THE UNITED REPUBLIC OF TANZANIA
NATIONAL EXAMINATIONS COUNCIL
ADVANCED CERTIFICATE OF SECONDARY EDUCATION EXAMINATION
1999 PHYSICS 2

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- Define "Young's Modulus" of a material and give its SI units.
- With the aid of a sketch graph, explain what happens when a steel wire is stretched gradually by an increasing load until it breaks.
- A force F is applied to a long steel wire of length L and cross-sectional area A.
  - Show that if the wire is considered to be a spring, the force constant k is given by: $k = AY/L$, where Y is Young's Modulus of the wire.
  - Show that the energy stored in the wire is $U = 1/2F\Delta L$ where ΔL is the extension of the wire
- The period T of vibrations of a tuning fork may be expected to depend on the density D , Young's Modulus Y of the material of which it is made and the length a of its prongs. Using dimensional analysis deduce an expression for T in terms of D , Y and a.
- Explain the meaning of the following terms:
  - Gravitational Potential of the Earth.
  - Gravitational Field Strength of the Earth.
  - How are the above quantities in and related?
- Show that the total energy of a satellite in a circular orbit equals half its potential energy.
- Calculate the height above the Earth's surface for a satellite in a parking orbit.
- What would be the length of a day if the rate of rotation of the Earth were such that the acceleration of gravity $g = 0$ at the equator?
- What do you understand by the term "moments of inertia" of a rigid body?
- State the perpendicular axes theorem of moments of inertia for a body in the form of a lamina

- Calculate the moments of inertia of a thin circular disc of radius 50 cm and mass 2 kg about an axis along a diameter of the disc.
- A wheel mounted on an axle that is not frictionless is initially at rest. A constant external torque of 50 Nm is applied to the wheel for 20 s. At the end of the 20 s, the wheel has an angular velocity of
  - 600 rev/min. The external torque is the removed, and the wheel comes to rest after 120 s more.
  - Determine the moments of inertia of the wheel.
  - Calculate the frictional torque which is assumed to be constant.
- State the main assumptions of the "kinetic theory" of gases.
- Derive an expression for the pressure exerted by an ideal gas on the walls of its container.
- How does the average translational kinetic energy of a molecule of an ideal gas change if
  - the pressure is doubled while the volume is kept constant?
  - the volume is doubled while the pressure is kept constant?
- Calculate the value of the root mean-square speed of molecules of helium at 0°C .
- What is "capacitance"?
- List three factors that govern the capacitance of a parallel plate capacitor.
- Show that the energy per unit volume stored in a parallel plate capacitor is given by: $U = 1/2\epsilon E^2$ and define all the symbols in this equation.
- Given that the distance of separation between the parallel plates of a capacitor is 5 mm, and the plates have an area of 5 m^2 . A potential difference of 10 kV is applied across the capacitor which is
  - parallel in vacuum. Compute:
  - the capacitance
  - the electric intensity in the space between the plates
  - the change in the stored energy if the separation of the plates is increased from 5 mm to 5.5 mm.
- With the help of illustrative diagrams explain the action of a choke in a circuit.
- When an impedance consisting of an inductance L and a resistance R in series is connected across a 12 V, 50 Hz power supply, a current of 0.050 A flows, which differs in phase from that of the applied potential difference by 60° .
  - Find the value of R and L .
  - Find the capacitance of the capacitor which, when connected in series in the above circuit, has the effect of bringing the current into phase with the applied voltage.
- An inductance of 4 mH is connected in series with a resistance of 20Ω together with a battery:

  - Determine how the current will vary with time in this circuit.
  - Sketch the current of above against time
  - Calculate the inductive time constant

- State the laws of electromagnetic induction and describe briefly experiments (one in each case) which can be used to demonstrate them.
- A flat coil of 100 turns and mean radius 5.0 cm is tying on a horizontal surface and is turned over in 0.20 sec. against the vertical component of the Earth's magnetic field. Calculate the average e.m.f. induced.
- With the help of clear diagrams, explain briefly how you would convert a sensitive galvanometer into:
  - an ammeter
  - a voltmeter
- State Bohr's postulates of the atomic model.
- Show that for an electron in a hydrogen atom, the possible radii of an electron orbit are given by:
  - $r_n = a_0 n^2$, $n = 1$, 2 , 3 , ...
- (i) Show that the possible energy levels (in Joules) for the hydrogen atom are given by the formula:
  - $E_n = -me^4/(8h^2\epsilon_0^2 * 1/n^2$
  - where m = mass of the electron
  - e = electronic charge
  - h = Planck's constant
  - ϵ_0 = permittivity constant of vacuum
  - What does the negative sign signify in the formula for E , in above?
- Define the term "binding energy" of a nuclide.
- Distinguish between:
  - $\beta-$ decay and $\beta+$ decay.
  - nuclear fission and nuclear fusion
  - activity and half-life of a radioactive material.
  - Taking the half-life of Radium -226 to be 1600 years, what fraction of a given sample remains after 4800 years?
- Briefly describe the major factors that you would consider when designing a voltage amplifier.
- Explain the term "thermal run away" as regards a transistor amplifier.
- With the help of clear diagrams, explain how you would overcome thermal run away in a voltage amplifier.