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Kinematics Review Textbook Questions.

Day 2 - 1.1 pg 10 # 1, 2, 4, 5

1) a) $\Delta \vec{d}_1 = 1.2\,km\,[E]$
$\Delta t_1 = 24\,min$
$\Delta \vec{d}_2 = 1.2\,km\,[W]$
$\Delta t_2 = 24\,min$
$v_{av} = ?$

$$v_{av} = \frac{\Delta d_{TOTAL}}{\Delta t_{TOTAL}} = \frac{(1.2 + 1.2)\,km}{48\,min}$$
$$= 0.050\,km/min \times 60\,min/h$$
$$= 3.0\,km/h$$

∴ her average speed was 3.0 km/h.

b) $\vec{v}_1 = ?$

$$\vec{v}_1 = \frac{\Delta \vec{d}_1}{\Delta t_1} = \frac{1.2\,km\,[E]}{0.40\,h} = 3.0\,km/h\,[E]$$

c) $\Delta \vec{d}_R = ?$
$\vec{v}_{av} = ?$
Let [E] = +

$$\Delta \vec{d}_R = \Delta \vec{d}_1 + \Delta \vec{d}_2$$
$$= 1.2\,km\,[E] + 1.2\,km\,[W]$$
$$= 1.2\,km - 1.2\,km$$
$$= 0\,km$$

$$\vec{v}_{av} = \frac{\Delta \vec{d}_R}{\Delta t} = 0\,km/h$$

∴ her average velocity was 3.0 km/h [E] for the first part of her walk and 0 km/h overall.

d) The answers for (b) & (c) are different as the woman walked backwards in the second part of the motion, returning to her starting point.

2) $\vec{v} = 27\,m/s\,[F]$
$\Delta t = 0.32\,s$
$\Delta \vec{d} = ?$

$$\Delta \vec{d} = \vec{v}\Delta t$$
$$= (27\,m/s\,[F])(0.32\,s)$$
$$= 8.6\,m\,[F]$$

∴ the bus moved 8.6 m [F] during the driver's reaction time.

4) $\Delta \vec{d}_1 = 140\,m\,[E]$
$\Delta t_1 = 55\,s$
$\Delta \vec{d}_2 = 45\,m\,[W]$
$\Delta t_2 = 21\,s$
Let [E] = +
$v_{av} = ?$
$\vec{v}_{av} = ?$

a) $$v_{av} = \frac{\Delta d_T}{\Delta t} = \frac{140\,m + 45\,m}{55\,s + 21\,s} = \frac{185\,m}{76\,s} = 2.4\,m/s$$

b) $$\vec{v}_{av} = \frac{\Delta \vec{d}_R}{\Delta t} = \frac{140\,m - 45\,m}{76\,s} = +1.25\,m/s = 1.2\,m/s\,[E]$$

∴ The student's average speed was 2.4 m/s and his average velocity [illegible]

5. $\Delta\vec{d}_1 = 62\ km\ [S]$

$\Delta\vec{d}_2 = 78\ km\ [N]$

$V_{av} = 55\ km/h$

$\Delta t = ?$

$\vec{V}_{av} = ?$

Let $[N] = +$

$$V_{av} = \frac{\Delta d_T}{\Delta t}$$

$$\Delta t = \frac{\Delta d_T}{V_{av}} = \frac{(62+78)\ km}{55\ km/h} = 2.54\dot{5}\dot{4}\ h$$

$$\vec{V}_{av} = \frac{\Delta\vec{d}_R}{\Delta t} = \frac{\Delta\vec{d}_1 + \Delta\vec{d}_2}{\Delta t} = \frac{-62km + 78km}{2.54\dot{5}\dot{4}\ h} = 6.3\ km/h\ [N]$$

∴ the magnitude of the average velocity is much less than the magnitude of the average speed as the truck changes direction so that the magnitude of the resultant displacement is much less than the total distance travelled.

