THE UNITED REPUBLIC OF TANZANIA
NATIONAL EXAMINATIONS COUNCIL OF TANZANIA
DIPLOMA IN SECONDARY EDUCATION EXAMINATION

731/2A **PHYSICS 2A**

(ACTUAL PRACTICAL A)

Time: 3 Hours **ANSWERS** **Wednesday, 15th May 2019 a.m**

Instructions.

1. This paper consists of **three (3)** questions.
2. Answer **all** questions
3. Question number 1 carries 40 marks and the rest carry 30 marks.
4. Cellular phones are **note** allowed in the examination room.
5. Write your **examination Number** on every page of your answer booklet(s).

1. Radius of Gyration and Acceleration Due to Gravity

(a) Tabulate your results:

Length l (cm)	Time for 20 Oscillations (s)	T (s) = Time/20	T^2 (s^2)
100	40.0	2.00	4.00
80	37.6	1.88	3.53
50	33.2	1.66	2.76
30	29.0	1.45	2.10
20	26.6	1.33	1.77
10	24.2	1.21	1.46

(b) Plot the graph of T^2 against l

(c) Determine the slope and intercept of the graph

Take two points from the straight line:

Point 1: ($l_1 = 10$, $T^2_1 = 1.46$)
Point 2: ($l_2 = 100$, $T^2_2 = 4.00$)

Slope (m) = $(T^2_2 - T^2_1) / (l_2 - l_1)$
$= (4.00 - 1.46) / (100 - 10)$
$= 2.54 / 90$
$= 0.0282\ s^2/cm$

Y-intercept (c) = $T^2 - m \times l$, use point (10, 1.46):
$c = 1.46 - (0.0282 \times 10) = 1.46 - 0.282 = 1.178$

(d) Use the relation to calculate g and k

Given:

$T = 2\pi \sqrt{[(l + 1.414k^2) / g]}$
Squaring both sides:

$T^2 = (4\pi^2 / g) \times (l + 1.414k^2)$

Compare with:

$T^2 = m \times l + c$
Where:

$m = 4\pi^2 / g$

$c = (4\pi^2 \times 1.414k^2) / g$

Now calculate g:

From slope:

$m = 0.0282 = 4\pi^2 / g$
$g = 4\pi^2 / 0.0282$
$= 39.478 / 0.0282$
$\approx$ **1400 cm/s² = 14.0 m/s²**

Now calculate k:

From intercept:

$c = (4\pi^2 \times 1.414k^2) / g$
$1.178 = (39.478 \times 1.414k^2) / 1400$

Multiply both sides by 1400:
$1649.2 = 55.84k^2$
$k^2 = 1649.2 / 55.84 = 29.53$
$k \approx \sqrt{29.53} \approx$ **5.43 cm**

(e) Other sources of errors:

1. **Air resistance** affecting the motion of pendulum and disc.
2. **Friction at the pivot** of the disc during oscillations.

2. Loss of Heat from a Copper Calorimeter

Let's assume room temperature $\theta_0 = 26°C$
Measured temperatures over 14 mins:

t (min)	θ (°C)	(θ - θ₀)°C	log(θ - θ₀)
0	80	54	1.732
1	77	51	1.708
2	74	48	1.681
3	71	45	1.653
4	69	43	1.633
5	66	40	1.602
6	63	37	1.568
7	60	34	1.531
8	57	31	1.491
9	54	28	1.447
10	52	26	1.415

11	50	24	1.380
12	48	22	1.342
13	46	20	1.301
14	44	18	1.255

(b) Plot graph of log(θ - θ₀) vs time (t)

X-axis: Time (t)
Y-axis: log(θ - θ₀)
The graph should be a straight line with negative slope.

(c) Check if it obeys:

log(θ - θ₀) = -kt + Constant
Yes, since graph is a straight line. Now find slope:

Use two points:
(0, 1.732) and (14, 1.255)

k = -(change in y / change in x)
k = -(1.255 - 1.732)/14
= -(-0.477)/14
= **0.0341 min⁻¹**

(d) Physical meaning of k:

k is the **cooling constant**. It shows the rate of heat loss per unit temperature difference. Higher k means faster cooling.

(e) Two sources of error:

- **Heat loss to surrounding air or calorimeter itself** (not just water).
- **Inaccurate stirring or non-uniform water temperature** in the calorimeter.

3. E.M.F. and Internal Resistance of a Dry Cell

(a) Tabulate results

Assumed readings:

R (Ω)	I (A)	1/I (A⁻¹)
4	0.20	5.00
6	0.167	5.99

8	0.143	6.99
10	0.125	8.00
15	0.100	10.00

(c) Determine slope:

Use points (5, 4) and (10, 15)

Slope = (15 - 4) / (10 - 5) = 11 / 5 = **2.2 Ω**

(d) Determine e.m.f. and internal resistance:

From the relation:

$R = E \times (1/I) - r$
So:

E = slope = 2.2 V

Intercept = -r → from y-axis intercept

Use R = 4 when 1/I = 5:
4 = 2.2×5 - r
4 = 11 - r
r = 11 - 4 = **7 Ω**