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

131/2 **PHYSICS 2**

(For Both School and Private Candidates)

Time: 3 Hours **Monday, 13th May 2019 a.m.**

Instructions

1. This paper consists of sections A, B and C with a total of **nine (9)** questions.
2. Answer **five (5)** questions, choosing at least **one (1)** question from each section.
3. Each question carries **twenty (20)** marks.
4. Mathematical tables and non-programmable calculators may be used.
5. Cellular phones and any unauthorized materials are **not** allowed in the examination room.
6. Write your **Examination Number** on every page of your answer booklet(s).
7. The following information may be useful:
   (a) Acceleration due to gravity $g = 9.8\ m/s^2$
   (b) Pie $\pi = 3.14$
   (c) Density of air $= 1.29\ kg/m^3$
   (d) Density of steel $= 1000\ kg/m^3$
   (e) Speed of light, $c = 3\times10^8\ m/s$.
   (f) Young's modulus of a steel wire $= 2.0\times10^{11}\ Nm^{-2}$.
   (g) Young's modulus of a copper wire $= 1.3\times10^{11}\ Nm^{-2}$.
   (h) Boltzmann's constant $= 1.38\times10^{-23} J\ K^{-1}$.
   (i) Pressure of the atmosphere $= 1.01\times10^5 Nm^{-2}$.
   (j) $\frac{1}{4\pi\varepsilon_0} = 9\times10^9\ N\,m^2\,C^{-2}$
   (k) Planck's constant, $h = 6.6\times10^{-34}\ Js$.
   (l) Charge to mass ratio of electron, $\frac{e}{m_e} = 1.8\times10^{11}\ C\,kg^{-1}$
   (m) Permeability of free space, $\mu_0 = 4\pi\times10^{-7}\ H\,m^{-1}$
   (n) Reydberg's constant, $R_H = 1.0974\times10^7\ m^{-1}$
   (o) Permittivity of free space, $\varepsilon_o = 8.8\times10^{-12}\ Fm^{-1}$.

SECTION A

Answer at least **one (1)** question from this section.

1. (a) (i) Give the meaning of the terms velocity gradient, tangential stress and coefficient of viscosity as used in fluid dynamics. **(03 marks)**

(ii) Write Stokes' equation defining clearly the meaning of all symbols used. **(02 marks)**

(iii) State two assumptions used to develop the equation in 1 (a) (ii). **(02 marks)**

(b) Calculate the terminal velocity of the rain drops falling in air assuming that the flow is laminar, the rain drops are spheres of diameter 1mm and the coefficient of viscosity, $\eta = 1.8 \times 10^{-5}\ \text{Ns/m}^2$. **(06 marks)**

(c) Water flows past a horizontal plate of area $1.2\ \text{m}^2$. If its velocity gradient and coefficient of viscosity adjacent to the plate are $10\ \text{s}^{-1}$ and $1.3 \times 10^{-5}\ \text{Nsm}^{-2}$ respectively, calculate the force acting on the plate. **(03 marks)**

(d) A horizontal pipe of cross - sectional area $10\ \text{cm}^2$ has one section of cross sectional area $5\ \text{cm}^2$. If water flows through the pipe, and the pressure difference between the two sections is 300 Pa, how many cubic meters of water will flow out of the pipe in 1 minute? **(04 marks)**

2. (a) (i) Provide one evidence which proves that sound is a wave. **(02 marks)**

(ii) Why thunder of lightning is heard some moments after seeing the flash? **(02 marks)**

(b) (i) What is Doppler effect? **(03 marks)**

(ii) The cyclist moving at 10 m/s and the railway train at 20 m/s are approaching each other. If the engine driver sounds a warning siren at a frequency of 480 Hz: calculate the frequency of the note heard by the cyclist before and after the train has passed away. **(06 marks)**

(c) Two sheets of a Polaroid are lined up so that their polarization directions are initially parallel. When one sheet is rotated;

(i) How does the transmitted light intensity vary with the angle between the polarization directions of the polaroid? **(02 marks)**

