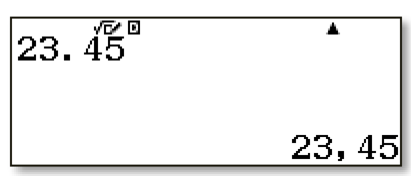
Compare the outputs in (a) and (b).
It is good practice to enter the zero before the decimal point nevertheless.

(c) 34.56 (d)3456.78

In some countries, the decimal mark is a comma.
To display a comma instead of a dot in the result: [SHIFT] [MENU] [▼] [3] [2]

Now enter 23.45 and observe the comma decimal mark in the result.

[2] [3] [•] [4] [5] [=] [S⇔D]

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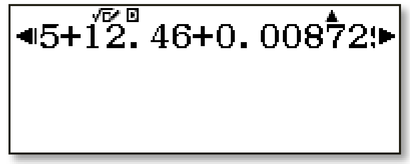
InitializeALL: [SHIFT] [9] [3] [=] [AC]

This resets the comma decimal mark to the default dot.

2(a) 1.532 – 0.2531 + 6.2 (b) 12.89 x (1.2 – -0.2)

(c) 0.03725 + 4.695 + 12. 46 + 0.008729 + 571.8
The ◄ and ►at the beginning or end of the input expression indicate that the input expression runs off the screen. Use ◀ or ▶ to view.

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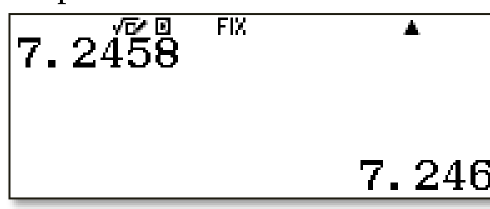
## 1.3.8.Display format

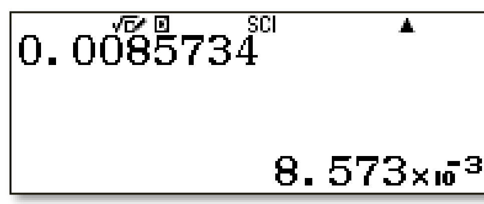
While the result is on display, you can change its format so that it is displayed to a selected number of decimal places using 1: Fix sub-menu, or in standard form to a selected number of significant figures using 2: Scisub-menu or in normal form using 3: Norm sub-menu.
Select 1: Fix sub-menuto display 7.2458 to 3 decimal places.






Select 2: Scisub-menuto display 0.0085734 to 4 significant figures.





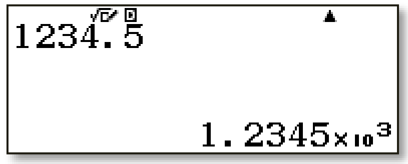

The above are only display features; the calculator still stores the original result. You can change a result display format to the other and even to the normal format.
There are two 3: Norm settings to select between: Norm 1 and Norm 2.
Norm 1 displays calculation results in standard form (exponential format) when they fall in the range $10^{-2} \leq x < 10^{10}$.
Norm 2 displays calculation results in standard form when they fall in the range $10^{-9} \leq x < 10^{10}$.For most purposes, Norm 2 is the most useful display and is the default setting (restored upon initialization).
Unless you exit an indicated number format, results for subsequent calculations will be in that format.

## 1.3.9. Engineering notation function: [ENG]

The engineering notation and its alternate function can also be used to change the display of the result by shifting the decimal point [ENG] three places to the right or left respectively.

Enter 1234.5 and use to shift the decimal mark three places to the left:

[1] [2] [3] [4] [•] [5] [=] [ENG]




Press [ENG] a few more times as you observe the output.
Enter 1234.5 and use the alternate function to [ENG] shift the decimal mark three places to the right: [1] [2] [3] [5] [•] [5] [=] [S⇔D] [SHIFT] [ENG]

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Where a template is displayed when operating a key cap function, use the cursor keys to position the cursor and input.

## 1.3.10. Simple fractions, improper fractions and mixed numbers: [▭/▭]

1. Enter $\frac{2}{5}$. [2] [▭/▭] [5] [=]
You can toggle the output between its fraction and decimal forms.
Continuing: [S⇔D]

Pressing [SHIFT] before [=] when entering displays only a decimal result.

2.Enter $\frac{17}{3}$ to obtain a decimal result: [1] [7] [▭/▭] [3] [SHIFT] [=]

As with simple fractions, you can toggle the output between its fraction and decimal forms.
Continuing: [S⇔D]

And you can also toggle the result between its improper fraction and mixed number forms:

[SHIFT] [S⇔D] Continuing: This displays a mixed number result.

[SHIFT] [S⇔D] Continuing: This displays an improper fraction result.

3.Enter $3\frac{2}{5}$ [SHIFT] [▭/▭] [3] [▶] [2] [▼] [5]

Now toggle the output between its mixed number and decimal forms and also between its mixed number and improper fraction forms.

While the input cursor is located within the input area of a mixed fraction template, pressing [SHIFT] [◀] or [SHIFT] [▶] jumps the cursor to the position immediately

to the left or right respectively of the template. Use a mixed fraction of your choice to see.

4.Enter $\frac{5}{8}$ and display the result as decimal. [5] [▭/▭] [8] [SHIFT] [=]

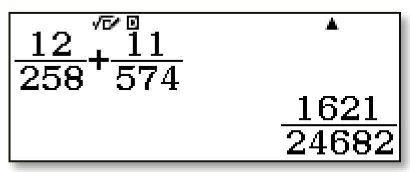
The fraction bar (vinculum) acts as a division operator.
The vinculum extends to accommodate numerator and or denominator expressions:

5. Enter $\frac{24+8-4}{5\times3+2}$ [▭/▭] [2] [4] [+] [8] [−] [4] [▼] [5] [×] [3] [+] [2] [=]

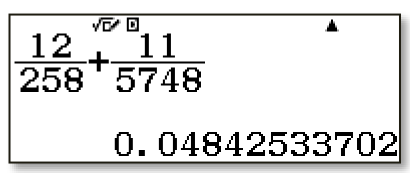
Can you display the result as a decimal and as a mixed number?

Not all results are displayed as fractions.

6.Enter $\frac{12}{258}+\frac{11}{574}$ [1] [2] [▭/▭] [2] [5] [8] [▶] [+] [1] [1] [▭/▭] [5] [7] [4] [=]




7.Enter $\frac{12}{258}+\frac{11}{5748}$ [1] [2] [▭/▭] [2] [5] [8] [▶] [+] [1] [1] [▭/▭] [5] [7] [4] [8] [=]




Here the result is a decimal and even pressing [S⇔D] does not convert it into a fraction.
This is because the fraction function for result display has a limit of 10 characters made up from the numerator, denominator and the vinculum beyond which it does not display a result as a fraction.

7.You can use values and expressions as arguments (Only in the MathI/MathO and MathI/DecimalO settings)

Enter $13 + \frac{9}{4}$ [1] [3] [+] [9] [$\frac{\square}{\square}$] [4]

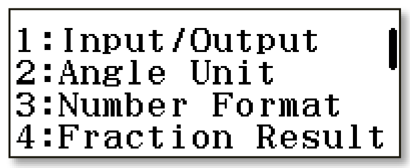
Change the input expression to $13 + \sqrt{\frac{9}{4}}$

Continuing: [◀] [◀] [◀] [◀] [◀] [◀] [SHIFT] [DEL] [√▪]

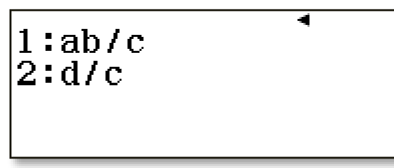
---

The default setting displays an output as a simple or improper fraction as opposed to a mixed number.

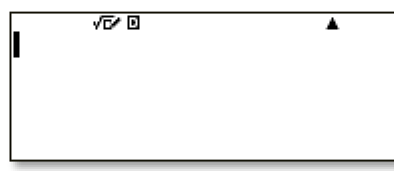
This setting can be changed so that the default display is a mixed number: [SHIFT] [MENU]




Continuing: [4]

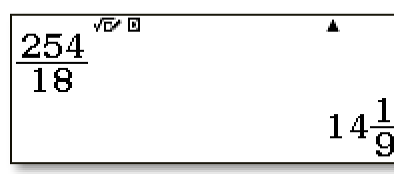



Continuing: [1]



---

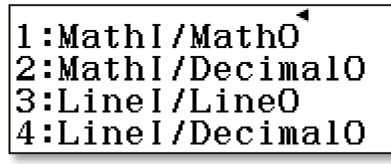
8. Enter $\frac{254}{18}$ [2] [5] [4] [$\frac{\square}{\square}$] [1] [8] [=]



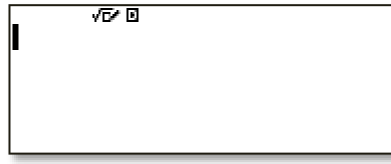

A mixed number result!

The Natural Textbook Display feature of the default mode allows for Natural Expression Input Display and the Natural Expression Result Display.

The feature can be restricted to input only in the MathI/DecimalO setting in which the output will always be [SHIFT] [MENU] [1]
displayed as a decimal.




Continuing: [2]
A blank screen…
Notice that the default setting indicators are still there.



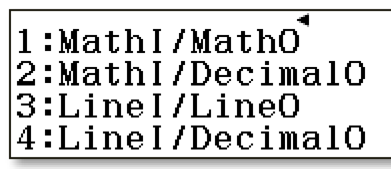
Enter each of the following and observe that the result is always a decimal.
9(a) $\frac{2}{5}$ (b)$\frac{17}{3}$(c) $2\frac{1}{4}+\frac{1}{2}$

Meanwhile initialize to the default setting: [SHIFT] [9] [3] [=] [AC]

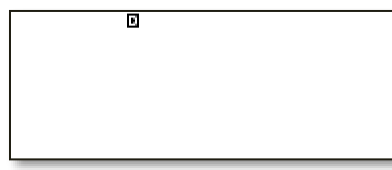
---

With the Natural Textbook Display technology, it is easy to relate the display of input and result expressions to mathematical symbols and expressions. This applies to fractions, roots, powers and logarithms.

Let us select LineI/LineO in which the Natural Textbook Display feature is disabled for both the input and the result expressions. [SHIFT] [MENU] [1]




Continuing [3]



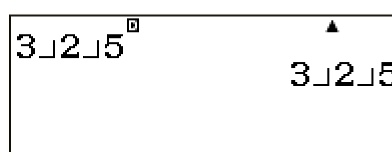
The default Natural Textbook Display indicator setting is no longer displayed.

10. Enter:

(a) $\frac{2}{5}$ [2] [▭/▭] [5] [=]

(b) $\frac{17}{3}$ [1] [7] [▭/▭] [3] [=]

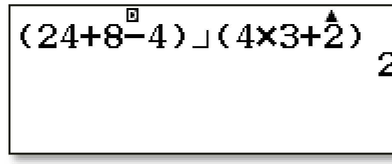
(c)$3\frac{2}{5}$ [3] [▭/▭] [2] [▭/▭] [5]




Doesn't look quite natural…. Does it?

The line input display may be cumbersome when inputting expressions.

(e) $\frac{24+8-4}{4\times 3+2}$ [(] [2] [4] [+] [8] [−] [4] [)] [fraction key] [4] [×] [3] [+] [2] [=]




Note that we have had to include brackets yet these are not part of the input expression.

(f) $\frac{12}{2584}+\frac{11}{574}$ (Try this…)

---

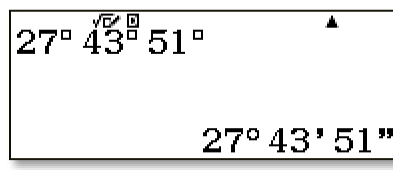
The Natural Textbook Display feature is also disabled in the LineI/DecimalO setting where the output will always be in decimal form. Select the LineI/DecimalO setting and enter (a), (b) and (c) above to observe the decimal results.

Meanwhile initialize ALL: [SHIFT] [9] [3] [=] [AC]

---

## 1.3.11. Sexagesimal notation: [°'"]

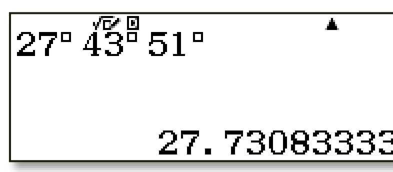
Used for calculations in degrees, minutes, seconds.
Enter $27^0 43'51''$ [2] [7] [°'"] [4] [3] [°'"] [5] [1] [°'"] [=]



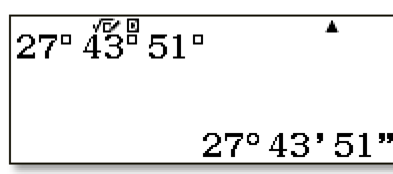

Notice the difference between the input and the output. The degrees, minutes and seconds symbols appear as square superscripts in the input.

To convert the result from a sexagesimal into a decimal:

Continuing: [SHIFT] [=]




To convert the decimal result back into a sexagesimal:
Continuing: [°'"]




To convert a decimal angle into asexagesimal, enter the decimal and press [°'"]

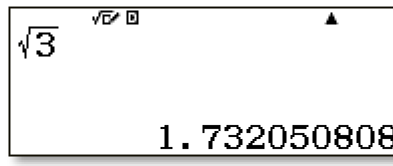
## 1.3.12.Square roots: [√■]

1. $\sqrt{4}$ [√■] [4] [=]


2. $\sqrt{3}$ [√■] [3] [=]

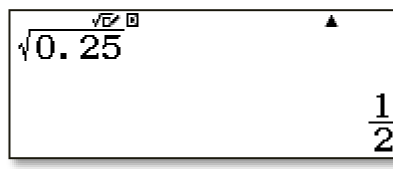

The result is displayed in surd form!

To display the result as a decimal:
Continuing: [S⇔D]

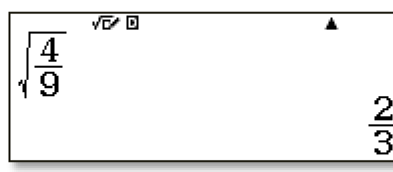



You also get the decimal result by pressing [SHIFT] before entering.

3. $\sqrt{0.25}$ [√■] [0] [•] [2] [5] [=]




4. $\sqrt{\frac{4}{9}}$ [√■] [4] [▭/▭] [9] [=]




Proceed to display a decimal result.

## 1.3.13. Squares: [x²]

1. $3^2$ [3] [x²] [=]
2. $0.567^2$ [0] [•] [5] [6] [7] [x²] [=]
3. $\left(\frac{2}{3}\right)^2$ [(] [2] [▭/▭] [3] [)] [x²] [=]
4. $\left(5\,\frac{1}{3}\right)^2$ [(] [5] [SHIFT] [▭/▭] [1] [▼] [3] [▶] [)] [x²]

5. $\left(\frac{8+17-5}{11-7}\right)^2$ [ ( ] [ ▭/▭ ] [ 8 ] [ + ] [ 1 ] [ 7 ] [ − ] [ 5 ] [ ▼ ] [ 1 ] [ 1 ] [ − ] [ 7 ] [ ▶ ] [ ) ] [ $x^2$ ]

---

**1.3.14. Cube roots**

The function is an alternate function of [ √▪ ]

To operate it press [SHIFT] [ √▪ ]

1. $\sqrt[3]{8}$ [SHIFT] [ √▪ ] [ 8 ]

2. $\sqrt[3]{0.125}$ [SHIFT] [ √▪ ] [ 0 ] [ • ] [ 1 ] [ 2 ] [ 5 ]

3. $\sqrt[3]{\frac{27}{64}}$ [SHIFT] [ √▪ ] [ 2 ] [ 7 ] [ ▭/▭ ] [ 6 ] [ 4 ]

4. $\sqrt[3]{8} + 2$ [SHIFT] [ √▪ ] [ 8 ] [ ▶ ] [ + ] [ 2 ]

---

**1.3.15. Cubes**: [ $x^3$ ]

1. $5^3$ [ 5 ] [ $x^3$ ] [ = ]

2. $0.2^3$ [ 0 ] [ • ] [ 2 ] [ $x^3$ ] [ = ]

Try these:

3. $\left(\frac{1}{2}\right)^3$ 4. $\left(2\,\frac{1}{8}\right)^3$ 5. $\left(\frac{45.05 \times 789.5}{54.11+45.28}\right)^3$

---

**1.3.16. Powers:** [ $x^{▪}$ ]

1) $2^0$ [ 2 ] [ $x^{▪}$ ] [ 0 ] [ = ]

2) $2^5$ [ 2 ] [ $x^{▪}$ ] [ 5 ] [ = ]

3) $4^{\frac{1}{2}}$ [ 4 ] [ $x^{▪}$ ] [ 1 ] [ ▭/▭ ] [ 2 ] [ = ]

4) $32^{\frac{2}{5}}$ [3] [2] [$x^{■}$] [2] [▭/▭] [5] [=]

5) $\left(\frac{1}{27}\right)^{-\frac{1}{3}}$ [(] [1] [▭/▭] [2] [7] [▶] [)] [$x^{■}$] [(−)] [1] [▭/▭] [3] [=]

## 1.3.17. Roots

This is the alternate function of ($\sqrt[■]{□}$)

Press [SHIFT] [$x^{■}$] to operate it.

1. $\sqrt[5]{32}$ [SHIFT] [$x^{■}$] [5] [▶] [3] [2] [=]
2. $\sqrt[7]{2187}$ [SHIFT] [$x^{■}$] [7] [▶] [2] [1] [8] [7] [=]

## 1.3.18. Absolute value: (Abs)

1. |-3| (Abs) [(−)] [3] [=]

2. |3| (Abs) [3]

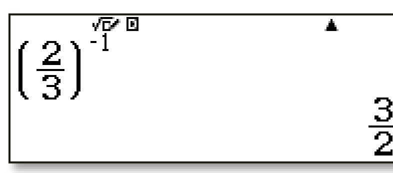
3. $\sqrt{|-4|}$ [$\sqrt{■}$] (Abs) [(−)] [4] [=]

4. |2 – 5| (Abs) [2] [−] [5] [=]

## 1.3.19. Reciprocals: ($x^{-1}$)

1. $2^{-1}$ [2] ($x^{-1}$) [=] 2. $3^{-1}$ [3] ($x^{-1}$) [1] [=]

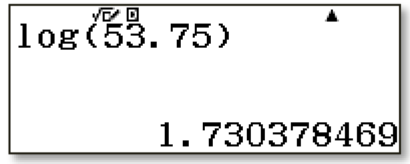
4. $\left(\frac{2}{3}\right)^{-1}$ [(] [2] [▭/▭] [3] [▶] [)] ($x^{-1}$) [=]




## 1.3.20. Logarithms to base 10: [log]

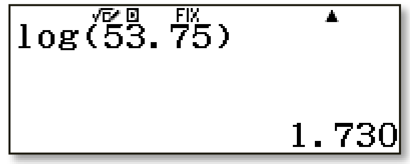
Enter each of the following and compare the result with the value obtained from tables of logarithms. Input of closing brackets is required for functions that include brackets.

1.log 53.75 [log] [5] [3] [•] [7] [5] [=]




To express the result to three decimal places:

Continuing: [SHIFT] [MENU] [3] [1] [3] [=]

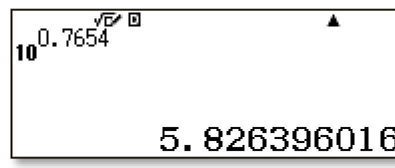



2.log100
3. log 0.7658

## 1.3.21. Base 10 antilogarithms

This is the alternate function of [log]
Press [SHIFT] [log] to operate it.

Find the antilog of:
1.0.7654 [SHIFT] [log] [0] [•] [7] [6] [5] [4] [=]




2.-0.458
3.-2.732
4. $\bar{1}.649$ (Note that this is the same as -1 + 0.649 = -0.351 so enter as $10^{-0.351}$)

## 1.3.22. Logarithms to other bases: [$\log_{\square}\square$]

This function is used only when MathI/MathO orMathI/DecimalO is selected. In this case you must input a value for the base.

