PHYS 121
WINTER 2006
O E Vilches

Answers to Sample Test #1

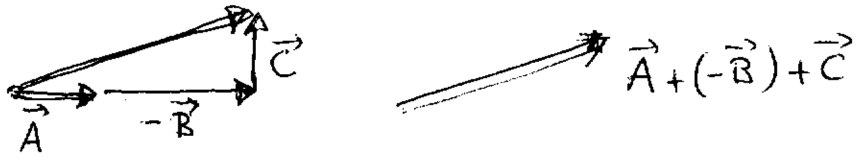
Multiple Choice

1.

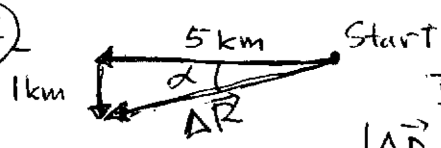

(a)

2.


(b)

3.


(c)

4.


DISPLACEMENT $\equiv \Delta\vec{R}$

$|\Delta\vec{R}| = [(5\text{ km})^2 + (1\text{ km})^2]^{1/2} = 5.1\text{ km}$ (b)

5. $\vec{v}_{Av} = \dfrac{\Delta\vec{R}}{\Delta t}$ This question was not "perfect", it should have had an angle

One needs to calculate the time from start to finish.

$\Delta t_1 = \dfrac{5\text{ km}}{10\text{ km/h}} = 0.5\text{ h}$ $\Delta t_2 = \dfrac{1\text{ km}}{2\text{ km/h}} = 0.5\text{ h}.$

So $\Delta t = \Delta t_1 + \Delta t_2 = 0.5\text{ h} + 0.5\text{ h} = 1\text{ h}.$ (c) (plus angle)

The average velocity is $\dfrac{5.1\text{ km}}{1\text{ hr}} = |\vec{v}_{Av}| = 5.1\text{ km/h}.$

at an angle $\alpha \Rightarrow \tan\alpha = \dfrac{1\text{ km}}{5\text{ km}}$ below west.

6. Average speed = 5.1 km/h (c)

This is not the "usual" meaning of average velocity in "car racing" (or any track race) - Average velocity or average speed is usually used to describe "lap velocity" = total distance travelled / time interval

(7)–(10) This is a projectile motion problem with the ball travelling with constant $v_x = v_0 \cos 30^\circ$, and $v_y = v_0 \sin 30^\circ - \frac{1}{2} g t^2$. The person is running with constant velocity, $v_{xp} = 3\ m/s$

(7) (c)	(8) (e)	(9) (d)

(10) Here one has to calculate the time it takes the ball to go up from 9.8 m and come down to 2 m.

$$2\,m = 9.8\,m + 5\,m/s \sin 30^\circ\, t - \frac{1}{2} \times 9.8 \frac{m}{s^2} t^2$$

$$2\,m = 9.8\,m + 2.5 \frac{m}{s} t - 4.9 \frac{m}{s^2} t^2$$

$$t = \frac{-2.5 \pm \left[(2.5)^2 + 4 \times 7.8 \times 4.9\right]^{1/2}}{-2 \times 4.9} = +1.54\,s.$$

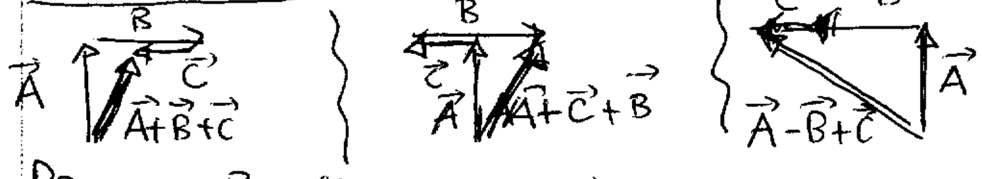
(d)

There is also a negative solution (−1.03 sec) which represents the solution to the same problem if the ball had been thrown "from the left" and reached the 9.8 m height at the 30° angle, still going up.

