Chapter 22 How to use your graphical calculator

22.1 Introduction

In the *Mathematical Studies for the IB Diploma* course, you are expected to use a graphical display calculator (GDC) at all times. It is a vital tool to use while you are learning, as well as during **both** the examinations.

If you learn to use your calculator quickly and efficiently you will find it invaluable. But be careful, not all calculators are the same. If you borrow someone else's, the required key sequences and menus may be different and you will have to relearn some processes. So, always take **your own** calculator to lessons.

When you choose your graphical calculator you need to make sure that it can:

- draw graphs
- change the scale of the screen
- solve equations numerically
- display matrices
- find a numerical derivative at any point
- give the results of normal distribution, chi-squared tests and correlation coefficients
- find *p*-values.

You are also allowed to use the following Apps:

- finance
- programs to solve simultaneous and quadratic equations
- language programs that translate prompts and error messages.

If you do not have any of the Apps, download them from the website that has been set up by the manufacturer:

Texas Instruments	*http://education.ti.com/educationportal/sites/US/productCategory/us_graphing.html*
Casio calculators	*http://www.casio.com/products/Calculators_%26_Dictionaries/Graphing/*

You are **not** allowed to use a calculator that has:

- a QWERTY keyboard (with letter keys like that of a computer keyboard)
- computer algebra systems installed
- Apps that give facts or formulae that you are expected to know.

The processes and key sequences in this chapter will be useful throughout the course. They have been written based on the following models of GDC because these are the ones the authors have, but this is in no way an endorsement of these specific models, and you should use a model of your choice:

- CASIO fx-9750GII
- TEXAS INSTRUMENTS TI-84 Plus Silver Edition. Please note that all instructions also apply to the TI-84 Plus, unless otherwise stated.

The instructions provided in this chapter will be very similar for many of the different models from the same manufacturers. If your model of GDC is not exactly the same as one of those used in this coursebook, you might find that despite some differences in the locations of keys and menus, you can still determine what you need to do. However, you might find that the keys, menus and entire processes are different and you will need to refer to the manufacturer's instruction booklet for support instead. Therefore, it is very important that you **don't throw the manufacturer's instruction booklet away or lose it**! You will almost definitely need it at some point.

Throughout this chapter, the left-hand column details the key sequences for the TI-84 Plus and the right-hand column details the key sequences for the Casio fx-9750GII. This is the convention used throughout this book for GDC screenshots.

TEXAS **CASIO**

22.2 Getting started

A. Setting your calculator to degree mode

TEXAS | **METHOD** | **CASIO**

1 Turn the calculator on.

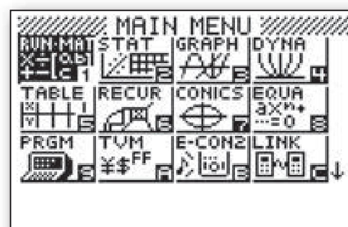
TEXAS: Press the [ON] button.

CASIO: Press the [AC/ON] button.

2 Access the required menu.

TEXAS: [MODE]

CASIO: [MENU]



3 Choose the required settings menu to change from radians to degree mode (new GDCs are set to radian by default).

TEXAS:

[▼]

[▼] [▶] (DEGREE)

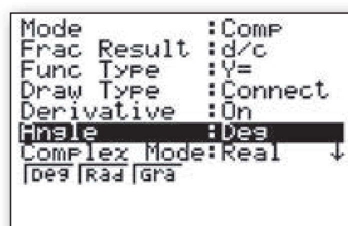
[ENTER]

CASIO:

[1] (RUN MAT)

[SHIFT] [MENU] (SET UP)

[▼] [▼] [▼] [▼] [▼] [F1] (Deg)



4 To exit the menu.

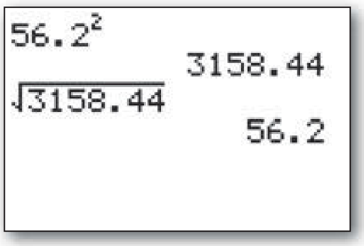
TEXAS: [2nd] [MODE] (QUIT)

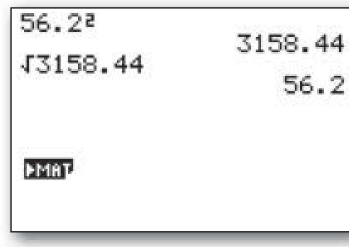
CASIO: [EXE]

B. The second and third functions of a calculator key

Some GDC keys have more than one function: the function written directly on the key and the function(s) written above it. This means that some keys can 'do' and 'undo' (inverse) the same operation. For example, the key used for the function 'sin' can also be used for the inverse function '$\sin^{-1}$'. Be aware, not all second or third functions are inverse functions; sometimes they are just different functions. Here we show an example where the x^2 key has the inverse function $\sqrt{x}$, and where the sin key has the inverse function $\sin^{-1}$.

TEXAS	METHOD	CASIO
5 6 . 2 x^2 ENTER	**1** Calculate 56.2^2.	5 6 • 2 x^2 EXE
2nd x^2 (√) 3 1 5 8 . 4 4 ENTER	**2** Calculate $\sqrt{3158.44}$.	SHIFT x^2 (√) 3 1 5 8 • 4 4 EXE





3 Write down the answers appropriately.

1. 3158.44
2. 56.2

TEXAS	METHOD	CASIO
3 . 9 ÷ SIN 3 2 ENTER	**1** Calculate $3.9 \div \sin(32)°$ (a calculation like this might be used in trigonometry to calculate an unknown length).	3 • 9 ÷ sin 3 2 EXE
2nd SIN 0 . 5 2 9 9 ENTER	**2** Calculate the angle in degrees equivalent to $\sin(x) = 0.5299192642$ (a conversion such as this might be required in a trigonometry question that asks for the size of an unknown angle).	SHIFT sin 0 • 5 2 9 9 EXE

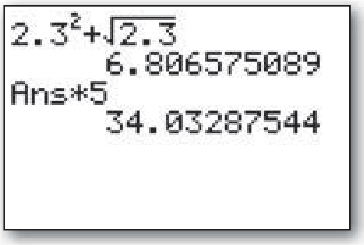
3 Write down the answer appropriately.

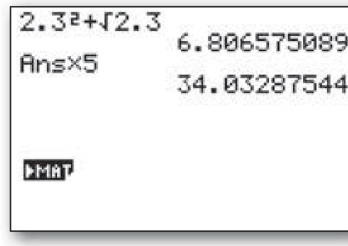
1. 7.36 (3 s.f.)
2. 32.0° (3 s.f.)

C. The Ans/ANS key

The Ans/ANS key automatically stores the answer to the last calculation you completed (it only works if you have pressed [ENTER] for TEXAS or [EXE] for CASIO at the end of the calculation). This means you can simply press this key to use the answer in the next calculation. So, if you have a calculation where you need to apply a function to the answer of the previous part of the calculation, don't delete the answer and rekey it; use the Ans/ANS key instead.

TEXAS	METHOD	CASIO
[2] [.] [3] [x^2] [+] [2nd] [x^2] [2] [.] [3] [ENTER]	**1** Calculate $2.3^2 + \sqrt{2.3}$.	[2] [.] [3] [x^2] [+] [SHIFT] [x^2] [2] [.] [3] [EXE]
[2nd] [(-)] (ANS) [×] [5] [ENTER]	**2** Multiply the answer by 5.	[SHIFT] [(−)] (Ans) [×] [5] [EXE]





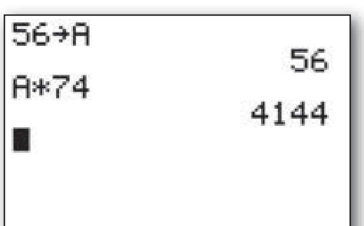
3 Write down the answers appropriately.

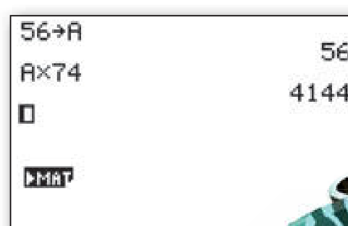
1. 6.81 (3 s.f.)
2. 34.0 (3 s.f.)

D. Using the GDC memory

GDCs have 26 memories, labelled using the letters of the alphabet. These are an example of a third function of a key, as the letter of the alphabet is printed above the relevant key.

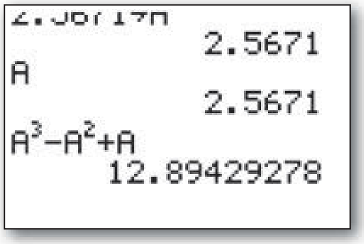
TEXAS	METHOD	CASIO
[5] [6] [STO▶] [ALPHA] [MATH] (A) [ENTER]	**1** Enter the number '56' into memory 'A' on your GDC.	[5] [6] [→] [ALPHA] [X,θ,T] (A) [EXE]
[ALPHA] [MATH] (A) [×] [7] [4] [ENTER]	**2** Recall the number from the memory for use in the calculation: 56 × 74.	[ALPHA] [X,θ,T] (A) [×] [7] [4] [EXE]





If you are doing a long calculation and using several memories, it is a good idea to write the letter of the memory that you use beside the relevant number.

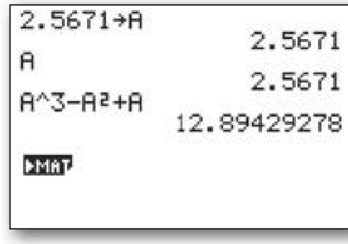
TEXAS



METHOD

Given the calculation: $x^3 - x^2 + x$, where $x = 2.5671$, you can store x as A, so that the calculation becomes $A^3 - A^2 + A$.

CASIO



E. Entering fractions

In some calculations it is more accurate to use fractions and to give the answer as a fraction. You can enter a fraction directly into your GDC. You can also convert a decimal answer into a fraction or a fraction into a decimal.

TEXAS | **METHOD** | **CASIO**

1 Enter the fraction $\frac{2}{3}$ into your GDC.

TEXAS: [2] [÷] [3]

[ENTER]

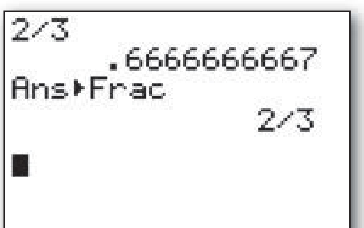
CASIO: [2] [a b/c] [3]

[EXE]

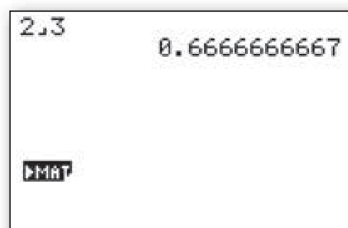
2 Convert decimal to fraction and/or fraction to decimal.

TEXAS: [MATH] [ENTER] (Frac)

[ENTER]



CASIO: [F↔D]



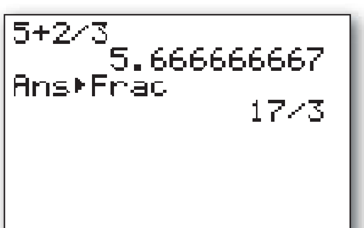
3 Enter the mixed fraction $5\frac{2}{3}$ into your GDC.

TEXAS: [5] [+] [2] [÷] [3]

[ENTER]

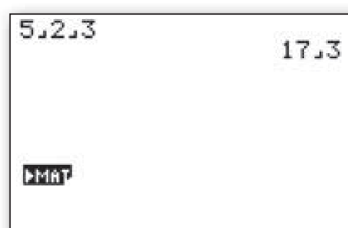
[MATH] [ENTER] (Frac)

[ENTER]



CASIO: [5] [a b/c] [2] [a b/c] [3]

[EXE]



F. The subtract (–) and negative ((–)) keys

The (–) key (where the '–' symbol is inside a pair of brackets) is used to make a number negative. The – key is the subtraction operator.

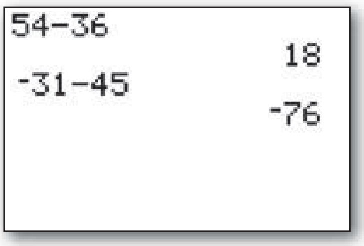
TEXAS

5 4 – 3 6

ENTER

(-) 3 1 – 4 5

ENTER



METHOD

1 Calculate 54 – 36.

2 Calculate –31 – 45.

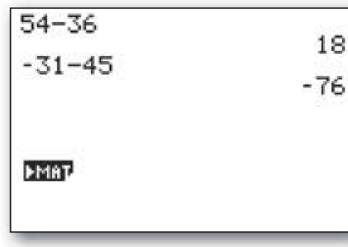
CASIO

5 4 – 3 6

EXE

(–) 3 1 – 4 5

EXE



3 Write down the answers appropriately.

1. 18
2. –76

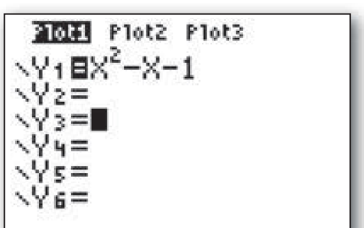
G. Graphs

(a) Drawing a graph

You can use your GDC to plot and draw a graph by entering its equation.

TEXAS

Y=

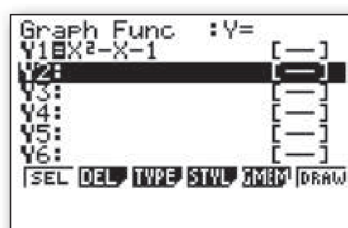


METHOD

1 Access the graph menu.

CASIO

MENU 3 (GRAPH)



TEXAS | **METHOD** | **CASIO**

METHOD

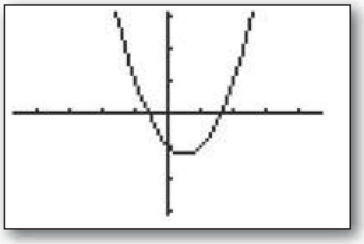
2 Enter the equation of the graph you want to plot:

$y_1 = x^2 - x - 1$

TEXAS

[X,T,Θ,n] [x^2] [−] [X,T,Θ,n] [−] [1]

[GRAPH]

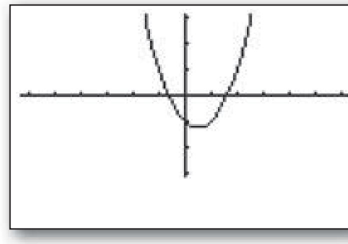


CASIO

[X,θ,T] [x^2] [−] [X,θ,T] [−] [1]

[EXE]

[F6] (DRAW)



(b) Setting a window

You can use the default scale and window set by the manufacturer or you can set up your own window to suit the graph that you are investigating. The best graphs are drawn using a window that you have set yourself but the programmed ones can be a useful starting point. If you plot a graph and you cannot see it on the screen, check the scale and window as this might be the problem.

