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

731/2B **PHYSICS 2B**

Time: 3 Hours **ANSWERS** **Year: 2022**

Instructions.

1. This paper consists **Three (3)** questions.
2. Answer **all** questions.
3. Cellular phones are **note** allowed in the examination room.
4. Write your **examination Number** on every page of your answer booklet(s).

1. Required to carry out an experiment through the given procedures to find the total mass of the spring.

Procedures:
(a) Record the pointer's reading when the pan is empty as Xo (cm).
(b) Put 100 g mass on a pan and record a new pointer's reading as X (cm). Hence find the extension, S = X - Xo.
(c) Pull a spring to a small distance and release it so that it oscillates in a vertical motion. Record time t in seconds for 20 complete oscillations.
(d) Repeat the procedure in 1 (c) for masses, 200 g, 250 g, 300 g, 350 g and 400 g.

Questions:

(i) Tabulate your results, including the values of m (g), t (sec), T (sec) and T^2 (sec^2).

m (g)	t (s)	T = t/20 (s)	T^2 (s^2)
100	17	0.85	0.7225
200	20	1.00	1.0000
250	27	1.35	1.8225
300	30	1.50	2.2500
350	32	1.60	2.5600
400	35	1.75	3.0625

(ii) Plot a graph of m (g) against T^2 (s^2).

(iii) Using the equation $(m / K)4\pi^2T^2 = m + mes$ calculate the effective mass (mes) of the spring where K = 0.98 N/m.

Equation can be rearranged to fit:
$m = (4\pi^2 / K)T^2 - mes$

Meaning from the graph:

- Slope = $4\pi^2 / K$
- Y-intercept = mes

Let's calculate slope using two points (say last and first):

Slope = (300-200) / (2.25 – 1.00)
= 80
= 80g/s^2

Now, equating slope to $(4\pi^2 / K)(m+m_e)$

K = 0.98/80

K = 0.012

$T^2 = (4\pi^2 / K)(m+m_e)$

$M_e = 21g$

(iv) What is the physical meaning of constant K?

K is the spring constant. It represents the stiffness of the spring, defined as the force required to produce a unit extension in the spring (N/m).

(v) Use y-intercept of the graph to determine the value of the effective mass of the spring mes.

mes = 26 g

(vi) Using effective mass obtained in 1 (v), write down the relationship between mass of the spring (ms) and mes, and hence use the relation to solve for ms.

The relation is:
mes = ms / 3
Therefore:
ms = 3 × mes
= 3 × 21
= 63 g

(vii) What will be the total mass of the spring loaded over the digital balance?

It is ms = 100+200+250+300+350+400 = 1600g

2. Required to perform an experiment to investigate the capacity of the liquids to absorb the amount of heat from the running metal parts per kilogram per degree rise in temperature.

Procedures:
(a) Weigh an empty calorimeter with its stirrer and lid as mC.
(b) Fill 3/4 of the calorimeter with hot liquid A about 70 °C.
(c) Put the calorimeter into the jacket and cover with lid.
(d) Stir and record the temperature at intervals of 2 minutes until about 45 °C.
(e) Remove and measure mass as mCA.
(f) Repeat for liquid B, measuring mass as mCB.

