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: 2004**

Instructions

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

2. Each question carries ten marks.

1. Fill in the gaps with the correct responses.

Name of Device	Sketch	(i) Physical Effect/Principle	(ii) Application (Uses)
(a) Pinhole Camera	(Image)	(i) Rectilinear propagation of light	(ii) Used in simple optical experiments and image formation
(b) Siphon	(Image)	(i) Principle of pressure difference	(ii) Used in transferring liquids from one container to another
(c) Electroscope	(Image)	(i) Electrostatic induction	(ii) Used to detect and measure electric charges
(d) Magnetic Compass	(Image)	(i) Earth's magnetic field	(ii) Used for navigation and direction finding
(e) Voltameter	(Image)	(i) Electrolysis	(ii) Used to measure the quantity of electric charge

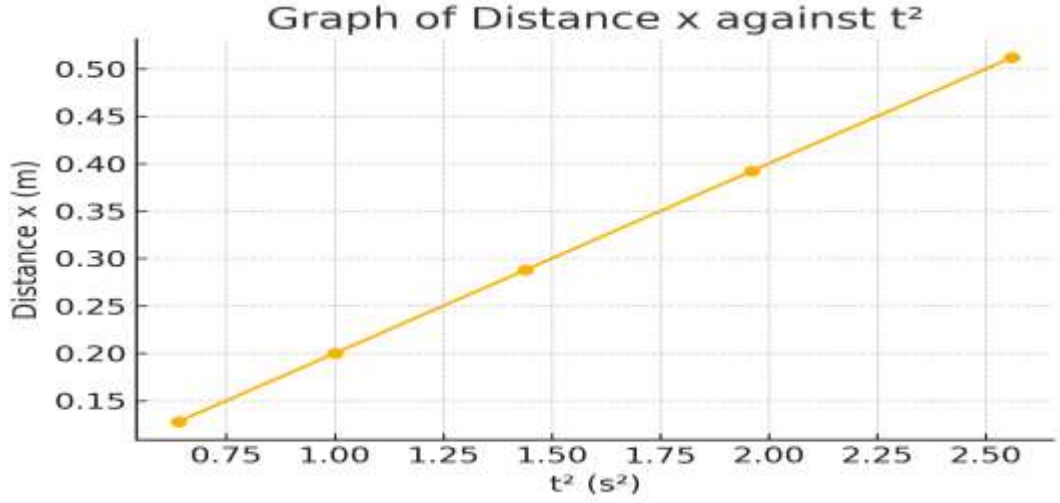
2. Table 1 below gives the variation of distance covered by a body sliding from rest, with time. The motion is similar to that of free fall, hence obeys the equation:

$x = (1/2)gt^2$

(a) Complete the table.

Distance, x (m)	Time, t (s)	t^2 (s^2)
0.128	0.8	0.64
0.2	1.0	1.0
0.288	1.2	1.44
0.392	1.4	1.96
0.512	1.6	2.56

(b) Plot a graph of x against t^2 (x - vertical axis).



(c) Find the slope of the graph.

The slope of a straight-line graph is given by the formula:
slope = (change in distance x) / (change in t^2)
Using two points from the graph:

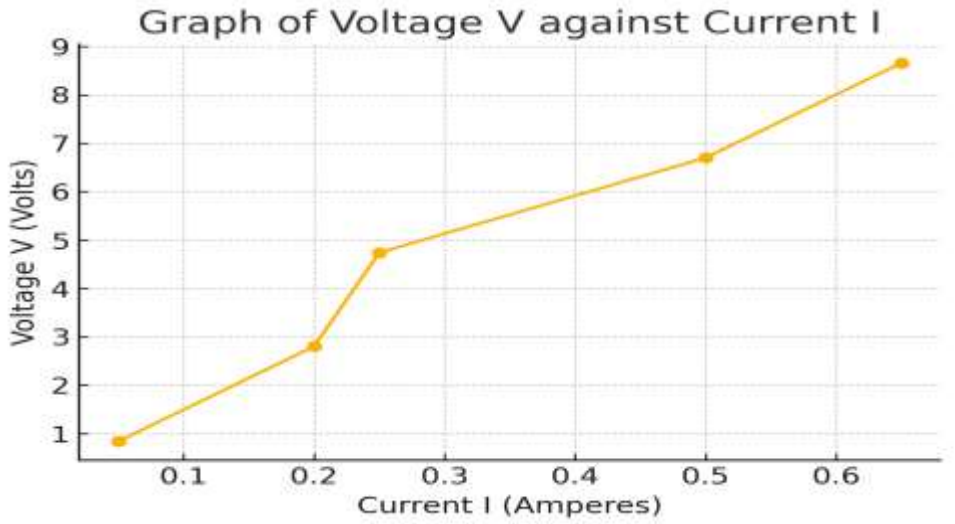
Point 1: (t^2 = 1.0, x = 0.200 m)
Point 2: (t^2 = 2.0, x = 0.400 m)
slope = (0.400 - 0.200) / (2.0 - 1.0)
slope = 0.200 / 1.0
slope ≈ 0.2
Thus, the calculated slope is 0.2.

