

Casio fx-991ES PLUS Mastering Guide

Comprehensive Field & Exam Operations Manual

TAILORED FOR UNEB S.6 A-LEVEL MATHEMATICS (P425) & PHYSICS (P510)

1. ESSENTIAL SETUP & EXAM CONFIGURATION

Critical Screen Indicators

Always verify the status icons at the top of the display before starting calculations:

- D** : **Degrees Mode** (Mandatory for Physics & Trigonometric Geometry).
- R** : **Radians Mode** (Mandatory for Calculus $\frac{d}{dx}\sin x$, Integration, Harmonic Motion).
- FIX** : Fixed decimal places active.
- STAT** : Statistics mode active (memory occupied).

Quick Mode Reset & Display Setup

Exam Emergency Reset

Press **SHIFT** **9** **3** **=** **AC** to clear memory, custom settings, and return to default COMP mode.

Set Display Format:

- **Natural Math Input/Output:** **SHIFT** **MODE** **1** (MathIO).
- **Toggle Fraction to Decimal:** Press **S $\leftrightarrow$ D**.
- **Switch Deg/Rad:** **SHIFT** **MODE** **3** (Deg) or **4** (Rad).

2. CALCULATOR MODES SWITCHBOARD (**MODE** KEY)

Key	Mode Name	Primary UNEB S.6 Application
MODE 1	COMP	General Arithmetic, Trigonometry, Calculus, Logarithms, standard numerical evaluations.
MODE 2	CMPLX	Complex Numbers: Cartesian ($a+bi$), Polar ($r \angle \theta$), De Moivre's theorem, AC circuits.
MODE 3	STAT	Statistics: Mean, Variance, Standard Deviation, Linear/Exponential Regression ($y = ax + b$, line of best fit).
MODE 4	BASE-N	Number Bases: Binary, Octal, Decimal, Hexadecimal operations and conversions.
MODE 5	EQN	Algebraic Equations: Simultaneous linear equations (2 or 3 variables), Quadratics, Cubics.
MODE 6	MATRIX	Matrix Algebra: Determinants, Matrix multiplication, Inverses (3×3 or 2×2).
MODE 7	TABLE	Numerical Analysis & Curve Plotting: Generates table of (x, y) values to locate roots/sketch curves.
MODE 8	VECTOR	3D Vector Geometry: Dot product, Cross product, Angle between vectors, Magnitudes.

3. ESSENTIAL FUNCTIONS & STEP-BY-STEP EXECUTION

A. Solving Polynomials & Simultaneous Equations (MODE 5)

1. Quadratic / Cubic Equations (e.g., $ax^2 + bx + c = 0$):

- Press **MODE** **5**. Select **3** for Quadratic or **4** for Cubic.
- Enter coefficients a , b , c pressing **=** after each.
- Press **=** to view x_1 and x_2 (includes complex roots with i).

2. 3-Variable Linear Systems ($a_i x + b_i y + c_i z = d_i$):

- Press **MODE** **5** **2**. Enter 9 coefficients in matrix format. Press **=** to get x , y , z .

UNEB Exam Tip:

Always write full working out on your paper first! Use **MODE** **5** to double-check your final roots instantly before handing in.

B. The 'SOLVE' Function (COMP Mode - Any Equation)

Finds numerical roots for any equation without rearranging terms (e.g., $3X + \cos(X) = 2$):

- In **MODE** **1**, type the equation using **ALPHA** **)** for variable X .
- Insert equal sign using **ALPHA** **CALC** (do NOT press **=** bottom right).
- Press **SHIFT** **CALC** (SOLVE).
- Input an initial guess value for X , then press **=**.
- Wait for calculation. Look for $L - R = 0$ (indicates exact answer).

D. Matrix Algebra (MODE 6)

- Press **MODE** **6**. Select **1** (MatA) and dimension (e.g., **1** for 3×3).
- Type matrix elements row by row, pressing **=** after each.
- Press **AC** to store Matrix A.
- Determinant ($\det A$):** Press **SHIFT** **4** (MATRIX) **7** (det) **SHIFT** **4** **3** (MatA) **)** **=**.
- Inverse Matrix (A^{-1}):** Press **SHIFT** **4** **3** (MatA) **)** press **x^{-1}** key **)** **=**.

E. 3D Vector Geometry (MODE 8)

Essential for A-Level Applied Mathematics & Mechanics:

- Press **MODE** **8**. Choose **1** (VctA) **)** select **1** (3 -dimensions).
- Input components i, j, k pressing **=**. Press **AC**.
- Define Vector B: Press **SHIFT** **5** (VECTOR) **)** **2** (Data) **)** **2** (VctB) **)** **1**. Enter components, press **AC**.
- Dot Product ($\mathbf{A} \cdot \mathbf{B}$):** **SHIFT** **5** **3** (VctA) **)** **SHIFT** **5** **7** (Dot) **)** **SHIFT** **5** **4** (VctB) **)** **=**.
- Cross Product ($\mathbf{A} \times \mathbf{B}$):** **SHIFT** **5** **3** **$\times$** **SHIFT** **5** **4** **=**.
- Magnitude ($|\mathbf{A}|$):** Press **SHIFT** **hyp** (Abs) **)** **SHIFT** **5** **3** **)** **=**.

C. Statistics & Linear Regression (MODE 3)

Single Variable Stats ($\bar{x}$, σ_x , s_x):

- ▶ Enable Frequency column: **SHIFT** **MODE** **▼** **4** **1** (ON).
- ▶ Press **MODE** **3** **1** (1-VAR). Enter X values and Frequencies.
- ▶ Press **AC** to save data into memory.
- ▶ Press **SHIFT** **1** (STAT) $\rightarrow$ select **4** (Var):
 - **2** ($\bar{x}$) = Mean
 - **3** (σ_x) = Population Standard Dev.
 - **4** (s_x) = Sample Standard Dev.