(ii) What angle must the polaroid be rotated to reduce the light intensity by 50%? **(04 marks)**

3. (a) (i) Give the meaning of the terms wave function, longitudinal wave and transverse wave. **(03 marks)**

(ii) The equation of a progressive wave travelling in the +x - direction is given by $y = a \sin(\omega t - k x)$. Show that the maximum velocity, $V_{max} = \frac{2\pi a}{T}$. **(04 marks)**

(b) (i) What is meant by diffraction grating? **(02 marks)**

(ii) A diffraction grating has 500 lines per millimetre when used with monochromatic light of wavelength 6×10^{-7}m at normal incidence. Determine the angle at which the bright diffraction images will be observed. **(04 marks)**

(iii) Why other orders of image in 3 (b) (ii) can not be observed? **(01 mark)**

(c) (i) State Huygens's principle of wave construction. **(02 marks)**

(ii) A lens was placed with a convex surface of radius of curvature 50.0 cm in contact with the plane surface such that Newton's rings were observed when the lens was illuminated with monochromatic light. If the radius of the 15^{th} ring was 2.13 mm; determine the wavelength. **(04 marks)**

SECTION B

Answer at least **one (1)** question from this section.

4. (a) (i) Define Young's Modulus of a material. **(01 mark)**

(ii) Why work is said to be done in stretching a wire? **(02 marks)**

(b) A steel wire AB of the length 60 cm and cross sectional area 1.5×10^{-6} m^2 is attached at B to copper wire BC of length 39 cm and cross sectional area 3.0×10^{-6} m^2. If the combination of the two wires is suspended vertically from a fixed point at A, and supports a weight of 250 N at C; find the extension (in millimeter) of the

(i) steel wire. **(04 marks)**

(ii) copper wire. **(04 marks)**

(c) Based on the kinetic theory of gases determine:

(i) The average translational kinetic energy of air at a temperature of 290 K. **(04 marks)**

(ii) The root mean square seed (r.m.s) of air at the same temperature as in 4 (c) (i). **(05 marks)**

5. (a) (i) Define the terms electric potential and electric field-strength E at a point in the electrostatic field. **(04 marks)**

(ii) How the two quantities in 5 (a) (i) are related? **(02 marks)**

(b) Outside the sphere, a charged sphere behaves like its charges were concentrated at the centre. If the electric field strength inside the sphere is zero and one sphere of radius 5.0 cm carries a positive charge of 6.7 nC, calculate;

(i) the potential at the surface of the sphere. **(04 marks)**

(ii) the capacitance of the sphere. **(04 marks)**

(c) Figure 1 shows two horizontal parallel conducting plates in a vacuum.

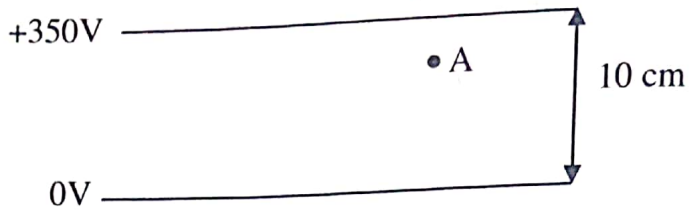

Figure 1

If a small particle of mass 4×10^{-12} kg carries a positive charge of 3.0×10^{-14} C is released at point A close to the upper plate,

(i) What is the total force on this particle? **(03 marks)**

(ii) Calculate the kinetic energy of the particle when it reaches the lower plate. **(03 marks)**

6. (a) (i) What is meant by dielectric constant? **(02 marks)**

(ii) State Coulomb's law of force between two electrically charged bodies. **(02 marks)**

(b) (i) Can there be a potential difference between two adjacent conductors carrying the same positive charge? Give a reason. **(04 marks)**

(ii) A parallel plate capacitor with air as a dielectric has plates of area 4.0×10^{-2} m^2 which are 2.0 mm apart. The capacitor is charged to 100 V battery and connected in parallel with a similar unchanged capacitor with plates of half the area and twice the distance apart. If the edge effect is neglected, calculate the final charge on each plate. **(04 marks)**

(c) (i) Derive an expression for the total capacitance of two capacitors C_1 and C_2 connected in series. **(04 marks)**

(ii) Two capacitor of 15 μF and 20 μF are connected in series with a 600 V supply. Calculate the charge and Potential difference across each capacitor. **(04 marks)**

SECTION C

Answer at least **one (1)** question from this section.

