You are allowed to use a graphing calculator for 1-21

Find all extrema and roots for each function.

1. $y = -\frac{9}{10}x^3 - \frac{3}{4}x^2 + 2x + 1$

Maximum Point(s) = $\mathbf{(0.626/7\,, 1.737)}$

Minimum Point(s) = $\mathbf{(-1.182\,, -0.925/6)}$

Root(s) = $\mathbf{(-1.742/3\,, 0), (-0.464\,, 0)}$ **and** $\mathbf{(1.373/4\,, 0)}$

2. $f(x) = \frac{e^x - 1}{x^2 - 4}$

Maximum Point(s) = **None**

Minimum Point(s) = $\mathbf{(3.175/6\,, 3.77)}$

Root(s) = $\mathbf{(0, 0)}$

Solve the systems of equations by graphing.

5. $y = -\ln(2x - 1) + 3$
$y = e^{\frac{2}{3}x} - 2$

$\mathbf{(2.033, 1.879)}$

6. $y = \sqrt{x^2 - 4}$
$y = \tan^{-1}(x) + 3$

$\mathbf{(-2.681, 1.786)}$ **and** $\mathbf{(4.801/2\,, 4.365)}$

Evaluate the function at the given point.

9. $f(x) = e^{x^2 - 1}$ at $x = e$

$\mathbf{595.294}$

10. $y = \sec(x) + 5x$ at $x = \frac{\pi}{5}$

$\mathbf{4.377/8}$

11. $f(x) = 3x\sqrt{x^2 + 5}$ at $x = \pi$

$\mathbf{36.343}$

12. $y = 2\sin^2(x) + \tan(2x)$ at $x = \frac{\pi}{3}$

$\mathbf{-0.232}$

Use the STORE feature to evaluate the following.

13. STORE $x = \cot\left(\frac{\pi}{9}\right)$ and use RECALL to find

$$\sqrt{x} + \ln(2x) - e^x$$

$\mathbf{-12.241/2}$

14. STORE $x = e^{\pi}$ and use RECALL to find

$$4x - 2\sqrt{x^2 + 1} + 2^x$$

$\mathbf{9247935.122}$

15. Solve the system of equations below. STORE the x coordinate of the left point of intersection as A. STORE the x coordinate of the right point of intersection as B.

$y = \sin^2(x^2) + 1$
$y = -|2x + 1| + 2.5$

Use RECALL to find $A - B$

$\mathbf{-1.193/4}$

16. STORE the x coordinate of the maximum point as A. STORE the x coordinate of the minimum point as B.

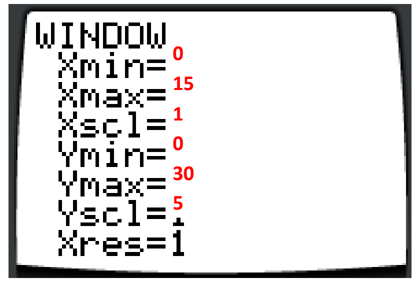
$y = -\frac{2}{5}x^3 - 2x^2 + x + 7$

Use RECALL to find $A - B$

$\mathbf{3.800/1}$

State the WINDOW that allows you to view the function. Answer the question.

17. A tortoise runs along a straight track, starting at position $x = 0$ at time $t = 0$. The tortoise has a velocity of $v(t) = \ln(1 + t^2)$ inches per minute, where t is measured in minutes such that $0 \le t \le 15$.



What is the tortoise's velocity at $t = 2.5$?

$\mathbf{1.981}$ ***inches/min***

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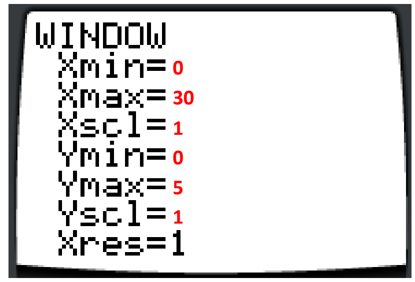
18. A cylindrical can of radius 10 millimeters is used to measure rainfall in Stormville. The can is initially empty, and rain enters the can during a 30-day period. The rate at which the height of the water is rising in the can is given by $s(t) = 2\sin(0.03t) + 1.5$ where $s(t)$ is measured in millimeters per day and t is measured in days.