(d) Determine the value of acceleration.
The equation of motion is given by:
$x = (1/2)gt^2$
From the graph, the slope represents (1/2) g.
Rearranging for g:
g = 2slope
Substituting the calculated slope:
g = 2 0.2
g = 0.4 m/s²
Thus, the calculated acceleration is 0.4 m/s².

3. Values of the current I passing through a coil for corresponding values V of the measured potential difference across the coil are recorded in a voltmeter as shown in Table 2 below.

I (Amperes)	0.05	0.20	0.25	0.50	0.65
V (Volts)	0.84	2.80	4.74	6.70	8.66

(a) Plot a graph to show the relation between V (y-axis) and I (x-axis).



(b) Use the graph to determine the

(i) Resistance of the coil.

From Ohm's Law:

V = IR

Rearranging for resistance:

R = V / I

The slope of the V vs I graph represents resistance.

From the graph, the calculated slope (resistance) is approximately 12.58 Ω.

(ii) Correction which must be applied to the voltmeter readings.

I. The voltmeter may have an internal resistance that slightly affects the voltage readings. A correction factor should be applied to account for this.

II. The connection wires and contact points may introduce small voltage drops, which should be minimized by using thick, low-resistance wires.

III. The initial zero error in the voltmeter should be checked and corrected before taking measurements.

(iii) Correct value of the first potential difference (p.d).

The corrected potential difference is determined using the equation of the best-fit line:

V = (Slope x I) + Intercept

For the first current value (I = 0.05 A):

V = (12.58 x 0.05) + intercept

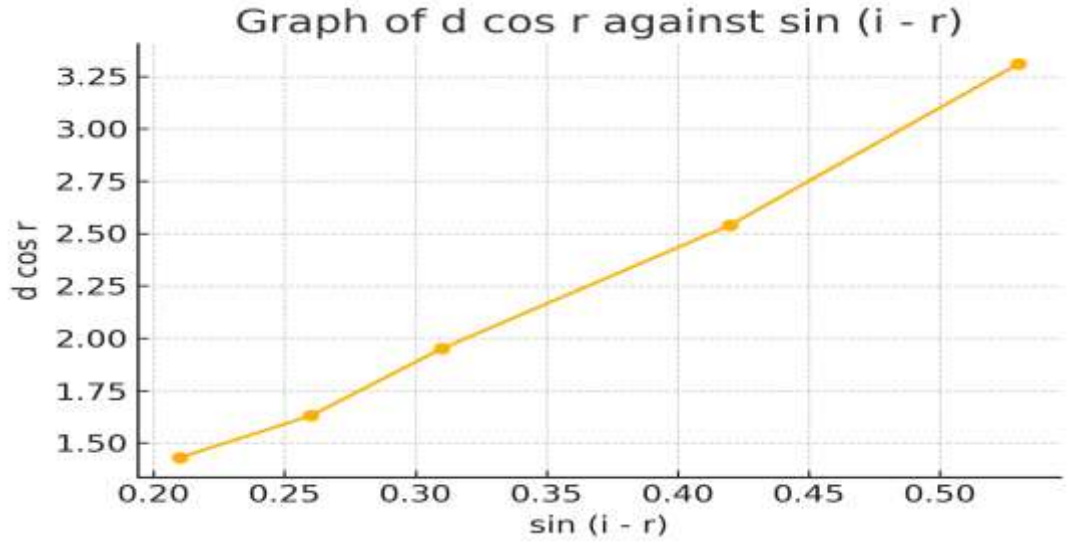
V = 0.63 + 0.60

V ≈ 1.22 V

4. An experiment was set as shown in figure 1 below. A glass block was placed on a drawing paper. With a sharp pencil, the outline of the glass block was drawn. Different paths of incident and refracted rays were drawn.
The results of the angles and the perpendicular distances 'd' measured between the incident ray and emergent ray are shown in table 3 below.

i (deg.)	r (deg.)	d (cm)	d cos r	sin (i - r)
30	18	1.5	1.43	0.21
40	25	1.8	1.63	0.26
50	32	2.3	1.95	0.31
60	35	3.1	2.54	0.42
70	38	4.2	3.31	0.53

(b) Plot a graph of d cos r against sin (i - r).



