Claim-Evidence-Reasoning

***Question**: Does the **battery-operated car** move at constant speed or does it accelerate? If it moves at constant speed, what is its speed? If it accelerates, what is its acceleration?*

Claim

The battery-operated car moves at a constant speed of about 43.4 centimeters per second.

Evidence

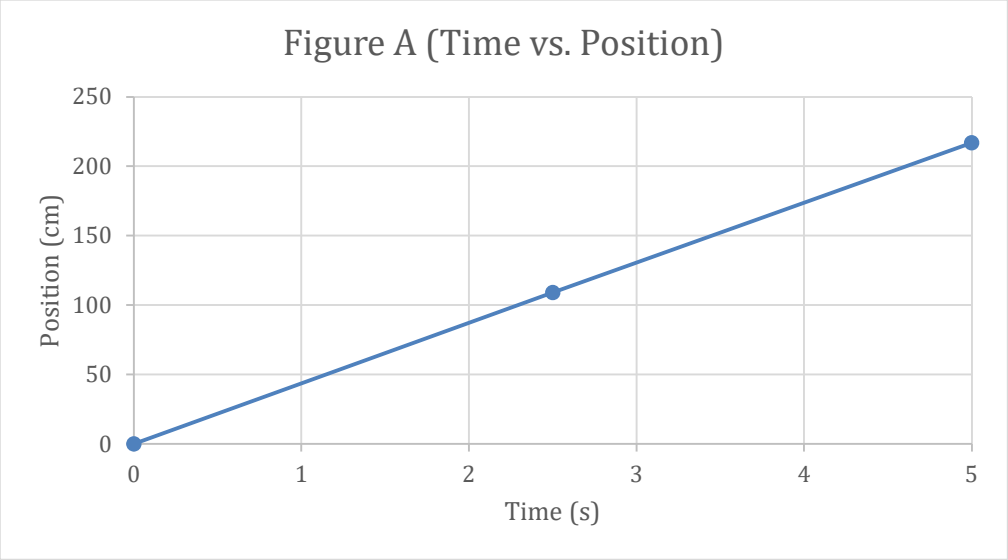
Lengths (centimeters)

Track Length	Car Length	Distance for Car
227	10.	217

Travel Times for Car (seconds)

Trials	Half Track (109 cm)	Whole Track (217 cm)
1st	2.37	5.07
2nd	2.58	4.93
3rd	2.41	5.01
4th	2.56	4.96
5th	2.62	5.04
Average	2.51	5.00

Reasoning



If an object moves as a constant speed, then no matter the distance it travels, it will always make the same distance in the same amount of time. After averaging our trials, we found that it takes about 2.51 seconds for the car to move across half the track, and 5.00 seconds for the total track. By subtracting the half track time from the whole track time, we see that the second half of the track took about 2.49 seconds to complete, which is approximately the same as the first half. This suggests that the car was moving at a constant speed. In Figure A, this can also be seen as the slope of time vs. position is constant (the line is straight). $x = vt$, so to find the velocity I divided the length of 217 centimeters by the total time of 5.00 seconds to get a speed of 43.4 cm/s or 0.434 m/s.

Claim-Evidence-Reasoning

***Question**: Does the **cart** move at constant speed or does it accelerate as it travels down the inclined track? If it moves at constant speed, what is its speed? If it accelerates, what is its acceleration?*

Claim

The cart accelerates down the inclined track at a rate of about 43.1 m/s^2.

Evidence

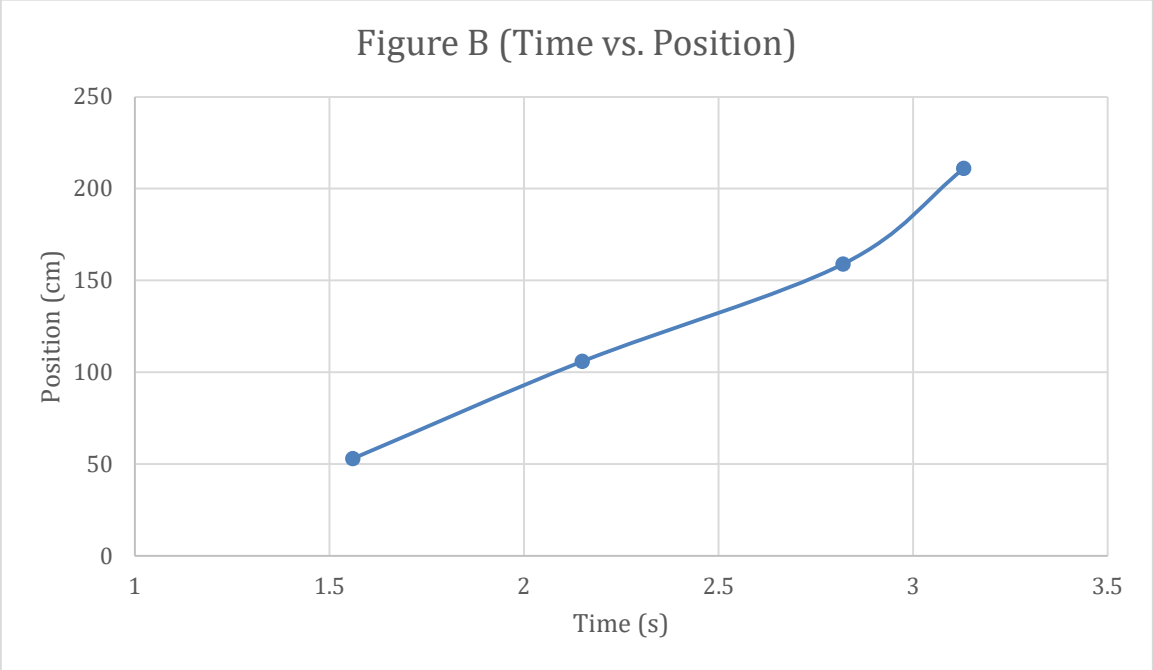
Lengths (centimeters)

Track Length	Cart Length	Distance for Cart
227	16	211

Travel Times for Cart (seconds)

Trials	1st Quarter (53 cm)	Half Track (106 cm)	3rd Quarter (159 cm)	Whole Track (211 cm)
1st	1.52	2.01	2.84	2.95
2nd	1.61	2.18	2.68	3.20
3rd	1.59	2.27	2.89	3.15
4th	1.59	2.16	2.86	3.18
5th	1.50	2.15	2.85	3.18
Average	1.56	2.15	2.82	3.13

Reasoning



If the cart accelerates, then it isn't traveling at a constant speed. Figure B shows the position of the cart compared to the time in which it reached the respective checkpoints. While Figure A's line is pretty much straight, Figure B depicts a slight upwards curve. Since velocity is the slope of time vs. position, this means that the velocity is increasing, which means that there is a positive acceleration. Acceleration can be calculated by using $\Delta x = v_0 t + \frac{1}{2}at^2$. Upon plugging in the proper values that turns into $211 = 0(3.13) + \frac{1}{2}a(3.13)^2$. After solving for a, $a \approx 43.1\ m/s^2$.