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 = $9.2 \times 10^2\ kg/m^3$
   (d) Stefan-Boltzmann constant, $\sigma = 5.67 \times 10^{-8}\ Wm^{-2}K^{-4}$
   (e) Coefficient of viscosity of oil = $8.4 \times 10^{-2}\ Ns/m^{-2}$
   (f) Electronic charge, $e = -1.6 \times 10^{-19}C$
   (g) $1\ eV = 1.6 \times 10^{-19}J$
   (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 = $3.25 \times 10^{-5}\ Jkg^{-1}$
   (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, $\gamma = \frac{hrJg}{2cosO}$, 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 $6.7\times10^{-11}Nm^{2}kg^{-2}$, $6.0\times10^{-24}kg$ and $6.4\times10^{6}m$ 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 $\frac{h}{H}$, 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.

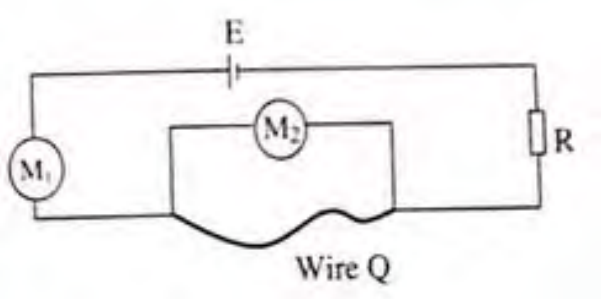


Figure 1

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)**

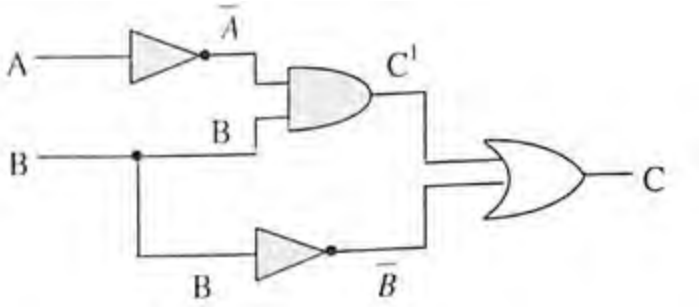


Figure 2

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

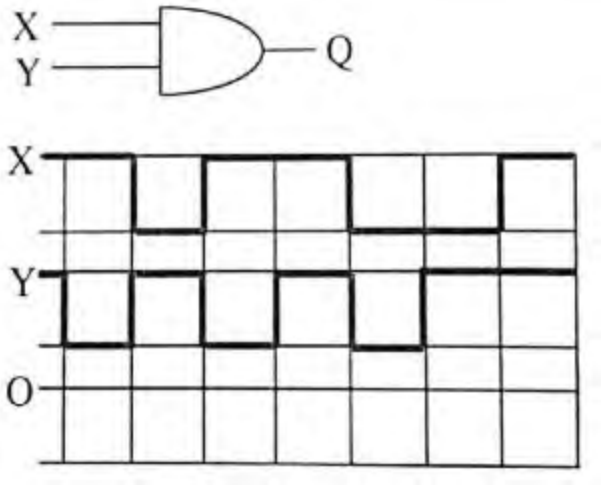


Figure 3

   (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.

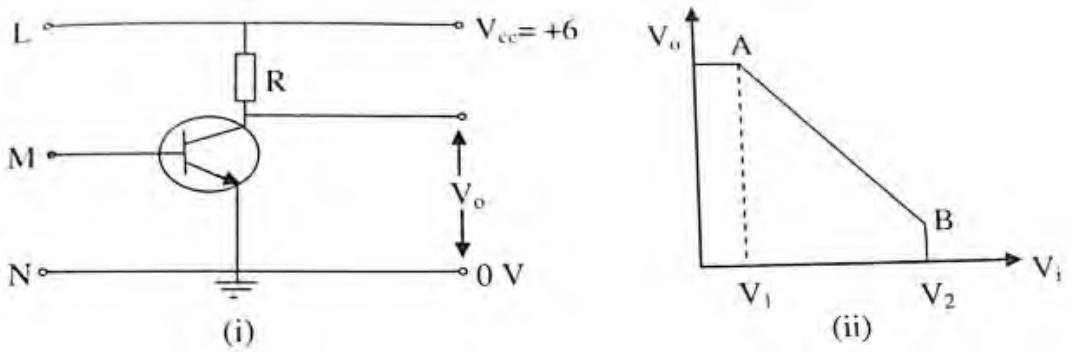


Figure 4

(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)**