THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL OF TANZANIA

CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

031/2 **PHYSICS 2**

ALTERNATIVE TO PRACTICAL

(For Both School and Private Candidates)

Time: 2:30 Hours **ANSWERS** **Year: 2013**

Instructions

1. This paper consists of sections Five questions. Answer all questions

2. Each question carries ten marks.

1. Fill in the gaps with correct responses.

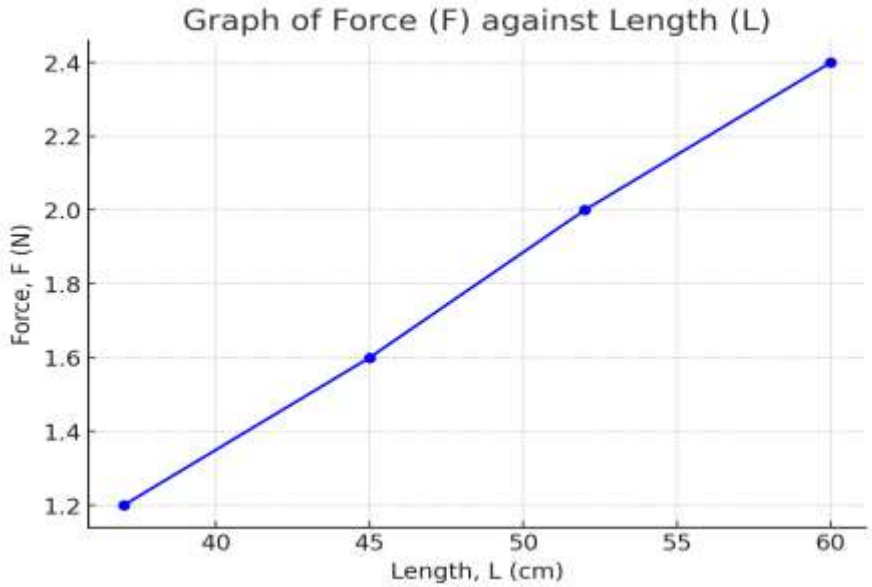
Name of Device	Sketch	Physical Effect/Principle	Application/Uses
Vernier caliper	[Sketch]	Precision measurement	Used to measure small distances with high accuracy
Voltmeter	[Sketch]	Measures electric potential difference	Used to measure voltage in circuits
Ratchet wheel and pawl	[Sketch]	Converts continuous motion into stepwise motion	Used in clocks, winches, and lifting mechanisms
Gap and bar	[Sketch]	Thermal expansion and contraction	Demonstrates expansion of metals when heated
Hydrometer	[Sketch]	Buoyancy principle	Used to measure the density of liquids

2. The following figure shows a spiral spring hung from one end and to the other end various loads are attached.

The table below shows the length of the spring for various loads:

F (load in N)	1.2	1.6	2.0	2.4
L (length in cm)	37	45	52	60

(a) Plot a graph of F against L.
The graph of force against extension should be a straight line indicating Hooke's Law. I will generate the graph.
The graph of force (F) against length (L). The straight-line trend suggests a linear relationship, consistent with Hooke's Law.



(b) Find the slope of the graph.
The slope of the graph is given by:
$S = \Delta F / \Delta L$
Using the two points (37, 1.2) and (60, 2.4):
$S = (2.4 - 1.2) / (60 - 37)$
$S = 0.0522$ N/cm

(c) What is the physical meaning of the slope obtained in (b) above?
The slope represents the spring constant (k) of the spiral spring, which is a measure of the stiffness of the spring. A higher value of k indicates that a greater force is required to produce a unit extension.

(d) If F and L are connected by the law, L = kF + C, find the values of k and C.
Comparing with the equation of a straight line, y = mx + c, where:

L = kF + C
The slope of the graph represents k, which has already been determined as 0.0522 cm/N.
To find C, we use one of the points, say (F = 1.2, L = 37):
$37 = (0.0522 \times 1.2) + C$
$C = 37 - (0.0522 \times 1.2)$
C = 36.937 cm
Thus, k = 0.0522 cm/N and C = 36.937 cm.