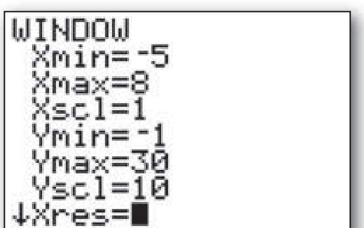
TEXAS | **METHOD** | **CASIO**

1 Plot the graphs of $y = 2^x$ *and* $y = 25$ as per section '*22.G Graphs*'.

2 Set the window so that you can view the x-axis from –5 to 8, and the y-axis from –1 to 30. To fit these axes on your GDC screen, use a scale of 1 for the x-axis and a scale of 10 for the y-axis.
(Note that on the CASIO, you press [F3] from the graph screen; if you are on the 'Graph func' screen where you enter the equation, you will need to press [SHIFT] [F3].)

TEXAS

[WINDOW]



[(-)] [5] [ENTER] (Xmin)

[8] [ENTER] (Xmax)

[1] [ENTER] (Xsc1)

[(-)] [1] [ENTER] (Ymin)

[3] [0] [ENTER] (Ymax)

[1] [0] [ENTER] (Yscl)

CASIO

[F3] (V-window)

[(−)] [5] [EXE] (Xmin)

[8] [EXE] (max)

[1] (scale)

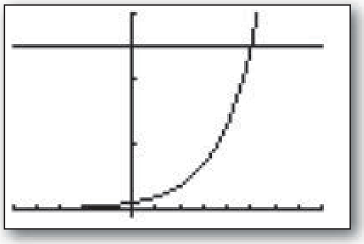
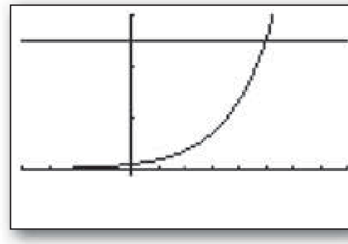
[▼]

[(−)] [1] [EXE] (Ymin)

[3] [0] [EXE] (max)

[1] [0] [EXE] (scale)

[EXE]

TEXAS	METHOD	CASIO
GRAPH 	**3** View the graph.	F6 (Draw) 

(c) Windows set by the manufacturer

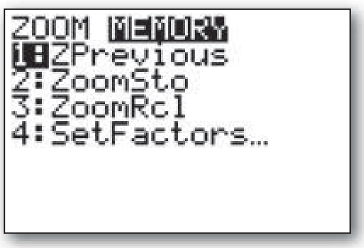
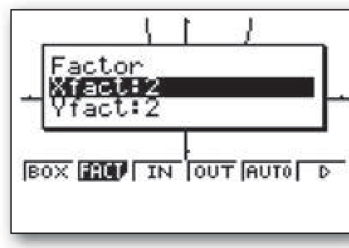
These are windows that you can access quickly, and make good starting points.

TEXAS	METHOD	CASIO
	1 Plot a graph of your choice as per section '*22.G Graphs*'.	
ZOOM 	**2** Access the list of available window options.	F3 (V-Window) 
▾ ▾ ▾ ENTER (4:ZDecimal)	**3** To fit one decimal place to each pixel. (This is the best to use with the trace function.)	F1 (INIT)
▾ ▾ ▾ ▾ ▾ ENTER (6:ZStandard)	**4** For a good general range and a good starting point.	F3 (STD)
▾ ▾ ▾ ▾ ▾ ▾ ENTER (7:ZTrig)	**5** The best window for use with trigonometric graphs.	F2 (TRIG)
▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ENTER (0:ZoomFit)	**6** To zoom automatically. Be careful with this because it looks useful but the scales can be very large.	(From graph screen) SHIFT F2 (ZOOM) F5 (AUTO)

(d) Zooming in

Using ZOOM allows you to:

- zoom in and look at a graph more closely
- zoom out to see more of a graph.

TEXAS	METHOD	CASIO
	1 Plot a graph of your choice as per section '*22.G Graphs*'.	
ZOOM ▸ (MEMORY) 4 (SetFactors…) 2 ENTER 2 GRAPH	**2** From the graph screen, set the zoom factor to 2 by 2 (this is more useful than 4 by 4).	F2 (Zoom) F2 (FACT) 2 EXE 2 EXE EXIT
		
ZOOM ▾ ENTER (2: Zoom In)	**3** Zoom in to get a closer look at your graph.	F2 (Zoom) F3 (IN) EXE
ZOOM ▾ ▾ ENTER (3: Zoom Out)	**4** Zoom out to see more of the graph.	F2 (Zoom) F4 (OUT) EXE

(e) The trace function

Use the trace function to find where the graph of $y = x^2 - 1$ crosses the x-axis.

TEXAS	METHOD	CASIO
	1 Plot the graph as per '*22.2G(a) Drawing a graph*'	
TRACE ▸ ◂ ▴ ▾	**2** Use the trace function to find where the graph crosses the x-axis; scroll as required and the x- and y- values will be displayed on the screen.	F1 (TRCE) ▶ ◀ ▲ ▼

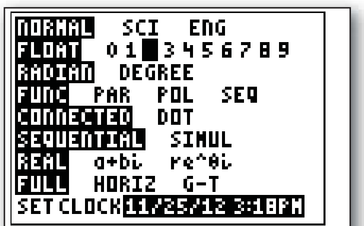
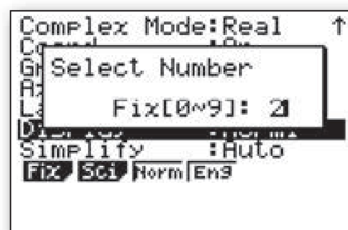
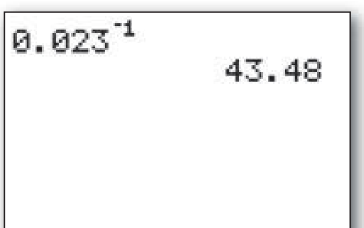
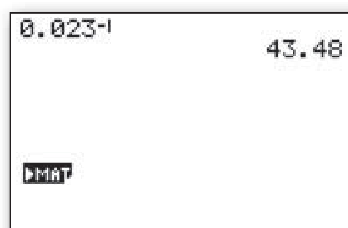
22.3 GDC support by chapter

22.3.1 Chapter 1 Number

1.1 Rounding

You can use your GDC to round answers to a specific number of decimal places. (Note, however, that not every model allows you to round to a specific number of significant figures.)

The model of TEXAS used in this book does not set to 3 s.f.; therefore, it is best to work in equivalent decimal places (using FLOAT), or leave the GDC in its default setting and round the answer yourself.

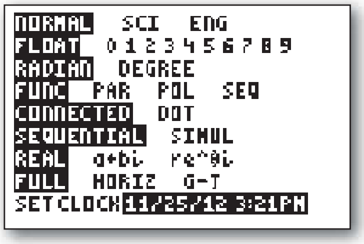
TEXAS	METHOD	CASIO
MODE	**1** Open the appropriate menu.	MENU 1 (RUN MAT) SHIFT MENU (SET UP)
▼ (FLOAT) ▶ ▶ ▶ (2) ENTER 	**2** Change to an accuracy of 2 decimal places.	▼ ▼ ▼ ▼ ▼ ▼ ▼ ▼ ▼ ▼ ▼ (Display) F1 (Fix) 2 EXE 
2nd MODE (QUIT) 0 . 0 2 3 x^{-1} ENTER 	**3** Enter the desired calculation: here we will use 0.023^{-1}.	EXIT 0 • 0 2 3 ^ (−) 1 EXE 

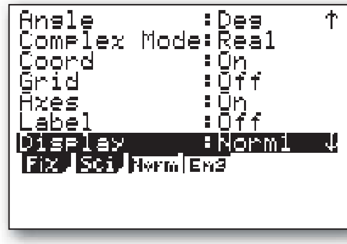
4 Write down the answer appropriately.

$0.023^{-1} = 43.48$ 2 d.p.

If you are confident in rounding you can leave your calculator in the default setting. To return to the default setting after you have changed the degree of accuracy, follow step 1 above and then proceed as follows:

TEXAS	METHOD	CASIO
▽ (FLOAT) ENTER	Return your GDC to the default degree of accuracy setting.	F3 (Norm) EXE

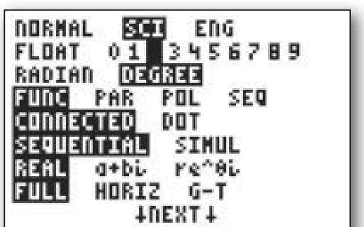


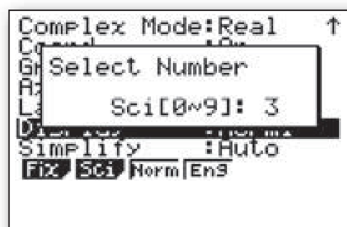


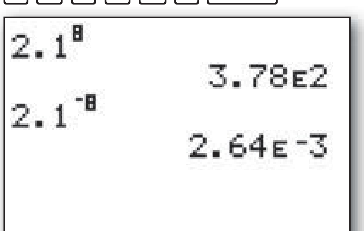
1.2 Answers in standard form

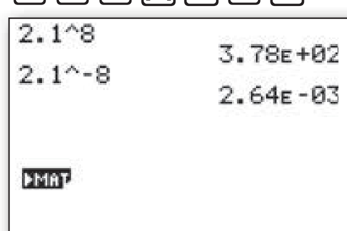
You can set your GDC to give all answers in the form $a \times 10^k$ where $1 \le a < 10$ and k is an integer (i.e. in standard form) to a given number of significant figures. **Be careful**: make sure that you write the answers in the correct mathematical form – not in calculator language!

TEXAS	METHOD	CASIO
MODE ▷ (SCI) ENTER	**1** Open the appropriate menu and set to standard form (also known as scientific notation).	MENU 1 (RUN MAT) SHIFT MENU (SET UP) ▽ ▽ ▽ ▽ ▽ ▽ ▽ ▽ ▽ ▽ ▽ (Display) F2 (Sci)
▽ (FLOAT) ▷ ▷ ▷ (2) 2nd MODE (QUIT)	**2** Choose the degree of accuracy to be 3 significant figures. Note that because the TEXAS GDC does not work to significant figures, here we have set it to 2 decimal places instead. You do not have to do this step, you could just round the final answer to 3 s.f. yourself.	3 EXE EXIT
2 . 1 ^ 8 ENTER 2 . 1 ^ (-) 8 ENTER	**3** Calculate: (a) 2.1^8 (b) 2.1^{-8}	2 . 1 ∧ 8 EXE 2 . 1 ∧ (–) 8 EXE









4 Write down the answers appropriately.
(a) 3.78×10^2
(b) 2.64×10^{-3}

1.3 Time in hours, minutes and seconds

Converting decimal time to a value given in hours, minutes and seconds is a very useful tool of your GDC.

TEXAS	METHOD	CASIO

METHOD 1 Change 463.7 minutes into hours, minutes and seconds.

TEXAS

4 6 3 . 7 ÷ 6 0 ENTER

2nd APPS (ANGLE)

4 (DMS)

ENTER

CASIO

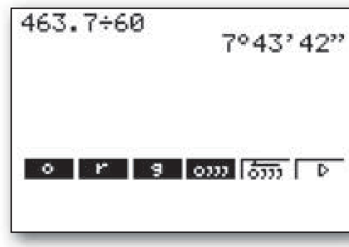
4 6 3 . 7 ÷ 6 0 EXE

OPTN F6 (▷)

F5 (ANGL)

F5

(or F6 (▷) F3 (DMS) EXE)



2 Write down the answer appropriately.

463.7 minutes = 7 hours, 43 minutes and 42 seconds

3 (a) Change 56 minutes and 31 seconds into a decimal.

TEXAS

5 6 2nd APPS (ANGLE) 1 (°)

3 1 2nd APPS (ANGLE) 2 (′)

ENTER

CASIO

5 6 OPTN F6 (▷)

F5 (ANGL)

F4 (°′″)

3 1 F4 (°′″) EXE

(b) Divide the answer by 60 to change the answer into hours.

TEXAS

÷ 6 0 ENTER

CASIO

÷ 6 0 EXE

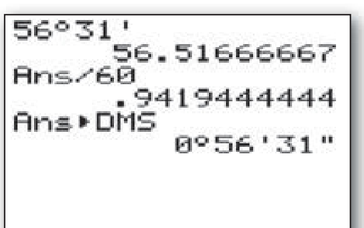
(c) Convert to hours, minutes and seconds.

TEXAS

2nd APPS (ANGLE)

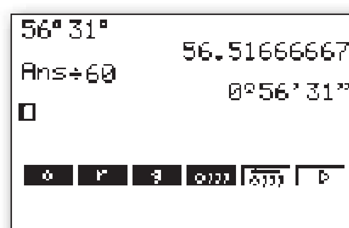
4 (DMS)

ENTER



CASIO

F5



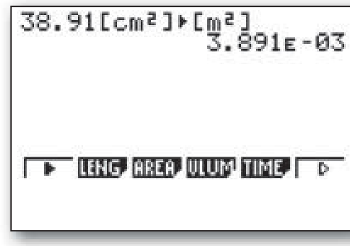
TEXAS | METHOD | CASIO

4 Write down the answers appropriately.

(a) 56.52 minutes (2 d.p.)
(b) 0.94 hours (2 d.p.)
(c) 0 hours, 56 minutes and 31 seconds.

5 On the CASIO, it is also possible to convert to other units such as area, length, volume, etc.

CASIO: [OPTN] [F6] [F1] (CONV)



22.3.2 Chapter 2 Solving equations

2.1 Solving linear equations

(a) using a graph

Solve the equation $2x + 3 = 25$

TEXAS | METHOD | CASIO

1 Plot the graphs of $y = 2x + 3$ and $y = 25$ as per section '***22.2G Graphs***'.

2 Find the point where the two lines intersect.

TEXAS:

[2nd] [TRACE] (CALC)

[5] (intersect)

(First curve?) [ENTER]

(Second curve?) [ENTER]

(Guess?) [▸] [▸] [▸] (use cursor to move to point of intersection)

[ENTER]

CASIO:

[SHIFT] [F5] (G-SLV)

[F5] (ISCT)

3 Write down the answer appropriately.

$x = 11$

(b) using an equation solver

TEXAS | **METHOD** | **CASIO**

METHOD

1 Access the linear equation solver program on your GDC.

*__Please note__ that on the TI-84 Plus and some operating systems on the Silver Edition it is: [MATH] [ALPHA] [APPS] (B: Solver …) (Or, [MATH] [▼] until 'B: Solver …' then [ENTER])

TEXAS

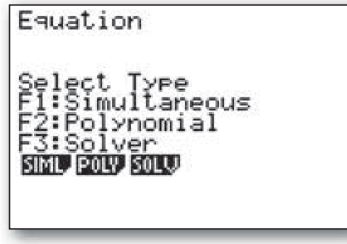
[MATH] [0] (0: Solver)*

(Or, [MATH] [▼] until '0: Solver …' then [ENTER])

CASIO

[MENU] [8] (EQUA)

[F3] (Solver)



METHOD

2 Enter the linear equation, $20 \times 1.3x = 500$, into your GDC and solve.

For the TEXAS GDC you will need to rearrange the equation so that it is equal to zero before you enter it into your GDC:

$20 \times 1.3x - 500 = 0$.