1. $\log_2 8$ [$\log_{\square}\square$] [2] [▶] [8] [=]

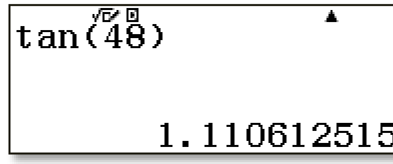
2.$\log_8 2$ [$\log_{\square}\square$] [8] [▶] [2] [=]

3. $\log_{\frac{1}{2}} 5$ [$\log_{\square}\square$] [1] [$\frac{\square}{\square}$] [2] [▶] [▶] [5] [=]

## 1.3.23. Trigonometric ratios: [sin] [cos] [tan]

1. tan $48^0$ [tan] [4] [8] [)] [=]

The degree symbol$^0$ is not input because the calculator already recognizes the degree as the angle unit. See the indicator D….



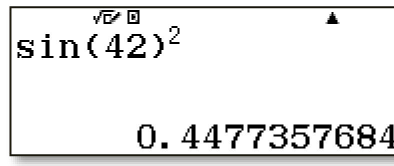

2. cos 27.35$^0$ [cos] [2] [7] [•] [3] [5] [)] [=]

3. cos -75$^0$ [cos] [(−)] [7] [5] [)] [=]

4. tan 159.34$^0$ [tan] [1] [5] [9] [•] [3] [4] [)] [=]

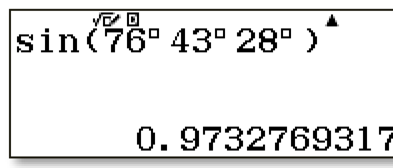
5. $\frac{\sin 30}{\cos 60}$ [sin] [3] [0] [)] [▭/▭] [cos] [6] [0] [)] [=]

6. sin$^2$42$^0$ [sin] [4] [2] [)] [$x^2$] [=]



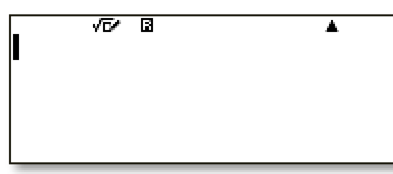

Generally ,sin$^n\Theta$ is input as sin$(\Theta)^n$; cos$^n\Theta$ as cos$(\Theta)^n$; tan$^n\Theta$ as tan$(\Theta)^n$

7.sin 76$^0$43’28” [sin] [7] [6] [°’’’] [4] [3] [°’’’] [2] [8] [°’’’] [)] [=]

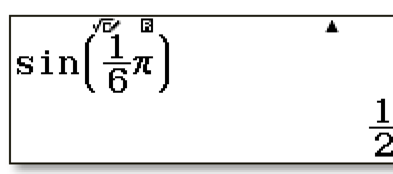



Let us now work with angles in radians.

We first select the radian angle unit: [SHIFT] [MENU] [2] [2]
Notice that R for radian has replaced D as the setting angle unit indicator.



8.sin$\frac{1}{6}\pi^r$ [sin] [1] [▭/▭] [6] [▶] [SHIFT] [$\times10^x$] [)] [=]




The radian symbol is not input because the radian is the configured angle unit.

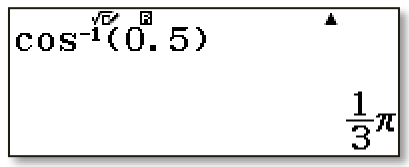
Remember to initialize ALL before proceeding.

## 1.3.24. Inverses of trigonometric ratios

These are the alternate functions of [sin] [cos] [tan]
Press [SHIFT] first to operate them.

1. $\sin^{-1}0.5$ [SHIFT] [sin] [0] [•] [5] [=]
2. $\cos^{-1}0.5774$
3. $\tan^{-1}16.56$

For an angles in radians, select the radian angle unit first: [SHIFT] [MENU] [2] [2]
4. $\cos^{-1}0.5$ [SHIFT] [cos] [0] [•] [5] [=]

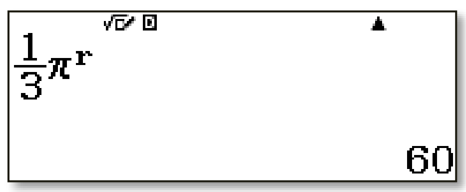



## 1.3.25. Menu configuring with [OPTN]

In the Calculate mode, this is useful when converting angles from one unit into another. By entering an angle, it is converted into the selected (indicated) angle unit.

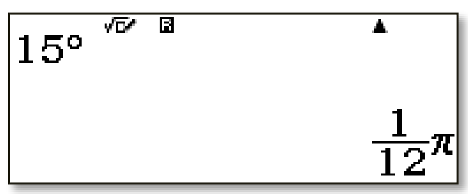
1.Convert $\frac{1}{3}\pi^r$ into degrees
Make sure the degree is the indicated angle unit.

[1] [$\frac{\square}{\square}$] [3] [▶] [SHIFT] [$\times10^x$] [OPTN] [2] [2] [=]




2.Convert $15^0$ into radians.
Make sure the radian is the indicated angle unit.

[1] [5] [OPTN] [2] [1] [=]




Degrees are commonly used for practical work, radians for mathematical work and gradians for some survey work. Convert some angles between degrees and gradians. Use your results to notice that 100 grads make a right angle, so a grad is a percentage of a right angle.

## 1.3.26.Inputting variables with [STO]

You can assign values to the variables (A,B,C,D,E,F,M,x and y).
These are ALPHA alternate functions.

Input a value and press [STO] followed by the key for the variable.

Let us assign 2 to A: [2] [STO]

The indicator appears meaning the calculator is standing by for input of a variable name to assign the value.

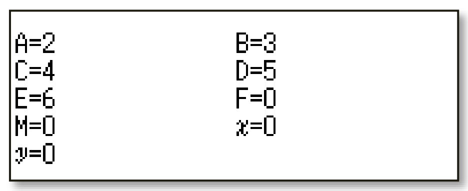

Continuing: [(−)]

Now assign 3 to B
Press [AC] to clear the screen

Then assign 4 to C, 5 to D and 6 to E.

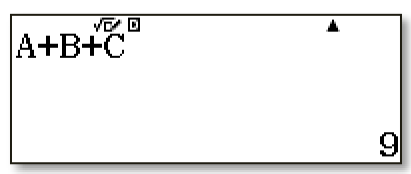
To view the variables that we have stored:

[SHIFT] [STO]



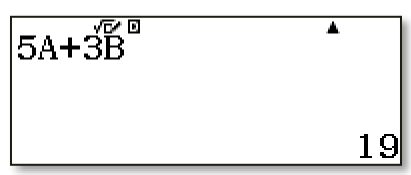

You can use the letters to input expressions.
Enter
1.A + B + C

[ALPHA] [(−)] [+] [ALPHA] [°’’’] [+] [ALPHA] [($x^{-1}$)] [=]



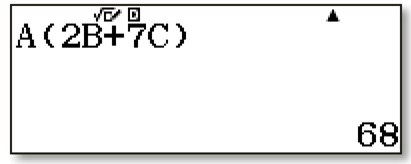

2.5A + 3B

[5] [ALPHA] [(−)] [+] [3] [ALPHA] [°’’’] [=]



3.A(2B + 7C)

[ALPHA] [(−)] [(] [2] [ALPHA] [°'''] [+] [7] [ALPHA] $(x^{-1})$ [)] [=]



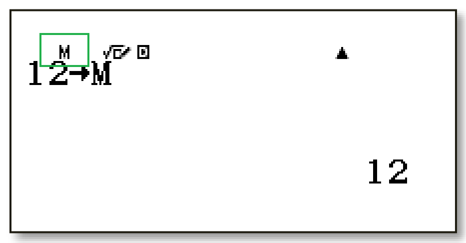

## 1.3.27. Independent Memory: [M+]

M is special among the variables. It is called the independent memory. You can assign a value to M as already described for variables. Indicator M is displayed when there is any value other than zero stored in independent memory. You can add calculation results to or subtract results from independent memory.

To assign 12 to M

[1] [2] [STO] [M+]

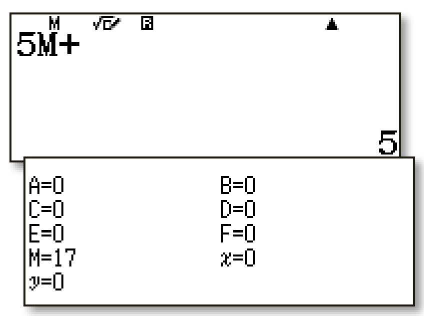
Notice the indicator M



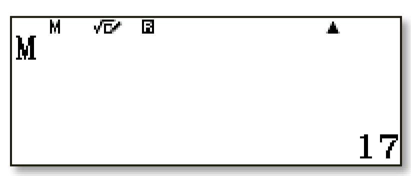

To add a number e.g. 5 to M: [5] [M+]

No need pressing [=]

Now recall the new value of M: [SHIFT] [STO]




Continuing: [M+] [=]




Note that our current M = 17

To add the result of 2 + 3 to M, continuing: [2] [+] [3] [M+] [=]

Now recall the new value of M: [SHIFT] [STO] [M+] [=]

Note that our current M = 22
To subtract a number e.g. 7 from M: [7] [SHIFT] [M+]

Now recall the new value of M: [SHIFT] [STO] [M+] [=]

Note that our current M = 15

To subtract the result of a calculation e.g. 3 x 4from M: [3] [×] [4] [SHIFT] [M+]

Now recall the new value of M: [SHIFT] [STO] [M+] [=]

Note that our current M = 3

To use M as a variable in a calculation e.g. to enter 9M: [9] [ALPHA] [M+] [=]

To clear the contents of all memories: [SHIFT] [9] [3] [=] [AC]
Or initialize ALL…

---

**1.3.28. Scientific (exponential) notation:** [$\times 10^x$]

Used to input numbers which are in standard form or generally, in the form of a product of a number and an integer power of 10.

1. $2.4 \times 10^4$ [2] [•] [4] [$\times 10^x$] [4] [=]
2. $3.543\text{x}10^{-5}$ [3] [•] [5] [4] [3] [$\times 10^x$] [(−)] [5] [=]
3. $6.875 \times 10^0$
4. $678 \times 10^3$
5. $0.2\text{x}10^6 + 300\text{x}10^4$
6. $2.3\text{x}10^4 \times 3.5\text{x}10^4$

*You cannot use this function when the power of 10 is not an integer.*
Enter
7. $2.4\text{x}10^{0.5}$
8. $3.45\text{x}10^{2+3}$

What do you observe?
Suggest how else you would input these expressions.

---

## 1.32.9. Prime factorization (FACT) function

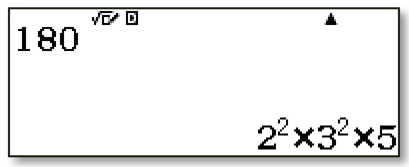
This is the alternate function of [°’”]
Press [SHIFT] [°’”] to operate it.

It is used to obtain prime factors of numbers:

1.12


[1] [2] [=] [SHIFT] [°’”]

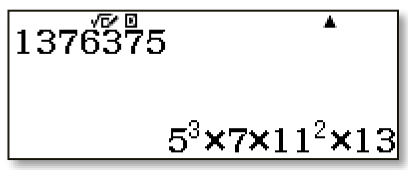
2.180




[1] [8] [0] [SHIFT] [°’”] [=]

3. 1376375

[1] [3] [7] [6] [3] [6] [5] [SHIFT] [°’”] [=]




4. 29
[2] [9] [SHIFT] [°’”] [=]
What is happening here?

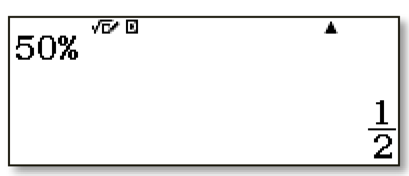

5. 879653. And here?

---

## 1.3.30. Percentages%

This is the alternate function of [Ans]
Press [SHIFT] [Ans] to operate it.

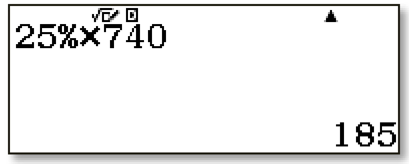
1.Enter50%




[5] [0] [SHIFT] [Ans] [=]

2.Calculate 25% of 740

2 5 SHIFT M+ × 7 4 0 =




3. Increase 400 by 20%
This is input as 400 + 20% x 400 or as 120% x 400

4.Decrease 6000 by 15%
This is input as 6000 – 15% x 6000or as 85% x 6000

---

**<u>1.3.31. Combinations: nCr</u>**

This is the alternate function of ÷
Press SHIFT ÷ to operate it.
nCr is read as ‘n combination r’. n and r are natural numbers and n≥r
To enter 3C2(three combination two):

3 SHIFT ÷ 2 =


Calculate the combinations and record the results in the triangle below:

1C0=
1C0= 1C1=
2C0= 2C1= 2C2=
3C0= 3C1= 3C2= 3C3=
4C0= 4C1= 4C2= 4C3= 4C4=

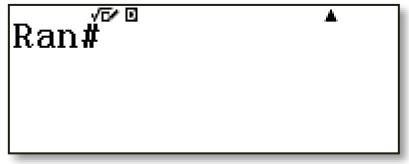
Compare the results with the terms of the Pascal’s triangle.

1
1 1
1 2 1
1 3 3 1
1 4 6 4 1

---

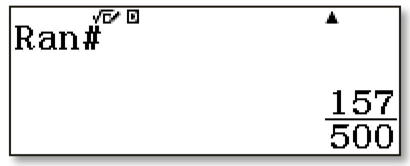
## 1.3.32. Random numbers:Ran#

This is the SHIFT alternate function of [•]
Press [SHIFT] [•]




Continuing, press [=] each time to display a random number.

Are your students getting the same results…?




In the default mode this generates random fractions.

Press [S⇔D] to convert it into a decimal. Or press [SHIFT] [=] each time to

automaticaly generate a random decimal.

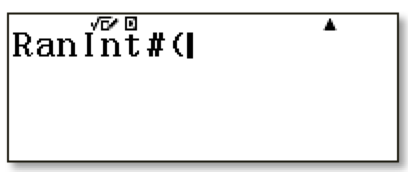
Or select a number format configuration that returns only decimal results.

What would you do for the function to automatically display whole numbers?
Would this work? [SHIFT] [•] [×] [1] [0] [0] [0] [=]

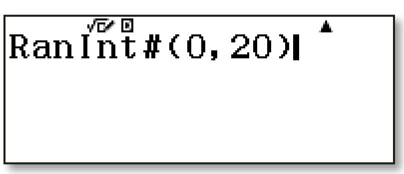
---

## 1.3.33. Random integer numbers

This is the ALPHA alternate function of [•]
Press [ALPHA] [•] to operate it.




Continue to input the range for the random integer numbers. For example, to generate random integer numbers in the range $0 \leq n \leq 20$:




[ALPHA] [•] [0] [SHIFT] [)] [2] [0] [)]

Continuing, generate a random integer number each time you press [=]

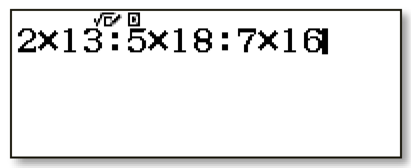
Record your random integer numbers and compare them with those obtained by others…

**1.3.34.Multi-Statements: :**

This is the ALPHA alternate function of [x³]

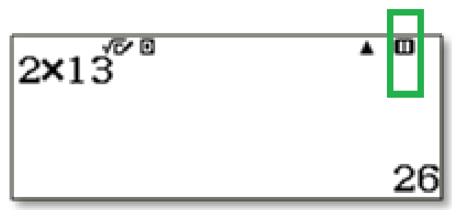
Press [ALPHA] [x³] to input it between expressions. You can then execute the calculations from left to right by pressing [=]

Input 2x13:5x18:7x16




[2] [×] [1] [3] [ALPHA] [x³] [5] [×] [1] [8] [ALPHA] [x³] [7] [×] [1] [6]

Continuing: [=]




The indicator means that the display currently shows an intermediate result of a multi-statement calculation.

For the remaining two calculations, continue: [=]

Select the LineI/LineO sub-menu and perform the above operation and observe the display: [SHIFT] [MENU] [1] [3]

Continuing: [2] [×] [1] [3] [ALPHA] [x³] [5] [×] [1] [8] [ALPHA] [x³] [7] [×] [1] [6]

Continuing: [=]

You may also try it with the LineI/DecimalOsub-menu.

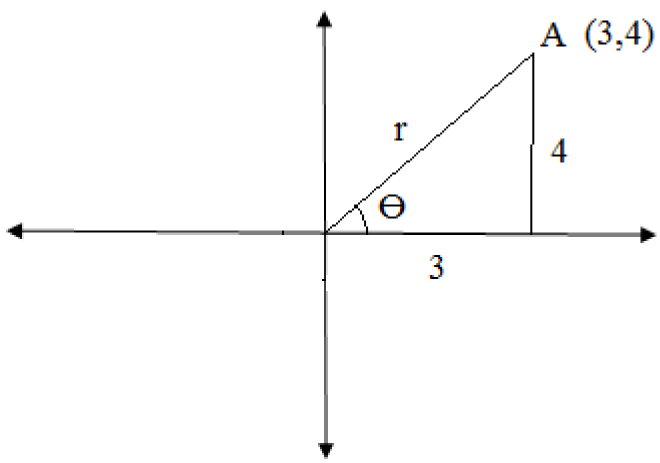
Meanwhile initialize to the default setting

## 1.3.35. Polar and Rectangular Coordinates: Pol and Rec

These are alternate functions of [+] and [−] respectively.

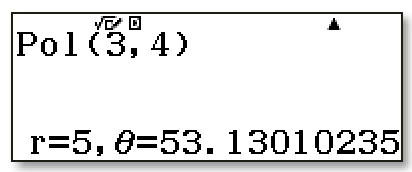
Pol converts rectangular coordinates into polar coordinates.
Rec converts polar coordinates into rectangular coordinates.
Polar coordinates of a point A are given as (r,Ө) where r is the length of a line from the origin (0,0) to the point A and Ө is the positive angle that line OA makes with the x-axis.

Rectangular coordinates refer to the (x,y) coordinates on a Cartesian plane e.g. A(3,4).




Enter Pol(3,4)

[SHIFT] [+] [3] [SHIFT] [)] [4] [)] [=]



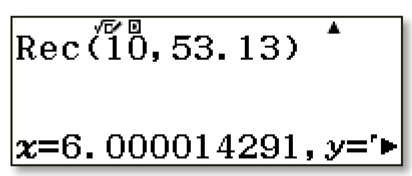

Does this agree with Pythagoras' theorem? Try the same for other right-angled triangles.

Enter Rec(10, $53.13^0$)

[SHIFT] [−] [1] [0] [SHIFT] [)] [5] [3] [•] [1] [3] [)]

Press [▶] to view the display that runs off the screen: x = 6, y = 4

Does this agree with Pythagoras' theorem? Try the same for other right angled triangles.
Notice that we have used similar right-angled triangles.



## 1.4. Statistics mode

This mode is also called the Statistics Editor. It is a convenient way of summarizing data numerically i.e. obtaining the statistical calculations: mean, median, standard deviation, variance, the quartiles etc.

MENU ▶


This booklet deals only with ungrouped single variable data (x); ungrouped single variable data with frequency (x, Freq) and grouped single variable data with frequency (x, Freq)

*The mode can however be used in regression calculations for paired variable data.*

**<u>1.4.1.Ungroupedsingle variable data (without frequency distribution)</u>**

The data set below represents the ages of 10 pupils who were treated at a clinic:

{9,5,12,5,10,11,6,14,2,8}

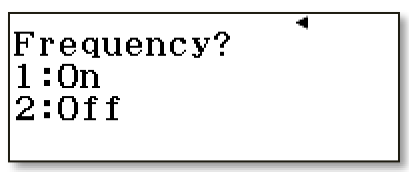
Display the statistical calculations for the data.

Starting from the default setting,

SHIFT MENU ▼


Continuing:

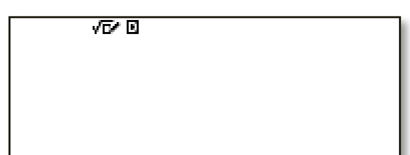
1




This is data without frequency distribution.

