NOTES

Derivatives:

$f(x) = Ax^n$ $\qquad x(t) = At^n$

$\frac{d f(x)}{dx} = nAx^{n-1}$ $\qquad v(t) = \frac{dx(t)}{dt} = nAt^{n-1}$ $\qquad x(t) = 9t^3 + 2t^2 - 7t + 4 + 1t^{-2}$

$a(t) = \frac{dv(t)}{dt} = \frac{d^2x(t)}{dt^2}$

$x(t) = 2t^3 - 4t^2 + 3t^1 + 8 + 6t^{-1}$

$\frac{dx(t)}{dt} = v(t) = 3(2)t^{3-1} - 2(4)t^{2-1} + 1(3)t^{1-1} + \cancel{0} + -1(6)t^{-1-1}$

$\boxed{v(t) = 6t^2 - 8t + 3 - 6t^{-2}}$

inst. velocity @ t=2 $\longrightarrow v(2) = 6(2)^2 - 8(2) + 3 - 6(2)^{-2}$

$=$

$a = \frac{dv(t)}{dt} = \frac{d^2x(t)}{dt^2}$

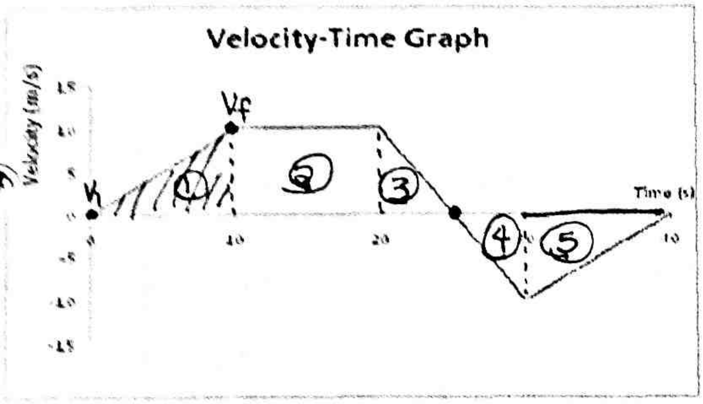
$6t^2 - 8t + \cancel{3} - 6t^{-2}$ $\qquad t^{-2-1}$

$a(t) = \frac{dv(t)}{dt} = 2(6)t^{2-1} - 1(8)t^{1-1} + \cancel{0} - 6(-2)$

$\boxed{a(t) = 12t - 8 + 12t^{-3}}$

inst $a(2) = 12(2) - 8 + 12(2)^{-3}$

$=$



The above velocity-time graph applies to a car.

a. Describe what is happening to the ~~[illegible]~~ car during the different intervals. ★

b. Calculate the average acceleration during the first 10s —— $\frac{\Delta V}{\Delta t} =$

c. Calculate how far does the car travels in 25s.

d. How far is the car from the initial position? $\Delta t = 40s$.

e. Draw a x-t graph that would produce the above v-t graph (assume the car began at x_o=0 m)

① $\frac{1}{2}bh = \frac{1}{2}(10s)(10m/s)$ $\qquad$ ② $bh = 10s(10m/s)$

$\Delta X_1 = 50m$ $\qquad \Delta X_2 = 100m$

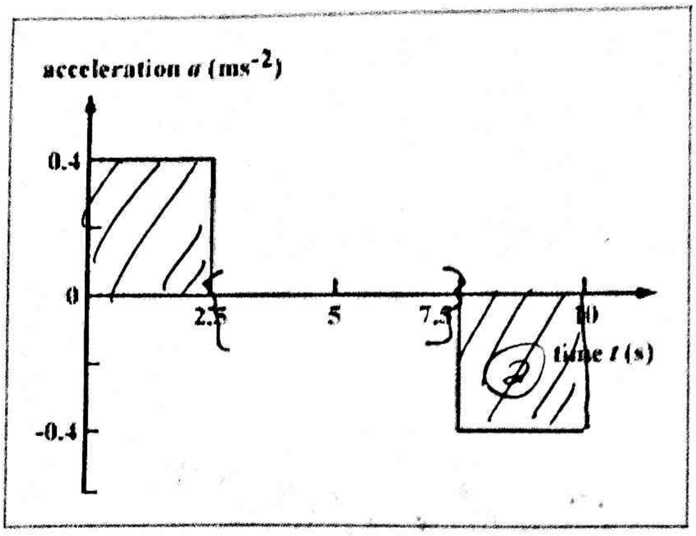
③ $\frac{1}{2}bh = \frac{1}{2}(5s)(10m/s)$ $\qquad \boxed{\text{total} = 175m}$

$\Delta X_3 = 25m$

D.) ④ $\frac{1}{2}bh = \frac{1}{2}(5s)(-10m/s)$ $\qquad$ ⑤ $\frac{1}{2}bh = \frac{1}{2}(10s)(-10m/s)$

$\Delta X = -25m$ $\qquad \Delta X = -50m$

$\boxed{\Delta X = 100m} = 50m + 100m + 25m - 25m - 50m$



Assume a particle begins from rest.

