PHYS101 Lab Final Exam-Solution Set

Department of Physics

Fall 2014/15 - January 26, 2015

Questions: The answers to the questions are marked in blue:

1. An object of mass $m = 5kg$ is moving on a horizontal frictionless surface under the application of net force $\vec{F}$. The measured position of the object at certain instances of time is given in the table below:

$d(m)$	0.00	10.00	20.00	28.00
$t(s)$	0.00	1.00	1.34	1.73
$t^2(s^2)$	0.00	1.00	1.84	2.99

Recall that the kinematic equation for the position of a particle with constant acceleration is given as $d = \frac{1}{2}at^2$ and that the equation of the least square line given as $y = mx + c$, with

$$m = \frac{n\sum(xy) - \sum x \sum y}{n\sum x^2 - (\sum x)^2}, \text{ and } c = \frac{\sum y \sum x^2 - \sum x \sum(xy)}{n\sum x^2 - (\sum x)^2}.$$

Find the equation of the least square line for $d(t^2)$ by using the following table.

$x = t^2(s^2)$	$y = d(m)$	$xy = t^2 d(s^2 m)$	$x^2 = t^4(s^4)$
0.00	0.00	0.00	0.00
1.00	10.00	10.00	1.00
1.80	20.00	36.00	3.24
2.99	28.00	83.72	8.94
$\sum x = 5.79$	$\sum y = 58.00$	$\sum(xy) = 129.72$	$\sum x^2 = 13.18$

$$m = \frac{n\sum(xy) - \sum x \sum y}{n\sum x^2 - (\sum x)^2} = \frac{4 \times 129.72 - 5.79 \times 58}{4 \times 13.18 - (5.79)^2} = 9.54$$

$$c = \frac{\sum y \sum x^2 - \sum x \sum(xy)}{n\sum x^2 - (\sum x)^2} = \frac{58 \times 13.18 - 5.79 \times 129.72}{4 \times 13.18 - (5.79)^2} = 0.15$$

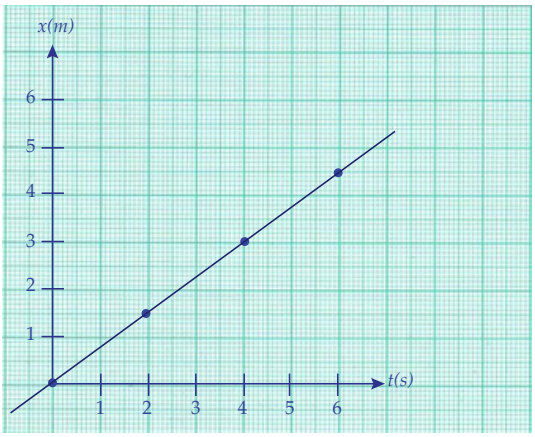
So we get for the least square line:

$$y = 9.54x + 0.15$$

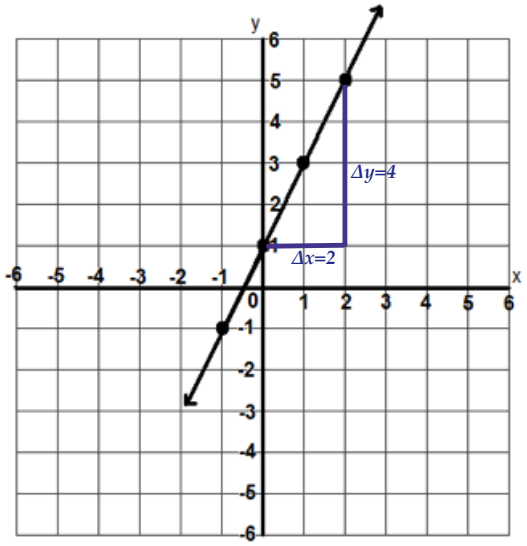
2. In an experiment the motion in x-direction is measured at certain instances of time. The measured values are given in the table below

$t(s)$	0	2	4	6
$x(m)$	0	1.5	3	4.5

Please draw the given points into the graph paper at the right and draw the graphics for $x = f(t)$.



3. The graph of the measublue data is given in the figure below. Please find the slope of the line.



The slope can be calculated as

$$m = \frac{\Delta y}{\Delta x} = \frac{4}{2} = 2$$

So we get for the equation of the line

$$y = 2x + 1$$

4. A football player kicks the ball such the balls trajectory is a parabola. The ball hits the ground after $5s$ at a distance of $25m$.

   (a) What is the acceleration of the ball after $2s$?

   $$\vec{a}(t) = -g\hat{\mathbf{j}} = const.$$

   (b) What is the acceleration of the ball at its highest point?

   $$\vec{a}(t) = -g\hat{\mathbf{j}} = const.$$