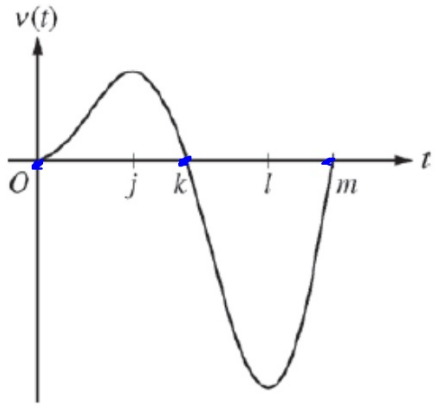
Motion on a line (Interpreting f'(velocity) graphs)

I. Review: Motion Along A Line

If $x(t)$ represents the position of a particle along the x-axis at any time t, then the following statements are true.

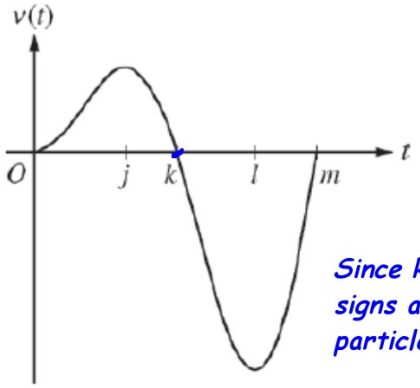
1. "Initially" means_____=0.
2. "At rest" means_____=0.
3. If the velocity of the particle is positive, then the particle is moving to the _____.
4. If the velocity of the particle is _____, then the particle is moving to the left.
5. To find average velocity over a time interval, divide the change in _____ by the change in time.
6. Instantaneous velocity is the velocity at a single moment or _____in time.
7. If the acceleration of the particle is positive, then _____is increasing.
8. If the acceleration of the particle is _____, then the velocity is decreasing.
9. In order for a particle to change direction, the _____must change signs.
10. Speed is the _____of velocity.



[0, m]

1) State the value(s) of t where the particle is at rest.

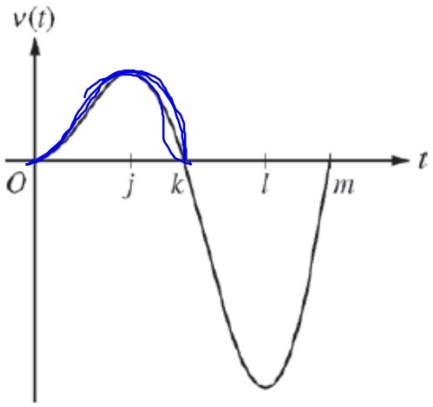
$t = 0, k, m$



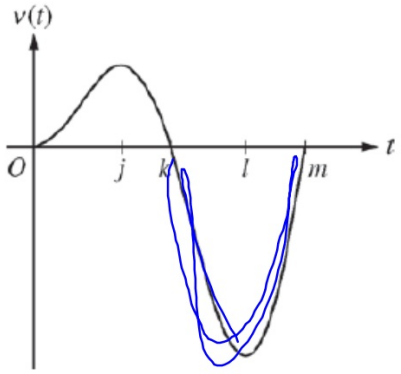
Since k is zero and v(t) changes signs at t = k, this is where the particle changes direction

2) State the value(s) of t where the particle is changing direction. $t = k$

$v(t) > 0$

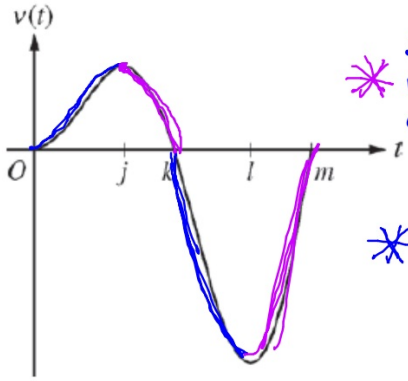


3) State the interval(s) where the particle is moving to the right. $(0, k)$



$V(t) < 0$

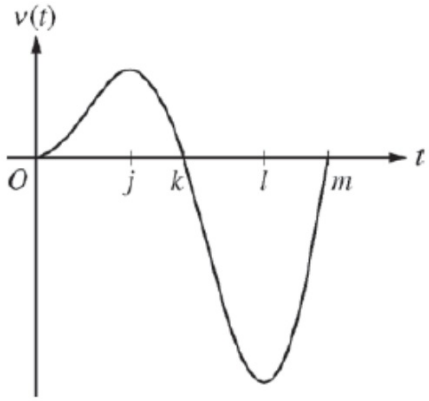
4) State the interval(s) where the particle is moving to the left. (k, m)



