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   **Year: 2020**

Instructions

1.   This paper consists of sections A and B with a total of **ten (10)** questions.

2.   Answer **all** questions in section A and **two (2)** questions from section B.

3.   Section A carries **seventy (70)** marks and Section B carries **thirty (30)** marks.

4.   Marks for each question or part thereof are indicated.

5.   Mathematical tables and non-programmable calculators may be used.

6.   Cellular phones and any unauthorized materials are **not** allowed in the examination room.

7.   Write your **Examination Number** on every page of your answer booklet(s).

8.   The following information may be useful:

   (a)   Acceleration due to gravity, $g = 9.8$ m/s^2
   (b)   Density of air $= 1.3$ kg/m^3
   (c)   Density of oil $= 9.2$ x 10^2 kg/m^3
   (d)   Stefan-Boltzmann constant, $\sigma = 5.67$ x 10^{-8} Wm^{-2}K^{-4}
   (e)   Coefficient of viscosity of oil $= 8.4$ x 10^{-2} Ns/m^{-2}
   (f)   Electronic charge, $e = -1.6$ x 10^{-19}C
   (g)   1 eV $= 1.6$ x 10^{-19}J
   (h)   Thermal conductivity of ice $= 2.3$ Wm^{-1}K^{-1}
   (i)   Density of water $= 1000$ kg m^{-3}
   (j)   Specific latent heat of fusion of water $= 3.25$ x 10^{-5} Jkg^{-1}
   (k)   Molar gas constant is 8.31 JMol^{-1}K^{-1}
   (l)   Pi, $\pi = 3.14$

SECTION A (70 Marks)

Answer **all** questions from this section.

1. (a) Apply the method of dimension to:

    (i)   derive an expression for the acceleration of a particle moving in a uniform circular motion. **(04 marks)**

    (ii) check the correctness of the equation, $\gamma = \dfrac{hrJg}{2cosO}$, where; O, J, r, g, γ and h are the angle of contact, density of the liquid, reading on the tube, acceleration due to gravity, surface tension and the height of the liquid respectively. **(03 marks)**

    (b) Calculate the tension in the cable which delivers the power of 23 kW when pulling a fully loaded elevator at constant speed of 0.75 m/s. **(03 marks)**

2. (a) (i)   Why the outer rail of a curved railway track is raised over the inner? **(03 marks)**

        (ii) Based on Newton's laws of motion explain how a helicopter gets its lifting force. **(03 marks)**

    (b) Determine the internal energy produced by a bullet of mass 10 g travelling horizontally at a speed of 1.0×10^2 ms^{-1} which embed itself in a block of wood of mass 9.9×10^2 g suspended freely by two strings. **(04 marks)**

3. (a) Find the gravitational potential at a point on the earth's surface if the values of universe gravitational constant, mass and radius of the earth are 6.7×10^{-11}Nm^{2}kg^{-2}, 6.0×10^{-24}kg and 6.4×10^6m respectively. **(03 marks)**

    (b) A communication satellite occupies an orbit such that its period of revolution about the earth is 24 hours.
         (i)   What is the physical significance of this period? **(02 marks)**
         (ii) Establish an expression for the radius, R_o of the orbit stating clearly the meaning of all symbols used. **(05 marks)**

4. (a) An object falling freely from a given height, H hits an inclined plane at a height, h from the ground. If the direction of velocity of the object as a results of the impact becomes horizontal, what would be the value of $\dfrac{h}{H}$, at the time it reaches the ground? **(05 marks)**

    (b) A ball is kicked with an initial velocity of 8.0 m/s such that, it just passes over the barrier which is 2.2 m high. Neglecting air resistance, calculate:
         (i)   the horizontal velocity of the ball. **(03 marks)**
         (ii) the total time of flight. **(02 marks)**

5. (a) Give the evidence for the validity of the first law of thermodynamics. **(03 marks)**

(b) (i) Based on Wien's displacement law, what would happen on a black body when constantly heated? **(03 marks)**

(ii) Estimate the rise in temperature of the gas if 60 Joule is supplied to 2 moles of helium gas placed inside an insulated container of a fixed volume. **(04 marks)**

6. (a) (i) Why is it preferred to purchase a cooking utensil of low specific heat capacity? **(03 marks)**

(ii) How does a fish survive in a pond during an extreme winter season even if the pond is deep frozen on the surface? **(03 marks)**

(b) The ice on a pond is 10 mm thick. If the temperature above and below its surface are 263 K and 273 K respectively; calculate the rate of heat transfer through the ice. **(04 marks)**

7. (a) For each of the following cases elaborate:
(i) two solutions for thermal pollution. **(04 marks)**
(ii) three disadvantages of tidal energy. **(03 marks)**

(b) What are the three constituents of outer zone of the earth? **(03 marks)**

SECTION B (30 Marks)

Answer **two (2)** questions from this section.

