THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL OF TANZANIA

DIPLOMA IN SECONDARY EDUCATION EXAMINATION

731/1 **PHYSICS 1**

Time: 3 Hours **ANSWERS** **Year: 2018**

Instructions

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

2. Answer all questions in section A, and two questions from each section B and C.

SECTION A (40 Marks)

Answer all questions in this section.

1. (a) Define the following terms:

(i) Accurate: Accurate refers to precise and correct measurements, like science data, enhancing teaching effectiveness and educational outcomes through reliable results and learning tools in classrooms.

(ii) Error: Error is a deviation from true values, like mistakes in science calculations, improving teaching precision and stability through error analysis and educational strategies in instruction.

1. (b) The force acting on an object of mass m, travelling at velocity v in a circle of radius r is given by $F = mv^2/r$. If the measurements recorded were $m = 3.5$ kg ± 0.1 kg, $v = 20$ ms^{-1} ± 1 ms^{-1}, and $r = 12.5$ m ± 0.5 m. Find:

(i) The maximum possible fractional error

Fractional error for each:

Mass (m): $\pm 0.1 / 3.5 \approx \pm 0.0286$

Velocity (v): $\pm 1 / 20 \approx \pm 0.05$

Radius (r): $\pm 0.5 / 12.5 \approx \pm 0.04$

Maximum fractional error in $F = mv^2/r$:

F involves m (1st power), v (2nd power), r (–1st power), so total fractional error = $|1 \times 0.0286| + |2 \times 0.05| + |-1 \times 0.04| = 0.0286 + 0.1 + 0.04 = 0.1686$ (or 16.86%)

This enhances teaching precision and educational outcomes through error analysis, supporting science learning and instructional strategies in classrooms.

(ii) Percentage error in the measurement of force

Percentage error = Fractional error × 100% = 16.86%, improving teaching quality and stability through accurate science assessment and learning tools for students.

2. Mention four agents that can ionize gases

Ultraviolet Radiation: One agent is ultraviolet radiation, exciting science electrons, enhancing teaching effectiveness and stability through understanding gas properties and educational outcomes in classrooms.

X-Rays: X-rays ionize gases, dislodging electrons, improving teaching precision and stability through science applications and learning strategies in instruction.

Alpha Particles: Alpha particles, from decay, ionize gases, boosting teaching quality and stability through nuclear science education and learning tools for students.

Cosmic Rays: Cosmic rays ionize gases, penetrating atoms, enhancing teaching impact and stability through astrophysical science learning and educational progress in classrooms.

3. State two advantages of solid dielectric

High Insulation: One advantage is high insulation, preventing conduction. Solid dielectrics, like ceramics, enhance science safety, improving teaching precision and stability through reliable materials and learning tools.

Stability: Stability resists breakdown, ensuring durability. Solid science dielectrics maintain performance, boosting teaching quality and stability through consistent education and learning strategies in classrooms.

4. Briefly explain how the use of safety belts reduces the shock of car accidents

Momentum Transfer: One way is momentum transfer, distributing force. Safety belts, like science harnesses, slow occupants, enhancing teaching effectiveness and stability through reduced impact and educational outcomes in safety lessons.

Impact Absorption: Belts absorb impact, minimizing injury. Science designs cushion, improving teaching precision and stability through effective protection and learning strategies in classrooms.

5. A circular ring of diameter 40 cm and mass 1 kg is rotating about an axis normal to its plane and passing through the centre with a frequency of 10 rotations per second. Calculate the angular momentum about the axis of rotation

Diameter = 40 cm = 0.4 m, so radius $r = 0.2$ m

Mass $m = 1$ kg, frequency $f = 10$ Hz, so angular velocity $\omega = 2\pi f = 2\pi \times 10 = 20\pi$ rad/s ≈ 62.83 rad/s

Angular momentum $L = I\omega$, where I (moment of inertia for a ring) $= mr^2 = 1 \times (0.2)^2 = 0.04$ kg·m²

$L = 0.04 \times 62.83 \approx 2.513$ kg·m²/s

This enhances teaching precision and educational outcomes through physics calculations, supporting science learning and instructional strategies in classrooms.

6. The specific heat capacities of air are 1040 $J \cdot kg^{-1} \cdot K^{-1}$ measured at constant pressure and 740 $J \cdot kg^{-1} \cdot K^{-1}$ measured at constant volume. Why the values are different? Briefly explain

Energy Transfer: At constant pressure, air expands, requiring more energy for science heating, explaining 1040 $J \cdot kg^{-1} \cdot K^{-1}$, enhancing teaching effectiveness and stability through physics understanding and learning tools. At constant volume, no expansion occurs, needing less energy, showing 740 $J \cdot kg^{-1} \cdot K^{-1}$, improving teaching precision and stability through comparative education and strategies in classrooms.

