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: 2023**

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 choose **two (2)** questions from section B.

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

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

5. All writing must be in **blue** or **black** ink **except** drawing which must be in pencil.

6. Cellular phones and any other 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, $g = 9.8 \text{ m/s}^2$

    (b) The ratio of specific heat capacity, $\gamma = 1.4$

    (c) 1 g of water $= 1 \text{ cm}^3$

    (d) Latent heat of vaporization of water $= 2256 \text{ Jg}^{-1}$

    (e) Density of water $= 10^3 \text{ kg/m}^3$

    (f) Pie, $\pi = 3.14$.

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Answer **all** questions from this section.

1. (a) (i) How is the term dimension differ from dimensional formula? **(02 marks)**

   (ii) Apply the method of dimension to deduce the value of x in the expression $F = kA\rho V^x$, where F, V, A, ρ and k are the force acting on the body, speed, surface area, density and dimensionless constant respectively.

   (04 marks)

   (b) The pressure P can be calculated from the relation $P = \dfrac{F}{\pi R^2}$, where F is the force and R the radius. If the percentage errors of F and R are ± 2 and ± 1 respectively, determine the possible percentage error of P. **(04 marks)**

2. (a) How is the horizontal range of a projectile affected when its initial velocity is doubled for a given angle of projection, θ ? **(04 marks)**

   (b) An aircraft travelling at 150 km/hr dropped a luggage of food to flood victims isolated on a patch of land 250 m below. Determine:

   (i) The time on which the luggage should be dropped before the aircraft is directed overhead. **(03 marks)**

   (ii) The speed of luggage as it reaches the ground. **(03 marks)**

3. (a) A car is moving with a speed of 40 m/s around unbanked curve of radius 500 m. Determine the least coefficient of friction which allows the car to negotiate the curve without sliding. **(03 marks)**

   (b) A stone of mass 1 kg attached to a string of length 1 m is whirled in a horizontal circle of radius 0.6 m at a constant speed. Calculate;

   (i) The tension in the string. **(04 marks)**

   (ii) The maximum number of revolutions per second it can make. **(03 marks)**

4. (a) (i) Give two daily life examples on which Newton's first law of motion applies.

   (02 marks)

   (ii) Sand drops vertically at the rate of 100 g/s on a horizontal conveyor belt moving at a steady velocity of 5 cm/s. Find the force required to keep the belt moving.

   (03 marks)

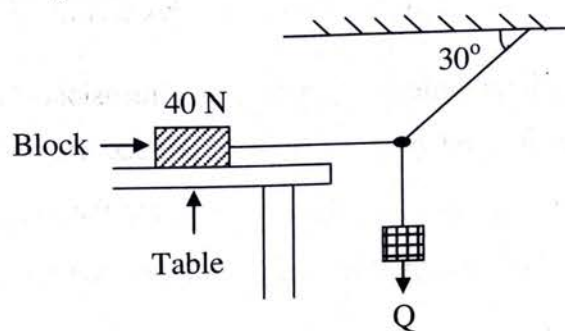(b) Figure 1 shows the system of forces being at equilibrium.

Figure 1

Determine the maximum value of the force Q if the friction force on the block cannot exceed 12 N. (05 marks)

5. (a) A motor car tyre has a pressure of 4 atmospheres at a room temperature of 27 °C. If the tyre suddenly burst, calculate the temperature of the escaping air. (03 marks)

(b) (i) Distinguish between triple point of water and thermometric property as used in heat. (03 marks)

(ii) The resistance R_θ of a particular resistance thermometer at a Celsius temperature θ as measured by a constant volume gas thermometer is given as $R_\theta = 2.50 \times 10^{-4}\theta^2 + 0.1850\theta + 40.0$. Calculate the temperature as measured on the scale of the resistance thermometer which corresponds to a temperature of 70 °C on the gas thermometer. (04 marks)

6. (a) (i) What is meant by reversible process as applied in thermodynamics? (01 mark)

(ii) Distinguish isobaric process from isochoric process. (03 marks)

(b) If 1 g of water is subjected at a pressure of 1.013×10^5 Pa it becomes 1671 cm^3 of steam. Calculate;

(i) The external work done. (03 marks)

