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

731 **PHYSICS 1**

Time: 3 Hours **ANSWERS** **Year: 2023**

Instructions.

1. This paper consists of sections A and B with a total of **Fourteen (14)** questions.
2. Answer **all** questions from section A and **four (4)** questions from section B.
3. Section A carries **forty (40)** marks and section B Carries **sixty (60)** marks.
4. Cellular phones are **note** allowed in the examination room.
5. Write your **examination Number** on every page of your answer booklet(s).

SECTION A (40 Marks)

Answer all questions from this section. Each question carries 4 marks.

1. The Form One students were given a task to measure a mass of a bob using beam balance. Explain two physical quantities that would be expressed by the students in carrying out such task.

The first physical quantity expressed is **mass**, which is the quantity of matter in the bob being measured, expressed in kilograms or grams.

The second physical quantity is **weight**, which is the gravitational force acting on the mass. Although the beam balance measures mass by comparing it to known masses, it essentially balances the weight on both pans under gravity.

2. An experimenter complained to you about a problem of obtaining different readings when using the new and old spring balance. What would be a reason for this difference?

The likely reason for the different readings is that the old spring balance may have undergone **wear and tear** or **loss of elasticity** due to prolonged use. This affects its ability to return to its original position, causing inaccurate or inconsistent readings compared to the new, properly calibrated one.

3. A passenger in the train noticed that the brake was applied when it was moving with a velocity of 72 km/h. After passing over 200 m, its velocity reduces to 36 km/h at the same rate of retardation. How much distance will it go before brought to rest?

Given:
Initial velocity, u = 72 km/h = 20 m/s
Final velocity after 200 m, v = 36 km/h = 10 m/s
Distance covered, s = 200 m
Solution
First, find acceleration (a) using:
$v^2 = u^2 + 2as$
$10^2 = 20^2 + 2a(200)$
$100 = 400 + 400a$
$400a = 100 - 400$
$400a = -300$
$a = -0.75\ m/s^2$

Now, find additional distance (S) it would travel before stopping (v = 0):
$v^2 = u^2 + 2aS$
$0 = 10^2 + 2(-0.75)S$
$0 = 100 - 1.5S$
$1.5S = 100$
$S = 66.67\ m$
So, the train will travel an additional 66.67 meters before coming to rest.

4. The College Principal invited a clinical officer to present to the second-year student teachers about qualities of a good thermometric property. What are the four key points will the clinical officer present to students?

First, the thermometric property should vary **uniformly and steadily with temperature** so that equal changes in temperature cause equal changes in the property.

Second, it should be **sensitive** enough to detect even small temperature changes.

Third, it must be **measurable over a wide range** of temperatures without rapid deterioration.

Fourth, it should be **easily reproducible**, meaning its readings should remain consistent when tested under the same conditions.

5. "If the distance between two objects is doubled, the gravitational force between them decreases to one fourth." Prove this statement by using Gravitation's equation.

Gravitational force is given by:
$F = G \times (m_1 m_2) / r^2$
If the distance (r) is doubled:
New distance = 2r
New force, $F' = G \times (m_1 m_2) / (2r)^2$
$F' = G \times (m_1 m_2) / (4r^2)$
$F' = 1/4 \times F$
Therefore, the gravitational force decreases to one fourth when the distance is doubled.

6. The radio technician was given a 5 Ω resistor and asked to connect it in series with a parallel combination of other resistors each of 5 Ω. For the radio to work, it requires a total resistance of 6 Ω. How many resistors are required to be in parallel connection for the radio to work properly?

Let n be the number of 5 Ω resistors in parallel.
The total resistance in parallel is:
$1/Rp = n / 5$
$\Rightarrow Rp = 5 / n$
Total resistance in series:
$R\_total = 5 + Rp = 6$
$5 + (5/n) = 6$
$(5/n) = 1$
$n = 5$
So, 5 resistors are required in parallel.

