Phy 2A 4/10

Monday, April 10, 2017 8:51 AM

**Goals for the Lecture:**

1) Introduce myself and the course
2) Discuss good study habits
3) Be able to do unit conversions
4) Gain a basic understanding of position, velocity, and acceleration

**Application of the Day:**

**Unit Conversions:**

JET'S FUEL RAN OUT AFTER METRIC CONVERSION ERRORS

By RICHARD WITKIN
Published: July 30, 1983

Air Canada said yesterday that its Boeing 767 jet ran out of fuel in midflight last week because of two mistakes in figuring the fuel supply of the airline's first aircraft to use metric measurements.

After both engines lost their power, the pilots made what is now thought to be the first successful emergency "dead stick" landing of a commercial jetliner.

The pilots of the Ottawa-to-Edmonton flight came in over the end of the runway at Gimli, Manitoba, at an abnormally high speed of about 180 knots because the engine failure made it impossible to use the flaps to make a slower approach. But the only serious damage was a collapsed nose gear, and the only casualties among the 69 people on board were two passengers who suffered minor injuries.

Mars Climate Orbiter – Crashed in September 1999 – the crash of the $125 million spacecraft has been blamed on the fact that one of the engineering teams use British unit while the other used SI units. The two groups relied on each other's numbers, without realizing the units were not the same.

Light year:

$$\left(3\times10^{8}\ \frac{m}{s}\right)\left(60\ \frac{s}{min}\right)\left(60\ \frac{min}{hr}\right)\left(24\ \frac{hr}{day}\right)\left(365\ \frac{day}{year}\right)\left(1\ year\right) = (\quad)\ m$$

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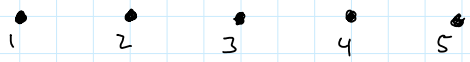
Motion Diagram:




moving to the right with constant speed


moving to the right with increasing speed

with acceleration – yes
with increasing velocity – yes
with increasing speed – yes
with positive acceleration – NO

Need to define positive direction

$\Delta\vec{x}$ → displacement $\quad \Delta\vec{x} = \vec{x}_f - \vec{x}_i$ (not distance traveled)

$\Delta\vec{X}$ → displacement $\Delta\vec{X} = \vec{X}_f - \vec{X}_i$ (not distance traveled)

Velocity = $\frac{\Delta\vec{X}}{\text{time}}$ (vector, has magnitude and direction)

speed = $\frac{\text{distance}}{\text{time}}$ (scalar, has magnitude only)

acceleration = $\frac{\Delta\vec{v}}{\text{time}}$ (vector)

1 2 3 4 5

moving to the right with decreasing speed

with Negative acceleration - NO
with deceleration - okay
with decreasing speed - yes
with acceleration to the left - yes

Speeding up or Slowing down:

When $\vec{a}$ and $\vec{v}$ have the same sign (they point in the same direction) → object is speeding up

When $\vec{a}$ and $\vec{v}$ have opposite signs (they point in opposite directions) → object is slowing down

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Worksheet p. 33

Top:

A) $\Delta X = X_f - X_i = 4\text{ m} - 0\text{ m} = 4\text{ m}$

B) $\Delta X = 1\text{ m} - 0\text{ m} = 1\text{ m}$

C) $\Delta X = 6\text{ m} - 0\text{ m} = 6\text{ m}$

D) $\Delta X = 9\text{ m} - 1\text{ m} = 8\text{ m}$

Find the average velocity over the first 2 seconds:

A) $\vec{v} = \frac{\Delta\vec{X}}{\text{Time}} = \frac{4\text{ m}}{2\text{ s}} = 2\ \frac{\text{m}}{\text{s}}$

1 m

B) $\vec{v} = \frac{1\text{ m}}{2\text{ s}} = 0.5\ \frac{\text{m}}{\text{s}}$

C) $\vec{v} = \frac{6\text{ m}}{2\text{ s}} = 3\ \frac{\text{m}}{\text{s}}$

D) $\vec{v} = \frac{8\text{ m}}{2\text{ s}} = 4\ \frac{\text{m}}{\text{s}}$

Find the average acceleration over the first 2 seconds:

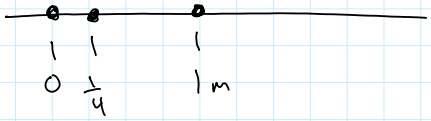
A) $\vec{a} = \frac{\Delta \vec{V}}{\text{time}} = \frac{V_2 - V_1}{\text{time}}$