TEXAS

[▲] (to get onto the correct line)

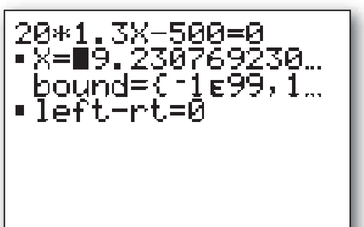
[CLEAR]

[2] [0] [×] [1] [.] [3] [X,T,Θ,n]

[−] [5] [0] [0]

[ENTER]

[ALPHA] [ENTER] (Solve)



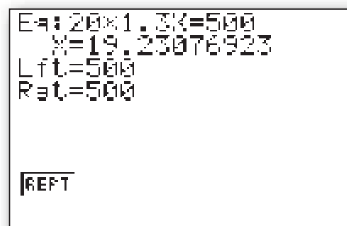
CASIO

[2] [0] [×] [1] [•] [3] [X,θ,T]

[SHIFT] [•] (=)

[5] [0] [0] [EXE]

[F6] (Solve)



3 Write down the answer appropriately.

$x = 19.2$ (3 s.f.)

2.2 Solving pairs of linear equations

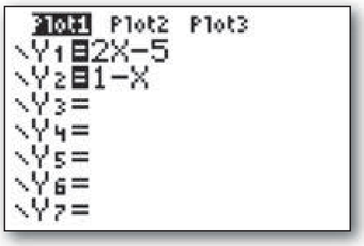
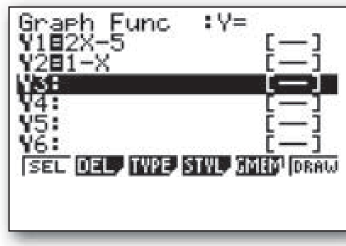
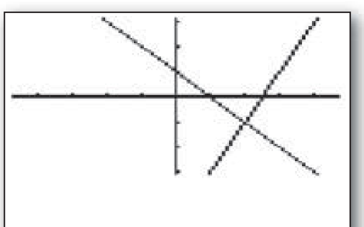
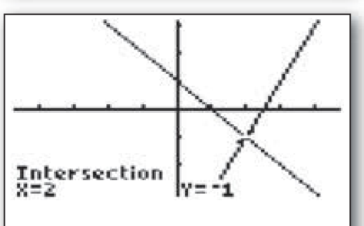
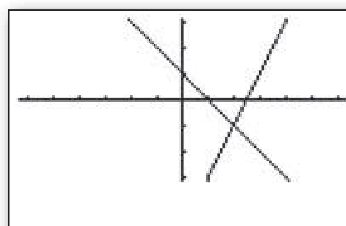
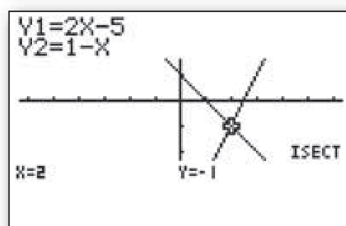
(a) using a graph

Solve $2x - y = 5$ and $x + y = 1$ by drawing a graph on your GDC.

TEXAS | **METHOD** | **CASIO**

1 Rearrange each equation into the form $y = mx + c$:

$y = 2x - 5$ and $y = -x + 1$

TEXAS	METHOD	CASIO
Y= CLEAR (to remove any existing equations) 2 X,T,Θ,*n* (-) 5 ENTER 1 − X,T,Θ,*n*	**2** Access the graph menu and enter the equations as per '*22.2G Graphs*': Y1 (2*x* – 5) Y2 (–*x* + 1)	MENU 3 (GRAPH) F2 (Del) F1 (Yes) (to remove any existing equations) 2 X,θ,T − 5 EXE − X,θ,T + 1 EXE
ZOOM 4 (Z:Decimal) 	**3** Set to an appropriate window (as per '*22.2G (b) Setting a window*'), in this case one that shows one decimal place as a pixel, and then plot the graph.	SHIFT F3 (INIT) F6 (DRAW) 
2nd TRACE (CALC) 5 (intersect) (First curve?) ENTER (Second curve?) ENTER (Guess?) ▸ ▸ ▸ (use cursor to move to point of intersection) ENTER  	**4** Find the point where the two lines intersect.	SHIFT F5 (G-SLV) F5 (ISCT)  

5 Write down the answer appropriately.

$x = 2$, $y = -1$

(b) using an equation solver

Solve $2x - y = 5$ and $x + y = 1$ using a simultaneous equation solver on your GDC.

TEXAS	METHOD	CASIO

1 Access the equation solver for simultaneous equations, and enter the number of unknowns (2).
*__Please note__ on the TI-84 Plus and some Silver Editions, the PlySmlt2 function is accessed by: [APPS] [9], or [APPS] [▼] until '9:PlySmlt2' [ENTER].

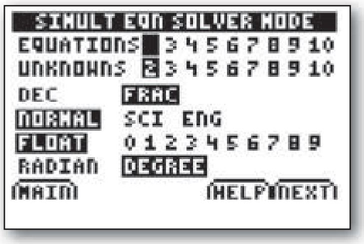
TEXAS

[APPS] [▼] until (PlySmlt2) [ENTER] *

[2] (SIMULT EQN SOLVER)

[ENTER] (Equations 2)

[▼] [2] (Unknowns 2) [ENTER]

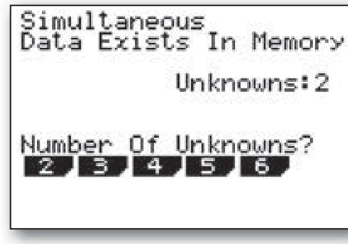


CASIO

[MENU] [8] (EQUA)

[F1] (Simultaneous)

[F1] (2 unknowns)



2 Enter the coefficient of x, the coefficient of y, and the constant for each equation.

TEXAS

[GRAPH] (NEXT)

[2] [ENTER] (x-coefficient)

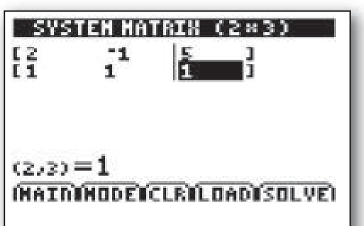
[(-)] [1] [ENTER] (y-coefficient)

[5] [ENTER] (constant)

[1] [ENTER] (x-coefficient)

[1] [ENTER] (y-coefficient)

[1] [ENTER] (constant)



CASIO

[2] [EXE]] (x-coefficient)

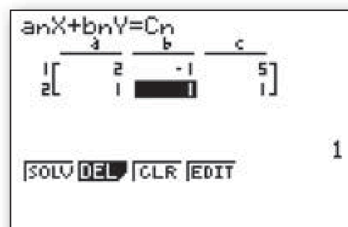
[−] [1] [EXE] (y-coefficient)

[5] [EXE] (constant)

[1] [EXE] (x-coefficient)

[1] [EXE] (y-coefficient)

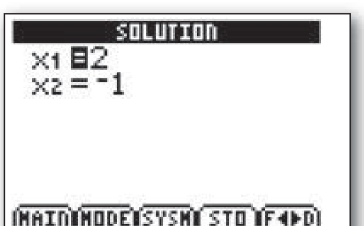
[1] [EXE] (constant)



3 Solve.

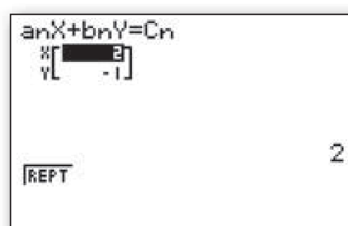
TEXAS

[GRAPH] (SOLVE)



CASIO

[F1] (SOLVE)

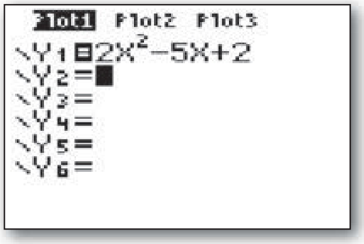
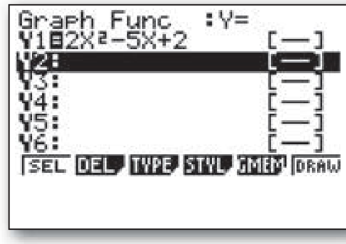
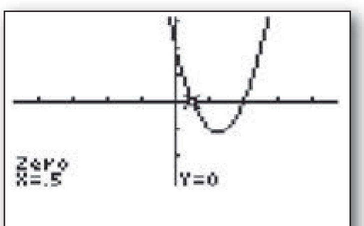
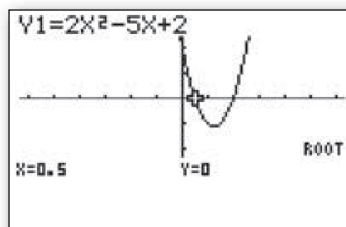
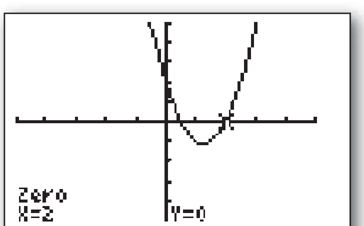
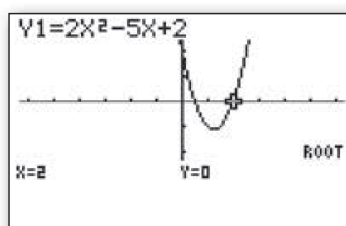


4 Write down the answers appropriately.

$x = 2$ and $y = -1$

(a) using a graph

Solve $2x^2 - 5x + 2 = 0$ by drawing a graph on your GDC.

TEXAS	METHOD	CASIO
[2] [X,T,Θ,*n*] [x^2] [−] [5] [X,T,Θ,*n*] [+] [2] 	**1** Plot the graph of $2x^2 - 5x + 2 = 0$ as per the methods in '*22.2G Graphs*'.	 [2] [X,θ,T] [x^2] [−] [5] [X,θ,T] [+] [2]
[ZOOM] [4] (ZDecimal)	**2** Set the window so that each decimal place is represented by a pixel, as per '*22.2G (b) Setting a window*'.	[SHIFT] [F3] (V-Window) [INIT] [EXIT] [DRAW]
[2nd] [TRACE] [2] (ZERO) (Move cursor to the left of the zero you need) [ENTER] (Move cursor to the right) [ENTER] (Move cursor to approximately the correct place) [ENTER] (Guess?) 	**3** The solutions are where the graph crosses the x-axis. To find the first solution …	[SHIFT] [F5] (G-SOLV) [F1] (ROOT) 
Repeat as per step 3 above. 	**4** To find the next solution …	[▶] 

5 Write down the answer appropriately.

$x = 0.5$ or $x = 2$

(b) using an equation solver

Solve $2x^2 - 5x + 2 = 0$ using a quadratic equation solver on your GDC.

TEXAS | **METHOD** | **CASIO**

1 Access the equation solver for quadratic equations. *****Please note** on the TI-84 Plus and some Silver Editions, the PlySmlt2 function is accessed by [APPS] [9], or [APPS] [▼] until 9:PlySmlt2 [ENTER].

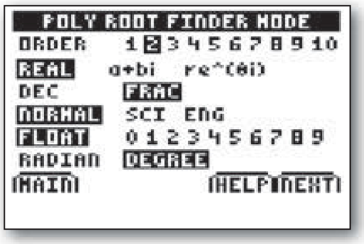
TEXAS

[APPS] [▼] until (PlySmlt2) [ENTER] *

[1] (POLY ROOT FINDER)

[2] (ORDER 2)

[ENTER]

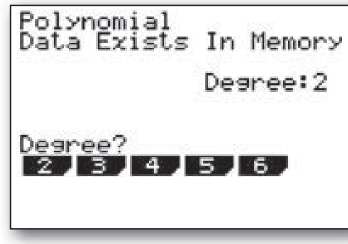


CASIO

[MENU] [8] (EQUA)

[F2] (Polynomial)

[F1] (2 Degree)



2 Enter the coefficient of x^2, the coefficient of x, and the constant.

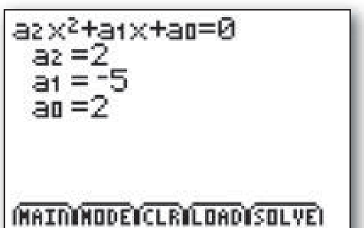
TEXAS

[GRAPH] (NEXT)

[2] [ENTER]

[(-)] [5] [ENTER]

[2] [ENTER]

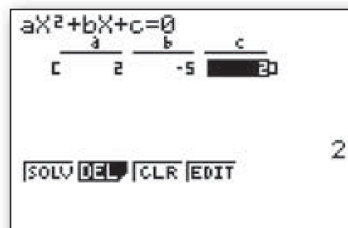


CASIO

[2] [EXE]

[−] [5] [EXE]

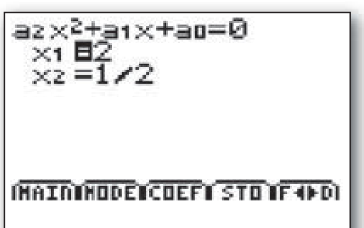
[2] [EXE]



3 Solve.

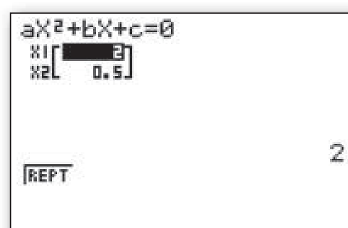
TEXAS

[GRAPH] (SOLVE)



CASIO

[F1] (SOLV)



4 Write down the answer appropriately.

$x = 0.5$ or $x = 2$

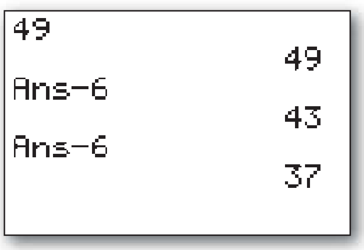
22.3.3 Chapter 3 Arithmetic and geometric series and sequences

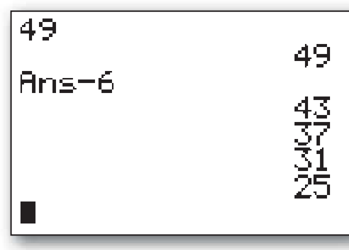
3.1 Finding the number of terms in an arithmetic sequence

(a) using the recursion mode to enter the common difference repeatedly

Find the number of terms in the sequence 49, 43, 37, …, 1

TEXAS	METHOD	CASIO
4 9 − 4 3 ENTER	**1** Work out the common difference by subtracting the second term from the first.	4 9 − 4 3 EXE
4 9 ENTER − 6 ENTER	**2** Enter the first term of the sequence into your GDC and press ENTER / EXE, then enter the common difference (–6).	4 9 EXE − 6 EXE
ENTER	**3** Keep count of how many times you press ENTER/EXE until you reach the last term of the sequence (1).	EXE

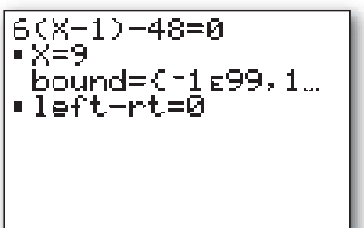
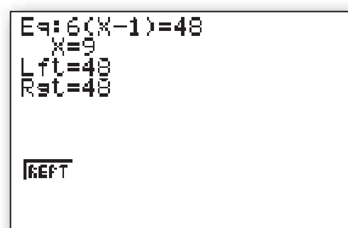




4 Write down the answer appropriately.
There are 9 terms in the sequence.

(b) using the linear equation solver

Find the number of terms in the sequence 49, 43, 37, …, 1

TEXAS	METHOD	CASIO
	1 Use the formula for the general term of an arithmetic sequence, $u_n = u_1 + (n - 1)d$, and substitute in the known values, for example: $1 = 49 + (n - 1) \times (-6)$ **2** Rearrange the formula so that it is equal to zero: $6(n - 1) - 48 = 0$	
MATH 0 * (Or MATH ▼ until '0: Solver') ▲ CLEAR 6 (X,T,Θ,n − 1) − 4 8 ENTER	**3** Access the linear equation solver on your GDC and enter the equation from (2). ***Please note** on the TI-84 and some Silver Editions, this is MATH ALPHA APPS (B: Solver), (Or MATH ▼, until 'B: Solver' then ENTER).	MENU 8 (EQUA) F3 (Solver) 6 (X,θ,T − 1) − 4 8 SHIFT • 0 EXE
1 ALPHA ENTER (SOLVE) 	**4** Enter the 'target' value of 1 and solve.	1 EXE F6 (SOLV) 
	5 Write down the answer appropriately. There are 9 terms in the sequence.	