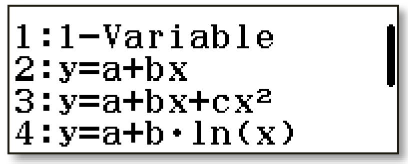
Continuing: 2

A blank screen…

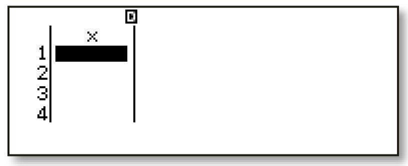


Continuing: [MENU] [▶]


Continuing: [2]

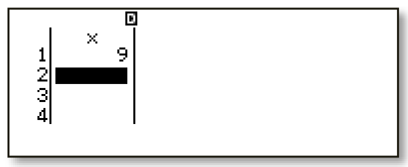



Continuing: [1]



Continuing: [9] [=]

The cursor has jumped to the next field…



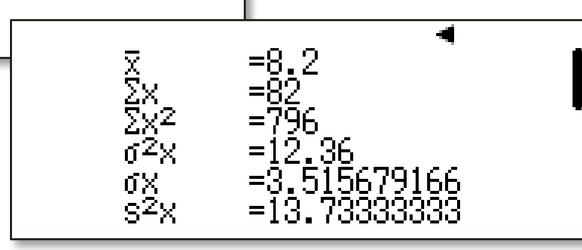
Input the second item and enter it by pressing [=]
Continue to the last item.

*You can input up to 160 data items.*

Continuing after inputting all the items: [AC]


Continuing: [OPTN]

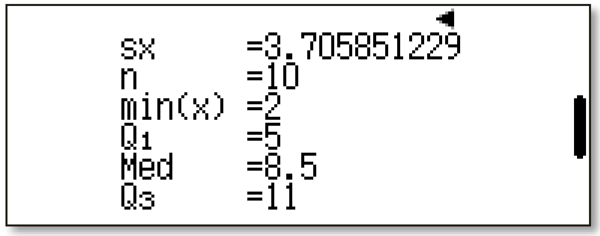

Continuing: [2]



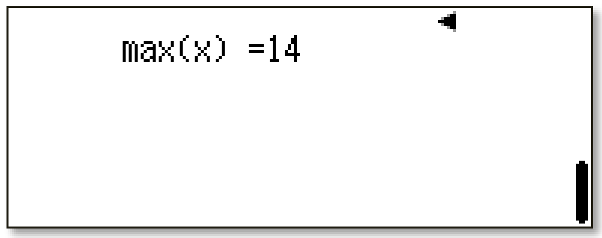

You have the statistical calculations.

Scroll down for more calculations…

Continuing: (▼)




Continuing: (▼)




**1.4.2. Ungrouped single variable data with frequency distribution**

In a test taken by 40 pupils, the marks scored out of 10 were:

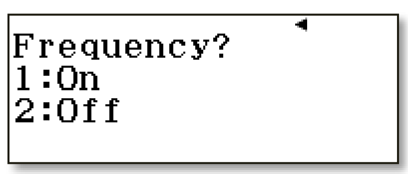
| Marks | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|
| No of pupils | 2 | 1 | 3 | 11 | 12 | 8 | 3 |

Display the statistical calculations.

Let us start from the default setting. Initialize ALL.

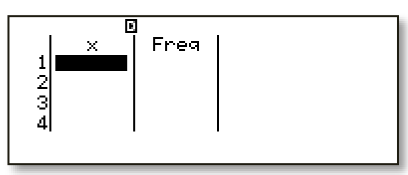
Continuing:

[SHIFT] [MENU] (▼) [1]




Our data has frequency distribution…
Continuing:

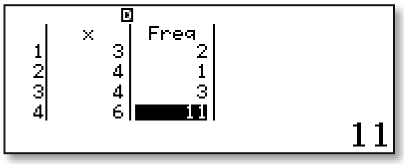
[1] [MENU] (▶) [2] [1]

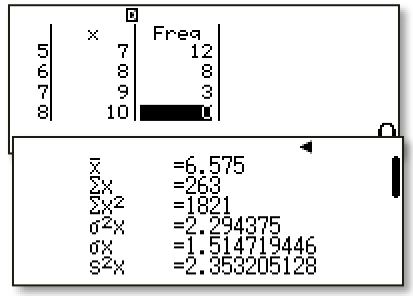



Enter the items (marks) in the first column.

Use the cursor keys to move the cursor to the top of the second column and enter the frequencies.

*You can input up to 80 data items and their frequencies.*

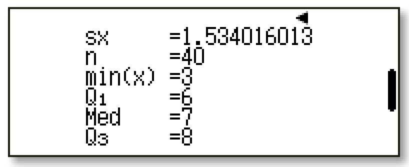


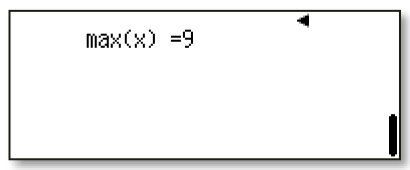

Continuing:

AC OPTN 2

Continuing:




Continuing:




## 1.4.3. Grouped single variable data with frequency distribution

The marks scored by a group of form two students in a Kiswahili test were as recorded in the table below. Obtain the statistical calculations

| Marks | 0-9 | 10-19 | 20-29 | 30-39 | 40-49 | 50-59 | 60-69 | 70-79 | 80-89 | 90-99 |
|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | 1 | 2 | 4 | 7 | 10 | 16 | 20 | 6 | 3 | 1 |

Display the statistical calculations.
Take x = the mid-points of the classes and proceed as for ungrouped single variable data with frequency distribution. (Refer to 1.4.2)

All data currently input in the Statistics Editor is deleted whenever you:

(a) Exit the Statistics Mode e.g. by initializing ALL.
(b) Switch to a different calculation mode (1: Calculate or 3: Table)

(c) Switch between the single-variable and paired-variable calculation type or
(d) Reconfigure the Statistics setting.

To delete a row, move the cursor to the line that you want to delete and press [DEL]

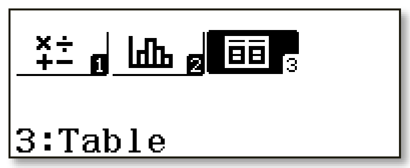
To insert a row, move the cursor to the location where you want to insert the row and perform the following key operation:
[OPTN] [2] (Editor) [1] (Insert Row)

To delete all Statistics Editor content, perform the following key operation:
[OPTN] [2] [2]

## 1.5. Table mode

This mode is also called the Table Function. It is used to generate, especially for graph work, a number table based on one or two functions.

[MENU] [▶] [▶]

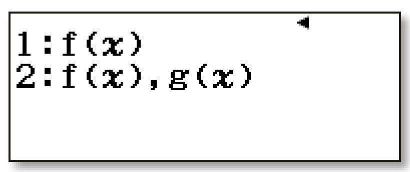



**1.5.1.SingleLinear functions**

Generate a number table for the function y = 3x + 5

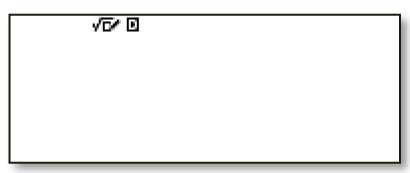
This is a single function.

[SHIFT] [MENU] [▼] [2]

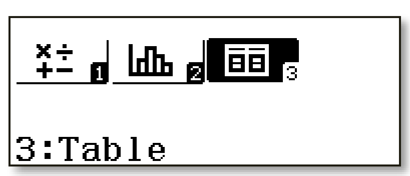



Continuing: [1]

A blank screen…

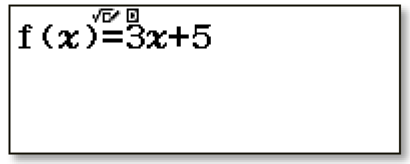


Continuing:
[MENU] [▶] [▶]

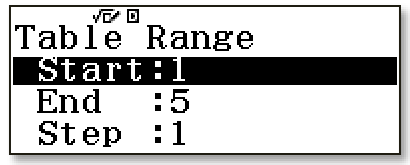


Continuing: [3]
f(x) is y…


Continuing:
[3] [ALPHA] [)] [+] [5]




Continuing: [=]

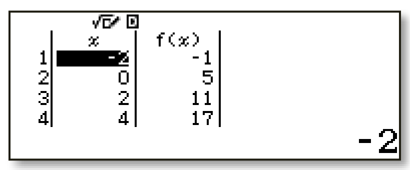



This is a linear function. We need at least three coordinates. Let us start from -2 to 4 in steps of 2.

Continuing:

[(−)] [2] [=] [4] [=] [2] [=]


Continuing: [=]




---

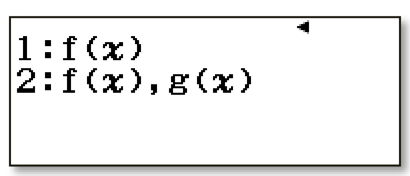
**1.5.2.Simultaneous linear functions**

Generate a table of values for the simultaneous functions:

$y = 5 - \frac{1}{2}x$ and $y = 3x + 11$

Select the Table mode:

[SHIFT] [MENU] [▼] [2]



Continuing, select the simultaneous function setup: [2]

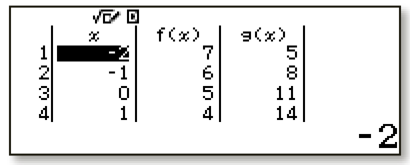
Continuing: [MENU] [▶] [▶] [3]

Continuing: [5] [−] [ALPHA] [)]

Continuing: [=] [3] [ALPHA] [)] [+] [1] [1]

Continuing: [=] [(−)] [2] [=] [2] [=] [=]

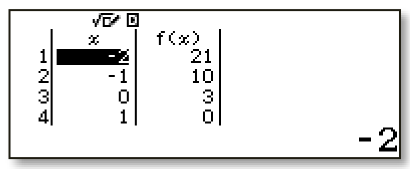
We have selected x from -2 to 4 in steps of 1.




## 1.5.3.Quadratic functions

Generate a table of values for the function: $y = 2x^2 - 5x + 3$ for the domain $-2 \leq x \leq 7$ at intervals of 1.

Starting from the default setting:




[SHIFT] [MENU] [▼] [2] [1] [MENU] [▶] [▶] [3] [2] [ALPHA] [)] [$x^2$] [−] [5] [ALPHA] [)] [+] [3] [=] [(−)] [2] [=] [7] [=] [1] [=] [=]

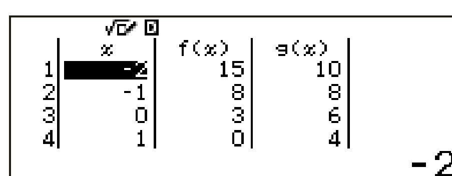
Scroll down using [▼] to view more values…

Do likewise for the functions described below.

## 1.5.4. Simultaneousquadratic and linear functions

Generate a table of values for the functions $y = x^2 - 4x + 3$ and $y = -2x + 6$ for the domain $-2 \leq x \leq 6$ at intervals of 1

Starting from the default setting:

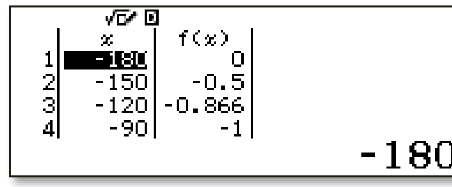


SHIFT MENU ▼ 2 2 MENU ▶ ▶ 3 ALPHA ) $x^2$ − 4 ALPHA ) + 3 = (−) 2 ALPHA ) + 6 = (−) 2 = 6 = 1 = =

**1.5.5.Single trigonometric functions for angles in degrees.**

Generate a table of values for the function y = sinx for the domain $-180^0 \leq x \leq 180^0$ at intervals of $30^0$

Starting from the default setting…

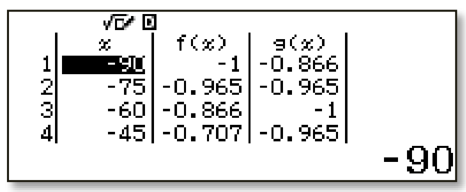



SHIFT MENU ▼ 2 1 MENU ▶ ▶ 3 sin ALPHA ) ) = (−) 1 8 0 = 1 8 0 = 3 0 = =

**1.5.6.Simultaneous trigonometric functions for angles in degrees.**

Generate a table of values for the function y = sinx and y = sin(x – $30^0$) for the domain $-90^0 \leq x \leq 90^0$ at intervals of $15^0$

Starting from the default setting:




SHIFT MENU ▼ 2 2 MENU ▶ ▶ 3 sin ALPHA ) ) = sin ALPHA ) − 3 0 ) = (−) 9 0 = 9 0 = 1 5 = =

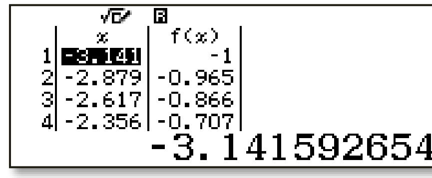
**1.5.7.Single trigonometric functions for angles in radians**

Generate a table of values for the function y = cosx for the domain $-л^r \leq x \leq л^r$ at intervals of $\frac{л^r}{12}$

Starting from the default setting: SHIFT MENU 2 2

This sets the angle unit to the radian)

Continuing:

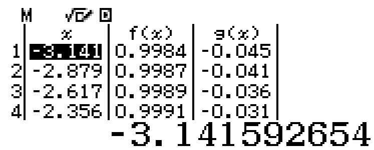



[SHIFT] [MENU] [▼] [2] [1] [MENU] [▶] [▶] [3] [cos] [ALPHA] [)] [)] [=] [(−)] [SHIFT] [×10^x] [=] [SHIFT] [×10^x] [=] [SHIFT] [×10^x] [▭/▭] [1] [2] [=] [=]

---

**1.5.8.Simultaneous trigonometric functions for angles in radians.**

Generate a table of values for the functions y = cosx and y = sin(x + $\frac{л}{6}$) for the domain -л$^{r}$≤ x≤ л$^{r}$at intervals of $\frac{л}{12}$




Starting from the default setting: [SHIFT] [MENU] [2] [2]

(This sets the angle unit to the radian)

[SHIFT] [MENU] [▼] [2] [2] [MENU] [▶] [▶] [3] [cos] [ALPHA] [)] [)] [=] [sin] [ALPHA] [)] [+] [SHIFT] [×10^x] [▭/▭] [6] [▶] [)] [=] [(−)] [SHIFT] [×10^x] [=] [SHIFT] [×10^x] [=] [SHIFT] [×10^x] [▭/▭] [1] [2] [=] [=]

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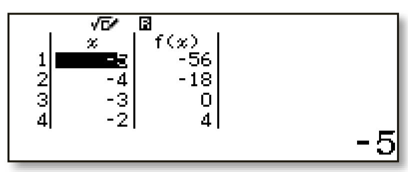
**1.5.9.Single cubic functions**

Generate a table of values for the function y = $x^3 + 2x^2 – 5x – 6$
for the domain -5≤x≤5  at intervals of 1.

Starting from the default setting:




[SHIFT] [MENU] [▼] [2] [1] [MENU] [▶] [▶] [3] [ALPHA] [)] [$x^3$] [+] [2] [ALPHA] [)] [$x^2$] [−] [5] [ALPHA] [)] [−] [6] [=] [(−)] [5] [=] [5] [=] [1] [=] [=]

# 2. Inquiry Based Learningwith CLASSWIZ

*"Good teaching is more a giving of right questions than a giving of right answers." – Josef Albers –*

## 2.1.Exploringbasic arithmetic with natural numbers

The sense of having control over what they are learning, helped by the convenient input and instant feedback that the calculator provides will encourage learners to experiment more – and think. The benefits of such active learning activities cannot be overemphasized.

1**.**Substitutesmall natural numbers in each expression and enter.Show how the results are arrived at. The number line may be used for addition and subtraction.

(a) Addition

| | |
|---|---|
| (i) p + -q where p>q | (ii) p + -q where p<q |
| (iii) -p + q where p<q | (iv)-p + q where p>q |
| (v)-p + -q where p<q | (vi)-p + -q where p>q |

(b) Subtraction

| | |
|---|---|
| (i)p – q where p>q | (ii)p – q where p<q |
| (iii)p – -q | (iv)-p – -q |

(c) Multiplication

| | | |
|---|---|---|
| (i)-p x q | (ii)p x -q | (iii)-p x -q |

(d) Division

| | | | |
|---|---|---|---|
| (i)p ÷ q | (ii)-p ÷ q | (iii)p ÷ -q | (iv)-p ÷ -q |

2.Substitute small natural numbers in the expressions below. Enter each side of your expression and record the result to affirmthe statements.

Example: p + q = p – -q
Taking p = 2 and q = 3; p + q = 2 + 3 = 5 and p – -q = 2 – -3 = 5

⇨ p + q = p – -q

| | | | |
|---|---|---|---|
| (a) p – q = p + -q | (b) -p + q = q – p | (c) p + q = q + p | (d) p – q ≠ q – p |
| (e) p x q = q x p | (f) p ÷ q ≠ q ÷ p | (g) n(p + q)<br>= n x p + n x q | (h) n(p – q)<br>= n x p – n x q |
| (i) p x -q = -p x q | (j) -(p + q)<br>= -1(p + q) | (k)-p + -q<br>= -p – q | (l) n(p x q)<br>= n x p x q |
| (m) -(p – q)<br>= -1(p – q) | (n) -1(p – q)<br>= -p + q | (o) n(p ÷ q) = $\frac{n \times p}{q}$ | |

3.Substitutesmallnatural numbers in the expressions below. Enter each side of your expression to investigate if the statement is true or false. If false, write the correct expression/statement.

Example
p x q ≠ $p_1 + p_2 + p_3 \ldots p_q$
e.g. 5 x 3 ≠ 5 + 5 + 5 + 5 + 5 + 5 + 5
5 x 3 = 15 and 5 + 5 + 5 = 15
False. p x q = $p_1 + p_2 + p_3 \ldots p_q$

| | | |
|---|---|---|
| (a)n(p x q) = n x p x n x q | (b) $n\left(\frac{p}{q}\right) \neq \left(\frac{n \times p}{n \times q}\right)$ | (c) If p + q = 0<br>then \|p\| = \|q\| |
| (d) If p x q = 0 then either<br>p = 0 or q = 0 or p = q = 0 | (e)If p = q, then<br>p ÷ q ≠ q ÷ p | (f)If p ÷ q = q ÷ p then<br>p ÷ q = q ÷ p = 1 |

4.Substitute small natural numbers in the expressions below. Enter your expression and record the sign of the result in the table.

| Operation | Sign of the result |
|---|---|
| (a) p – q where p > q | |
| (b) p – q where p < q | |
| (c) p – q where p = q | |

(i)By observing the signs of the results, describe how you would use subtraction to compare two numbers p and q.
(ii)Find out if your description works for negative numbers, fractions and decimals.
(iii)Compare: (i) -56 and -78 (ii) 2 and -45 (iii) $\frac{2}{3}$ and $\frac{6}{7}$
(iv)Compare p and q if p – q = q – p.
(v)Compare p and q if p – q = 0.

5.Substitutesmall natural numbers in the expressions below. Enter your expression and use the result to complete the table.

| Operation | Observation: Is the result less than, equal to or greater than 1? |
|---|---|
| (a)p ÷ q where p>q. | |
| (b)p÷ q where p<q. | |
| (c)p ÷ q where p = q | |

Explain how you would use division to compare two numbers p and q.

6.Use any three numbers p, q and r such that p is divisible by q but is indivisible by r.
(a)Enter (i)p ÷ q (ii)p ÷ r.
(b)State one difference between the results in (a)(i) and (a)(ii)
(c)Explain how you would use a calculator to perform divisibility tests.

(d)Enter the following and record the mixed number result: (i)11 ÷ 3 (ii) 15 ÷6
(e)By observing the results in (d) describe how you would use the mixed number result of a division operation to identify the (i) quotient (ii) remainder.
7(a)Mrs. Njuguna is to share out 37 candies equally among 8 pupils. How many candies will each pupil receive and how many candies will she be left with?

(b)A school has 500 students to go for a trip. Each bus carries 44 students. How many buses are needed and how many students will still be left out?

*Provide an exercise on more of such real-life problems that require a bit of 'mathematical thinking'.*

---

8.Substitutea natural number in each of the expressions and enter expression in CLASSWIZ.

| | | | |
|---|---|---|---|
| p + 0<br>Example: 3 + 0 = 0 | 0 + p | p – 0 | 0 – p |
| p x 0 | 0 x p | 0 ÷ p or $\frac{0}{p}$ | p ÷ 0 or $\frac{p}{0}$ |

*To explain the concept of infinity, you may use division by numbers approaching 0 to show that the result increasingly becomes big or small beyond the realms of both reality and imagination hence infinity,∞ (a concept and not a normal number)*
$\frac{1}{0.001}, \frac{1}{0.000001}, \frac{1}{0.00000001} \ldots$ and $\frac{1}{-0.001}, \frac{1}{-0.000001}, \frac{1}{-0.00000001} \ldots$

---

9. Evaluate the following without using a calculator. By entering each expression check the accuracy of your result.
(a) 3(75 + 32) + 5(35 + 60) (b) 975 ÷ 15 x 8 + 420
(c) 70 – 2(20 + 12 ÷ 4 x 3 – 2 x 2) + 10 (d) 6 ÷ 2(1 + 2) (e) $\frac{7 \times 3-5}{(10-6)\times 2}$

10.If x = 5, y = 3 and z = 2, evaluate the following without using a calculator.
7x – (4y + 5z). Use a calculator to check the accuracy of your result.

