THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL

CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

031/1 **PHYSICS PAPER 1**

(For Both School and Private Candidates)

Time: 3 Hours 9 November 1999 A.M.

INSTRUCTIONS

1. This paper consists of Sections A, B and C.
2. Answer ALL questions in Section A and B and any FOUR (4) questions from Section C.
3. Write all your answers neatly and systematically in the answer booklet provided.
4. Marks for questions or parts thereof are given in brackets.
5. Wherever necessary use the following constants:

   Acceleration due to gravity, $g = 9.8 m/s^2$

   Value of pi $\pi = \frac{22}{7}$

   Radius of the earth $r = 6.4 \times 10^3$ km.

   Distance of the earth from sun $R_0 = 1.5 \times 10^8$ km.

This paper consists of 7 printed pages.

SECTION A (15 Marks)

This section consists of fifteen (15) multiple choice items.
Answer ALL the items. Each item carries 1 mark.

1. Write the letter of the best answer in the answer booklet provided.

(i) Measurement of mass by using equal-arm beam balance uses the principle of

A. conservation of momentum.
B. conservation of energy
C. moments
D. gravitational pull of the earth
E. conservation of matter.

(ii) The principle of fluid pressure which is used in hydraulic brakes, is the

A. pressure is the same at all levels in a fluid
B. increases of pressure are transmitted equally to all parts of a fluid
C. the pressure at a point in fluid is due to the weight of the fluid above it
D. increases of pressure can only be transmitted through fluids
E. the pressure at a given depth is proportional to the depth in the fluid.

(iii) The surface tension of a fluid is due to

A. molecules on its surface
B. a semi-permeable membrane which covers it
C. the Brownian motion of surface molecules
D. the cohesive force between its surface molecules
E. the adhesive force between molecules of different materials.

(iv) Which of the following occurs when more molecules of water return to it than escape

A. Evaporation
B. Condensation
C. Diffusion
D. Crystallisation
E. Atomisation.

(v) Given cubical expansivities of mercury and glass are 1.8×10^{-4}/K and 1.0×10^{-5}/K respectively; a glass vessel of capacity 100ml holding mercury to the brim, heated through 100°C will expel mercury of the following volume.

A. 18ml
B. 28ml
C. 10ml
D. 8ml
E. 17ml.

(vi) Light waves of a given colour from the sun are allowed to pass through different transparent media. The quantity associated with the wave motion that remains unchanged throughout the path is

A. wavelength
B. velocity
C. frequency
D. amplitude
E. wave energy

(vii) When total internal reflection is just about to occur at an air-water boundary as the incident angle is increased from zero, the refracted ray then

A. travels in water at 90° to the normal
B. travels in air along the normal
C. makes the critical angle with the normal in air
D. travels in the air at an angle less than 90°
E. makes an angle 90° with the incident ray.

(viii) Which of the following materials can be used for electromagnet?

A. Copper as commutator for a d.c. motor
B. Soft iron for a core of an electric bell
C. Steel for a magnet in a moving coil meter
D. Aluminium as slip rings for a.c. generator
E. Nickel for a magnet in telephone receiver.

(ix) A rod of insulating material is charged positively by rubbing against a piece of fabric and the latter is tested for electric charge. The fabric will be expected to have a

A. positive charge equal to that on the rod
B. positive charge less than that on the rod
C. negative charge equal to that on the rod
D. negative charge greater than that on the rod
E. negative charge less than that on the rod.

(x) For resistors connected in parallel the following is true.

A. equivalent resistance is greater than any one of the individual resistances
B. equivalent resistance is the sum of individual resistances
C. equivalent resistance is the sum of reciprocals of individual resistances
D. reciprocal of equivalent resistance is the sum of the individual resistances
E. equivalent resistance is always less than either of the resistances.

(xi) High voltage is used for transmitting electricity on the National Grid. This is because high voltage

A. is needed everywhere
B. means high current would be used
C. needs transformers for conversion
D. would minimize electrical energy losses by using low current.
E. would facilitate power distribution to customers.

(xii) If A is mass number, Z is atomic number and N is number of neutrons, identify the **incorrect** statement about nuclear decay

A. when gamma (γ) ray emission occurs A and Z remain unchanged
B. beta (β) particle emissions are common in nuclei with N greater than Z.
C. nuclear decay aims at making Z equal to N
D. nuclei with N greater than Z decay by neutron emission
E. alpha (α) particle decay occur mainly in heaviest nuclei.

(xiii) A transistor is a device which

A. amplifies alternating current or voltage
B. amplifies direct current or voltage
C. rectifies direct current or voltage
D. amplifies and rectifies alternating current or voltage
E. rectifies alternating current or voltage.

(xiv) What causes water tides in the sea?

A. Rotation of the earth about the sun
B. Rotation of the moon about the earth
C. Rotation of the earth about its axis
D. Gravitational force due to the earth on the sea
E. Gravitational force due to the moon on the sea.

(xv) Which is an **incorrect** statement about the solar planets?

A. They are always moving in space
B. They are all non-luminous
C. They all revolve round the sun as their centre
D. They all have at least one moon
E. The brightest planet as observed from the earth is venus.

SECTION B (45 Marks)

Answer all questions in this Section.