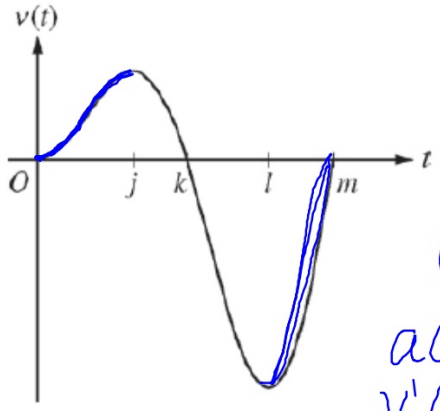
Slowing down: v(t) and a(t) have opposite signs. $(j,k) \cup (l,m)$

Speeding up: v(t) and a(t) same signs. $(0,j) \cup (k,l)$

5) State the interval(s) where the particle is slowing down and speeding up.



6) State the interval(s) where the particle is speeding up.



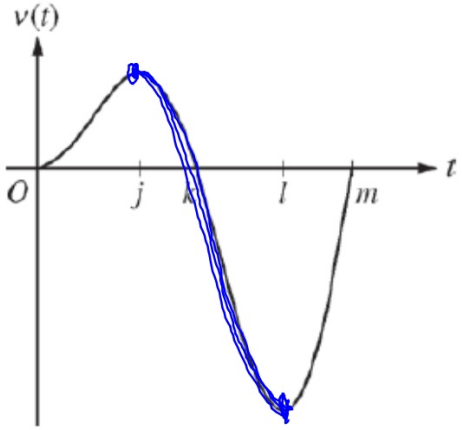
$(0, j) \cup (l, m)$

$a(t) > 0$

$v'(t) > 0$

7) State the interval(s) where the velocity is increasing.

(acceleration is positive)
(slope of $v(t)$)

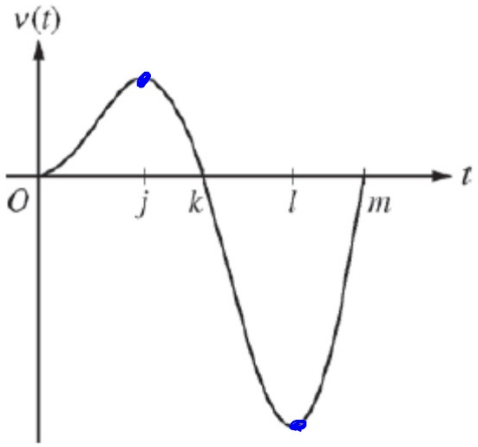


a(t) < 0
(acceleration is negative or slope of velocity is negative)

(j, ℓ)

slope of $v(t) < 0$ ✓

8) State the interval(s) where the velocity is decreasing.



j, l

because

slope of v(t) is changing signs at those points.

9) At what time(s) is the acceleration zero?

2. Analytical (NO CALCULATOR)
A particle moves along the x-axis so that at any time t its position is given by:

$$x(t) = t^3 - 6t^2 + 9t + 11$$

b) At t=1, is the velocity of the particle increasing or decreasing? JYA.

$x'(t) = 3t^2 - 12t + 9$

$x''(t) = 6t - 12$

$x''(1) = -6$

Decreasing because a(1) < 0

$a(t) < 0$ at $t = 1$

2. Analytical (NO CALCULATOR)
A particle moves along the x-axis so that at any time t its position is given by:

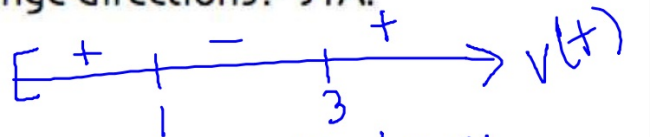
$$x(t) = t^3 - 6t^2 + 9t + 11$$

d) At what time does the particle change directions? JYA.

