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** **Thursday, 10th May 2012 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. The aim of this experiment is to determine the force constant of the spring.

Apparatus:

You are provided with a weight pan, meter rule, pointer, spiral spring, slotted weights, stop watch and two retort stands with clamps.

Meter rule
Retort Stand
Pointer
Spring
Weight pan
Load
Retort Stand

Figure 1

Procedures:

(a) Set up the apparatus provided for this experiment as shown in Figure 1 above.

(b) Record the scale reading x_o.

(c) Add 50 gm on the weight pan and record the new scale reading x_s.

(d) Calculate the extension $(x = x_s - x_o)$ caused by the weight.

(e) Repeat with different load of 100 gm, 150 gm, 200 gm, 250 gm, until 600 gm.

Questions:

(i) Tabulate your results.

Answer:

Load (gm)	**x_s (cm)**	**Extension x (cm)**
0	20.0	0.0
50	22.5	2.5
100	25.0	5.0
150	27.5	7.5
200	30.0	10.0
250	32.5	12.5
300	35.0	15.0
350	37.5	17.5
400	40.0	20.0
450	42.5	22.5
500	45.0	25.0

550	47.5	27.5
600	50.0	30.0

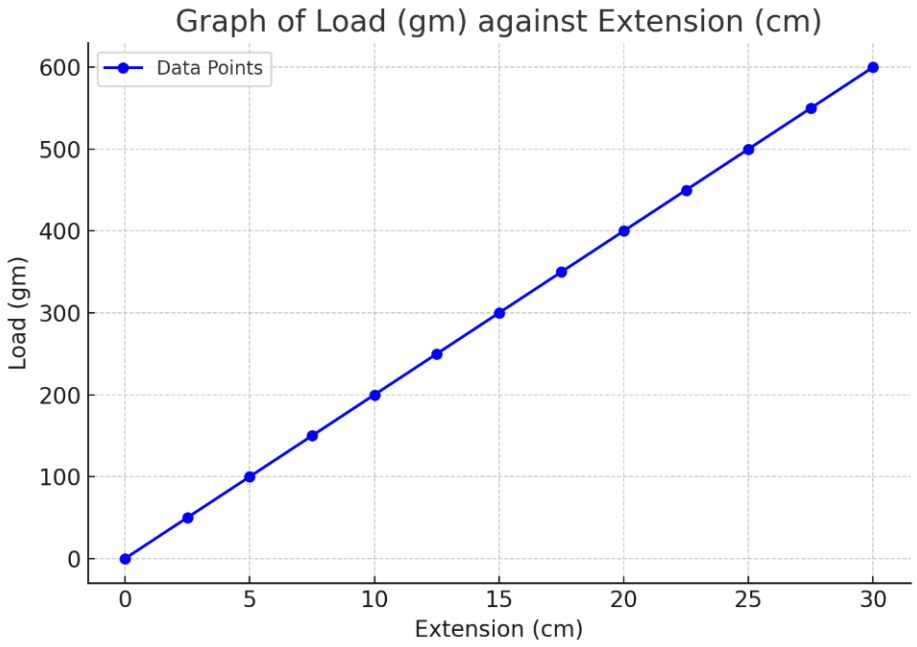
(ii) Sketch a well labeled diagram of the experiment.

Answer:

Labels:

- Retort Stand A — holding spring
- Spring — hanging vertically
- Pointer — fixed at bottom of spring
- Weight pan — attached at bottom
- Load — placed on weight pan
- Retort Stand B — holding meter rule alongside
- Meter rule — vertically placed beside spring

(iii) Plot a graph of load against extension.



(iv) Find the gradient G of your graph.

Answer:

Pick two points:
Point 1: (2.5 cm, 50 gm)
Point 2: (30.0 cm, 600 gm)

G = (600 − 50) / (30.0 − 2.5)
G = 550 / 27.5
G = 20.0 gm/cm

(v) What is the physical meaning of the gradient?

Answer:
The gradient represents the **force constant k** (spring constant) of the spring. It is the force required per unit extension to stretch the spring.

(vi) State four sources of errors and suggest the ways to minimize.