7. (a) (i) Based on Balmer series of hydrogen spectra determine the wavelength of the series limit of Paschen series. **(03 marks)**

(ii) Why electrons do not fall into the nucleus due to electrostatic force of attraction?. **(03 marks)**

(b) (i) Why hydrogen atom is stable in the ground state? **(01 mark)**

(ii) According to Bohr's theory, the angular momentum of an electron is an integral multiple of $\frac{h}{2\pi}$. Express this statement by using a mathematical equation in which angular momentum is represented by the letter L and orbit by the letter n. **(02 marks)**

(iii) Determine the angular momentum of the electron in the orbit of energy level - 3.4 eV given that $E_n = \frac{-13.6}{n^2}$ eV, where E is the energy of an electron and n is the principal quantum number of hydrogen atom. **(03 marks)**

(c) Figure 2 represents a series of lines obtained when the excited electron of an atom of a certain element falls back. Read it carefully then answer the questions which follow:

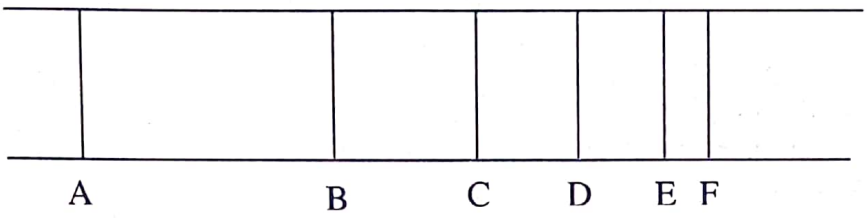

Figure 2

(i) Account for the observed convergence of the lines from A to F. **(03 marks)**

(ii) If the energy value of each line in the spectrum can be calculated using the equation, $E_n = \frac{-13.6}{n^2}$ eV; to which spectral series does the spectrum belongs if the energy value of line A is -1.51eV? **(05 marks)**

8. (a) What is meant by the following terms as used in nuclear Physics?

(i) Mass defect **(02 marks)**

(ii) Binding energy. **(02 marks)**

(b) Disintegration of $^{238}_{92}U$ to give alpha particles can be represented by the following equation: $^{238}_{92}U \rightarrow ^{234}_{90}Th + ^{4}_{2}He$. Use this equation to calculate:

(i) The total energy released in the disintegration reaction. **(04 marks)**

(ii) The kinetic energy of alpha particles when the nucleus was at rest before disintegration. **(04 marks)**

(c) (i) Elaborate two aspects on which fission reactions differs from fusion reactions. **(04 marks)**

(ii) Why is high temperature required to cause nuclear fusion? **(04 marks)**

9. (a) (i) Identify four factors that affect the force experienced by a current-carrying conductor in a magnetic field. **(04 marks)**

(ii) Write the mathematical expression which define magnetic flux density and use it to deduce its S.I units. **(02 marks)**

(iii) Apply an expression obtained in 9 (a) (ii) to develop the formula for the force on a conductor carrying current I if the conductor and the magnetic fields are not at right angles. **(02 marks)**

(b) (i) Distinguish the terms magnetically soft and magnetically hard materials. **(02 marks)**

(ii) State the condition which makes the magnetic force on a moving charge in a magnetic field to be maximum. **(02 marks)**

(iii) Determine the magnitude of force experienced by a stationary charge in a uniform magnetic field. **(02 marks)**

(c) (i) At which position of the rotating coil in the magnetic field, the induced e.m.f is zero? Give a reason. **(03 marks)**

(ii) Use mathematical expression to justify the statement that there will be no change in the kinetic energy of a charged particle which enters a uniform magnetic field when its initial velocity is directed parallel to the field. **(03 marks)**