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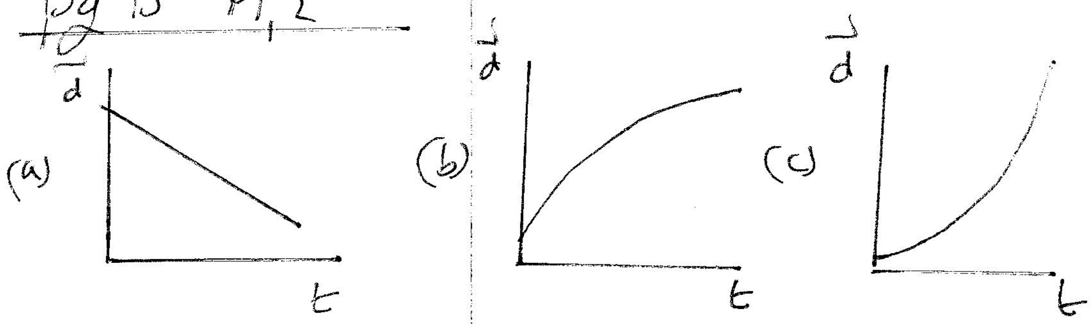
1.



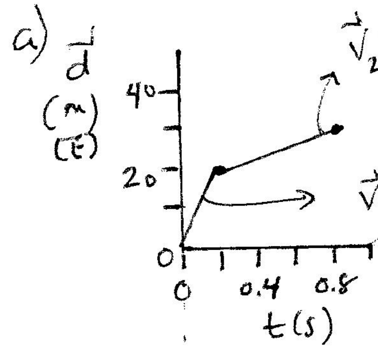
a) The velocity increases with time in C as the slope of the curve gets steeper with time.

b) The velocity in graph B decreases with time as the slope of the curve gets shallower.

*Graph A indicatess constant velocity.

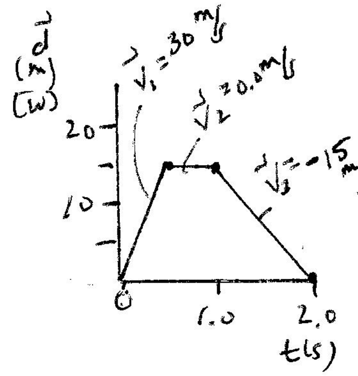
P2 pg 13

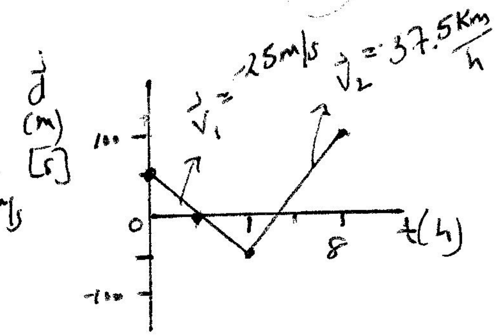
a)

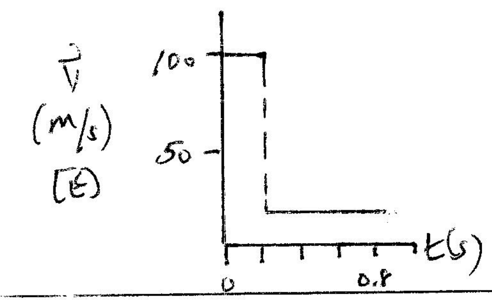


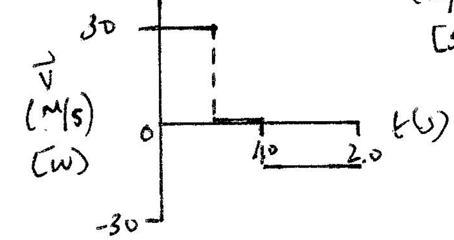
$\vec{V}_2 = \frac{\Delta \vec{d}}{\Delta t} = \frac{30-20}{0.8-0.2} = \frac{10}{0.6} = 16.7\ m/s$

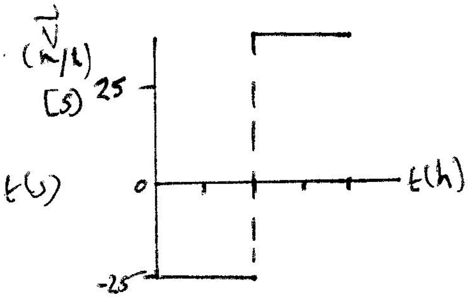
$\vec{V}_1 = \frac{\Delta \vec{d}}{\Delta t} = \frac{20-0}{0.2-0} = 100.\ m/s$











