HW1

Monday, January 10, 2022 11:26 PM

1) "SI units" are the standard units in science; length in meters, time in seconds, mass in kilograms. Convert the following to SI units. Report your answer to three significant figures.

A. 8.0 in

$8\,in \cdot \frac{0.0254\,m}{1\,in} = 0.20\,m$

B. 66 ft/s

$\frac{66\,ft}{s} \cdot \frac{0.3048\,m}{1\,ft} = 20.1\,\frac{m}{s}$

C. 60 mph

$\frac{60\,mi}{hr} \cdot \frac{1609.34\,m}{1\,mi} \cdot \frac{1\,hr}{60\,min} \cdot \frac{1\,min}{60\,sec} = 26.82\,\frac{m}{s}$

D. 14 in^2

$14\,in^2 \cdot \frac{0.0254\,m}{1\,in} \cdot \frac{0.0254\,m}{1\,in} = 0.009\,m$

2) In an equation, every term that is added or subtracted must have the same units (you can't subtract seconds from meters, in the same way that you can't subtract apples from oranges). In the following equations, which term on the right has the wrong units? (d is distance, v is velocity, a is acceleration and t is time)

A. $d_2 = d_1 + v$

the v does not belong

$d_2 = m + m/s$ ≠ distance

B. $d_2 = d_1 + v \cdot t^2$

the t^2 does not belong, it would have to be t

$d_2 = m + m/s \cdot s^2 = m + m \cdot s$ ≠ distance

C. $d_2 = d_1 + v \cdot t + \frac{1}{2}a$

The a does not belong because the result will not be a distance.

$d_2 = m + m/s \cdot s + m/s^2 = m + m/s^2$ ≠ distance

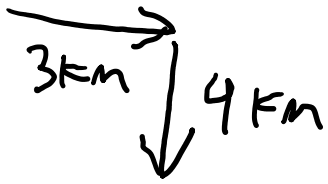
D. $d_2 = d_1 t + v \cdot t + \frac{1}{2}a \cdot t^2$

I think the t in d_1 doesn't belong, $d_2 = m \cdot s + m/s \cdot s + m/s^2 \cdot s^2$

$d_2 = d_1 + v \cdot t + \frac{1}{2}a \cdot t^2$ $= m \cdot s + m + m$ is ≠ distance

$= m + m + m$ = distance

3) A car travels east for 3 km, then south for 4 km. What is the car's total displacement (include magnitude and direction)?



displacement = 7 km

4) When you sneeze, the air in your lungs accelerates from rest to 150 km/h in about 0.50 s. (Wow!) What is the acceleration of the air in m/s^2?

$a = \frac{v_f - v_0}{\Delta t} = \frac{150\frac{km}{hr} - 0}{0.50\,s} = 300\frac{km}{hr \cdot s}$

$300\frac{km}{hr \cdot s} \cdot \frac{1000m}{1km} \cdot \frac{1hr}{60min} \cdot \frac{1min}{60sec} = \boxed{83.3\frac{m}{s^2}}$

5) Suppose you travel from Ogden to Salt Lake City, a distance of about 50 km. About how long will this take you, traveling at 60 mph?

A. Make a prediction: What units should you have for your answer? Give an example of an answer with a magnitude that is totally, totally wrong.

I think it will take about $\frac{1}{2}$ hour.

B. Calculate the answer.

$60\frac{mi}{hr} \cdot \frac{1.60934km}{1mi} = 96.56\frac{km}{hr}$ $\frac{50\,km}{96.56\frac{km}{hr}} = \boxed{0.51\,hr}$

C. Check your work: Did you have the correct units? Does this time seem about right?

Yes hours is an appropriate measurement. This seems about right.

6) A car travels at constant velocity for 1.5 hours. During that time, the car travels 100 km.

A. What was the average speed of the car, in km/hr?

$\frac{100\,km}{1.5\,hr} = \boxed{66.6\frac{km}{hr}}$

B. What was the average speed of the car in m/s?

$66.6\frac{km}{hr} \cdot \frac{1000m}{1km} \cdot \frac{1hr}{60min} \cdot \frac{1min}{60sec} = \boxed{18.5\,m/s}$

C. Was the car most likely traveling on the highway, or on side roads?

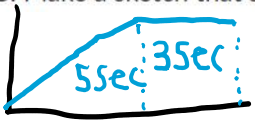
the car is most likely on side roads.

7) Suppose that you read the following problem: "Alex accelerates from a stoplight at 5 m/s^2 for five seconds, and then coasts for three more seconds. How far has Alex traveled?" This problem must be solved in two parts.

A. Make a prediction: What should the units of your answer be? Give an example of the magnitude of an answer that is totally, totally wrong.

