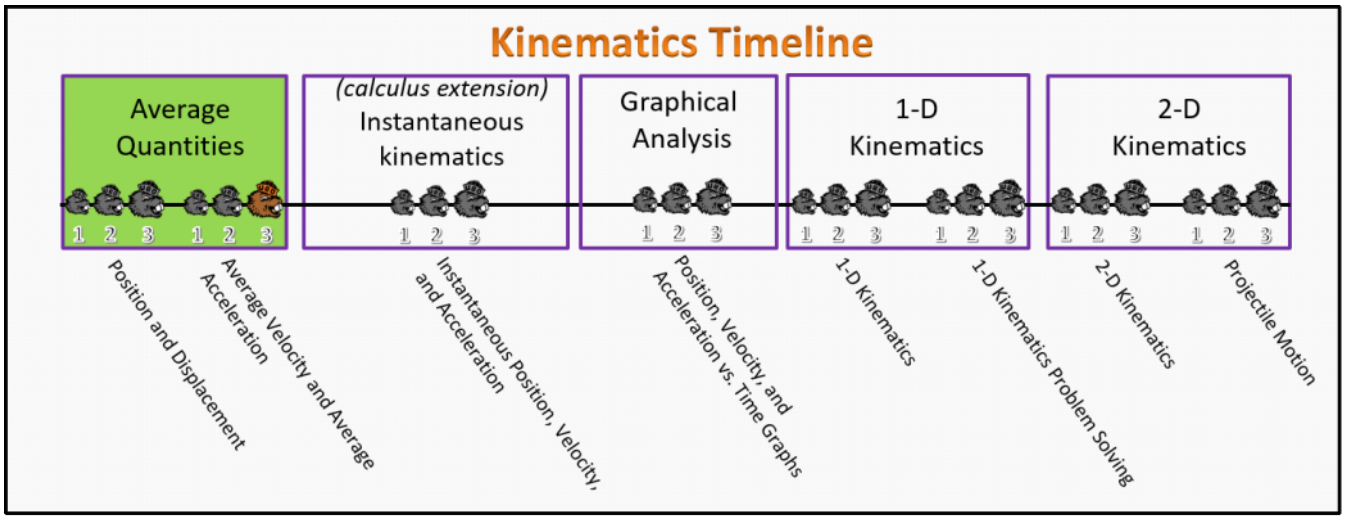
(AQ.L2.3-sols) Practice Stage Solutions

Thursday, March 29, 2018 8:34 PM

Average Quantities
Foundation Stage (AQ.L2.3)

Post-Lecture 2
Average Velocity and Average Acceleration



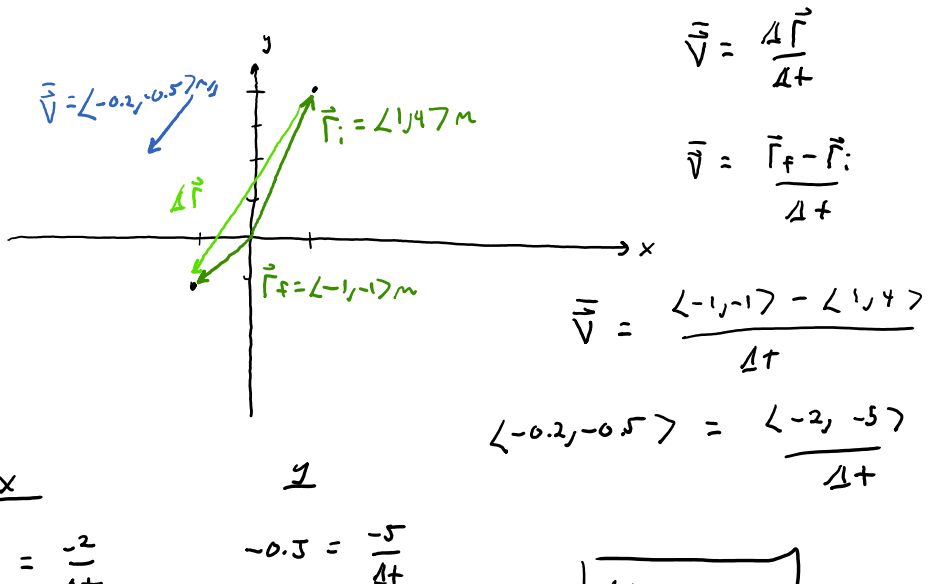
Questions

AQ.L2.3-01

Description: Find the elapsed time given initial and final positions along with average velocity.