(c) Find the gradient of the graph.
The gradient of a straight-line graph is given by:
gradient = (change in d cos r) / (change in sin (i - r))
Using two points from the graph:

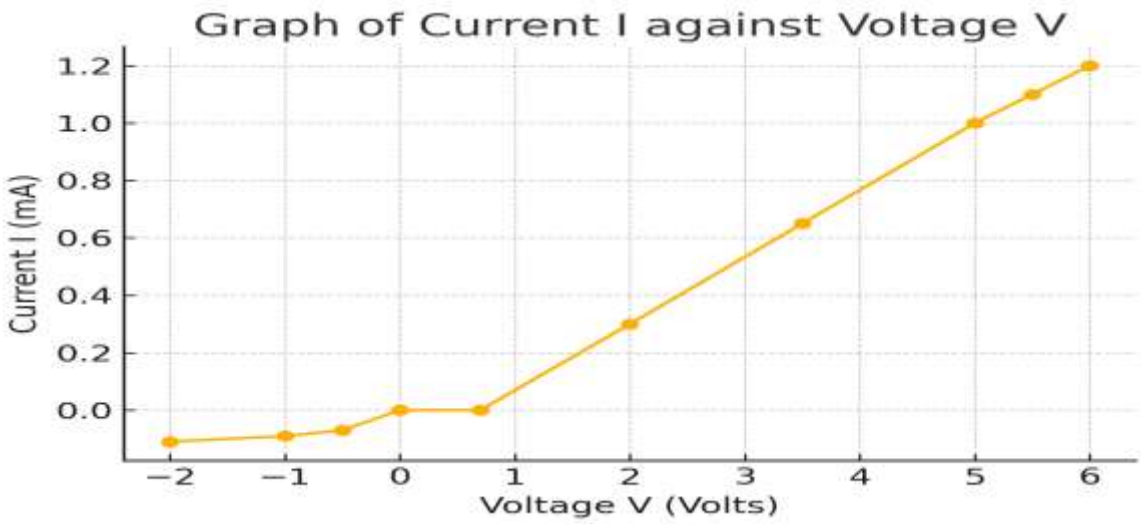
Point 1: (sin (i - r) = 0.21, d cos r = 1.24)
Point 2: (sin (i - r) = 0.53, d cos r = 3.31)

gradient = (3.31 - 1.24) / (0.53 - 0.21)
gradient = 2.07 / 0.32
gradient ≈ 5.90
Thus, the calculated gradient is approximately 5.90.

5. Table 4 below shows the voltage across a semiconductor diode and its corresponding current.

Voltage (V)	-2.0	-1.0	-0.5	0.0	0.7	2.0	3.5	5.0	5.5	6.0
Current, I (mA)	-0.11	-0.09	-0.07	0.00	0.00					

(a) Plot a graph of I against V (x-axis).



(b) Give the term used to describe such a curve for a plot of I vs V for a diode.

The term used to describe the I-V characteristic curve of a diode is "non-linear" or "exponential relationship".

This is because the diode does not follow Ohm's law linearly; instead, it exhibits a sharp increase in current after a threshold voltage is reached.

(c) What is the significance of negative values of voltage and current?

I. The negative voltage represents the reverse bias condition of the diode, where the external voltage is applied in a direction that opposes the natural flow of current.

II. The negative current indicates a very small leakage current flowing in the reverse direction due to minority charge carriers. In an ideal diode, no current would flow in reverse bias, but in reality, a small leakage current exists.

(d) What do positive values represent?

I. The positive voltage represents the forward bias condition of the diode, where the external voltage is applied in a direction that allows current to flow freely.

II. The positive current indicates the exponential increase in current once the diode reaches its threshold voltage (typically around 0.7V for a silicon diode). This means the diode is conducting electricity efficiently.

(e) State the use of the property of the device.

I. The rectification property of the diode is used in converting AC to DC in power supply circuits.

II. The unidirectional current flow of the diode is used in signal demodulation in radio receivers.
III. The voltage-dependent conduction is used in voltage regulation and protection circuits to prevent damage from voltage spikes.