

# Graspable Math Summary Sheet

## Shorthands and Lingo

- “An expression Circle”: the gray circle to the right of an expression
- **ARRANGE**: “Arrange” Mode (shown in a button in the menu bar)
- **C**: Click on the target
- **C&D**: Click on a spot, holding the mouse down, and drag
- **C&H**: Click on a spot and hold the mouse down
- **Ctrl-**: Hold control key down, and while holding take the next action.
- **D**: Drag a selected element
- **DC**: Double-Click
- **Drag Out**: drag a selected expression outside of the parent expression, e.g., to the left or right side
- **DRAW**: Draw mode
- **EEC&D**: Enter an expression into the calculator and press done.
- **EGT**: Any content box, including Expressions, Graphs, and Text
- **ERASE**: Erase mode
- **Group**: Any subexpression
- **KEY**: Enter the keyboard mode, e.g., by creating an expression
- **MENU BUTTON -> ACTION**: Click on the corresponding button in the menu before taking the action.
- **Num & Denom**: Numerator and Denominator of a fraction
- **Present Value**: a value that appears in an EGT on the current canvas
- **SAE**: Select an expression in any way, and take the next action while ‘holding’ it with the mouse down
- **SAF**: Select a fraction in any way, and take the next action holding it
- **SCRUB**: “Scrub” Mode
- **Shift-**: Hold shift down, and while holding shift take the action.
- **SubE**: Subexpression, which could be the entire expression
- **T&D**: Touch and drag with multitouch
- **TRANS**: “Transformation” Mode
- **#**: A number

## Create, Destroying, & Arranging EGTs

- Create a content EGT: *press and hold anywhere on the screen, select*
- Destroy an EGT: *In arrange mode, click on the gray X*
- Move an EGT: *ARRANGE-> C&D from anywhere in the box*
- Move an ET: *TRANS->C&D from the left (invisible) edge of the box*
- Clone an Expression: *C&D right or left on the circle*
- Hide or show expression history: *C&D up or down on the circle*
- Graph an equation: *C&D an equation circle into a Graph*
- Graph a point: *C&D a point expression circle into a Graph*
- Create text: *copy text from another application into a text box*
- Create an image: *Drag an image file from your desktop to the canvas*
- Create an image: *Drag an image from another webpage to the canvas*
- Create an Expression: *Drag math text from a webpage/app to the canvas*
- Create an Expression: *Drag LaTeX from a webpage/app to the canvas*

## Equalities and Inequalities

- Invert Operations on an Equality: *C&D a term to the other side*
- Invert Operations on an Inequality: *C&D term to other side, taking care to keep inequality valid when variables are moved*
- Substitute Values: *C&D a term in one expression. Drag it onto a variable in a different expression.*
- Substitute Values: *C&D one side of an equation. Drag it onto a matching expression in a different expression or equation.*
- Operate on both sides: *Press and hold on the equals sign. EEC&D. Note: The capital letter E represents each side of the equation (which will be operated on)*

## Selecting Symbols and Subexpressions

- Parent expression: *C&D a symbol & D far down or far up*
- Parent expression: *Ctrl-tap*
- Parent expression: *C&D a symbol & press the space bar*
- Group: *Shift-tap or Shift-drag to select in a rectangle*
- Group: *C&D the operator to the left of a group*
- Group in parentheses: *C&D either parentheses*
- Fraction group: *C&D the fraction bar*
- With multitouch: *T&D with two fingers to select between the fingers*
- With multitouch: *T&D one symbol, and tap to add terms to a selection*

## Fraction Operations

- Add/Sub fractions with like Denom: *click the plus/minus sign*
- Add/Sub fractions w/ like Denom: *SAF & drag it onto the other fraction*
- Add/Sub fractions with unlike Denom: *DC the plus/minus sign*
- Make common denominators: *CD one denom onto the other fraction*
- To multiply a fraction num & denom: *C&H on the fraction bar. EEC&D.*
- Split a numerator into two fractions: *SAE in the Num and drag out*
- Pull a coefficient out of a Num: *SAE in the Num and drag out*
- Pull a coefficient out of a Denom: *SAE in the Denom and drag out*
- Pull a coefficient into a Num: *SAE and drag into the Num*
- Pull the Denom of a fraction into a Denom: *SAE in the Denom and drag in*