11.Solve the following linear equations and use a calculator to check the accuracy of you answer (i.e. by substituting it in each side of the equation, calculating and comparing the results)

(a) -2x + 6 = 4x – 2 (b) -(-x – 8) = 3x – 2 (c) $\frac{-(3x-1)}{3} - \frac{2(x-8)}{5} = \frac{x+8}{5} - 3$

*Provide a further practice exercise including real-life problems.*

## 2.2.Exploring decimals, fractions, percentages and ratios

1(a)Enter the following fractions and record the decimal results.

| Fraction | $\frac{1}{10}$ | $\frac{1}{100}$ | $\frac{1}{1000}$ |
|---|---|---|---|
| Decimal | | | |

(b)Compare the number of zeroes in the denominator withthe number of digits after the decimal point.

(c)By observing the pattern in the table, express:

(a) $\frac{3}{1000000}$ as a decimal. (b) 0.000000017 as a fraction.

(d) Write each of the following fractions so that the denominator is a power of ten and convert the result into a decimal.

(i) $\frac{3}{5}$ (ii) $\frac{1}{8}$ (iii) $\frac{7}{20}$

(e) Why are such fractions also called decimal fractions?

2(a) Enter a fraction of your choice in which the numerator and the denominator have common factors e.g. $\frac{6}{30}$ . Use your result to affirm the following statements:

If $\frac{a}{b} = \frac{c}{d}$ where $\frac{c}{d}$ is the simplest form of $\frac{a}{b}$

then (i) $\frac{a}{c} = \frac{b}{d} = e$ (ii) $\frac{a}{b} = \frac{c \times e}{d \times e}$

(b) Enter a mixed number of your choice and use the improper fraction result toaffirm the following statement:

If $a\frac{b}{c} = \frac{d}{e}$, then d = a x c + b and c = e

(c) Enter an improper fraction of your choice and use the mixed number result to affirm either of the following statements:

(i)If $\frac{d}{e} = a\frac{b}{c}$and e = c, then d ÷ e = a remainder b

(ii)If$\frac{d}{e} = a\frac{b}{c}$ and e ≠ c, then d ÷ e = a + $\frac{\frac{e}{c} \times b}{\frac{e}{c} \times c}$

3(a)Subtract a small natural number from the numerator of a simpleor an improper fraction. From the denominator, subtract a larger natural number. *(Ensure that the results for both the numerator and the denominator are greater than zero)*

Example: Using $\frac{5}{7}$, subtract 2 from 5 and 3 from 7 and compare the result to $\frac{5}{7}$.

Does this operation cause an increase or a decrease in the size of the fraction?

(b)Subtract a small natural number from the numerator of a simple or an improper fraction. From the denominator, subtract a smaller natural number. *(Ensure that the results for both the numerator and the denominator are greater than zero)*

Example: Using $\frac{9}{8}$, subtract 4 from 9 and 2 from 8 and compare the result to $\frac{9}{8}$

Does this operation cause an increase or a decrease in the size of the fraction?

---

4(a)Enter the following fractions and record the decimal results in short form:

$\frac{1}{3}, \frac{2}{3}, \frac{7}{9}, \frac{5}{18}, \frac{77}{900}, \frac{13}{555}$

(b) A recurring decimal is represented as $0.1\dot{2}\dot{3}$.

(i) Is it possible to use a calculator to convert it into fraction?

(ii) Convert the recurring decimal into a fraction.

(iii)Enter the fraction to obtain a decimal result and compare it with the recurring decimal.

---

5.(a)Complete the tables below:

| Fraction | $\frac{1}{100}$ | $\frac{1}{4}$ | $\frac{3}{8}$ | $\frac{1}{2}$ |
|---|---|---|---|---|
| Decimal | | | | |

| Percentage | 1 | 25 | 37.5 | 50 |
|---|---|---|---|---|
| Fraction | | | | |
| Decimal | | | | |

(b)Study the patterns in the above tables and answer the questions below.

(i)A percent of a quantity refers to what fraction of that quantity?

(ii)Given a fraction $\frac{a}{b}$, how do you express it as a percentage?

(iii)What is n% as a fraction?

(c)Express as a percentage.

(i) $\frac{57}{100}$ (ii) $\frac{21}{30}$ (iii) $\frac{139}{100}$ (iv) $\frac{7}{4}$ (e) $2\frac{3}{7}$

(d)Express 0.8 as a fraction then as percentage.

(e)Express as a percentage (i)0.659 (ii) 0.04 (iii) 1.2

(f)What is 15% of 500?

(g)Mathematically, ratio a : b = $\frac{a}{b}$. Use the fraction function to simplify the following ratios:

(i) 0.375: 0.5 (ii) 5.06:17.71 (iii) $\frac{3}{16}$ : $\frac{9}{4}$ (iv) $3\frac{1}{2}$:$5\frac{1}{4}$

---

6.(a)Evaluate the following expression.

$$\frac{\frac{3}{4}+1\frac{2}{7} \div \frac{3}{7} \times 2\frac{1}{3}}{\left(\frac{9}{7}-\frac{3}{8}\right) \times \frac{2}{3}}$$

(b)Check the accuracy of your answer by entering the expression in CLASSWIZ.

*Provide an exercise on more of such sums.*

---

7.(a)What is 35% profit on an item whose marked price is Ksh. 25000?

(b)In one year the average rainfall record at a weather station was 34 mm. In the following year the record was 29 mm. What was the percentage decrease?

(c)A cylinder has a radius, r = 0.7694 m and a height, h = 2.871 m.

(d)Find the volume V where V = $\frac{1}{3}$ лr$^2$h. (Take л = 3.142)

(e)If V is increased by 20%, what is the new value for r if h is constant?

(f) Find the percentage change in V if r is decreased by 30% and h is increased by 15%. State whether the change is a decrease or an increase.

(g)$\frac{3}{5}$of students in a class of 40 are boys while the rest are girls.

(h)Find the number of (i) boys (ii) girls in the class.

(i) Express the number of (i)boys (ii) girls as a percentage of the total number of students.

(j) What was the ratio of boys to girls?

(k) Five new boys joined the class while three girls left. What was the new ratio of boys to girls?

*Provide a further practice exercise including real-life problems.*

---

# 2.3. Exploring prime numbers and composite numbers

1. Study the following sets of numbers

| | | | | | |
|---|---|---|---|---|---|
| Group 1<br>Prime numbers | 2 | 3 | 4 | 5 | 7 |
| Group 2<br>Composite numbers | 4 | 6 | 8 | 9 | 10 |

(a) Use the FACT function of CLASSWIZ to obtain the prime factor(s) of numbers from Group 1 and from Group 2.

(b) Based on (a) state one difference between a prime number and a composite number.

(c) Which of the following numbers are prime numbers?

13, 15, 29, 87, 123, 359, 8643, 22451, 105503, 1299811,

(d)What are the prime factors of 540 and 800?

(e)Find the LCM and the GCD of 540 and 800.

(f)Determine the greatest number which when used to divide 447, 577 and 669 will leave a remainder of 7, 5 and 9 respectively.

2.Anne gave the following description on how she would list down all the factors of a number:

- Use the FACT function to obtain the prime factors of the number.
- Search for other factors from the products of these prime factorsalways checking to see that these multiples of the prime numbers are also factors of the number.
- Including 1 and the number, arrange all the factors in ascending order.
- Starting with 1 list down in ascending order the prime factors and their multiples.
- For example, to find all the factors of 60: [6] [0] [=] [SHIFT] [°'"]
- The prime factors are $2^2$ , 3 and 5.
- Therefore all the factors are: 1, 2, 3, 4(i.e. 2 x 2), 5, 6(i.e. 2 x 3), 10(i.e.2 x 5), 12(i.e. $2^2$ x 3), 15(i.e. 3 x 5), 20(i.e. $2^2$ x 5), 30(i.e. $2^2$ x 3 x 5), 60

Use other numbers of your choice to find out if the description is reliable.

3.(a) A natural phenomena has been observed to occur after every 9 years. Another phenomenon has been observed to occur after every 12 years. The two phenomena are expected to coincide in 2020. Predict the year after 2020 when they will be expected to coincide again.

(b)An oil dealer has two underground tanks of capacities 3000000 litres and 5000000 litres. He intends to buy an oil tanker that can fill any of the two tanks exactly. Determine the largest capacity of the tanker.

*Provide a further practice exercise on the applications of prime factors to solvereal-life problems.*

## 2.4. Exploring variation

The calculator facilitates the repeated computation required. Easy-to-compute values have been used in the following examples. Transfer the concepts to real-life situations.

### 2.4.1.Direct variation

- Substitute small natural numbers in the expression k x p
- Enter and record the result.
- While keeping k constant increase the value of p by a small value.
- Enter and record the result.
- Repeat for at least 5 different values of q.

Example

| k x p | 2 x 1 | 2 x 2 | 2 x 3 | 2 x 4 | 2 x 5 |
|---|---|---|---|---|---|
| Result, r | | | | | |

(a)How does r vary as p increases?

(b)What happens to r when p is doubled?

(c)Write a law relating k, p and r in which r is the subject (i.e. r is the dependent variable while p is the independent variable). In your law, replace k with the constant you used.

(d)Use your law to determine the value of (a) r when p = 27 (b) p for which r = 5.

(e)Predict the value of r when p = 0

(f)Extract the values of r and q from the table and complete the table below:

| r | | | | |
|---|---|---|---|---|
| p | | | | |

(g)Sketch a graph of r against q and determine its slope.

(h)How does the slope compare with k (the constant you used)?

## 2.4.2.Inverse variation

- Substitute natural numbers in the expression $\frac{k}{p}$ .
- Using CLASSWIZ, enter and record the result in the table below.
- While keeping kconstant increase the value of q by a small number, enter and record the result in the next column.
- Repeat for at least 5 different values of p.

Example: k = 10

| $\frac{k}{p}$ | $\frac{10}{2}$ | $\frac{10}{3}$ | $\frac{10}{4}$ | $\frac{10}{5}$ | $\frac{10}{6}$ |
|---|---|---|---|---|---|
| Result, r (to 1 d.p.) | | | | | |

(a)How does r vary as p increases?
(b) What happens to r when p is doubled?
(c)Write the law relating k, pand r in which r is the subject and k is the constant you used (10 in the above example)
(d)Use your law to determine the value of (a) r when p = 15 (b) p for which r = 2.8.
(e)Predict the value of (a) r when p = 10 (b) r when p = 0

(f)Extract the values of p and r from the table and complete the table below:

| | | | | |
|---|---|---|---|---|
| r | | | | |
| p | | | | |
| $\frac{1}{p}$ | | | | |

(g)With the aid of the Table Function, draw a graph of:
(i) r against q.
(ii) r against $\frac{1}{p}$ and determine its slope. How does the slope compare withthe value of k you used?

### 2.4.3.Joint variation

If r varies jointly as p and q, they are related by the equation r = kpq where k is a constant.

Use k = 5 (or any other value) and complete the table below:

| | | | | |
|---|---|---|---|---|
| p | 1 | 2 | 1 | 2 |
| q | 1 | 1 | 2 | 2 |
| r | | | | |

How does r vary:

(a)when p is doubled while q is constant?

(b)when r is doubled while q is constant?

(c)when both p and q are doubled?

### 2.4.4.Partial variation

(a)If r is partly constant and varies partly as p, then r and p and related by the equation:

r = kp + m where k and m are constants.

(b)Use k = 2 and m = 3 (or any other values) and complete table below:

| | | | | | |
|---|---|---|---|---|---|
| p | 1 | 2 | 3 | 4 | 5 |
| r | | | | | |

(i)Plot a graph of p against r.

(ii)Determine the slope of the graph

(iii)How does the slope compare with k?

(iv)What is the y-intercept?

(v)How does the y-intercept compare with m?

(c)y is partly constant and varies partly as x. y = 11 when x = 2 and y = 26 when x = 7. Determine the law relating r and p and use it to find:

(i)r when p = 31. (ii)p when r = 17.

*Provide a further practice exercise including real-life problems.*

## 2.5. Exploring standard form

A number is in standard form when expressed in the form $a \times 10^n$ where $1 \leq a < 10$ and n is an integer. *a* is called the coefficient and *n* the index.

1.SelectCLASSWIZ'sMathI/DecimalO and Sci(4)setup for this exercise.
SHIFT MENU 1 2 And, continuing: SHIFT MENU 3 2 4

*This setting displays decimal results in standard form to 4 significant figures.*

2.Enter the following and record the result.

| Input | Result |
|---|---|
| (a)23.45 | |
| (b)6784 | |
| (c)0.8539 | |
| (d)0.0008765 | |
| (e)7.564 | |

(a)Compare the value of *n* withthe number of places that the decimal point moves for the condition $1 \leq a < 10$ to be met?

(b)What is the sign of n if for the condition $1 \leq a < 10$ to be met, the decimal point moves:

(i)to the left (ii)to the right?

(c)What is the value of n when the number already meets the condition $1 \leq a < 10$?

3(a)Substitute numbers for a, b and n such that a + b < 10 (e.g. 3 + 5).Enter and record the result for each side of the expression to affirm the following rule for numbers with the same index: $a \times 10^n + b \times 10^n = (a + b) \times 10^n$

(b)Substitute numbers for a, b and n such that $a + b \geq 10$ (e.g. 7 + 8).Enter and record the result for each side of the expression to affirm the following rule for numbers with the same index: $a \times 10^n + b \times 10^n = \left(\frac{a+b}{10}\right) \times 10^{n+1}$

(c)Substitute numbers for a, b and n such thata – b $\geq 1$ (e.g. 7 – 3). Enter and record the result for each side of the expression to affirm the following rule for numbers with the same index: $a \times 10^n - b \times 10^n = (a - b) \times 10^n$

(d)Substitute numbers for a, b and n such thata – b <1 (e.g. 3 – 5). Enter and record the result for each side of the expression to affirm the following rule for numbers with the same index: $a \times 10^n - b \times 10^n = (a - b) \times 10^n$

(e)Substitute numbers for a, b and n such that 0 <a – b <1 (e.g. 8.7 – 8.2). Enter and record the result for each side of the expression to affirm the following rule for numbers with the same index: $a \times 10^n - b \times 10^n = [(a - b) \times 10] \times 10^{n-1}$

---

4.Enter the following and record the results for operations on numbers with different indices:

(a) $2.0 \times 10^5 + 3.0 \times 10^4 =$
(b) $2.0 \times 10^5 + 3.0 \times 10^3 =$
(c) $5.0 \times 10^7 - 4.0 \times 10^6 =$
(d) $5.0 \times 10^7 - 4.0 \times 10^5 =$

---

5.Study the results and explain how you would evaluate the following when m > n:

(a) $a \times 10^m + b \times 10^n$ (b) $a \times 10^m - b \times 10^n$

---

6.Substitute numbers for a, b and n such that 1≤ a x b < 10 (e.g. 2 x 3). Enter and record the result for each side of the expression to affirm the following rule:

$$a \times b \times 10^n = ab \times 10^n$$

---

7.Substitute numbers for a, b and n such that 1≤ b ÷ a <10 (e.g. 6 ÷ 2). Enter and record the result for each side of the expression to affirm the following rule:

$$b \times 10^n \div a = \frac{b}{a} \times 10^n$$

---

8.Substitute numbers for a, b and n such that 10 ≤ a x b < 100 (e.g.7 x 8 ). Enter and record the result to affirm the following rule:

$$a \times b \times 10^n = \left(\frac{ab}{10}\right) \times 10^{n+1}$$

---

9.Enter 15.69 and record the result. Now enter the following and record the results:
(a) $156.9 \times 10^3$ (b) $1.569 \times 10^3$ (c) $0.01569 \times 10^3$

---

10.By studying activity 9, express the following in standard form without using a calculator:
(a) $478.3 \times 10^5$ (b) $0.02384 \times 10^4$ (c) $602.3 \times 10^{21}$ (d) $0.0008356 \times 10^{-7}$

---

11.Enter $(2 \times 10^2)^3$ and record the result. Given $7.659^3 = 449.3$, determine without using a calculator $(7.659 \times 10^3)^3$. (Leave your answer in standard form.)

13(a)A mole of atoms of a substance contains $6.0 \times 10^{23}$ atoms of that substance.

How many moles are made up of $1.5 \times 10^{18}$ atoms ?

(b)A $8.0 \times 10^{-6}$ F capacitor is connected in parallel to a $6.0 \times 10^{-6}$ F capacitor. The combination is then connected to a 1.5V supply. Evaluate:

(a)the effective capacitance, $C_T$ (Add the capacitances)

(b)the total charge stored, Q leaving your answer in standard form. (Use the the formula: $Q = C_TV$.

*Provide a further practice exercise including real-life problems.*

## 2.6.Exploring indices (powers)and radicals (roots)

### 2.6.1. Squares

1.Enter $3^2$ and 3 x 2 and record the results.
2.Whichone is correct? $p^2 = p \times 2$ or $p^2 = p \times p$?
3.Enter and record the result: (a) $1^2$ (b) $0^2$
4.Enter $\left(\frac{p}{q}\right)^2$ where p and q are positive integers. Use the result to show that:
$\left(\frac{p}{q}\right)^2 = \frac{p \times p}{q \times q}$
5.Enter each of the following and record the result.
(a)$2^2$ and $0.2^2$ (b) $3^2$ and $0.03^2$ (c) $1.2^2$ and $0.12^2$ (d) $32^2$ and $0.032^2$
6. For the decimals in activity 5, how do the number of decimal places in the input compare with the number of decimal places in the result?
7. Enter -3 x -3 and record the result.
8.Enter each of the following and record the result: (i) $-3^2$ (ii) $(-3)^2$
9.Between $-p^2$ and $(-p)^2$ which one is the square of -p?
10.Explain the difference between $-p^2$ and $(-p)^2$
11.Why is the sign of the result of $(-3)^2$ positive?

12. Study the tables below:

| | | | | | | |
|---|---|---|---|---|---|---|
| Number | $10^1$ | $10^2$ | $10^3$ | $10^4$ | $10^5$ | $10^6$ |
| Square | $10^2$ | $10^4$ | $10^6$ | $10^8$ | $10^{10}$ | $10^{12}$ |

| | | | | | | |
|---|---|---|---|---|---|---|
| Number | $10^{-1}$ | $10^{-2}$ | $10^{-3}$ | $10^{-4}$ | $10^{-5}$ | $10^{-6}$ |
| Square | $10^{-2}$ | $10^{-4}$ | $10^{-6}$ | $10^{-8}$ | $10^{-10}$ | $10^{-12}$ |

Study the following operations:

567.4 = 5.674 x $10^2$ (in standard form)
$(567.4)^2 = (5.674 \times 10^2)^2 = 5.674^2 \times (10^2)^2$
Without using a calculator, evaluate:
(a)$567.4^2$ given that $5.674^2 = 32.19$ (b) $0.009354^2$ given that $9.354^2 = 87.50$.

*Provide a further practice exercise including real-life problems.*

---

### 2.6.2. Square roots

1.Enter each of the following expressions and record the result.
(a)$\sqrt{25}$(b) 5 x 5
2.If$\sqrt{a}$ = b then b x b = a. True or False?
3.Enter -5 x -5 and compare the result with the results in 1 above.
4.Apart from 5, is -5 also a square root of 25?
5.Does a positive number have two distinct square roots?