$x'(t) = 3t^2 - 12t + 9$

$3(t^2 - 4t + 3)$

$3(t-3)(t-1)$



$t = 1, 3$; $v(t)$ changes signs at these times

2. Analytical (NO CALCULATOR)
A particle moves along the x-axis so that at any time t its position is given by:

$$x(t) = t^3 - 6t^2 + 9t + 11$$

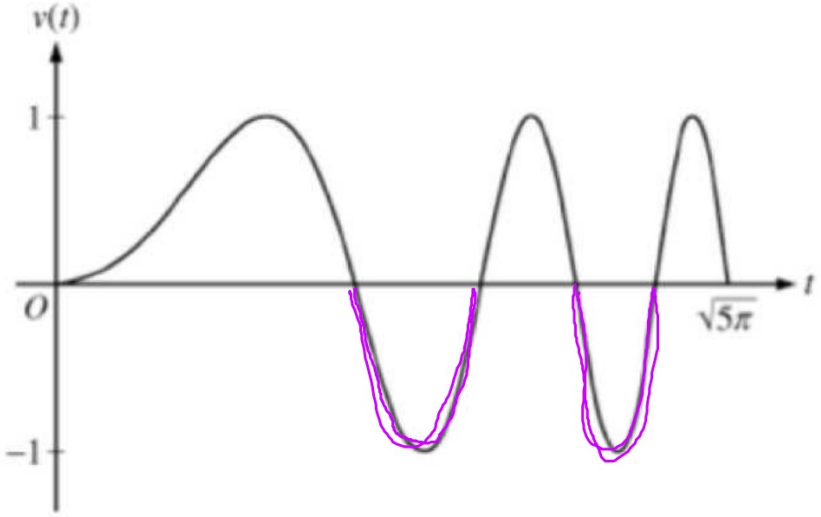
e) At t=5, is the speed of the particle increasing or decreasing? JYA.

$v(5) > 0$
$a(5) > 0$

$v(5)$ and $a(5)$ have the same sign $\therefore$ the speed is increasing.

HW: 6 (CALCUALTOR)

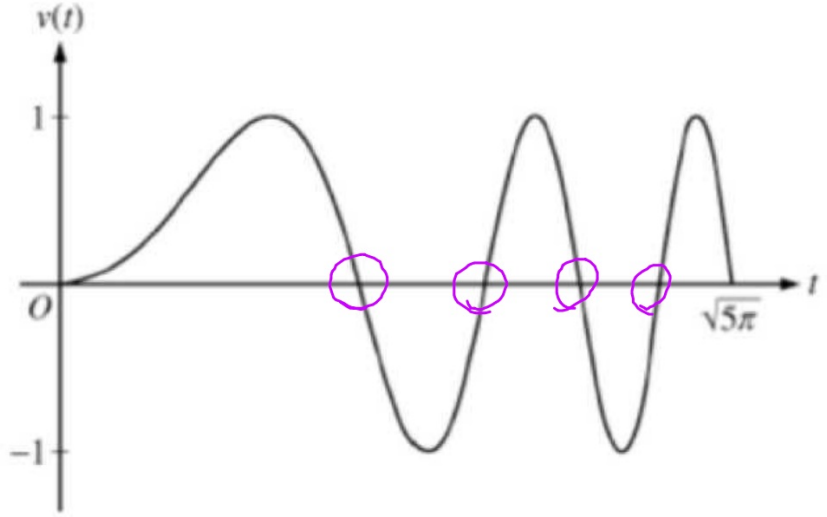
3 decimal places



$$v(t) = \sin(t^2)$$

a) When is the particle moving to the left? JYA.

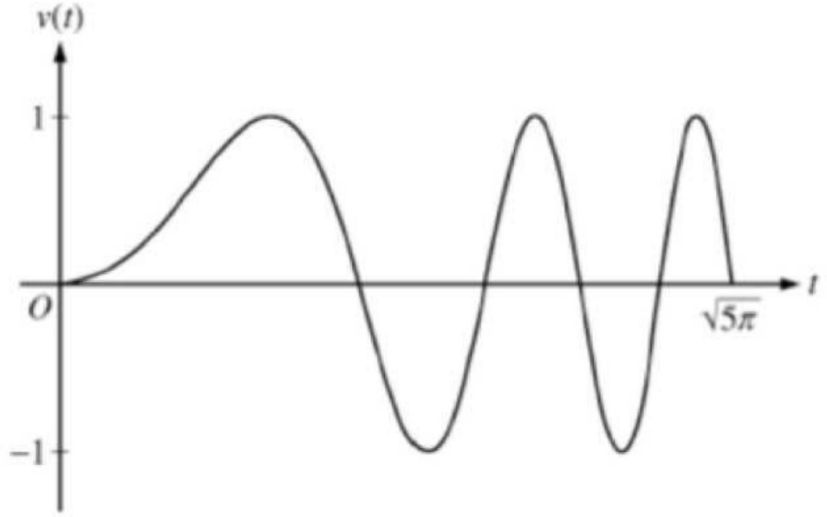
HW: 6 (CALCUALTOR)