3.2 Finding the sum of an arithmetic series using the 'sum' and 'seq' functions

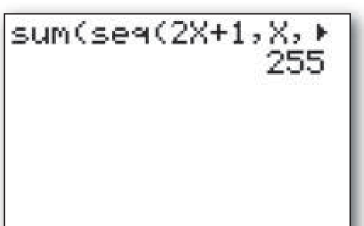
The GDC has a function called 'seq' that can calculate the terms in an arithmetic series when given the first term, the common difference and the formula for the *n*th term. GDCs also have a function that can calculate the sum of an arithmetic series, this is called 'sum'. You can use the 'sum' and 'seq' functions together to find the sum of a series.

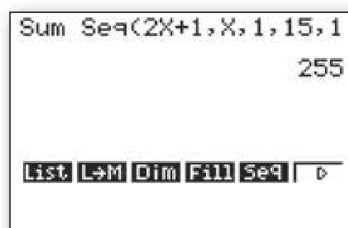
This is not a substitute for using the correct formulae but does allow you to quickly check your answer and to calculate sums to different numbers of terms.

→

Calculate the sum of the arithmetic series with the formula for the nth term of $u_n = 2x + 1$, when $n = 15$, $u = 3$ and $d = 2$.

TEXAS	METHOD	CASIO
[2nd] [STAT] (LIST) [▸] [▸] (MATH) [5] (sum)	**1** Access the 'sum' function first. (Your GDC screen should just have the text 'sum' on it with a flashing cursor; your GDC will sum whatever you type in place of the cursor.)	[MENU] [1] (RUNMAT) [OPTN] [F1] (LIST) [F6] (>) [F6] (>) [F1] (Sum)
[2nd] [STAT] (LIST) [▸] (OPS) [5] (seq)	**2** Now you need to tell your GDC about the sequence you want to sum. Access the 'seq' function...	[OPTN] [F1] (LIST) [F5] (Seq)
[2] [X,T,Θ,n] [+] [1] (Expr) [ENTER]* [X,T,Θ,n] (Variable) [ENTER] [1] (Start) [ENTER] [1] [5] (End) [ENTER] [1] (Step) [ENTER] (until see answer)	**3** ... and enter the parameters that allow your GDC to generate the sequence and then activate the 'sum' function: • the variable (x) • the starting position is term 1, so enter 1 • number of terms (15) • the increase in position from term to term (1). ***Please note** that if you get an error you should replace [ENTER] with [,].	[2] [X,θ,T] [+] [1] [,] [X,θ,T] [,] [1] [,] [1] [5] [,] [1] [EXE]





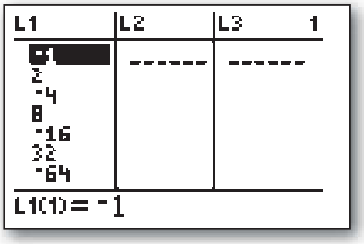
4 Write down the answer appropriately.

$S_n = 255$

3.3 Finding the sum of a geometric series using the list function

Calculate the sum of the first ten terms in the sequence with the formula $u_n = -1 \times -2^{n-1}$.

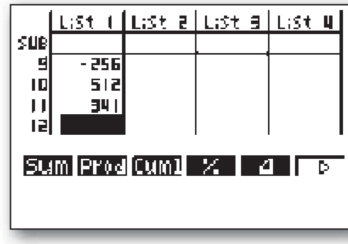
TEXAS



METHOD

1 Calculate the first 10 terms and enter them into List 1 as per section '*5.1 Entering list of data*'.

CASIO



TEXAS

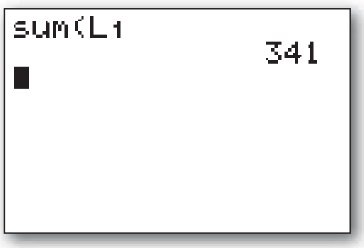
2nd STAT (LIST)

▶ ▶ (MATH)

5 (sum)

2nd 1 (LIST 1)

ENTER



METHOD

2 Sum the values in List 1. (Make sure you exit the list before doing step 2).

CASIO

MENU 1 (RUNMAT)

OPTN F1 (LIST)

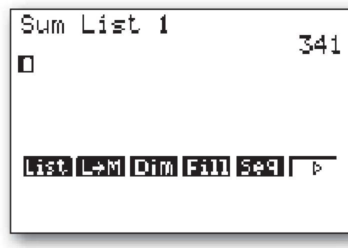
F6 (>) F6 (>) F1 (SUM)

F6 (>)

F1 (LIST)

1 (List 1)

EXE



22.3.4 Chapter 4 Financial mathematics

4.1 The financial App, TVM

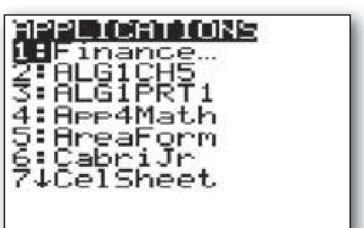
This is the financial App allowed by the IB. It is built into the CASIO calculator and *some* TEXAS models. If it is not on your GDC you can download it from the TI website.

Siva invests 15,000 INR at a rate of 4.3% per annum. How long does it take for his investment to double?

TEXAS

APPS 1 (Finance...)

1 (TVM Solver ...)



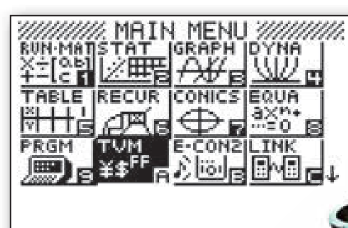
METHOD

1 Access the financial App.

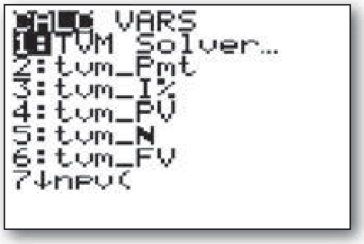
CASIO

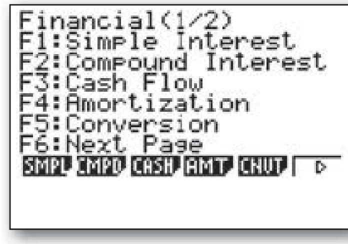
MENU ALPHA X,θ,T (TVM)

F2 (Compound interest)



TEXAS | **METHOD** | **CASIO**





2 Enter the parameters appropriate for your example. (We want to calculate N so we can enter any placeholder value for N.)

N = number of time periods.

I% = rate of interest given (4.3)

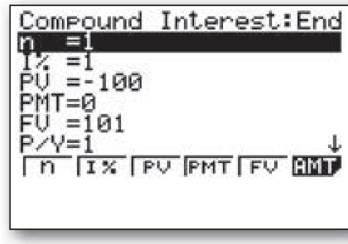
PV = Present Value. (–15000 as investments are negative)

PMT = extra payments to the account (0)

FV = Final Value (30 000)

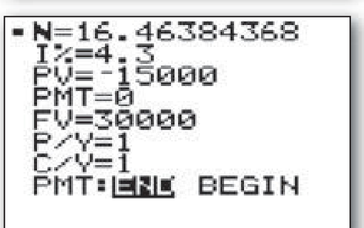
P/Y = number of interest payments made to the account each year (1)

C/Y = number of compounding periods each year (1)



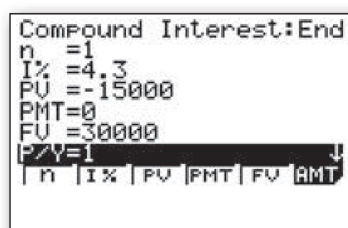
▲ until N, then

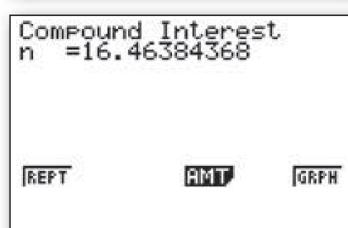
ALPHA ENTER (SOLVE)



3 Select the value you want to calculate (in this example it is N).

F1 (n)





TEXAS	METHOD	CASIO
	4 Write down the answer appropriately. $N = 16.46\ldots$. Siva's investment will not double until year 17.	

22.3.5 Chapter 5 Classification and display of data

5.1 Entering lists of data

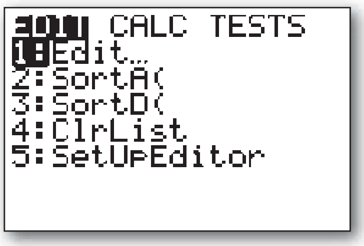
TEXAS | **METHOD** | **CASIO**

1 Access the statistics menu.

TEXAS:

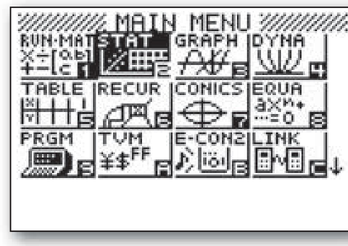
[STAT]

[1] (Edit...)



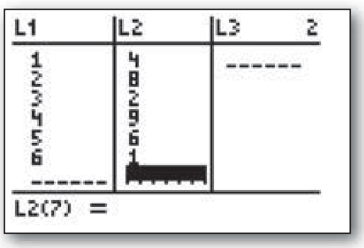
CASIO:

[MENU] [2] (STAT)

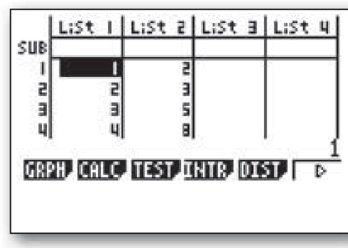


2 Enter data values individually. Press [ENTER]/[EXE] as appropriate after each entry. Use [▶] [◀] to scroll between lists.

TEXAS:



CASIO:



3 To delete a list, for example List 1 (L_1).

TEXAS:

[STAT] [4] (ClrList)

[2nd] [1] (L_1)

[ENTER]

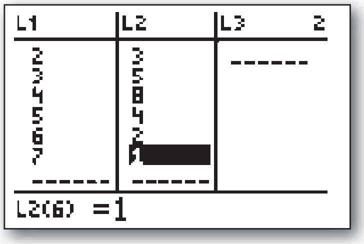
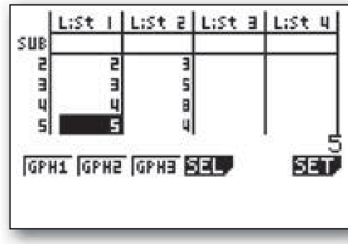
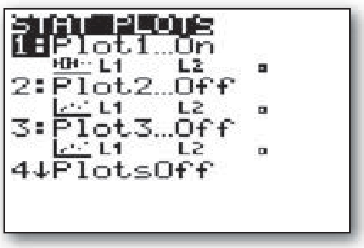
CASIO:

(Make sure the cursor is in the list you want to delete, e.g. List 1.)

[F6] (>)

[F4] (DEL A)

[F1] (Yes)

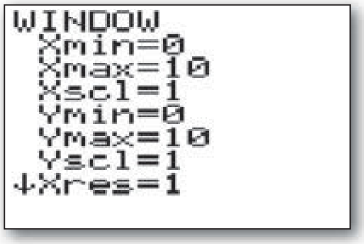
TEXAS	METHOD	CASIO
	**1** Enter your data into a list as per the instructions in section ‘*5.1 Entering lists of data*’: List 1: 1, 2, 3, 4, 5, 6, 7 List 2: 2, 3, 5, 8, 4, 2, 1 (If there is already data stored in lists, you might need to delete it.)	
[2nd] [Y=] (STAT PLOTS) [ENTER] (1: Plot 1 ... off)  [ENTER] (ON) [▼] [▶] [▶] (histogram) [ENTER] 	**2** Access the graph menu and set to histogram.	[F1] (GRPH) [F6] (SET) [▼] (Graph Type) [F6] (>) [F1] (Hist) 
[▼] (Xlist); [2nd] [1] (L_1) [▼] (Freq); [2nd] [2] (L_2)	**3** Make sure that you have the correct data set as Xlist (variable), e.g. List 1, and Frequency, e.g. List 2.	[▼] (Xlist); [F1] (LIST) [1] [EXE] [▼] (Frequency); [F2] (LIST) [2] [EXE]
[GRAPH] [WINDOW] [0] [ENTER] (Xmin) [1] [0] [ENTER] (Xmax) [1] [ENTER] (Xsc1)	**4** Display the histogram and set the window so that you can view your histogram appropriately.	[EXIT] [EXIT] [F1] (GRPH) [F1] (GPH1) [0] [EXE] (initial point)

TEXAS

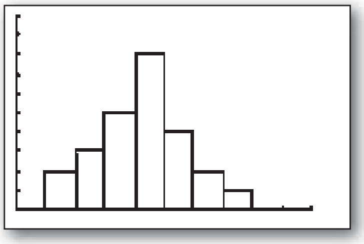
0 ENTER (Ymin)

1 0 ENTER (Ymax)

1 ENTER (Ysc1)



GRAPH*



METHOD

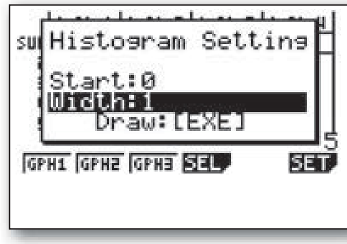
* If the graph does not plot, clear graphs in Y=.