(ii) The increase in internal energy of the system. (03 marks)

7. (a) Analyse three possible solutions to the side effects of global warming. (03 marks)

(b) (i) Briefly explain four major causes of water pollution. (04 marks)

(ii) What are the three disadvantages of using solar energy? (03 marks)

SECTION B (30 Marks)

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

8. (a) (i) Identify two conservation laws embodied in Kirchhoff's rules stating its physical significance. **(02 marks)**

(ii) Why is it safe for a bird to stand on a high voltage wire without being harmed? **(02 marks)**

(b) Study the circuit diagram in Figure 2 and apply Kirchhoff's rules to find the values of the currents I_1, I_2 and I_3. **(04 marks)**
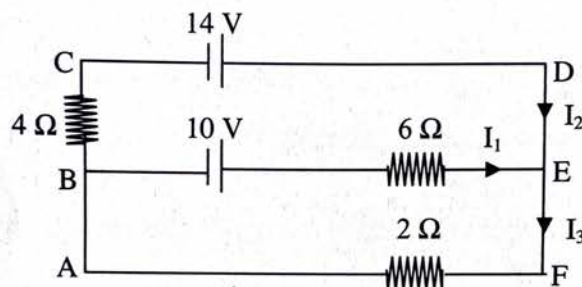
Figure 2

.(c) (i) A capacitor of $1\,\mu F$ is used in a television circuit where the frequency and the current flowing are 1000 Hz and 2 mA (r.m.s) respectively. Compute the voltage across the capacitor. **(03 marks)**

(ii) Determine the current flowing when an a.c voltage of 20 V (r.m.s) and frequency of 50 Hz is connected to a capacitor in 8 (c) (i). **(04 marks)**

9. (a) (i) Comment on the argument that electrical conductivity of a semiconductor depends on temperature variation. **(02 marks)**

(ii) Draw a circuit diagram showing a reverse biased diode. **(02 marks)**

(iii) Why there is a very little current flow in the circuit drawn in (a) (ii)? **(01 mark)**

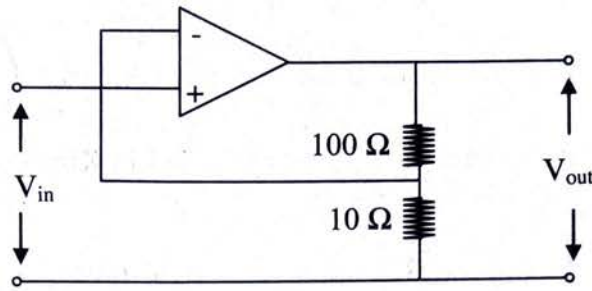(b) (i) Study the circuit diagram in Figure 3 then find the gain of the amplifier. **(03 marks)**

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Figure 3

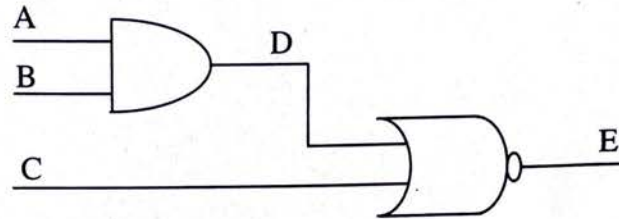(ii) Generate the truth table for the logic gates in Figure 4. **(03 marks)**

Figure 4

(c) (i) What is meant by a voltage follower? Give one importance. **(02 marks)**

(ii) Draw a diagram to show an Op-Amp as a voltage follower. **(02 marks)**

10. (a) (i) Sketch the circuit symbol for NPN transistor showing the direction of a convectional current. **(02 marks)**

(ii) Under what condition does a semiconductor diode behave as an open switch? **(02 marks)**

(b) (i) Why insulators do not conduct electricity under ordinary condition? Explain in terms of energy band theory. **(03 marks)**

(ii) A common emitter amplifier has an input resistance of 0.5 Ω and output resistance of 45 Ω. If the current gain, $\beta = 65$; find the voltage gain. **(03 marks)**

(c) (i) What is the purpose of the barrier potential difference in a P-N Junction? **(02 marks)**

(ii) Identify two advantages of a junction diode and sketch its characteristic curve which shows how it can act as a rectifier. **(03 marks)**

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