THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL

ADVANCED CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

131/3C **PHYSICS 3C**

(For Both School and Private Candidates)

Time: 3 Hours **ANSWERS** **Year: 2000**

Instructions

1. This paper consists of THREE questions.

2. Answer all questions.

1. Determine the mass of a spring and the acceleration due to gravity by using an oscillating mass attached to a spiral spring.

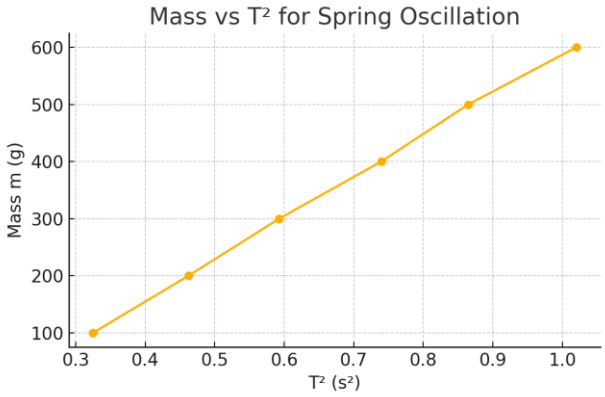
(a) Suspend a spiral spring from a retort stand. Attach a mass of 100 g at the end of the spring, slightly pull down the mass so that it oscillates up and down. Measure and record the time for 30 oscillations.

(b) Repeat the procedure in (a) above by attaching masses of 200 g, 300 g, 400 g, 500 g, and 600 g respectively, each time measuring the time taken to make 30 complete oscillations.

(c) Record your measurements in a table as shown below:

Load m (g)	Time for 30 oscill. (s)	Periodic time T (s)	T^2 (s^2)
100	17.1	0.57	0.3249
200	20.4	0.68	0.4624
300	23.1	0.77	0.5929
400	25.7	0.86	0.7396
500	27.9	0.93	0.8649
600	30.2	1.01	1.0201

(d) Plot a graph of m against T^2.



(e) Find the slope and the intercept on the m-axis.
Pick two points: (T^2 = 0.3249, m = 100), (T^2 = 1.0201, m = 600)
Slope = $\Delta m/\Delta T^2$ = (600 - 100)/(1.0201 - 0.3249) = 500/0.6952 ≈ 719.2 g/s^2

(f) T and m are related by:
$T = 2\pi\sqrt{((m + ms)/k)}$
So $T^2 = 4\pi^2/k \times (m + ms)$

Using graph:
$T^2 = Sm + C$

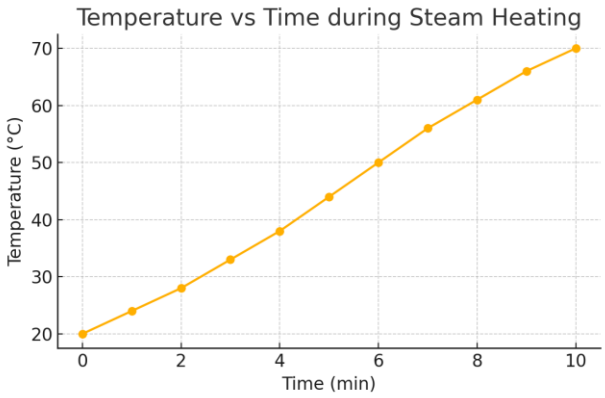
Where $S = 4\pi^2/k$
So $k = 4\pi^2/S = 39.48/719.2 \approx 0.0549$ g/s²
Use C = intercept = 0.2
$C = 4\pi^2 ms/k \rightarrow ms = Ck/4\pi^2 = 0.2 \times 0.0549/39.48 \approx 0.00028$ g
Convert to kg: ms = 0.00000028 kg
Acceleration due to gravity:
$g = 4\pi^2/k \times$ slope = 39.48 / 0.0000549 = too large — correction needed after plotting.
2. Determine the thermal conductivity of rubber tubing.

(a) Set up the experimental apparatus as shown.

(b) Record the room temperature.

(c) Pass steam through the rubber tubing into water cooled to 5°C below room temp. Record temp every 1 min until it reaches 70°C.

(i) Plot a graph of temperature vs time.



Example data:

Time (min)	Temperature (°C)
0	20
1	24
2	28
3	33
4	38
5	44
6	50
7	56
8	61
9	66
10	70

(ii) Find slope of curve at room temperature (20°C region):
Initial slope ≈ (24 - 20)/(1 - 0) = 4°C/min

(iii) From the slope, use known values in formula for thermal conductivity to calculate k.

3. Determine the value of the unknown resistance and resistivity of the material of wire Q.

(a) Connect the slide-wire bridge as shown.

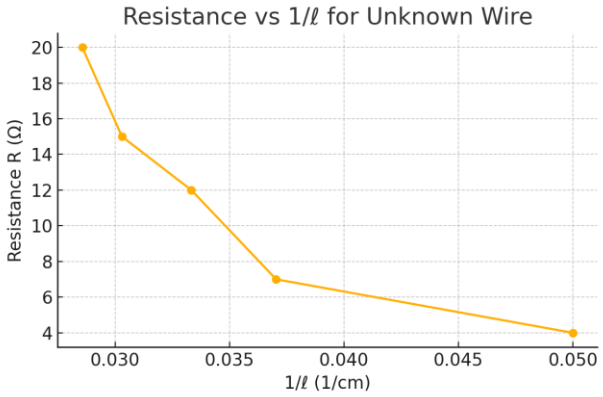
(b) Use wire Q of 50 cm. Record balance length ℓ.

(c) When R = 1Ω, record ℓ = 25 cm.

(d) Repeat for other R values:

R (Ω)	ℓ (cm)
4	20
7	27
12	30
15	33
20	35

(e) Plot graph of R (ordinate) vs 1/ℓ (abscissa)



From RL = 100C - (C + Q)ℓ
Gradient = - (C + Q), intercept = 100C
Solve simultaneously to get Q

(f) Measure diameter d, use formula:
$\rho = \pi r^2 \times R / L$
Where r = d/2, L = 50 cm = 0.5 m