Learning Objectives: [11,25]

Problem Statement: An object is initially seen at a location < 1 , 4> m. Sometime later it is seen at another location < -1 , -1 > m. If the average velocity of the object was < -0.2 , -0.5 >, how much time elapsed in seconds?



$-0.2 = \frac{-2}{\Delta t}$ $\quad -0.5 = \frac{-5}{\Delta t}$

$\Delta t = 10$ s ✓ $\quad \Delta t = 10$ s ✓

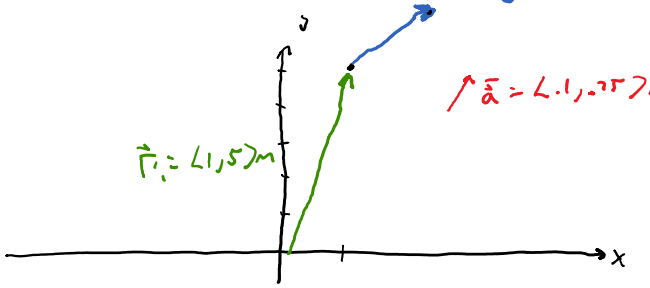
$\Delta t = 10$ SEC

AQ.L2.3-02

Description: Find the elapsed time given initial and final velocities along with average acceleration.

Learning Objectives: [11,26]

Problem Statement: An object is first seen at a location < 1.0 , 5.0 > m, traveling with a velocity < 3.0 , 2.0 > m/s. Sometime later the object is traveling with a velocity < 5.0 , 7.0 > m/s. If the average acceleration of the object during this time period is < 0.10 , 0.25 > m/s^2, how much time in seconds elapsed between observations?



$\vec{v}_f = \langle 5, 7 \rangle$ m/s

$\vec{a} = \langle 0.1, 0.25 \rangle$ m/s^2

$\vec{a} = \frac{\Delta \vec{v}}{\Delta t}$

$\vec{a} = \frac{\vec{v}_f - \vec{v}_i}{\Delta t}$

$\vec{a} = \frac{\langle 5, 7 \rangle - \langle 3, 2 \rangle}{\Delta t}$

$\vec{a} = \frac{\langle 2, 5 \rangle}{\Delta t}$

$\langle 0.1, 0.25 \rangle = \frac{\langle 2, 5 \rangle}{\Delta t}$

x: $0.1 = \frac{2}{\Delta t}$ $\quad \Delta t = 20$ s ✓

y: $0.25 = \frac{5}{\Delta t}$ $\quad \Delta t = 20$ s ✓

$\Delta t = 20$ SEC

AQ.L2.3-03

Description: Find the final velocity given the initial velocity and average acceleration.

Learning Objectives: [x]

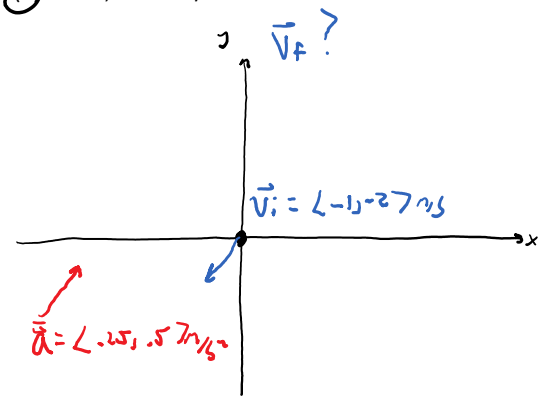
Problem Statement: An object is initially located at position < 0.0 , 0.0 > m and is traveling with a velocity < -1.0 , -2.0 > m/s. The object travels for 4.0 s with an average acceleration equal to < 0.25 , 0.50 > m/s^2. At the end of the 4.0 s, what is the velocity of the object?