8. (a) (i) How does a step-up transformer differ from a step-down transformer? **(02 marks)**

(ii) Why the transmission of electricity is always done at the highest possible voltage. **(02 marks)**

(b) (i) An accumulator of e.m.f. 50 V and internal resistance 2 Ω is charged on a 100 V d.c. source. What resistance will be required to give a charging current of 2 A? **(02 marks)**

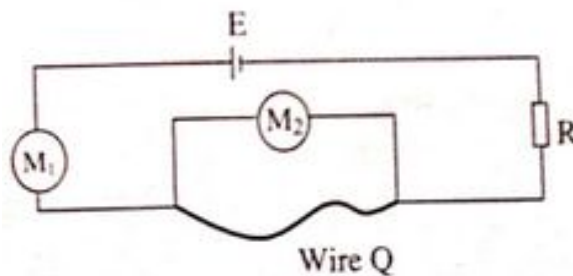(ii) Figure 1 shows a circuit for measuring the resistance of a wire Q which is kept at constant temperature.

Figure 1

Identify the device labelled M_1 and M_2 and state its functions. **(03 marks)**

(c) (i) Why alloys are used for making standard resistance coils? **(02 marks)**

(ii) A coil of a wire has a resistance of 10.8 Ω at 20°C and 14.1 Ω at 100°C. Determine the temperature coefficient of resistance and hence its resistance at 0°C. **(03 marks)**

9. (a) State the function of each of the following devices:
   (i) Digital circuit (02 marks)
   (ii) Integrated Circuit (02 marks)

   (b) (i) Identify three basic logic gates that make up all digital circuits. (03 marks)
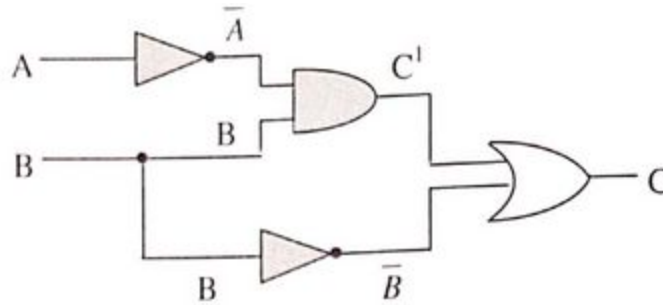   (ii) Construct the truth table from the logic gates shown in Figure 2. (04 marks)

Figure 2

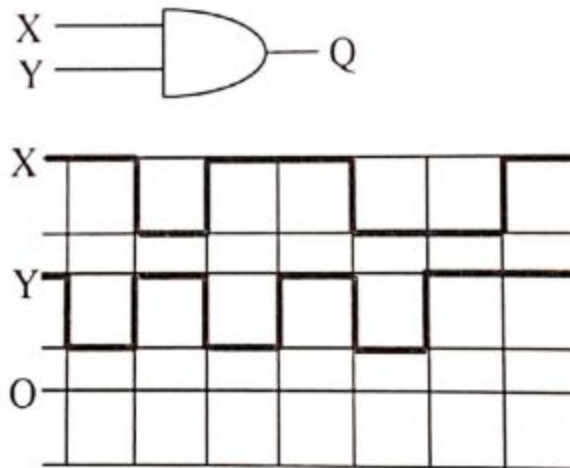   (c) Figure 3 shows a circuit symbol of a logic gate and two input waveforms X and Y.

Figure 3

   (i) What does the circuit symbol represent? (01 mark)
   (ii) Sketch the output waveform Q. (03 marks)

10. (a) (i) What are the four important properties of semiconductors? (04 marks)
   (ii) If the resistivity of n-type germanium is 0.01 Ω m at room temperature, find the donor concentration given that the mobility of electrons is 0.39 m^2/volt sec. (03 marks)

   (b) Figure 4 (i) and (ii) shows a transistor circuit and the relationship between the input V_i voltage and output voltage V_o respectively.
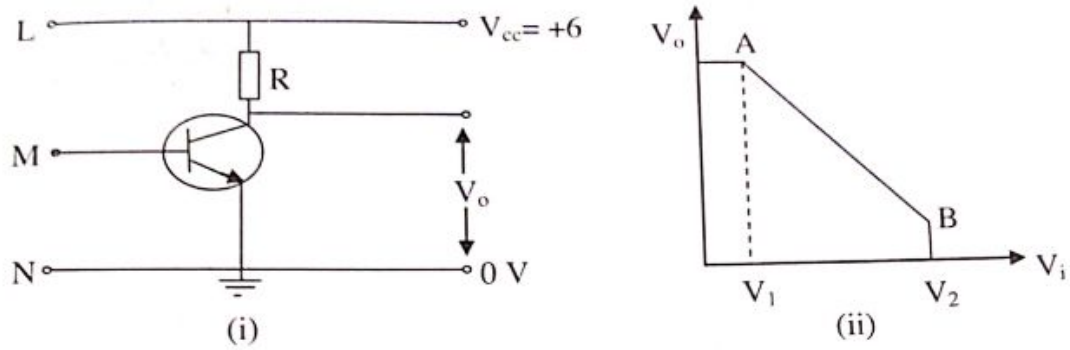
Figure 4

    (i)   What will be the output voltage when L is connected to M?   **(02 marks)**

    (ii) How the circuit can be used as switching circuit?   **(03 marks)**

(c) Briefly explain the transfer characteristic of an operational amplifier.   **(03 marks)**