THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATION COUNCIL

DIPLOMA IN SECONDARY EDUCATION EXAMINATION

731/1 **PHYSICS 1**

Time: 3 Hours. **ANSWERS** **Year: 2012**

Instructions

1. This paper consists of sections A, B and C.

2. Answer **all** questions from Section A and any **two (2)** questions from each of sections B and C.

4. Cellular phones are **not** allowed inside the examination room.

5. Write your **Examination Number** on every page of your answer booklet

SECTION A (30 Marks)

Answer all questions in this section.

1. Using equations of Newton's laws of motion, verify that dimensional analysis can be used to check the correctness of the formula.

Newton's second law states that Force F = mass × acceleration, F = m × a. The dimension of mass is [M] and acceleration is [L T^-2]. Therefore, the dimension of force is [M L T^-2]. By performing dimensional analysis on any formula involving force, mass, and acceleration, we can check if the dimensions on both sides match, verifying correctness.

2. A 2Ω, 3Ω and 5Ω resistors are connected in series across a 90 V d.c. supply. Calculate:

(a) The current flowing in the circuit.

Total resistance R = 2 + 3 + 5 = 10Ω.
Current I = V / R = 90 / 10 = 9 A.

(b) The potential difference across each resistor.

V1 = I × R1 = 9 × 2 = 18 V
V2 = I × R2 = 9 × 3 = 27 V
V3 = I × R3 = 9 × 5 = 45 V

3. Define the following terms:

(a) Alpha particle – A particle consisting of 2 protons and 2 neutrons, identical to a helium nucleus.

(b) Beta particle – A high-speed electron or positron emitted during radioactive decay.

(c) Gamma rays – High-energy electromagnetic radiation emitted from the nucleus during radioactive decay.

4. Draw the symbol of n-p-n transistor.

The n-p-n transistor has an arrow pointing outwards from the emitter. (Diagram should show collector, base, emitter with arrow outward).

5. Distinguish between semi-conductor and conductor.

A conductor allows easy flow of electric current due to a large number of free electrons, e.g., copper.

A semi-conductor allows limited flow of current, depending on temperature or doping, e.g., silicon.

6. A steel wire of length 4.7 m and cross-sectional area 3×10^{-5} m^2 stretches by the same amount as a copper wire of length 3.5 m and cross-sectional area 4×10^{-5} m^2 under a given load. Find the ratio of Young's Modulus of steel to that of copper.

Strain = $\Delta L / L$, Stress = F / A, Young's Modulus Y = Stress / Strain = $(F/A) / (\Delta L/L) = (F L) / (A \Delta L)$.

Ratio $Y_{steel} / Y_{copper} = (F L_s / A_s \Delta L) / (F L_c / A_c \Delta L) = (L_s / A_s) / (L_c / A_c) = (4.7 / 3\times10^{-5}) \div (3.5 / 4\times10^{-5}) = (4.7 \times 4\times10^{-5}) / (3.5 \times 3\times10^{-5}) = (0.000188) / (0.000105) \approx 1.79$

7. The equation $^7Li + ^1H \rightarrow 2\ ^4He + Q$ occurred when Lithium nuclei bombarded with proton. Using this equation perform the following:

(a) State what is represented by Q.

Q represents the energy released during the nuclear reaction.

(b) Calculate the value of Q.

Mass of ^7Li = 7.016 u, mass of ^1H = 1.0078 u, mass of 2 ^4He = 2 × 4.0026 = 8.0052 u
Mass defect Δm = (7.016 + 1.0078) – 8.0052 = 8.0238 – 8.0052 = 0.0186 u
Energy released $Q = \Delta m \times 931$ MeV/u ≈ 0.0186 × 931 ≈ 17.3 MeV

8. Mention five activities that a Physics teacher is required to do in planning for his/her teaching.

Select appropriate content and topics to teach according to syllabus and learners' level.

Design lesson objectives that are clear, measurable, and achievable.

Choose suitable teaching and learning methods, including experiments, demonstrations, and discussions.

Prepare necessary teaching aids and laboratory equipment for practical sessions.

Plan assessment methods to evaluate learners' understanding and progress.

9. Outline six criteria for selecting variety methods of teaching and learning process.

Suitability to learners' age, ability, and prior knowledge.

Effectiveness in achieving lesson objectives and desired learning outcomes.

Availability of resources and teaching aids required for the method.

Time efficiency and ability to cover the syllabus within the allocated period.

Encouragement of learner participation and active engagement.

Adaptability to different classroom settings and sizes.

10. List three important things to consider when a teacher purchases the Physics books for teaching.

Accuracy and correctness of content according to the curriculum.

Clarity of explanations and inclusion of relevant examples and diagrams.

Level of difficulty appropriate for the learners' understanding.

11. Briefly explain why the Physics teacher needs to evaluate his or her students during teaching and learning process.

Evaluation helps the teacher identify learners' understanding and misconceptions, guiding further instruction.

It measures students' progress and learning outcomes, ensuring lesson objectives are achieved.

Evaluation provides feedback to both teacher and students for improvement in teaching and learning.