50m

B. Make a sketch that shows both parts that you will need to solve to solve the problem.



C. Solve the first part.

5sec

C. Solve the first part.

$V = ?$ $V_f = V_0 + a \cdot t = 0 + 5 m/s^2 \cdot 5s = 25 m/s$

D. Solve the second part.

$d = Vt = 25 m/s \cdot 3s = 75m$

E. How far has Alex traveled?

$d_T = d_1 + d_2$, $d_1 = V_f \cdot t = 25 m/s \cdot 3 = 75m$

$d_2 = Vt = 75m$, $d_T = 75m + 75m = 150m$

F. Check your work: Does your answer have the correct units? Does the numerical value seem reasonable?

yes the distance seems right and it is in meters

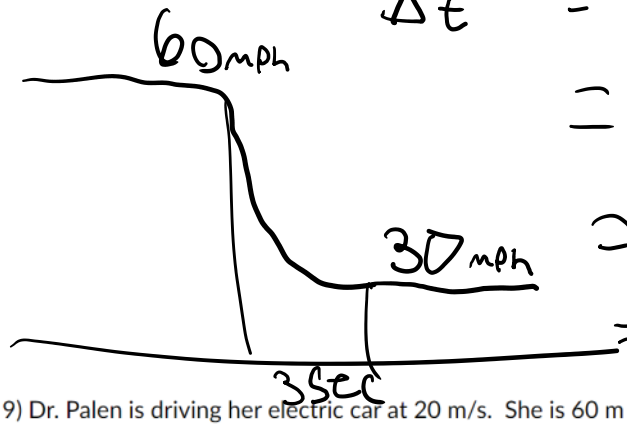
8) Sam is recklessly driving 60 mph in a 30 mph speed zone when she suddenly spies a patrol car. She steps on the brakes and slows to 30 mph in 3 seconds, looking nonchalant as she passes the officer. How far does she travel while braking?

$\frac{V_f - V_0}{\Delta t} = \frac{30 mph - 60 mph}{3s} = -10 \frac{mi}{hr \cdot s} =$

$= 10 \frac{mi}{hr \cdot s} \cdot \frac{1609.34 m}{1 mi} \cdot \frac{1 hr}{60 min} \cdot \frac{1 min}{60 sec}$

$= 4.47 \frac{m}{s^2} \rightarrow 3^2 s \cdot 4.47 m$

$= 40.23$ meters in 3 seconds

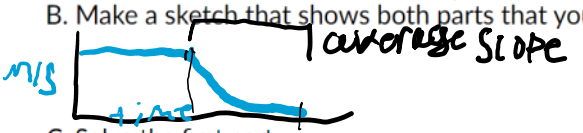


9) Dr. Palen is driving her electric car at 20 m/s. She is 60 m from a stoplight when she sees it turn yellow. Her reaction time, before she steps on the brakes is 0.5 s. What steady deceleration, while braking, will bring her to a stop at the light? This problem must be solved in two parts. 3 sec total to stop

A. Make a prediction: What should the units of your answer be? Give an example of the magnitude of an answer that is totally, totally wrong.

$-30 m/s$

B. Make a sketch that shows both parts that you will need to solve to solve the problem.



C. Solve the first part.

$time = \frac{60m}{20 m/s} = 3s - reaction\ time = 2.5 sec$

D. Solve the second part.

$\frac{V_f - V_i}{\Delta t} = \frac{0 - 20 m/s}{2.5s} = -8 m/s^2 = acceleration$

E. What deceleration does Dr. Palen need, in order to stop?

$-8 m/s^2$

F. Check your work: Does your answer have the correct units? Does the numerical value seem reasonable?

I think the units are correct. It has distance over time, except time is squared. the value seems ok for the time aspect being squared.

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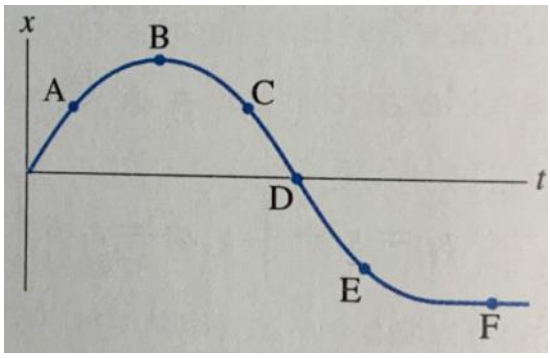
10) Suppose that, in lab, you obtain the following position-versus-time graph for a moving object. At which lettered point or points was the object



A. moving fastest?

It is close between A, C, D, & E but D seems to have the greatest absolute value slope.

B. moving to the left?

from D to F

C. speeding up?

A

D. turning around?

B