Quiz 5 **Solutions**, Math 111, Section 2 (Vinroot)

As always, show all steps clearly in your solution.

A particle is moving along a line, with position at time t seconds given by $s(t) = t^3 + t^2 - 3$, where $s(t)$ is measured in cm, positive direction is forwards, and $t \geq 0$.

(a): Find the equation giving the velocity, $v(t)$, and acceleration, $a(t)$, at time t, and find the velocity and acceleration after 1 second (include units).

Solution: We know $v(t) = s'(t)$, and $a(t) = v'(t) = s''(t)$. Then $v(t) = \frac{d}{dt}(t^3 + t^2 - 3) = 3t^2 + 2t$ and $a(t) = \frac{d}{dt}(3t^2 + 2t) = 6t + 2$, where $v(t)$ is in cm/sec and $a(t)$ is in cm/sec^2.

After 1 second, $t = 1$, so $v(1) = 3(1^2) + 2(1) = 5$ cm/sec, and $a(1) = 6(1) + 2 = 8$ cm/sec^2.

(b): Explain why the particle is never moving backwards and its velocity is never decreasing (remember we are only considering $t \geq 0$).

Solution: Since "moving backwards" means that position is decreasing, this would occur when $\frac{ds}{dt} = s'(t)$ is negative. But $s'(t) = v(t) = 3t^2 + 2t \geq 0$ when $t \geq 0$.

Similarly, the velocity of the particle would be decreasing at time t if $v'(t) < 0$. However, $v'(t) = a(t) = 6t + 2 \geq 0$ when $t \geq 0$. So the velocity is never decreasing.