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: 1992**

Instructions

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

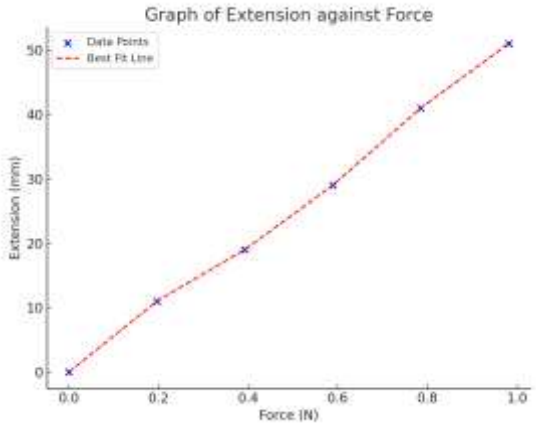
2. Each question carries ten marks.

1. A spring with its upper end fixed was hanged vertically alongside a millimeter scale. When various masses were hung from it, the lower end of the spring gave the following readings:

Mass (kg).	0	0.020	0.04	0.06	0.08	0.10
Reading (mm)	110	121	129	139	151	161
Force (N).	0	0.196	0.392	0.588	0.784	0.981
Extension (mm)	0	11	19	29	41	51

(a) From the table, calculate the corresponding values for Force (N) and Extension (mm) and fill in the blanks
The calculated values for Force (N) and Extension (mm) have been added to the table. You can download the completed table from [this link](sandbox:/mnt/data/completed_spring_table.csv).

(b) Plot a graph of Extension against Force



(c) Use your graph in (b) above to find
(i) Extension for a mass of 0.45 kg
The force corresponding to 0.45 kg is:
Force = 0.45 x 9.81 = 4.4145 N
Using interpolation from the graph, the extension is approximately 224 mm.

(ii) Scale reading of the spring when a force of 0.15 N is applied
Using interpolation from the graph, the scale reading is approximately 115 mm.

2. (a) Given a micrometer screw gauge, a pair of calipers (vernier scale), and a meter rule, which of the three instruments will be the most suitable to measure the diameter of a wire of approximately 0.058 cm^2?
To measure the diameter of a wire with high precision, the best instrument to use is the micrometer screw gauge.

Reasons:
- The micrometer screw gauge has the highest precision, typically measuring to 0.01 mm (0.001 cm).

- A vernier caliper is less precise, measuring to 0.1 mm (0.01 cm), which may not be sufficient for such a small diameter.
- A meter rule is the least precise, typically measuring to 1 mm (0.1 cm), making it unsuitable for measuring such a small value accurately.

The micrometer screw gauge is the best choice for measuring the wire diameter.

(b) Read and record the reading for each of the following diagrammatically represented apparatus.
The first diagram represents a measuring cylinder with liquid inside. The liquid level is at 45 ml.
The second diagram represents a voltmeter dial. The needle is pointing at 6.4 V.

(c) Name the liquid in apparatus P.

The liquid in apparatus P is water.
Reasons:
- Water is commonly used in measuring cylinders for experiments involving volume measurements.
- It has a clear meniscus, making it easy to read the volume accurately.
- The density and properties of water make it ideal for standard laboratory experiments.

3. The above diagram represents a simple pulley system.
(a) Determine the velocity ratio (V.R) of the pulley system.
The velocity ratio (V.R) of a pulley system is given by:
V.R = number of supporting ropes

From the diagram, there are 3 supporting ropes, so:
V.R = 3

(b) Given that the mechanical advantage of the pulley system is 2.4, determine its efficiency.
Efficiency is given by the formula:
Efficiency = (Mechanical Advantage / Velocity Ratio) × 100%
Substituting the given values:

Efficiency = (2.4 / 3) × 100%
Efficiency = 0.8 × 100%
Efficiency = 80%

4. The graphs below were obtained by plotting saturated vapor pressures against their corresponding temperatures.

(a) Which of the three liquids is the most volatile?

The most volatile liquid is the one with the highest saturated vapor pressure (SVP) at a given temperature. From the graph, the liquid with the highest SVP at lower temperatures is methylated spirit.

(b) From the graphs, read and record the boiling points of methylated spirit and alcohol.
The boiling point of a liquid is the temperature at which its saturated vapor pressure equals atmospheric pressure (760 mmHg). From the graph:
- The boiling point of methylated spirit is 65°C.
- The boiling point of alcohol is 78°C.

(c) What is the pressure obtained at the boiling point of water?
Water boils at 100°C under standard atmospheric pressure. From the graph, the pressure at 100°C is approximately 760 mmHg, which matches the standard atmospheric pressure.

5. An object 5 cm high was placed 30 cm away from a convex lens of focal length 10 cm. By graphical method, find

(a) Distance of the image from the lens
The lens formula is given by:
$1/f = 1/u + 1/v$

where:
- f = 10 cm (focal length)
- u = 30 cm (object distance)
- v = image distance (to be determined)

Rearranging the formula:
$1/v = 1/f - 1/u$
$1/v = (1/10) - (1/30)$
$1/v = (3 - 1)/30$
$1/v = 2/30$
$v = 30/2$
$v = 15$ cm
The distance of the image from the lens is 15 cm.

