**5**. [10 points] Ivan is walking back and forth along a straight line represented by the $x$-axis, and his position in meters along this path $t$ **seconds** after 12 noon is given by $x = f(t)$. Suppose $f(0) = 0$, so Ivan is $f(t)$ meters east of his starting point $t$ seconds after noon, for all $0 \le t \le 100$. Assume Ivan starts out walking eastward, with positive velocity, but at 12:01 is west of his starting point.

Match each expression on the left with the <u>one</u> letter (a) – (h) that it represents, or else write "x" if does not represent any of (a) – (h). Assume all units in (a) – (h) match those given in the introduction above, i.e., *meters* or *meters per second*, as appropriate.

*Note: any particular letter (a) – (h) may appear once, more than once, or not at all.*

i. h $|f(60)|$

ii. e $f'(60)$

iii. f $|f'(60)|$

iv. c $\dfrac{f(60) - f(0)}{60 - 0}$

v. x $\left|\dfrac{f(60) - f(0)}{60 - 0}\right|$

vi. x $\displaystyle\int_0^{60} f(t)\,dt$

vii. a $\displaystyle\int_0^{60} f'(t)\,dt$

viii. b $\displaystyle\int_0^{60} |f'(t)|\,dt$

ix. c $\dfrac{1}{60 - 0}\displaystyle\int_0^{60} f'(t)\,dt$

x. e $\displaystyle\lim_{h \to 0} \frac{f(60 + h) - f(60)}{h}$

(a) Ivan's net change in position between 12:00 and 12:01.

(b) The total distance Ivan travels between 12:00 and 12:01.

(c) Ivan's average velocity between 12:00 and 12:01.

(d) Ivan's average speed between 12:00 and 12:01.

(e) Ivan's instantaneous velocity at 12:01.

(f) Ivan's instantaneous speed at 12:01.

(g) The furthest distance Ivan gets from his starting point between 12:00 and 12:01.

(h) The distance from Ivan's starting point to his position at 12:01.

(x) NONE OF (a) – (h).