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

131/1 **PHYSICS 1**
(For Both School and Private Candidates)

Time 3 Hours **Thursday, 10th May 2018 p.m.**

Instructions

1. This paper consists of sections A, B and C with a total of **fourteen (14)** questions.
2. Answer **ten (10)** questions choosing **four (4)** questions from section A and **three (3)** questions from each of sections B and C.
3. Marks for each question or part thereof are indicated.
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) Density of water = $1000 kg/m^3$
   (b) Density of air = $1.3 kg/m^3$
   (c) Radius of Earth = $6.4 \times 10^6 km$
   (d) Stefan's constant = $5.67 \times 10^{-8} Wm^{-2}K^{-4}$
   (e) Solar constant $1.4 kWm^{-2}$
   (f) Specific heat capacity of water = $4200 Jkg^{-1}$
   (g) Acceleration due to gravity = $10 m/s^2$
   (h) One gram of water = $1 cm^3$
   (i) 1 atmosphere = $1.013 \times 10^5 Pa$
   (j) Pi, $\pi = 3.14$

SECTION A (40 Marks)

Answer any **four (4)** questions from this section.

1. (a) (i) How can random and systematic errors be minimized during an experiment? **(02 marks)**

(ii) Estimate the precision to which the Young's modulus, γ of the wire can be determined by the formula $\gamma = \frac{4Fl}{\pi d^2 e}$, given that the applied tension $F = 500N$, the length of the loaded wire, $l = 3m$, the diameter of the wire, $d = 1mm$, the extension of the wire, $e = 5mm$ and the error associated with these quantities are 0.5N, 2mm, 0.01mm and 0.1mm respectively. **(04 marks)**

(b) (i) State the law of dimensional analysis. **(01 mark)**

(ii) If the speed V of the transverse wave along a wire of tension, T and mass, m is given by, $V = \sqrt{\frac{T}{m}}$. Apply dimensional analysis to check whether the given expression is correct or not. **(03 marks)**

2. (a) (i) Under what condition a passenger in a lift feels weightless? **(01 mark)**

(ii) Calculate the tension in the supporting cable of an elevator of mass 500kg which was originally moving downwards at 4m/s and brought to rest with constant acceleration at a distance of 20m. **(03 marks)**

(b) (i) The rotating blades of a hovering helicopter swept out an area of radius 2m imparting a downward velocity of 8m/s of the air displaced. Find the mass of a helicopter. **(02 marks)**

(ii) Compute the mass of water striking the wall per second when a jet of water with a velocity of 5m/s and cross-sectional area of $3 \times 10^{-2}\ m^2$ striked the wall at the right angle losing its velocity to zero. **(04 marks)**

3. (a) (i) How does projectile motion differ from uniform circular motion? **(02 marks)**

(ii) A rifle shoots a bullet with a muzzle velocity of 1000m/s at a small target 200m away. How high above the target must the rifle be aimed so that the bullet will hit the target? **(03 marks)**

(b) (i) Where does the object strike the ground when thrown horizontally with a velocity of 15m/s from the top of a 40m high building? **(02 marks)**

(ii) Find the speed of travel when a man jumps a maximum horizontal distance of 1m spending a minimum time on the ground. **(03 marks)**

4. (a) What is meant by the following terms as used in simple harmonic motion (S.H.M.)?

(i) Periodic motion. **(01 mark)**

(ii) Sketch a labeled graph that represents the total energy of a particle executing simple harmonic motion (S.H.M.). **(02 marks)**

(b) (i) List four important properties of a particle executing simple harmonic motion (S.H.M.). **(04 marks)**

(ii) Sketch a labeled graph that represents the total energy of a particle executing simple harmonic motion (S.H.M.). **(02 marks)**

(c) The periodic time of a body executing S.H.M. is 4 seconds. How much time interval from time, t = 0 will its displacement be half its amplitude? **(02 marks)**

5. (a) A satellite of mass 600kg is in a circular orbit at a height 2×10^6 *km* above the earth's surface. Determine the:
   (i) Orbital speed. **(03 marks)**
   (ii) Gravitational potential energy. **(02 marks)**

