PHYS 101: General Physics 1 KOÇ UNIVERSITY Fall Semester 2016

College of Sciences

Section 1 Quiz 2 October 14, 2016

Closed book. Duration: 10 minutes

Name: Student ID: Signature:

The x-position of a particle (don't worry about the units) with respect to time t is given as $x(t) = 6t^2 - t^3$

Find

a) the total distance traveled by the particle, and
b) the displacement of the particle

from $t = 0$ to $t = 4$?

a) $x(t) = 6t^2 - t^3$ the particle will eventually stop, when $v(t) = 0$.

$$\frac{dx(t)}{dt} = v(t) = 12t - 3t^2 = 0$$

$$12 - 3t = 0$$

$$t = 4\,s.$$

Let's investigate its position for every second.

at $t=0 \Rightarrow x(0) = 0$

at $t=1 \Rightarrow x(1) = 5\,m.$

at $t=2 \Rightarrow x(2) = 16\,m.$

at $t=3 \Rightarrow x(3) = 27\,m$

at $t=4 \Rightarrow x(4) = 32\,m$

b) Since the particle moves only in one direction until $t=4s.$, total distance traveled by the particle and the displacement of the particle are equal.

$$\Delta x = x(4) - x(0) = 32\,m.$$

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Section 2 Quiz 2 October 14, 2016

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The y-position of a particle (don't worry about the units) with respect to time t is given as $y(t) = 3t^2 - t^3$. Find the position of the particle when it reaches maximum velocity?

$$y(t) = 3t^2 - t^3$$

$$\frac{dy(t)}{dt} = v(t) = 6t - 3t^2$$

$$\frac{dv(t)}{dt} = a(t) = 6 - 6t = 0 \quad \text{(max. velocity condition)}$$

$$t = 1\,s.$$

$$\boxed{y(t=1) = 2\,m}$$

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Section 3 Quiz 2 October 14, 2016

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The z-position of a particle (don't worry about the units) with respect to time t is given as $z(t) = t^2 - 2t^3$.

Carefully sketch

a) the position z, and
b) the velocity v_z

of the particle as a function of t for $0 < t < 4$. Indicate special points where necessary.

$$v_z(t) = \frac{dz(t)}{dt} = 2t - 6t^2 = 0 \Rightarrow 2t = 6t^2$$

$$t = 1/3 \text{ s.}$$

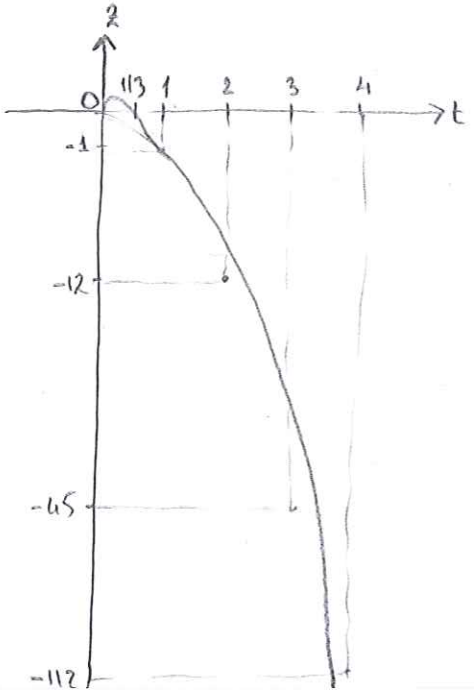
at $t=0 \Rightarrow z(0) = 0$, $v(0) = 0$

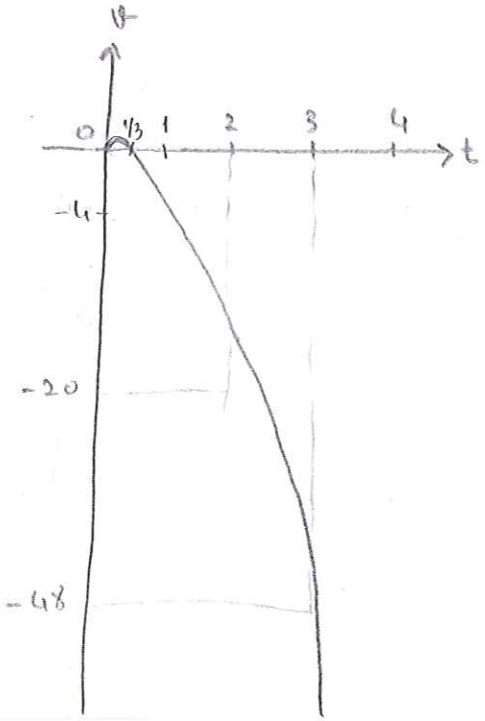
at $t=1 \Rightarrow z(1) = -1$, $v(1) = -4$

at $t=2 \Rightarrow z(2) = -12$, $v(2) = -20$

at $t=3 \Rightarrow z(3) = -45$, $v(3) = -48$

at $t=4 \Rightarrow z(4) = -112$, $v(4) = -88$





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Section 4 Quiz 2 October 14, 2016

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Consider two cannon balls that are both in free fall under the influence of Earth's gravitational acceleration g. At $t = 0$ the speed and height of the first ball are measured to be $v_1 = 0$ and $y_1 = h$, and at time $t = 1s$ the speed and height of the second ball are measured to be $v_2 = 0$ and $y_2 = H$.

Find the relation between h and H if the balls hit the ground at the same instant.

first ball: $y - y_0 = v_0 t_1 + \frac{1}{2} a t_1^2$

$y: 0,\ y_0: h,\ v_0: 0,\ a: -9,8$

$-h = -4,9\, t_1^2$

$t_1 = \sqrt{\frac{h}{4,9}}$

second ball: $y - y_0 = v_0 t_2 + \frac{1}{2} a t_2^2$

$y: 0,\ y_0: H,\ v_0: 0,\ a: -9,8$

$-H = -4,9\, t_2^2$

$t_2 = \sqrt{\frac{H}{4,9}}$

$t_1 = 1 + t_2$

$\sqrt{\frac{h}{4,9}} = 1 + \sqrt{\frac{H}{4,9}}$

$\frac{\sqrt{h}}{\sqrt{4,9}} - \frac{\sqrt{H}}{\sqrt{4,9}} = 1$

$\boxed{\sqrt{h} - \sqrt{H} = \sqrt{4,9}}$