(e) Name and state the law governing this experiment.
The law governing this experiment is Hooke's Law.
Hooke's Law states that the extension of a spring is directly proportional to the applied force, provided the elastic limit is not exceeded. Mathematically,
F = kL
where F is the force applied, k is the spring constant, and L is the extension.

(f) Does the graph pass through the origin? Give a reason for your answer.
The graph does not pass through the origin because the equation includes a constant term (C = 36.937 cm). This means that even when no force is applied, the spring has an initial unstretched length.

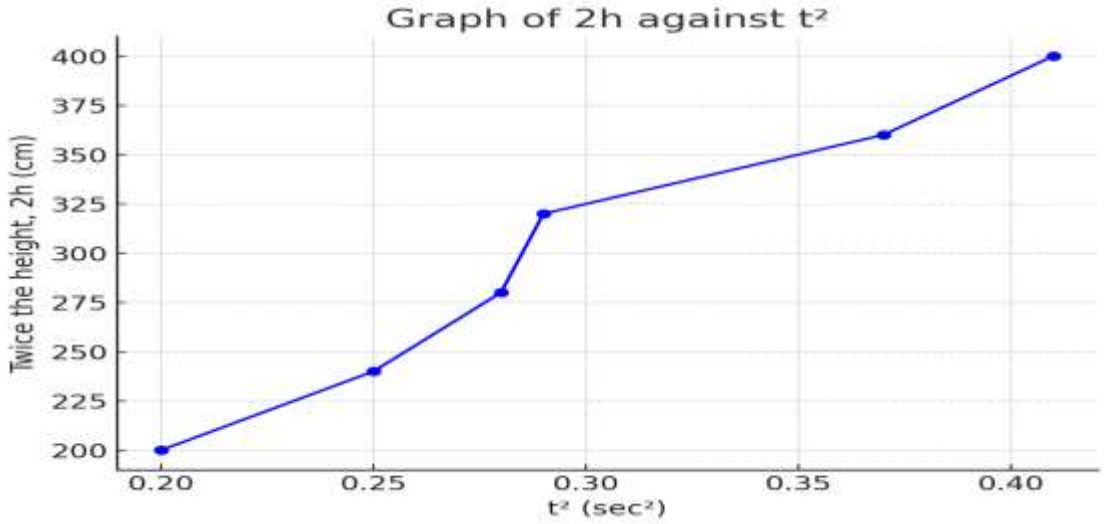
3. The following readings were from an experiment to determine the acceleration due to gravity, g.

Height of fall from rest, h (cm)	200	180	160	140	120	100
Time of fall, t (sec)	0.64	0.61	0.54	0.53	0.50	0.45

(a) Complete the table for the values of 2h in centimeters and t^2 corrected to two significant figures.
Twice the height of fall is given by:
$2h = 2 \times h$
The square of the time of fall is given by:
$t^2 = t \times t$

Height of fa	Time of fall,	Twice the h	t^2 (sec^2)
200	0.64	400	0.41
180	0.61	360	0.37
160	0.54	320	0.29
140	0.53	280	0.28
120	0.5	240	0.25
100	0.45	200	0.2

Here is the graph of twice the height (2h) against the square of time (t^2). The linear relationship suggests that acceleration due to gravity follows the equation $2h = g\,t^2$.

