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: 2024**

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** drawings, which must be in pencil.
6. Communication devices 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, $g = 9.8\ m/s^2$
   (b) Gravitational constant, $G = 6.67 \times 10^{-11}\ Nm^2kg^{-2}$
   (c) Mass of earth, $M_E = 6.0 \times 10^{24}\ kg$
   (d) Radius of earth, $R_E = 6.4 \times 10^{6}\ m$
   (e) Distance of the moon from the earth, $r = 3.8 \times 10^{5} km$
   (f) Density of water at $25^oC = 1000\ kgm^{-3}$
   (g) Specific heat capacity of water is $4200\ Jkg^{-1}K^{-1}$
   (h) Density of ice $= 1\ g/cm^3$
   (i) Thermal conductivity of ice $= 0.005$ cal/sec.cm ^oC
   (j) Latent heat of ice $= 80$ cal/g
   (k) Pie, $\pi = 3.14$

SECTION A (70 Marks)

Answer **all** questions in this section.

1. (a) Use dimensional analysis to find the numerical values of length and mass given that the velocity of light, acceleration due to gravity and normal atmospheric pressure are 3×10^{8} ms^{-1}, 10 ms^{-2} and 10^{5} N/m^{2} respectively. **(04 marks)**

   (b) Give reason for the following phenomenon:

   (i) A racing car travel faster around banked curved trucks than if it were flat. **(03 marks)**

   (ii) An ice skater pulls both arms and legs toward the axis of rotation and sometimes throws out the arms and one leg. **(03 marks)**

2. (a) (i) Provide three examples which illustrate the application of the law of conservation of linear momentum. **(03 marks)**

   (ii) A rocket projected vertically up ward expels its exhaust gases at 5.0×10^{4} ms^{-1}. If its mass is 3.5×10^{6} kg and the fuel is consumed at a rate of 1.3×10^{2} kgs^{-1}; find its thrust acceleration. **(03 marks)**

   (b) An object with frictionless surface of 1 m long is inclined at an angle of 40^{o} to the horizontal. How fast will it be going if it moves in a positive direction down the plane? **(04 marks)**

3. (a) The motion of simple pendulum will be simple harmonic only if its amplitude of oscillation is small. Use formula to stipulate this statement. **(04 marks)**

   (b) (i) Identify two distinctive examples of bodies executing Simple Harmonic Motion (S.H.M). **(02 marks)**

   (ii) Use mathematical expressions to show that the total energy of a body executing S.H.M is independent of time. **(04 marks)**

4. (a) (i) Assess the motion of a solid sphere dropped from an artificial satellite orbiting around the earth in a circular orbit towards the earths' surface. **(03 marks)**

   (ii) Why space rockets are usually launched from west to east? **(02 marks)**

   (b) A satellite of mass 1000 kg moves in a circular orbit of radius 7000 km around the earth which is assumed to be a sphere.

   (i) Derive an expression for the total energy needed to place the satellite in that orbit. **(03 marks)**

   (ii) Compute the numerical value of total energy described in 4 (b) (i). **(02 marks)**

5. (a) (i) Give two daily life activities which utilize the mechanism of heat transfer by convection. **(03 marks)**

(ii) What are the two necessary conditions for Newton's law of cooling to be valid? **(03 marks)**

(b) A metal box cools in 5 minutes from 65 °C to 45 °C. If the temperature of the surrounding is 10 °C, determine its temperature within next 5 minutes. **(04 marks)**

6. (a) Briefly explain on each of the following phenomenon:

(i) Birds often swell their feathers during winter season. **(03 marks)**

(ii) Animals curl into nearly a ball shape when they feel cold. **(03 marks)**

(b) A layer of ice 10 cm thick is formed on a pond. If the temperature of air is $-10\ ^0$C, how long it will take for the thickness of ice to increase by 1 mm? **(04 marks)**

7. (a) (i) What are the four advantages of tidal energy? **(04 marks)**

(ii) Which characteristic property of seismic waves is used to locate discontinuities in the earth crust? **(02 marks)**

(b) Give two causes and two effect of thermal pollution. **(04 marks)**

SECTION B (30 Marks)

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

8. (a) (i) What are the four functions of a pure capacitor in a circuit? **(02 marks)**

(ii) Show that the resonance frequency of L.C circuit is given by the expression $f = \frac{1}{2\pi\sqrt{LC}}$. **(02 marks)**