Answer:

1. **Parallax error** when reading the pointer scale — view at eye level.
2. **Friction at the spring's suspension point** — lubricate or hang it freely.
3. **Elastic limit exceeded if too much load is added** — avoid overloading.
4. **Oscillations during measurement** — wait until the spring stabilizes.

2. The aim of this experiment is to determine the rate of cooling of liquid B.

Apparatus:

You are provided with a thermometer, a calorimeter, a stirrer, a stopwatch/stop clock, beaker and liquid labeled B.

Procedures:

(a) Using a beaker, take about 200cm³ of the liquid B and heat until it boils.

(b) Quickly transfer the boiling liquid B from a beaker to the calorimeter provided. Record the temperature immediately you pour the liquid.

(c) While stirring the liquid and constantly fanning with the piece of paper provided, note and record the temperature of the liquid as it cools at intervals of 2 minutes. Continue with reading the temperature for 20 minutes.

Questions:

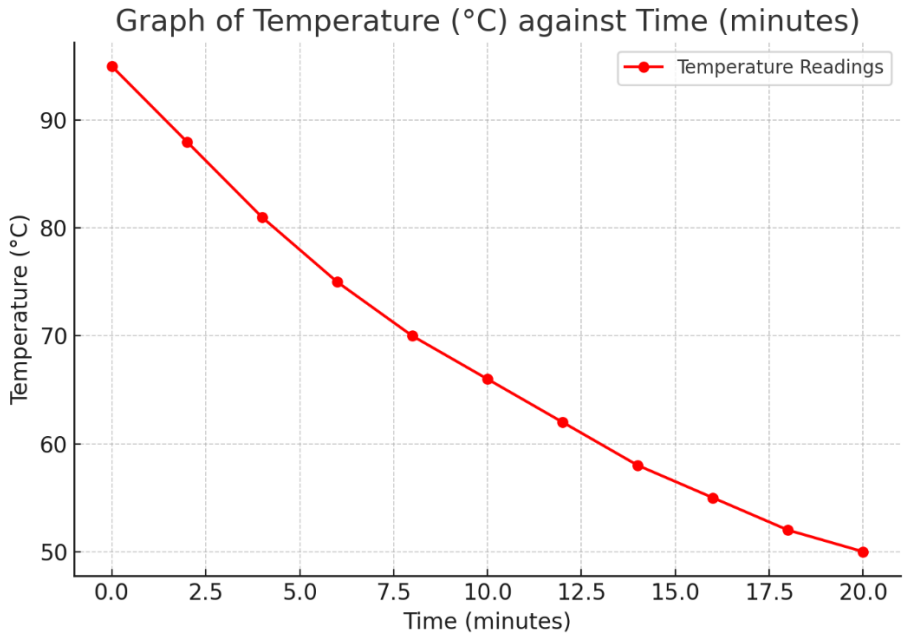
(i) Tabulate your results for θ and t, where θ is the temperature in °C and t is the time in minutes.

Answer:

Time t (min)	**0**	**2**	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**	**20**
Temperature θ (°C)	95	88	81	75	70	66	62	58	55	52	50

(ii) Draw a well labeled diagram of the experiment.

(iii) Plot a graph of θ against t.



(iv) Determine the rate of cooling of liquid B at 70°C, 60°C, 50°C.

Answer:

Approximate rate of cooling = Δθ / Δt over nearest 2-minute intervals.

- At **70°C**
  From 70°C (at 8 min) to 66°C (at 10 min)
  Rate = (70 − 66) / (10 − 8)
  Rate = 4 / 2 = 2°C per minute
- At **60°C**
  From 62°C (at 12 min) to 58°C (at 14 min)
  Rate = (62 − 58) / (14 − 12)
  Rate = 4 / 2 = 2°C per minute
- At **50°C**
  From 52°C (at 18 min) to 50°C (at 20 min)
  Rate = (52 − 50) / (20 − 18)
  Rate = 2 / 2 = 1°C per minute

(v) Mention four sources of error in this experiment.

