THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL

ADVANCED CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

131/3A **PHYSICS 3A**

(For Both School and Private Candidates)

Time: 3 Hours **ANSWERS** **Year: 2012**

Instructions

1. This paper consists of THREE questions.

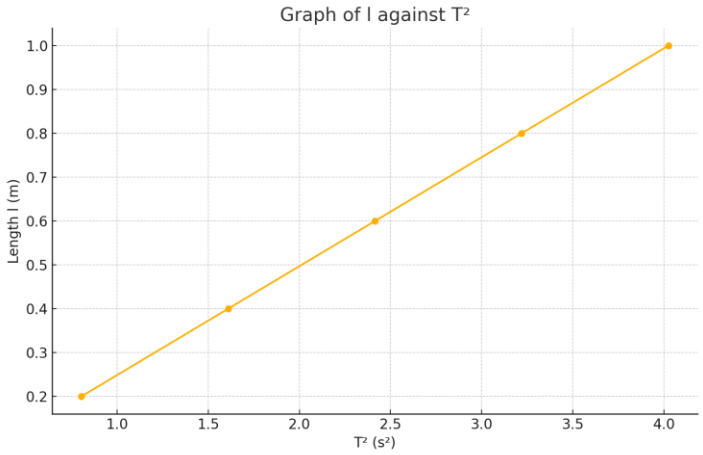
2. Answer all questions.

1. You are required to determine the acceleration due to gravity g.

(e) Tabulate your results:

l (m)	Time for 20 osc (s)	T (s)	T^2 (s^2)
1.00	40.12	2.006	4.024
0.80	35.89	1.794	3.219
0.60	31.08	1.554	2.415
0.40	25.37	1.269	1.610
0.20	17.94	0.897	0.805

(f)(i) Plot a graph of l against T^2.



Plot T^2 on the x-axis and l on the y-axis. This gives a straight line.
From two points: ($T^2_1 = 4.024$, $l_1 = 1.00$) and ($T^2_2 = 0.805$, $l_2 = 0.20$):

(f)(ii) Use the graph and the relation $T^2 = 4\pi^2 l/g$ to determine the value of g.

Use T^2 vs l → slope = $4\pi^2 / g$ → slope = $\Delta T^2 / \Delta l = (4.024 - 0.805) / (1.00 - 0.20) = 3.219 / 0.80 = 4.023$
Then $g = 4\pi^2$ / slope = 39.48 / 4.023 = 9.81 m/s^2

(g) State two possible sources of error in this experiment.

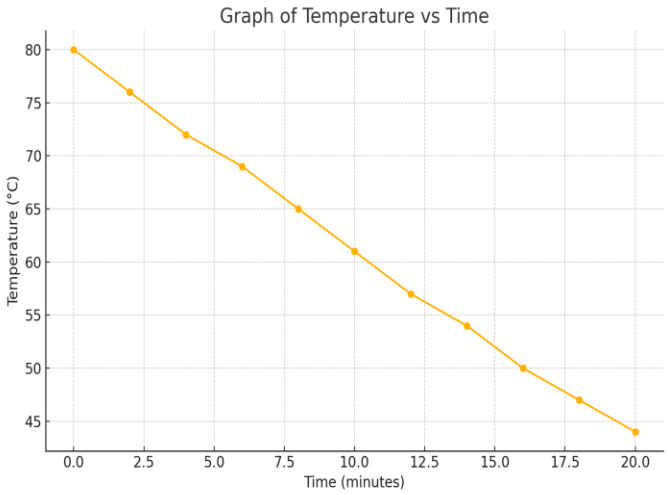
Timing error due to human reaction time when starting and stopping the stopwatch.
The pendulum may swing in an arc not perfectly vertical, causing deviation in the length of swing.