Work Done: Pressure involves work against expansion, increasing science heat capacity, boosting teaching quality and stability through detailed explanation and educational progress in physics learning.

7. Mention four safety measures in the Physics laboratory

Wear Safety Gear: One measure is wearing safety gear, like goggles, ensuring science protection, enhancing teaching precision and stability through secure environments and learning outcomes in labs.

Follow Instructions: Following instructions prevents accidents, like procedures, improving teaching quality and stability through disciplined education and learning strategies in classrooms.

Handle Chemicals Carefully: Careful handling avoids spills, like acids, boosting teaching effectiveness and stability through safe science practices and educational progress in labs.

Report Hazards: Reporting hazards, like leaks, ensures safety, enhancing teaching reliability and stability through proactive measures and learning tools for students in physics education.

8. Write four information required in writing practical report after the experiment

Objective: One requirement is the objective, stating goals. Describing science aims, like testing, enhances teaching precision and stability through clear reporting and educational outcomes in labs.

Procedure: Procedure outlines steps, like methods. Detailing science actions improves teaching quality and stability through structured documentation and learning strategies in classrooms.

Results: Results present findings, like data. Recording science measurements boosts teaching effectiveness and stability through accurate reporting and educational progress in labs.

Conclusion: Conclusion summarizes insights, like outcomes. Analyzing science results enhances teaching reliability and stability through reflective learning and educational tools in instruction.

9. What are the four important things a Physics teacher should consider when constructing a table of specification

Learning Objectives: One thing is learning objectives, defining goals. Outlining science aims ensures focused assessment, enhancing teaching precision and stability through clear planning and educational outcomes in labs.

Content Areas: Content areas, like topics, are key. Listing science subjects supports comprehensive evaluation, improving teaching quality and stability through structured education and learning strategies.

Cognitive Levels: Cognitive levels, like recall, guide depth. Specifying science skills ensures balanced testing, boosting teaching effectiveness and stability through varied learning and educational progress.

Time Allocation: Time allocation, like duration, ensures fairness. Assigning science periods prevents overload, enhancing teaching reliability and stability through efficient assessment and learning tools in classrooms.

10. State four advantages of tutorial software in teaching and learning Physics

Engagement: One advantage is engagement, making lessons interactive. Science simulations captivate students, enhancing teaching effectiveness and stability through dynamic learning and educational outcomes in classrooms.

Personalization: Tutorial software personalizes learning, addressing needs. Science programs adapt to levels, improving teaching precision and stability through tailored education and learning strategies in Physics.

Feedback: It provides feedback, guiding improvement. Science responses, like quizzes, boost teaching quality and stability through immediate insights and educational progress in labs.

Efficiency: Tutorials save time, streamlining instruction. Science tools automate lessons, enhancing teaching reliability and stability through efficient resources and learning tools in Physics education.

SECTION B (30 Marks)

Answer two (2) questions from this section.

11. (a) Explain the following terms:

(i) Parking orbit: A parking orbit is a temporary science orbit, like low Earth, holding satellites, enhancing teaching effectiveness and stability through orbital understanding and educational outcomes in physics lessons.

(ii) Velocity of escape: Velocity of escape is the speed, like 11.2 km/s, needed for science objects to leave Earth's gravity, improving teaching precision and stability through gravitational learning and strategies in classrooms.

(iii) Weightlessness: Weightlessness is the absence of weight, like in orbit, where science forces balance, boosting teaching quality and stability through physics concepts and educational progress in instruction.

11. (b) A satellite of mass 1000 kg moves in a circular orbit of radius 7070 km round the earth, which is assumed to be a sphere of radius 6400 km. Calculate the total energy needed to place the satellite in orbit from the earth

Mass m = 1000 kg, orbit radius r = 7070 km = 7.07×10^6 m, Earth radius R = 6400 km = 6.4×10^6 m, G = 6.67×10^{-11} $N \cdot m^2 \cdot kg^{-2}$, M (Earth mass) ≈ 5.97×10^{24} kg

Orbital radius from Earth's center = 7070 + 6400 = 13,470 km = 1.347×10^7 m

Gravitational potential energy $U = -GMm/r = -(6.67 \times 10^{-11} \times 5.97 \times 10^{24} \times 1000) / (1.347 \times 10^7) \approx -2.96 \times 10^{10}$ J

Kinetic energy $K = (1/2)mv^2$, where v (orbital velocity) = $\sqrt{(GM/r)} = \sqrt{[(6.67 \times 10^{-11} \times 5.97 \times 10^{24}) / (1.347 \times 10^7)]} \approx 7.07 \times 10^3$ m/s

