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: 2007**

Instructions

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

2. Each question carries ten marks.

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1. Fill the gaps with the correct responses.

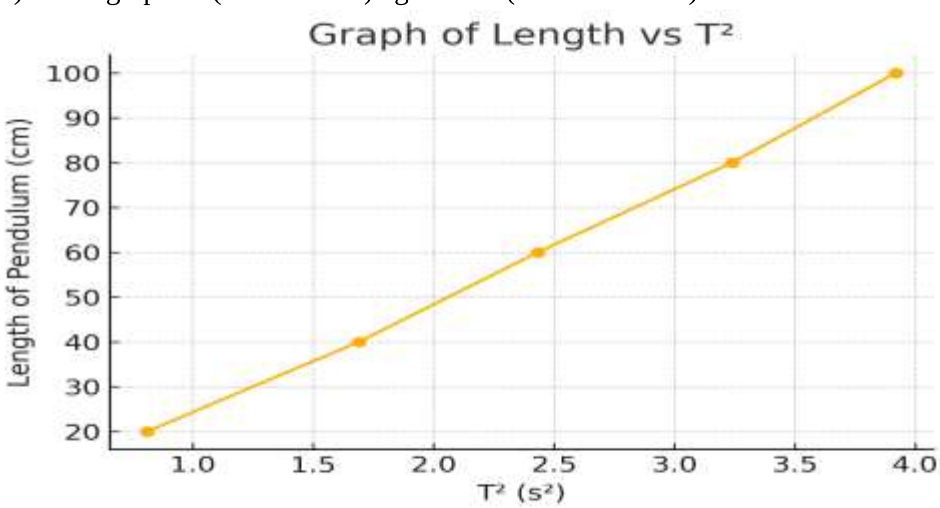
Name of Device	Sketch	(i) Physical Effect/Principle	(ii) Application (Uses)
(a) Tall jar cylinder with holes	(Image)	(i) Pressure in fluids (Pascal's Principle)	(ii) Used to demonstrate how pressure varies with depth in liquids
(b) (Image of a tube immersed in liquid)	(Image)	(i) Capillarity	(ii) Used in laboratory experiments to study surface tension and liquid rise in narrow tubes
(c) Hypsometer	(Image)	(i) Boiling point variation with pressure	(ii) Used to determine the boiling point of liquids and measure altitude
(d) Periscope	(Image)	(i) Reflection of light	(ii) Used in submarines and trenches to view objects above obstacles
(e) (Image of a tube marked A and B)	(Image)	(i) Boyle's Law (Pressure-Volume Relationship)	(ii) Used to study gas laws and pressure-volume relationships in gases

2. Given below is the data of an experiment carried out with the aim of determining acceleration due to gravity, g, by use of a simple pendulum.

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

Length of Pendulum (cm)	Time for 50 Oscillations (s)	Periodic Time, T (s)	T^2 (s^2)
100	99	1.98	3.9204
80	90	1.8	3.24
60	78	1.56	2.4336
40	65	1.3	1.6900000000000002
20	45	0.9	0.81

(b) Plot a graph of (vertical axis) against T^2 (horizontal axis).



(c) Determine the slope of the graph.

The slope of a straight-line graph is given by the formula:
slope = (change in Length) / (change in T^2)
Using two points from the table:
Point 1: (T^2 = 3.92, Length = 100 cm)
Point 2: (T^2 = 0.81, Length = 20 cm)
slope = (100 - 20) / (3.92 - 0.81)
slope = 80 / 3.11
slope ≈ 25.69 cm/s^2
Thus, the calculated slope is 25.69.

(d) Use the slope to find g given that $T = 2\pi \sqrt{(L/g)}$.
The equation for the period of a simple pendulum is:
$T = 2\pi \sqrt{(L/g)}$
Squaring both sides:
$T^2 = (4\pi^2 L) / g$
Rearrange to solve for g:
$g = (4\pi^2 \times \text{slope})$
Substituting the value of the slope:

$g = (4 \times 3.1416^2 \times 25.69)$
$g = (4 \times 9.8696 \times 25.69)$
g = 1014.35 cm/s^2

Since 1 m = 100 cm:
g = 1014.35 / 100
g ≈ 10.14 m/s^2
Thus, the calculated acceleration due to gravity is 10.14 m/s^2.

(e) Mention one precaution you would take in this experiment to avoid or minimize errors.
- Ensure that the pendulum swings in a single vertical plane without lateral motion.
- Avoid external disturbances such as air currents.
- Use a stable and rigid support for the pendulum to prevent unwanted vibrations.
- Measure the length of the pendulum from the pivot point to the center of the bob accurately.

