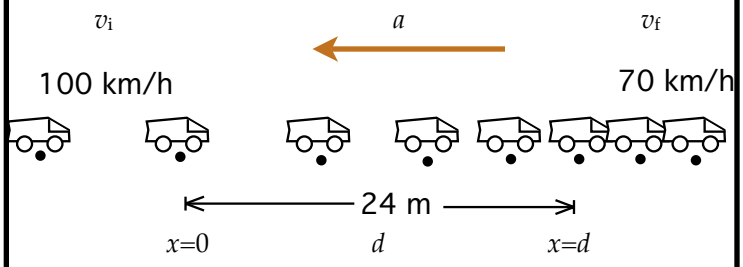
Workshop Physics Based on an assignment authored by R. Morse at St. Albans School

Name_____**Sec**_____**Date**_____

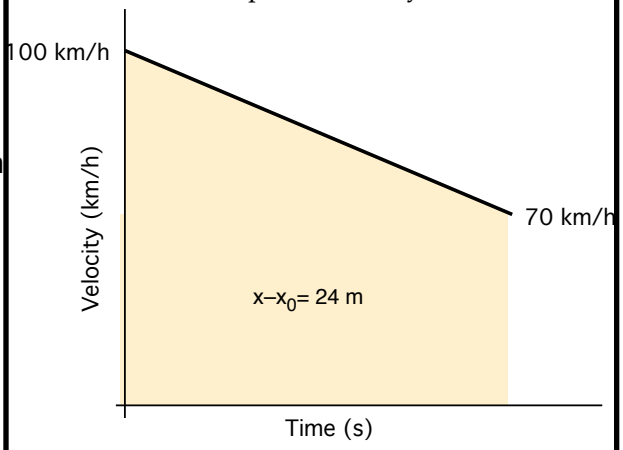
CONSTANT ACCELERATION SAMPLE PROBLEM

A car is travelling 100 km/h when it starts to brake. The car slows at a constant rate until its speed is 70 km/h. When it reaches 70 km/h it is 24 m from the point where it started slowing. How long does it take the car to slow from 100 km/h to 70 km/h and what is the car's braking acceleration? Mass of the Car = 1.6×10^3 Kg

Part 1: Motion Diagram



Part 1: Sketched Graph for Velocity vs. Time



Part 2: Tables and Unit Conversions

known: v_i, v_f, d

to find: t, a

$$(100\text{ km/h})\left(\frac{1\text{h}}{3600\text{s}}\right)\left(\frac{1000\text{m}}{1\text{km}}\right) = \frac{100}{3.6}\text{m/s} = 27.78\text{ m/s}$$

$$(70\text{ km/h}) = \frac{70}{3.6}\text{m/s} = 19.44\text{ m/s}$$

Part 2: Equations

$$d = v_{avg}t = \frac{v_i + v_f}{2}t \qquad v_i t + \tfrac{1}{2}at^2 = d$$

Part 3: Algebra and Substitution Solve for t and then a:

$v_{avg} = 23.61$ m/s,

$t = d/v_{avg} = 24\text{m}/23.61\text{ m/s} = 1.017$ s

$$a = \frac{d - v_i t}{t^2} = \frac{24\text{m} - (27.79\text{m/s})(1.017\text{s})}{(1.017\text{s})^2} = -4.19\text{m/s}^2$$

ANSWER $a = -4.19$ m/s² $= -4.2$ m/s²
(with proper sig. fig.)

Part 4: Units Check,

m/s²; (m/s)(s)/s² = m/s²

reasonable?:

4.2 m/s² is about 1/2 the acceleration of free fall. seems ok.

Part 5: Description of the Net Force Causing the Acceleration and its Calculation based on a knowledge of the Acceleration

The braking force may be due to locking the wheels and having them rub against the track or to a friction pad dragging on the center of the track.

$F = ma = (1.6 \times 10^3\text{ Kg})(-4.2\text{ m/s}^2) = -6.8 \times 10^3$ N

The force is negative since a is negative.