(b) A capacitor of 0.4 μF, a coil of inductance 0.4 H, a resistor of 10 Ω and a lamp are connected in series with an alternating voltage of 0.01 V (r.m.s). If its frequency is varied from low to high while the magnitude of alternating voltage is kept constant;

(i) Use a relevant circuit diagram to sketch the graphs showing the variation of impedence and current with frequency and briefly explain how the brightness of the lamp will vary. **(04 marks)**

(ii) Calculate the voltage across the capacitor at resonance, neglecting the lamp resistance. **(02 marks)**

(c) (i) Why is the power consumed in a pure inductor or capacitor is zero? **(02 marks)**

(ii) What will happen when a lamp and a capacitor in part (b) are connected in series with a direct voltage of 0.05 V instead of alternating voltage of 0.01 V (r.m.s)? **(03 marks)**

9. (a) (i) How does amplitude modulation (AM) differ from frequency modulation (FM)? **(02 marks)**

(ii) Elaborate two basic functions of a receiver as used in communication system. **(02 marks)**

(b) Figure 1 is an op-amp circuit with negative feedback made through a capacitor C.

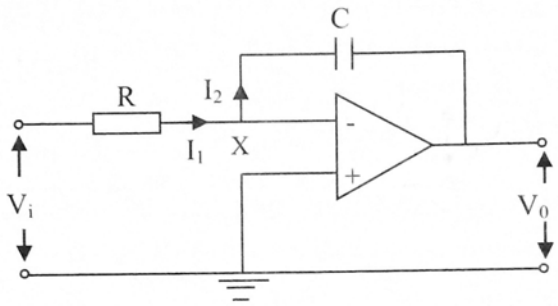

Figure 1

(i) State the practical use of the circuit shown in Figure 1. **(01 mark)**

(ii) If R = 2 kΩ, C = 2 μF and f = 50 Hz; determine the maximum voltage of the circuit at time t = 2 seconds given that V_i = 0.5sin ωt and V_O $= -\frac{1}{RC}\int V_i dt$ **(04 marks)**

(c) (i) Why is the television transmission towers made high? **(03 marks)**

(ii) Describe the methods of transmission and reception of radio signals. **(03 marks)**

10. (a) (i) Apply Boolean Algebra to analyze the logic circuit diagram shown in Figure 2 and create its truth table. **(04 marks)**

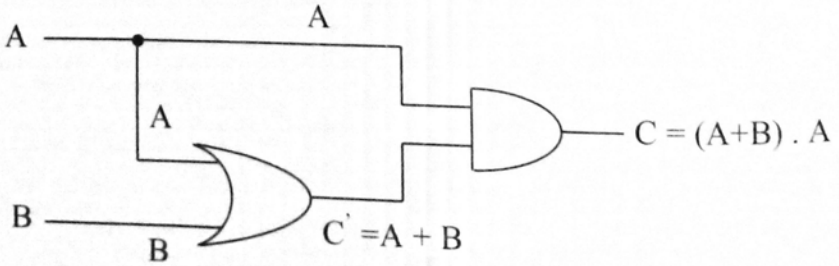

Figure 2

(ii) Why NOT gate is known as an inverter? **(02 marks)**

(b) (i) How do metals differ from semiconductors in terms of energy band and conductivity? **(04 marks)**

(ii) Identify any two factors to be considered when designing a voltage amplifier. **(02 marks)**

(c) Figure 3 is a silicon common–emitter amplifier circuit with base–emitter voltage $V_{BE} = 0.7$ V.

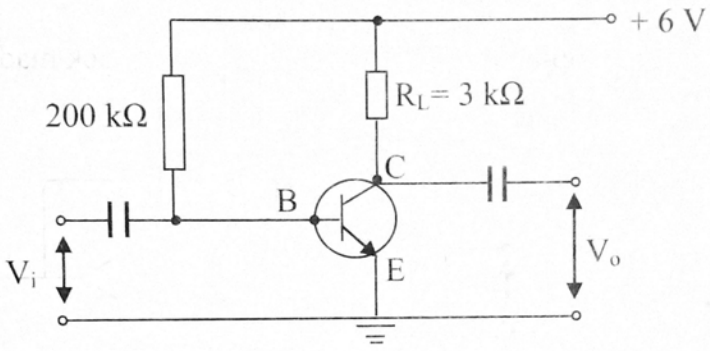

Figure 3

If the current amplification factor, β is 50, calculate the base current I_B and the voltage V_{CE} in the circuit. **(03 marks)**