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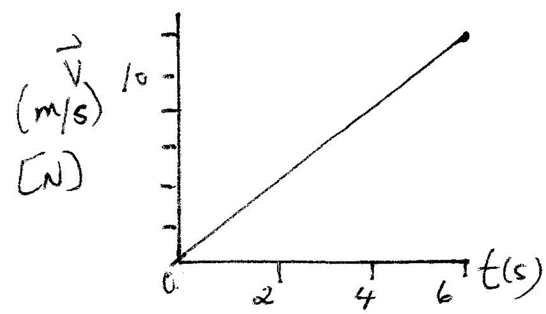

a) Since the graph is a straight diagonal line with constant slope we know the car has constant acceleration. (slope$_{v-t}$ = acceleration)

b) The car starts from rest and accelerates uniformly as it moves in the north direction.

c) $\vec{a} = \text{slope } v\text{-}t = \frac{12.0\ m/s - 0}{6.0\ s} = 2.0\ m/s^2\ [N]$

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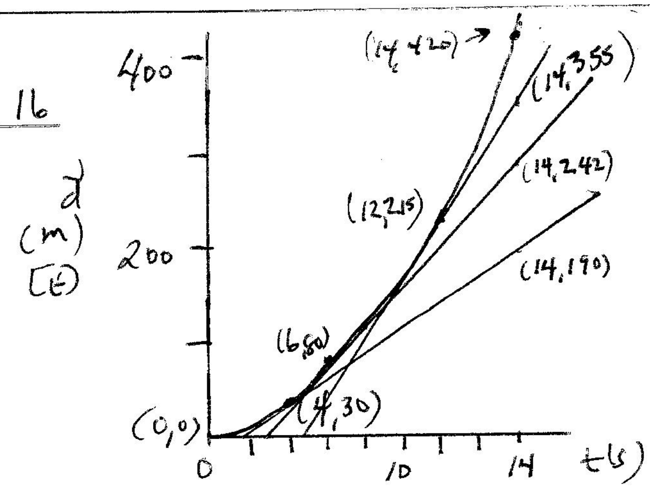


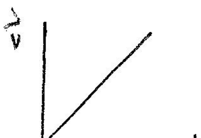
a) $\vec{V}_{av} = \frac{\Delta \vec{d}_R}{\Delta t} = \frac{420 m [E]}{14 s} = 30.\ m/s\ [E]$

b) $\vec{V}_{av\ (last\ 10s)} = \frac{\Delta \vec{d}_R}{\Delta t} = \frac{420-30}{10.s} = 39\ m/s\ [E]$

Since the car is accelerating, the velocity is increasing so the average velocity of the last 10s is higher than the overall average.

c) $\vec{V}_{4.0} = \frac{190-30}{10} = 16\ m/s\ [E]$ $\quad \vec{V}_{6.0} = \frac{242-80}{8.0} = 20.\ m/s\ [E]$

$\vec{V}_{12.} = \frac{355-215}{2.0} = 70.\ m/s\ [E]$



d)

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~~Day 4 - Part C~~

Day 4 - 1.2 P1,2,3,4,6 pg 19

P.1. $\vec{v}_1 = 15.0\,m/s\,[F]$

$\vec{a} = 5.0\,m/s^2\,[B]$

$\vec{v}_2 = 0.0\,m/s$

$\Delta\vec{d} = ?$

Let [F] = +

a) $\Delta\vec{d} = \frac{\vec{v}_2^{\,2} - \vec{v}_1^{\,2}}{2\vec{a}} = \frac{(0.0) - (15.0)^2}{2(-5.0)} = 22.5\,m\,[F]$

$\sim 22\,m\,[F]$

b) In the sample problem the initial speed of the motorcycle was double the initial speed of this problem but the braking distance was more than four times the distance in the second problem (90.m vs 22m). This indicates that the risk of not being able to stop safely increases dramatically as speed is increased.

2. $\vec{v}_1 = 0.0\,m/s$

$\Delta\vec{d} = 120\,m\,[N]$

$\Delta t = 15\,s$

$\vec{a} = ?$

Let N = +

$\Delta\vec{d} = \cancel{\vec{v}_1 \Delta t}^{\,0} + \frac{1}{2}\vec{a}\,\Delta t^2$

$a = \frac{2\Delta\vec{d}}{\Delta t^2} = \frac{2(120\,m\,[N])}{(15\,s)^2} = 1.067\,m/s^2\,[N]$

$\sim 1.1\,m/s^2\,[N]$.

∴ his acceleration is $1.1\,m/s^2\,[N]$.