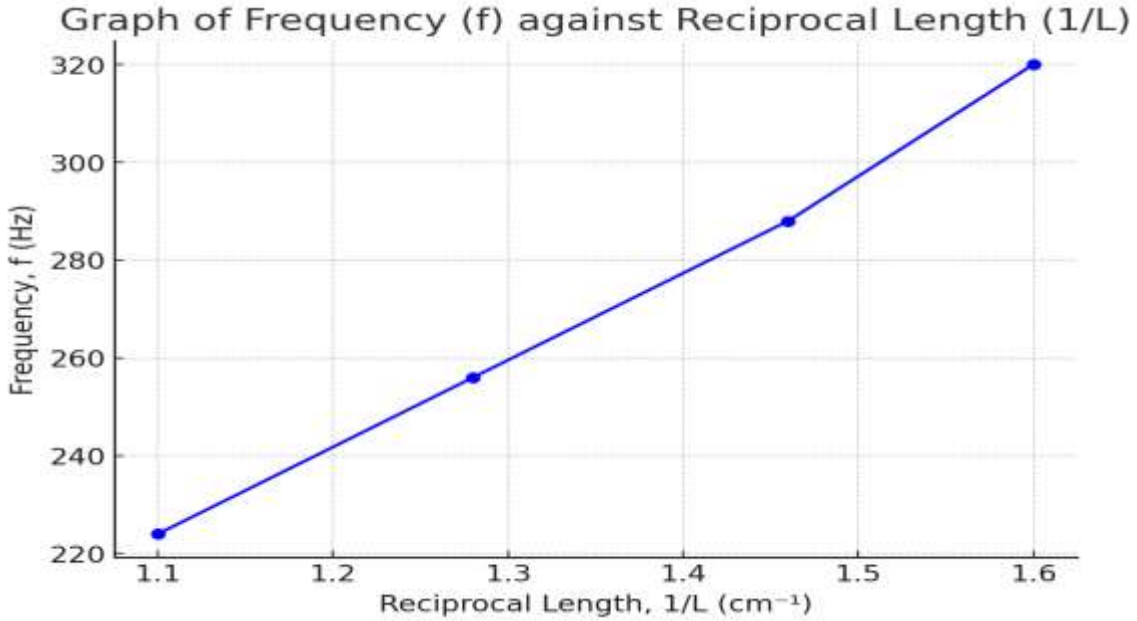


(c) The gradient of the graph is approximately 952.38 cm/sec^2.
Since the equation governing free fall is given by:
$2h = g\,t^2$
The gradient of the graph represents the acceleration due to gravity \(g \), which means:
$g \approx 952.38$ cm/sec^2
Converting to SI units:
$g \approx 9.52$ m/sec^2
This value is close to the standard acceleration due to gravity, which is approximately 9.81 m/sec^2. The small difference may be due to experimental errors.
4. In investigating the relationship between the frequency of a stretched string and its length, several different tuning forks were used together with a sonometer fitted with a thin steel wire. While the tension of the vibrating string was kept constant, its length was varied in order to tune the string to a series of tuning forks (sonometer wire adjusted in unison with the forks).

The results for frequency, length of string, and reciprocal length were recorded as follows:

Frequency of fork, f (Hz)	224	256	288	320
Length of string, L (cm)	0.91	0.78	0.68	0.63
Reciprocal length, 1/L (cm^{-1})	1.10	1.28	1.46	1.60

(a) Plot the graph of frequency, f, against 1/L.
A graph of frequency against reciprocal length should be a straight line, indicating a direct proportionality.



the graph of frequency (f) against reciprocal length (1/L). The linear trend confirms the direct proportionality between frequency and reciprocal length.

(b) Find the slope k of the graph.
The slope of the graph is given by:
$k = \Delta f / \Delta(1/L)$
Using the two points (1.10, 224) and (1.60, 320):

$k = (320 - 224) / (1.60 - 1.10)$
$k = 192.0$ Hz·cm

This slope represents the rate at which the frequency changes with respect to the reciprocal length of the string.

(c) Deduce from the graph the frequency of an unmarked fork, X, which was in unison with a sonometer wire whose length is 0.80 cm.
To find the frequency, we first determine the reciprocal length:

$1/L = 1 / 0.80 = 1.25\ cm^{-1}$

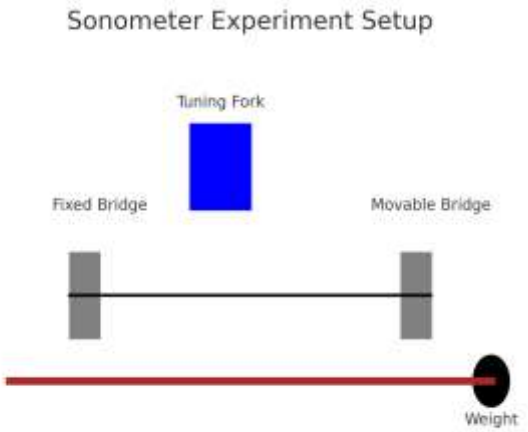
Using the equation of the straight line:

$f = k(1/L) + c$

The reciprocal length is calculated as:
$1/L = 1 / 0.80 = 1.25\ cm^{-1}$
Using the equation of the straight-line graph:
$f = k(1/L) + c$

From the graph, k = 192.0 Hz·cm and c was determined using a known data point:
$c = 224 - (192.0 \times 1.10)$
$c = 11.2$
Now, substituting 1/L = 1.25:
$f = (192.0 \times 1.25) + 11.2$
$f \approx 252.8$ Hz
Therefore, the frequency of the unmarked tuning fork X is approximately 252.8 Hz.