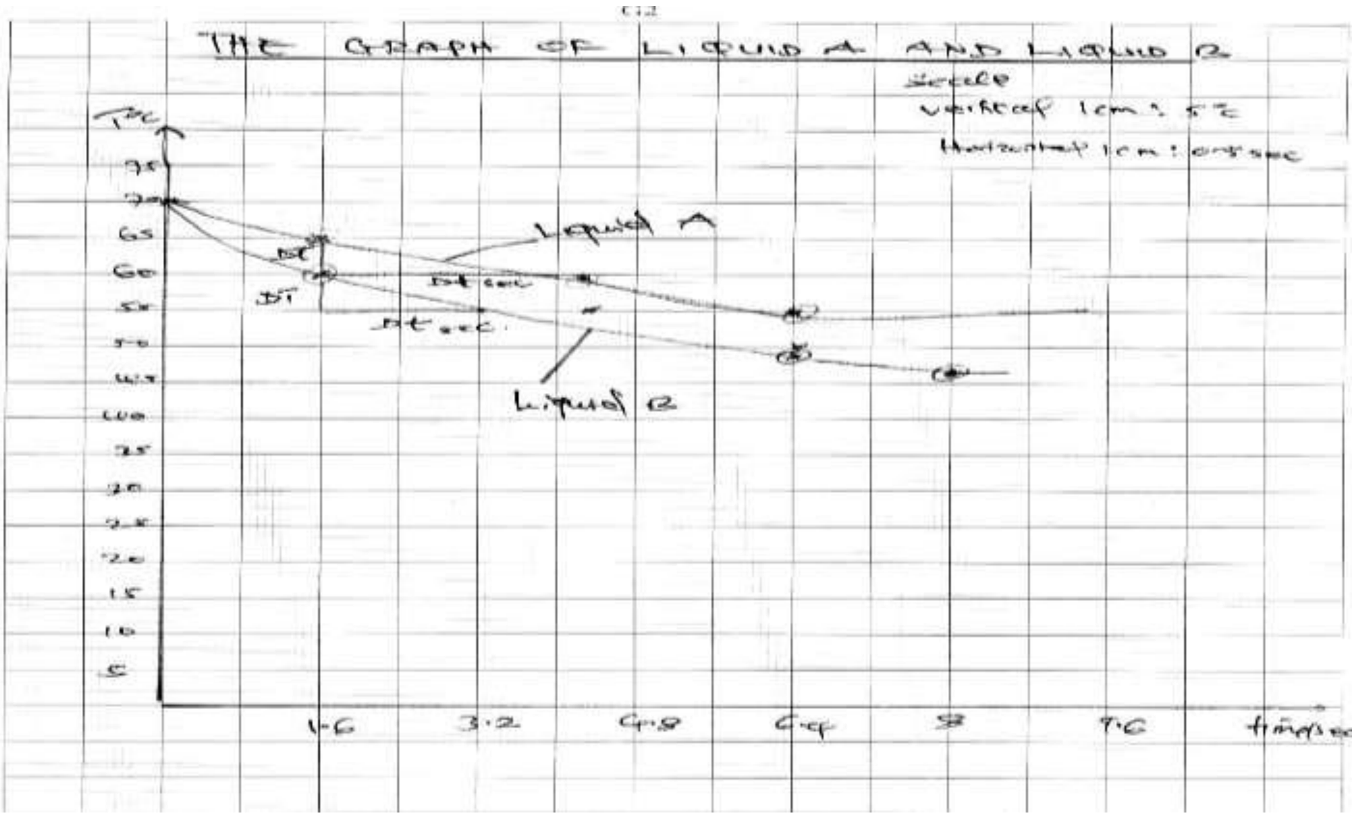
Questions:

(i) Tabulate your results.

Let’s tabulate assumed time vs temperature for both liquids.

Time (min)	Temp A (°C)	Temp B (°C)
0	70	70
2	66	64
4	62	59
6	58	55
8	54	51
10	50	47
12	46	44

(ii) Plot the cooling curve for liquid A and B on the same axis.



(iii) Obtain the gradient at 60 °C for each liquid from the graph plotted in 2 (ii).

Gradient for liquid A = 6.66 (°C/2 min)

(iv) Deduce the equation governing this experiment.

Equation:

$Q = mc\Delta T$

Where:
Q = heat lost
m = mass of liquid
c = specific heat capacity
ΔT = change in temperature

Rate of cooling (gradient) ∝ 1/(mc)

(v) Determine the specific heat capacity of liquid B given cA = 4200 J/kgK, and calorimeter heat capacity C = 400 J/kgK.

Using:

Rate of cooling ∝ 1/(mc)

cB/cA = Gradient A / Gradient B

Given:
cA = 4200 J/kgK
Gradient A = 6.66
Gradient B = 1.14 (approx. average of 2.75)

Then:
cB = cA × Gradient A / Gradient B
= 4200 × 6.66 / 1.14
= 24500 J/kgK

(vi) Compare the specific heat capacities of the two liquids and explain why one is more suitable for a car radiator.

Liquid B has a much higher specific heat capacity than liquid A. This means liquid B can absorb more heat per kilogram per degree temperature rise, making it more suitable as a cooling agent in a car radiator since it can remove more heat from the engine efficiently.

(vii) What is the aim of doing this experiment?

To compare the capacities of different liquids to absorb heat energy and to determine which liquid is more effective for use as a cooling agent based on their specific heat capacities.

3. Conduct an experiment to determine the resistance of the resistor Q from the following procedures:

Procedures:
(a) Connect resistor Q, resistance box, two dry cells and a switch in series. Connect a 0–5 V voltmeter across the resistance box.
(b) Read V when resistance box = 2 Ω.
(c) Repeat for 4 Ω, 6 Ω, 8 Ω, 10 Ω.

Questions:

(i) Draw the circuit diagram you connected as per instructions given.