6.Study the tables below.

| Number | $10^0$ | $10^1$ | $10^2$ | $10^3$ | $10^4$ | $10^5$ | $10^6$ |
|---|---|---|---|---|---|---|---|
| Square root | 1 | 3.162 | $10^1$ | 31.62 | $10^2$ | 316.2 | $10^3$ |

| Number | $10^0$ | $10^{-1}$ | $10^{-2}$ | $10^{-3}$ | $10^{-4}$ | $10^{-5}$ | $10^{-6}$ |
|---|---|---|---|---|---|---|---|
| Square root | 1 | 0.3162 | $10^{-1}$ | 0.03162 | $10^{-2}$ | 0.003162 | $10^{-3}$ |

(a)Write an expression for the square root of $10^n$ where n is an even integer.
(b) Enter the following and record the result:
(i)$\sqrt{4}$ (ii)$\sqrt{100}$ (iii)$\sqrt{4 \times 100}$
Use the results to evaluate (i) $\sqrt{40000}$ (ii) $\sqrt{4000000}$
(c)Given $\sqrt{39.26}$ = 6.266, express 3926 as the product of 39.26 and an even power of ten and evaluate: (i)$\sqrt{3926}$(ii) $\sqrt{0.3926}$
(d)Enter $\sqrt{-25}$.Suggest an explanation for the message displayed.
(e)Enter$\sqrt{|-25|}$ . Suggest an explanation for how the Abs function works.
(f)Enter: (a) $\sqrt{0}$ (b) $\sqrt{-0}$
(g)Does zero have a sign?

(h)Enter the following and record the result

| Input | $\sqrt{\frac{4}{9}}$ | $\frac{\sqrt{4}}{\sqrt{9}}$ | $\sqrt{0.04}$ | $\sqrt{0.16}$ |
|---|---|---|---|---|
| Result | | | | |

By observing the results, evaluate the following without using a calculator:

(i) $\sqrt{\frac{25}{64}}$ (ii) $\sqrt{1\frac{7}{9}}$ (iii) $\sqrt{0.16}$ (iv) $\sqrt{0.000025}$

*Provide a further practice exercise including real-life problems.*

**2.6.3.Cubes**

1.(a) Enter $2^3$ (b) Evaluate $3^3$(c) Enter $(-2)^3$

2.Why is the result in (c) a negative number?

3.Given that $p^3 = m$, what is $(-p)^3$ in terms of m?

4.Study the patterns in the table below.

| Index form | $0.2^3$ | $0.02^3$ | $0.002^3$ |
|---|---|---|---|
| Standard form | $(2.0 \times 10^{-1})^3$ | $(2.0 \times 10^{-2})^3$ | $(2.0 \times 10^{-3})^3$ |
| Decimal form | 0.008 | 0.000008 | 0.000000008 |

Given $6.785^3 = 312.4$, evaluate the following without using a calculator.

(a) $0.6785^3$ (b) $0.006785^3$ (c) $67.85^3$

*Provide a further practice exercise including real-life problems.*

**2.6.4. Cube roots**

1.Enter $\sqrt[3]{8}$ and $\sqrt[3]{27}$and use the results to prove that if $\sqrt[3]{a}$ = b then a = b x b x b.

2.Enter each of the following and record the result;

(a)$\sqrt[3]{-8}$ (b)$\sqrt[3]{-27}$ (c)$\sqrt{-4}$(iv)$\sqrt{-9}$

3.State the reason why: (a)a negative number has a real cube root but not a real square root. (b)the cube root of a negative number is negative.

4.Evaluate without using a calculator. Use a calculator to check the accuracy of your answer. $\frac{\sqrt[3]{13824} - 4}{3+4 \div 2-5 \times 7}$

*Provide a further practice exercise including real-life problems.*

### 2.6.5. Reciprocals and negative indices

1.Enterthe following using the reciprocal function $(x^{-1})$ and record the result.

(a)$4^{-1}$ (b) $\left(\frac{2}{3}\right)^{-1}$ (c)$0.125^{-1}$

2.Evaluate: (a) $4 \times \frac{1}{4}$(b) $\frac{2}{3} \times \frac{3}{2}$ (c) $8 \times \frac{1}{8}$

3.What is the product of a number and its reciprocal?

4.A whole number can be thought of as a fraction. What would be the denominator of such a fraction?

5. Enter 8 ÷ 0.7654 and record the result.

6. Rewrite the above expression by replacing the division operator by the multiplication operator. Enter your expression to check that it gives the same result as the one in 5.

7.Enter 67.54 x 12.48 and record the result.

8.Rewrite the expression in 7 by replacing the multiplication operator by the division operator. Enter your expression to check that it gives the same result as the one in 7.

9.Study the tables below

| | | | | |
|---|---|---|---|---|
| Number | $10^1$ | $10^2$ | $10^3$ | $10^4$ |
| Reciprocal | $10^{-1}$ | $10^{-2}$ | $10^{-3}$ | $10^{-4}$ |

| | | | | |
|---|---|---|---|---|
| Number | $10^{-1}$ | $10^{-2}$ | $10^{-3}$ | $10^{-4}$ |
| Reciprocal | $10^1$ | $10^2$ | $10^3$ | $10^4$ |

(a)Given the reciprocal of 7.868 = 0.1271and 78.68 = 7.868 x $10^1$ in standard form explain why the reciprocal of 78.68 is 0.01271.

(b) Given the reciprocal of 5.676 = 0.1762 and 567.6 = 5.676 x $10^2$ in standard form, find without using a calculatorthe reciprocal of: (i) 567.6.(ii) 0.0005676

(c)Given that $52.83^{-1}$ = 0.01892 and $0.003735^{-1}$ = 267.64. Work out without using tables or a calculator the value of:

$$\frac{7}{0.5283} + \frac{0.5}{3.735}$$

*Provide a further practice exercise including real-life problems.*

**2.6.6. Operations with indices**

Use any small ***prime number*** for p.

1. Enter $p^2$ x $p^3$ and use the FACT function to express the result in terms of its prime factors

Example: $5^2$ x $5^3$ [5] [$x^2$] [×] [5] [$x^3$] [=] [SHIFT] [°’’’]

By observing the powers of p in the input and the result, complete the expression: $p^x$ x $p^y$=

2. Enter $p^7 \div p^4$ and use the FACT function to express the result in terms of its prime factors.

Example: $3^7 \div 3^4$

[3] [$x^■$] [7] [▶] [÷] [3] [$x^■$] [4] [=] [SHIFT] [°’’’]

By observing the powers of p in the input and result, complete the expression

$p^x \div p^y = \frac{p^x}{p^y} =$

3.Enter$(p^2)^3$and use the FACT function to express the result in terms of its prime factors.

Example: $(2^3)^4$

[(] [2] [$x^3$] [)] [$x^■$] [4] [=] [SHIFT] [°’’’]

By observing the powers of p in the input and the result, complete the expression

$(p^x)^y$ =

4. Enter the following. Where the result is not a prime number, use the FACT function to express it as a power and record the result.

5(a) $3^{-1}$ [3] [$x^{-1}$] [=] We get $\frac{1}{3}$. 3 is a prime number.

(b)$3^{-2}$ [3] [$x^■$] [(−)] [2] [=] We get $\frac{1}{9}$ . 9 is not a prime number.

Continuing: [9] [=] [SHIFT] [°’’’]

We get $\frac{1}{3^2}$

Similarly,

(c)$3^{-3} = \frac{1}{27} = \frac{1}{3^3}$

By observing the results, express $p^{-x}$ as a fraction.

6. Nestled indices.

Enter $2^{3^2}$ and use the FACT function to express the result in terms of its prime factors:

[2] [$x^{■}$] [3] [$x^2$] [=] [SHIFT] [°’’’]

By observing the input and the result, state whether the input was worked out as $2^3$ x $2^3$ i.e. $(2^3)^2$ or as $2^9$ i.e. $2^{(3^2)}$.

---

7. Enter $p^0$ where p is any number other than zero and record your result. Repeat for other values. What do you observe?

8. For an explanation to the observation made in 7,study the operations below.

$\frac{p^n}{p^n} = p^{n-n} = p^0$ (subtracting indices)

$\frac{p^n}{p^n} = 1$ (dividing identical entities)

⇨ $p^0 = 1$

9. Replace p and n with numbers of your choice and affirm the operations in 8.

---

10.Positive and negative base indices.

Enter the following and record the results.

| Power | $2^1$ | $2^2$ | $2^3$ | $2^4$ | $2^5$ | $2^6$ |
|---|---|---|---|---|---|---|
| Result | | | | | | |

| Power | $(-2)^1$ | $(-2)^2$ | $(-2)^3$ | $(-2)^4$ | $(-2)^5$ | $(-2)^6$ |
|---|---|---|---|---|---|---|
| Result | | | | | | |

Comment on the pattern of the signs of the outputs for:
(a)positive base indices (b) negative base indices.

---

11. Fraction base indices.
Enter the following and record the results:

| Fraction | $\left(\frac{1}{2}\right)^2$ | $\left(\frac{2}{3}\right)^3$ | $\left(\frac{3}{4}\right)^4$ |
|---|---|---|---|
| Result | | | |

By observing the results express $\left(\frac{a}{b}\right)^n$ such that the numerator and the denominator are separate powers.

12. Relationship between fraction indices and radicals (roots)
Enter the following and record the results.

| Index | $4^{\frac{1}{2}}$ | $9^{\frac{1}{2}}$ | $16^{\frac{1}{2}}$ |
|---|---|---|---|
| Result | | | |

| Radical | $\sqrt{4}$ | $\sqrt{9}$ | $\sqrt{16}$ |
|---|---|---|---|
| Result | | | |

| Index | $8^{\frac{1}{3}}$ | $27^{\frac{1}{3}}$ | $64^{\frac{1}{3}}$ |
|---|---|---|---|
| Result | | | |

| Radical | $\sqrt[3]{8}$ | $\sqrt[3]{27}$ | $\sqrt[3]{64}$ |
|---|---|---|---|
| Result | | | |

(a)By observing the patterns in the tables, express:
(i)$p^{\frac{1}{2}}$as a radical. (ii)$\sqrt[3]{p}$ in index notation.
(b)Compare the results for:
(i) $625^{\frac{1}{4}}$ and $\sqrt[4]{625}$(ii) $243^{\frac{1}{5}}$ and $\sqrt[5]{243}$
(c)Express (i) $q^{\frac{1}{m}}$ as a radical.(ii) $\sqrt[n]{p}$ in index notation.

13(a)Simplify the following expression and use a calculator to check the accuracy of your answer:

$$\frac{125^{\frac{2}{3}} \div 3^4}{243^{-\frac{3}{5}}}$$

14.Solve for the unknown by expressing both sides to the same base or index and use a calculator to check the accuracy of your answer.
(i)$2^x = 8$ (ii) $3^x = 81$(iii) $x^5 = 32$(iv) $3x^4 = 1875$

**Learners need to appreciate that expressing both sides to the same base or index may not be that straightforward in some cases e.g. in $3^x = 7$ and $x^5 = 2.458$.*

*Provide a further practice exercise including real- life problems.*

# 2.7.Exploring logarithms and antilogarithms

## 2.7.1. Logarithmic and index notations

1.Enter the following and record the results in the table.

| Input | log1 | log 10 | log 100 | log1000 |
|---|---|---|---|---|
| Result | | | | |

Complete the table below.

| Number, n | 1 | 10 | 100 | 1000 |
|---|---|---|---|---|
| $10^n$ | | $10^1$ | | $10^3$ |

By studying the patterns in the tables above:
(a)Predict the value of (i)log 10,000 (ii)log 100,000

(b)Express $10^n = m$ in terms of log m, 10 and n.

2. Given log 65.31 = 1.815(to 4 significant figures)rewrite the expression in terms of10, 65.31 and 1.815.

3. Enter the antilogarithm of 1.815. [SHIFT] [log] [1] [•] [8] [1] [5] [=]

4. Define (a) logarithm of a number to base 10(b) antilogarithm of a number to base 10.

5. Why is $\log_{10}1 = 0$?

6. Why is $\log_{10}10 = 1$?

7. Does it follow from 6 that for any number m, $\log_m m = 1$?
Use [log▪□] to enter any number to the same base to find out e.g. $\log_3 3$, $\log_7 7$….

8.(a) Express the following equations in logarithmic notation and use a calculator to affirm your equation: (i)$5^2 = 25$ (ii) $3^{-3} = \frac{1}{27}$ (iii)$36^{\frac{1}{2}} = 6$

(b) Express the following equations in index notation and use a calculator to affirm your equation:

(i) $\log_2 32 = 5$ (ii) $\log_8 2 = \frac{1}{3}$ (iii) $\log_4\left(\frac{1}{64}\right) = -3$

*Provide a further practice exercise.*

### 2.7.2. Laws of logarithms

*Use any set of numbers whose products, quotients and powers learners already know e.g. 2 and 3. For group discussions provide each group with a different set of numbers. Different groups arriving at the same laws will be a real learning experience!*

Given log 2 = 0.3010 =>$10^{0.3010} = 2$ and log 3 = 0.4771 =>$10^{0.4771} = 3$

1.To evaluate 2 x 3, we would proceed as follows:

log2 x log 3 (taking logarithms of the numbers)

= $10^{0.3010} \times 10^{0.4771} = 10^{0.3010 + 0.4771}$

= $10^{0.7781}$ (finding the antilog)

= 6

From the above log 6 = log (2 x 3) = log 2 + log 3

In general log AB = log A + log B

Logarithms have enabled us to reduce multiplication to addition.

So, we multiply numbers by looking up their logarithms from tables, adding the logarithms and then looking up the antilogarithm of the sum.

2.To evaluate 3 ÷ 2 = $\frac{3}{2}$, we would proceed as follows:

log 3 ÷ log 2 = $10^{0.4771} \div 10^{0.3010} = 10^{0.4771 - 0.3010}$

= $10^{0.1761}$(finding the antilog)

= 1.5

From the above log 1.5 = log $\frac{3}{2}$ = log 3 – log 2

In general log $\frac{A}{B}$ = log A – log B

Logarithms have enabled us to reduce division to subtraction.

So we divide numbers by looking up their logarithms, subtracting the logarithms and looking up the antilogarithm of the difference.

3.To evaluate $2^3$, we would proceed as follows:

$\log 2^3 = \log (2 \times 2 \times 2) = 10^{0.3010} \times 10^{0.3010} \times 10^{0.3010}$

$2^3 = (10^{0.3010})^3 = 10^{0.3010 \times 3}$

$\log 2^3 = \log 10^{0.3010 \times 3}$

$= 3\log 2$

In general $\log A^n = n \log A$

Logarithms have enabled us to reduce exponentiation to multiplication.

So when raising a number to a power, look up its logarithm, multiply the logarithm by the power and look up the antilogarithm of the product.

---

4.(a)Use $\boxed{\log_{\blacksquare}\square}$ with positive numbers for m and n in each side of the expression to affirm the law:

$$\log_n m = \frac{1}{\log_m n}$$

---

5. Express the following equations in logarithmic notation:

(a) $y = a^x$ (b) $y = ka^x$

---

6(a)Evaluate the expressions and use a calculator to check the accuracy of your result.

(i) $2\log_5 25 - \log_4 16$ (ii) $2\log_3 10 - \log_3 4$

(b)Solve for x in each of the following equations and use a calculator to check the accuracy of your result by substituting your answer in the expression.

(i) $3^x = 7$ (ii) $x^5 = 2.458$. (iii) $\log 5 - \log(x - 2) = \log (x+2)$.

7. Evaluate using logarithms: $\sqrt[3]{\frac{854.7 \times 0.6934}{21.72}}$. Use a calculator to check the accuracy of your answer.

8. After how many years will a principal of Ksh. 36000 invested at 14% compound interest amount to Ksh. 450,000? $A = P\left(1 + \frac{r}{100}\right)^n$

*Provide a further practice exercise including real-life problems.*

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# 2.8. Exploring quadratic expressions and equations.

## 2.8.1. Factorizing quadratic expressions.

1.To factorize a quadratic expression $ax^2 + bx + c$, express b as the sum of two numbers whose product = ac then factorize by grouping.

Examples:

1.Factorize $3x^2 + 5x + 2$

b = 5 and ac = 6

The two numbers are 3 and 2

$3x^2 + 3x + 2x + 2$

$\underbrace{3x^2 + 3x} + \underbrace{2x + 2}$

$3x(x + 1) + 2(x + 1)$

$(x + 1)(3x + 2)$

The set of numbers is not always so obvious. So how do you find them?

Partly it is guess work. However, having all the factors of a number and knowledge of basic arithmetic simplifies the search.

Examples:

(a)Factorize $3x^2 – 2x – 5$

ac = -15 and b = -2

Use the FACT function to find the prime factors of 15 as 3 and 5

Include 1 and 15.

Therefore all the factors of 15 in ascending order are 1,3,5 and 15

For the two numbers to have a product of -15, one is negative and the other positive.

For their sum to be -2 the difference between them is 2 and the 'larger' one is negative and the 'smaller' one is positive'.

You can tell that the two numbers are -5 and 3 and proceed to factorize the expression:

$3x^2 – 2x – 5 = 3x^2 – 5x + 3x – 5 = x(3x – 5) + 1(3x – 5) = (3x - 5)(x + 1)$

(b)Factorize $6x^2 + 5x – 6$

ac = -36 ; b = 5

The positive prime factors of -36 are 2 and 3

All the factors of 36 in ascending order are: 1, 2, 3, 4, 6, 9, 12, 18, 36

For the two numbers to have a product of -36, one is negative and the other positive.

For their sum to be 5 the difference between them is 5 and the larger one is positive and the smaller one is negative.

The numbers are -4 and 9

So, $6x^2 + 5x - 6 = 6x^2 - 4x + 9x - 6 = 2x(3x - 2) + 3(3x - 2) = (3x - 2)(2x + 3)$

2.Solve the following quadratic equations by factorization. Substitute each of your answers in the equation and enter in CLASSWIZ to check its accuracy.

(a)$x^2 - x - 6 = 0$ (b) $-x^2 - 6x - 5 = 0$ (c) $2x^2 + 5x + 3 = 0$ (d) $3x^2 = 5x + 2$

*Provide a further practice exercise including real-life problems. Confirm that the problems reduce to quadratic equations solvable by factorization.*

**2.8.2. Completing the square method**

Solve the following quadratic equations by completing the square method. Substitute each of your answers in the equation and enter using CLASSWIZ to check its accuracy.

(a)$x^2 - 5x - 8 = 0$ (b) $x^2 - 2x - 4 = 0$(c) $2x^2 + 22x - 18 = 0$ (d) $\frac{1}{2}x^2 + 2x = 3$

*Provide a further practice exercise including real-life problems. Restrict solutions to completing the square method.*

**2.8.3. The quadratic formula:**

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Example: Solve $3x^2 - 7x + 1 = 0$

Solution:
$a = 3$, $b = -7$ and $c = 1$

It is convenient with CLASSWIZ's NATURAL TEXTBOOK DISPLAY technology to input the values in the formula. However, ± is not an operator and you will have to add and subtract the discriminant,$\sqrt{b^2 - 4ac}$(symbol Δ)separately:

Either x = $\frac{-(-7)+ \sqrt{(-7)^2 - 4 \times 3 \times 1}}{2 \times 3}$= 2.180 (to 4 decimal places)

Or, x = $\frac{-(-7)- \sqrt{(-7)^2 - 4 \times 3 \times 1}}{2 \times 3}$= 0.1529 (to 4 decimal places)

Solve the following quadratic equations by using the quadratic formula:

(a) $2x^2 + 9x - 3 = 0$ (b) $\frac{3}{2}x^2 + 5x - 1 = 0$ (c) $-5x^2 - 2x + 1 = 0$

*Provide a further practice exercise including real-life problems. Restrict solutions to the formula method.*

---

### 2.8.4. The nature of roots of quadratic equations.

If $\sqrt{b^2 - 4ac} > 0$ (i.e. it has two roots, one positive and the other negative),the equation has real and distinct roots.

If $\sqrt{b^2 - 4ac} = 0$, the discriminant is zero, the equation has real and indistinct roots.

If $\sqrt{b^2 - 4ac} < 0$ (i.e. it is a negative number and the discriminant is therefore not real), the equation has no real roots. (The calculator returns an error message because a negative number has no real roots.)

1. Use CLASSWIZ to calculate the discriminant of each of the following equations to predict the nature of the roots.
(a) $2x^2 - 6x - 3 = 0$ (b) $9x^2 + 24x + 16 = 0$ (c) $5x^2 - x + 9 = 0$
2. Solve (or attempt to solve) each of the equations using the quadratic formula or otherwise to check if your prediction was correct.

*Provide a further practice exercise.*

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## 2.9.Exploring surds

A surd is an expression containing under a root sign a positive integer whose root is a non-terminating and non-repeating decimal.Surds of order 2 have the square root sign:$\sqrt{\ }$ ; those of order 3 have the cube root sign: $\sqrt[3]{\ }$ …We will discuss surds of order 2.

