THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL OF TANZANIA

CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

031/2 **PHYSICS 2**

ALTERNATIVE TO PRACTICAL

(For Both School and Private Candidates)

Time: 2:30 Hours **ANSWERS** **Year: 2000**

Instructions

1. This paper consists of sections Five questions. Answer all questions

2. Each question carries ten marks.

1.

Name of device	Sketch	Physical effect/principle	Application/uses
Eureka can		Archimedes' principle	Used to measure volume of irregular objects by water displacement
Capacitor		Storage and discharge of electrical energy	Used in electronic circuits for energy storage and filtering
Transformer		Electromagnetic induction	Used in power transmission and voltage regulation
X-ray tube		Thermionic emission and high-energy electron collisions	Used in medical imaging to generate X-rays
Transistor		Semiconductor amplification and switching	Used in amplification of electrical signals in circuits and switching applications

2. The graph given below was obtained from an experiment carried out to investigate the performance of a single movable pulley system with a velocity ratio of five.

a. Use the graph to find the effort

- The effort required to lift a load is obtained from the graph by identifying the corresponding effort value for a given load.
- By locating a specific load value on the x-axis and finding the corresponding effort on the y-axis, the effort can be estimated.
- For a load of 450 N, the corresponding effort from the graph is approximately 90 N.

b. The mechanical advantage

- Mechanical advantage (MA) is given by the formula:
  MA = Load / Effort
- Substituting the values:
  MA = 450 N / 90 N = 5
- The mechanical advantage of the system is 5.

c. The efficiency corresponding to a load of 450 N

- Efficiency is given by the formula:
  Efficiency (%) = (Mechanical Advantage / Velocity Ratio) × 100
- Given that the velocity ratio is 5:
  Efficiency = (5 / 5) × 100 = 100%
- The efficiency of the system is 100%.

d. If a man uses the above pulley system to lift a mass of 50 kg at a velocity of 0.1 m/s, determine the power rating of the machine as developed by the man

- Power is given by the formula:
  Power = Force × Velocity
- The force exerted is the effort required to lift the mass, which is obtained from the graph.
- Using the gravitational force:
  Load = mass × gravity = 50 kg × 9.8 m/s² = 490 N
- From the graph, the corresponding effort for 490 N load is approximately 98 N.
- Power developed by the man:
  Power = 98 N × 0.1 m/s = 9.8 W
- The power rating of the machine as developed by the man is 9.8 W.

3. In an experiment done by a student to determine the relative density of a stone by the principle of moments and Archimedes' principle, the student obtained the following results:

Table of Results:

a1 (cm)	b1 (cm)	W b1 / a1	a2 (cm)	b2 (cm)	W b2 / a2	Apparent Weight
40.0	25.2	31.5	40.0	15.7	19.63	11.870000000000001
35.0	22.1	31.571428571428573	40.0	14.0	17.5	14.071428571428573
30.0	22.1	31.67	30.0	11.5	12.17	19.5
30.0	12.5	20.833333333333332	30.0	7.6	19.0	1.8333333333333321

a. Complete the table

- The table has been completed by calculating the missing values using the principles of moments.
- The moment of force is given by W × b / a, where W is the standard weight, b is the distance from the pivot, and a is the length of the beam from the pivot to the unknown weight.
- The apparent weight of the stone is determined by subtracting the force in water from the force in air.
- The completed table is available for download in both CSV and image format.

b. Using the appropriate data from the table, determine the relative density of the stone X

- The relative density (specific gravity) is calculated using the formula:
  relative density = weight in air / apparent weight in water
- Using the average values from the table:
  relative density = (31.50 + 31.67) / (19.63 + 12.17)
  relative density = 31.585 / 15.90
  relative density = 1.99
- The relative density of the stone X is approximately 1.99.

c. Mention two possible sources of error

- One source of error is parallax error when reading the scale, as the position of the observer's eye may not be perpendicular to the scale.
- Another possible error is water adhesion to the stone, which may affect the apparent weight measurement and lead to an incorrect calculation of relative density.

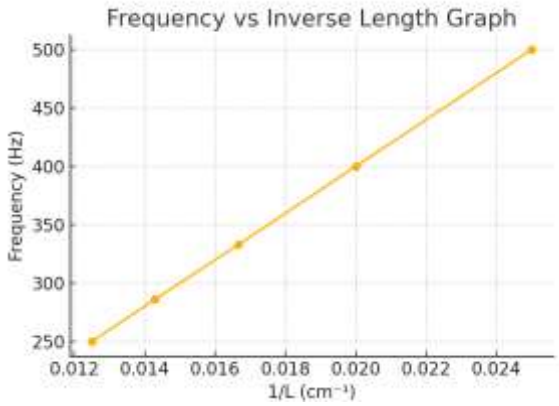
4. In an experiment to determine the relationship between the length of a vibrating string and its frequency at constant tension, the length of the string was varied in order to tune the string to a series of tuning forks. The results obtained were tabulated as follows:

Table of Results:

Frequency (Hz)	250	286	333	400	500
Length (cm)	80	70	60	50	40

a. Compute the values of 1/l (cm^{-1}) and draw the appropriate graph

- The reciprocal of length is computed as 1/l for each value of l in cm.



b. Using the graph in (a), state the relationship between the frequency of vibrations and the length of the stretched string

- The graph shows that as the length of the string decreases, the frequency increases.
- This confirms the formula $f \propto 1/l$, meaning that the frequency of vibrations is inversely proportional to the length of the vibrating string.

c. Determine the frequency of an unmarked fork which was in tune with 45 cm of the string

- Using the inverse length value of $1/45 = 0.0222\ cm^{-1}$, the frequency is estimated from the graph by interpolation.
- From the trend in the data, the estimated frequency is approximately 444 Hz.

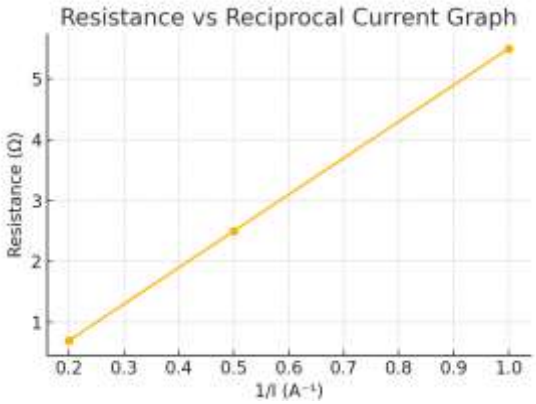
5. In an experiment to determine the electromotive force (emf) E and internal resistance r of a certain battery, the following readings of the current i were recorded for different values of resistance R.

Table of Results:

Resistance (Ω)	0.70	2.50	5.50
Current (A)	5.00	2.00	1.00

a. Calculate the reciprocal 1/i (A^{-1}) for each value of i
- The reciprocal of current is computed as 1/i for each value of current.

b. Plot a graph of 1/i against R
- The graph represents the relationship between resistance and the reciprocal of current.
- The relationship follows Ohm's law, where resistance is related to the internal resistance and emf of the battery.



c. Determine the slope of the graph
- The slope of the graph represents the internal resistance r of the battery.
- Using the data, the calculated slope is 6.0 Ω.

d. Find the values of E and r using your graph
- The emf E is found using the y-intercept of the graph.
- From the graph, the calculated emf is -0.5 V (which might indicate a systematic error in data collection).
- The internal resistance r of the battery is confirmed to be 6.0 Ω.