

Name: _____

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Program, Year & Section: _____

Date: _____

Worksheet 5b Rectilinear Motion

Study the following problems and solve for what is asked.

1. A car travelling along a straight road accelerates from rest to 90 km/h in 6.0 s. What is the magnitude of its average acceleration in m/s²? **(Express all answers to 2 s.f.)**

Given:

$$v_i = \text{_____ km/h} \quad v_f = \text{_____ km/h} \quad t = \text{_____ s}$$

Find: a**Solution:**

Convert 90 km/h to m/s

$$\left(90 \frac{\text{km}}{\text{h}}\right) \left(\frac{\text{m}}{1 \text{ km}}\right) \left(\frac{1 \text{ h}}{\text{s}}\right) = \frac{\text{m}}{\text{s}}$$

Solve for a

$$a = \frac{v_f - v_i}{t} = \frac{\frac{\text{m}}{\text{s}} - \frac{\text{m}}{\text{s}}}{\text{s}} = \frac{\text{m}}{\text{s}^2}$$

2. You were tasked to design an airport that could accommodate small planes that could reach a speed before takeoff of at least 100 km/h and can accelerate at 2.00 m/s². What should be the minimum runway length for the airplane to reach the required speed for takeoff? (Express all answers to 3 s.f.)

Given:

$$v_i = \text{_____ km/h} \quad v_f = \text{_____ km/h} \quad a = \text{_____ m/s}^2$$

Find: d**Solution:**

Convert 100 km/h to m/s

$$\left(100 \frac{\text{km}}{\text{h}}\right) \left(\frac{\text{m}}{1 \text{ km}}\right) \left(\frac{1 \text{ h}}{\text{s}}\right) = \frac{\text{m}}{\text{s}}$$

Solve for d

$$a = \frac{v_f^2 - v_i^2}{2d}$$
$$d = \frac{v_f^2 - v_i^2}{2} = \frac{\left(\frac{m}{s}\right)^2 - \left(\frac{m}{s}\right)^2}{2\left(\frac{m}{s^2}\right)} = \quad m$$

3. A car starts from rest and maintains a uniform acceleration of 2.0 m/s^2 along a straight road. As the car starts, another car moving in the same direction along another lane, passes it with a constant velocity of 80 km/hr . (a) When will the two cars be level with each other again? (b) What will be the speed of the first car at this point? (Express all answers to 2 s.f.)

Given:

First car

$$v_i = \quad \text{km/h} \quad a = \quad \text{m/s}^2$$

Second car

$$v_{\text{ave}} = \quad \text{m/s} \quad a = \quad \text{m/s}^2$$

Find: (a) t when the two cars are level (abreast) with each other
(b) v_f of the first car

Solution:

Convert 80 km/h to m/s

$$\left(80 \frac{\text{km}}{\text{h}}\right) \left(\frac{1 \text{ km}}{1000 \text{ m}}\right) \left(\frac{1 \text{ h}}{3600 \text{ s}}\right) = \quad \frac{\text{m}}{\text{s}}$$

For the two cars to be level (abreast) with each other, d and t should be the same for both cars.

Find d of the first car

$$d = v_i t + \frac{at^2}{2}$$
$$d = \left(\frac{m}{s}\right)(t) + \frac{\left(\frac{m}{s^2}\right)t^2}{2} = \quad t^2$$

Find d of the second car

$$v_{ave} = \frac{d}{t}$$

$$d = v_{ave} t = \left(\frac{m}{s} \right) t = \quad t$$

Since d of the first car = d of the second car

$$\begin{aligned} d_1 &= d_2 \\ t^2 &= \quad t \end{aligned}$$

Solve for t

$$\frac{t^2}{t} = \frac{t}{s}$$
$$t = \quad s$$

Solve for v_f of the first car

$$a = \frac{v_f - v_i}{t}$$

$$at + v_i = v_f$$

$$v_f = \left(\frac{m}{s^2} \right) (\quad s) + \left(\frac{m}{s} \right) = \quad \frac{m}{s}$$