Name: KEY

Date:

Section C D F

The Masters School
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Physics

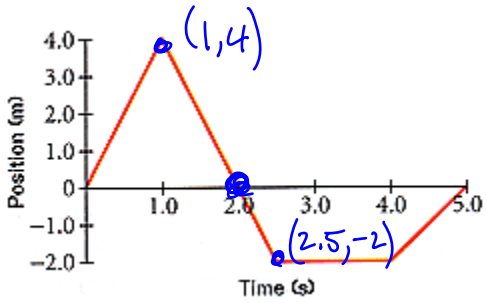
Position and Velocity I

1. If you live 20.0 km from your school and the bus takes 0.77 h to reach the school driving due east, what is the average velocity of the bus? (in m/s)

$$v_{avg} = \frac{\Delta x}{\Delta t} = \frac{20\text{ km}}{.77\text{ hr}} = \frac{25.97\text{ km}}{\text{hr}} \times \frac{1\text{ hr}}{3600\text{ s}} \times \frac{1000\text{ m}}{1\text{ km}}$$

$$= 7.2\text{ m/s}$$

2. The graph below gives the position-time graph for a squirrel running along a clothesline.



   a. What is the squirrel's displacement during the time interval from t = 0 to t = 3.0 s?

$$\Delta x = -2\text{ m}$$

   b. What is the squirrel's average velocity during this interval?

$$v_{avg} = \frac{\Delta x}{\Delta t} = \frac{-2\text{ m}}{3\text{ s}} = -.66\text{ m/s}$$

   c. What is the squirrel's velocity at t = 2 seconds?

$$\text{Velocity} = \text{slope} = \frac{\text{rise}}{\text{run}} = \frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-2-4}{2.5-1} = \frac{-6}{1.5} = -4\text{ m/s}$$

3. A car traveling in a straight line has a velocity of +6.5 m/s. After 4.5 s, its velocity is +5.0 m/s. What is the car's average acceleration in this time interval? Make sure to give correct units!

$$a_{avg} = \frac{\Delta v}{\Delta t} = \frac{v_2 - v_1}{\Delta t_2 - \Delta t_1} = \frac{5 - 6.5}{4.5 - 0} = \frac{-1.5}{4.5} = -.33\text{ m/s}^2$$

Emily takes a trip, driving with a constant velocity of 89.5 km/h to the north except for a 22 min rest stop. If Emily's average velocity is 74.8 km/h to the north, how long does the trip take, in hours? Give the answer to 2 decimal places; your answer should be between 2.10 and 2.30 hours.

Split the problem into two sections

① Constant Velocity of 89.5 km/h

② Rest stop for 22 min

$\Delta t_{tot} = \Delta t_1 + \Delta t_2$

$= \Delta t_1 + 22 \text{ min}$

Find Δt_1

Given

$V_1 = 89.5$ km/h

$\Delta x_1 = ?$

$\Delta t_1 = ?$

$V_2 = 0$ km/h

$\Delta x_2 = 0$ km

$\Delta t_2 = 22 \text{ min} = .367$ hrs

$V_{avg} = 74.8$ km/h

$$V_{avg} = \frac{\Delta x_{tot}}{\Delta t_{tot}} = \frac{\Delta x_1 + \Delta x_2}{\Delta t_1 + \Delta t_2}$$

$$V_{avg} = \frac{\Delta x_1}{\Delta t_1 + \Delta t_2}$$

$$V = \frac{\Delta x}{\Delta t}$$

$$\Delta x = V \Delta t$$

Find Δt_1

isolate Δt_1

$$V_{avg} = \frac{V_1 \Delta t_1}{\Delta t_1 + \Delta t_2}$$

all variables known except Δt_1

$$V_{avg}(\Delta t_1 + \Delta t_2) = V_1 \Delta t_1$$

Distribute

$$(V_{avg})(\Delta t_1) + (V_{avg})(\Delta t_2) = V_1 \Delta t_1$$

Factor

$$V_{avg} \Delta t_1 - V_1 \Delta t_1 = -V_{avg} \Delta t_2$$

$$\Delta t_1 (V_{avg} - V_1) = -V_{avg} \Delta t_2$$

$$\Delta t_1 = \frac{-V_{avg} \Delta t_2}{(V_{avg} - V_1)} = \frac{-(74.8)(.367)}{(74.8 - 89.5)} = 1.867 \text{ h}$$

Find Δt_{tot}

$$\Delta t_{tot} = \Delta t_1 + \Delta t_2 = 2.234 \text{ h}$$