Name: Key Date:

AP Calculus AB: 8.9 Integration of Absolute Values

1. Evaluate $\int_1^4 |6-3x|\,dx$

$6-3x=0$, $-3x=-6$, $x=2$

$\left|\int_1^2 6-3x\,dx\right| + \left|\int_2^4 6-3x\,dx\right|$

$\left|\left[6x-\frac{3x^2}{2}\right]_1^2\right| + \left|\left[6x-\frac{3x^2}{2}\right]_2^4\right| = \left|(12-6)-(6-\frac{3}{2})\right| + \left|(24-24)-(12-6)\right| = \boxed{\frac{15}{2}}$

2. A particle's velocity is given by the function $v(t) = -12t + 4$, find the distance the particle travels from $-1 \le t \le 3$

$\int_{-1}^3 |-12t+4|\,dt$ $\quad -12t+4=0$, $-12t=-4$, $t=\frac{4}{12}=\frac{1}{3}$

$\left|\int_{-1}^{1/3} -12t+4\,dt\right| + \left|\int_{1/3}^3 -12t+4\,dt\right|$

$\left|\left[\frac{-12t^2}{2}+4t\right]_{-1}^{1/3}\right| + \left|\left[\frac{-12t^2}{2}+4t\right]_{1/3}^3\right| = \boxed{\frac{160}{3}}$

Use a calculator for the below problem

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

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

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

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

a) $v(5.5) = -$, $a(5.5) = +$ speed is decreasing since $v(5.5)$ and $a(5.5)$ are different signs.

b) $\frac{\int_0^6 v(t)\,dt}{6-0} = \boxed{1.949}$

c) $\int_0^6 |v(t)|\,dt = \boxed{12.573}$

d) graph $v(t)$ and find where $v(t)$ changes from positive to negative or vis a versa $t = 5.2$

then find $x(5.2) = 2 + \int_0^{5.2} v(t)\,dt = \boxed{14.135}$