In the surd $b\sqrt{a}$ e.g. $2\sqrt{3}$,*b* is the rational factor or coefficient and *a* the surd factor or radicand.A surd in which the rational factor is 1 e.g. $\sqrt{2}$ is an entire surd while that in which the rational factor is an integer other than 1 (or zero, for that matter…) e.g. $5\sqrt{3}$ is a mixed surd.

Like surds have the same radicand even if the coefficients are different e.g. $2\sqrt{3}$ and $7\sqrt{3}$.Unlike surds have different radicands e.g.$\sqrt{2}$and$\sqrt{5}$

Operations on surds follow certain rules.

---

Make sure the calculator is in the default setting.

1.Enter each of the following expressions and by observing the result (expression), identify surds from the group.
$\sqrt{2}$ , $\sqrt{4}$ , $\sqrt{9}$, $\sqrt{5}$, $\sqrt{6}$, $\sqrt{16}$ ,$\sqrt{25}$.

2(a) Substitute a surd in which the radicand is a *prime number* in each side of the following expressions to affirm the rules.
(i)$\sqrt{a} + \sqrt{a} + \sqrt{a} = 3\sqrt{a}$ (ii)$3\sqrt{a} + 2\sqrt{a} = 5\sqrt{a}$(iii)$7\sqrt{a} - 3\sqrt{a} = 4\sqrt{a}$
(b)Explain how like surds are added or subtracted.

3. Simplify without using a calculator.
(a) $\sqrt{5} + \sqrt{5} + \sqrt{5} + \sqrt{5}$
(b) $4\sqrt{3} - \sqrt{3}$
(c)Express $5\sqrt{7}$ as (i) a sum of three surds. (ii) a difference between two surds.

4(a)Enter the following unlike surds.
(i) $\sqrt{5} + 3\sqrt{2}$ (ii) $5\sqrt{7} - 3\sqrt{2}$
(b) What do you observe concerning addition or subtraction of unlike surds?

5. Enter a surd in which the radicand is a composite number whose factors include a perfect square e.g. $\sqrt{8}$ , $\sqrt{12}$, $\sqrt{18}$ … to confirm that:
(a)where a surd $\sqrt{a}$ simplifies to $n\sqrt{b}$ then $a = b \times n^2$
(b)where the radicand can be expressed in terms of factors such that one of the factors is a perfect square, the root of the perfect square becomes the rational factor i.e. If $\sqrt{a} = \sqrt{b\ x\ c}$ where c is a perfect square, then $\sqrt{a} = \sqrt{c}\sqrt{b}$

6. Substitute surds in which the radicands are prime numbers and m and n are natural numbers in the following expressions to affirm the rules on products of surds:

| | |
|---|---|
| (a)Like entire surds.<br>$\sqrt{a}$ x $\sqrt{a} = a$ | (b) Like mixed surds<br>$m\sqrt{a}$ x $n\sqrt{a} = mna$ |
| (c)Unlike entire surds<br>$\sqrt{a}$ x $\sqrt{b} = \sqrt{axb}$ | (d)Unlike mixed surds<br>$m\sqrt{a}$ x $n\sqrt{b} = mn\sqrt{ab}$ |

7. Substitute surds in the following expressions to affirm that the product of a binomial surd and its conjugate is a rational number, c:
(a)$(\sqrt{a} + \sqrt{b})(\sqrt{a} - \sqrt{b}) = c$ (b)$(\sqrt{a} - \sqrt{b})(\sqrt{a} + \sqrt{b}) = c$

8. Jane was asked to describe how to rationalize the denominator of the expression $\frac{1}{3+\sqrt{5}}$ i.e. rewrite it such that the denominator is a rational number. She suggested that she would multiply the denominator by its conjugate i.e. $(3-\sqrt{5})$ and expand. The teacher informed her that such an action would alter the value of the expression because only the denominator would be affected. The teacher then wrote the following expression to jog Jane's mind: $\frac{a}{b} = \frac{a \times c}{b \times c}$.
(a) Suggest what the teacher was telling Jane to do.
(b) Use your suggestion to rationalize the denominator of the expression.
(c) Enter the expression in CLASSWIZ to affirm your suggestion.

9. Simplify by rationalizing the denominator.

(a) $\frac{3}{\sqrt{5}}$ (b) $\frac{5}{4-\sqrt{7}}$ (c) $\frac{1}{2+\sqrt{3}} + \frac{6}{\sqrt{3}-5}$

10. Enter the expressions in 9 in CLASSWIZ to check the accuracy of your answers.
*Some results will be displayed first as decimals. See if the [S⇔D] function can help display the decimals as surd expressions. It works sometimes. For a sum like (c) try also to enter each term separately. For such activities as 9 and 10 select for learners only expressions that give surd expression results.

*Provide a further practice exercise.*

## 2.10. Further confidence building with CLASSWIZ

We have seen activities in which CLASSWIZ was used to affirm BODMASand to check the accuracy of answers obtained after evaluating expressions and after solving equations. The approach can be extended to solutions of simultaneous equations and linear inequalities.

1(a)Solve the following simultaneous equations:
(i) $x + y = 9$; $2x - y = 3$ (ii) $y = 3x^2 + 2x - 10$; $y = 7x - 8$.

(b)Substitute your answers in each equation and evaluate to check their accuracy.

2(a)Solve the following inequalities:(i) $-2x \leq 9$ (ii) $\frac{(2x-3)}{4} \leq 2$ (iii) $\frac{13x+2}{3} > 3x + \frac{1}{5}$
(iv) $10 \leq 3x + 4 < 19$

(b)Substitute your answer in the inequality and evaluate to check agreement with the statement of the inequality.

*Provide a further practice exercise.*

## 2.11. Automation with CLASSWIZ

Some tasks can be automated by certain sequences of instructions.

**2.11.1. Sequential operations with the Answer memory function:** [Ans]

1(a)Use CLASSWIZ find the sum 2, 3, 4 and 6

(b)Use the answer memory to divide the sum in (a) by 5

(c)Use the answer memory to multiply the quotient in (b) by 10

**2.11.2.Generating number patterns with the Answer memory function:**

1. Use the answer memory to set the calculator to generate a pattern of [Ans] numbers starting from 1 and increasing by 3 each time you press [=]

[1] [=] [Ans] [+] [3]

Continuing: Press [=] and each time record the result.

2. Set the calculator to generate the number patterns described below:

(a)Increasing odd numbers starting from 1.

(b)Increasing even numbers starting from 0.

(c)A number pattern starting from 6 and increasing by 1.5%.

(d)A number pattern staring from 10 and decreasing by 3.

(e)A number pattern starting from 0 and increasing by 10.

(f)A number pattern starting from 1 and increasing by powers of 10 i.e. 1, 10, 100, 1000, 10,000….

3(a)Describe the patterns below:

(i) 2, 3, 5, 7, 11, 13, 17, 19… (ii) 0, 1, 1, 2, 3, 5, 8, 11…

(iii) 0,1,4,9,16,25,36…(iv) 0,1,8,27,64…

(b)Is it possible to automate CLASSWIZ to generate the patterns in (a) above?

4(a)Ksh. 750,000 is invested at 8% compound interest. What were the values of the investment at the beginning of the second, third and fourth years?

(b)A car valued at Ksh. 6,500,000 depreciates at 2 % p.a. What were its values at the end of each of the first 6 years?

(c)After how many half-lifes will an 8 g sample of Cobalt-60 decay to 0.125 g?

*Provide a further practice exercise including real-life problems. Select sums based on concepts that learners have already learnt.*

### 2.11.3. Automation with the Number Format function.

1. Automate CLASSWIZ to display the following measurements recorded in an experiment to 2 decimal places. 4.567, 6.043, 7.200, 9.325, 5.3
2. Automate CLASSWIZ to display following data in standard form to 4 significant figures: 876.497, 371.936, 7862.52, 6732.63, 1999. 8

*Provide a further practice exercise.*

### 2.11.4. Automation with combined functions

The following example illustrates how the multi-statement, letter memory and number format functions can be used to automate data processing with CLASSWIZ.

Marks out of 30 scored by pupils in a class.

| Score/30 | 12 | 23 | 6 | 27 | 8 | 17 | 18 | 9 | 1 | 24 | 28 | 21 | 16 | 15 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Score % | | | | | | | | | | | | | | | |

Task: Automate CLASSWIZ to convert the marks into percentage to the nearest whole number for efficient recording in the table.

To convert each mark into percentage, express it as a fraction of 30 and multiply by 100. For example $\frac{12}{30}$ x 100 = 40

Doing that for each mark would be inefficient.

Would the Multi-statement function improve things?

Let us input $\frac{12}{30}$x100:$\frac{23}{30}$x100:$\frac{6}{30}$ x 100… and execute them one by one by pressing '=' to display each converted mark.

It certainly makes things easier. Only that we are inputting $\frac{100}{30}$ repeatedly….

What about storing $\frac{100}{30}$ in a Letter memory and using it with the Multi-statement?

Let us store $\frac{100}{30}$ as variable A: [1] [0] [0] [▭/▭] [3] [0] [STO] [(−)]

Now input 12A: 23A: 6A… and execute them by pressing [=]

But some results are in fraction form and we have to again press [S⇔D] to convert them into decimals.

What about selecting [SHIFT] [MENU] [1] [2] a setting that automatically displays decimal results?

Let us try MathI/DecimalO:

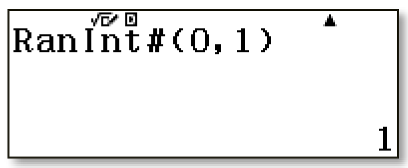
Almost there…! But we still have to round off some results to the nearest whole number….
What if we selected 1: Fix sub-menu so that each result is automatically rounded off to the nearest whole number? [SHIFT] [MENU] [3] [1] [0]

Now execute the Multi-statement by pressing [=]
We have got it!
Can you also use the Calculation history function instead of the Multi-statement function for convenient recording?

---

**2.11.5. Simulating a random process.**
Such activities as the tossing of a fair coin, the rolling of a die and even random sampling of data can be simulated using the Ran# function.

1.Simulating the tossing of a fair coin.
If the outcome of a 'head' is associated with '1' and a 'tail' with '0' then in the screenshot below, the outcome was a head.
[ALPHA] [•] [0] [SHIFT] [)] [1] [)] [=]

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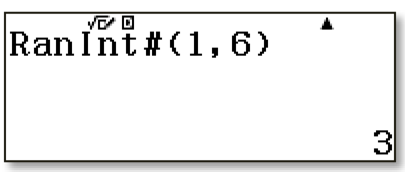
2.Simulating the rolling of a fair 6-sided die.
If the outcome is associated with a number from 1 to 6 inclusive, then in the screenshot below, the outcome was a '3'
[ALPHA] [•] [1] [SHIFT] [)] [6] [=]

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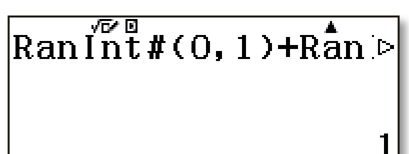
3.Simulating the tossing of two fair coins
In the screenshot below, the command **Ran#(0,1) + Ran#(0,1)** has been executed i.e. the command for a single coin has been duplicated by separating them by a +.

[ALPHA] [•] [0] [SHIFT] [)] [1] [)] [+]
[ALPHA] [•] [0] [SHIFT] [)] [1] [)] [=]



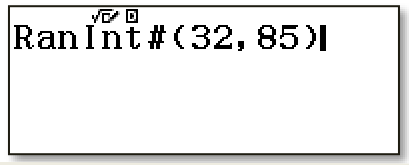
(a)What were the possible outcomes?
(b)What would be the possible outcome if the output was a:
(i) 2? (ii) 0?

4. Simulate random marks obtained by 10 students in a test in which the percentage scores ranged between 32 and 85:

[ALPHA] [•] [3] [2] [SHIFT] [)] [8] [5] [)]

{75,77,60,85,57,61,76,44,38,50}

{59,68,41,59,49,45,70,42,53,60}




## 2.11.6. Automation with the Statistics Editor

The function automatically calculates statistical summaries for entered data as already explained.

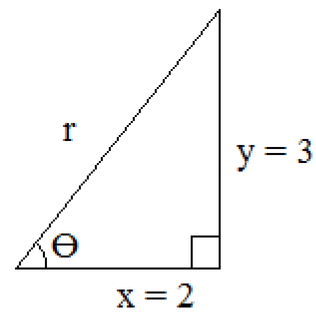
## 2.11.7. Automation with the Table Function

This another example of a function that automates generation of tables of values within defined parameters.

# 2.12.Exploring geometry

## 2.12.1. Affirming Pythagoras' theorem.

1.For any right-angled triangle with base = x, height = y and hypotenuse = r, use the Pol function to obtain r.
Example: (refer to the triangle alongside)
To obtain r, for x = 2 and y = 3:
Press: [SHIFT] [+] [2] [SHIFT] [)] [3] [)] [=]




r = 3.61
Note that Θ = 56.31$^0$(to 2 decimal places) is the angle between the base and the hypotenuse.

2.Forothervalues of x and y of your choice, obtain the values of r and complete the table below.

| base, x | height, y | hypotenuse, r | $x^2$ | $y^2$ | $x^2 + y^2$ | $r^2$ |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

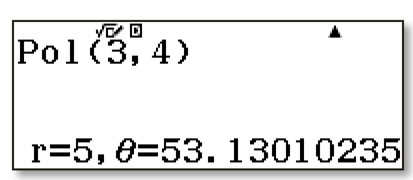
3.By studying the table, write an equation relating the base, the height and the hypotenuse of a right angled triangle.

5.A land surveyor marks a triangular piece of land using three beacons A, B and C. B lies 117.2 m to the east of A and C lies 63.9 m to the north of B.
Determine the:(a)distance from A to C (b)area of the piece of land.

*Provide a further practice exercise on real-life problems.*

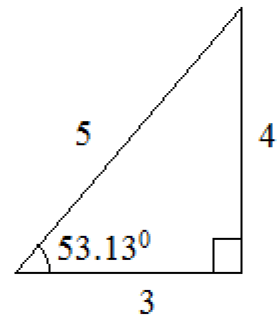
## 2.12.2. Exploring enlargement

1. Use the Pol function to resolve any triangle of your choice.
Let us use the 3,4,5 triangle in our example:
Enter Pol (3,4)
[SHIFT] [+] [3] [SHIFT] [)] [4] [)] [=]
r = 5, Θ = 53.13$^0$ (to 2 decimal places)



2.Enter Rec (r,53.13$^0$) for r = 6.0, 7.0, 8.0, 9.0, 10.0… and complete the table below:

| Triangle | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| r(hypotenuse) | 5.0 | 6.0 | 7.0 | 8.0 | 9.0 | 10.0 |
| x(base) | 3.0 | 3.6 | | | | 6.0 |
| y(height) | 4.0 | 4.8 | | | | 8.0 |




*Notice that 1 to 6 are similar triangles.*

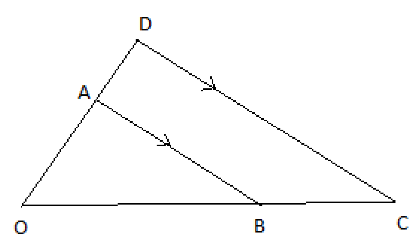
3.For any two triangles, calculate the ratios of the lengths of the larger triangle to the corresponding length of the smaller triangle.
Example: For triangles 1 and 4, $\frac{r_4}{r_1}$= ?; $\frac{x_4}{x_1}$ = ? ; $\frac{y_4}{y_1}$ = ?
What do you observe?

4.For the two triangles used in 3, calculate the ratio of the area of the larger triangle to the area of the smaller triangle.

5.Squarethe ratio of lengths from 3and observe how it relates with the ratio of areas from 4.

6. The ratio of the length of a triangle to a smaller similar triangle is $\frac{a}{b}$. Write an expression for the ratio of the area of the larger triangle to the smaller triangle.

7. In the figure alongside AB//DC. Given that OA = 2cm, AD=4cm and that the area o of ΔOAB is 15cm$^2$. Find the area of the trapezium ABCD.




8.Complete the table below for the spheres A,B and C.(Input л directly from the calculator and record your results without simplifying).

| Sphere | Radius, r | Surface area, 4лr$^2$ | Volume, $\frac{4}{3}$лr$^3$ |
|---|---|---|---|
| A | 5 | | |
| B | 10 | | |
| C | 15 | | |

(a)For any two spheres calculate:
(i) the ratio of the radius of the larger sphere to the smaller sphere.
(ii) the ratio of the surface area of the larger sphere to the smaller sphere.
(iii) the ratio of the volume of the larger sphere to the smaller sphere.
(b)Square the ratio of the radii and observe how it relates with the ratio of the surface areas.
(c)Cube the ratio of the radii and observe how it relates with the ratio of the volumes.
(d)The ratio of the radius of a sphere to a smaller sphere is $\frac{a}{b}$. Write an expression for the ratio of the (i) surface area of the larger sphere to the surface area of the smaller sphere.(ii)the volume of the larger sphere to the volume of the smaller sphere.

*The calculator provides you with the convenience to calculate the areas and volumes even with other values of radii. The sphere is easy to use because only one dimension (the radius) is needed. You can analyze any three dimensional object provided you vary the dimensions proportionally.*

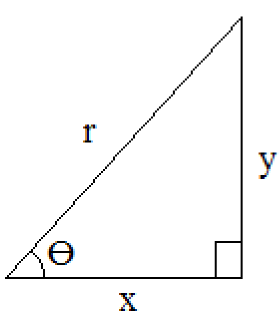
9.Cube A has a volume of 27 cm$^3$ while cube B has a volume of 64 cm$^3$. Determine the ratio of: (a) the length of B to the length of A (b)the surface area of B to the surface area of A.

*Provide a further practice exercise including real-life problems.*

## 2.13.Exploring trigonometry

1. Use the Rec function to resolve a right-angled triangle of your choice.

*Different groups of learners may use different angles,$\Theta$ and compare their findings.*




In our example, we will use a triangle with a hypotenuse, r = 5 and base angle,$\Theta$ = 20$^0$.
Enter Rec (5,20)
SHIFT − 5 SHIFT ) 2 0 ) =
Record the values of x = 4.7 and y = 1.7 (both to 1 decimal place) in the table below

Enter Rec (r, 20) for r = 7, r = 11 and r = 13 and complete the table to 1 decimal place.The values for r = 9 have also been calculatedand recoreded.
ϴ = $20^0$

| r (hypotenuse) | x (base) | y (height) | $\frac{y(\text{opposite})}{x(\text{adjacent})}$ | $\frac{y(\text{opposite})}{r(\text{hypotenuse})}$ | $\frac{x(\text{adjacent})}{r(\text{hypotenuse})}$ |
|---|---|---|---|---|---|
| 5 | 4.7 | 1.7 | | | |
| 7 | | | | | |
| 9 | 8.5 | 3.1 | | | |
| 11 | | | | | |
| 13 | | | | | |

(b)Complete the table to 1 decimal place.

(c)What do you observe about the ratios: $\frac{y\ (\text{opposite side})}{x(\text{adjacent side})}$ , $\frac{y(\text{opposite side})}{r(\text{hypotenuse})}$ and $\frac{x(\text{adjacent side})}{r(\text{hypotenuse})}$for the angle ϴ used?

(d)Use CLASSWIZ to recall:

(i)tan $20^0$ and compare it with your value for $\frac{y\ (\text{opposite side})}{x(\text{adjacent side})}$

(ii)sin $20^0$ and compare it withyour value for $\frac{y(\text{opposite side})}{r(\text{hypotenuse})}$

(iii)cos $20^0$ and compare it with your value for $\frac{x(\text{adjacent side})}{r(\text{hypotenuse})}$

Repeat for other values of ϴ.