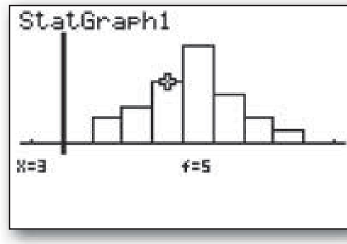
CASIO

1 (width of bar)

EXE

EXE (Draw)





TRACE

▶ / ◀ (as often as required)

5 Find the frequency value of a bar using trace.

SHIFT F1 (TRCE)

▶/◀ (as often as required)

5.3 Drawing a box and whisker diagram

TEXAS | **METHOD** | **CASIO**

1 Enter your data into a list as per the instructions in section '*5.1 Entering lists of data*'. Use:

List 1: 1, 2, 3, 4, 5

List 2: 2, 3, 5, 8, 4

(If there is already data stored in lists, you might need to delete it.)

2nd Y= (STAT PLOT)

ENTER (1: Plot 1 ... off)

ENTER (ON)

▼ ▶ ▶ ▶ ▶ (icon of a box and whisker with median)

ENTER

2 Access the graph menu and set to box and whisker diagram. (Make sure you have the correct data as Xlist (variable), e.g. List 1, and Frequency, e.g. List 2.

F1 (GRPH)

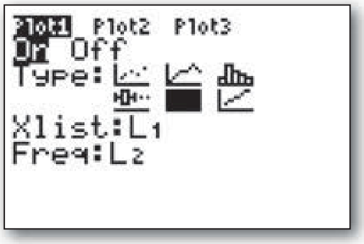
F6 (SET)

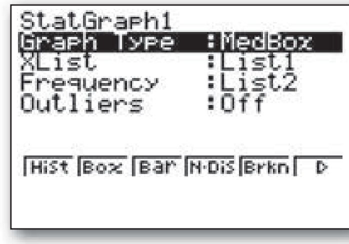
▼ (Graph Type)

F6 (>)

F2 (Box)

TEXAS | **METHOD** | **CASIO**

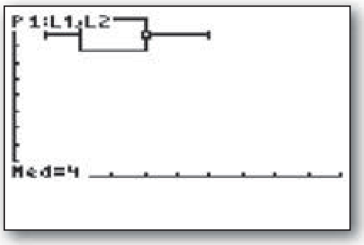




3 Display the box and whisker diagram.

Texas:

GRAPH



Casio:

EXIT EXIT

F1 (GRPH)

F1 (GPH1)

4 Find the highest and lowest values, the upper and lower quartiles and the median using trace.

Texas:

TRACE

▶/◀ (as often as required)

Casio:

SHIFT F1 (TRCE)

▶/◀ (as often as required)

22.3.6–7 Chapter 6 Measures of central tendency and Chapter 7 Measures of dispersion

6.1 Finding the mean, median, quartiles and standard deviation

(a) for a simple list of data (single variable, no frequency)

TEXAS | **METHOD** | **CASIO**

1 Enter data into List 1 as per the instructions in section '*5.1 Entering lists of data*'; here we use 12, 16, 9, 24

2 Select the statistics for a single variable and select List 1 (frequency should be blank).

* On the TI-84 Plus, and some operating systems on the Silver Edition, you will need to press ENTER three times (leave FreqList blank).

Texas:

STAT

▶ (CALC)

1 (1-Var Stats)

2nd 1 (L_1)

ENTER*

Casio:

F2 (Calc)

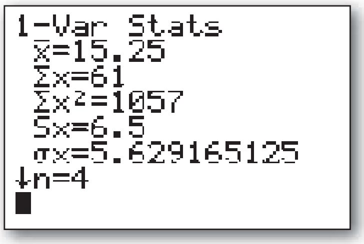
F6 (SET)

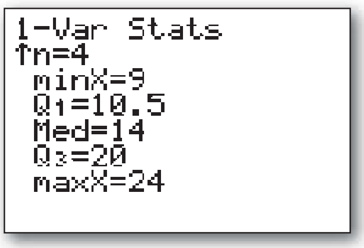
F1 (LIST)

1 EXE

F1 (1) EXE

TEXAS





▲ ▼

METHOD

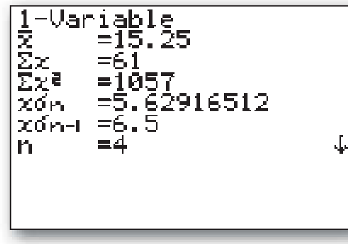
3 To find values of:

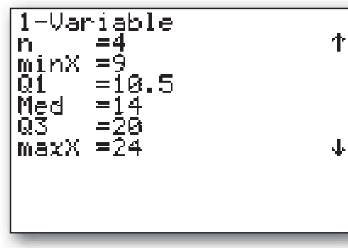
- $\bar{x}$ (the mean)
- σ_x (the standard deviation)
- n (the number of entries)
- Q1 (lower quartile)
- Med (median)
- Q3 (upper quartile)

scroll as required.

CASIO

F1 (1Var)

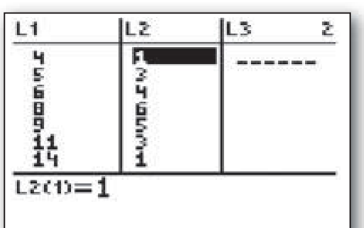




▲ ▼

(b) for grouped data (single variable with frequency)

TEXAS

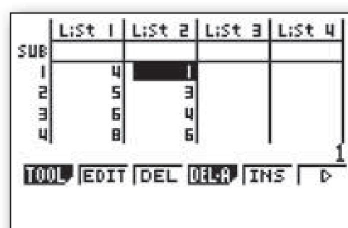


METHOD

1 Enter the variable into List 1 and the frequency into List 2, as per the instructions in section '*5.1 Entering lists of data*'; here we use:

x	Freq
4	1
5	3
6	4
8	6
9	5
11	3
14	1

CASIO



TEXAS | **METHOD** | **CASIO**

2 Select the statistics for a single variable; make sure that the variable is entered as List 1 and the frequency as List 2.

*__Please note__ that on the TI-84 Plus and some operating systems of the Silver Edition you will need to replace [,] with [ENTER].

TEXAS:

[STAT]

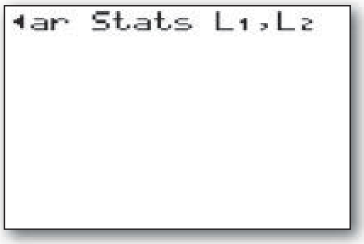
[▶] (CALC)

[1] (1-Var Stats)

[2nd] [1] (L_1) [,]*

[2nd] [2] (L_2) [,]

[ENTER]



CASIO:

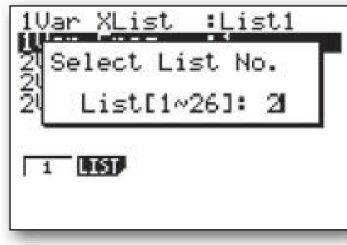
[F2] (CALC)

[F6] (SET)

[F1] (LIST) [1] [EXE]

[▼] (1 Var Freq)

[F2] (LIST) [2] [EXE]

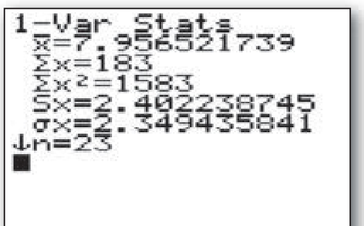


3 To find values of:

- $\bar{x}$ (the mean)
- σ_x (the standard deviation)
- *n* (the number of entries)
- *Q*1 (lower quartile)
- Med (median)
- *Q*3 (upper quartile)

Scroll as required.

TEXAS:

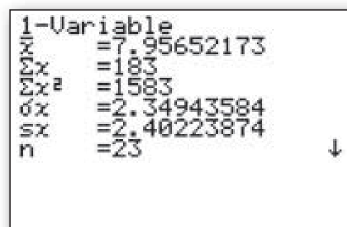


[▲] [▼]

CASIO:

[EXE]

[F1] (1 VAR)



[▲] [▼]

Be careful! You are expected to use the σ_x value as the standard deviation even though this is not the symbol used elsewhere for the *sample* standard deviation. On GDCs, s_x represents the standard deviation of the population, so you do not have to look at that value.

22.3.8–10 Chapters 8–10 (Topic 3: Logic, sets and probability)

Your calculator is useful for general calculations and for working with fractions, but not for any specific techniques in this topic.

22.3.11 Chapter 11 The normal distribution

11.1 Finding the area under a normal distribution curve

(a) using a graph

TEXAS	METHOD	CASIO

1 Make sure you know the parameters of your normal distribution N (μ, σ^2). Make sure you know what the lower and upper bounds are. For this example:

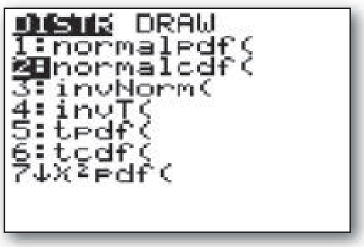
X~N (0, 1^2) so μ = 0, σ = 1, Upper = 1.4, Lower = –1E+99

2 Select the normal distribution statistics for drawing a normal distribution curve.

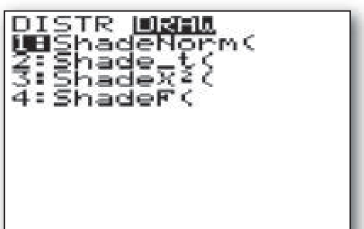
TEXAS

[2nd] [VARS] (DISTR)

[▼] (2: normal cdf) (do not press enter yet)



[▶] (DRAW)



[1] (ShadeNorm)

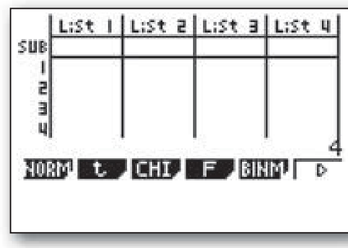
CASIO

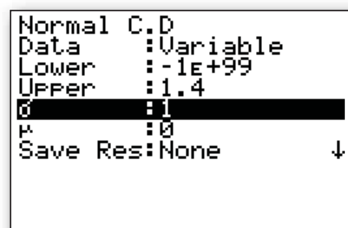
[MENU] [2] (STATS)

[F5] (DIST)

[F1] (NORM)

[F2] (Ncd)





3 Enter the parameters and draw the graph.

TEXAS

[(-)] [1] [2nd] [,] (EE) [9] [9]

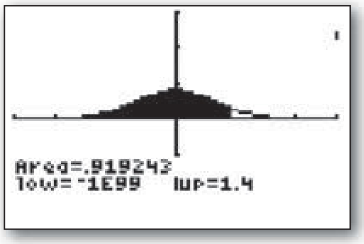
[,]*

[1] [.] [4] [,]

[0] [,] (mean)

[1] (standard deviation)

[ENTER] (Draw)



METHOD

*** Please note** on the TI-84 Plus, and some operating systems on the Silver Edition, replace [,] with [ENTER] (except when selecting EE).

CASIO

(Make sure 'Data' is set to variable.)

[F2] (Var)

[▼] [(–)] [1] [EXP] [9] [9] [EXE]

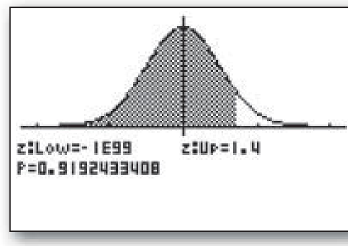
[1] [•] [4] [EXE]

[1] [EXE] (standard deviation)

[0] [EXE] (mean)

[▼]

[F6] (DRAW)



4 Write down the answer appropriately.

$p = 0.919$ (3 s.f.)

(b) without a graph

TEXAS

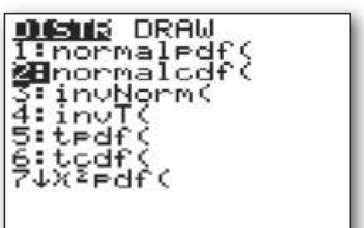
METHOD

CASIO

In this example, X ~ N(5, 1.6^2), the lower bound is 6 and the upper bound is 8.

[2nd] [VARS] (DISTR)

[2] (normal cdf)



1 Select the normal distribution statistics.

[MENU] [2] (STATS)

[F5] (DIST)

[F1] (NORM)

[F2] (Ncd)

TEXAS

6 ,*

8 ,

5 ,

1 . 6

ENTER

METHOD

2 Enter the parameters.

* **Please note** on the TI-84 Plus, and some operating systems on the Silver Edition, replace , with ENTER.

3 Write down the appropriate answer.

p = 0.236 (3 s.f.)

CASIO

(Make sure 'Data' is set to variable.)

F2 (Var)

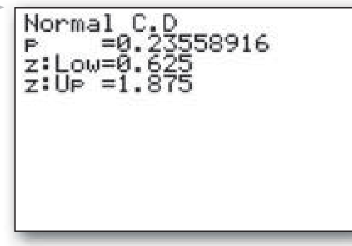
▼ 6 EXE

8 EXE

1 • 6 EXE

5 EXE

EXE

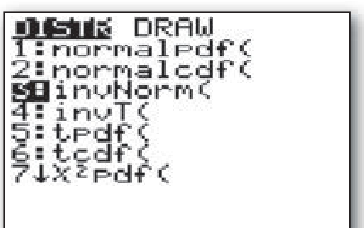


11.2 Inverse normal calculations

TEXAS

2nd VARS (DISTR)

3 (invNorm)



METHOD

1 Select the inverse normal distribution from the statistics menu.

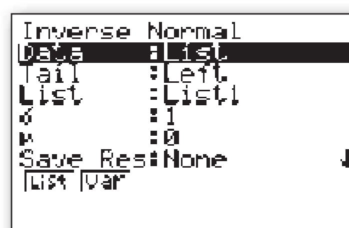
CASIO

MENU 2 (STATS)

F5 (DIST)

F1 (NORM)

F3 (InvN)



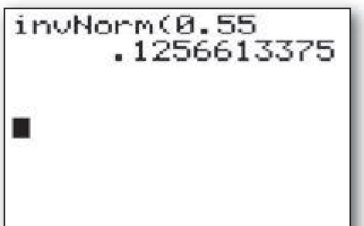
TEXAS

[0] [.] [5] [5] [,]* (area)

[0] [,] (mean)

[1] (standard deviation)

[ENTER]



METHOD

2 Enter the parameters. In this example: the data is a variable and we have a left tail; area is 0.55, standard deviation is 1 and mean is 0.

* **Please note** on the TI-84 Plus, and some operating systems on the Silver Edition, replace [,] with [ENTER].

