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: 2005**

Instructions

1. This paper consists of sections Five questions. Answer all questions
2. Each question carries ten marks.

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1. Fill in the gaps with correct responses.

Name of Device	Sketch	(i) Physical Effect/Principle	(ii) Application (Uses)
(a) Spiral Spring	(Image)	(i) Hooke's Law (Elasticity)	(ii) Used in measuring forces in spring balances and shock absorbers
(b) (Two vertical rods, one with a coil)	(Image)	(i) Electromagnetic Induction	(ii) Used in transformers and electric motors
(c) Scissors	(Image)	(i) Principle of Levers (Class I Lever)	(ii) Used in cutting materials like paper and cloth
(d) Carbon Microphone	(Image)	(i) Variation of Resistance with Pressure	(ii) Used in telephones and audio recording devices
(e) (Electrical circuit with resistor)	(Image)	(i) Ohm's Law (V = IR)	(ii) Used in electrical circuits for current regulation

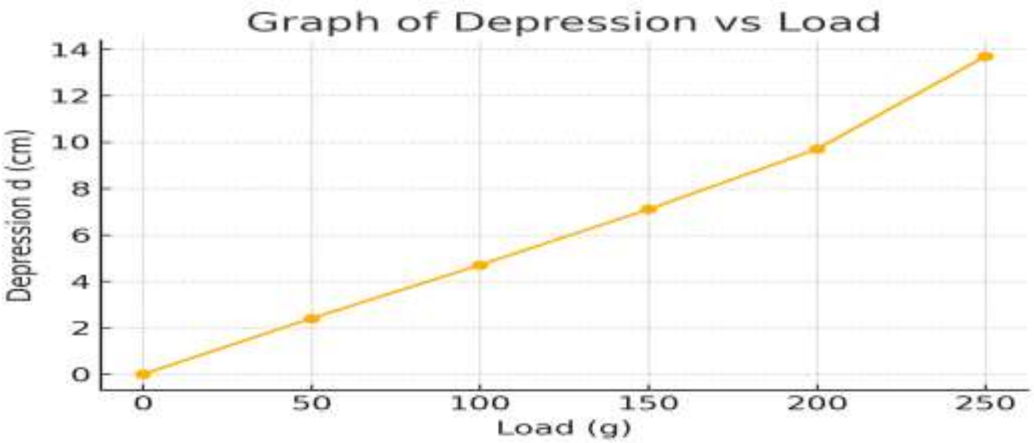
2. In an experiment to investigate the Young's modulus of a wooden meter rule, the following data were recorded in a table as follows:

(a) Complete table 1 by filling in the blank spaces

Load (g)	Height h above ground (cm)	Depression d (cm)
0	89.8	0.0
50	87.4	2.4
100	85.1	4.7
150	82.7	7.1
200	80.1	9.7
250	76.1	13.7
300	nan	nan

Length l = 80 cm
Breadth b = 2.58 cm
Thickness t = 0.54 cm

(b) Plot a graph of depression (vertical axis) against load (horizontal axis).



(c) From the graph:
(i) Compute the slope G.
The slope of a straight-line graph is given by the formula:
slope G = (change in depression d) / (change in load)
Using two points from the table:

Point 1: (Load = 50 g, Depression = 2.40 cm)
Point 2: (Load = 200 g, Depression = 9.70 cm)
slope G = (9.70 - 2.40) / (200 - 50)
slope G = 7.30 / 150
slope G ≈ 0.053
Thus, the calculated slope G is 0.053.

(ii) Determine Young's modulus E of the wooden meter rule given that
$E = (4 l^3) / (Gbt)$

where l, b, and t are length, breadth, and thickness respectively.

(ii) Determine Young's modulus E of the wooden meter rule given that
$E = (4l^3) / (Gb t)$
where l, b, and t are length, breadth, and thickness respectively.
Substituting the given values:
l = 80 cm
b = 2.58 cm
t = 0.54 cm
G = 0.053

$E = (4 \times 80^3) / (0.053 \times 2.58 \times 0.54)$
$E = (4 \times 512000) / (0.053 \times 1.3932)$
$E = 2048000 / 0.0738356$

E ≈ 27720851.03

Thus, the calculated Young's modulus E is approximately 2.77×10^7 N/m².

