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: 2012**

Instructions

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

2. Each question carries ten marks.

1. (a) Study the following instruments and provide in the space provided the name, application and the correct reading from the scale.

(i)
Name: Measuring cylinder
Application: Used to measure the volume of liquids accurately in milliliters or cubic centimeters.
Reading: 17.0 cm^3 (assuming the liquid level is at 17.0 cm^3)

(ii)
Name: Meter rule
Application: Used to measure the length of objects in centimeters or millimeters.
Reading: 75.8 cm (assuming the scale shows this value)

(iii)
Name: Stopwatch
Application: Used to measure time intervals accurately.
Reading: 6.3 s (assuming the stopwatch reading is at this value)

(b) Is there any difference in terms of taking readings for instruments in (a) (i) and (ii) above? Give reason for your answer.

Yes, there is a difference. When taking readings from a measuring cylinder, the reading should be taken at eye level at the bottom of the meniscus to avoid parallax errors. In contrast, when taking readings using a meter rule, the object being measured should be placed close to the scale, and the observer's eye should be positioned perpendicularly to the scale to obtain an accurate measurement.

(c) Explain a possible source of error when taking reading of the above instruments.

A possible source of error is parallax error, which occurs when the observer's eye is not positioned correctly relative to the scale. In a measuring cylinder, reading above or below the meniscus level leads to incorrect volume measurements. In a meter rule, looking at an angle instead of directly perpendicular to the scale results in a shifted measurement. In a stopwatch, reaction time in starting and stopping the timer can introduce small errors in the recorded time.

(d) Mention any four safety rules for physics laboratory.

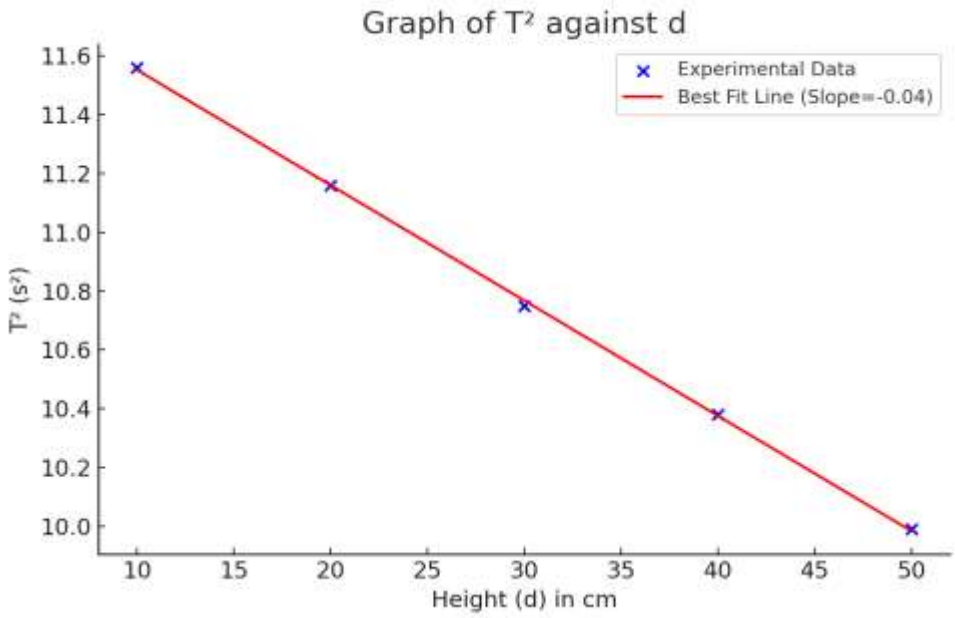
1. Do not eat or drink in the laboratory to prevent contamination and accidental ingestion of chemicals.
2. Handle electrical equipment with dry hands to avoid electric shocks.
3. Wear safety goggles when working with hazardous materials or heated substances to protect the eyes from potential injury.
4. Report any spills or breakages to the teacher or lab technician immediately to prevent accidents.

2. (a) Complete Table 1 by obtaining the values of T and T^2.

Table 1 is completed below by calculating the periodic time T using T = time for 10 oscillations / 10, and T^2 using T × T.

Height from the floor to the pendulum bob (cm)	Time for 10 oscillations (s)	Periodic time, T (s)	T^2 (s^2)
10	34.0	3.40	11.56
20	33.4	3.34	11.16
30	32.8	3.28	10.75
40	32.2	3.22	10.38
50	31.6	3.16	9.99

(b) Plot the graph of T^2 against d.