2. The aim of this experiment is to investigate the rate of cooling of calorimeter containing hot water.

(d) Record the values as shown in Table 1:

Time (min)	Temperature (°C)
0	80
2	76
4	72
6	69
8	65
10	61
12	57
14	54
16	50
18	47
20	44

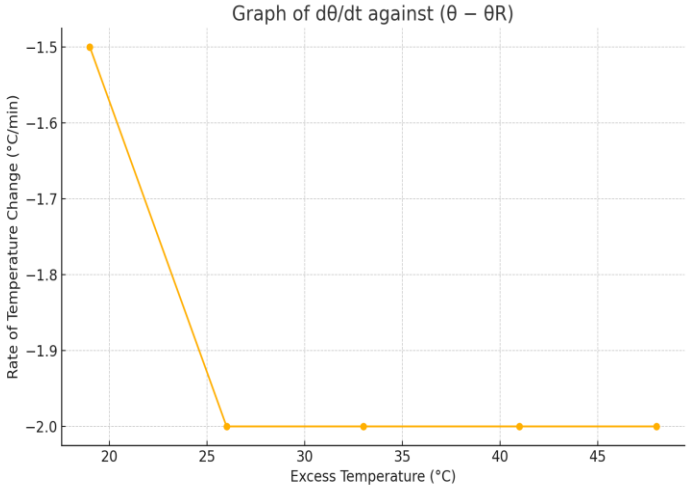
(e) Plot the graph of θ against time t.



(f) From your graph in (e), choose five points and fill Table 2:

Temperature (°C)	Rate of change of temperature (°C/min)	Excess temperature (°C)
76	-2.0	48
69	-2.0	41
61	-2.0	33
54	-2.0	26
47	-1.5	19

(g) Plot the graph of dθ/dt against (θ − θR).
This will be a straight line showing a negative linear relationship.



(h) In your own words, comment on the graph in (g).

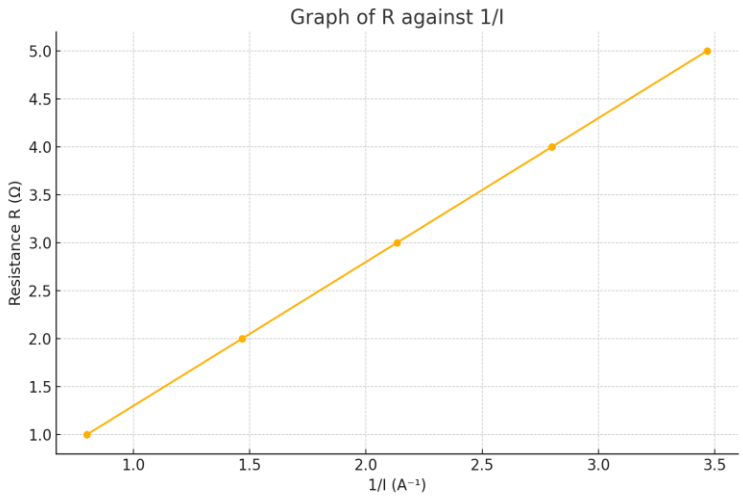
The graph shows that the rate of heat loss is directly proportional to the excess temperature. As the difference between the hot water and room temperature decreases, the rate of cooling reduces. This confirms Newton's Law of Cooling.

3. The aim of this experiment is to estimate the resistance r_a of an ammeter and e.m.f E of the cell.

(d) Tabulate your results:

R (Ω)	I (A)	1/I (A^{-1})
5	0.288	3.467
4	0.357	2.800
3	0.469	2.133
2	0.682	1.467
1	1.250	0.800

(e) Plot a graph of R against 1/I.
Graph is a straight line with positive slope.



(f) Use your graph to determine the resistance of the ammeter r_a and the e.m.f E of the cell.
From the equation:

$E = I(R + r_a)$
Rewriting: $R = (E \times 1/I) - r_a$
This is of the form: $y = m\,x + c$, where slope = E and y-intercept = $-r_a$

From two points:
$(1/I_1 = 3.467, R_1 = 5)$, $(1/I_2 = 0.800, R_2 = 1)$

Slope = $\Delta R / \Delta(1/I) = (5 - 1) / (3.467 - 0.800) = 4 / 2.667 = 1.5$
Therefore, E = 1.5 V

Using the equation again with point (1/I = 3.467, R = 5):
$5 = 1.5 \times 3.467 - r_a \rightarrow 5 = 5.2005 - r_a \rightarrow r_a = 0.2005 \approx 0.2\ \Omega$

(g) Mention a source of error in this experiment.

The internal resistance of the battery might change slightly due to heating, affecting the current reading. Also, contact resistance at the terminals may introduce additional resistance unaccounted for.