<table>
<thead>
<tr>
<th>Determine when the particle</th>
<th>Justify/Explain/Give a reason</th>
<th>Where to look on the velocity graph</th>
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<tr>
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<tr>
<td>Stopped/At rest</td>
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<tr>
<td>Changes Direction</td>
<td>$v(t) = 0$ and $v(t)$ changes sign</td>
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<tr>
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<td>Acceleration Negative</td>
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</table>

**Greatest Speed** $|v(t)|_{\text{greatest}}$ **Graph furthest from x-axis in either direction**
Consider the curve defined by the equation \(2y^3 + 6x^2y - 12x^2 + 6y = 1\) with \(\frac{dy}{dx} = \frac{4x - 2xy}{x^2 + y^2 + 1}\).

b) Write an equation of each horizontal tangent to the curve.

c) The line through the origin with slope -1 is tangent to the curve at point P. Find the x and y-coordinates of P.

d) Find \(\frac{d^2y}{dx^2}\) in terms of y.
C) Truck A travels east at 40 mi/hr. Truck B travels north at 30 mi/hr. How fast is the distance between the trucks changing 6 minutes later?

\[ \frac{h}{r} = \frac{10}{3} \]
\[ \frac{h}{r} = \frac{2}{1} \]
\[ 2r = h \]
\[ r = \frac{h}{2} \]
\[ h = 2r \]
\[ \frac{dh}{dt} = 2 \frac{dr}{dt} \]

D) Water runs into a conical tank at the rate of 9 ft³/min. The tank stands point down and has a height of 10 ft and a base radius of 5 ft. How fast is the water level rising when the water is 6 ft deep?

\[ \frac{dV}{dt} = 9 \text{ ft}^3/\text{min} \]

Find \( \frac{dh}{dt} \) when \( h = 6 \text{ ft} \)

\[ V = \frac{1}{3} \pi r^2 h \]
\[ \frac{dV}{dt} = \frac{1}{3} \pi \left( r^2 \frac{dh}{dt} + h \left( 2r \frac{dr}{dt} \right) \right) \]
\[ q = \frac{1}{3} \pi \left( 3^2 \frac{dh}{dt} + 6 \left( 2 \frac{dr}{dt} \right) \frac{1}{2} \frac{dh}{dt} \right) \]

\[ 2r = h \]
\[ r = \frac{h}{2} \]

\[ V = \frac{1}{3} \pi \left( \left( \frac{h}{2} \right) ^2 \right) h \]
\[ V = \frac{1}{3} \pi \left( \frac{h^3}{4} \right) h \]

\[ V = \frac{1}{12} \pi h^3 \]

\[ \frac{dV}{dt} = \frac{1}{4} \pi \left( h \right) ^2 \frac{dh}{dt} \]
\[ q = \frac{1}{4} \pi \left( h \right) ^3 \frac{dh}{dt} \]
\[ q = 9 \pi \frac{dh}{dt} \]
21. Water is draining from a conical tank with height 12 feet and diameter 8 feet into a cylindrical tank that has a base with area 400π square feet. The depth, h, in feet, of the water in the conical tank is changing at the rate of \( \frac{dh}{dt} \) feet per minute. Volume of a cone: \( V = \frac{1}{3} \pi r^2 h \)

A) Write an expression for the volume of water in the conical tank as a function of h.

\[
V = \frac{1}{3} \pi r^2 h \quad \Rightarrow \quad V = \frac{1}{3} \pi \left( \frac{h}{3} \right)^2 (h) = \frac{1}{27} \pi h^3
\]

B) At what rate is the volume of water in the conical tank changing when \( h = 3 \) feet? Indicate units of measure.

\[
\frac{dV}{dt} = \frac{1}{9} \pi h^2 \frac{dh}{dt}
\]

\[
\frac{dV}{dt} = \frac{1}{9} \pi h^2 (h-12)
\]

\[
\frac{dV}{dt} = \frac{1}{9} \pi (3)^2 (3-12) \text{ ft}^3/\text{min} = -9\pi \text{ ft}^3/\text{min}
\]

C) Let y be the depth, in feet, of the water in the cylindrical tank. At what rate is y changing when \( h = 3 \) feet? Indicate units of measure.

\[
V = \frac{\pi r^2 h}{3}
\]

\[
V = 400\pi \text{ ft}^3
\]

\[
\frac{dV}{dt} = 400\pi \frac{dh}{dt}
\]

\[
\frac{dV}{dt} = 400\pi \text{ ft}^3/\text{min}
\]

\[
\frac{dh}{dt} = \frac{9}{400} \text{ ft/min}
\]