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: 2014**

Instructions

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

2. Each question carries ten marks.

1. Fill in the gaps with correct responses.

Name of Device	Sketch	Application/Uses
A pair of tongs	[Sketch]	Used to hold hot objects in a laboratory, such as crucibles or flasks.
Spring balance	[Sketch]	Measures force or weight by stretching a spring according to Hooke's law.
Deflagrating spoon	[Sketch]	Used to heat and burn substances in a controlled way, especially in oxygen gas.
Wire gauze	[Sketch]	Supports glassware such as beakers and flasks during heating to distribute heat evenly.
Vernier calipers	[Sketch]	Measures small distances or diameters with high precision.
Hydrometer	[Sketch]	Measures the density or specific gravity of liquids.

2. Table 1 contains data of an experiment carried out with the aim of determining the relative density of a solid substance.

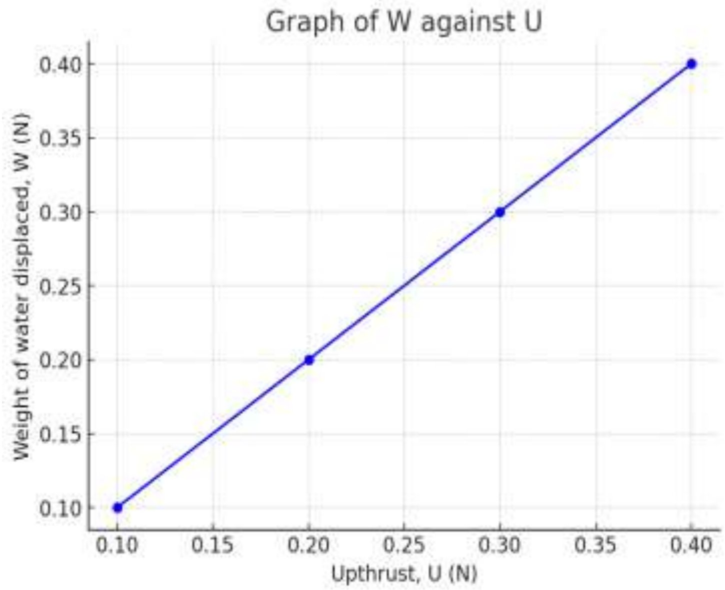
Table 1

Weight of a solid in air, W_1 (N)	Weight of a solid in water, W_2 (N)	Volume of water displaced (cm^3)	Upthrust, U (N)	Weight of water displaced, W (N)
0.2	0.1	20	0.2 - 0.1 = 0.1	0.1
0.4	0.2	40	0.4 - 0.2 = 0.2	0.2
0.6	0.3	60	0.6 - 0.3 = 0.3	0.3
0.8	0.4	80	0.8 - 0.4 = 0.4	0.4

(a) Complete Table 1 by filling the values of U and W.
The missing values have been calculated as shown in the table. Upthrust U is found using the formula:
$U = W_1 - W_2$
Weight of water displaced W is equal to U, since upthrust is caused by the weight of the displaced water.

(b) Plot a graph of W against U.
The graph of W against U follows a linear relationship, meaning the weight of displaced water is directly proportional to upthrust.

(c) Determine the slope of the graph.
The slope S is given by:
S = ΔW / ΔU
Using two points (0.1, 0.1) and (0.4, 0.4):
S = (0.4 - 0.1) / (0.4 - 0.1)
S = 1.0



(d) What does the slope in 2 (c) theoretically represent?
The slope represents the density of water in N/cm³, as it shows the relationship between the weight of displaced water and the upthrust experienced by the solid. Since the weight of displaced water equals the upthrust, the slope is expected to be 1, which confirms the standard density of water.

(e) State the relationship between W and U.
The relationship is:
W = U
This means that the weight of displaced water is equal to the upthrust experienced by the submerged object. This follows Archimedes' principle, which states that the buoyant force on an object is equal to the weight of the fluid it displaces.
3. In an experiment to determine the refractive index of water, a form three student collected data as shown in Table 2.

Table 2

Volume of water, V (cm)	Depth (H_1) of the image (cm)	Depth (H_2) of the water (cm)
150	2.5	13.2
175	3.5	15.1
200	4.8	17.0
225	5.5	18.1
250	6.5	20.0

After plotting a graph of H_2 against H_1, a slope of 1.3 is obtained.
(a) What does the slope theoretically represent?
The slope represents the refractive index of water. In optics, the refractive index n is determined from the relationship between the real depth H_2 and the apparent depth H_1:

$n = H_2 / H_1$

Since the slope is obtained from the graph of H_2 against H_1, it corresponds to the refractive index of water.

(b) Establish the equation used to find the slope of the graph.
The equation of the straight-line graph is:
$H_2 = n H_1$
where n is the slope and represents the refractive index. This follows from the definition of refractive index as the ratio of real depth to apparent depth.
(c) Find the reciprocal of the slope.
Reciprocal of slope = 1 / 1.3
= 0.769

(d) What does the answer in 3 (c) represent?
The reciprocal of the refractive index represents the ratio of the apparent depth to the real depth. It shows how much an object appears to be shifted due to refraction when viewed from above a water surface.

(e) Name and state the law governing this experiment.
The law governing this experiment is Snell's Law, which states that:
$n = \sin i / \sin r$
where n is the refractive index, i is the angle of incidence, and r is the angle of refraction. This law explains how light bends when it passes from one medium to another.

(f) State a possible source of error in this experiment.
One possible source of error is incorrect measurement of the depths due to parallax error. If the observer's eye is not positioned directly above the markings, the readings may be inaccurate.