   (b) (i) What would happen if gravity suddenly disappears? **(02 marks)**
   (ii) Two base of a mountain are at sea level where the gravitational field strength is $9.81N/kg$. If the value of gravitational field at the top of the mountain is $9.7N/kg$, calculate the height of the mountain above the sea level. **(03 marks)**

6. (a) (i) Why is flywheel designed such that most of its mass is concentrated at the rim? Briefly explain. **(02 marks)**
   (ii) Estimate the couple that will bring the wheel to rest in 10 seconds when a grinding wheel of radius 40 cm and mass 3 kg is rotating at 3600 revolutions per minute. **(03 marks)**

   (b) (i) Why an ice skater rotates at relatively low speed when stretches her arms and leg outward? **(02 marks)**
   (ii) Calculate the moment of inertia of a sphere about an axis which is a tangent to its surface given that the mass and radius of the sphere are 10 kg and 0.2 m respectively. **(03 marks)**

SECTION B (30 Marks)

Answer **three (3)** questions from this section.

7. (a) (i) Which type of thermometer is most suitable for calibration of other thermometers? **(01 mark)**
   (ii) Why at least two fixed points are required to define a temperature scale? **(02 marks)**

   (b) (i) List two qualities which makes a particular property suitable for use in practical thermometers. **(02 marks)**
   (ii) Describe how mercury in glass thermometer could be made sensitive. **(02 marks)**

   (c) (i) What is meant by the triple point of water? **(01 marks)**
   (ii) Evaluate the temperature in Kelvin if the pressure recorded by a constant volume gas thermometer is $6.8\times10^4\ Nm^{-2}$ given that the pressure at triple point 273.16 K is $4.6\times10^4\ Nm^{-2}$. **(02 marks)**

8. (a) One gram of water becomes 1671 cm^3 of steam at a pressure of 1 atmosphere. If the latent heat of vaporization at this pressure is 2256 J/g, determine the:
   (i) external work done. **(03 marks)**
   (ii) increase in internal energy **(02 marks)**

(b) (i) Why during emission of radiations from black body its temperature does not reach zero Kelvin? **(1.5 marks)**

(ii) A black ball of radius 1 m is maintained at a temperature of 30°*C*. How much heat is radiated by the ball in 4 seconds? **(3.5 marks)**

9. (a) (i) What do you understand by the term node as applied to electric circuits? **(01 mark)**

(ii) Outline three important points which are usually referred as sign convection in solving Kirchhoff's second law problems. **(1.5 marks)**

(b) (i) How is ohmic conductor differ from non-ohmic conductor? Give one example in each case. **(02 marks)**

(ii) Study Figure 1 then find the reading on the high resistance voltmeter, V. **(02 marks)**

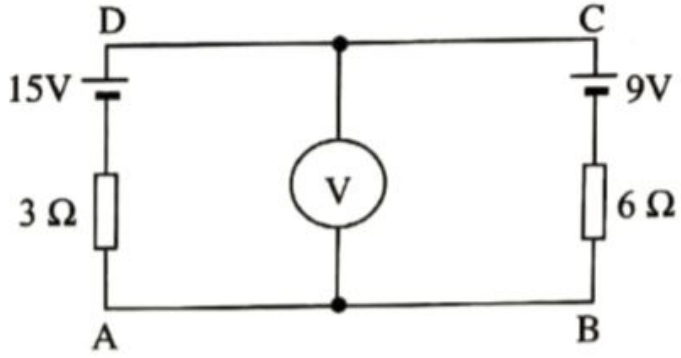

Figure 1

(c) (i) Why the e.m.f. of a cell is sometimes called a special terminal potential difference? **(1.5 marks)**

(ii) Calculate the current flowing in the circuit when three similar cells each of e.m.f. 1.5 V and internal resistance 0.3 Ω are connected in parallel across a 2 Ω resistor. **(02 marks)**

10. (a) (i) Mention four types of energy losses suffered by a transformer. **(02 marks)**

(ii) Why choke coil is preferred over resistance to control alternating current? **(01 mark)**

(b) (i) Identify two difficulties which would arise when two straight wires are used to transmit electricity direct from the source to the city station. **(02 marks)**

(ii) Explain what could be done to light a 30 V bulb from a 220 volt A.C. supply? **(1.5 marks)**

(c) A series LCR circuit with inductance, $L = 0.12H$, capacitance, $C = 480nF$ and resistance, $R = 23\Omega$ is connected to a 230 V variable frequency supply. Determine the:

(i) Maximum current flowing in the circuit. **(1.5 marks)**

(ii) Source frequency for which the current is maximum. **(02 marks)**

SECTION C (30 Marks)

Answer **three (3)** questions from this section.