3 Write down the appropriate answer.

For $X \sim (0,1)$,
$P(X \leq a) = 0.55$

$a = 0.126$ (3 s.f.)

CASIO

[F2] (VAR)

▼ (Tail)

[F1] (LEFT)

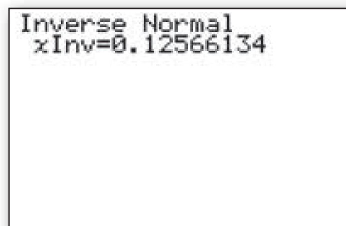
▼ (Area)

[0] [•] [5] [5] [EXE]

[1] [EXE] (standard deviation)

[0] (mean)

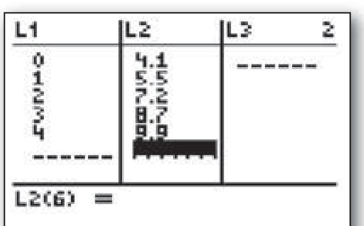
[EXE] [EXE]



22.3.12 Chapter 12 Correlation

12.1 Drawing a scatter diagram of bivariate data

TEXAS

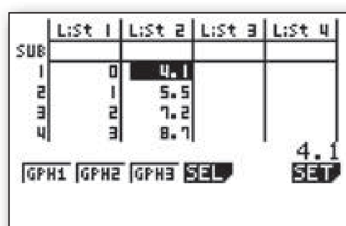


METHOD

1 Enter your data into lists as per '*5.1 Entering lists of data*'.

Make sure you enter the independent x-variable in List 1 and the dependent y-variable in List 2.

CASIO



TEXAS | **METHOD** | **CASIO**

2 Select a scatter diagram from the graph menu and make sure that 'Xlist' is your list of x-variables (L_1) and 'Ylist' is your list of y-variables (L_2).

TEXAS

[2nd] [Y=] (STAT PLOT)

[1] [ENTER]

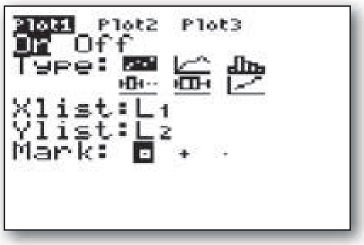
[ENTER] (ON)

[▼] (Type)

[ENTER] (highlight the scatter graph, the first icon)

[▼] [2nd] [1] (L_1) [ENTER]

[2nd] [2] (L_2) [ENTER]



CASIO

[MENU] [2] (STATS)

[F1] (GRPH)

[F6] (SET)

[▼] (Graph Type)

[F1] (Scat)

[▼] (XList)

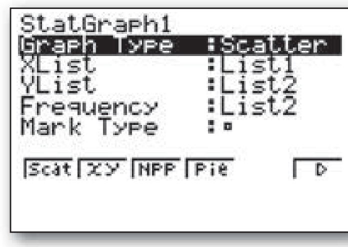
[F1] (LIST)

[1] [EXE] (L_1)

[▼] (YList)

[F1] (LIST)

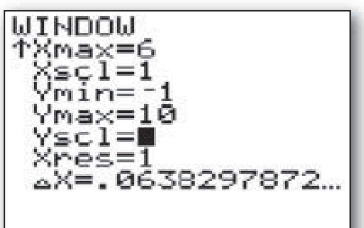
[2] [EXE] (L_2)

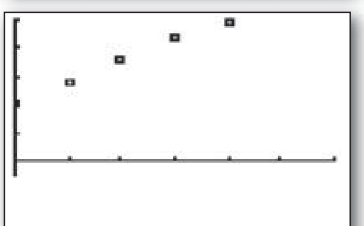


3 Display the graph and set the window if you need to.

TEXAS

[GRAPH]

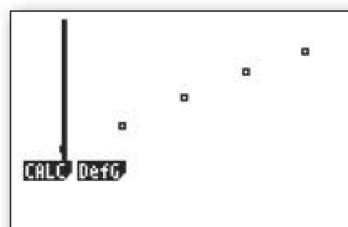




CASIO

[EXIT]

[F1] (GPH1)



TEXAS	METHOD	CASIO

1 Enter your data into lists as per step (1) in '*12.1 Drawing a scatter diagram of bivariate data*'.

2 Set up your calculator appropriately.

TEXAS:

[2nd] [0] (CATALOG)

[▼] scroll down to 'DiagnosticOn' [ENTER] [ENTER]

CASIO:

Plot a scatter graph as per steps (2) and (3) in '*12.1 Drawing a scatter diagram of bivariate data*'

3 Access the linear regression function on your GDC. Make sure that Xlist is your list of x-variables (List 1) and Ylist is your list of y-variables (List 2).

*** Please note** on the TI-84 Plus, and some operating systems on the Silver Edition, replace [,] with [ENTER], [CLEAR] the FreqList, and press [ENTER] three times after [2nd] [2] (L_2).

TEXAS:

[STAT]

[▶] (CALC)

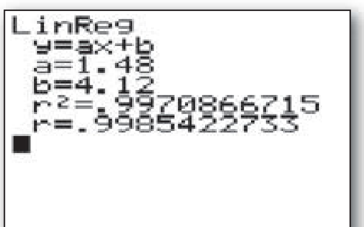
[4] (LinReg ($ax + b$))

[2nd] [1] (L_1)

[,]*

[2nd] [2] (L_2)

[ENTER]



CASIO:

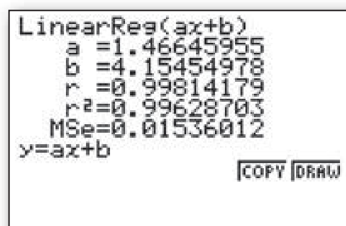
(With the scatter diagram on the screen.)

[F1] (CALC)

[F2] (X)

[F1] (ax + b)

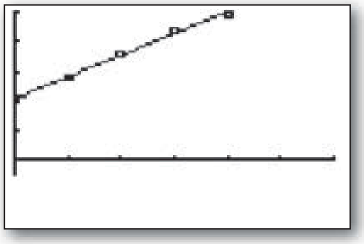
(Using [F2] (X) assumed that the scatter graph was linear. You can also test for curves.)



TEXAS

Y= 1 . 4 8 X,T,Θ,n +

4 . 1 2 GRAPH



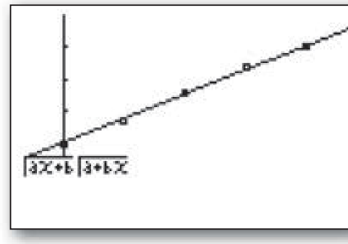
METHOD

4 Display the regression line.

5 Write down the information appropriately. Note that *a* and *b* will vary according to GDCs.
CASIO:
$y = 1.47x + 4.15$ (3s.f.)
TEXAS:
$y = 1.48x + 4.12$ (3s.f.)

CASIO

F6 (DRAW)



22.3.13 Chapter 13 Chi-squared hypothesis testing

13.1 The χ^2 test for independence

This is broken down into two parts: entering the data into a matrix (steps 1–3) and calculating the χ^2 statistic (steps 4–6).

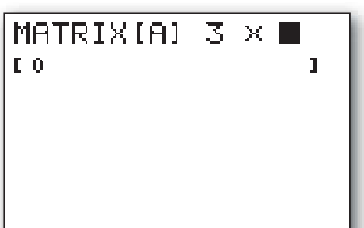
TEXAS

2nd x^{-1} (MATRIX)

▶ ▶ (EDIT)

1 (Matrix A) (You can select other blank matrices.)

3 ▶ 3 ENTER



METHOD

1 Access the matrix menu and select a matrix (some GDCs might have one already entered so you can delete the data in this matrix, or select a different matrix).

2 Enter the number of rows and the number of columns. In this example, we use the following data:

	BH	BrH	BlH
BE	5	7	12
BrE	15	10	2
GE	3	4	5

There are 3 rows of data and 3 columns of data.

CASIO

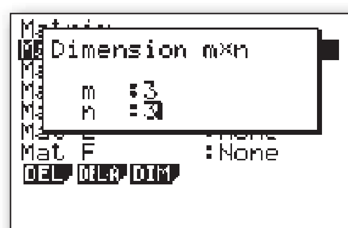
MENU 1 (RUN MAT)

F1 (MAT)

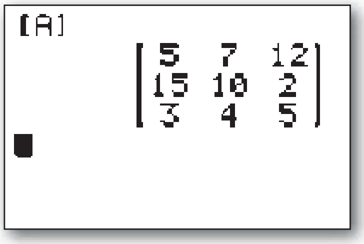
EXE (Matrix A) (You can select other blank matrices.)

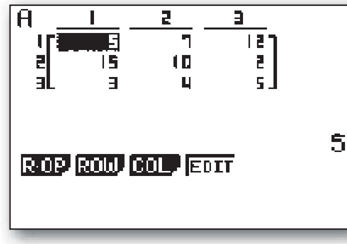
3 EXE

3 EXE

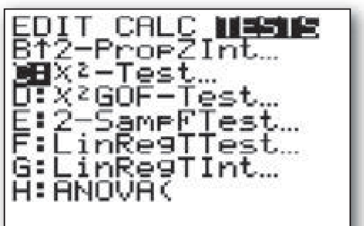


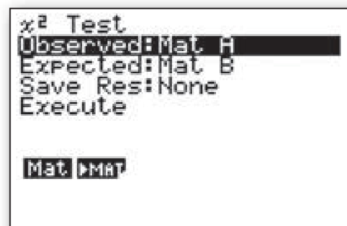
TEXAS	METHOD	CASIO
5 ENTER 7 ENTER 1 2 ENTER 1 5 ENTER 1 0 ENTER 2 ENTER 3 ENTER 4 ENTER 5 ENTER 2nd MODE (QUIT)	**3** Enter the observed data.	5 EXE 7 EXE 1 2 EXE 1 5 EXE 1 0 EXE 2 EXE 3 EXE 4 EXE 5 EXE EXIT EXIT



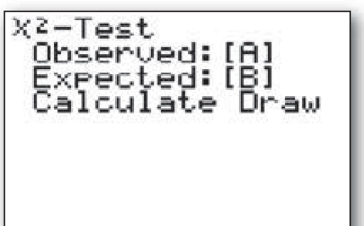


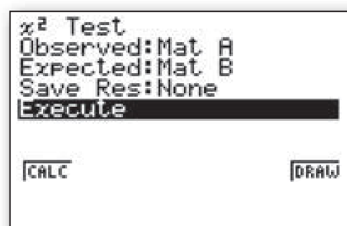
TEXAS	METHOD	CASIO
STAT ▶ ▶ (TESTS) ALPHA PRGM (C: χ^2-test) (or scroll ▼ until you reach 'C: χ^2 test' and then ENTER)	**4** Select the χ^2 statistic function.	MENU 2 (STAT) F3 (TEST) F3 (CHI) F2 (2WAY)



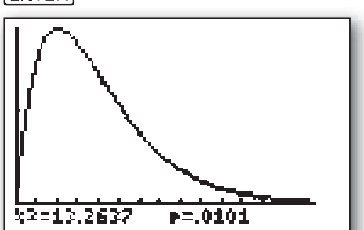


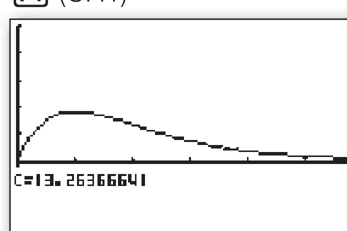
TEXAS	METHOD	CASIO
	5 Confirm that observed data is in matrix A. Matrix B will fill automatically (you can change the degree of accuracy as required).	





TEXAS	METHOD	CASIO
▼ ▼ ▶ (DRAW) ENTER	**6a** Draw the graph or go to step 6b.	▼ ▼ ▼ (Execute) F6 (DRAW) F1 (CH1)

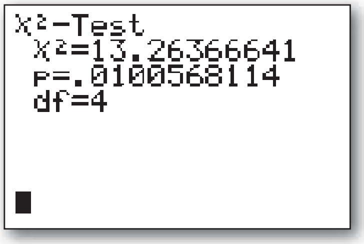




TEXAS

▼ ▼ (CALCULATE)

ENTER

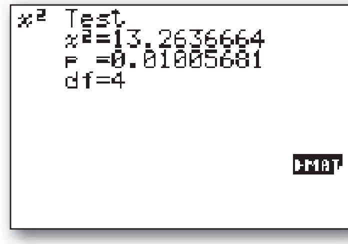


METHOD

6b Get the statistics as a list on screen.

CASIO

Press EXE immediately after doing point 4.



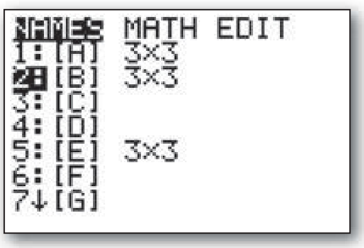
13.2 Viewing the contents of a matrix

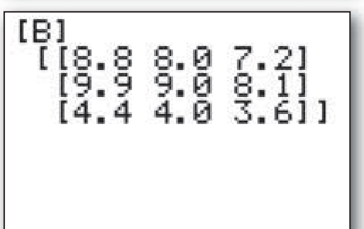
TEXAS

2nd x^{-1} (MATRIX)

2 (B)

ENTER





METHOD

Access the matrix menu and view matrix B.