3. $\Delta\vec{d}_1 = ?$

$\left.\begin{array}{l}\vec{v} = 22\,m/s\,[E]\\ \Delta t = 12\,s\end{array}\right\}$ constant velocity

$\left.\begin{array}{l}\vec{v}_1 = 22\,m/s\,[E]\\ \vec{a} = 1.2\,m/s^2\,[W]\\ \vec{v}_2 = 0.0\,m/s\end{array}\right\}$ slowing down.

$\Delta d_2 = ?$

$\Delta\vec{d}_R = ?$

Displacement during constant velocity:

$\Delta\vec{d}_1 = \vec{v}_1\,\Delta t$

$= (22\,m/s\,[E])(12\,s)$

$= 264.\,m\,[E]$

Slowing down:

$\Delta\vec{d}_2 = \frac{\vec{v}_2^{\,2} - \vec{v}_1^{\,2}}{2\vec{a}}$

$= \frac{(0.0\,m/s)^2 - (22\,m/s)^2}{2(-1.2\,m/s^2)}$

$= 201.7\,m\,[E]$

Total displacement

$\Delta\vec{d}_R = \Delta\vec{d}_1 + \Delta\vec{d}_2 = 465.7\,m\,[E]$

$\sim 4.7 \times 10^2\,m\,[E]$

∴ the displacement was 470 m [E]

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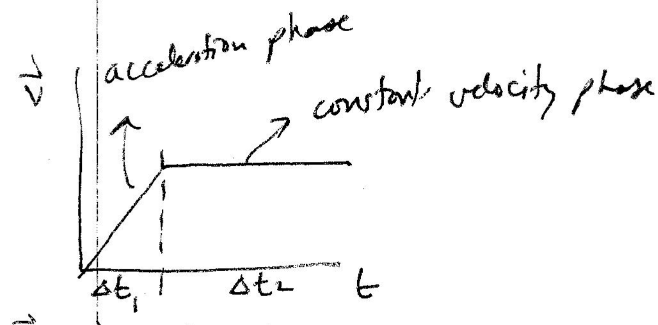
4) 100.0m sprint:



a) $\vec{v}_1 = 0.0\,m/s$
$\vec{v}_2 = 9.6\,m/s\ [W]$
$\Delta t_1 = 4.2\,s$
$\vec{a} = ?$
Let W = +

$$\vec{a} = \frac{\vec{v}_2 - \vec{v}_1}{\Delta t_1} = \frac{9.6\,m/s - 0}{4.2\,s} = 2.3\,m/s^2\ [W]$$

b) $\Delta\vec{d} = ?$ (during acceleration phase)

$$\Delta\vec{d} = \frac{(\vec{v}_1 + \vec{v}_2)}{2}\Delta t_1 = \frac{(9.6\,m/s + 0.0)(4.2\,s)}{2}$$
$= 20.16\,m\ [W]$
$\sim 20.\,m\ [W]$

c) $\Delta t_2 = ?$
$\Delta d_2 = 100.0\,m - 20.16\,m = 79.84\,m$
$V_2 = 9.6\,m/s$
$\Delta t_{total} = ?$

$$\Delta t_2 = \frac{\Delta d_2}{V_2} = \frac{79.84\,m}{9.6\,m/s} = 8.317\,s$$

$$\Delta t_{TOTAL} = \Delta t_1 + \Delta t_2 = 4.2 + 8.317\,s$$
$\simeq 12.52\,s$
$\simeq 13\,s.$

∴ it takes the runner 13 s to run the 100 m sprint.

6) $\vec{v}_1 = 110\,m/s\ [F]$
$\vec{v}_2 = 0.0\,m/s$
Let [F] = + ∴ $\vec{a} = 6.2\,m/s^2\ [B]$
$\Delta t = ?$
$\Delta\vec{d} = ?$

a) $$\Delta t = \frac{\vec{v}_2 - \vec{v}_1}{\vec{a}} = \frac{0.0 - 110\,m/s}{-6.2\,m/s^2} = 17.74\,s \simeq 18\,s$$

b) $$\Delta\vec{d} = \frac{1}{2}(\vec{v}_1 + \vec{v}_2)\Delta t$$
$= \frac{1}{2}(110 + 0)(17.74)$
$= 975.8\,m$
$\sim 980\,m$

∴ the jet stops in 18 s and travels 980 m as it comes to rest.

c) The runway should be longer than the minimum length as a safety measure - Jets may land farther along the runway and may overshoot the minimum length. As well different planes may require