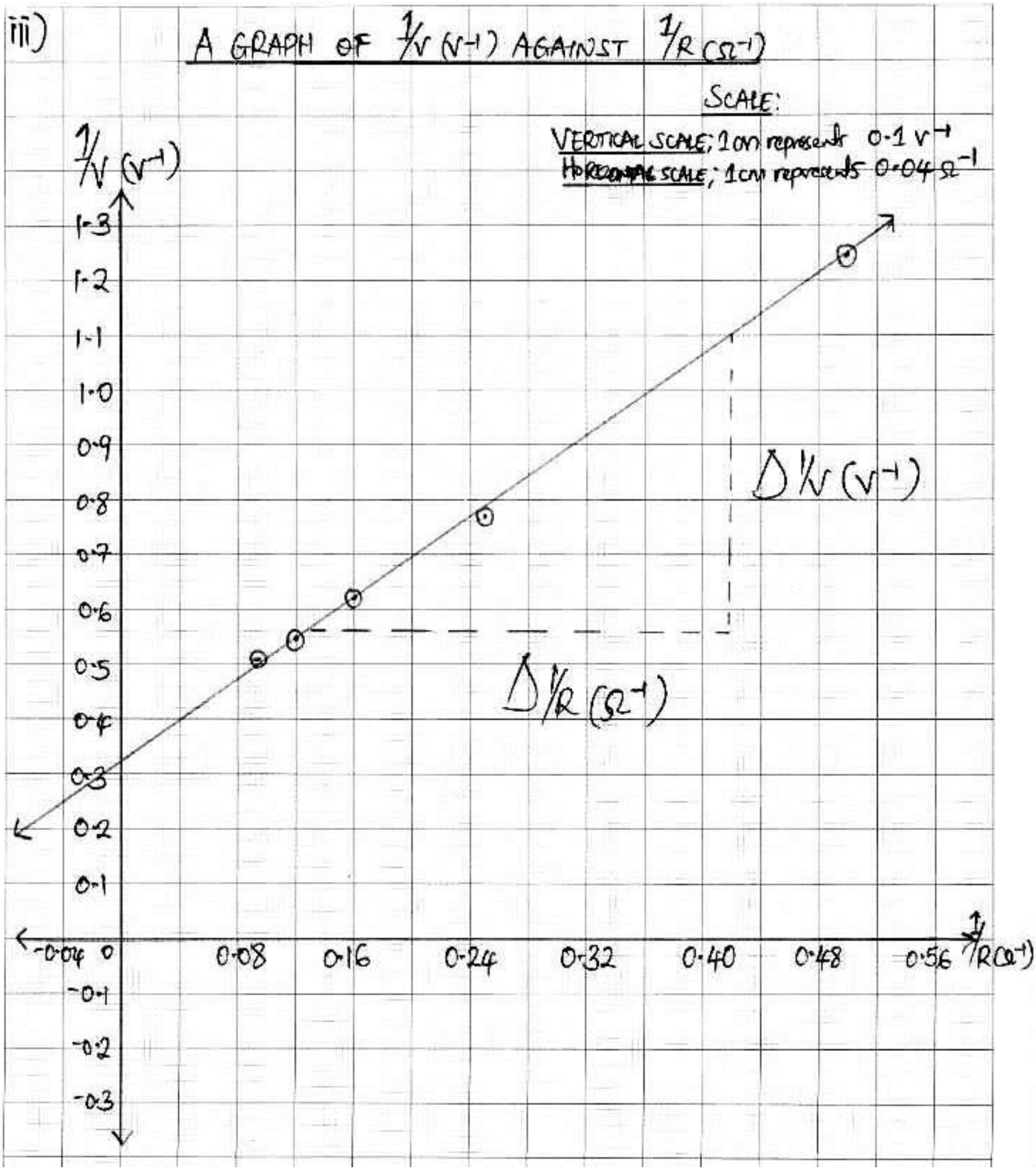
Battery — Switch — Ammeter — Resistor Q — Resistance box — Voltmeter across Resistance box.

(ii) Tabulate your results including columns for 1/V and 1/R

Given:

R (Ω)	1/R (Ω^{-1})	1/V (V^{-1})
2	0.500	0.42
4	0.250	0.37
6	0.1667	0.36
8	0.125	0.35
10	0.100	0.34

(iii) Plot a graph of 1/V against 1/R



(iv) Using the graph and V = (R/(Q+R))E determine values of Q and e.m.f

Slope = E / Q
Intercept = E / (Q+R) at 1/R = 0

From graph:
Choose two points, compute slope:

(0.500,0.42) and (0.100,0.34)

Slope = (0.42-0.34)/(0.5-0.1) = 0.08/0.4 = 0.20

Intercept (at 1/R = 0) = around 0.33

Then:
E = 0.33 V
Q = E / slope = 0.33 / 0.20 = 1.65 Ω

(v) If another method gave Q = 5 Ω, would it be recommended to replace the damaged resistor? Justify

Yes, Since experimental result is 1.65 Ω and 5 Ω is a significantly higher value, using 5 Ω would alter the circuit performance, voltage drops, and current.