Closed book. No calculators are to be used for this quiz.
Quiz duration: 10 minutes

The graph below shows the velocity of a motorcycle police officer plotted as a function of time. (a) Find the instantaneous acceleration at t=3 s, at t=7 s, and at t=11 s. (b) How far does the officer go in the first 6 s? The first 10 s? The first 14 s?

\[ v(t) \text{ (m/s)} \]

\[ 0 \quad 2 \quad 4 \quad 6 \quad 8 \quad 10 \quad 12 \quad 14 \quad t \text{ (s)} \]

\[ a) \quad \text{At } t=3 \text{ s, } v_x-t \text{ curve is a straight line which has zero slope.} \]
\[ \bullet \quad \text{At } t=3 \quad v_x = 0 \]
\[ \bullet \quad \text{At } t=7 \quad v_x = \frac{\Delta v_x}{\Delta t} = \frac{15 \text{ m/s} - 20 \text{ m/s}}{11 \text{ s} - 6 \text{ s}} = -4.5 \text{ m/s}^2 \]
\[ \bullet \quad \text{At } t=11 \quad v_x = \frac{0 - (15 \text{ m/s})}{14 \text{ s} - 10 \text{ s}} = -7.5 \text{ m/s}^2 \]

\[ b) \quad \text{For } t=0 \text{ to } t=6 \text{ s: } \quad x-x_0 = v_x \cdot t + \frac{1}{2} a t^2, \text{ but } v_x = 0 \text{ in this interval.} \]
\[ x-x_0 = v_x \cdot t = (20 \text{ m/s}) \cdot (6 \text{ s}) = 120 \text{ m}. \]

\[ \text{For } t=6 \text{ to } t=10 \text{ s: } \quad x-x_0 = v_x \cdot t + \frac{1}{2} a t^2, \quad a = -6.25 \text{ m/s}^2, \quad v_x = 20 \text{ m/s} \]
\[ x-x_0 = (20 \text{ m/s}) \cdot (4 \text{ s}) + \frac{1}{2} (6.25 \text{ m/s}^2) (4 \text{ s})^2 \]
\[ x = 250 \text{ m}. \]

\[ \text{For } t=10 \text{ to } t=14 \text{ s: } \quad a = -41.25 \text{ m/s}^2, \quad v_x = 5 \text{ m/s}, \quad x_0 = 280 \text{ m}. \]
\[ x-x_0 = (4.5 \text{ m/s}) \cdot (4 \text{ s}) + \frac{1}{2} (-41.25 \text{ m/s}^2) (4 \text{ s})^2 \]
\[ x = 250 \text{ m} + 4 \text{ m} = 284 \text{ m}. \]
A test car travels in a straight line along the x-axis. The graph below shows the car’s position as a function of time. (a) Find the car’s instantaneous velocity at points A, B, C, D, and E. (b) Find the car’s instantaneous acceleration at points A, B, C, D, and E.

A: \[ \frac{dx}{dt} = \frac{40 \text{ m} - 20 \text{ m}}{3 \text{ s}} = 6.7 \text{ m/s} \]

B: same as point A, \( \frac{dx}{dt} = 6.7 \text{ m/s} \).

C: \( \frac{dx}{dt} = 0 \) (straight line)

D: \[ \frac{dx}{dt} = \frac{10 \text{ m} - 10 \text{ m}}{4 \text{ s}} = 0 \text{ m/s} \]

E: same as point D, \( \frac{dx}{dt} = 0 \text{ m/s} \)

Since the \( \frac{dx}{dt} - t \) graph is straight line, slope is zero, so acceleration is zero through all points.
A cat walks in a straight line. The graph of its velocity as a function of time is given below. (a) Find the cat's velocity at \( t=4 \) s and \( t=7 \) s. (b) What distance does the cat move during the first 4 s (between \( t=0 \) s and \( t=4 \) s)?

![Graph of velocity vs. time](image)

a) Use the formula \( v_x = v_{0x} + a_x t \) to find the velocity.

For \( t=4 \) s:
\[
\begin{align*}
v_x &= 8 \text{ m/s} + (-1.4 \text{ m/s}^2) \times 4 \\
&= 8 \text{ m/s} - 5.6 \text{ m/s} \\
&= 2.4 \text{ m/s}
\end{align*}
\]

For \( t=7 \) s:
\[
\begin{align*}
v_x &= 8 \text{ m/s} + (-1.4 \text{ m/s}^2) \times 7 \\
&= 8 \text{ m/s} - 9.8 \text{ m/s} \\
&= -1.8 \text{ m/s}
\end{align*}
\]

b) \( \chi = x_0 + v_{0x} t + \frac{1}{2} a t^2 \)

\[
\begin{align*}
\chi &= (8 \text{ m/s}) \times 4 \text{ s} + \frac{1}{2} (-1.4 \text{ m/s}^2) \times (4 \text{ s})^2 \\
&= 32 \text{ m} - 11.2 \text{ m} \\
&= 20.8 \text{ m}
\end{align*}
\]
A ball is thrown vertically upward with an initial velocity $v_0$. Find an expression for the height of the ball at $t = t_{\text{max}}/2$ where $t_{\text{max}}$ is the time it takes for the ball to reach the maximum height. You should consider the gravitational acceleration to be $g$. Your answer should be a function of $v_0$ and $g$ only.

At maximum height $v_y = 0$.

\[ v_y = v_{y0} - gt \quad \Rightarrow \quad v_{y0} = v_y + gt \]

\[ 0 = v_{y0} - gt_{\text{max}} \]

\[ v_{y0} = gt_{\text{max}} \quad \Rightarrow \quad t_{\text{max}} = \frac{v_{y0}}{g} \]

\[ y - y_0 = v_{y0}t + \frac{1}{2}at^2 \]

\[ t_{\text{max}} = \frac{v_{y0}}{2g} \quad \Rightarrow \quad y - y_0 = v_{y0} \left( \frac{v_{y0}}{2g} \right) + \frac{1}{2}g \left( \frac{v_{y0}}{2g} \right)^2 \]

\[ y - y_0 = \frac{v_{y0}^2}{2g} - \frac{v_{y0}^2}{8g} \]

\[ y - y_0 = \frac{3v_{y0}^2}{8g} \]
PHYS 101: General Physics 1  KOÇ UNIVERSITY  Fall Semester 2012
College of Arts and Sciences  Quiz 2  4 October 2012

Section 5

Closed book. No calculators are to be used for this quiz.
Quiz duration: 10 minutes

Name:  
Student ID:  
Signature:

The acceleration of a bus is given by \( a_x(t) = at \) where \( a = 1.2 \, \text{m/s}^3 \).
(a) If the bus's velocity at \( t=1 \, \text{s} \) is \( 5 \, \text{m/s} \) what is its velocity at \( t=2 \, \text{s} \)?
(b) If the bus's position is \( 6 \, \text{m} \) at \( t=1 \, \text{s} \) what is its position at \( t=2 \, \text{s} \)?

\[ a(t) = \int a(t) \, dt \]

\[ = \int at \, dt \]

\[ v(t) = \frac{1.2 \, t^2}{2} + c \]

\[ x(t) = \frac{1.2 \, t^3}{6} + (4.1 \, \text{m/s}) \cdot t + c \]

\[ v(1) = 5 \, \text{m/s} \]

\[ v(2) = 6.8 \, \text{m/s} \]

\[ x(1) = 6 \, \text{m} \]

\[ x(2) = 11.8 \, \text{m} \]