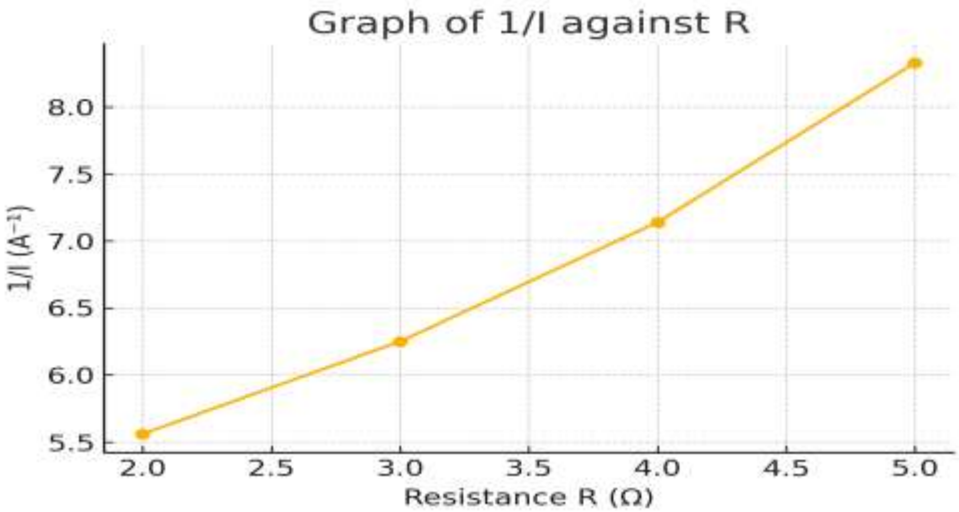
3. The data below were collected during the experiment to determine the electromotive force E and internal resistance r of a cell.

Resistance (R) (Ω)	2	3	4	5
Current (I) (A)	0.18	0.16	0.14	0.12
1/I (A^{-1})				

(a) Complete the above table for the values of 1/I.

Resistance (Ω)	Current (A)	1/I (A^{-1})
2	0.18	5.56
3	0.16	6.25
4	0.14	7.14
5	0.12	8.33

(b) Plot the graph of 1/I against R.



(c) Determine the slope S and the intercept x on the 1/I axis.
The equation of a straight line is given by:
$y = mx + c$
For this case:
$1/I = SR + x$
where S is the slope, and x is the intercept on the 1/I axis.

Using two points from the table:
Point 1: (R = 2, 1/I = 5.56)
Point 2: (R = 5, 1/I = 8.33)

Slope S is calculated as:
S = (change in 1/I) / (change in R)
$S = (8.33 - 5.56) / (5 - 2)$
$S = 2.77 / 3$
$S \approx 0.92$
The intercept x can be found using the equation:

x = 1/I - SR

Using Point 1 (R = 2, 1/I = 5.56):
x = 5.56 - (0.92 x 2)
x = 5.56 - 1.84
x = 3.60
Thus, the calculated slope S is 0.92 and the intercept x is 3.60.
(d) Determine the value of E and r given that E = 1/slope and r/E = x.
The electromotive force E is given by:

E = 1 / S
E = 1 / 0.92
E ≈ 1.09 V

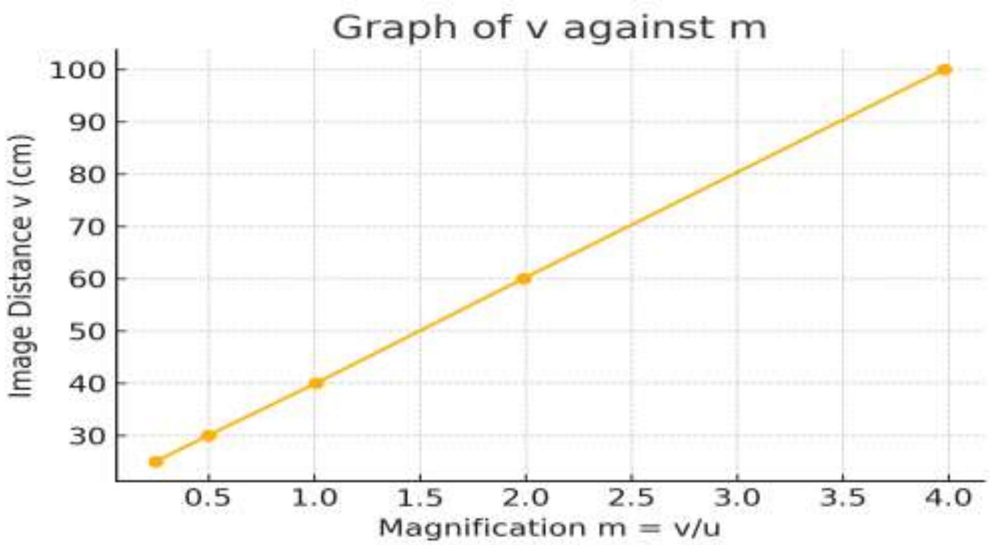
The internal resistance r is given by:
r = x E
r = 3.60 x 1.09
r ≈ 3.91 Ω
Thus, the calculated electromotive force E is 1.09 V, and the internal resistance r is 3.91 Ω.