7. Scientists have discovered two hypothetical elements, A and B. If element A has energy gap of 3.0 eV and element B has energy gap of 1.2 eV; which element will be suitable in the manufacturing of semiconductor devices? Justify your answer using energy band diagram.

Element B is suitable for manufacturing semiconductor devices.
Reason: A good semiconductor has a small energy gap (typically around 1 eV). Since element B has an

energy gap of 1.2 eV, electrons can be easily excited from the valence band to the conduction band under normal operating conditions. Element A with 3.0 eV is too large, behaving more like an insulator.
An energy band diagram would show a narrow gap for B, allowing easy electron transition.

8. You have been employed at Uhai Secondary School which has scarcity of laboratory apparatus and equipment. Unfortunately, you wanted to conduct an experiment to determine acceleration due to gravity to Form Two students. How would you improvise the apparatuses so that you perform such an experiment effectively? Give four points.

First, use a **small stone or metal nut tied with a thread** as a simple pendulum bob.

Second, use a **string or thread measured using a meter rule** to determine pendulum length.

Third, use a **chalk mark on a wall and a stop-watch app on a phone** to time the oscillations.

Fourth, use a **wooden stand or ceiling hook** to suspend the pendulum.

9. Some of the Physics teachers argued that preparing a lesson plan is too demanding and time wastage activity. Comment on teacher arguments giving four points.

First, a lesson plan helps a teacher **organize content and teaching methods**, making the lesson flow efficiently.

Second, it acts as a **time management tool**, ensuring that essential topics are covered within the available time.

Third, it provides a **reference for future lessons**, helping improve teaching through self-evaluation.

Fourth, a lesson plan improves **learner engagement and participation** by including suitable activities and assessments.

10. Form Three students were given a task of conducting an experiment to verify Ohm's law. You have decided to use observation schedule to record their participation during experiment. What four key points would you record for students' assessment?

First, whether the student **correctly sets up the electric circuit** according to the diagram.

Second, whether the student **accurately reads and records values** of voltage and current.

Third, whether the student **plots a correct and labeled graph** of V against I.

Fourth, whether the student **interprets results and draws correct conclusions** to verify Ohm's law.

SECTION B (60 Marks)

Answer all questions from this section. Each question carries 15 marks.

11. (a) Scientists at Tanzania Atomic Energy Agency bombarded the stable and naturally occurring nuclide of Cobalt-59 with neutrons. Explain this process basing on neutron-activation.

Neutron-activation is a process where stable isotopes are converted into radioactive isotopes by capturing free neutrons. When Cobalt-59 is bombarded with neutrons, it absorbs a neutron and transforms into Cobalt-60, a radioactive isotope. This new isotope emits gamma radiation as it decays, making it useful in industrial and medical applications like radiotherapy and sterilization.

(b) An employee in the nuclear plant project has identified a radioactive element to have an initial count rate of 2400 counts per minute on a scale meter. After 30 hours the count was observed to fall to 300 counts per minute;

(i) Determine the half-life of the element.

Given:
Initial count rate, N_0 = 2400 cpm
Final count rate, N = 300 cpm
Time, t = 30 hours

Use the decay formula:
$N = N_0 \times (1/2)^{(t/T)}$

Substituting values:
$300 = 2400 \times (1/2)^{(30/T)}$
$(1/8) = (1/2)^{(30/T)}$

But $1/8 = (1/2)^3$
So, $3 = 30/T$
$T = 30 / 3$
T = 10 hours

The half-life of the element is 10 hours.

(ii) If the initial number of atoms in another sample is 6×10^{20}, how many atoms will have decayed in 50 hours?