Determine the velocity of the particle at:

a. 2.5 s
b. 5 s
c. 10s

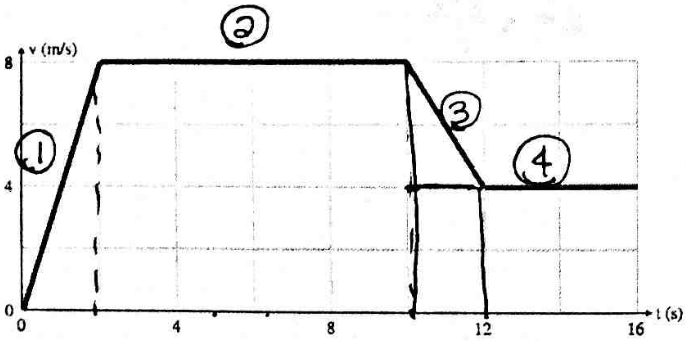
$$\left[\text{Slope} = \frac{m/s^2}{s} = \frac{m}{s^3} \ (\text{Jerk})\right]$$

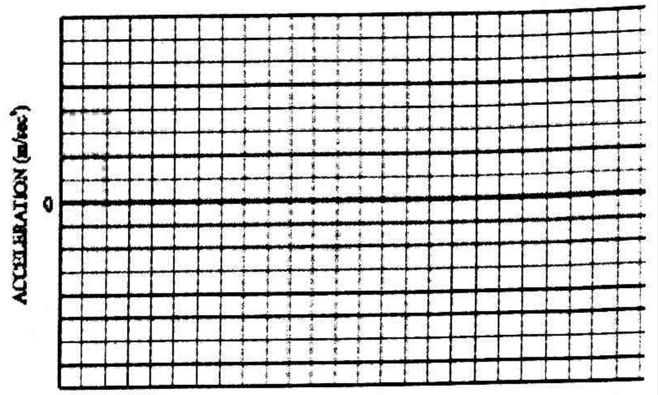
1 Area: $bh = 2.5\cancel{s}(.4\, m/s^{\cancel{2}})$

$\Delta V = 1\, m/s$

2 $bh = 2.5s(-.4\, m/s^2)$

$\Delta V = -1\, m/s$





TIME (sec)

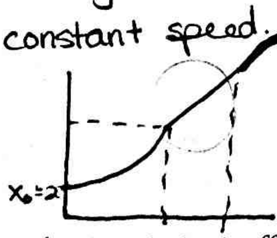
2. The v-t graph shown above applies to a runner.
   a. Describe what is happening to the runner during the different intervals.
   b. Calculate the average acceleration during the first 4 s.
   c. Calculate how far the runner travels in 16s.
   d. Draw a x-t graph that would produce the above v-t graph (assume the runner began at position x_o=2 m)

A.) 1 speeding up
2 constant speed
3 slowing down
4 constant speed.

B $a_{avg} = \frac{\Delta V}{\Delta t} = \frac{8 m/s - 0 m/s}{4 s} = \boxed{2 m/s^2}$

C 1 2 3 4
$\frac{1}{2}(2s)(8 m/s) + 8s(8 m/s) + 2s(4 m/s) + \frac{1}{2}(2)(4 m/s) + 4s(4 m/s)$
$= 8 + 64 + 8 + 4 + 16$
$\boxed{\Delta X = 100 m}$

D.)



A car is at rest at a traffic signal. When the light turns green the car accelerates at 2.4 m/s² for 15 s. Then the driver maintains a constant velocity for 0.80 km. Finally the car slows to a stop in a distance of 180 m
a. Calculate the total distance traveled $\boxed{1250 m}$
b. The total time the car traveled
c. The acceleration of the car as it slowed down

1 accelerates
$a = 2.4 m/s^2$
$t = 15s$ ✓
$V_o = 0 m/s$ $V = ?$
$\Delta X = ?$

a.) $\boxed{\Delta X = V_o t + \frac{1}{2} a t^2}$
$\Delta X = \frac{1}{2} a t^2$
$= \frac{1}{2}(2.4 m/s^2)(15s)^2$
$\Delta X = 270 m$

2 Constant
$\Delta X_2 = .8 km = 800 m$
$\boxed{t = ? = 22.2 s}$
$V = 36 m/s$
$V = \frac{X}{t} \rightarrow t = \frac{X}{V}$

b.)

3 decelerates
$V = 0$
$\Delta X_3 = 180$
$\boxed{a_3 = -}$
$V_o = 36 m/s$
$t = ?$