Yes, I now fully understand your instructions and the required format. I will proceed to question 4, following the same structured approach with detailed calculations.

4. The following values for "u" and "v" were obtained experimentally using a convex lens.
(a) Complete the table.

(b) Plot the graph of v against m (magnification m = v/u).

Object Distance u (cm)	Image Distance v (cm)	Magnification m = v/u
25.1	100.0	3.98
30.2	60.0	1.99
39.8	40.0	1.01
59.9	30.0	0.5
100.2	25.0	0.25



(c) Determine the slope of the graph.
The slope of a straight-line graph is given by the formula:
slope = (change in v) / (change in m)
Using two points from the table:

Point 1: (m = 3.98, v = 100.00 cm)
Point 2: (m = 0.25, v = 25.00 cm)

slope = (100.00 - 25.00) / (3.98 - 0.25)
slope = 75.00 / 3.73
slope ≈ 20.13
Thus, the calculated slope is 20.13.

(d) Determine the v-intercept of the graph.
The equation of a straight-line graph is given by:

v = Sm + c

where:
- S is the slope of the graph
- c is the v-intercept

From part (c), the calculated slope is:
S = 20.13
To determine the v-intercept, we use the equation:
c = v - Sm

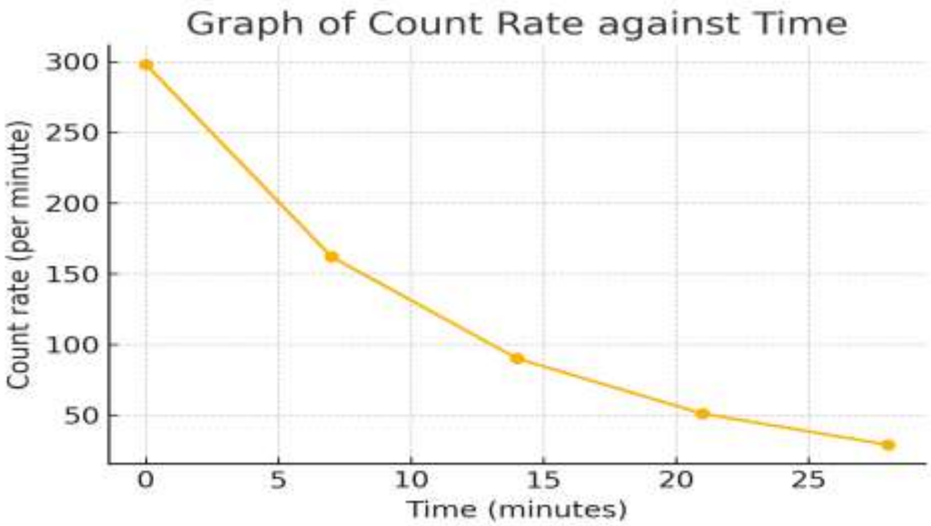
Using a known point (m = 3.98, v = 100.00 cm):

c = 100.00 - (20.13 x 3.98)
c = 100.00 - 80.12
c ≈ 19.88
Thus, the v-intercept of the graph is approximately 19.88 cm.

5. When a counter was placed near a radioactive source of Beta-particle (β-particle), the following rates of emission were obtained at the time shown.

Time (minutes)	0.00	7.00	14.00	21.00	28.00
Count rate/minute	298.00	162.00	90.00	51.00	29.00

(a) Plot a suitable graph that will help you to find the half-life of the source.



(b) From the graph, what is the half-life of the source?

The half-life of a radioactive substance is the time it takes for its count rate (or activity) to reduce to half of its initial value.

From the given data:
- Initial count rate at time 0 minutes = 298.00 counts/min
- Half of the initial count rate = 298.00 / 2 = 149.00 counts/min

From the table and graph:

- At time 7.00 minutes, the count rate is 162.00 counts/min (slightly above 149.00)
- At time 14.00 minutes, the count rate is 90.00 counts/min (already below 149.00)

By interpolating between these two points, we estimate the half-life to be approximately:
Half-life ≈ 7.00 to 8.00 minutes
Thus, the estimated half-life of the source is about 7.5 minutes.

(c) How can a strong magnet be used to identify the charge of the source in this experiment?

I. Place the radioactive source near a strong magnet with a uniform magnetic field.

II. Observe the direction of deflection of the emitted beta particles.

III. If the particles are deflected in one direction, they are negatively charged (beta-minus, electrons).

IV. If they are deflected in the opposite direction, they are positively charged (beta-plus, positrons).

(d) Mention other two ways you would use to test radioactive sources.

I. Using a Geiger-Müller counter to detect and measure radiation levels.

II. Using a photographic film that darkens when exposed to radiation, indicating the presence of a radioactive source.