(e)Use CLASSWIZ to recall:

(i) $\tan^{-1}a$, where a = $\frac{y\ (\text{opposite side})}{x(\text{adjacent side})}$ (ii) $\sin^{-1}b$, where b = $\frac{y(\text{opposite side})}{r(\text{hypotenuse})}$

(iii) $\cos^{-1}c$, where c = $\frac{x(\text{adjacent side})}{r(\text{hypotenuse})}$

*At this point, the sine, the cosine and the tangent together with their inverses may be easier to conceptualize.*

2.Use CLASSWIZ to complete the following table:

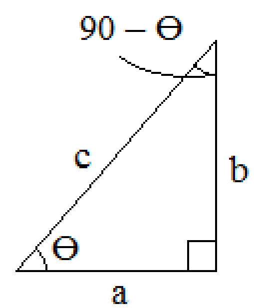
| Θ | sin Θ | cos Θ |
|---|---|---|
| (a) 15 | | |
| 75 | | |
| | | |
| (b) 36 | | |
| 54 | | |
| | | |
| (c) 18 | | |
| 72 | | |

*The calculator provides you with the convenience to work with any pair of complementary angles including decimals and sexagesimals.*

(a)What do you notice about any pair of angles in the table above?
(b) By observing the table write an expression relating:
(i)sin Θ and cos (90 – Θ)(ii) cos Θ and sin (90 – Θ)

(c) Study the right angled triangle alongside:
Write an expression using a, b and c for
(i)sin Θ and cos(90 – Θ)
(ii)cos Θ and sin (90 –Θ**)**

(d)Use your expressions to affirm the findings in (b)



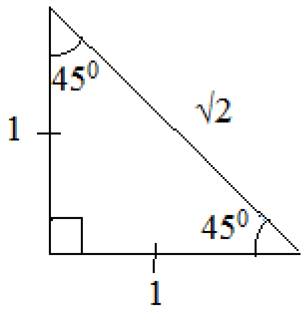

3.Solve for θ given that θ is acute and $\sin(3\theta - 50^0) - \cos(2\theta + 10^0) = 0$.
By substituting your answer in the expression enter in CLASSWIZ to check its accuracy.

4.Complete the table below to 4 decimal places.

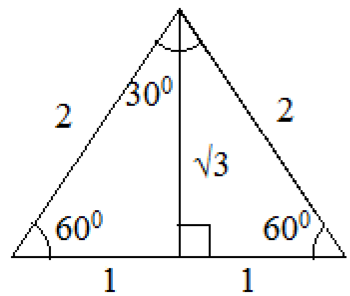
| $\Theta^0$ | sin Θ | cos Θ | tan Θ | $\frac{\sin\Theta}{\cos\Theta}$ |
|---|---|---|---|---|
| 15 | | | | |
| 32 | | | | |
| 48 | | | | |
| 63 | | | | |
| 88 | | | | |

Write an expression relating sin Θ, cosΘ and tan Θ

5.Study the triangles below and use them to complete the table.




**Isosceles right-angled triangle**




**Equilateral triangle of sides 2 units**

| Angle, Θ | sin Θ | cos Θ | tan Θ |
|---|---|---|---|
| $30^0$ | | | |
| $45^0$ | | | |
| $60^0$ | | | |

Use CLASSWIZ to obtain the values of the sine, the cosine and the tangent of $30^0$, $45^0$ and $60^0$ and compare them with the values in the table.

6.Without using a calculator, evaluate leaving your answer in surd form with a rational denominator:$\frac{\cos 45 \tan 30}{\sin 60}$

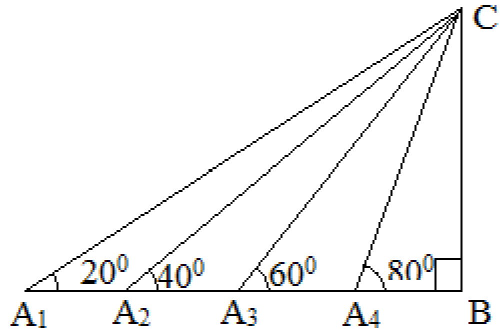
Use CLASSWIZ to check the accuracy of your answer.

7.Affirmthe following Pythagorean trigonometric identities by substituting an angle in each side of the equation and calculating.
(a)$\sin^2\Theta + \cos^2\Theta = 1$ (b)$1 + \tan^2\Theta = \sec^2\Theta$(c)$1 + \cot^2\Theta = \mathrm{cosec}^2\Theta$
Remember: sec Θ= $\frac{1}{\cos\theta}$; cosec Θ = $\frac{1}{\sin\theta}$; cot Θ = $\frac{1}{\tan\theta}$

*Provide a further practice exercise.*

8.Study the figure alongside of right-angled triangles of a constant height, varying bases, varying hypotenuses and varying base angles,ϴ.

(a)Use CLASSWIZ to complete the table below and use it with the figure in the activities that follow.




| ϴ | $20^0$ | $40^0$ | $60^0$ | $80^0$ |
|---|---|---|---|---|
| tan ϴ | | | | |
| sin ϴ | | | | |
| cos ϴ | | | | |

(b)(i)State how the values of tan ϴ vary as ϴ increases from $20^0$ to $80^0$.
(ii)State how the bases $A_1B$, $A_2B$, $A_3B$ and $A_4B$vary as ϴ increases from $20^0$ to $80^0$.
(iii)How does the value of a fraction (ratio) vary when the denominator is decreased while the numerator is kept constant?
(iv)Given that tan ϴ = $\frac{\text{opposite side}}{\text{adjacent side}}$, explain why the values of tan ϴ vary as in the table as ϴ increases from $20^0$ to $80^0$.
(v)What would be the value of the base (adjacent side) when ϴ = $90^0$?
(vi)Use the formula in (iv) to write down a fraction (ratio) for the value of tan $90^0$ when the height (opposite side), BC = 5 cm(or any other measurement).
(vii)Enter your fraction. What do you observe?
(viii)Enter tan ϴ and observe the results as ϴ approaches $90^0$ e.g. tan $89.9^0$, tan $89.99^0$, tan $89.999^0$…
(ix)Enter tan $90^0$. Explain the output.

(c)(i)State how the values of sin ϴ vary as ϴ increases from $20^0$ to $80^0$.
(ii)State how the hypotenuses $A_1C$, $A_2C$, $A_3C$ and $A_4C$ vary as ϴ increases from $20^0$. to $80^0$.
(iii)How does the value of a fraction vary when the denominator is decreased while the numerator is kept constant?
(iv)Given that sin ϴ = $\frac{\text{opposite side}}{\text{hypotenuse}}$, explain why the values of sin ϴ vary as in the table as ϴ increases from $20^0$ to $80^0$.
(v)How would the hypotenuse compare with the height, BC when ϴ = $90^0$?
(vi) Use the formula in (iv) to write down a fraction (ratio) for the value of sin $90^0$ when the height (opposite side), BC = 5 cm (or any other measurement) and simplify it.

(vii) Enter sin Θ and observe the results as Θ approaches $90^0$ e.g. sin $89.9^0$, sin $89.99^0$, sin $89.999^0$…
(viii)Enter sin $90^0$. Explain the output.

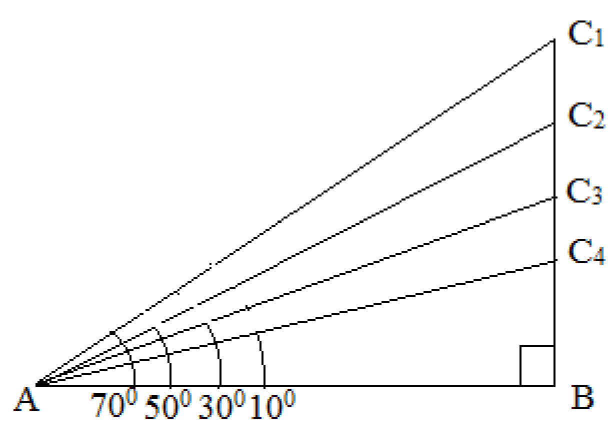
---

(c))(i)State how the values of cos Θ vary as Θ increases from $20^0$ to $80^0$.
(ii)State how the hypotenuses $A_1C$, $A_2C$, $A_3C$ and $A_4C$ vary as Θ increases from $20^0$ to $80^0$.
(iii)State how the bases $A_1B$, $A_2B$, $A_3B$ and $A_4B$ vary as Θ increases from $20^0$ to $80^0$.
(iv)Compare the rate of variation of the hypotenuses $A_1C$, $A_2C$, $A_3C$ and $A_4C$ with that of the bases $A_1B$, $A_2B$, $A_3B$ and $A_4B$ as Θ increases from $20^0$ to $80^0$.
(v)How does the value of a fraction vary when the denominatoris decreased and the numerator is decreased more?
(vi)Given that cos Θ = $\frac{\text{adjacent side}}{\text{hypotenuse}}$, explain why the values of cosΘ vary as in the table as Θ increases from $20^0$ to $80^0$.
(vii)What would be the value of the base (adjacent side) when Θ = $90^0$?
(viii)How would the hypotenuse compare with the height, BC when Θ = $90^0$?
(ix) Use the formula in (vi) to write down a fraction (ratio) for the value of cos $90^0$when the height (opposite side), BC = 10 cm (or any other measurement) and simplify it.
(x) Enter cos Θ and observe the results as Θ approaches $90^0$ e.g. cos $89.9^0$, sin $89.99^0$, cos $89.999^0$…
(xi)Enter cos $90^0$. Explain the output.

---

9.Study the figure alongside of right-angled triangles of a constant base, varying heights, varying hypotenuses and varying base angles, Θ.

(a)Use CLASSWIZ to complete the table below and use it with the figure in the activities that follow.




| Θ | $70^0$ | $50^0$ | $30^0$ | $10^0$ |
|---|---|---|---|---|
| tan Θ | | | | |
| sin Θ | | | | |
| cos Θ | | | | |

(b)(i)State how the values of tan Θ vary as Θ decreases from $70^0$ to $10^0$.

(ii)State how the heights $BC_1$, $BC_2$, $BC_3$ and $BC_4$vary as Θ decreases from $70^0$ to $10^0$.
(iii)How does the value of a fraction vary when the numerator is decreased while the denominator is kept constant?
(iv)Given that tan Θ = $\frac{\text{opposite side}}{\text{adjacent side}}$, explain why the values of tan Θ vary as in the table as Θ decreases from $70^0$ to $10^0$.
(v)What would be the value of the height (opposite side) when Θ = $0^0$?
(vi) Use the formula in (iv) to write down a fraction (ratio) for the value of tan $0^0$ when the base (adjacent side), AB = 5 cm (or any other measurement) and simplify it.
(vii)Enter tan Θ and observe the results as Θ approaches $0^0$ e.g. tan $2^0$, tan $1^0$, tan $0.5^0$, tan $0.01^0$…
(viii)Enter tan $0^0$. Explain the output.

---

(b)(i)State how the values of sin Θ vary as Θ decreases from $70^0$ to $10^0$.
(ii)State how the hypotenuses $AC_1$, $AC_2$, $AC_3$ and $AC_4$ vary as Θ decreases from $70^0$ to $10^0$.
(iii)State how the heights $BC_1$, $BC_2$, $BC_3$ and $BC_4$ vary as Θ decreases from $70^0$ to $10^0$.
(iv)Compare the rate of variation of the hypotenuses $AC_1$, $AC_2$, $AC_3$ and $AC_4$ to that of the heights $BC_1$, $BC_2$, $BC_3$ and $BC_4$ as Θ decreases from $70^0$ to $10^0$.
(v)How does the value of a fraction vary when the denominator is decreased and the numerator is decreased more?
(vi)Given that sin Θ = $\frac{\text{opposite side}}{\text{hypotenuse}}$, explain why the values of sin Θ vary as in the table as Θ decreases from $70^0$ to $10^0$.
(vii)What would be the value of the height (opposite side) when Θ = $0^0$?
(viii)How would the hypotenuse compare with the base AB when Θ = $0^0$?
(ix)Use the formula in (vi) to write down a fraction (ratio) for the value of sin $0^0$ when the base (adjacent side), AB = 5 cm (or any other measurement) and simplify it.
(x)Enter sin Θ and observe the results as Θ approaches $0^0$ e.g. sin $2^0$, sin $1^0$, sin $0.5^0$, sin $0.01^0$ …
(xi)Enter sin $0^0$. Explain the output.

---

(c))(i)State how the values of cos Θ vary as Θ decreases from $70^0$ to $10^0$.
(ii)State how the hypotenuses $AC_1$, $AC_2$, $AC_3$ and $AC_4$ vary as Θ decreases from $70^0$ to $10^0$.

(iii)How does the value of a fraction vary when the denominator is decreased while the numerator is kept constant?

(iv)Given that cos Θ = $\frac{\text{adjacent side}}{\text{hypotenuse}}$, explain why the values of cos Θ vary as in the table as Θ decreases from $70^0$ to $10^0$.

(v)How would the hypotenuse compare with the base, AB when Θ = $0^0$?

(vi) Use the formula in (iv) to write down a fraction (ratio) for the value of cos $0^0$ when the base (adjacent side), BC = 5 cm (or any other measurement) and simplify it.

(vii) Enter cos Θ and observe the results as Θ approaches $90^0$ e.g. cos $5^0$, cos $1^0$, cos $0.5^0$, cos $0.1^0$

(viii)Enter cos $0^0$. Explain the output.

---

10(a)A quantity is given by the relationship E = VsinΘ for $0^0 \leq \Theta \leq 90^0$.
For V = 12, find:
(i)the minimum value of E. (ii) the maximum value of E. (iii)the value of E when Θ = $60^0$ (iv) the value of Θ when E = 8.537.

(b)A quantity is given by the relationship v = $\sqrt{Rg\tan\Theta}$ for $0^0 \leq \Theta \leq 90^0$.
(i)How does v vary as Θ increases from $0^0$ to $90^0$?
(ii)Find v when R = 750, g = 10 and Θ = $15^0$.
(iii)Comment on the value of v when Θ = $90^0$ for any values of R and g.

---

11(a)Enter using appropriate angles, Θ to affirm the signs of the trigonometric ratios in the given ranges.

| Range | sin Θ | cosΘ | tan Θ |
|---|---|---|---|
| $0^0 < \Theta < 90^0$ | + | + | + |
| $90^0 < \Theta < 180^0$ | | | |
| $180^0 < \Theta < 270^0$ | | | |
| $270^0 < \Theta < 360^0$ | | | |

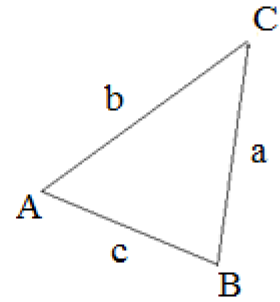
(b)Use the unit circle to explain the results in the table.

---

12(a) Enter using appropriate angles to affirm that:
(i) the sine and the tangent of negative acute angle have negative signs.
(ii) the cosine of a negative acute angle has a positive sign.
(b)Explain why:
(i) cos($120^0$) and cos(-120) both have a negative sign.
(ii)sin($-225^0$) has a positive sign.

---

13(a)Draw any acute triangle ABC.
(b)Measure the angles A, B and C and the lengths a, b and c and record in the table below.
(c)Compute the values for the last three columns and complete the table.




| <A | <B | <C | A | B | c | $\frac{a}{\sin A}$ | $\frac{b}{\sin B}$ | $\frac{c}{\sin A}$ |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |

(d)What do you observe?
(e)Use the measurements to affirm the following rules:

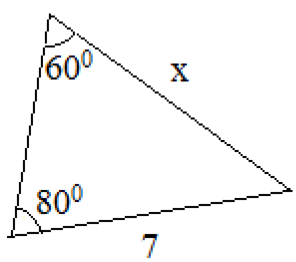
(i) cos A = $\frac{b^2 + c^2 - a^2}{2bc}$

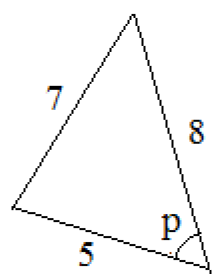
(ii) cos B = $\frac{a^2 + c^2 - b^2}{2ac}$

(iii) Write an expression for cos C
(iv) Make $a^2$, $b^2$ and $c^2$ the subjects of the formulae using (i), (ii) and (iii) and affirm them using the measurements in the table.

14.Draw any obtuse triangle ABC and repeat activity 10.

15. Find the unknown side or angle.




*Provide a further practice exercise including real-life problems.*

## 2.14.Exploring binomial expansion

1.Revise the use of the nCr function to derive the terms of the Pascal's triangle.

2.Study the pattern below for binomial expansions of $(x + y)^n$ for n = 0, 1, 2, 3…

$(x + y)^0 = 1$

$(x + y)^1 = 1x + 1y$ (i.e. $x + y$)

$(x + y)^2 = 1x^2y^0 + 2x^1y^1 + 1x^0y^2$ (i.e. $x^2 + 2xy + y^2$)

$(x + y)^3 = 1x^3y^0 + 3x^2y^1 + 3x^1y^2 + 1x^0y^3$ (i.e. $x^3 + 3x^2 + 3xy^2 + y^3$)

$(x + y)^4 = 1x^4y^0 + 4x^3y^1 + 6x^2y^2 + 4x^1y^3 + 1x^0y^4$ (i.e. $x^4 + 4x^3y + 6x^2y^2 + 4xy^3 + y^4$)

(a)How do the coefficients of the terms compare with the terms of Pascal's triangle?

(b)In any term, what do n and r in the nCr function correspond to?

(c)What happens to the powers of x and y from the left to the right of an expansion?

(d)What is the relationship between the powers of x and y in each term and n?

7.A term in the expansion of $(x + y)^7$ contains $x^5y^m$. What would be the value of m?

8.In any first term, y is to power 0; in any second term y is to power 1; in any third term, y is to power 2… What would be the power of (i) y (ii) x in the $6^{th}$ term of $(x + y)^8$?

9.State and explain how the expansion of $(x – y)^4$ differs from the expansion of $(x + y)^4$

10.Expand:(a)$(x + y)^5$ (b) $(2x – 3y)^4$ (c) $\left(\frac{x}{2} + 3y\right)^7$

11.Without expanding, determine the fourth term in the expansion of $(x - \frac{2}{y})^6$

## 2.15.Exploring statistics with technology

*The technology revolution has had a great impact on the teaching of statistics, perhaps more so than many other disciplines. This is not so surprising given that technology has changed the way statisticians work and has therefore been changing what and how we teach (Moore, Cobb, Garfield, & Meeker 1995). (Source: The Role of Technology in Improving Student Learning of Statisticshttps://escholarship.org/uc/item/8sd2t4rr)*

Our technology here is CLASSWIZ – a standard scientific calculator. Not a graphing calculator and not a computer software. Let us see how much we can make out of it.

### 2.15.1. Basic computations.

And we are not going to avoid basic computations for us to learn basic statistics concepts. Fortunately, with CLASSWIZ's Natural Expression Input Display working with even the most forbidding statistical formulae becomes quite manageable.

1. A farmer has 12 ha on which he uses 3.5 ha for planting maize, 6.8 ha for livestock, 1.5 ha for his dwellings and the rest for growing horticultural crops. Represent the farmer's land use on a pie chart.

2. The following data represents the numbers and types of vehicles that passed through a roadblock.

| Type of vehicle | Number of vehicles |
|---|---|
| Nissan | 11 |
| Subaru | 8 |
| Peugeot | 4 |
| Toyota | 25 |
| Mercedes Benz | 3 |
| Mazda | 6 |
| Ford | 4 |
| Honda | 9 |

Express the number of vehicles of each type as a percentage of the total number of vehicles and represent the information on a bar graph.

3.Calculate the mean, $\bar{x}$ of the data set 27, 28, 32, 34, 37, 28 and 33 using the formula, $\bar{x} = \frac{\text{sum of data items}}{\text{number of data items}}$

4. A candidate's mean percentage mark in 8 subjects was 63.5. What would be his mean had the mean included a ninth subject in which he scored 84%?

5.Find x and y so that the ordered data set has a mean of 42 and a median of 35.

$$\{17,22,26,29,34,x,42,67,70,y\}$$

6. On a given day, the noon temperature measurements in Fahrenheit ($^0$F) reported by 14 weather stations were:

| Station | A | B | C | D | E | F | G | H | I | J | K | L | M | N |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature ($^0$F) | 76 | 82 | 75 | 78 | 78 | 75 | 74 | 77 | 79 | 77 | 81 | 74 | 80 | 79 |

(a)Calculate the mean temperature in $^0$F.

(b)The Celcius scale ($^0$C) is related to the Fahrenheit ($^0$F) scale by the formula:
C = $\frac{5}{9}$(F – 32). What was the mean temperature in $^0$C?