1. **Heat loss to the surroundings before recording initial temperature**
   Minimize time between transferring liquid and recording.
2. **Parallax error in reading thermometer**
   Always read at eye level.
3. **Inconsistent stirring speed**
   Maintain steady, even stirring.
4. **Air currents affecting cooling rate**
   Use a consistent fanning method.

3. The aim of this experiment is to determine the electromotive force (E) and internal resistance (r) of a cell.

Procedures:

(a) Connect the circuit as shown in Figure 2 above.

(b) Put R = 1Ω and quickly read the value i on the ammeter.

(c) Repeat the procedure in 3(a) above for values of R = 2Ω, 3Ω, 4Ω, 5Ω and 6Ω.

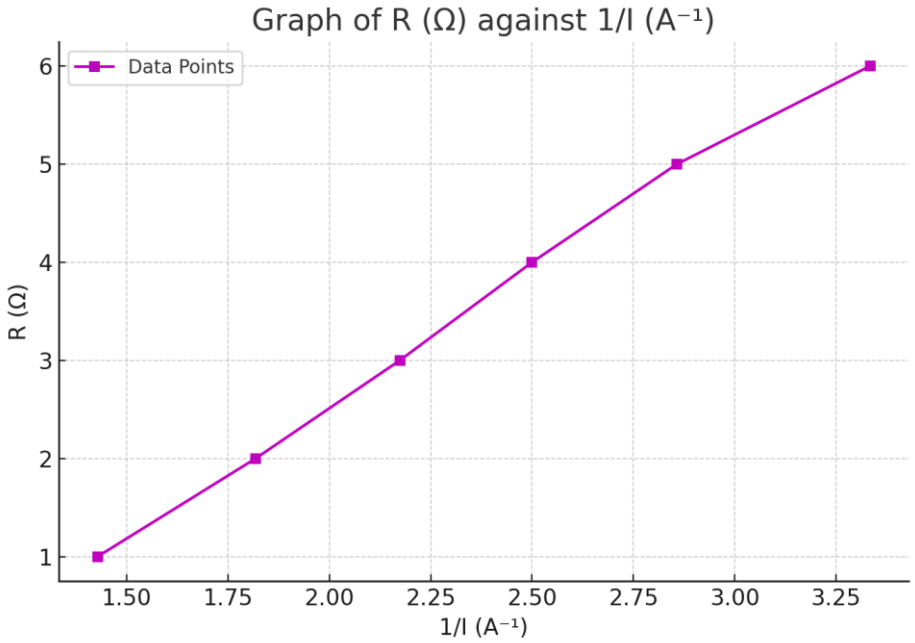
Questions:

(i) Tabulate your results and complete the following table

Answer:

Resistance R(Ω)	**Current I(A)**	**1/I (A^{-1})**
1	0.70	1.429
2	0.55	1.818
3	0.46	2.174
4	0.40	2.500
5	0.35	2.857
6	0.30	3.333

(ii) Plot the graph R against 1/I.



(iii) Using the graph and the equation R = (E × 1/I) − r. Find the value of E.

Answer:

From the equation:
R = E × (1/I) − r

The slope of the graph = E

Pick two points from the graph:

Point 1: (1.429, 1)
Point 2: (3.333, 6)

Slope (E) = (6 − 1) / (3.333 − 1.429)
Slope (E) = 5 / 1.904
E = 2.625 V

(iv) Suggest how E and r may be evaluated from your graph.

Answer:

- **E is the slope** of the straight-line graph of R against 1/I.
- **r is the negative intercept** on the R-axis when 1/I = 0.

(v) Evaluate E for one cell.

Answer:

E = 2.625 V (from calculation above)

(vi) Evaluate r for one cell.

Answer:

From graph intercept:

Using point-slope form:
At $(1/I = 0)$, $R = -r$

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

Substituting point (1.429, 1)

$1 = 2.625 \times 1.429 - r$
$1 = 3.750 - r$
$r = 3.750 - 1$
$r = 2.750\ \Omega$

So,
$r = 2.75\ \Omega$

(vii) State the source of error and suggest one way of minimizing it.

Answer:

Source of Error:

- Contact resistance and heating of connections affecting current readings.

Minimization:

- Use clean, tight connections and take readings quickly to avoid temperature rise.