First, find how many half-lives in 50 hours:
Number of half-lives = 50 / 10 = 5

Remaining atoms after 5 half-lives:
$N = N_0 \times (1/2)^5$

$N = 6\times10^{20}$ x (1/32)
$N = 1.875\times10^{19}$

Atoms decayed:
Decayed atoms = Initial atoms - Remaining atoms
Decayed atoms = $6\times10^{20} - 1.875\times10^{19}$
Decayed atoms = 5.8125×10^{20}

So, 5.8125×10^{20} atoms will have decayed in 50 hours.

12. In determining the beat frequency of a guitar string and turning fork, two student teachers were assigned to strike a guitar string and sound a turning fork by hitting it on a rubber band. If the tension of the string was 129.6 N and the beat frequency obtained when the string and the turning fork sounded was 10 beats per second, calculate the frequency of turning fork if the tension on the string is raised to 160 N.

Given:
f_1 = initial frequency of string
f_2 = frequency of tuning fork
Beat frequency = $|f_2 - f_1| = 10$ Hz

The frequency of a vibrating string is proportional to the square root of its tension:
$f \propto \sqrt{T}$

Let initial tension $T_1 = 129.6$ N and new tension $T_2 = 160$ N

New frequency:
$f_1' = f_1 \times \sqrt{(T_2/T_1)}$
$= f_1 \times \sqrt{(160/129.6)}$
$= f_1 \times \sqrt{(1.234)}$
$= f_1 \times 1.111$

Now, since beat frequency remains the same, tuning fork frequency is unchanged.

Assuming $f_1 < f_2$ initially:
$f_2 = f_1 + 10$

But with new tension:
$f_2 = f_1' - 10$

Equating both:
$f_1 + 10 = f_1 \times 1.111 - 10$
$10 + 10 = f_1(1.111 - 1)$
$20 = f_1 \times 0.111$
$f_1 = 180.18$ Hz

Then, $f_2 = f_1 + 10$
$f_2 = 180.18 + 10$
$f_2 = 190.18$ Hz

So, the frequency of the tuning fork is approximately 190 Hz.

13. During the block teaching practice, the academic master appointed you to present a sample of a lesson notes on "global warming and greenhouse" for the period of 80 minutes to your fellow student teachers before actual teaching. Prepare a lesson notes for the topic given using five points.

Lesson Notes: Global Warming and Greenhouse Effect

Introduction (10 min):
Explain the concept of global warming as the gradual increase in Earth's average temperature due to the trapping of heat by greenhouse gases.

Point 1:
Define greenhouse effect as the natural process where gases like carbon dioxide, methane, and water vapor trap heat in the atmosphere, maintaining Earth's temperature for life.

Point 2:
Explain how human activities like burning fossil fuels, deforestation, and industrial emissions increase greenhouse gas concentration, enhancing the natural greenhouse effect.

Point 3:
Discuss consequences of global warming: melting ice caps, rising sea levels, frequent heatwaves, and extreme weather conditions.

Point 4:
Describe strategies to reduce global warming: afforestation, using renewable energy, reducing fossil fuel use, and enforcing environmental policies.

Conclusion (10 min):
Summarize key points and engage students in a short discussion on what individuals can do to reduce global warming in their local environment.

14. Suppose you have been invited by the District Education Officer to orient the newly employed teachers on the application of principles of teaching and learning Physics, what would be your explanations on the following principles?

(a) A learning environment should be supportive, productive and safe.
This principle ensures that students learn in a positive atmosphere where they feel valued, respected, and encouraged to participate without fear. A supportive environment promotes confidence and curiosity.

Productivity is achieved when teaching is well-organized with clear objectives, proper resources, and active student involvement. Safety is essential, especially in Physics practicals, to prevent accidents and protect learners' welfare.

(b) Students learn better from simple to complex.
This principle involves presenting learning material in a logical sequence, starting from basic concepts and gradually advancing to complex ones. It allows students to build a strong foundation of knowledge and skills before tackling more challenging content. In Physics, this could mean teaching the concept of motion before introducing Newton's laws or covering basic circuit concepts before dealing with alternating currents.