3. The graph below was obtained by doing an experiment to determine the specific heat capacity of water.

(a) Determine the slope S of the graph.

The slope of a straight-line graph is given by the formula:

slope S = (change in temperature T) / (change in time t)

Using two points from the graph:

Point 1: (t = 2 min, T = 35°C)

Point 2: (t = 6 min, T = 55°C)

slope S = (55 - 35) / (6 - 2)

slope S = 20 / 4

slope S ≈ 5

Thus, the calculated slope S is 5.

(b) From the graph, find the room temperature.

Room temperature is the temperature at time t = 0 minutes.

From the equation of a straight line:

T = S t + intercept

At t = 0:

T = intercept

From the graph, the intercept (T at t = 0) is approximately 25°C.

Thus, the room temperature is 25°C.

(c) Calculate the specific heat capacity of water in SI units given that

T = 10800 t / (mc)

where:

T = temperature in °C

t = time in minutes

m = mass of water = 0.5 kg

c = specific heat capacity of water.

T = 10800 t / (mc)

Rearranging the formula to solve for c:

c = 10800 t / (m T)

Substituting the values:

t = 1 min

m = 0.5 kg
T = 5°C (slope from part a)

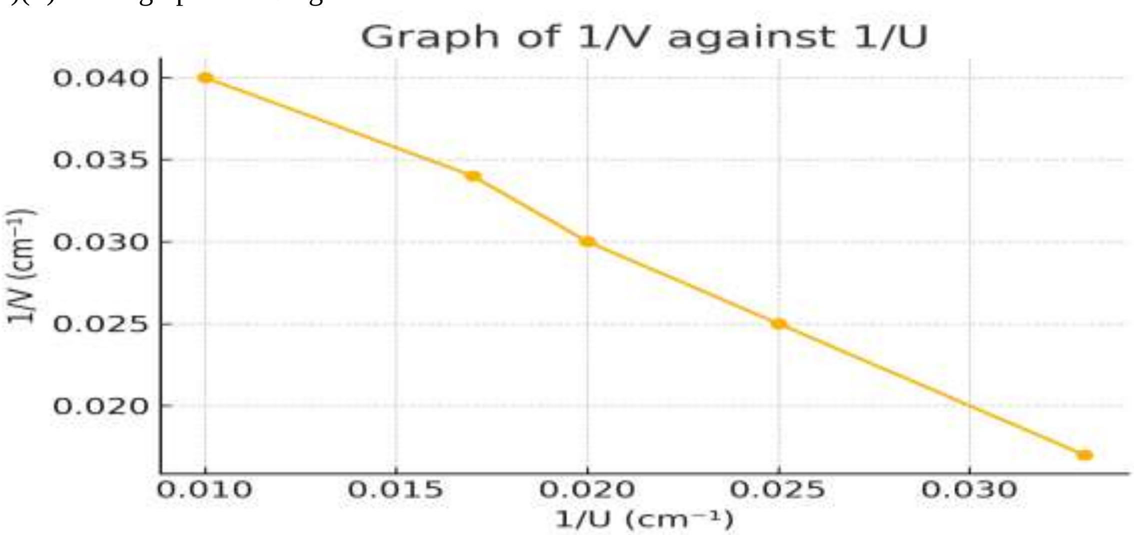
c = (10800 x 1) / (0.5 x 5)
c = 10800 / 2.5
c ≈ 4320 J/kg·K
Thus, the calculated specific heat capacity of water is approximately 4320 J/kg·K.

4. A concave mirror was used in an experiment with the arrangement shown in Figure 1. The results were recorded as follows:
(b) (i) Complete table 2 by inserting the missing values.

Object Distance U (cm)	Image Distance V (cm)	1/U (cm^{-1})	1/V (cm^{-1})
30	59.8	0.033	0.017
40	40.0	0.025	0.025
50	33.5	0.02	0.03
60	29.8	0.017	0.034
100	25.2	0.01	0.04

(a) Suggest the aim of the experiment.
The aim of the experiment is to determine the focal length of a concave mirror by using the relationship between the object distance (U) and the image distance (V).