7. Estimate the mean of the following data using assumed mean method.

| Marks obtained | 10-19 | 20-29 | 30-39 | 40-49 | 50-59 | 60-69 | 70-79 | 80-89 | 90-99 |
|---|---|---|---|---|---|---|---|---|---|
| Number of students | 4 | 5 | 4 | 4 | 3 | 4 | 16 | 13 | 11 |

Estimated mean, $\bar{x} = A + \frac{\sum fd}{\sum f}$ where:
A – is the assumed mean. (Let us use A = 55 in this example)
$\sum$fd – is the summation of the products of frequencies i.e. number of students and the deviations of the mid-points of the classes i.e. marks obtained from the assumed mean = 1560.
$\sum$f – is the summation of the frequencies i.e. number of students.
*You will have to prepare another table for easier data visualization.*

8. Estimate the median from the grouped data:

| Class | Frequency |
|---|---|
| 51 – 55 | 2 |
| 56 – 60 | 7 |
| 61 – 65 | 8 |
| 66 – 70 | 4 |

Estimated median = L + $\frac{\left(\frac{n}{2}\right) - B}{G}$ x w, where:
L – is the lower class boundary of the class containing the median = 60.5.
n – isthe total number of values = 21
B – is the cumulative frequency of the groups before the median class = 2 + 7 = 9
G – is the frequency of the median class = 8
w – class width = 5

9.The heights of 80 plants at a research station were measured and the results tabulated as in the table below.

| Height in cm | 20-24 | 25-29 | 30-34 | 35-39 | 40-44 | 45-49 | 50-54 |
|---|---|---|---|---|---|---|---|
| Number of plants | 4 | 16 | 25 | 18 | 40 | 5 | 2 |

(a) By using an assumed mean of 32, calculate the mean height.
(b) Draw a cumulative frequency curve . Hence use the curve to estimate:
(i) the median height
(ii) the number of plants whose height were above 42cm.
10.Given the data set: 62,65,68,70,72,74,76,78,80,82,96,101.
Calculate (a)the median (b)the first quartile (c)the third quartile (d)the interquartile range.
11. The following gives frequency distribution of the daily commuting time (in minutes) from home to work for 25 employees of a company:

| Daily commuting time | Number of employees |
|---|---|
| 0 – 9 | 4 |
| 10 – 19 | 9 |
| 20 – 29 | 6 |
| 30 – 39 | 4 |
| 40 – 49 | 2 |

Use appropriate formulae to calculate the:
(a) variance (b) standard deviation.(c) quartiles (d)interquartile range.
12. During an experiment, 20 crystals were grown from a solution and the length of each crystal measured in millimeters. The data was as follows:
9,2,5,4,12,7,8,11,9,3,7,4,12,5,4,10,9,6,9,4.
(a)Calculate the sample mean and indicate its unit,
(b)Calculate the sample variance and indicate its unit.
(c)Calculate the sample standard deviation and indicate its unit.

**2.15.2. Summarizing data numerically**

CLASSWIZ’s Statistics Editor comes in handy in obtaining a numerical summary of data. Such a summary can be used to check accuracy in a situation where the calculations are ‘done by hand’. In the above examples, simply run the data through the Statistics Editor and compare the displayed calculations with your answers. Of even greater importance, problem solving in the digital world is increasingly becoming dependent on how to interpret situations based on such summaries.

1.The data below represents the rainfall in mm recorded at a weather station over a 12 day period:65 ,72 ,89, 58 , 35, 14 , 45,  55, 87, 45, 45, 92.Give a report based on the data.
2. The table below provides information on the percentage marks scored by two students in the KCSE examinations.

| | Kiswahili | English | Mathematics | Biology | Physics | Chemistry | Geography |
|---|---|---|---|---|---|---|---|
| A | 63 | 67 | 64 | 65 | 66 | 65 | 68 |
| B | 46 | 48 | 83 | 75 | 84 | 76 | 46 |

Give an analysis of the performances of the two students.

3.Astate trooper wondered if the speed distributions are similar for cars travelling northbound and for cars travelling southbound on an isolated stretch of a highway. Heusesaradarguntomeasurethespeedofallnorthboundandallsouthboundcars passing a particular location during a fifteen-minute period. The results are below:

| Northbound Cars | | | | |
|---|---|---|---|---|
| 60 | 62 | 62 | 63 | 63 |
| 63 | 64 | 64 | 64 | 65 |
| 65 | 65 | 65 | 66 | 65 |
| 67 | 68 | 70 | 83 | |

| Southbound Cars | | | | |
|---|---|---|---|---|
| 55 | 56 | 57 | 57 | 58 |
| 60 | 61 | 61 | 62 | 63 |
| 64 | 65 | 65 | 67 | 67 |
| 68 | 68 | 68 | 68 | 71 |

Write a few sentences comparing the speeds of the northbound cars and southbound cars at this location during the fifteen minute time period.

### 2.15.3. ‘Seeing’ statistics by exploring ‘The what if?’ questions.

1. Use the Statistics Editor to calculate the mean, median and standard deviation for the following data:  27, 28, 32, 34, 37, 28, 33
Change the value of x = 27 to x = 5 and use the Statistics Editor to calculate the new values for mean, median and standard deviation.
Make an observation on how the three measures have been affected by the presence of an extreme value in the data.

2(a)Use the Statistics Editor to calculate the mean, median and standard deviation for the following data: 71.9, 71.2, 76, 73.6, 70.4, 73.4, 76.9.

(b)Add a fixed number, say 10 to each item and calculate the new values of the mean, median and standard deviation.

(c)Compare the calculations with the results for the original data and make observations on how the operation affected the mean, median and standard deviation.

(d)Multiply each item by a fixed number, say 0.8 and calculate the new values of the mean, median and standard deviation.

(e)Compare the calculations with the results for the original data and make observations on how the operation affected the mean, median and standard deviation.

3.The table below represents the wages of staff at a factory

| Staff | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Salary (x1000KES) | 15 | 18 | 16 | 14 | 15 | 15 | 12 | 17 | 90 | 95 |

(a)Calculate the mean and the median salary at the factory.

(b)By inspecting the data, do you think the mean accurately reflects the typical salary of a worker?

(c)Do you think the median reflects the typical salary of a worker than the mean?

5.The procedure for calculating sample variance and sample standard deviation is described below:
- Calculate the mean.
- Subtract the mean from each data point and square the result.
- Add up all the squared results.
- Divide the sum by one less than the number of data points (n – 1). This gives you the sample variance.
- Find the square root of the variance to get the sample standard deviation. (a)Suggest a reason for squaring the differences between the data points and the mean.

(b)Suggest a reason for dividing the sum of the squares by n – 1 and not by n.
(c)Given the data set {2,3,4,5 ,6} find out how the value of the standard deviation changes when the sum of the squares is divided by n – 1 and when n is used.

(d) How is the difference between the values of standard deviation calculated using n – 1 and n affected as the number of data points increases?

### 2.15.4. Learning Statistics with simulated data

You can simulate real-life data collection with CLASSWIZ.This is particularly useful when obtaining data for the 'see what happens if…' activities.

1.A survey found out that the mean height of an adult in Kenya was 160 cm (to the nearest cm). Use CLASSWIZ's Ran# function to generate simulated data to represent measurements of heights of 20 adults.

(a) With a range of 4 about the mean i.e. $158<\bar{x}\leq162$
(b) With a range of 10 about the mean i.e. i.e. $155<\bar{x}\leq165$
(c) With a range of 20 about the mean i.e. $150<\bar{x}\leq170$

For each set of data, use CLASSWIZ to calculate the mean, the median and the standard deviation and comment on how the three measures are affected as the range widens.

2.Use CLASSWIZ's Ran# function to generate simulated data to represent a 10-item data set with Min(x) = 5 and Max(x) = 20.
Predict the mean, the median and the standard deviation for your data.
Obtain a numerical summary of the data and compare relevant calculations with your predictions.

3.The lengths of carrots grown under experimental conditions at a research station ranged between 15 cm and 20 cm.
(a)Use CLASSWIZ's Ran# function to generate simulated data to represent the lengths of carrots chosen at random for a sample of:
(i)5 carrots. (ii)10 carrots. (iii) 15 carrots.
(b)Use the Statistics Editor to obtain a numerical summary of each data set.
(c)Comment on how the calculations change as the sample size increases.

## 2.16. Exploring functions

CLASSWIZ's Table Function reduces the labors that go into manual preparation of graphs by providing easy access to 'completed' tables of functions. This way, more time is freed up for learning the mathematics behind the graphs.

### 2.16.1. Linear functions

1(a)Use the Table Function to generate tables of values for the following functions:
(i) $y = x$(ii) $y = 2x + 3$ (iii)$y = 5x – 7$
(b)Graph the functions on the same axes.

(c)Determine the gradient and the y-intercept of each function.
(d)The general equation of a linear function is y = mx + c. What do m and c represent?
(e)Without graphing, state the value of the gradient and the y-intercept for the following functions: (a)2y = 7x + 10 (b) $\frac{2}{3}x + \frac{1}{4}y = 2$
2(a)Use the Table Function to generate tables of values for the following pairs of functions.
(i) y = 2x + 3 and y = -2x + 3 (ii) y = 5x – 1 and y = -5x – 1
(b)Graph each pair of functions on the same axes and measure the angles they make to the right with the x-axis.
(c)What is the relationship between the sign of m in y = mx + c and the angle that the function makes to the right with the x-axis?

3(a)Use the Table Function to generate tables of values for the following pairs of functions.
(i) y =2x + 3 and y = 2x + 5 (ii)y = 5x – 7 and y = 5x + 2
(iii) y = -3x – 2 and y = -3x + 4
(b) Graph each pair of functions on the same axes.
(c)What do you notice about functions which have the same value of m in the general equation y = mx + c?
4(a)Use the Table Function to generate tables of values for the following pairs of functions. (i) y = 2x + 3 and y = $-\frac{1}{2}x + 3$ (ii) y = $\frac{5}{2}x + 1$ and y = $-\frac{2}{5}x + 1$
(b) Graph each pair of functions on the same axes and measure the angle of intersection.
(c) By inspecting each pair of functions what do you notice about the values of m in the general equation y = mx + c?

5(a)Solve the following simultaneous equations: x + 3y = 10 and -2x + y = 8
(b) Rewrite each equation in the form y = mx + c
(c) Use the Table Function to generate a table of values for the functions in (b) above.
(d)Graph the two functions and compare the coordinates of the point of intersection with the solutions of the simultaneous equations in (a).
(e)Describe how you would solve simultaneous equations graphically.

### 2.16.2. Logarithmic functions

Estimate the values of k and a if $y = ka^x$ represents the following data values:

| | | | | | |
|---|---|---|---|---|---|
| x | 0.5 | 1.0 | 2.0 | 3.0 | 4.0 |
| y | 5.93 | 8.80 | 19.36 | 45.59 | 93.70 |

*Hint: Use the laws of logarithms to rewrite the function in the form $y = mx + c$*
*Prepare another table for logx and logy and plot a graph of logy against logx.*

### 2.16.3. Quadratic functions

1(a)Use the Table Function to complete tables of values for the following pairs of functions: (i) $y = x^2$ and $y = -x^2$ (ii) $y = 3x^2$ and $y = -3x^2$

(b) Graph each pair of functions on the same axes.

(c)State the relationship between the sign of *a*in $y = ax^2$and whether the parabola opens downwards or upwards.

2(a)Solve the following quadratic equations by any method:

(i) $2x^2 + 5x + 3 = 0$ (ii)$3x^2 – 5x – 2 = 0$ (iii) $x^2 – x – 6 = 0$

(b)Use the Table Function to generate tables of values and graph the following functions separately:

(i) $y = 2x^2 + 5x + 3$ (ii) $y = 3x^2 – 5x – 2$ (iii) $y = x^2 – x – 6$

(c) Compare the x-intercepts of each function with the solutions of the equations in the corresponding number in (a).

(d) Describe how you would solve a quadratic equation graphically.

3(a)Solve the equation: $x^2 – 6x + 5 = 0$

(b)Use the Table Function to generate a table of values for the function

$y = x^2 – 6x + 5$ for the domain $0 \leq x \leq 6$ in steps of 1 and graph the function.

(c)Being that a parabola is symmetrical, use the x-intercepts of the function to calculate the x-coordinate for the axis of symmetry.

(d) Substitute the x-coordinate for the axis of symmetry in the function

$y = x^2 – 6x + 5$and evaluate the value of y.

(e)Compare the value of x in (c) and the value of y in (d) with the coordinates of the turning point of the function.

(f) Without graphing, determine the x-intercepts and the turning point of the function: $y = x^2 – 2x – 15$.

3(a) Determine the discriminant of each of the following quadratic equations.
(i) $2x^2 - 6x - 3 = 0$ (ii)$9x^2 + 24x + 16 = 0$ (iii)$5x^2 - x + 9 = 0$
(b)Use the Table Function to complete tables of values and graph the functions separately:
(i) $y = 2x^2 - 6x - 3$ (ii)$y = 9x^2 + 24x + 16$(iii)$y = 5x^2 - x + 9$
(c) By studying each function and the discriminant of the corresponding equation in (a), describe how you would use the discriminant to predict whether a quadratic function has one, two or no x-intercepts.

---

**2.16.4. Cubic functions**

1(a)Solve the equation $(x + 2)(x - 3)(x - 5) = 0$
*Hint: Equate each expression in brackets to zero and solve for x.*
(b)Expand the expression $(x + 2)(x - 3)(x - 5)$
(c)Use the Table Function to complete a table of values and graph the function
$y = x^3 - 6x^2 - x + 30$ for $-4 \le x \le 7$ in steps of 1.
(d)Compare the x-intercepts with the solutions of the equation:
$(x + 2)(x - 3)(x - 5) = 0$
(e)Describe how you would solve a cubic function graphically.

---

**2.16.5. Trigonometric functions**

1(a) Use the Table Function to complete a table of values for the functions
y = sin x and y = cos x for the domain $0^0 \le x \le 180^0$ in steps of $30^0$
(b)Describe the transformation that maps:
(i)y = cos x onto y = sin x (ii) y = sin x onto y = sin x.
2(a)Use the Table Function to complete a table of values for each of the following sets of functions in the domain $0^0 \le x \le 180^0$ in steps of $30^0$
(i) y = sinx , y = 2sinx and y = $\frac{1}{2}$sin x (ii) y = cosx, y = 3cos x and y = $\frac{3}{4}$cosx
(b)Graph each set of functions on the same axes.
(c) What does *a* represent in a function y = *a*sinx or y = *a*cosx?

3(a)Use the Table Function to complete a table of values for each of the following sets of functions in the domain $-90^0 \le x \le 90^0$ in steps of $30^0$
(i)y = sin x, y = sin $(x + 15^0)$ and y = sin $(x - 15^0)$
(ii)y = cos x, y = cos $(x + 20^0)$ and y = cos $(x - 20^0)$
(b)Describe how adding Θ to x transforms the functions y = sin x and y = cos x.
(c) Describe how subtracting Θ from x transforms the functions y = sin x and y = cos x.

4(a)Use the Table Function to generate a table of values for the function y = sinx where x is in radian for the domain $-\frac{\pi}{2} \leq x \leq \frac{\pi}{2}$ and in steps of $\frac{\pi}{6}$.
(b)On the same axes, sketch (without tabling) the function $y = 2\sin(x - \frac{\pi}{12})$

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**2.16.6. Aiding calculus**

1(a)Use the Table Function to generate a table of values for the function $y = (x + 1)(x + 2)(x – 3)$ in the domain $-4<x<5$ in steps of 1. Enter the values of x and y (f(x)) in the table below:

| X | -4 | -3 | -2 | -1 | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|---|---|---|---|
| y | | | | | | | | | | |

(b)Graph the function.
(c)On the table, mark:
(i)the values of x for the coordinates of the turning point.
(ii)the- and the y-intercepts.
(d)Explain how, by inspecting a table of values for the function, you would identify: (i) the turning points (ii) the x- and y-intercepts.

2(a)Use the Table Function to generate a table of values for the function $f(x) = x^2 – 2x + 5$ for the domain $-4 \leq x \leq 4$ in steps of 1.
(b)Draw a graph of the function.

(c)Determine the gradient of the function at the points: x = -3, x = -2, x = 0, x = 1 and x = 2 and complete the table below:

| x | -3 | -2 | 0 | 1 | 2 |
|---|---|---|---|---|---|
| $\frac{dy}{dx}$ | | | | | |

(d)Differentiate the function.
(e)Use the Table Function to generate a table of values for the function $g(x) = 2x – 2$ for the domain $-4 \leq x \leq 4$ in steps of 1.
*Note that the function in (e) is the gradient ($\frac{dy}{dx}$) function of the function in (a).*
(f)Compare the values of g(x) with the values of $\frac{dy}{dx}$ in the table in (c).
(g)Explain how you would use the Table Function to determine the gradient of a function at a point (or several points) by differentiating the function.

3.Use the Table Function to generate a table of values for the function $y = -2x^3 – x^2 + 13 – 6$ for the domain $-4 \leq x \leq 4$ in steps of 1.
(a)Extract from the table, the: (i) turning points (ii) x- and y-intercepts.

(b)Use the extracted values only to sketch the graph of the function.

4. Use the Table Function to generate a table of values for the functions $y = x^2 - 2x + 5$ and $y = -3x + 11$ for the domain $-4 \leq x \leq 4$.

(a)Extract from the table: (i) the turning point (ii) the x- and y-intercepts of the function $y = x^2 - 2x + 5$.

(b)Sketch the graphs of the functions.

(c)Mark the coordinates of the points of intersection of the two functions.

(d)Calculate the area bounded by the two functions by integration

5(a)Use the Table Function to generate a table of values for the function $y = x^2$ for $0 \leq x \leq 10$.

(b)Sketch the graph of the function and using the trapezoidal rule with 5 strips, approximate the area bounded by the curve, the line x = 3 and the line x = 8.

(c)Sketch the graph of the function and using the mid-ordinate rule with 5 strips, approximate the area bounded by the curve, the line x = 3 and the line x = 8.

(d) Calculate the area (by integration) bounded by the curve, the line x = 3 and the line x = 8 where area, $A = \int_3^8 x^2 dx$

(e) Compare the answers in (b), (c) and (d).

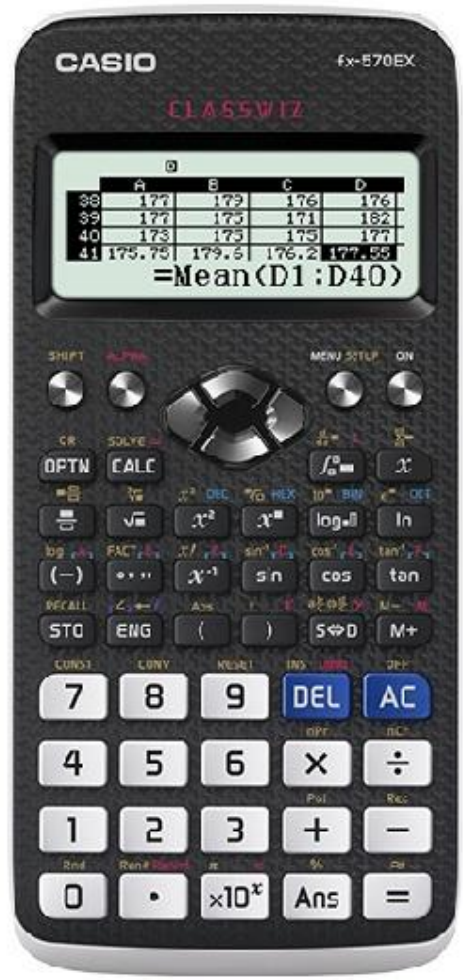
(f) Investigate how increasing the number of strips affects the accuracy of the area obtained using the (i) trapezoidal rule (ii) mid-ordinate rule.

# 3. *CASIO fx-570EX &fx-991EX*

*"The best investment is in the tools of one's own trade". – Benjamin Franklin –*

These two have the same functions. The only difference is that *fx-570EX* is powered by AAA x 1(RO3) cell while *fx-991EX* operates on two-way power (Solar + LR44 x 1 cell)

In addition to the functions of *fx-82EX*, they have the following functions:




- Spreadsheet calculations.
- Integration calculations.
- Differential calculations.
- CALC function.
- SOLVE function.
- Complex number calculations.
- Base-n calculations (Binary/Octal/Hexadecimal)
- Equation calculations.
- Matrix calculations.
- Vector calculations.
- 47 Scientific constants.
- 40 metric conversions.
- Inequality calculations.
- Ratio calculations.
- Engineering symbol calculations.
- QR Code generator – for displaying graphs and other information on smartphones or computers.

(Back cover page)

Contact CASIO GAKUHAN-KENYA at…………………………………..
for any inquiries and further support such as:

- Free lesson ideas.
- The use of projectors, emulators and other technology for lessons.
- Worksheets.
- Other educational resources.