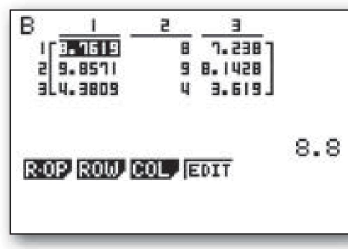
CASIO

MENU 1 (RUN MAT)

F1 (MAT)

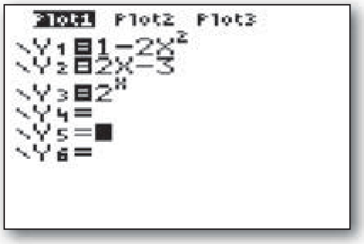
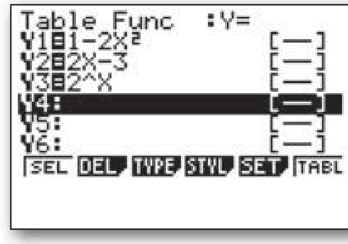
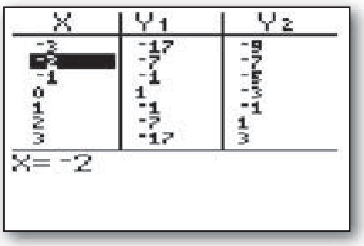
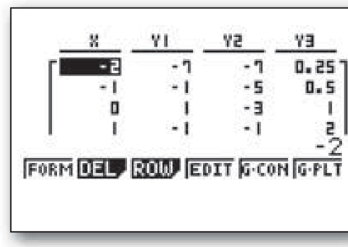
▼ (Mat B)

EXE



22.3.14 Chapter 14 Equation of a line in two dimensions

14.1 Accessing the table of coordinates from a plotted graph

TEXAS	METHOD	CASIO
	**1** Plot the graphs of your equation(s) as per '*22.2G Graphs*' but stop **before** you draw the graph.	
[2nd] [GRAPH] (TABLE) 	**2** Select the table of coordinates.	[MENU] [5] (TABLE) [F6] (TABL) 

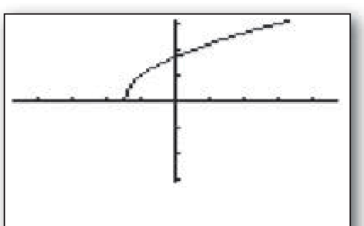
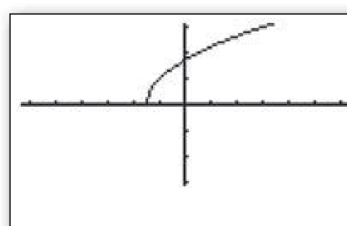
22.3.15–16 Chapter 15 Trigonometry and Chapter 16 Geometry of three-dimensional solids

Your calculator is useful for finding the values of the sine, tangent and cosine for a given angle, and the inverses, $\sin^{-1}$, $\cos^{-1}$ and $\tan^{-1}$. Remember to make sure that your GDC is A**LWAYS** set in **degree mode.**

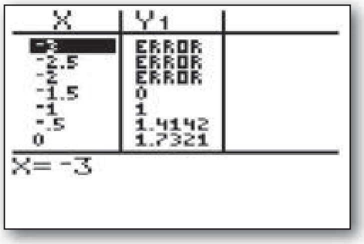
22.3.17 Chapter 17 Functions and graphs

17.1 Finding the range for a given domain

Find the range for $f(x) = \sqrt{(3+2x)}$, $x \geq -1.5$.

TEXAS	METHOD	CASIO
	**1** Draw the graph as per '*22.2G (a) Drawing a graph*'. →	

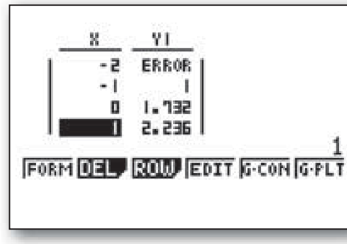
TEXAS



METHOD

2 Access the table of coordinates as per '*14.1 Accessing the table of coordinates from a plotted graph*'. Use this table to work out the range.

CASIO



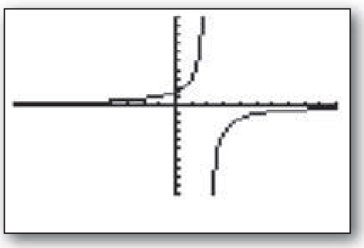
3 Write down the answer appropriately.

The range is $f(x) \geq 0$

17.2 Finding the vertical asymptote

Find the vertical asymptote of the graph $y = \dfrac{3}{2-x}$.

TEXAS

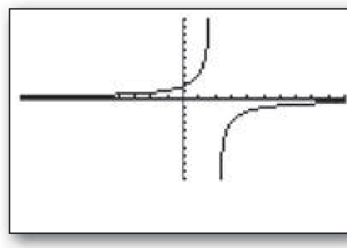


METHOD

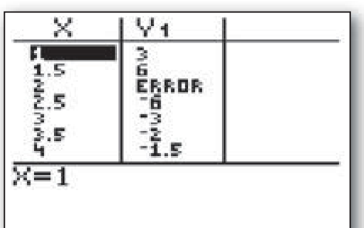
1 Draw the graph as per '*22.2G (a) Drawing a graph*'.

Find the asymptote by looking for the break in the graph along the x-axis. In this example, we can see a break at $x = 2$.

CASIO



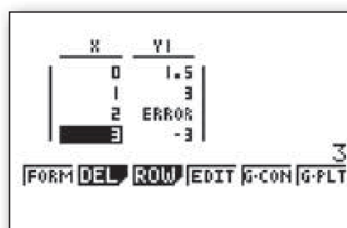
TEXAS



2 Access the table of coordinates per '*14.1 Accessing the table of coordinates from a plotted graph*'. Use this table to confirm the asymptote from step 1.

The error message confirms that the vertical asymptote occurs when $x = 2$.

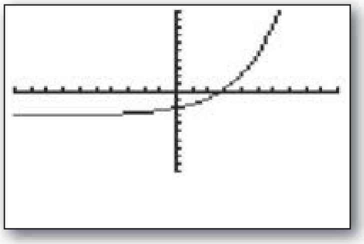
CASIO

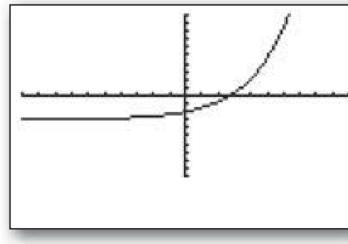


17.3 Finding the horizontal asymptote

Find the horizontal asymptote of the graph $y = 1.5^x - 3$.

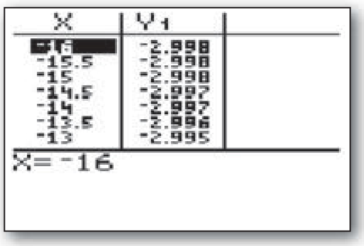
TEXAS | **METHOD** | **CASIO**

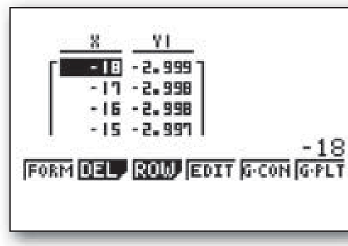




1 Draw the graph as per '*22.2G (a) Drawing a graph*'.

Find the asymptote by looking for what value of *y* the graph approaches.





2 Access the table of coordinates as per '*14.1 Accessing the table of coordinates from a plotted graph*'. Scroll through the table to confirm the asymptote from step 1.

You can see that the value of Y_1 approaches –3. This confirms that the asymptote is $y = -3$.

22.3.18 Chapter 18 Linear and quadratic models

18.1 Using a graph to find the vertex and line of symmetry of a parabola

Find the vertex and line of symmetry of the graph $y = 7 - 5x - 2x^2$

TEXAS | **METHOD** | **CASIO**

1 Draw the graph as per '*22.2G (a) Drawing a graph*'.

TEXAS

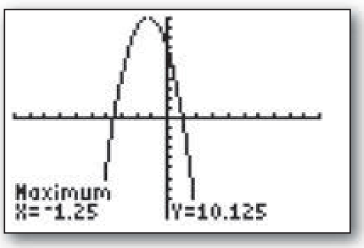
2nd TRACE (CALC)

4 (maximum)

Move the cursor to the left of the vertex:
ENTER (confirm left bound).

Move cursor to the right of the vertex:
ENTER (confirm right bound).

Move cursor over the vertex:
ENTER (confirm position of vertex).



3 (minimum)

METHOD

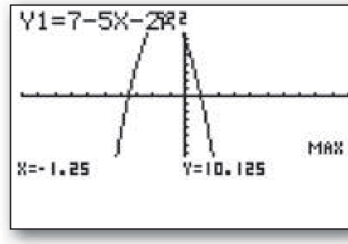
2 Decide if the graph has a minimum or a maximum and select appropriately. In this example, the parabola has a maximum.

To find the minimum, you would do as above but select 'minimum' instead of 'maximum'.

CASIO

SHIFT F5 (G-Solv)

F2 (MAX)



F3 (minimum)

3 Write down the answer appropriately.

The vertex is at (–1.25, 10.125) and the line of symmetry is $x = -1.25$

18.2 Finding the zeros (roots) of a quadratic equation using a graph

Solve $y = 7 - 5x - 2x^2$.

TEXAS | **METHOD** | **CASIO**

1 Draw the graph as per '*22.2G (a) Drawing a graph*'.

TEXAS | **METHOD** | **CASIO**

2 Use the appropriate tool to find the first zero (the left-most arm of the curve that crosses the x-axis).

Texas:

[2nd] [TRACE] (CALC)

[2] (zero)

Move the cursor to the left of the zero:

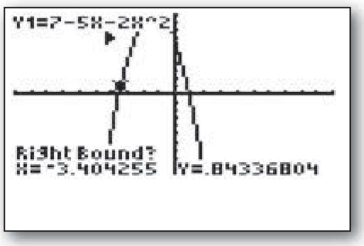
[ENTER]

Move cursor to the right of the zero:

[ENTER]

Move cursor over the zero:

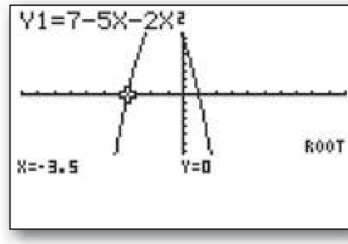
[ENTER]



Casio:

[SHIFT] [F5] (G-Solv)

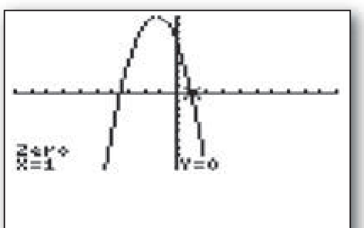
[F1] (ROOT)



3 Find the second zero.

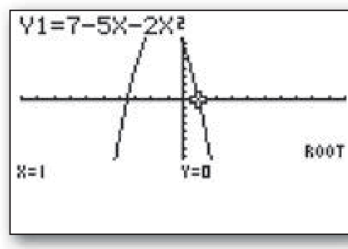
Texas:

Repeat as per step (2) for second zero.



Casio:

[F6] (>) for the second zero.



4 Write down the answer appropriately.

$x = -3.5$ or $x = 1$.

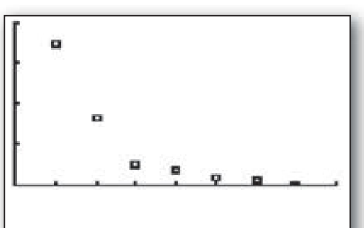
18.3 Using the statistics menu to find an equation

You might have a set of data plotted on a graph and want to find the equation of the curve or line without having to use the methods learned in Chapter 14. You can use the statistics menu to find the equation of different curves, or of a line.

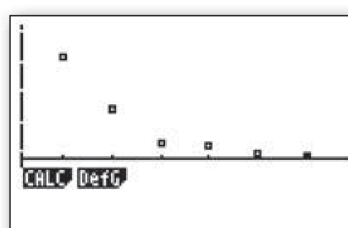
TEXAS | **METHOD** | **CASIO**

1 Draw a scatter diagram as per '*12.1 Drawing a scatter diagram of bivariate data*'.

Texas:



Casio:



TEXAS

STAT

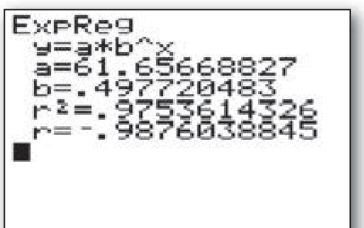
▶ (CALC)

0 (ExpReg)

(Make sure the Xlist and Ylist are the correct lists according to where you entered the data in step 1, e.g. Xlist should be the x-variable in L_1 and Ylist should be the y-variable in L_2)

▼ (CALCULATE)

ENTER



METHOD

2 Look at the shape of the graph to decide what type of graph it is (linear, parabola, hyperbola, exponential). In this example, the shape of the graph suggests it is an exponential graph: $y = a \times b^x$. Select this type of graph from the list.

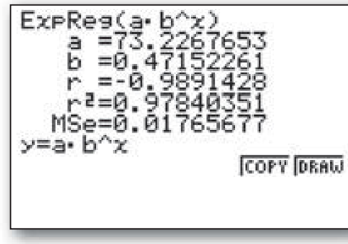
CASIO

F1 (CALC)

F6 (>)

F3 (EXP)

F2 (ab^x)



22.3.19 Chapter 19 Exponential and polynomial functions

19.1 Solving growth and decay problems

Growth and decay problems often involve finding the variable when it is the exponent, e.g. $y = a \times b^x$. In many cases you will have a value of y and want to know what value of x gives this value of y, e.g. if $y = 10$, you would get the equation $10 = a \times b^x$, where the values of a and b are known. A simple way to solve an equation involving x in the exponent is to plot the exponential graph ($y = a \times b^x$) and the line of the target value of y, e.g. $y = 10$. At the point where the line intersects with the exponential curve, you will find the value of x that makes the equation $10 = a \times b^x$ true. This is the solution to the equation.

Solve $0.3 \times 1.7^x = 35$.

TEXAS | **METHOD** | **CASIO**

The value of x that makes this equation true can be found at the point of intersection between the two graphs:

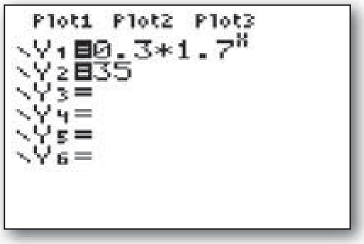
$y = 0.3 \times 1.7^x$ and $y = 35$.

TEXAS | **METHOD** | **CASIO**

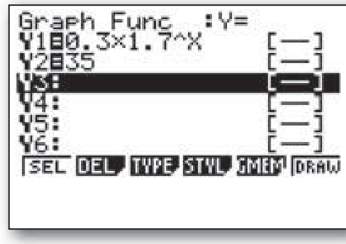
1 Plot the graphs as per '*22.2G (a) Drawing a graph*'.

Adjust the window as required.

Texas:



Casio:



2 Find the point of intersection of the line with the exponential equation.

Texas:

[2nd] [TRACE] (CALC)

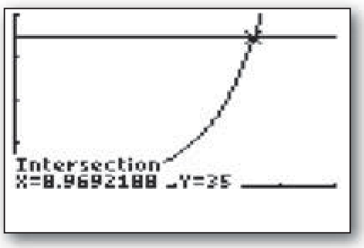
[5] (intersect)

(First curve?) [ENTER]

(Second curve?) [ENTER]

(Guess?) [▶] [▶] [▶] (use cursor to move to point of intersection)

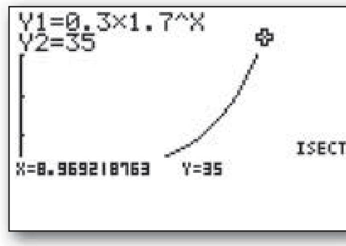
[ENTER]



Casio:

[SHIFT] [F5] (G-Solv)

[F5] (ISCT)



3 Write down the answer appropriately.

$x = 9.00$ (3 s.f.)

19.2 Solving unfamiliar equations

Your GDC can be particularly useful when you have equations whose graph would be quite complicated to plot by hand. Examples of such graphs are those where the variable is the exponent, e.g. $y = 1 - 2^x$. Other more complicated equations include those in the form $y = \sqrt{(2 + x)}$, where the variable is inside a root function.

(a) using a graph

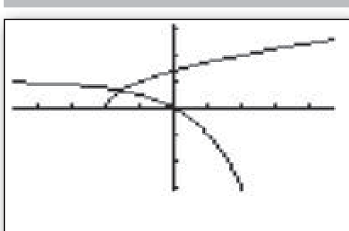
Solve $1 - 2^x = \sqrt{(2+x)}$.

