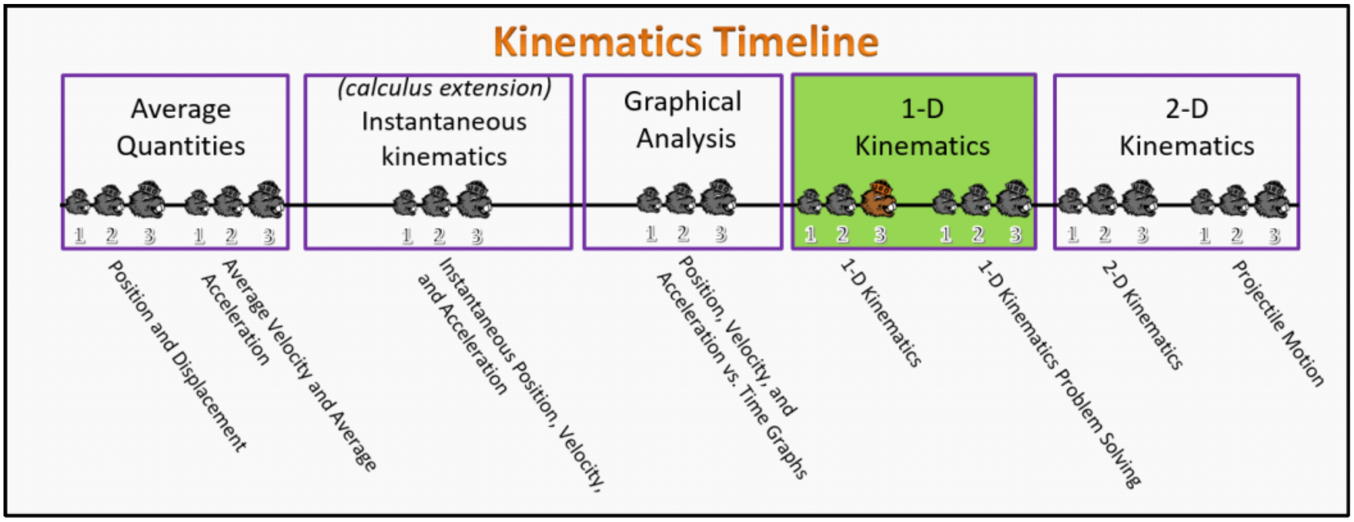
(K1.L1.3-sols) Practice Stage Solutions

Thursday, March 29, 2018 8:34 PM

1-D Kinematics

Foundation Stage (K1.L1.3)

Post-Lecture 1
1-D Kinematics



Questions

K1.L1.3-01

Description: Direction of velocity and acceleration for an object slowing down.

Learning Objectives: [x]

Problem Statement: Which of the following statements are true concerning a situation where a car is moving in the positive x-direction and is slowing down?

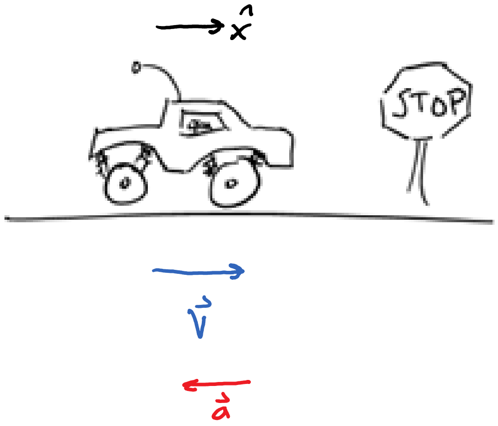
F (1) The velocity and acceleration both point the negative x-direction.

F (2) The velocity and the acceleration both point in the positive x-direction.

F (3) The velocity points in the positive x-direction but the acceleration could point in either the positive or negative x-direction.

F (4) The velocity points in the negative x-direction while the acceleration points in the positive x-direction.

T [✓ (5)] The velocity points in the positive x-direction while the acceleration points in the negative x-direction.



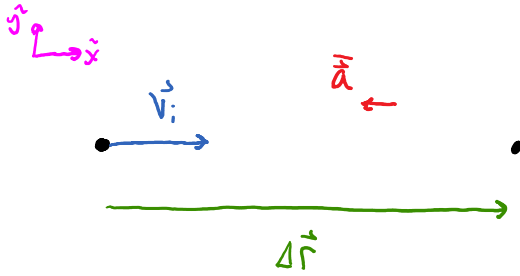
K1.L1.3-02

Description: Average acceleration from change in speed and distance.