11. (a) (i) List two chief properties of semiconductors. **(01 mark)**
(ii) Why is it easier to establish the current in a semiconductor than in an insulator? **(02 marks)**

(b) (i) State a condition that could be employed to make an insulator conduct some electricity. **(01 mark)**
(ii) Distinguish between conductors and semiconductors on the basis of their energy band structures. **(03 marks)**

(c) (i) What is meant by depletion layer as used in *pn*-junction devices? **(01 mark)**
(ii) Describe the effect of applying a reverse bias to the junction diode. **(02 marks)**

12. (a) (i) Sketch the graph of transfer characteristic of a transistor. **(1.5 marks)**
(ii) State the significance of the slope from the graph in (a) (i). **(01 mark)**

(b) (i) What is the basic condition for a transistor to operate properly as an amplifier? **(1.5 marks)**
(ii) Briefly explain how a junction transistor can be connected to act as a current operated device. **(1.5 marks)**

(c) (i) Why is the magnitude of output frequency of a full wave rectifier twice the input frequency? **(1.5 marks)**
(ii) Draw a simple basic transistor switching circuit diagram. **(03 marks)**

13. (a) (i) What is meant by a logic gate? **(01 mark)**
(ii) List three basic logic gates that make up all digital circuits. **(1.5 marks)**

(b) Study Figure 2 then answer the questions that follow.

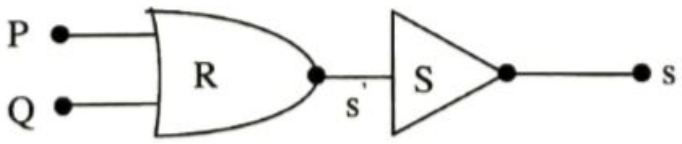

Figure 2

(i) Identify the logic gates marked R and S. **(02 marks)**
(ii) Write down the output at *s*, such that when P = 1, Q = 1 and when P = 0, Q = 0. **(02 marks)**

(c) Obtain the truth table for the circuit shown in Figure 3. **(3.5 marks)**

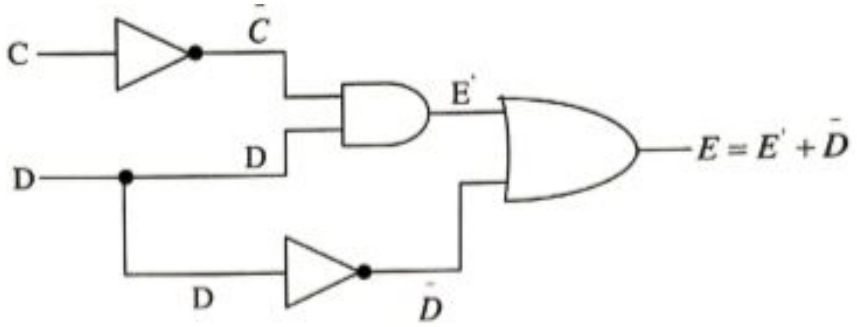

Figure 3

14. (a) (i) What is meant by solar constant? **(01 mark)**
(ii) List two factors on which the solar constant depends. **(02 marks)**

(b) (i) Give two advantages of photovoltaic systems. **(02 marks)**
(ii) Briefly explain how photovoltaic cells work. **(02 marks)**

(c) (i) Estimate the maximum power available from $10m^2$ of solar panels. **(01 mark)**
(ii) Calculate the volume of water per second which must pass through if the inlet and outlet temperature of the panels are at $10°C$ and $60°C$ respectively. (Assume the wave carries away energy at the same rate as the maximum power available). **(02 marks)**