TEXAS | **METHOD** | **CASIO**

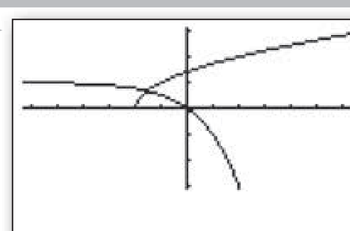
Draw the equation each side of the '=' sign as a separate graph and find the point of intersection. At this point, the value of x makes both equations true such that $1 - 2^x = \sqrt{(2 + x)}$.

1 Draw each graph as per '*22.2G (a) Drawing a graph*'.

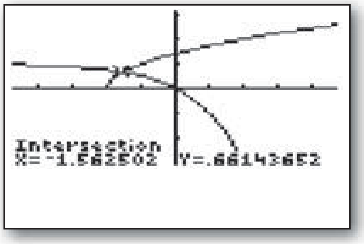
Texas:



Casio:



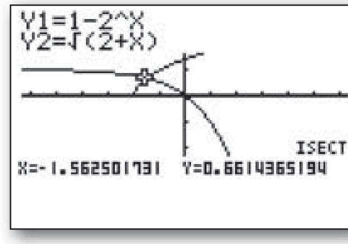
TEXAS



METHOD

2 Find the point of intersection as per step (2) in ‘*19.1 Solving growth and decay problems*’.

CASIO



3 Write down the appropriate answer.

$x = -1.56$ (3 s.f.)

(b) using an equation solver

Solve $1 - 2^x = \sqrt{(2+x)}$.

TEXAS

[MATH] [0] * (0: Solver…)

(Or, [MATH] [▼] until ‘0: Solver...’ [ENTER])

(You will need to rearrange the equal to equal zero.)

[2nd] [x^2] (√‾) [2] [+] [X,T,Θ,n] [)]

[−] [(] [1] [−] [2] [^] [X,T,Θ,n] [)]

[ALPHA] [ENTER] (Solve)

METHOD

1 Use the equation solver and key in the equation.

* **Please note** on the TI-84 Plus, and some OS on other Silver Editions, it is: [MATH] [ALPHA] [APPS] (B: Solver...) or [MATH] [▼] until ‘B: Solver’ [ENTER].

CASIO

[MENU] [8] (EQUA)

[F3] (Solver)

[1] [−] [2] [^] [X,θ,T] [SHIFT] [•] (=)

[SHIFT] [x^2] (√‾) [(] [2] [+] [X,θ,T] [EXE]

[F6] (SOLV)

2 Write down the appropriate answer.

$x = 14.5.$

19.3 Solving polynomial equations

(a) using a graph

Use the methods as per section ‘*18.2 Finding the zeros (roots) of a quadratic equation using a graph*’, repeating the methods to find all the roots as required.

(b) using an equation solver

Use the methods as per section ‘*2.3 (b) Solving quadratic equations using an equation solver*’, but in step 1 you would enter the appropriate order/degree to suit the polynomial that you have. So, if you wanted to solve a cubic equation, the order/degree would be ‘3’; if you wanted to solve a quadratic equation, the order/degree would be ‘2’ and so on. In step 2, you enter the appropriate coefficients in decreasing order/degree of x terms. So, for a cubic graph you would enter the coefficient of the x^3 term first, then the coefficient of the x^2 term, then the coefficient of the x term and finally the constant.

20.1 Finding the numerical value of the derivative $\left(\frac{dy}{dx}\right)$

(a) using a graph

TEXAS	METHOD	CASIO

1 Set up your calculator appropriately.

Texas: (Not required)

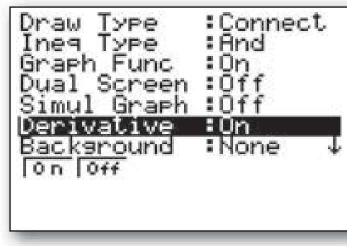
Casio:

MENU 3 (GRAPH)

SHIFT MENU (SET UP)

▼ ▼ ▼ ▼ ▼ (Derivative)

F1 (ON)

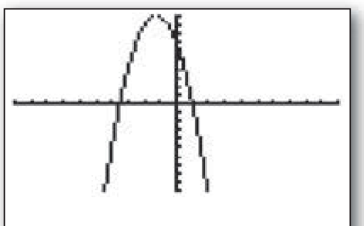


2 Draw a graph as per '*22.2G (a) Drawing a graph*'.

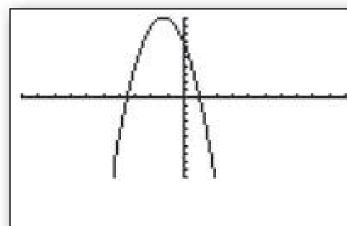
We will use the following graph in this example:

$y = 7 - 5x - 2x^2$

Texas:



Casio:



3 Select the tangent tool and choose an x-coordinate from which it can be drawn. In this example we will use $x = 2$.

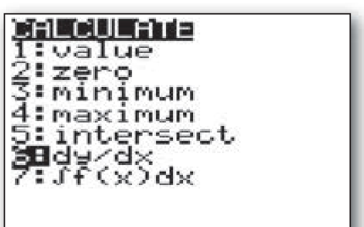
Texas:

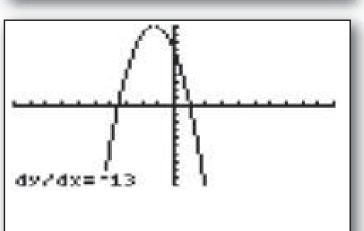
2nd TRACE (CALC)

6 $\left(\frac{dy}{dx}\right)$

2

ENTER

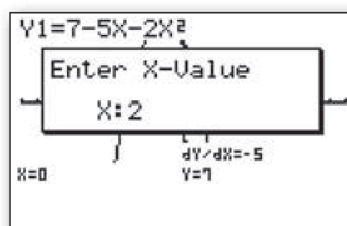




Casio:

SHIFT F1 (TRACE)

2 EXE



(b) using the table

TEXAS

The table function does not give values of the derivative at a point on this calculator.

METHOD

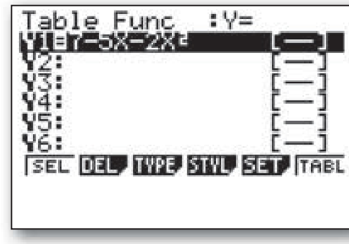
1 Access the table menu and enter the equation whose derivative you want to find. In this example we will use $y = 7 - 5x - 2x^2$

2 Use the table to read off the x-coordinate, y-coordinate and value of $\frac{dy}{dx}$ (y'1), at each point.

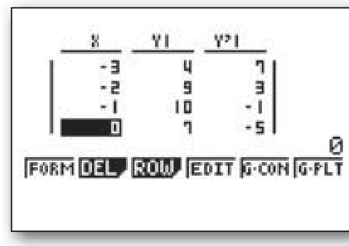
CASIO

MENU 5 (TABLE)

7 − 5 X,θ,T − 2 X,θ,T x^2



F6 (TABL)



20.2 Finding the equation of the tangent at a point

TEXAS

(Not possible)

METHOD

1 Set up your calculator appropriately.

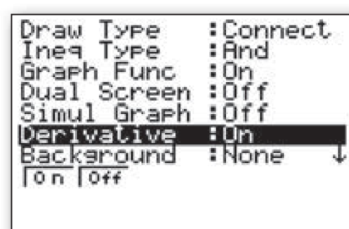
CASIO

MENU 3 (GRAPH)

SHIFT MENU (SET UP)

▼ ▼ ▼ ▼ ▼ (Derivative)

F1 (ON)



2 Draw a graph as per '*22.2G (a) Drawing a graph*'.
We will use the following graph in this example:
$y = 7 - 5x - 2x^2$

TEXAS	METHOD	CASIO

METHOD

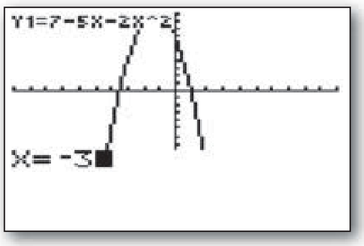
3 Once you have the graph on screen, select the tangent function and enter the value of x at the coordinate of choice. This will give you the tangent and tell you its equation.

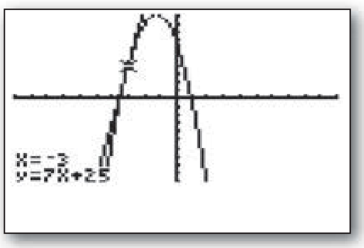
TEXAS

[2nd] [PRGM] (Draw)

[5] (Tangent)

[(-)] [3] [ENTER]



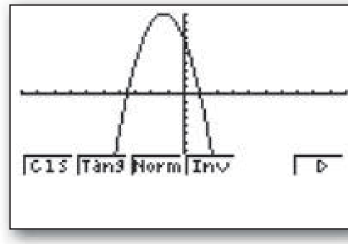


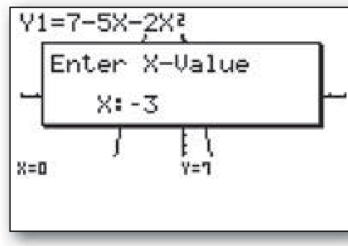
CASIO

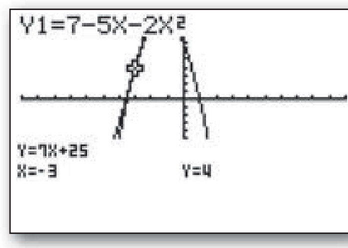
[SHIFT] [F4] (Sketch)

[F2] (Tang)

[(–)] [3] [EXE]







METHOD

4 To find the equation of the normal.

TEXAS

There is no program for finding the equation of the normal on this calculator.

CASIO

Repeat as per steps (2) and (3) above but replace:

[F2] (Tang) with:

[F3] (Norm)

[(–)] [3] [EXE]

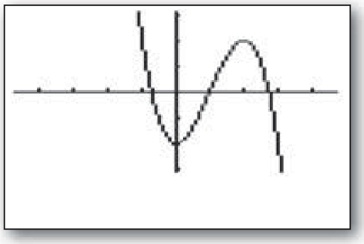
22.3.21 Chapter 21 Stationary points and optimisation

21.1 Finding increasing and decreasing functions

Describe the function $f(x) = 3x^2 - x^2 - 2$ in terms of when it is increasing and decreasing.

(a) using a graph

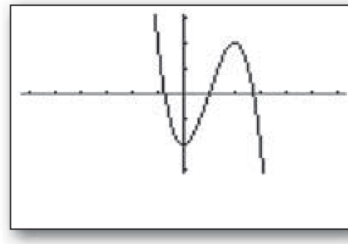
TEXAS



METHOD

1 Plot the graph as per '*22.2G (a) Drawing a graph*'.

CASIO



2 Look at the graph and determine for what values of x:

- the gradient is negative, $f'(x) < 0$; this is where the function is decreasing
- the gradient is positive, $f'(x) > 0$; this is where the function is increasing
- the gradient is zero, $f'(x) = 0$; this is a stationary point.

3 Write down the answer appropriately.

The function is decreasing when $x < 0$.

The function is increasing when $0 < x < 2$.

The function is decreasing when $x > 2$.

(b) using a table

TEXAS

The table function does not give values of the derivative at a point.

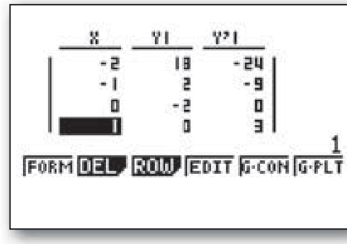
METHOD

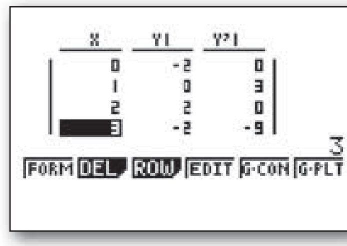
1 Access the table of values as per the instructions in '*20.1 (b) Finding the numerical value of the derivative* $\left(\frac{dy}{dx}\right)$ *using a table*'.

CASIO

MENU 5 (TABLE)

F6 (TABL)





If Y'1 is negative, the function is decreasing.

If Y'1 is positive, the function is increasing.

2 Write down the answer appropriately.
When $x < 0$ the function is decreasing.
When $0 < x < 2$ the function is increasing.
When $x = 3$, the function is decreasing.

21.2 Finding local maximum and minimum points

Find the local maximum and minimum points of the graph $y = 3x^2 - x^2 - 2$.

TEXAS

METHOD

CASIO

1 Draw a graph as per '*22.2G (a) Drawing a graph*'.

TEXAS

2nd TRACE (CALC)

3 (minimum)

Move the cursor to the left of vertex:
ENTER (confirm left bound)

Move cursor to the right of vertex:
ENTER (confirm right bound)

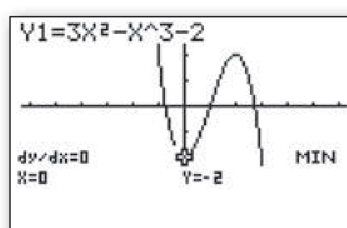
METHOD

2 Use the appropriate tool to locate the minimum.

CASIO

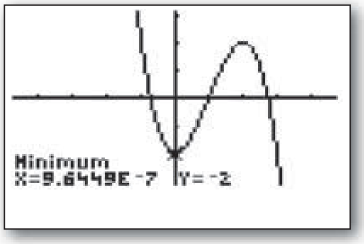
SHIFT F5 (G-Solv)

F3 (MIN)



TEXAS

Move cursor over the vertex:
[ENTER] (confirm position of vertex)



In this example, $x = 0$ even though the GDC has actually given a value very close to zero.

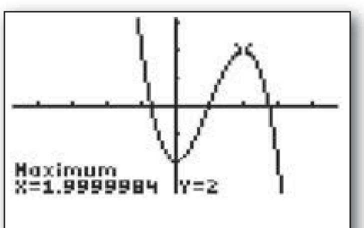
[2nd] [TRACE] (CALC)

[4] (maximum)

Move the cursor to the left of the vertex [ENTER] (confirm left bound).

Move cursor to the right of the vertex [ENTER] (confirm right bound).

Move cursor over the vertex [ENTER] (confirm position of vertex).



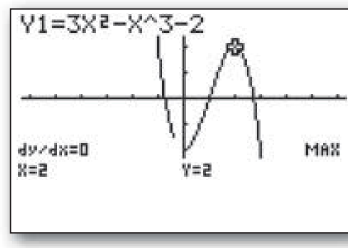
METHOD

3 Use the appropriate tool to locate the maximum.

CASIO

[SHIFT] [F5] (G-Solv)

[F2] (MAX)



4 Write down the answer appropriately.
The local minimum is $x = 0$ and the local maximum is $x = 2$.