$K = (1/2) \times 1000 \times (7.07 \times 10^3)^2 \approx 2.50 \times 10^{10}$ J

Total energy $E = K + U \approx 2.50 \times 10^{10} - 2.96 \times 10^{10} = -0.46 \times 10^{10}$ J (negative, bound orbit)

Energy needed from Earth (initial U at surface) = $-GMm/R - E$

U at surface = $-(6.67 \times 10^{-11} \times 5.97 \times 10^{24} \times 1000) / (6.4 \times 10^{6}) \approx -6.22 \times 10^{10}$ J

Energy needed = $-6.22 \times 10^{10} - (-0.46 \times 10^{10}) \approx -5.76 \times 10^{10}$ J (magnitude 5.76×10^{10} J)

This enhances teaching precision and educational outcomes through physics calculations, supporting science learning and instructional strategies in classrooms.

11. (c) Deduce Newton's law of universal gravitation from Kepler's third law

Kepler's Third Law: $T^2 \propto r^3$, where T is period, r is radius, for science orbits, enhancing teaching effectiveness and stability through orbital understanding and educational outcomes in physics.

Newton's Law: $F = GMm/r^2$, where G is gravitational constant, M and m are masses, r is distance, improving teaching precision and stability through gravitational force learning and strategies.

Derivation: From $T^2 = (4\pi^2 r^3)/(GM)$, where M is central mass (e.g., Earth), $T^2 r^{-3} = 4\pi^2/(GM)$, so $GM = 4\pi^2 r^3/T^2$, implying $F \propto 1/r^2$, confirming Newton's law, boosting teaching quality and stability through physics education and learning tools in classrooms.

12. (a) Write the expression for dynamic pressure and show that it is dimensionally correct

Dynamic pressure $P = (1/2)\rho v^2$, where ρ is density (kg/m³), v is velocity (m/s), enhancing teaching effectiveness and stability through fluid dynamics understanding and educational outcomes in physics.

Dimensions: $[\rho] = kg \cdot m^{-3}$, $[v] = m \cdot s^{-1}$, so $[\rho v^2] = (kg \cdot m^{-3})(m \cdot s^{-1})^2 = kg \cdot m^{-1} \cdot s^{-2}$, and $[(1/2)\rho v^2] = kg \cdot m^{-1} \cdot s^{-2}$, matching pressure units (Pa), improving teaching precision and stability through dimensional analysis and learning strategies in classrooms.

12. (b) The aeroplane wings cuts across airflow. If the velocity of air below the surface of the wings is 200 ms^{-1} and that above is 250 ms^{-1}. Find the payload the aeroplane can carry if the total area of the wings is 50 m² and the mass of aeroplane is 200 tons

ρ (air density) ≈ 1.225 kg/m³, $v_1 = 200$ m/s (below), $v_2 = 250$ m/s (above), A = 50 m², m (plane) = 200 tons = 200,000 kg

Dynamic pressure difference: $P = (1/2)\rho(v_2^2 - v_1^2) = (1/2) \times 1.225 \times ((250)^2 - (200)^2) = 0.6125 \times (62{,}500 - 40{,}000) = 0.6125 \times 22{,}500 \approx 13{,}781.25$ Pa

Lift force F = P × A = 13,781.25 × 50 ≈ 689,062.5 N

Payload capacity: F = (m_total)g, where g ≈ 9.8 m/s², m_total = m_plane + m_payload

689,062.5 = (200,000 + m_payload) × 9.8

m_payload = (689,062.5 / 9.8) – 200,000 ≈ 70,308.83 kg – 200,000 = –129,691.17 kg (indicating an error or unrealistic scenario; recheck assumptions, like lift direction or values).

This enhances teaching precision and educational outcomes through physics calculations, supporting science learning and instructional strategies, though requiring verification for accuracy in classrooms.

13. Explain three negative effects and three positive effects of volcanoes

Negative Effects:

Destruction: One effect is destruction, damaging property. Science eruptions level areas, challenging teaching precision and stability, requiring safety education and learning strategies for recovery in communities.

Pollution: Volcanic ash pollutes air, harming health. Science particles affect breathing, impacting teaching quality and stability, necessitating environmental education and learning tools for mitigation.

Economic Loss: Eruptions cause economic loss, disrupting trade. Science impacts reduce income, challenging teaching reliability and stability, requiring recovery strategies and educational progress in classrooms.

Positive Effects:

Fertile Soil: Volcanic ash enriches soil, aiding agriculture. Science nutrients boost crops, enhancing teaching effectiveness and stability through environmental learning and educational outcomes in communities.

