

APPENDIX B  
Competition E: Graphing Calculator  
Restrictions and Examples

**FS – Contest 1** – This contest will stress the basic functions of a scientific calculator. Order of operations will be stressed, understanding that mathletes may be just beginning an Algebra I class.

1. Simplify  $(1674.23 - 1829)(17.893 + 932.91)$ , rounding your answer to TWO DECIMAL PLACES.
2. Simplify  $\frac{76291 - 42835}{23.21^5 - 82313}$ , rounding your answer to THREE DECIMAL PLACES.
3. Simplify  $\frac{73142}{0.03} - (714365 - 815723)$ , rounding your answer to the NEAREST INTEGER.
4. Simplify  $43257 - 68415 \times 3$ .
5. Simplify  $\frac{31 - \sqrt{7.1}}{2.3(7.1 + 8.2)}$ , rounding your answer to THREE DECIMAL PLACES.

**FS – Contest 2** – In addition to topics from Contest 1, mathletes are responsible for knowing how to evaluate algebraic expression. Examples of evaluations are given below.

1. Evaluate  $xy - x^2$  if  $x = 2.34$  and  $y = 8.73$ . Round your answer to THREE DECIMAL PLACES.
2. Evaluate  $\frac{3a^2 - b^3}{ab}$  if  $a = 17.98$  and  $b = 10.1$ . Round your answer to TWO DECIMAL PLACES.
3. Evaluate  $c^2 - d^2 + 2cd$  if  $c = 9.4$  and  $d = 7.12$ . Round your answer to THREE DECIMAL PLACES.
4. Evaluate  $mn - 2(m + n) + 2n^2$  if  $m = 6.2$  and  $n = -2.9$ . Round your answer to ONE DECIMAL PLACE.
5. Evaluate  $\frac{5c + ef - 17d}{d^3}$  if  $c = 4$ ,  $d = 3$ , and  $e = 5$ . Round your answer to TWO DECIMAL PLACES.

**FS – Contest 3** – In addition to all topics from Contests 1 and 2, mathletes are responsible for knowing how to solve linear equations and basic proportion equations. Examples of the additional topics are given below:

1. Solve for  $a$ , rounding your answer to TWO DECIMAL PLACES:  $\frac{2x}{11.3} = \frac{7}{41.2}$
2. Solve for  $b$ , rounding your answer to THREE DECIMAL PLACES:  $7.8x - 4.78 = 7.39 - 9.18x$
3. Solve for  $c$ , rounding your answer to TWO DECIMAL PLACES:  $13\left(\frac{18}{3}x - 14\right) = 31.3$
4. Solve for  $d$ , rounding your answer to ONE DECIMAL PLACE:  $\frac{7}{3x + 2} = \frac{7.9}{8.33}$
5. Solve for  $e$ , rounding your answer to TWO DECIMAL PLACES:  $2(3.1x + 83.12) - \frac{2}{3}(4x - 11) = 21$

**FS – Contest 4** – In addition to all topics from Contests 1, 2, and 3, mathletes are responsible for knowing the quadratic formula and basic area/perimeter. Examples of the additional topics are given below:

1. Find the larger solutions of  $4.83x^2 - 4.35x + 147 = 19 - 33x + 41x^2$ . Round your answer to TWO DECIMAL PLACES.

- Find the smaller solution of  $\frac{32x+18}{11} = \frac{83}{25x-32}$ . Round your answer to the NEAREST INTEGER.
- Find the area of the circle that has radius 7.19. Use 3.14 for  $\pi$ , and round your answer to TWO DECIMAL PLACES.
- Find the perimeter of a square which has a side of length 79.42. Round your answer to THREE DECIMAL PLACES.
- If the area of a rectangle is 832.31 square units, and the length is twice the wide, find the measure of the length. Round your answer to TWO DECIMAL PLACES

**FS – Contest 5** – Topics covered during the first four contests are all fair game for Contest 5.

**JS – Contest 1** – The contestant should be able to do the following on a graphing calculator:

- Have an understanding of interval notation, including  $[a, b]$  for closed and  $(a, b)$  for open intervals. Students should also understand the use of  $\infty$  in an interval.
- Input various transcendental functions, including trigonometric, inverse trigonometric, exponential, logarithmic, and natural logarithmic.
- Solve an equation using the graphing calculator
- Graph using an appropriate window (outside of  $-10$  to  $10$ )
- Find the point of intersection between two graphs

