AP® Calculus AB
2003 Sample Student Responses

Work for problem 2(a)

(a) $v(t) = -(t+1)\sin\left(\frac{t^2}{2}\right)$ $v(2) = -3\sin(2) = -2.728$

$a(t) = -\sin\left(\frac{t^2}{2}\right) - (t+1)\cdot t\cos\left(\frac{t^2}{2}\right)$

$a(t) = -\sin\left(\frac{t^2}{2}\right) - t(t+1)\cos\left(\frac{t^2}{2}\right)$

$a(2) = -\sin(2) - 2(3)\cos(2)$

$\boxed{a(2) = 1.588}$

the speed of the particle is decreasing at $t = 2$ because acceleration, the rate of change of the velocity is positive while velocity itself is negative, meaning that speed, the absolute value of velocity, is actually decreasing!

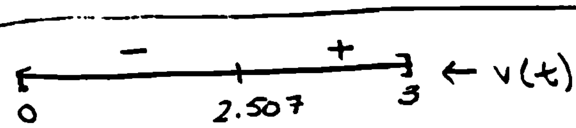
Work for problem 2(b)

(b) $v(t) = -(t+1)\sin\left(\frac{t^2}{2}\right)$

$t+1 = 0$ $\sin\left(\frac{t^2}{2}\right) = 0$

~~$t = -1$~~ $t = 2.507$

reject - not in interval



particle changes direction where $t = 2.507$

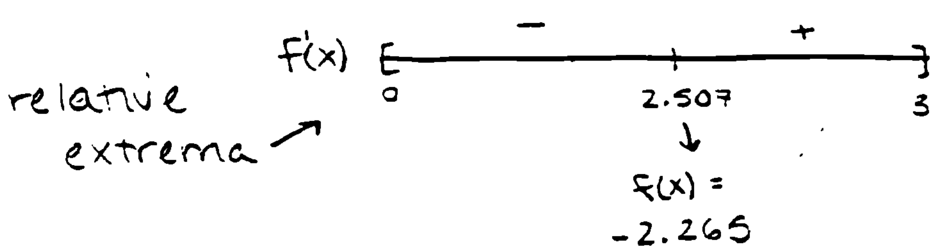
Continue problem 2 on page 7.

Work for problem 2(c)

(c) Total distance traveled = $\int_0^3 |v(t)|\,dt$ = **4.338**

Work for problem 2(d)

Greatest distance between particle and origin will occur where the function $f(x) = 1 + \int_0^x v(t)\,dt$ achieves a relative max. or relative minimum.



distance between particle and origin = $1 + \int_0^{2.507} v(t)\,dt$ =

2.265

Work for problem 2(a)

$v(t) = -(t+1)\sin\left(\frac{t^2}{2}\right)$

$v'(t) = a(t) = -(t+1)\cos\left(\frac{t^2}{2}\right)\cdot t + -\sin\left(\frac{t^2}{2}\right)\cdot t$

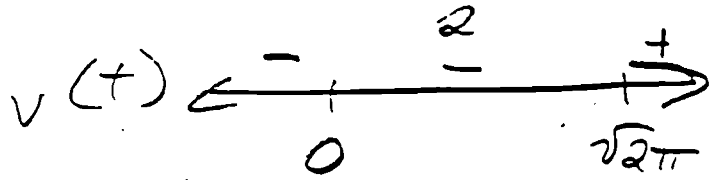
$a(2) = 1.588$

yes, the acceleration is positive. there For the slope of the velocity is positive.

Work for problem 2(b)

$v(t) = -(t+1)\sin\left(\frac{t^2}{2}\right) = 0$ at $0, + \sqrt{2\pi}$

$\frac{t^2}{2} = \pi$



The particle changes direction only at $\sqrt{2\pi}$ because the velocity changes from negative to positive.

Continue problem 2 on page 7.

Work for problem 2(c)

$\int_0^{\sqrt{2\pi}} v(t)\,dt \quad \int_{\sqrt{2\pi}}^{3} v(t)\,dt$

$= 4.334$

Work for problem 2(d)

$\int_0^{\sqrt{2\pi}} v(t)\,dt = -3.265 + 1 = \boxed{-2.265}$

$v(t)$: − on $(0, \sqrt{2\pi})$, + on $(\sqrt{2\pi}, 3)$; marks at 0, $\sqrt{2\pi}$, 3

at $\sqrt{2\pi}$, the particle began to move towards the origin.

GO ON TO THE NEXT PAGE.