Learning Objectives: [x]

Problem Statement: A jumbo jet, flying northward, is landing with a speed of 70 m/s. Once the jet touches down, it has 800 m of runway in which to reduce its speed to 5.0 m/s. Compute the average x-component of acceleration of the plane during the landing. Assume north is the positive direction.

(1) 2.45 m/s^2
(2) -2.45 m/s^2
(3) 3.05 m/s^2
[✓ (4) -3.05 m/s^2]
(5) 6.40 m/s^2
(6) -6.40 m/s^2



X

K	UK
$\Delta x = 800$ m	
$v_{ix} = 70$ m/s	$\bar{a}_x$
$v_{fx} = 5$ m/s	4+

$$\overset{\checkmark}{v_{fx}^2} = \overset{\checkmark}{v_{ix}^2} + 2\,\overset{?}{\bar{a}_x}\,\overset{\checkmark}{\Delta x}$$

$$5^2 = 70^2 + 2(-|\bar{a}_x|)(800)$$

$$|\bar{a}_x| = 3.046875 \ m/s^2$$

$$\boxed{\bar{a}_x = -3.05 \ m/s^2}$$

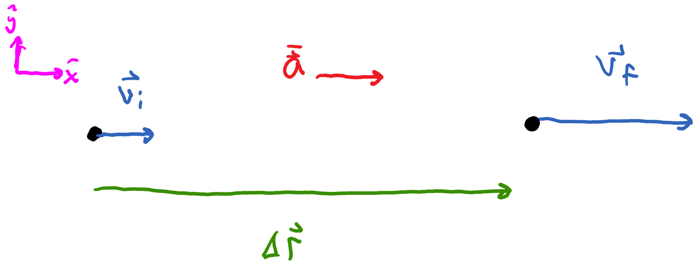
K1.L1.3-03

Description: Acceleration given a change in velocity over time.

Learning Objectives: [x]

Problem Statement: The driver of a sports car traveling at 10.0 m/s in the positive x-direction steps down hard on the accelerator for 5.0 s and the velocity increases to 30.0 m/s . What was the average x-component of acceleration of the car during the 5.0 s time interval? Assume standard coordinate system.

(1) –10.0 m/s^2
(2) –2.50 m/s^2
[✓ (3) 4.00 m/s^2]
(4) 6.00 m/s^2
(5) 20.0 m/s^2



X

X

k	uk
V_{ix}=10m/s	Δx
V_{fx}= 30m/s	$\bar{a}_x$
Δt= 5 s	

$$\overset{\checkmark}{V_{fx}} = \overset{\checkmark}{V_{ix}} + \overset{?}{\bar{a}_x}\,\overset{\checkmark}{\Delta t}$$

$$30 = 10 + \bar{a}_x (5)$$

$$\boxed{\bar{a}_x = 4.00\ m/s^2}$$

K1.L1.3-04

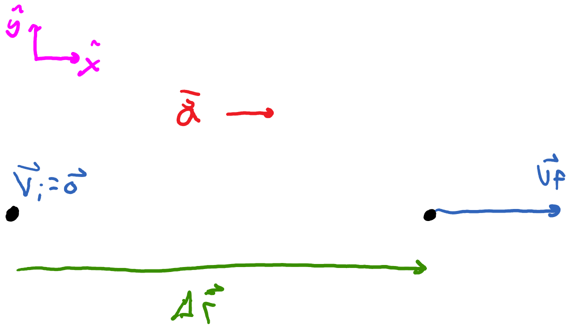
Description: Find acceleration and final velocity given time and distance.

Learning Objectives: [x]

Problem Statement: A dragster race car can accelerate from rest to incredible speeds. In one case a dragster is able to finish the 305 m run in 3.64 s.

(a) What was the magnitude of the average acceleration during this run?

(1) 16.0 m/s^2
(2) 26.0 m/s^2
(3) 36.0 m/s^2
[✓ (4)] 46.0 m/s^2
(5) 56.0 m/s^2



X

k	uk
Δx= 305 m	
V_{ix}=0	V_{fx}
Δt = 3.64s	$\bar{a}_x$

$$\overset{\checkmark}{\Delta x} = \cancel{\overset{\checkmark\,0}{V_{ix}}\,\overset{\checkmark}{\Delta t}} + \frac{1}{2}\overset{?}{\bar{a}_x}\,\Delta t^2$$

$$305 = 0(3.64) + \frac{1}{2}\bar{a}_x (3.64)^2$$

$$\bar{a}_x = 46.0391\ m/s^2$$

$$\boxed{|\bar{a}_x| = 46.0\ m/s^2}$$

(b) What is the top speed of the dragster?