(1) < 0.25 , 0.50 > m/s
(2) - < 0.60 , -0.60 > m/s
(3) < 0.50 , -0.75 > m/s
(4) < 0.50 , 0.25 > m/s
(5) - < 1.0 , 1.0 > m/s

$\vec{a} = \frac{\Delta \vec{v}}{\Delta t}$

$\vec{a} = \vec{v}_f - \vec{v}_i$ ✓ ✓

(3) < 0.50 , -0.75 > m/s
(4) < 0.50 , 0.25 > m/s
(5) - < 1.0 , 1.0 > m/s
(6) < 0.0 , 0.0 > m/s



$$\vec{a} = \frac{\vec{v}_f - \vec{v}_i}{\Delta t}$$

$$\Delta t\,\vec{a} = \vec{v}_f - \vec{v}_i$$

$$\vec{v}_f = \vec{v}_i + \Delta t\,\vec{a}$$

$$= \langle -1, -2 \rangle + 4 \langle .25, .5 \rangle$$

$$= \langle -1, -2 \rangle + \langle 1, 2 \rangle$$

$$\vec{v}_f = \langle 0, 0 \rangle \text{ m/s}$$

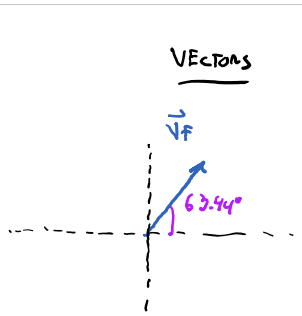
AQ.L2.3-04

Description: Find initial speed from information about final speed, duration, and average acceleration.

Learning Objectives: [x]

Problem Statement: A farmer observes a strange light accelerating uniformly in the sky above his fields. After watching for 45 s they take a short 10 s video of the phenomena with their cell phone and show it to you. After analyzing the video you determi ne that the object's final speed was 2.236 m/s in a direction 63.44º from what you've called the positive x -axis towards the positive y-axis. You also determined that the object had an average acceleration of < 3 , -1 > m/s². Assuming the average acceleration in the last 10 s was the same throughout the entire time, what was the initial speed of the object when the farmer first sighted it?

(1) 142 m/s
(2) 10 m/s
(3) 43 m/s
(4) -43 m/s
(5) 312 m/s



$$v_{fx} = 2.236 \cos 63.44° \qquad v_{fy} = 2.236 \sin 63.44$$

$$v_{fx} = 0.99979 \text{ m/s} \qquad v_{fy} = 2.00003 \text{ m/s}$$

$$\vec{v}_f = \langle 0.99979, 2.00003 \rangle \text{ m/s}$$

$$\vec{a} = \frac{\Delta \vec{v}}{\Delta t}$$

$$\vec{a} = \frac{\vec{v}_f - \vec{v}_i}{\Delta t}$$

$$\vec{v}_i = \langle 0.99939, 2.00003 \rangle - 45 \langle 3, -1 \rangle$$

$$= \langle 0.99939, 2.00003 \rangle - \langle 135, -45 \rangle$$

$$\vec{v}_i = \langle -134.00061, 47.00003 \rangle$$ m/s

Δt

$\Delta t \vec{a} = \vec{v}_f - \vec{v}_i$

$\vec{v}_i = \vec{v}_f - \Delta t \vec{a}$

$\vec{v}_i = \langle -134.00061, 47.00003 \rangle$ m/s

$|\vec{v}_i| \approx 142.004$ m/s

$\boxed{|\vec{v}_i| \approx 142 \text{ m/s}}$