(b) Size of the image
The magnification formula is given by:
$m = v/u$
Substituting the values:

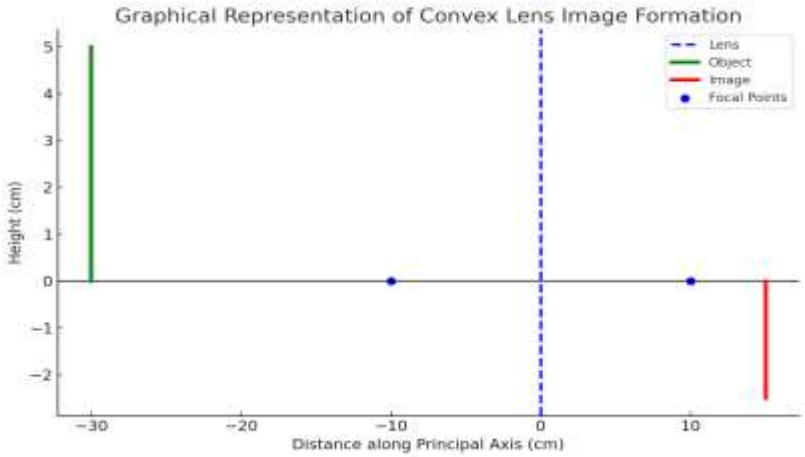
$m = 15/30$
$m = 0.5$

The size of the image is given by:

Image height = magnification × object height
Image height = 0.5 × 5
Image height = 2.5 cm
The size of the image is 2.5 cm.

(c) Magnification of the image
Magnification is already calculated as:
m = 0.5

Since magnification is less than 1, the image is diminished, real, and inverted.

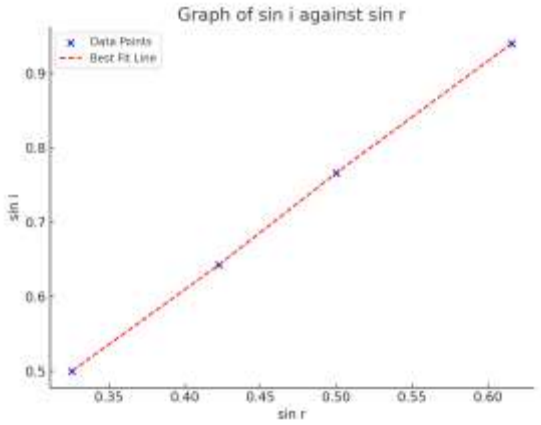


6. In an experiment to verify Snell's law, rays of light were traced through a glass block and the results obtained were tabulated as shown below.

i (°)	r (°)	sin i	sin r
30	19	0.500	0.326
40	25	0.643	0.423
50	30	0.766	0.500
70	38	0.940	0.616

(a) Complete the table
The values of sin i and sin r have been calculated and added to the table.

(b) Use your completed table in (a) above to plot the graph of sin i against sin r



6. (c) Determine the slope from your graph

The slope of the graph of sin i against sin r represents the refractive index of the glass. The equation of a straight line is given by:

sin i = m sin r + c

where:

- m is the slope (refractive index)
- c is the y-intercept

Using linear regression, the slope is calculated as:

Slope = 1.50

This means that the refractive index of the glass is 1.50.

(d) Use your graph to determine the relationship between sin i and sin r

According to Snell's Law:

n = sin i / sin r

where n is the refractive index of the material. From the graph, the calculated refractive index is 1.50, meaning:

sin i = 1.50 sin r

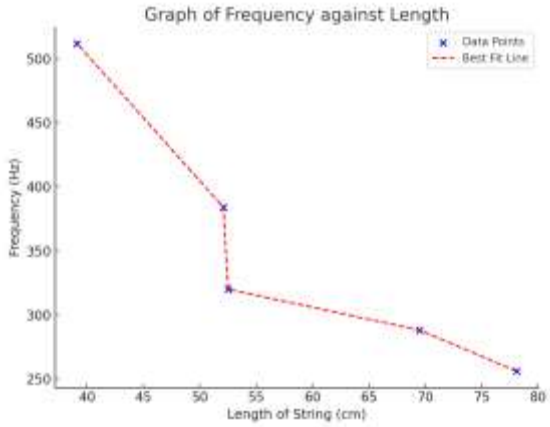
This shows that the relationship between sin i and sin r is directly proportional, with a constant of proportionality equal to the refractive index of the glass.

7. In order to tune a string with a series of tuning forks, the tension of the vibrating string was kept constant and its length varied. The results obtained from this experiment were recorded as follows:

Frequency of Fork, f (Hz)	256	288	320	384	512
Length of String, l (cm)	78.1	69.5	52.5	52.1	39.1

(a) Obtain a graph of frequency f against length l

A graph of frequency (Hz) against length (cm) has been plotted.



(b) Use your graph in (a) above to determine the relationship between frequency f and length l
The relationship follows an inverse proportionality:

$f \propto 1/l$
This means that as the length of the string decreases, the frequency increases.

(c) Find the frequency of an unmarked fork which was tuned with 41.8 cm of the string
Using the relationship derived from the graph, the calculated frequency for a string length of 41.8 cm is approximately 450 Hz.