PHYS 101: General Physics 1 **KOÇ UNIVERSITY** **Spring Semester 2016**

College of Sciences

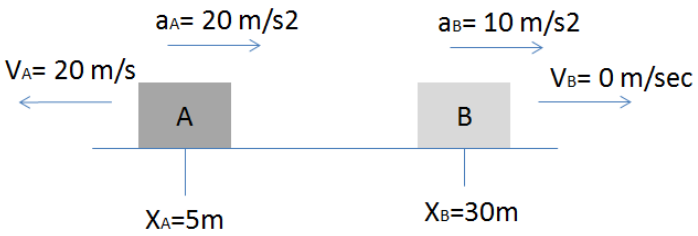
Section 1 **Quiz 2** **19 February 2016**

Closed book. No calculators are to be used for this quiz.

Quiz duration: 10 minutes

Name: **Student ID:** **Signature:**

As shown in the figure below, two cars **A** and **B** move along the x –axis. **A** is travelling with a constant acceleration 20 m/sec2 and its initial velocity is 20 m/sec. The second car **B** is travelling with a constant acceleration of 10 m/sec. Pls note that their initial positions are also different.



a) At what time(s) do **A** and **B** have the same position?
b) Plot a graph of position (X) versus time (t) for each car.

a.)

$$x_A = 5\,\text{m} - (20\,\text{m/s})t + \frac{1}{2}(20\,\text{m/s}^2)t^2$$
$$x_B = 30\,\text{m} + \frac{1}{2}(10\,\text{m/s}^2)t^2$$

We are looking for the time(s) where $x_A = x_B$.

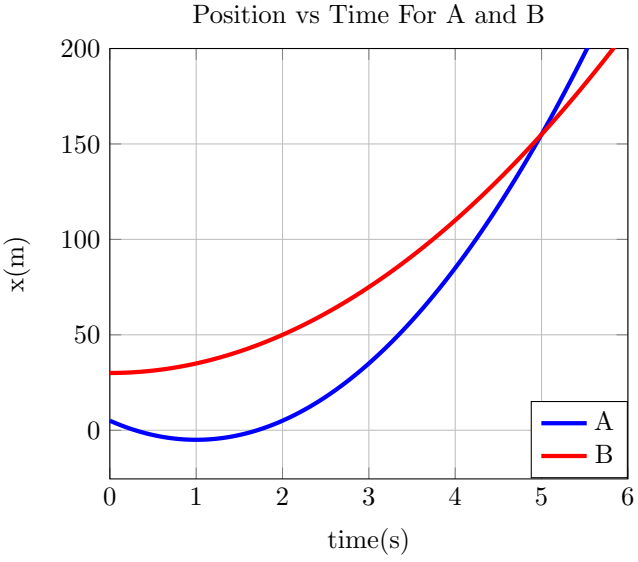
$$5\,\text{m} - (20\,\text{m/s})t + \frac{1}{2}(20\,\text{m/s}^2)t^2 = 30\,\text{m} + \frac{1}{2}(10\,\text{m/s}^2)t^2$$
$$(5\,\text{m/s}^2)t^2 - (20\,\text{m/s})t - 25\,\text{m} = 0$$
$$t = \frac{20\,\text{m/s} \pm \sqrt{(-20\,\text{m/s})^2 - 4(5\,\text{m/s}^2)(-25\,\text{m})}}{10\,\text{m/s}^2} = \frac{20 \pm 30}{10}\text{s}$$

We get two solutions:

$$t_1 = 5\,\text{s}$$
$$t_2 = -1\,\text{s}.$$

Only the positive root is a valid solution.

b.)



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Section 2 Quiz 2 19 February 2016

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Quiz duration: 10 minutes

Name: Student ID: Signature:

Suppose that while driving on the road to the university, you attempt to take over a car which is moving with constant speed $v_0 = 40 km/h$ ahead of you. Your car's initial speed is the same. You start the takeover maneuver $10m$ behind the car by applying a constant acceleration of $2m/s^2$ and complete it $15m$ ahead of the car, where you stop accelerating and move with your final constant speed.

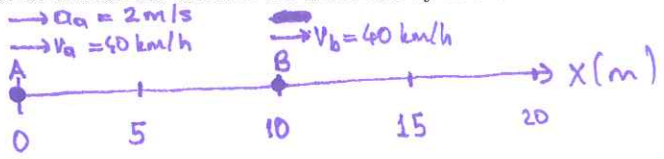
a) Sketch the initial configuration of the problem. (Draw coordinate system, positions, velocities etc. on your sketch.)

b) Calculate the total distance your car travels to complete the maneuver from where it has reached.

c) Plot the position-time graph of the two cars on the same figure. Take your car's position as the origin and indicate the time coordinate where both cars are moving side by side. Also show the distances given in the question and calculated in part (b) on the graph.

(a.)

Let us denote our car and the other car by A and B.



b.)

