2003 AB2

2a. Acceleration is the derivative of velocity so

$$\frac{dy}{dt} = \left.\frac{d\left(-(t+1)\sin\left(\frac{t^2}{2}\right)\right)}{dt}\right|_{t=2} = 1.58758$$

v(2)<0. So since acceleration is positive at t = 2 when v(2)<0. The speed is decreasing at t = 2.

2b. Particle changes direction when v(t)=0. Solving this graphically gives t = 2.50663. A sign study of v(t) indicates that v(t) is negative from (0,2.50663) and positive from (2.50663,3).

2c. Total distance

$$\int_0^{2.50663} -v(t)dt + \int_{2.50663}^{3} v(t)dt = 4.33382$$

2d. This is the position function. There are three possibilities for the maximum distance from the origin. At the start of the problem when t = 0, the particle is at position x = 1. When the particle turns around at t = 2.50663 (or $\sqrt{2\pi}$) the particle has traveled 3.265483 to the left and ended up at position x = -2.265483 (to the left of the origin). Then the particle turns around and travels to the right 1.0683354 to a position of -1.197 which is still to the left of the origin at t = 3. Find the position at each of these times yields the following:

t	x(t)
0	1
2.50663	-2.26548
3	-1.197

The maximum distance from the origin is -2.265 at t = $\sqrt{2\pi}$.