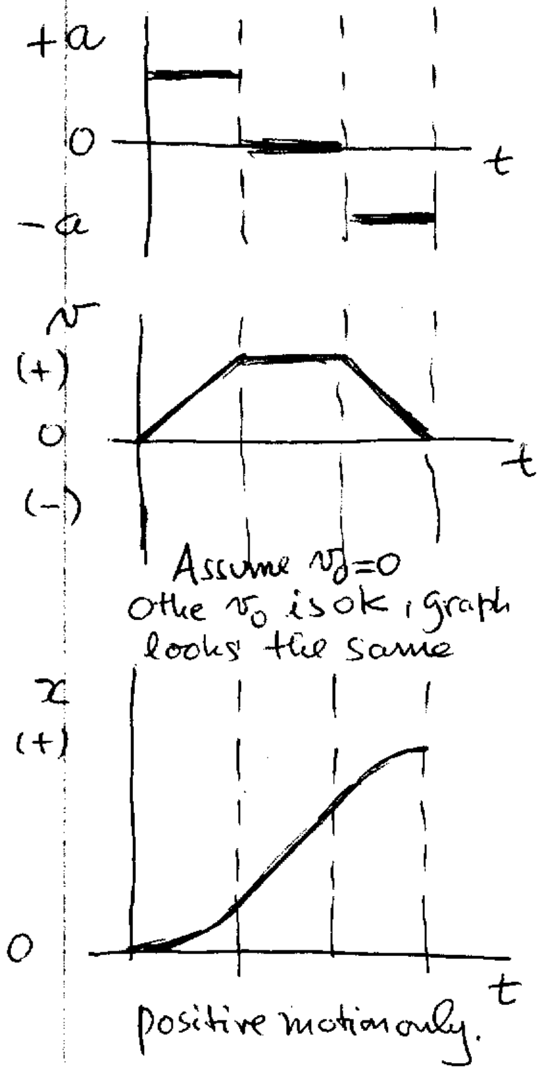
PROBLEM 1,

$$\frac{3\ \text{inches}}{\text{minute}} \times \frac{0.0254\,m}{\text{inch}} \times \frac{1}{60\ \frac{\text{sec}}{\text{min}}} = 1.27 \times 10^{-3} \frac{m}{s}$$

PROBLEM 2,



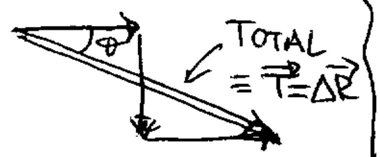
PROBLEM 3 (See next page)



(b) <u>No</u> - Car moves forward only, goes to some high speed, then moves at constant speed, then slows down and stops.

PROBLEM 4

(a)



(b) $\Delta R_x = 1 + 1 = 2$ km.
$\Delta R_y = -1 = -1$ km.
$|\Delta R| = ((2)^2 + (1)^2)^{1/2} = 2.23$ km.
$\tan\theta = \frac{-1}{2} = -27°$ with East (or x)

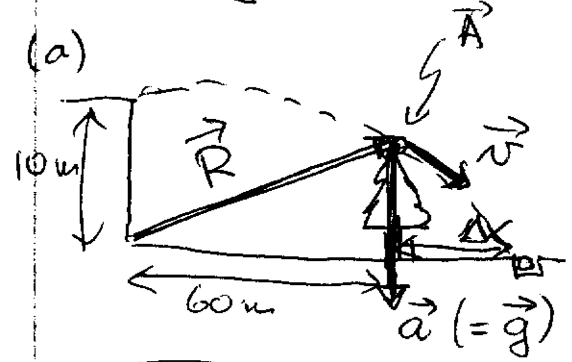
(c) $\Delta t = \Delta t_1 + \Delta t_2 + \Delta t_3 = \frac{1\text{ km}}{10\text{ km/hr}} + \frac{1\text{ km}}{5\text{ km/hr}} + \frac{1\text{ km}}{2\text{ km/hr}} = 0.8$ hrs.

(d) $\{\vec{v}\}_{average} = \frac{2.23\text{ km}}{0.8\text{ hr}} = 2.79$ km/hr ; $\theta = -27°$ (same as $\Delta\vec{R}$).