- How many times does the graph of  $y = \tan x$  intersect the line  $y = 2$  on the interval  $[15, 20]$ ?
- Find the x-coordinate of the point of intersection nearest to the y-axis of  $y = \ln(x + 3)$  and  $y = 2\cos x$ . Round your answer to TWO DECIMAL PLACES.
- Find the largest solution of  $\cos x - \sin x + 2\ln x = 4$ . Round your answer to THREE DECIMAL PLACES.
- Find the largest solution of  $\tan\left(\frac{1}{2}x + 3\right) = 4$  on the interval  $[50, 70]$ . Round your answer to THREE DECIMAL PLACES.
- Find the y-coordinate of the point of intersection in the second quadrant of  $y = |2x - 3|$  and  $y = e^{x+3}$ . Round your answer to TWO DECIMAL PLACES.

**JS – Contest 2** – In addition to topics from Contest 1, mathletes should be able to:

- Evaluate a function at various points using  $Y_1(a)$
- Perform basic matrix operations on a graphing calculator
- Compute the value of a composite function using  $Y_1(Y_2(a))$
- Solve an inequality using the graph on a graphing calculator.

- Compute  $f(1.314) - f(3.145)$  if  $f(x) = 2x^4 - 3\cos x + 2e^x$ . Round your answer to TWO DECIMAL PLACES.
- Find the value of the element in the first row, second column of  $(AB)^2 - 2B$  if  $A = \begin{bmatrix} 2 & 1 \\ 3 & 2 \end{bmatrix}$  and  $B = \begin{bmatrix} -3 & 1 \\ 2 & 2 \end{bmatrix}$ .
- Compute  $f(g(4.16))$  if  $f(x) = x^2 - 2\cos x$  and  $g(x) = \ln x - \log(2x^2)$ . Round your answer to THREE DECIMAL PLACES.
- Given the interval  $[0, 10]$ , for what values of  $x$  is  $3\cos(x - 4) > \ln(x + 1) + 1$ ? Write your answer

using interval notation  $(a, b)$ , where  $a$  and  $b$  are rounded to TWO DECIMAL PLACES.

5. Compute  $\frac{f(5.14)}{g(3.91)}$  if  $f(x) = 3x^3 - 2\sec x$  and  $g(x) = \ln x - e^x$ . Round your answer to TWO DECIMAL PLACES.

**JS – Contest 3** – In addition to the topics from Contest 1 and Contest 2, mathletes should be able to:

- Perform basic complex number operations on a graphing calculator (bar notation for conjugate)

1. Simplify  $(3.17 - 2.21i)^4$ . Write your answer in the form  $a + bi$ , rounding  $a$  and  $b$  to TWO DECIMAL PLACES.
2. Simplify  $(27.1 - 82.1i)\left(\overline{71.2 - 31.6i}\right)$ . Write your answer in the form  $a + bi$ , rounding  $a$  and  $b$  to THREE DECIMAL PLACES.
3. Simplify  $\frac{71.3 - 32.9i}{23.1 + 19.4i}$ . Write your answers in the form  $a + bi$ , rounding  $a$  and  $b$  to THREE DECIMAL PLACES.

**JS – Contest 4** - In addition to the topics from Contests 1, 2, and 3, mathletes should be able to:

- State the domain and/or range of a function using interval notation based upon its graph
- Graph an equation given in parametric and/or polar form

1. If  $x(t) = 2.9t - 3.7$  and  $y(t) = 7.1t - 4.2$ , find the value of  $y$  when  $x = 3.14$ . Round your answer to TWO DECIMAL PLACES.
2. Given a domain of  $[2, 5]$ , find the range of  $f(x) = \frac{(x+3)(2x+1)(3x-2)}{(x-1)(2x+3)(x-7)}$ . Write your answer as the interval  $[a, b]$ , where  $a$  and  $b$  are rounded to TWO decimal places.
3. Find the  $x$ -coordinate of the point of intersection of  $x_1(t) = 3t^2 - 2t$ ,  $y_1(t) = 3\cos t$  and  $x_2(t) = 3t + 2$ ,  $y_2(t) = t - 5$ . Round your answer to TWO DECIMAL PLACES.

**JS – Contest 5** - Topics covered during the first four contests are all fair game for Contest 5.