Name: _____ Score: _____

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/s^2? **(Express all answers to 2 s.f.)**

Given:

v_i = _____ km/h v_f = _____ km/h t = _____ s

Find: a

Solution:

Convert 90 km/h to m/s

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

Solve for a

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

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/s^2. 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 = _____ km/h v_f = _____ km/h a = _____ m/s^2

Find: d

Solution:

Convert 100 km/h to m/s

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

Solve for d

$$a = \frac{{v_f}^2 - {v_i}^2}{2d}$$

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

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 = _____ km/h a = _____ m/s^2

Second car

V_{ave} = _____ m/s a = _____ m/s^2

Find: (a) **t** *when the two cars are level (abreast) with each other*
(b) $\mathbf{v_f}$ *of the first car*

Solution:

Convert 80 km/h to m/s

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

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

$$d = v_i t + \frac{at^2}{2}$$

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

Find d of the second car

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

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

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

$$d_1 = d_2$$

$$t^2 = \qquad t$$

Solve for t

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

$$t = \qquad s$$

Solve for v_f of the first car

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

$$at + v_i = v_f$$

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