(e) ~~Text used then~~ Average speed is 2.79 km/hr.
Text used in 1999 defined average speed as $\frac{\text{linear distance travelled}}{\text{time}}$
which here will be $\frac{3\text{ km}}{0.8\text{ hr}} = 3.75$ km/hr.

PROBLEM 1 (121A, 1998)

(a)

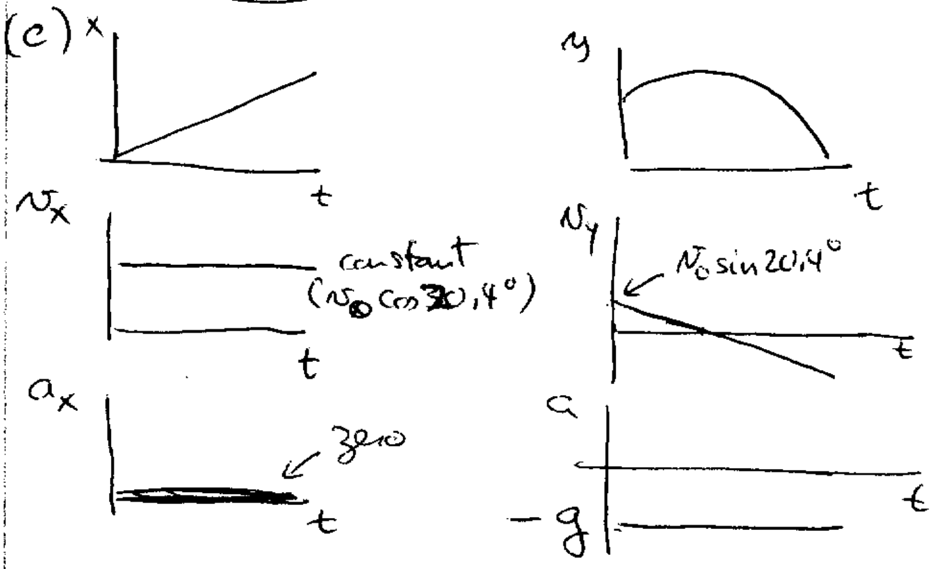


(b) $\vec{R} = 60\,m\,\hat{i} + 10\,m\,\hat{j}$

$\vec{v} = 30\frac{m}{s}\cos 20.4^\circ\,\hat{i} - 30\frac{m}{s}\sin 20.4^\circ\,\hat{j}$

$\vec{a} = -9.8\frac{m}{s^2}\,\hat{j}$.

(c)



(d) One way is to calculate the time to the ground, another one to calculate Δx directly.

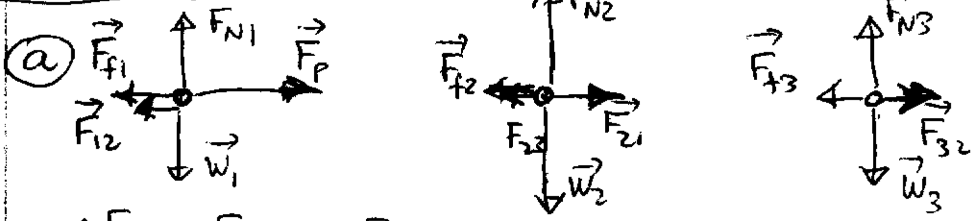
$y \rightarrow \quad 0 = 10\,m + 30\,m/s\,\sin 20.4^\circ\, t - \frac{1}{2}\,9.8\frac{m}{s^2}\,t^2 \qquad (1)$

$x \rightarrow \quad L + \Delta x = v_0 \cos\theta\, t = 30\frac{m}{s}\cos 20.4^\circ\, t \qquad (2)$

Solve for t in (1), insert in (2), Solve for Δx.

Problem 1 (114, 1999)

(a)



$F_{32} > F_{friction\,3}$

$|\vec{a}| = 0.1\,m/s^2$

(b) F_{12} and F_{21}, F_{23} and F_{32}

(c) YES, mass 2 is accelerating at $0.1\,m/s^2$, so $F_{net\,2} = m_2 a_2$

(d) Can be solved using $F_P - F_{friction} = (m_1 + m_2 + m_3)\,a$