$$v(t) = \sin(t^2)$$

e) When does the particle change direction? JYA.

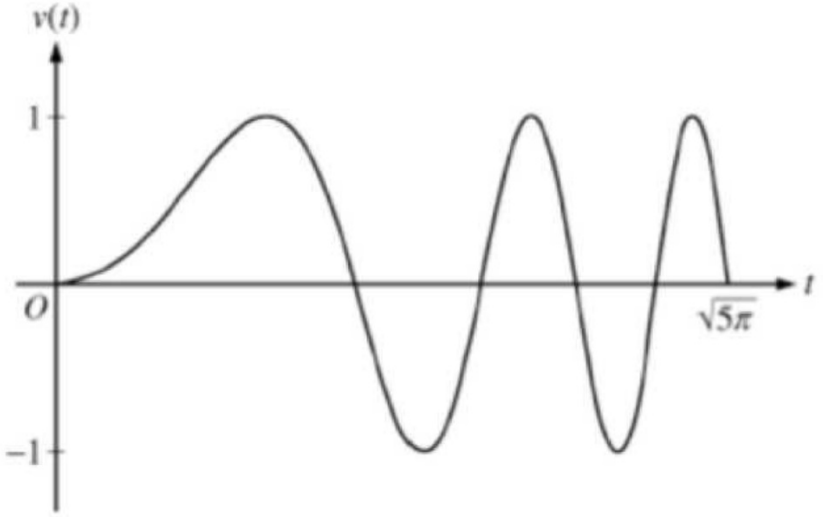
HW: 6 (CALCUALTOR)



$$v(t) = \sin(t^2)$$

c) Is the particle slowing down at t =1.5? Explain.

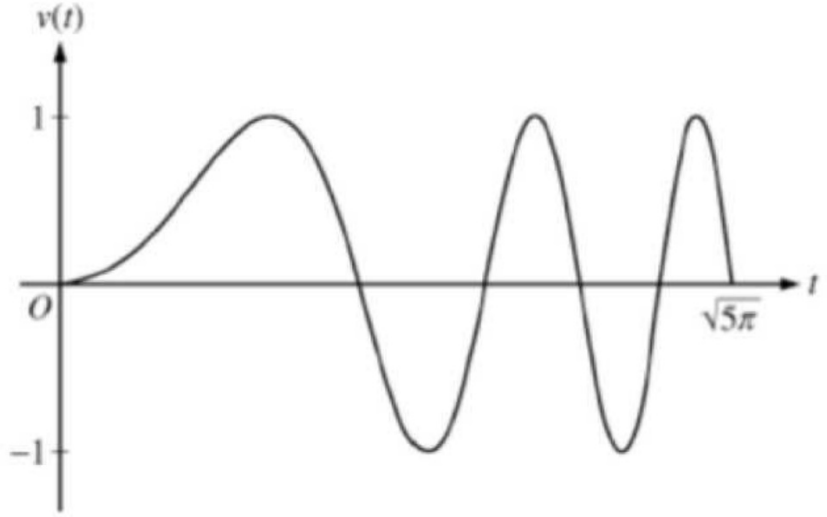
HW: 6 (CALCUALTOR)



$$v(t) = \sin(t^2)$$

d) Is the particle speeding up at t = 2.4? Explain.

HW: 6 (CALCUALTOR)



$$v(t) = \sin(t^2)$$

f) What is the average acceleration on the interval [1, 4]?

Curve sketching given characteristics
Analyzing derivative graphs
Analyzing velocity graphs
Velocity increasing/decreasing
Slowing down/speeding up