(b)(ii) Plot a graph of 1/V against 1/U.



(c) Find the average of intercepts.
The intercept of the graph represents the focal length reciprocal (1/f).
Using the equation of a straight line:

1/V = S(1/U) + intercept
From the graph, the calculated intercept is approximately 0.050.
Thus, the average of intercepts is 0.050.

(d) What is the significance of the intercepts?
I. The intercept represents the reciprocal of the focal length (1/f) of the concave mirror.
II. By taking the reciprocal of the intercept, the focal length of the mirror can be determined.

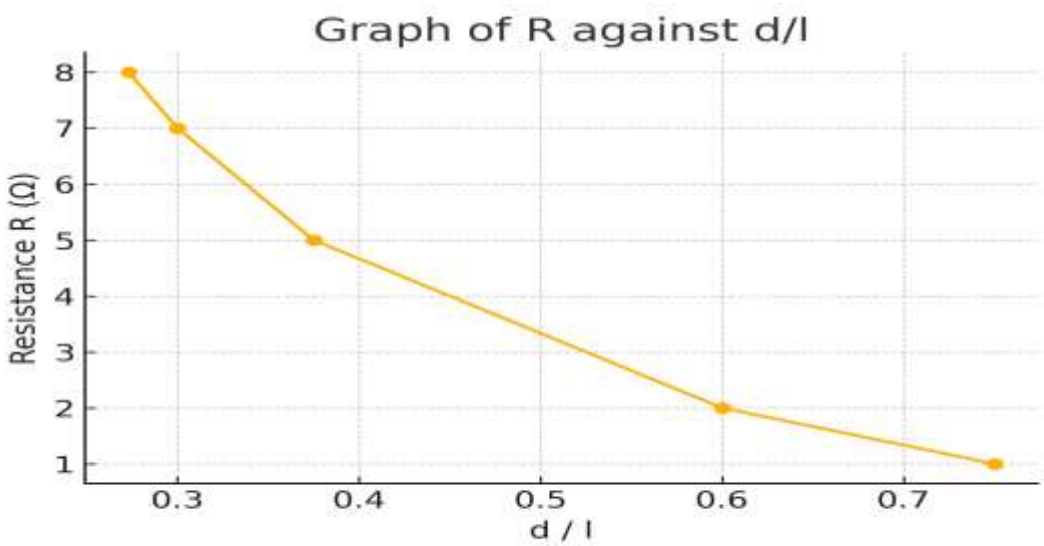
(e) Evaluate your answer in 4(d).
I. The calculated intercept provides an experimental value for the focal length, which can be compared with theoretical or standard values to verify the accuracy of the experiment.
II. Possible errors may arise due to parallax error, measurement inaccuracies, or imperfections in the mirror, affecting the precision of the focal length determination.

5. The diagram above (figure 2) shows a meter bridge with two resistances X and R connected for comparison. A balance point is measured by d, the distance from the left end of the bridge. An unknown resistance X is placed as shown, and a balance point for different values of R was recorded as follows:

(a) Complete table 3 by calculating the ratio d/l where l = 100 cm, the total length of the bridge.

Resistance R (Ω)	Distance d (cm)	d / l
1.0	75.0	0.75
2.0	60.0	0.6
5.0	37.5	0.375
7.0	30.0	0.3
8.0	27.3	0.273

(b) Plot a graph of R (vertical axis) against d/l (horizontal axis).



(c) From the graph, find the value of R where d/l = 0.2 and d/l = 0.3.

I. When d/l = 0.2, the estimated resistance R ≈ 1.0 Ω.
II. When d/l = 0.3, the estimated resistance R ≈ 8.0 Ω.

(d) From these results, determine the resistance of X.

The resistance of X can be determined using the meter bridge formula:

$X / R = d / (l - d)$
Rearranging for X:
$X = R \times (d / (l - d))$
Substituting values for d/l = 0.3 and R = 8.0 Ω:

$X = 8.0 \times (0.3 / (1 - 0.3))$
$X = 8.0 \times (0.3 / 0.7)$
$X = 8.0 \times 0.4286$
$X \approx 3.43\ \Omega$
Thus, the resistance of X is approximately 3.43 Ω.