## Using the Keyboard

- Greek letter (like  $\pi$ ): *KEY-> C the  $\alpha\beta\gamma$  button on the right side*
- $\leq$  or  $\geq$ : *KEY->C&H on the equals sign.*
- $\pm$ : *KEY-> C&H on the + sign*
- Enter a letter: *KEY -> C on the abc on the right side of the keyboard*
- Use a long variable name: *KEY -> C on the “Long var” button*
- Enter a trig function: *KEY-> enter “sin”, “cos” etc in the keyboard. GM will automatically convert to a trig function.*

## Other Canvas Actions

- Tracing a term: *SCRUB->C on the term*
- Tracing several terms: *SCRUB->C on one term. Shift-Click on next term*
- Scrubbing: *SCRUB-> C&D up or down on a # in the top row of a derivation to raise or lower its value*
- Drawing: *DRAW-> C&D anywhere on the canvas*
- Erasing: *ERASE -> C&D where you want to erase*

## Working with Canvas Pages

- To work with Canvas pages, you must first log in using a google account*
- Saving a new page: *SAVE-> select a title, and select ‘save’*
  - Loading a saved page: *LOAD->C the title of the page to load*
  - Deleting a saved page: *LOAD-> C the X to the right of the page title*
  - Making a copy of a page: *SAVE->write a title and select ‘duplicate’*
  - Sharing a page: *SHARE, copy the link and email it separately*
  - Sharing a page: *SHARE->Email, and enter the email you desire (functionality blocked by some schools)*
  - Publishing a page: *SAVE-> click the “Publish” checkbox. Your page will appear on our materials page after we approve it (usually within a few hours)*

## Changing Expressions By Hand

- To enact a custom algebra action: *SAE & shake Down Up Down. EEC&D.*
- To alter a SubE: *SAE & shake Down Up Down. EEC&D. Confirm Change.*
- To do like things to an equation: *C&H on the =’s sign. EEC&D, using the “E” to represent either side of the equation., e.g., “E\*8”*
- To do like things to an inequality: *C&H on the < or >. EEC&D, as above*
- To enter a value in a box: *C on the box. EEC&D*
- To enter a present value in a box: *C&D on the value and drag onto the box*
- To multiply a fraction num & denom: *C&H on the fra*

## Some Common Algebra Operations

- Factor out a term: *C&D target to identical term in same expression.*
- Distribute terms: *C target outside parentheses. D into parentheses*
- Substitute Values: See “Equalities and Inequalities”
- Take the log: *C the word “log” or “ln”*
- Reduce  $e^{\ln x}$ : *C the word “log” or “ln”*
- Move in and out of a log: *C&D target into or out of log*
- Convert a fractional radical to a root: *C&D the fraction left of the base*
- Convert a root to a fractional radical: *C&D the radical expression to the right of the base (does not work for square roots)*
- Separate a form  $a^{b+c}$ -> $a^b a^c$ : *SAE in the exponent & D out*
- Combine  $a^b a^c$ : *C anywhere the right-hand term*
- Combine  $a^b a^c$ : *C&D either base on top of the other*

## Working with Negative signs

- Separating a - sign from a # or VAR: *C&D the - sign very slightly leftward*
- Separating a - sign from a group: *C&D the - sign very slightly leftward*
- Combining a negative sign with a # or VAR: *C&D the - sign onto the #*
- Combining a negative sign with a # or VAR: *C the #*
- Combining a negative sign with a Group: *C the #*
- Distributing a - sign into a parenthesis group: *Separate the - sign from the group, then C&D the -1 into the parentheses*
- Multiplying an equation by -1: *C&H on the =’s sign. EEC&D, using -1*
- Multiply top and bottom of a fraction by -1: *C&H on the fraction bar. EEC&D, using -1.*

## Common Desires that Are Currently not Supported

- Changing Pen Colors
- Entering proper (non-trig) functions
- Calculus expressions
- Complex Graph Interactions