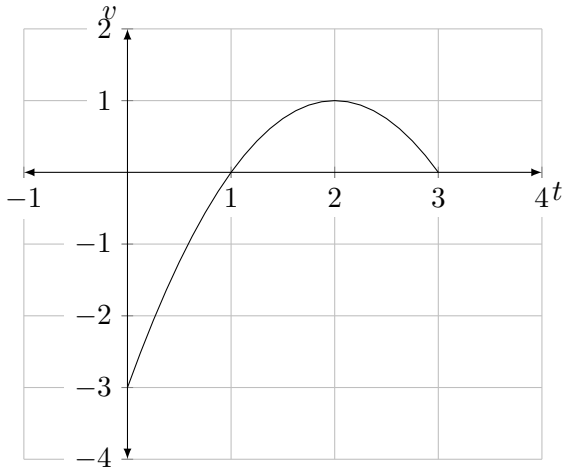
Name: _____ Mark: _____

Mini-math Div 3/4: Wednesday, November 24, 2021 (15 minutes)

1. (1 point) If a particle is at rest, then
   A. its displacement is 0
   B. its acceleration is 0
   C. its acceleration is non-zero
   D. none of the above

2. (1 point) (AP) Suppose $f(t), v(t)$, and $a(t)$ represents a particle's position, velocity, and acceleration, respectively. The particle is moving away from its starting position when:
   A. $f(t)$ and $v(t)$ have the same sign
   B. $f(t)$ and $a(t)$ have the same sign
   C. $v(t)$ and $a(t)$ have the same sign
   D. none of the above

3. (2 points) The graph below shows the velocity of a particle over time.



If $f(t)$ represents the position of the particle at time t, write an expression which calculates the total distance travelled in the first 2 seconds.

4. (2 points) Renal function is an indication of the state of the kidneys. Creatine clearance rate is a useful measure of this, and is given by the formula

$$C = \frac{U \cdot V}{S \cdot t}$$

where C is creatine clearance in mL/min, U is urine creatine in mg/dL, V is urine volume in mL, S is serum creatine in mg/dL, and t is collection time in min. Find the rate of change of U with respect to V if the other quantities are constant.

5. (2 points) (AP) Let f be a differentiable function such that $f(-1) = 5$, $f'(-1) = -\frac{1}{2}$, and it is concave up on the interval $(-3, 0)$. If we use the tangent line to the graph of $f(x)$ at $x = -1$ to approximate the value of $f(-1.2)$, what is the approximate value and is it an over or underestimate?

6. (2 points) Particle A moves on the x-axis, with position $x(t)$ and velocity $\frac{dx}{dt}$. Particle B moves on the y-axis, with position $y(t)$ and velocity $\frac{dy}{dt}$. The distance z between particles A and B is given by $z^2 = x^2 + y^2$. At a certain instant, $x = 3$ cm, $y = 4$ cm, particle A is moving left at 3 cm/s, and particle B is moving up at 2 cm/s. How fast is is z changing and are the particles getting closer together or further apart?

7. (AP) Find the following limits, if they exist. You may use l'Hôpital's Rule where applicable, but **you must indicate why it is applicable**.

   (a) (2 points) $\lim_{x\to 0} \dfrac{\sin x}{\ln(2e^x - 1)}$

   (b) (2 points) Let $f(x) = 2x + 3e^{-x}$ and g be a differentiable function with $g'(x) = 3 + \frac{1}{x}$. It is known that $\lim_{x\to\infty} g(x) = \infty$. Find $\lim_{x\to\infty} \dfrac{f(x)}{g(x)}$.