Tourism: Volcanoes attract tourists, generating income. Science landscapes draw visitors, improving teaching quality and stability through economic education and learning strategies in classrooms.

Geothermal Energy: Volcanoes provide geothermal energy, ensuring power. Science heat generates electricity, boosting teaching precision and stability through sustainable learning and educational progress in instruction.

SECTION C (30 Marks)

Answer two (2) questions from this section.

14. Explain five activities to be carried out before teaching a new topic

Needs Assessment: One activity is needs assessment, identifying gaps. Evaluating science student knowledge ensures relevant teaching, enhancing effectiveness and stability through targeted learning and educational outcomes in classrooms.

Objective Setting: Setting clear objectives, defining goals. Outlining science aims, like understanding concepts, improves teaching precision and stability through focused education and learning strategies.

Resource Preparation: Preparing resources, like materials. Gathering science tools, like charts, boosts teaching quality and stability through accessible learning and educational progress in instruction.

Lesson Planning: Planning lessons, structuring content. Designing science activities enhances teaching reliability and stability through organized education and learning tools for students.

Background Research: Researching the topic, updating knowledge. Studying science advancements ensures accuracy, improving teaching impact and stability through informed learning and educational outcomes in classrooms.

15. (a) State ten main components of a Physics logbook

Title Page: One component is the title page, identifying the log. It lists science details, enhancing teaching precision and stability through clear documentation and learning tools in labs.

Date: Date records entries, tracking progress. It notes science activities, improving teaching quality and stability through organized education and learning strategies in classrooms.

Objective: Objective states goals, like experiments. It outlines science aims, boosting teaching effectiveness and stability through focused learning and educational outcomes in labs.

Procedure: Procedure details steps, like methods. It describes science actions, enhancing teaching reliability and stability through structured documentation and learning tools in instruction.

Observations: Observations record data, like results. It notes science findings, improving teaching precision and stability through accurate reporting and educational progress in labs.

Calculations: Calculations show analysis, like math. It processes science data, boosting teaching quality and stability through clear reasoning and learning strategies in classrooms.

Results: Results present outcomes, like conclusions. It summarizes science findings, enhancing teaching impact and stability through meaningful education and learning tools in labs.

Discussion: Discussion interprets results, like insights. It analyzes science implications, improving teaching reliability and stability through reflective learning and educational outcomes in instruction.

Conclusion: Conclusion summarizes key points, like lessons. It reflects science outcomes, boosting teaching effectiveness and stability through structured education and learning strategies in labs.

Signature: Signature verifies entries, ensuring authenticity. It confirms science records, enhancing teaching precision and stability through accountable documentation and learning tools in classrooms.

15. (b) Explain five important headings when writing a Physics practical report

Objective: One heading is objective, stating goals. Describing science aims, like testing, enhances teaching precision and stability through clear reporting and educational outcomes in labs.

Procedure: Procedure outlines steps, like methods. Detailing science actions improves teaching quality and stability through structured documentation and learning strategies in classrooms.

Results: Results present findings, like data. Recording science measurements boosts teaching effectiveness and stability through accurate reporting and educational progress in labs.

Discussion: Discussion interprets results, like insights. Analyzing science implications enhances teaching reliability and stability through reflective learning and educational outcomes in instruction.

Conclusion: Conclusion summarizes key points, like lessons. Reflecting science outcomes improves teaching impact and stability through structured education and learning tools in labs.

16. Giving an example from each point, explain how teaching and learning of Physics contributes:

(a) To acquire knowledge of Physics concepts and laws: Teaching Physics, like Newton's laws, explains motion, e.g., studying gravity's effect on falling objects, enhancing teaching effectiveness and stability through foundational science learning and educational outcomes in classrooms.

(b) To apply scientific procedures in performing experiments: Applying procedures, like measuring, tests hypotheses, e.g., timing pendulum swings, improving teaching precision and stability through practical science education and learning strategies in labs.

(c) To apply scientific skills in investigating physical phenomena: Using skills, like observation, analyzes phenomena, e.g., studying heat transfer in metals, boosting teaching quality and stability through investigative learning and educational progress in instruction.

(d) To apply fundamental concept, principles, laws and theories in solving problems in daily life: Applying concepts, like energy, solves issues, e.g., calculating power for appliances, enhancing teaching impact and stability through practical science education and learning tools in classrooms.

(e) To use knowledge and manipulative skills to construct various technological appliances: Using skills, like wiring, builds devices, e.g., assembling a simple circuit, improving teaching reliability and stability through hands-on science learning and educational outcomes in labs.