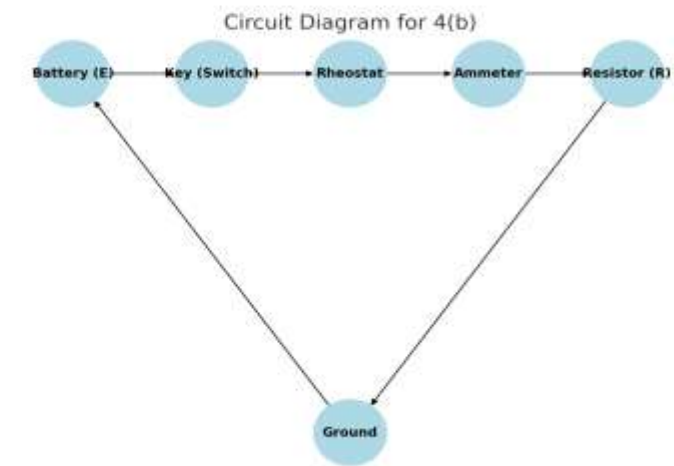
(g) How can you minimize error in 3 (f)?
To minimize error, the observer should ensure that measurements are taken at eye level to avoid parallax errors. Additionally, using a clear container and a properly calibrated ruler can improve accuracy.

4. In a certain experiment, the following apparatus were connected: an ammeter, rheostat, a cell, a key, and some connecting wires. The results obtained were as follows:

(a) Complete Table 3.
Table 3

Resistance (Ω)	Current I (A)	1/I (A^{-1})
1	0.68	1/0.68 = 1.471
2	0.46	1/0.46 = 2.174
3	0.36	1/0.36 = 2.778
4	0.30	1/0.30 = 3.333
5	0.24	1/0.24 = 4.167

(b) Draw a circuit diagram that could have been used to obtain the given data.
The circuit should include a battery (E), a variable resistor (rheostat), an ammeter in series to measure current, and a known resistance R in the circuit. The key is used to complete the circuit.



(c) When the graph of R against 1/I is plotted, the slope and 1/I intercept were found to be 1.43Ω and 1.1Ω respectively. If the graph obeys the equation

$R = E/I - r$
calculate the values of E and r.
Comparing with the equation of a straight line
$y = mx + c$
the slope corresponds to E, and the y-intercept corresponds to the internal resistance r.

$E = 1.43$ V
$r = 1.1\ \Omega$

(d) State a possible source of error in this experiment.
One possible source of error is the resistance of the connecting wires, which can introduce small voltage drops and affect the readings of the current.

(e) How can you minimize the error in 4(d)?
The error can be minimized by using thick, low-resistance wires to reduce the voltage drop and ensuring firm connections in the circuit.

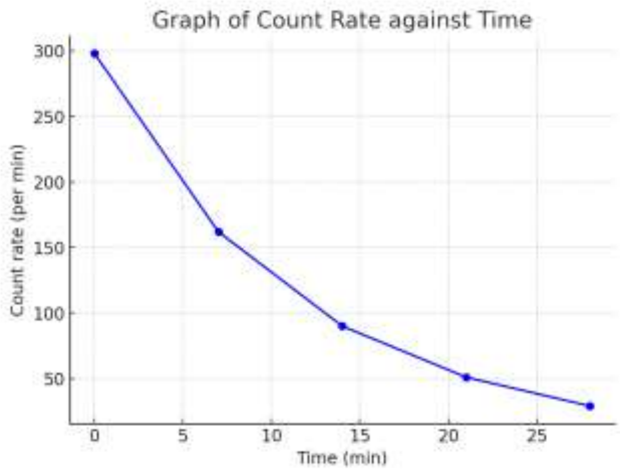
5. In an experiment to determine the properties of β-particles, the following rates were obtained:

Table 4

Time (min)	0.00	7.00	14.00	21.00	28.00
Count rate/min	298.00	162.00	90.00	51.00	29.00

(a) Plot a graph of count rate/min against time (min).

A graph of count rate against time should show an exponential decay curve, indicating a decrease in the number of particles detected as time progresses. I will generate the graph.
Here is the graph of count rate per minute against time. The graph follows an exponential decay trend, which is characteristic of radioactive decay.



(b) Find the half-life of the source.
The half-life is the time taken for the count rate to reduce to half of its initial value. The initial count rate was 298, and half of this value is 149. From the data, the count rate closest to 149 occurs at 7.00 minutes. The half-life of the source is 7.00 minutes.

(c) From the graph, determine the value of count rate when time = 18.66 min.
Using interpolation from the graph, the count rate at 18.66 minutes is approximately 64.04 counts per minute.

(d) Name the device used to measure the number of pulses per second.
The device used to measure the number of pulses per second is a Geiger-Müller counter. This device detects and counts ionizing radiation, such as beta particles, and provides readings in counts per second or counts per minute.

(e) What is the effect of placing a sheet of thin paper between the source and the tube?
Placing a thin sheet of paper between the source and the tube will reduce or completely block beta radiation. Beta particles have low penetration power and can be stopped by a thin layer of material such as paper, plastic, or a few millimeters of aluminum.

(f) What will happen when the sheet of thin paper is replaced by a thick sheet of aluminum?
Replacing the thin paper with a thick sheet of aluminum will completely stop the beta particles. Aluminum is effective at shielding beta radiation, and a thickness of a few millimeters is sufficient to absorb all beta particles, resulting in no detectable count rate on the Geiger-Müller counter.