$V_2 = \frac{4\text{m} - 2\text{m}}{1\text{ s}} = 2\ \frac{\text{m}}{\text{s}}$

$V_1 = \frac{2\text{ m} - 0\text{m}}{1\text{ s}} = 2\ \frac{\text{m}}{\text{s}}$

$\vec{a} = \frac{2-2}{2} = 0$

B)




$\vec{a} = \frac{V_2 - V_1}{\text{time}}$

$V_2 = \frac{(1 - 0.25)\text{m}}{1\text{ s}} = 0.75\ \frac{\text{m}}{\text{s}}$

$V_1 = \frac{(0.25 - 0)\text{m}}{1\text{ s}} = 0.25\ \frac{\text{m}}{\text{s}}$

$\vec{a} = \frac{(0.75 - 0.25)\ \frac{\text{m}}{\text{s}}}{2\text{ s}} = 0.25\ \frac{\text{m}}{\text{s}^2}$

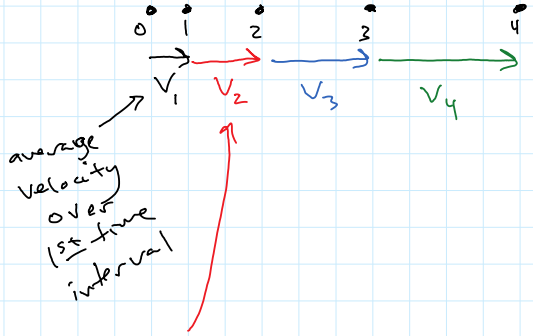
C) $a = 0$

D) $a = \frac{V_2 - V_1}{\text{time}}$

$V_2 = \frac{9\text{m} - 6\text{m}}{1\text{ s}} = 3\ \frac{\text{m}}{\text{s}}$

$V_1 = \frac{6\text{m} - 1\text{m}}{1\text{ s}} = 5\ \frac{\text{m}}{\text{s}}$

$a = \frac{3\ \frac{\text{m}}{\text{s}} - 5\ \frac{\text{m}}{\text{s}}}{2\text{ s}} = -\frac{2\ \frac{\text{m}}{\text{s}}}{2\text{ s}} = -1\ \frac{\text{m}}{\text{s}^2}$




if $V_1 = 4 \frac{m}{s}$

and $V_2 = 8 \frac{m}{s}$

then $V_3 = 12 \frac{m}{s}$

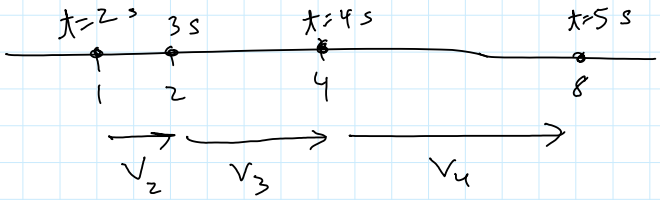
$V_4 = 16 \frac{m}{s}$

$$a_3 = \frac{V_4 - V_3}{\text{time}} = \frac{4 \frac{m}{s}}{1 s} = 4 \frac{m}{s^2}$$

$$a_2 = \frac{V_3 - V_2}{\text{time}} = \frac{4 \frac{m}{s}}{1 s} = 4 \frac{m}{s^2}$$

$$a_1 = \frac{V_2 - V_1}{\text{time}} = \frac{4 \frac{m}{s}}{1 s} = 4 \frac{m}{s^2}$$

p. 33 B)




if $V_2 = 1 \frac{m}{s}$

then $V_3 = 2 \frac{m}{s}$

$V_4 = \frac{4 m}{1 s} = 4 \frac{m}{s}$

$$a_3 = \frac{V_4 - V_3}{1 s} = \frac{4 - 2}{1} = 2 \frac{m}{s^2}$$

$$a_2 = \frac{V_3 - V_2}{1 s} = \frac{2 - 1}{1} = 1 \frac{m}{s^2}$$

} changing (Not constant acceleration)