Linear Regression ($y = A + Bx$):

- ▶ Press **MODE** **3** **2** (A+BX). Input (x, y) pairs. Press **AC**.
- ▶ Press **SHIFT** **1** $\rightarrow$ **5** (Reg): Select **1** (A), **2** (B), or **3** (r correlation).

F. Numerical Calculus & Integration (COMP Mode)

Calculus Rule:

Switch to Radians mode (**SHIFT** **MODE** **4**) before evaluating trigonometric derivatives or integrals!

1. Numerical Definite Integration ($\int_a^b f(x) dx$):

- ▶ Press **$\int dx$** button.
- ▶ Type function using **ALPHA** **)** for X .
- ▶ Use arrow keys to enter lower bound a and upper bound b . Press **=**.

2. Derivative at a Point ($\frac{d}{dx}f(x)\Big|_{x=a}$):

- ▶ Press **SHIFT** **$\int dx$** ($\frac{d}{dx}$).
- ▶ Enter function $f(X)$ and the evaluation point $x = a$. Press **=**.

4. PHYSICS & APPLIED MATHEMATICS QUICK REFERENCES

G. Complex Numbers (MODE 2)

Used in Pure Math P425/1 and AC Electricity Physics:

- Press **MODE** **2** (CMPLX).
- Enter imaginary unit i by pressing **ENG** key.
- **Convert Rectangular to Polar ($a+bi \rightarrow r \angle \theta$):** Type complex number $\rightarrow$ press **SHIFT** **2** (CMPLX) $\rightarrow$ **3** ($\mathbf{\cdot}$) $\rightarrow$ $\rightarrow$ **=**.
- **Convert Polar to Rectangular ($r \angle \theta \rightarrow a+bi$):** Type r , press **SHIFT** **(-)** ($\angle$), type $\theta \rightarrow$ press **SHIFT** **2** $\rightarrow$ **4** ($\mathbf{\cdot}$) $\rightarrow$ $\rightarrow$ **=**.
- **Conjugate:** **SHIFT** **2** **2** (Conjg).

H. Built-in Scientific Constants (40 Physical Constants)

Access values directly during UNEB Physics exams:

- Press **SHIFT** **7** (CONST), then enter 2-digit code:

Code	Constant Name	Symbol / Value
01	Proton mass	$m_p = 1.6726 \times 10^{-27} \text{ ext{ kg}}$
03	Electron mass	$m_e = 9.1093 \times 10^{-31} \text{ ext{ kg}}$
23	Elementary charge	$e = 1.6021 \times 10^{-19} \text{ ext{ C}}$
24	Avogadro constant	$N_A = 6.022 \times 10^{23} \text{ ext{ mol}^{-1}}$
28	Speed of light	$c_0 = 2.9979 \times 10^8 \text{ ext{ m/s}}$
35	Standard acceleration	$g = 9.80665 \text{ ext{ m/s}^2}$
39	Gravitational constant	$G = 6.674 \times 10^{-11} \text{ ext{ N m}^2 / \text{ ext{kg}^2}}$

(Note: Complete constant list is printed inside your calculator's hard snap cover).

I. Unit Conversions (40 Built-in Conversions)

Quick conversion between SI and alternative units:

- Type value $\rightarrow$ press **SHIFT** **8** (CONV) $\rightarrow$ enter 2-digit code $\rightarrow$ **=**.

Code	Conversion	Code	Conversion
01	in $\rightarrow$ cm	02	cm $\rightarrow$ in
03	ft $\rightarrow$ m	04	m $\rightarrow$ ft
23	kPa $\rightarrow$ atm	24	atm $\rightarrow$ kPa
37	$^{\circ}\text{F} \rightarrow ^{\circ}\text{C}$	38	$^{\circ}\text{C} \rightarrow ^{\circ}\text{F}$
39	J $\rightarrow$ cal	40	cal $\rightarrow$ J

J. Power Tricks & High-Speed Shortcuts

1. Prime Factorization (FACT):

- Type any integer (e.g., 2520) $\rightarrow$ **=**.
- Press **SHIFT** **' '** (FACT). Result: $2^3 \times 3^2 \times 5 \times 7$.

2. Coordinate Transformations (Pol / Rec):

- **Rectangular to Polar ($x, y \rightarrow r, \theta$):** Press **SHIFT** **+** (Pol) $\rightarrow$ enter x , **SHIFT** **)** (comma), $y \rightarrow$ **=**.
- **Polar to Rectangular ($r, \theta \rightarrow x, y$):** Press **SHIFT** **-** (Rec) $\rightarrow$ enter r , **SHIFT** **)**, $\theta \rightarrow$ **=**.

3. Combinations (nC_r) & Permutations (nP_r):

- ${}^{10}C_3$: Press **10** **SHIFT** $\div$ (nC_r) **3** **=**.
- ${}^{10}P_3$: Press **10** **SHIFT** $\times$ (nP_r) **3** **=**.

Final UNEB S.6 Exam Day Checklist:

- Ensure solar panel is clean and fresh AAA battery is installed.
- Before starting Paper 1 (Pure Math) or Physics: Check upper display status for **D** (Degrees) or **R** (Radians). Misconfigured angle modes cause loss of method marks in calculus/trigonometry.
- Reset statistical memory (**SHIFT** **9** **3** **=**) before starting numerical analysis questions to prevent old data contamination.