

1. (10pts) A displacement (in centimeter) of a particle moving along a curve is defined as:  $s(t) = 2t^2 - 3t$  where  $t$  is measured in seconds.

(1) Find the displacement when  $t = 1$ .

$$s(1) = 2(1) - 3(1) = -1$$

(2) Express the average velocity during the time period:  $[1, b]$  in terms of  $b$ .

$$v_{[1,b]} = \frac{s(b) - s(1)}{b - 1}$$

(3) Express the average velocity during the time period:  $[1, 1 + h]$  in terms of  $h$ .

$$v_{[1,1+h]} = \frac{s(1+h) - s(1)}{h}$$

(4) (Calculator) Find the average velocity during each time period:

(i)  $[1, 2]$     (ii)  $[1, 1.1]$     (iii)  $[1, 1.01]$     (iv)  $[1, 1.001]$     (v)  $[1, 1.0001]$

Using the formula in (2):

$$v_{[1,b]} = \frac{2b^2 - 3b - (-1)}{b - 1} = g(b) = \frac{2b^2 - 3b + 1}{b - 1}$$

$b$	$\frac{2b^2 - 3b + 1}{b - 1}$
2	3
1.1	1.2
1.01	1.02
1.001	1.002
1.0001	1.0002

Using the formula in (3):

$$\begin{aligned} v_{[1,1+h]} &= \frac{s(1+h) - s(1)}{h} = \frac{2(1+h)^2 - 3(1+h) - (-1)}{h} \\ &= \frac{2(1+2h+h^2) - 3 - 3h + 1}{h} = \frac{2+4h+2h^2-2-3h}{h} = \frac{h+2h^2}{h} = 1+2h \end{aligned}$$

$h$	$1+2h$
1	3
0.1	1.2
0.01	1.02
0.001	1.002
0.0001	1.0002

(5) Estimate the velocity of the particle at  $t = 1$ .

$$v(1) = 1 \text{ cen/sec}$$