(1) 142 m/s
(2) 154 m/s
[✓ (3) 168 m/s]
(4) 205 m/s
(5) 234 m/s

$$V_{fx} = \cancel{V_{ix}}^{0} + a_x \Delta t$$

$$V_{fx} = (46.0391)(3.64) \text{ m/s}$$

$$V_{fx} = 167.582 \text{ m/s}$$

$$\boxed{|V_{fx}| = 168 \text{ m/s}}$$

K1.L1.3-05

Description: Proportional reasoning with changing acceleration to change displacement.

Learning Objectives: [x]

Problem Statement: Consider that you've been tasked with creating better brakes for a car company. You're specification is to make the car stop in three quarters the distance they currently stop. By what factor then must you make the car's average acceleration change?

(1) 3/4
[✓ (2) 4/3]
(3) 9/16
(4) 16/9
(5) 3
(6) 4

$$\Delta x_f = \frac{3}{4}\Delta x :$$

$$V_f^2 = V_i^2 + 2 a_x \Delta x$$

w/ V_f & V_i = const

$$a_x \propto \frac{1}{\Delta x}$$

If $\Delta x \to \frac{3}{4}\Delta x$

$$a_x \to \frac{4}{3} a_x$$

K1.L1.3-06

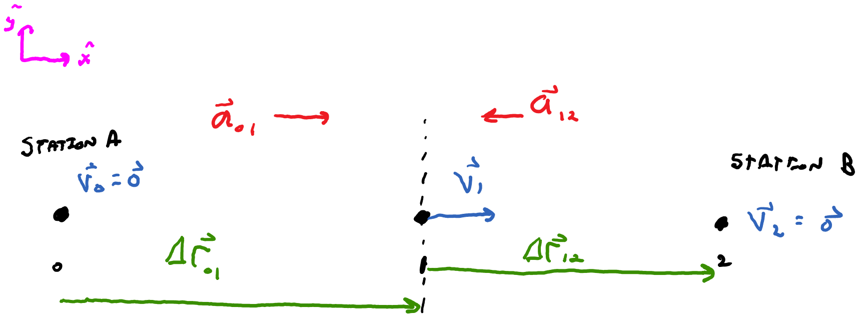
Description: Two stage train problem about fastest speed and shortest time between stations.

Learning Objectives: [x]

Problem Statement: Two train stations are 800 m apart. The maximum acceleration that feels comfortable in a train is 1.2 m/s^2.

(a) What is the fastest speed the train could attain between the stations and still pick/drop passengers at both.

[✓ (1)] 31.0 m/s
(2) 34.8 m/s
(3) 42.0 m/s
(4) 44.1 m/s
(5) 51.6 m/s



CONNECTIONS

$|\vec{a}_{01}| = |\vec{a}_{12}|$

$\Delta t_{01} = \Delta t_{12}$

$0 \rightarrow 1$

x

k	uk
$\Delta x_{01} = 400m$	v_{1x}
$v_{0x} = 0$	
$a_{01x} = 1.2 \, m/s^2$	Δt_{01}

$$\overset{?}{v_{1x}^2} = \overset{\checkmark}{v_{0x}^2} + 2\overset{\checkmark}{a_{01x}}\overset{\checkmark}{\Delta x_{01}}$$

$$= 0^2 + 2(1.2)(400)$$

$$v_{1x}^2 = 960 \, m/s$$

$$v_{1x} = 30.98387 \, m/s$$

$$\boxed{|\vec{v}_1| \approx 31.0 \, m/s}$$

(b) What is the shortest time between the stations?

(1) 31.0 s
(2) 34.8 s
(3) 42.0 s
(4) 44.1 s
[✓ (5)] 51.6 s

$$\Delta t_{AB} = \Delta t_{01} + \Delta t_{12}$$

$$\Delta t_{AB} = 2\,\Delta t_{01}$$

$$\Delta x_{01} = \overset{0}{\cancel{v_{0x}\Delta t_{01}}} + \frac{1}{2}a_x \Delta t_{01}^2$$

$$400 = \frac{1}{2}(1.2)\,\Delta t_{01}^2$$

$$\Delta t_{01} \approx 25.81989 \text{ SEC}$$

$$\Delta t_{AB} \approx 51.63978 \text{ SEC}$$

$$\boxed{\Delta t_{AB} \approx 51.6 \text{ SEC}}$$