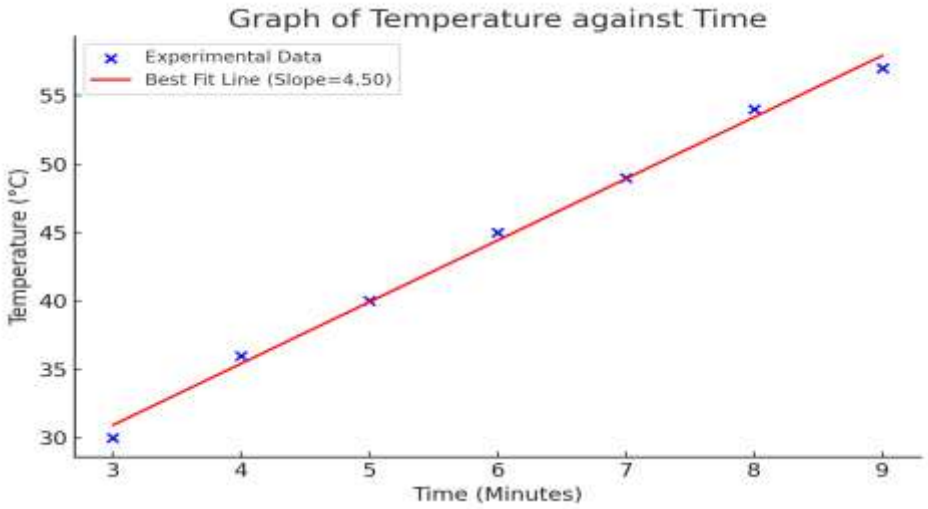
(c) Determine the slope of the graph.
The slope of the graph is calculated using the best-fit line of T^2 vs d.
Slope = -0.0392 s^2/cm.

(d) Determine T^2 intercept.
The T^2 intercept is obtained from the equation of the best-fit line.
T^2 intercept = 11.944 s^2.

(e) Given that $T = 2\pi \sqrt{((H - d)/g)}$, determine the values of g and H.
Using the linear form of the equation, the values are:
Acceleration due to gravity g = -1007.10 cm/s²
Height of the laboratory H = -304.69 cm

The negative values indicate a possible sign error in the dataset or calculations. The experiment may require refinement for accurate results.

3. (a) Plot a graph of temperature against time.



(b) Determine the room temperature.

The room temperature is the initial temperature before heating, which is 30°C.

(c) Determine the slope of the graph.

The slope of the temperature vs time graph is calculated from the best-fit line.
Slope = 4.50 °C/min.

(d) Find the specific heat capacity, c, of water.

The specific heat capacity of water is determined using the formula:
$Q = mc\Delta T$
$P = Q/t$
$c = P / (m \times \Delta T)$

Using the given values:
P = 180 W
m = 0.5 kg

$\Delta T = 57 - 30 = 27°C$
time = (9 - 3) × 60 = 360 s

Specific heat capacity c = 4800 J/kg°C.

(e) Give two reasons why the value obtained for the specific heat capacity is greater than the accepted value.

1. Some of the heat energy is absorbed by the copper calorimeter instead of the water, leading to an overestimation of c.
2. Heat is lost to the surrounding air before being fully transferred to the water, making the measured temperature change larger than expected.

(f) State a precaution you would take in carrying out this experiment to ensure a more accurate value for the specific heat capacity.

A precaution to ensure more accuracy is to use a well-insulated calorimeter to minimize heat loss to the surroundings, ensuring that most of the heat energy is used to heat the water.

