KU Physics Department
PHYS 101 Laboratory

Quiz #1 Key

Groups a, b, d, f:

Q1. *(a,b,d,f) What's the aim/objective of the experiment?*

The aim/object ive of this experiment is to investigate the relationships between an object's position, velocity and acceleration when it is moving oin a straight line. The experiment will be performed in a situation which is a close approximation to ideal frictionless motion (no forces acting on the object).

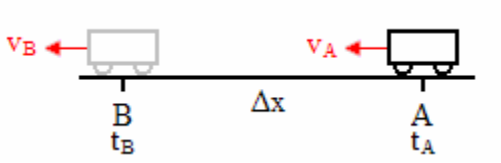
Group a(Thu B1):

Q2. *What is a picket fence?*

A picket fene is a small plastic card with a rows of black and clear regions. It should be placed vertically on top of the cart, with the 1-cm row (the row with the smallest black and clear regions) facing up.

Q3. *What's the average acceleration of the object?*

Δx=8m, v_A=10m/s and v_B=6m/s.



$$2 \cdot a \cdot \Delta x = v_B^{\,2} - v_A^{\,2} \Rightarrow a = \left(\frac{v_B^{\,2} - v_A^{\,2}}{2 \cdot \Delta x} \right)$$

$$a = \left(\frac{(6m/s)^2 - (10m/s)^2}{2 \cdot (8m)} \right) = -\frac{64}{16} m/s^2$$

$$a = -4m/s^2$$

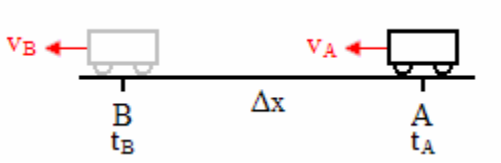
Group b(Thu B2):

Q2. *What's the experimental setup?*

The experimental setup is composed of:

- a Macintosh computer,
- a signal interface,
- two photogates,
- a picket fence,
- a small card and
- an ideally frictionless metal track.

Q3. *What's the initial velocity of the object?* v_A=?
Δx=16m, a=-4m/s^2 and v_B=8m/s.



$$2 \cdot a \cdot \Delta x = v_B{}^2 - v_A{}^2 \Rightarrow v_A{}^2 = v_B{}^2 - 2 \cdot a \cdot \Delta x \Rightarrow v_A = \sqrt{v_B{}^2 - 2 \cdot a \cdot \Delta x}$$

$$v_A = \sqrt{(8m/s)^2 - 2 \cdot (-4m/s^2) \cdot (16m)} = \sqrt{64 + 128} m/s$$

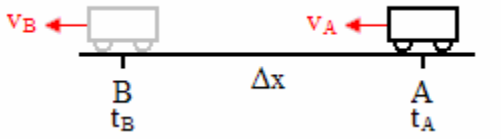
$$v_A = \sqrt{192} m/s$$

Group d(Thu B4):

Q2. *Briefly explain the procedure.*
The experimental procedure is as follows:

- Place the cart on the track and set the photogates 20cm apart,
- Place the picket fence vertically on top of the cart, with the 1-cm row (the row with the smallest black and clear regions) facing up,
- Connect the photogates to the signal interface and turn the computer on,
- Set the opaque spacing to 0.01m,
- Start record data by clicking REC and give the cart a slight push,
- Click STOP after the cart passes the second photogate,
- Repeat the same 2 more times.

Q3. *Calculate the average accelerations of the object for the following conditions.*



(a) v_A=2m/s, t_A=2s, t_B=6s, x_A=3m, x_B=35m,

$$v_{av} = \frac{x_B - x_A}{t_B - t_A} = \frac{35m - 3m}{6s - 2s} = \frac{32m}{4s}$$

$$v_{av} = 8m/s$$

$$v_{av} = \frac{v_A + v_B}{2} \Rightarrow v_B = 2 \cdot v_{av} - v_A$$

$$v_B = 2 \cdot (8m/s) - 2m/s = 16m/s - 2m/s$$

$$v_B = 14m/s$$

$$a = \frac{v_B - v_A}{t_B - t_A} = \frac{14m/s - 2m/s}{6s - 2s} = \frac{12m/s}{4s}$$

$$a = 3m/s^2$$

(b) v_A=12m/s, v_B=4m/s, t_A=3s, t_B=7s.

$$a = \frac{v_B - v_A}{t_B - t_A} = \frac{4m/s - 12m/s}{7s - 3s} = \frac{-8m/s}{4s}$$

$$a = -2m/s^2$$

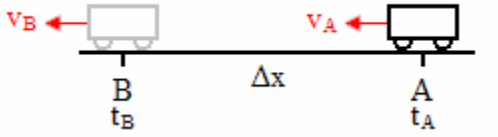
Group d(Thu B6):

Q2. *What is the purpose of the photogates?*

Photogates sensitively record the time between the succesive regions of darkness and illumination on the picket fence. In the experiment they are initially set 20cm apart, overhanging the track.

Q3. *What's the initial velocity of the object? v_A=?*

Δx=8m, a=-4m/s^2 and v_B=6m/s.



$$2 \cdot a \cdot \Delta x = v_B^{\,2} - v_A^{\,2} \Rightarrow v_A^{\,2} = v_B^{\,2} - 2 \cdot a \cdot \Delta x \Rightarrow v_A = \sqrt{v_B^{\,2} - 2 \cdot a \cdot \Delta x}$$

$$v_A = \sqrt{(6m/s)^2 - 2 \cdot (-4m/s^2) \cdot (8m)} = \sqrt{36 + 64} m/s = \sqrt{100} m/s$$

$$v_A = 10m/s$$