It allows adjustment of teaching methods and materials to suit students' learning needs.

SECTION B (30 Marks)

Answer two (2) questions from this section

12. Derive Bernoulli's equation and state any conditions and assumptions made.

Consider incompressible, non-viscous fluid in steady flow along a streamline. Using work-energy principle:

Work done by pressure + potential energy + kinetic energy = constant

$P/\rho + \frac{1}{2} v^2 + g h = \text{constant}$

Assumptions: fluid is incompressible, non-viscous, flow is steady, along a streamline, and gravity acts uniformly.

13. (a) The side of a cube is (3.0 ± 0.2) cm. Calculate the percentage relative error in:

(i) Surface area S = 6 L^2 → ΔS/S ≈ 2 ΔL/L = 2 × (0.2 / 3.0) ≈ 0.1333 → 13.33%

(ii) Volume V = L^3 → ΔV/V ≈ 3 ΔL/L = 3 × (0.2 / 3.0) ≈ 0.2 → 20%

(b) V = A t^2 + B t + C. Units:

[V] = m/s, [t] = s

A t^2 → A × s^2 = m/s → A = m / s^3

B t → B × s = m/s → B = m / s^2

C = m/s

(c) Three ways thermionic emission differs from photoelectric emission:

Thermionic emission occurs due to heating, photoelectric occurs due to light energy.

Thermionic emission can occur in the dark, photoelectric requires light.

Thermionic emission depends on temperature, photoelectric depends on light frequency and intensity.

(d) Necessary condition for photoelectric emission: frequency of incident light must be equal to or greater than threshold frequency.

(e) Einstein's photoelectric equation:

$hf = \varphi + KE_{max}$

hf – energy of photon, φ – work function, KE_{max} – maximum kinetic energy of emitted electron.

(f) Sodium threshold frequency $f = 5.6 \times 10^{14}$ Hz. Work function $\varphi = h f = 6.626\times10^{-34} \times 5.6\times10^{14} \approx 3.71\times10^{-19}$ J

Convert to eV: $\varphi = 3.71\times10^{-19} / 1.6\times10^{-19} \approx 2.32$ eV

14. (a) Two limitations of projectile motion:

Air resistance is neglected, which is unrealistic in practice.

Only motion under constant gravity is considered, ignoring other forces or effects.

(b) Projectile is the object in motion under gravity; trajectory is the path it follows.

(c) Path equation: horizontal $x = v_0 \cos \theta\, t$, vertical $y = v_0 \sin \theta\, t - \frac{1}{2} g t^2$

Eliminate t: $y = x \tan \theta - (g / 2 v_0^2 \cos^2 \theta) x^2 \rightarrow$ parabola.

SECTION C (40 Marks)

Answer two (2) questions from this section

15. With illustrative diagram (warning signs) for laboratory rules and precautions, explain why the study of laboratory rule in Physics is important to students.

Laboratory rules ensure students' safety, preventing accidents such as burns, electric shocks, or chemical exposure.

They guide proper handling and storage of equipment, preserving the functionality of expensive instruments.

Rules teach students discipline and responsibility, essential for professional practice in science.

Awareness of warning signs helps students identify hazards and respond appropriately, minimizing risks.

Studying lab rules encourages a culture of care and proper conduct, promoting safe and effective learning.

16. Describe five significance of microteaching practice to a student teacher.

Microteaching allows student teachers to practice teaching in a controlled, low-risk environment, improving confidence.

It provides opportunity to focus on specific teaching skills, such as questioning, explanation, and classroom management.

Immediate feedback from peers and supervisors helps identify strengths and weaknesses for improvement.

Encourages reflective practice, allowing teachers to analyze and adjust their teaching methods.

Builds communication and interaction skills with students, preparing for real classroom situations.

17. Explain five advantages of Physics experiments in teaching and learning process.

Experiments reinforce theoretical knowledge, allowing students to observe physical principles in action and understand abstract concepts more clearly.

They develop practical skills, such as accurate measurement, proper use of instruments, observation, and recording of data, which are essential for scientific work.

Experiments promote critical thinking and problem-solving, as students analyze results, identify patterns, and draw logical conclusions based on evidence.

Hands-on activities increase student engagement and motivation, making learning more interactive and enjoyable compared to purely theoretical lessons.

Experiments help students connect theory to real-life applications, showing the relevance of Physics in everyday situations and future technological developments.

18. Examine five problems faced by Physics teacher in classroom teaching and learning process in Tanzania.

Shortage of laboratory equipment and teaching aids limits the ability to perform practical experiments, making lessons less effective and students' understanding more abstract.

Large class sizes make it difficult for teachers to give individual attention, manage classroom activities, and ensure that every student participates in learning.

Limited electricity or unreliable power supply in schools prevents the use of modern teaching aids, such as computers, projectors, and experimental apparatus that require power.

Students' low background knowledge or weak foundation in mathematics and science affects their ability to grasp Physics concepts, slowing the pace of teaching.

Insufficient professional development and lack of ongoing training reduce teachers' exposure to modern teaching methods and innovative strategies, making it harder to deliver engaging and effective lessons.