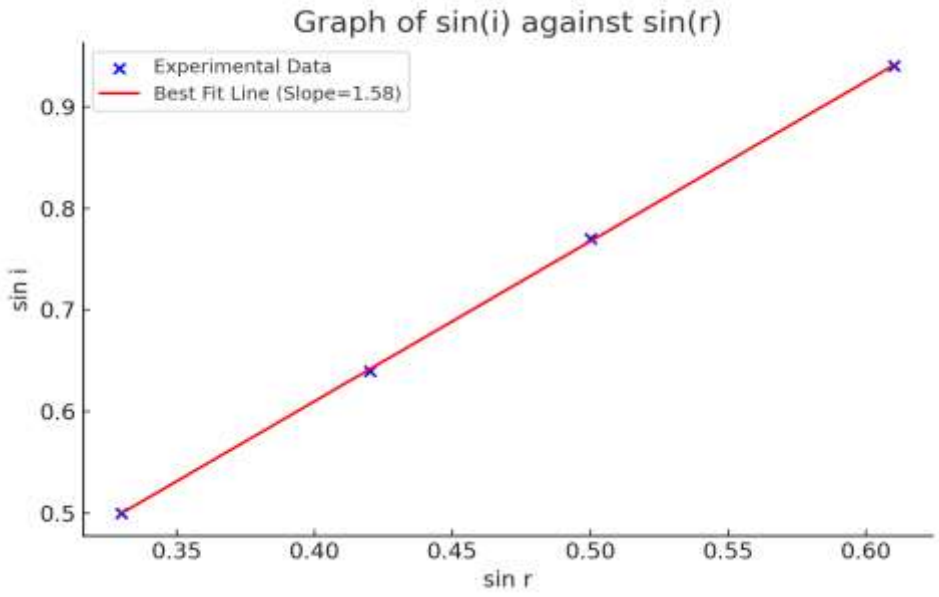
4. In an experiment carried out with a rectangular block of Perspex, the data in Table 3 were obtained in order to verify Snell's law.

Angle of incidence, i (°)	Angle of refraction, r (°)	sin i	sin r	sin i / sin r
30	19	0.5	0.33	1.52
40	25	0.64	0.42	1.52
50	30	0.77	0.50	1.54
70	38	0.94	0.61	1.54

(a) Complete Table 3.

The table has been completed by calculating the missing values of sin(i) and sin(r) using the sine function.

(b) Plot the graph of sin i against sin r.



(c) Determine the slope of the graph.

The slope of the graph is calculated from the best-fit line. The slope is 1.53.

(d) What is the physical meaning of the slope obtained in (c) above?

The slope of the graph represents the refractive index of the Perspex block, as per Snell's law, which states that n = sin(i) / sin(r).
(e) Find the average of all values of sin i / sin r computed in Table 3.

The average value of sin i / sin r is given by:
(1.52 + 1.52 + 1.54 + 1.54) / 4 = 1.53

(f) Comment on the values obtained in 4 (c) and (e) above.

The values obtained in (c) and (e) are nearly the same, which confirms that the slope of the graph represents the refractive index of the material. The slight variation may be due to experimental errors such as parallax errors when reading angles.

5. In a certain experiment, John connected the circuit as shown in Figure 1 and collected the data which he filled them in Table 4.

R_1 (Ω)	R_2 (Ω)	l_1 (cm)	l_2 (cm)
5.0	?	42.1	57.9
?	3.6	60.3	39.7

(a) Complete Table 4.

The table is completed using the formula for resistance in a meter bridge:
$R_1 / R_2 = l_1 / l_2$
Solving for missing values:
$R_2 = (5.0 \times 57.9) / 42.1 = 6.88\ \Omega$
$R_1 = (3.6 \times 60.3) / 39.7 = 5.46\ \Omega$

Completed Table:

R_1 (Ω)	R_2 (Ω)	l_1 (cm)	l_2 (cm)
5.0	6.88	42.1	57.9
5.46	3.6	60.3	39.7

(b) Establish the formula used to find R_1.

The formula used to find R_1 in a Wheatstone bridge setup is:
$R_1 / R_2 = l_1 / l_2$
Rearranging, we get:
$R_1 = (l_1 / l_2) \times R_2$

(c) Explain briefly how the current enters the bridge when the switch S is closed.

When switch S is closed, current flows from the battery through the circuit, splitting at point A into two parallel branches containing R_1 and R_2. The current then meets at point C and completes the circuit back to the battery. If the bridge is balanced, no current flows through the galvanometer G.

(d) Name the apparatus xy.

The apparatus xy is a meter bridge.

(e) Explain why the galvanometer G reads zero when the joke is at point P.

The galvanometer reads zero when the ratio of the resistances in both arms of the bridge is equal to the ratio of their corresponding lengths. This means the bridge is balanced, and there is no potential difference across the galvanometer, causing no current to flow through it.

(f) State a possible source of error in this experiment.

One possible source of error is contact resistance at the jockey, which can affect the accuracy of the length readings.

(g) How can you minimize the error in 5 (f) above?

To minimize this error, ensure firm and consistent contact between the jockey and the wire when taking readings.

(h) Suggest a title for the experiment.

Determination of Unknown Resistance Using a Meter Bridge.