Relating Velocity, Acceleration and Displacement

2/2 points earned (100%)

Excellent!

Retake

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1.
[#231] **Accelerating vehicle**

You're travelling in a straight line. With a constant acceleration of $0.50\ \mathrm{m} \cdot s^{-2}$, how long does it take to accelerate from $13\ \mathrm{m} \cdot \mathrm{s}^{-1}$ to $18\ \mathrm{m} \cdot \mathrm{s}^{-1}$, and how far do you travel while doing so?

Time = _____ seconds

Distance = ______ metres.

Separate your answers with a comma (ex: a,b)

10, 160

Correct Response
We have constant acceleration. $v = v_0 + at$, so

$t = (v - v_0)/a = (18\ \mathrm{m \cdot s^{-1}} - 13\ \mathrm{m \cdot s^{-1}})/(0.50\ \mathrm{m \cdot s^{-2}}) = 10\ \mathrm{s}$ (to either 1 or 2 sig figs).

To find the distance travelled, we use:

$v^2 - v_0^2 = 2a(x - x_0)$, so

$(x - x_0) = (v^2 - v_0^2)/(2a) = [(18\ \mathrm{m \cdot s^{-1}})^2 - (13\ \mathrm{m \cdot s^{-1}})^2]/[2(0.50\ \mathrm{m \cdot s^{-2}})] = 160\ \mathrm{m}$ (to 2 sig figs).

The correct answer is: 10, 160 (or 10, 200 to one significant figure)

And no, the cyclist in the picture was not travelling at $18\ \mathrm{m \cdot s^{-1}}$!

Show other acceptable responses

1 / 1 points

2.
[#232] **Stopping distance**

A value commonly taken for the perception-reaction time of motorists is $\Delta t = 1.5\ \mathrm{s}$. Using this value, determine the total stopping distance for a car travelling at $30\ \mathrm{m \cdot s^{-1}}$ (two significant figures). In calculating the stopping distance, let's assume that the vehicle continues at its initial speed for Δt, then decelerates to rest. A reasonable value for the deceleration in braking is (constant) $8.0\ \mathrm{m \cdot s^{-2}}$.

Stopping distance = ______ metres. (Hint: How many significant figures?)

100

Correct Response
During the constant deceleration, $a = -8.0\ \mathrm{m \cdot s^{-2}}$, $v_0 = 30\ \mathrm{m \cdot s^{-1}}$, and $v = 0$.

$v^2 - v_0^2 = 2a(x - x_0)$

$(x - x_0) = -v_0^2/2a = -(30\ \mathrm{m \cdot s^{-1}})^2/(-16.0\ \mathrm{m \cdot s^{-2}}) = 56\ \mathrm{m}$.

To this we must add the distance the car travels during Δt. During reaction time, the car travels $\Delta x = v\Delta t = 45\ \mathrm{m}$, so the total stopping distance, to 2 sig figs, is $100\ \mathrm{m}$.

Important note. For an alert driver, perception-reaction times may be shorter, and they may be longer for a drowsy one. Under good conditions (clean, dry road), deceleration may be greater, but on a wet road it may be smaller. In any case, it's a long distance, so be careful on the highway.