2. (a) Using Newton's second law of motion, state two quantities which vary with net force applied on a body. (02)

   (b) Write an equation obtained by combining the force and the two quantities you have mentioned. (02)

   (c) Evaluate the proportionality constant if your equation is used to define the unit of force, the Newton, while taking a unit of each variable in your equation. (01)

   (d) A certain force gives a mass m_1 an acceleration of 12.0 m/s^2. What acceleration will the same force give the two masses when they are joined together? (04)

3. (a) State Boyle's law. (01)

   (b) Sketch the graph of pressure (p) against the reciprocal of volume ($^1/_v$) for air at constant temperature. (02)

   (c) A bubble of air of volume 50.0 mm^3 is released by a diver at a depth where the pressure is 304.0cm Hg. Assuming the temperature remains constant, what is its volume just before it reaches the surface where the pressure is 76.0 cm Hg?

4. (a) Explain what is meant by 'beats' as applied to sound (01)

   (b) Briefly explain how beats are formed. (02)

   (c) A vibrating string is sounded with a 288 Hz tuning fork and 3 beats are counted per second. The string is then loaded with small amount of plasticine and 2 beats are counted per second.
   (i) What is the frequency of the string? (03)
   (ii) What is the frequency of the loaded string? (03)

5. (a) Give two differences between a primary and a secondary cell . (02)

   (b) Six cells each of 2.0V and internal resistance 2.0Ω are connected in two groups of three in series, the two groups are then connected in parallel to an external resistor of 30.0Ω.
   (i) Sketch the arrangement by using conventional electrical symbols (03)
   (ii) calculate the current which will flow through the external resistor. (04)

6. (a) Name two objects in space which are the earth's nearest neighbours.

   (b) What are the real names of objects in the sky which are commonly known by the following names?
   (i) An evening star
   (ii) A morning star
   (iii) A shooting star (03)

(c) The earth appears to be stationary, but it is always in motion. Calculate the unnoticed speed of a man along the equator, in km/h, due to

(i) Rotational motion of the earth about its axis (02)

(ii) Revolution of the earth around the sun (02)

Take 1 year = 365 days.

SECTION C (40 Marks)

Answer any FOUR (4) questions from this section.

7. (a) State Pascal's principle of transmission of pressure. (01)

(b) A piston of small cross section area of 30.0 cm^2 is used in hydraulic press to exert a force of 300.0N on the enclosed liquid. A connecting pipe leads to a large piston of cross section area 600.0 cm^2. Find

(i) the force sustained by the larger piston (03)

(ii) the force applied on the smaller piston to support 2.0 tonnes on the larger piston. (03)

(iii) the mechanical advantage (MA) of the pistons of the press. (02)

8. (a) (i) Define refractive index of a material. (01)

(ii) Explain how the refractive index is related to the velocities in two different adjacent media when refraction of light occurs between them. Hence deduce the relation between refractive index and the wavelengths in the two media. (02)

(b) If the speed of light in air is 3.0×10^8m/s and the wavelength, λ, of yellow light in air is 5.89×10^{-7}m, calculate:

(i) the speed, C_s, of yellow light in sulphur of refractive index 1.96. (03)

(ii) the wavelength, λ_s, of yellow light in sulphur of refractive index 1.96. (03)

(c) What causes light to refract when it passes through two adjacent media of different densities? (01)

9. (a) What is meant by magnetic materials? Give two examples. (03)

(b) State the law of magnets. (01)

(c) Explain with an illustration how one can locate the position of a north-pole of a bar magnet. (03)

(d) Explain with an illustration how to magnetize a steel bar using electric current. (03)

10. (a) (i) Give an account, with a diagram, of the structure of a step-down transformer. (03)

(ii) Why is the iron core made of laminations instead of being in one solid piece?

(b) A transformer is used on the 240V a.c. supply to deliver 8A at 90 Volts to a heating coil; calculate

(i) the current in the primary winding (02)

(ii) the power in the secondary winding (02)

(c) If the primary current is used to light 25 12V, 24W ray lamps what is the efficiency of the transformer? (02)

11. (a) Complete the table below for the three particles which are emitted in a nuclear decay process

Type of particle emitted	Charge on the particle	Position of daughter nuclide in Periodic Table with respect to parent nuclide	Effect on mass number of parent nuclide after emission
Alpha (α)			
Beta (β)			
Gamma (γ)			No effect

(04)

(b) Part of a certain nuclear decay series is represented by the following unbalanced equations, in each stage only ONE type of a particle is emitted.

(i) $^{232}_{90}\text{Th} \longrightarrow {}^{228}_{88}\text{Ra}$ (01)

(ii) $^{228}_{88}\text{Ra} \longrightarrow {}^{228}_{89}\text{Ac}$ (01)

(iii) $^{228}_{89}\text{Ac} \longrightarrow {}^{228}_{90}\text{Th}$ (01)

(iv) $^{228}_{90}\text{Th} \longrightarrow {}^{224}_{88}\text{Ra}$ (01)

identify the type of particle emitted in each of the above stages.

(c) Write two pairs of isotopes from the above series. (02)

12. (a) Define the following terms.

(i) Capacitor (01)

(ii) Semi-conductor (01)

(iii) Transistor (01)

(b) What are the differences between a conductor, a semiconductor and an insulator in terms of their conductivity? (03)

(c) An output of a transformer is connected in series with a semiconductor diode

(i) Draw the sketch of the expected variation of electromotive force against time. (02)

(ii) Give a reason whether this device is suitable or not for use in a radio. (02)