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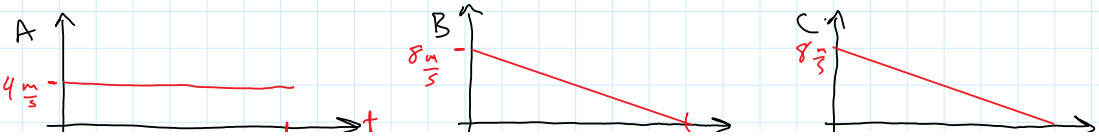
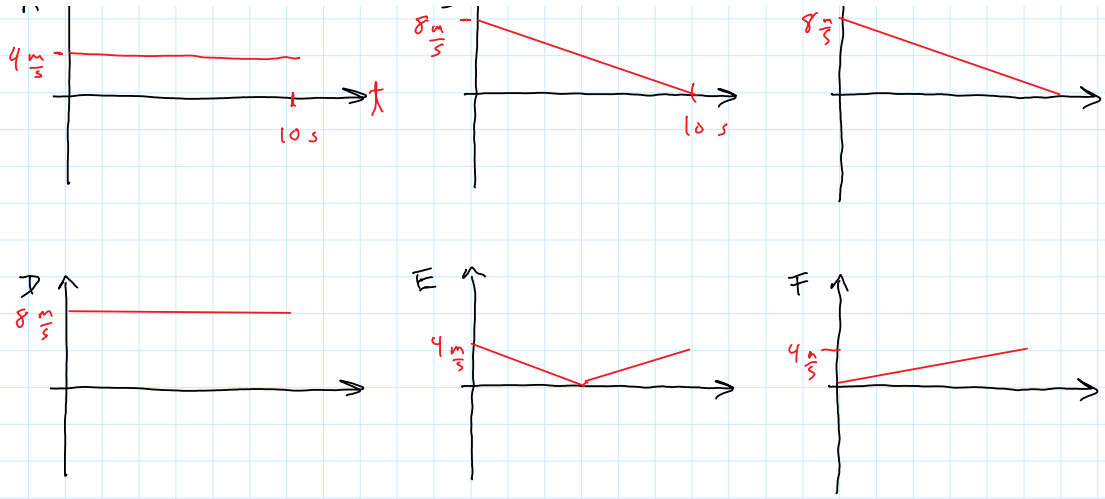
Worksheet p. 37 given velocity vs. time, draw speed vs. time:







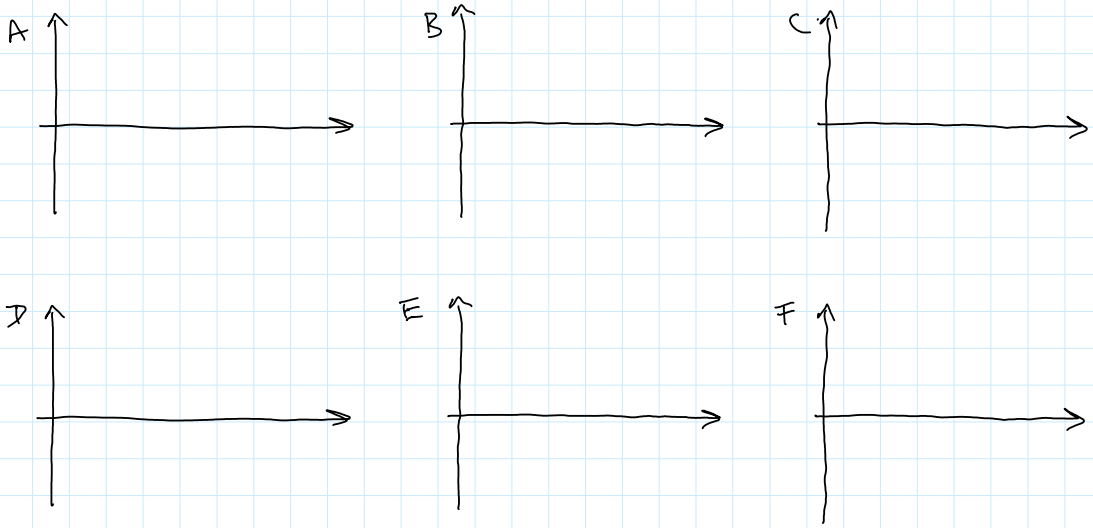


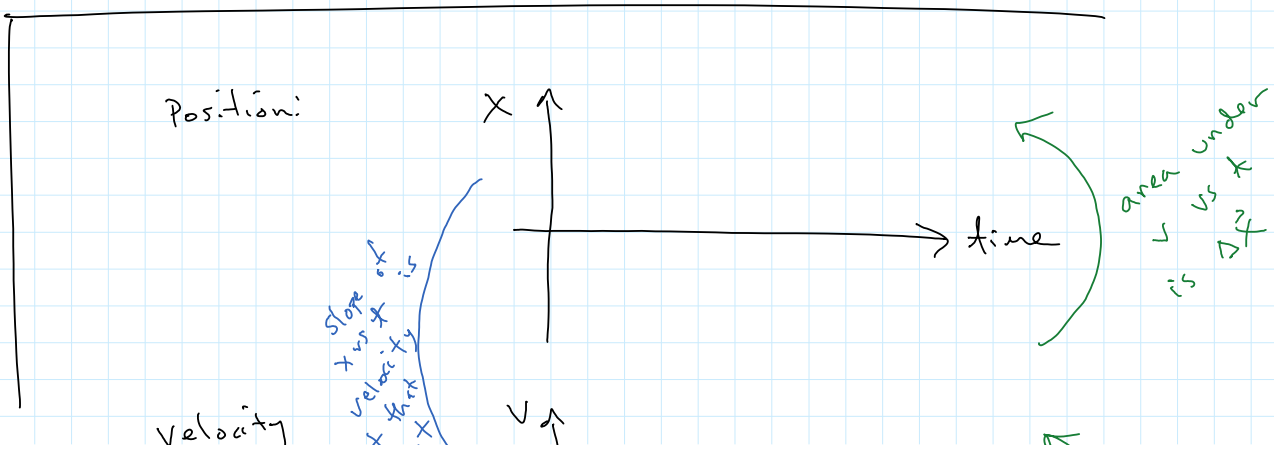
Find: 1) Distance traveled for each one

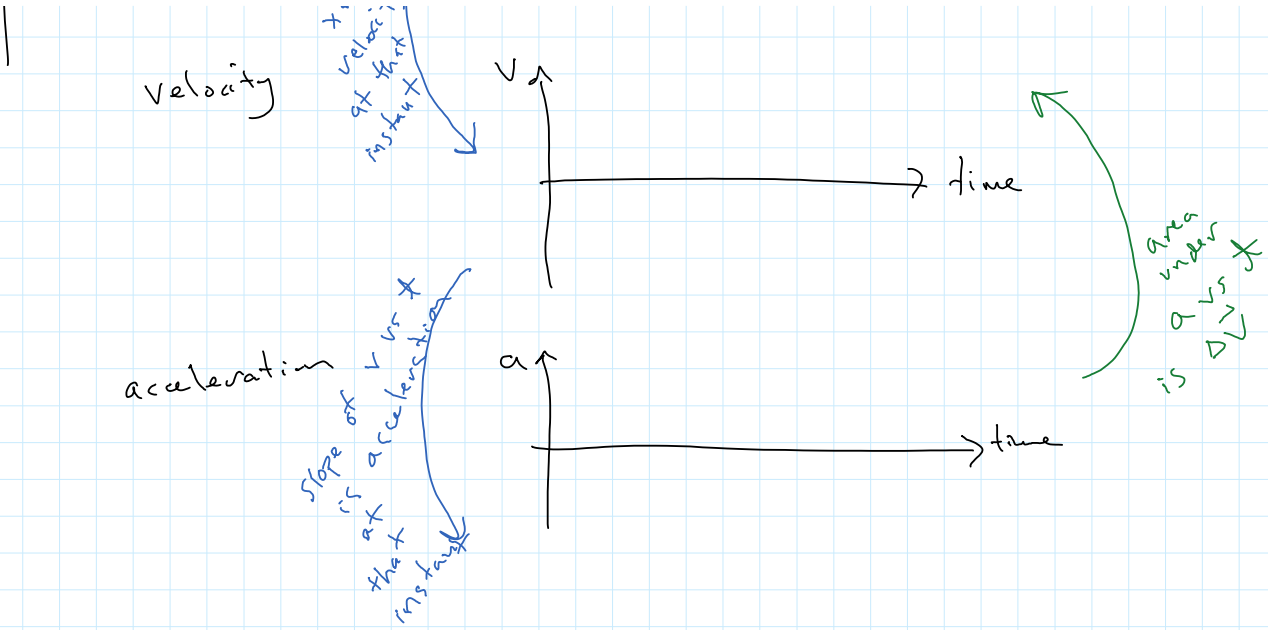
2) Displacement for each one

3) acceleration for each one

4) graph acceleration vs. time for each




Velocity
velocity at that instant
v
time
area under v vs t is Δv
acceleration
slope of v vs t is acceleration at that instant
a
time