## The Particle Problem

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 velocity of the particle is given by $v(t) = 2\sin\left(e^{\frac{t}{4}}\right) + 1$. The acceleration of the particle is given by $a(t) = \frac{1}{2}e^{\frac{t}{4}}\cos\left(e^{\frac{t}{4}}\right)$ and $x(0) = 2$.

(a) Is the speed of the particle increasing or decreasing at time $t = 5.5$? Give a reason for your answer.

$$v(5.5) : 2\sin\left(e^{\frac{5.5}{4}}\right) + 1 \qquad a(5.5) : -1.2585$$

$$: -0.453$$

Speed is increasing, as it's increasing

Speeding up in the negative direction.

(b) Find the average velocity of the particle for the time period $0 \le t \le 6$.

$$\frac{1}{6}\int_0^6 2\sin\left(e^{t/4}\right) + 1 = \boxed{1.949}$$

(c) Find the total distance traveled by the particle from time $t = 0$ to $t = 6$.

$$\int_6^6 |v(t)| \, dt$$

$$\boxed{: 12.573}$$

(d) For $0 \le t \le 6$, the particle changes direction exactly once. Find the position of the particle at that time.

$$v(t) : 0$$

$$2\sin\left(e^{t/4}\right) + 1 \quad \tau_0$$

$$t : 5.188$$

$$\int_0^{5.188} v(t) \, dt \quad \boxed{(4.1547)}$$