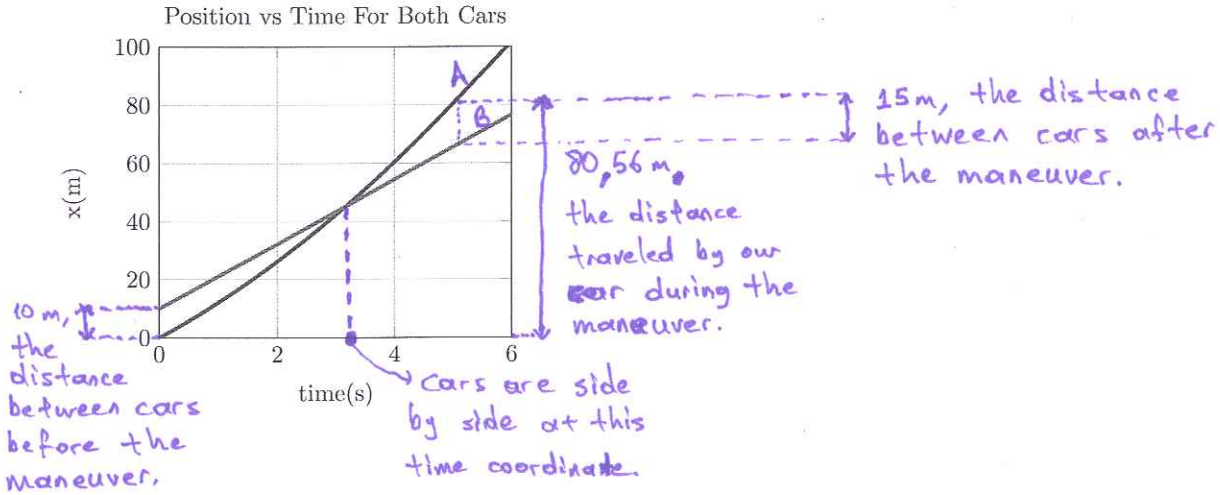
$$(5\,\text{km/h}) = \frac{40 \times 1000}{3600}\text{m/s} = \frac{100}{9}\text{m/s}$$

$$x_A = (\frac{100}{9}\text{m/s})t + \frac{1}{2}(2\,\text{m/s}^2)t^2$$
$$x_B = 10\,\text{m} + (\frac{100}{9}\text{m/s})t$$

We are looking for the time where $x_A = x_B + 15\,\text{m}$.

$$(\frac{100}{9}\text{m/s})t + \frac{1}{2}(2\,\text{m/s}^2)t^2 = 10\,\text{m} + (\frac{100}{9}\text{m/s})t + 15\,\text{m}$$
$$(1\,\text{m/s}^2)t^2 - 25\,\text{m} = 0$$
$$t = 5\,\text{s}$$
$$x_A(t = 5\,\text{s}) = (\frac{100}{9}\text{m/s})5\,\text{s} + \frac{1}{2}(2\,\text{m/s}^2)(5\,\text{s})^2 = 80.56\,\text{m}$$

c.)



PHYS 101: General Physics 1 **KOÇ UNIVERSITY** **Spring Semester 2016**

College of Sciences

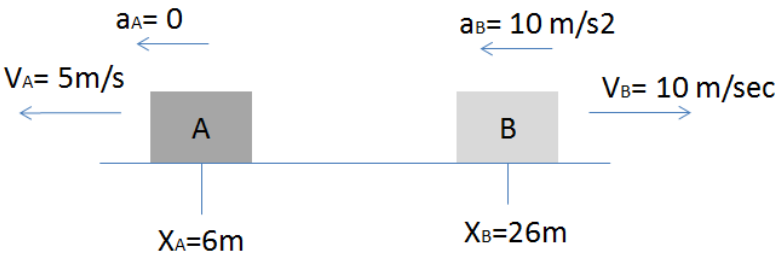
Section 3 **Quiz 2** **19 February 2016**

Closed book. No calculators are to be used for this quiz.

Quiz duration: 10 minutes

Name: **Student ID:** **Signature:**

As shown in the figure below, two cars **A** and **B** move along the x –axis. **A** is travelling with a constant velocity of 5 m/sec2. The second car **B** is travelling with a constant acceleration of 10 m/sec2 and its initial velocity is 10 m/sec. Pls note that their initial positions are also different.



a) At what time(s) do **A** and **B** have the same position?
b) Plot a graph of position (X) versus time (t) for each car.

a.)

$$x_A = 6\,\text{m} + (5\,\text{m/s})t$$
$$x_B = 26\,\text{m} + (10\,\text{m/s})t - \frac{1}{2}(10\,\text{m/s}^2)t^2$$

We are looking for the time(s) where $x_A = x_B$.

$$6\,\text{m} + (5\,\text{m/s})t = 26\,\text{m} + (10\,\text{m/s})t - \frac{1}{2}(10\,\text{m/s}^2)t^2$$
$$(5\,\text{m/s}^2)t^2 - (15\,\text{m/s})t - 20\,\text{m} = 0$$
$$t = \frac{15\,\text{m/s} \pm \sqrt{(-15\,\text{m/s})^2 - 4(5\,\text{m/s}^2)(-20\,\text{m})}}{10\,\text{m/s}^2} = \frac{15 \pm 25}{10}\text{s}$$

We get two solutions:

$$t_1 = 4\,\text{s}$$
$$t_2 = -1\,\text{s}.$$

Only the positive root is a valid solution.

b.)