When will the rate of change of the height be 2 mm/day?

On day 8.422/3

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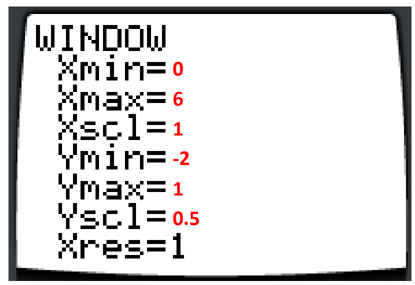
19. For $0 \le t \le 6$, a particle is moving along the x-axis. The particle's position, $x(t)$, is not explicitly given. The acceleration of the particle is given by $a(t) = \frac{1}{2}e^{t/4}\cos\left(e^{t/4}\right)$ in units per second^2.

(NOTE: Acceleration can be positive or negative!)



What is the particle's maximum acceleration? $\mathbf{-1.644}$ ***units/sec***^{2}

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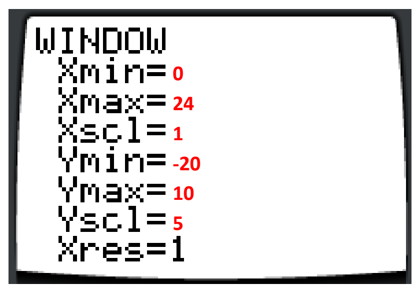
20. The temperature on New Year's Day in Mathlandia was given by by $T(H) = -5 - 10\cos\left(\frac{\pi H}{12}\right)$ where T is the temperature in degrees Fahrenheit and H is the number of hours from midnight $0 \le H \le 24$.



Find $T(12)$ and explain what it means in this context.

$T(12) = 5$, this means that 12 hours after midnight (noon) the temperature on New Year's day in Mathlandia is 5°F

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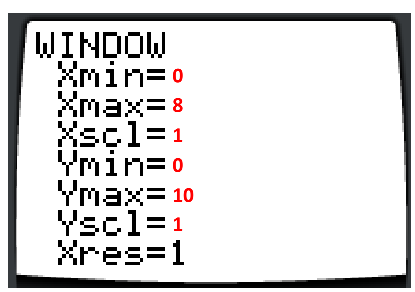
21. A hospital patient is receiving a drug on an IV drip. The rate at which the drug enters the body is given by $E(t) = \frac{4}{1+e^{-t}}$ cubic centimeters per hour. The rate at which the body absorbs the drug is given by $D(t) = 3^{\sqrt{t}-1}$ cubic centimeters per hour. The IV drip starts at time $t = 0$ and continues for 8 hours until time $t = 8$.



Is the amount of drug in the body increasing or decreasing at $t = 6$?

$E(6) - D(6) = -0.926\ cm^3/hr$ so decreasing!

You are allowed to use a graphing calculator for 1-4

MULTIPLE CHOICE

1. **E**
2. **A**
3. **B**
4. **A**

FREE RESPONSE

Your score: ____ out of 5

An online retailer has a warehouse that receives packages that are later shipped out to customers. The warehouse is open 12 hours per day. On one particular day, packages are delivered to the warehouse at a rate of $D(t) = 300\sqrt{t} - 3t^2 + 75$ packages per hour. Packages are shipped out at a rate of $S(t) = 60t + 300\sin\left(\frac{\pi}{6}t\right) + 300$ packages per hour. For both functions, $0 \le t \le 12$, where t is measured in hours. At the beginning of the workday, the warehouse already has 4000 packages waiting to be shipped out.

1. What is the rate of change of the number of packages in the warehouse at time $t = 10$?

$$\boldsymbol{D(10) - S(10) = 83.491\ \textit{packages per hour}}$$

1 point set up

1 point answer (must be labeled correctly)

2. What is the rate of change of packages shipped out of the warehouse when the rate of change of packages delivered to the warehouse on this day is a maximum?

$$\boldsymbol{S(8.549) = 521.286\ \textit{packages shipped per hour}}$$

1 point *x*-value at maximum

1 point answer (must be labeled correctly)

3. During what time interval(s) is the rate of packages being delivered to the warehouse greater than rate of packages being shipped out of the warehouse?

$$\boldsymbol{[5.660/1, 10.491/2]}$$

From 5.660/1 hours to 10.491/2

1 point for correct interval