SPEED AND ACCELERATION – PRACTICAL 2

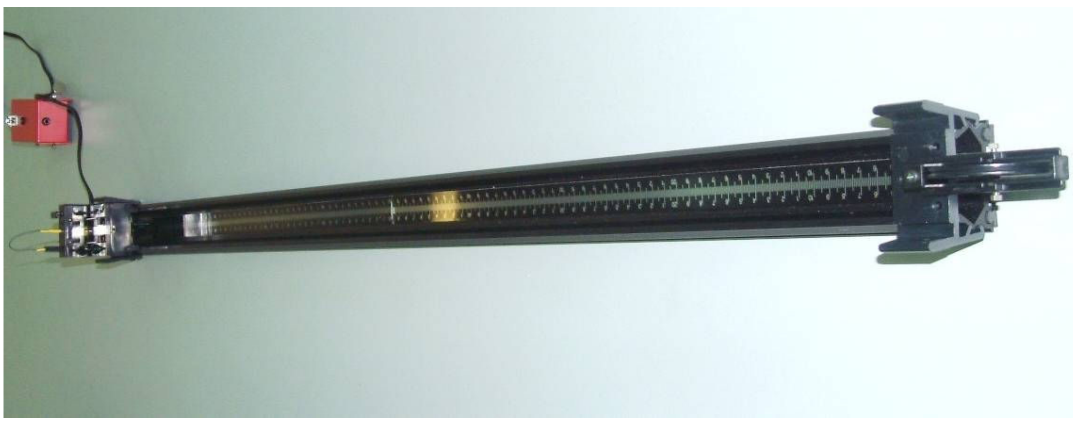
Name:	**ID Number:**
Class:	**Lab Group:**
Date:	

(/ 40 Marks)

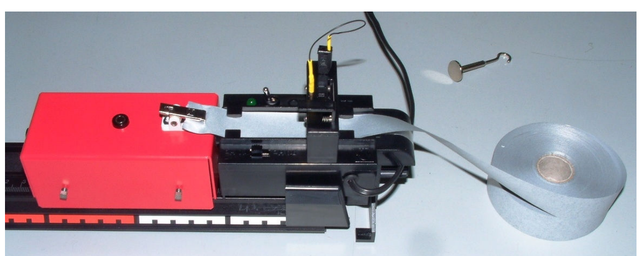
1. TICKER TIMER-TROLLEY-METAL RAIL TO FIND THE ACCELERATION

(25 Marks)

Apparatus:



Metal Track



Trolley, Ticker Timer and tape

Method:

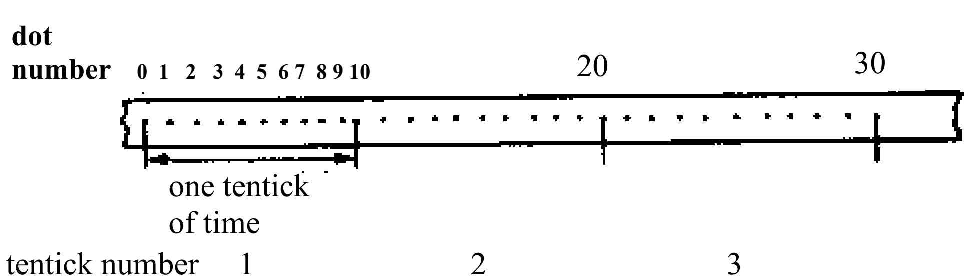
1. Attach a mass of 5 g to one end of a string making. Attach the other end to the trolley.
2. Pass the string with the mass over the pulley so that the mass hangs freely.
3. Attach one end of the given paper tape to the trolley and thread the tape through the timer, then attach the other end of the tape to the timer making sure that the paper tape will run smoothly through the instrument. Hold the trolley without allowing it to move.

   (1 Mark)
4. Switch on the power supply.
5. Release the trolley. The trolley accelerates over the track pulling the ticker tape until it reaches the end of the track.
6. Remove the ticker tape for analysis.

   (1 Mark)

Ticker Tape Analysis:

1. Remember: The ticker timer vibrates 50 times per second. It makes 50 dots per second on the ticker tape.
2. Ignore the lengths of tape for the first few dots which are very close at the beginning of the tape. *Choose for your number* 0 *dot one which is clear and separate form the muddle of dots at the very beginning of the motion.*
3. Count ten dot-to-dot spaces and cut the tape. Starting from your last cut, count ten more spaces, and cut again after each 10 space mark. Repeat this, until you have a collection of consecutive tapes, each one longer than the one before it. Number the order of your tapes, from 1 onwards as shown in the figure below.



4. Stick the tentick strips side by side on a sheet of graph paper to make a tape chart as shown in the figure below.

   (5 Marks)

5. Draw a horizontal line on the sheet of graph paper. Make a 'bar chart' by sticking the tapes vertically side by side, so that their bottoms just touch the horizontal line. The first and shortest tape should be at the left hand end of the line.