(d) Draw a sketch diagram for the set-up of the apparatus for this experiment.



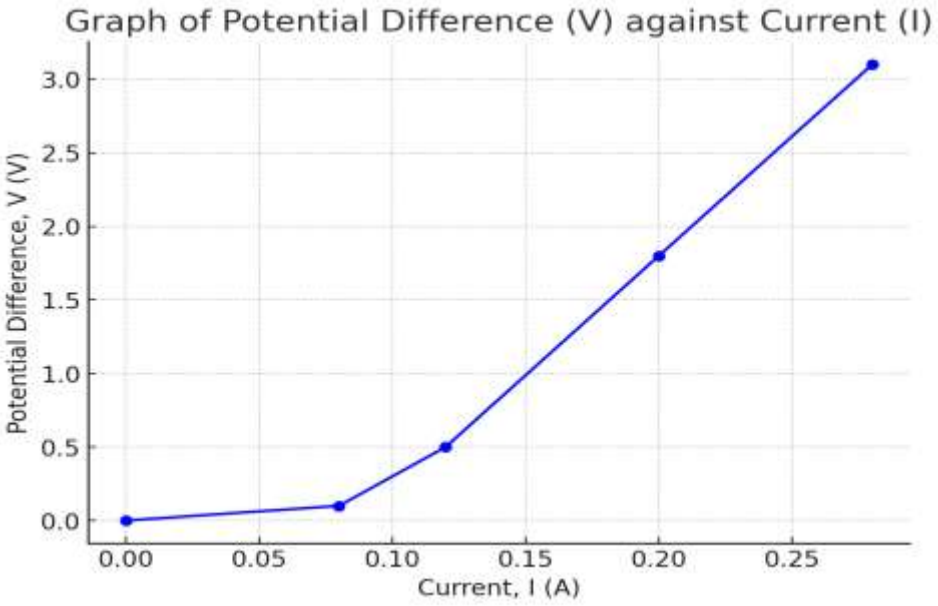
This is the sketch diagram for the sonometer experiment setup. It includes a fixed bridge, a movable bridge, a tuning fork placed above the vibrating wire, and a weight at the end to maintain tension.

5. In a certain experiment, the following apparatus were connected: an ammeter, a voltmeter, a rheostat, a torch bulb, a dry cell, a key, and some connecting wires. The results obtained were as follows:

Potential difference, V (V)	0	0.10	0.50	1.80	3.10
Current, I (A)	0	0.08	0.12	0.20	0.28

(a) Draw a circuit diagram that could have been used to obtain these data.

(b) Sketch the graph
Here is the graph of potential difference (V) against current (I). The relationship appears to be non-linear, indicating that the resistance of the bulb filament increases as the current increases.



(c) Find the slope of the graph when the current is 0.10A.
The slope of the graph is given by:

slope = $\Delta V / \Delta I$
Using the two points (0.08, 0.10) and (0.28, 3.10):
slope = (3.10 - 0.10) / (0.28 - 0.08)
slope = 15.0 Ω
This slope represents the resistance of the bulb filament in the given range.

(d) What is the resistance of the bulb filament when the current is 0.10A?
Resistance is given by Ohm's Law:

$R = V / I$
At $I = 0.10A$, $V = 0.50V$:
$R = 0.50 / 0.10$
$R = 5.0\ \Omega$
The resistance of the bulb filament at 0.10A is 5.0 Ω.

(e) What was the aim of the experiment?
The aim of the experiment was to investigate the relationship between the potential difference across a torch bulb and the current passing through it. The results demonstrate how resistance changes with current, showing that the bulb filament does not obey Ohm's Law as its resistance increases with increasing current.