(1 Mark)

6. Describe in words what the graph says about the trolley motion

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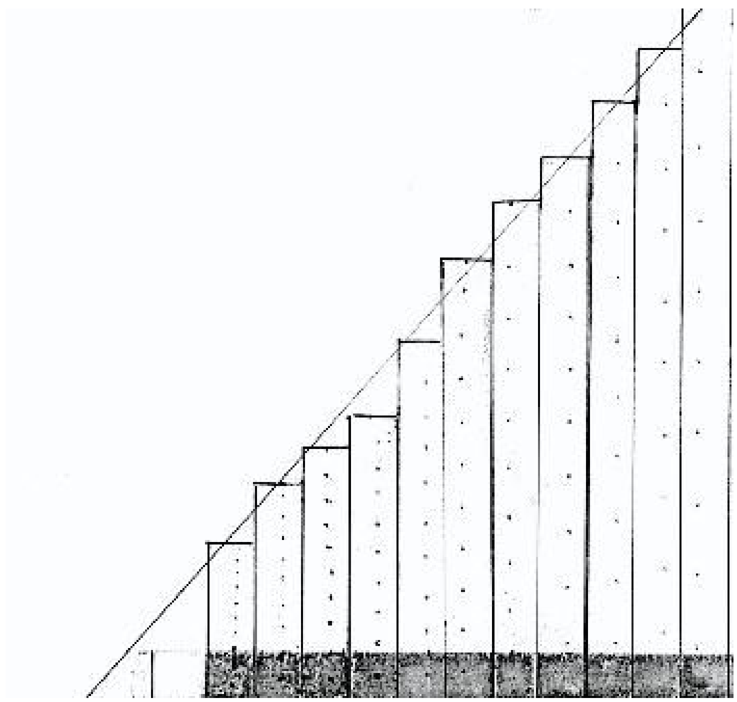
(1 Mark)



7. The horizontal line acts as a time axis, with its left end time zero. Mark your horizontal axis in intervals of 0.2 seconds, and add a suitable axis label.

8. Draw a vertical line through the zero of the time axis. This vertical line is the velocity axis. When time was zero for the trolley journey, velocity was zero. (The trolley started from standstill, or rest.)

9. Mark the scale on the vertical axis, in centimeters per second. Each vertical centimeter represents 5 centimeters per second of speed.

10. Draw a smooth line through the top-centre of each tape on your velocity-time graph.

Calculation of velocity and acceleration:

1. The time interval between two dots (one space) is = …………………..

(1 Mark)

2. Therefore for 10 spaces, the time interval is Δt = ……………………….

(1 Mark)

3. The length d_1 of the first tape is = …………………

(1 Mark)

4. The instantaneous speed at the beginning of the motion: v_1 = ……………..

(1 Mark)

5. The length d_2 of the last tape is = ……………….

(1 Mark)

6. The velocity will be v_2 = ……………………….

(1 Mark)

7. The acceleration is = ……………………….

(1 Mark)

Repeat the experiment for a mass of 10g.

1. Sick the tentick strips side by side on the sheet of the graph paper provided to make a tape chart

   (4 Marks)
2. The length d_1 of the first tape is = ……………………..

   (1 Mark)
3. The instantaneous speed at the beginning of the motion: v_1 = ……………..

   (1 Mark)
4. The length d_2 of the last tape is = ……………….

   (1 Mark)
5. The velocity will be v_2 = ……………………….

   (1 Mark)
6. The acceleration is = ……………………….

   (1 Marks)

3. MOTION DETECTOR

(15 Marks)

Motion Detector

CBL

The Motion Detector uses ultrasound to measure distance. Ultrasonic pulses are emitted by the Motion Detector, reflected from a target, and then detected by the device. The time it takes for the reflected pulses to return is used to calculate position, velocity, and acceleration. This allows you to study the motion of objects such as a person walking, a ball in free fall, or a cart on a ramp. The Motion Detector can measure objects as close as 40 cm to the detector and as far away as 6 m. The short minimum target distance allows objects to get closer to the detector, which reduces stray reflections.

Procedure:

1. Connect the cable from the motion detector to DIG/SONIC terminal on the CBL2 unit.
2. Slide your calculator onto the CBL2 cradle and connect the link cable to it.
3. Turn on your calculator.
4. Press APPS.
5. Press 4.
6. Hold the wooden block horizontal in level with the edge of the stool.
7. Press 2 on your calculator.
8. When the calculator reads SAMPLING drop the piece of wood and wait.
9. PRESS ENTER when you see DIG-DISTANCE.
10. Neglect the beginning of the graph which is a straight line. Using ⟶ Move to the part where the graph just starts to rise. Note down the *x*-value (time) and the corresponding *y* – value (distance). Using ⟶ move to another *x*- value which comes 0.1 sec after the first *x*-value and note down the corresponding *y*-value. Take at least 5 such *x*- values. Find t^2. Note these values down in a table.

X time in seconds	$\mathbf{t = X - X_0}$ the time of travel in seconds	**Y** distance from the detector in meters	$\Delta Y = Y - Y_0$	t^2 (in s^2)

(4 Marks)

Questions:

1. Plot a graph of the displacement ΔY (Y-axis) against the square of time t^2 (X-axis) on the graph paper provided.

(5 Marks)

2. Find the slope of the graph. The slope of the graph gives $\Delta Y/t^2$.

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(3 Marks)

3. From the equation $\Delta Y = \frac{1}{2} g t^2$, calculate g.

$g = 2\,(\mathbf{\Delta Y}/t^2) = 2 \times$ slope of the graph.

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(3 Marks)

Hint:

The ball is freely falling because of gravity.

The traveled distance is $\Delta Y = Y - Y_0 = v_0\, t + \frac{1}{2} g\, t^2$, where Y_0 is the initial vertical distance from the motion detector (m), and $v_0 = 0$ m/s.

*The time(**X**) measured by the system is actually the time elapsed since the detector is activated. The time of travel is $t = X - X_0$, where X_0 is the time when the curve starts rising.*

We then conclude that $\Delta Y = \frac{1}{2} g\, t^2$, ($\frac{1}{2}$ g) is constant, and $\Delta Y = f(t^2)$