TANZANIA HEADS OF ISLAMIC SCHOOLS COUNCIL
FORM SIX INTER ISLAMIC MOCK EXAMINATION
PHYSICS 1
(For Both School and Private Candidates)

131/1

TIME: 3 HOURS   **Wednesday, 5th March 2025 a.m.**

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. 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 constants may be useful:-

    (a) Acceleration due to gravity, $g = 9.8 m/s^2$.

    (b) Density of water, $\rho = 1000 kg/m^3$

    (c) Specific heat capacity of metal, $C = 400 J/kg^oC$

    (d) Thermal conductivity of dry sand, $0.27 W/m^oC$

    (e) Density of sea water, $1023 kg/m^3$

    (f) Stefan's Boltz man constant, $\rho = 5.67 \times 10^{-8} k^{-4} wm^{-2}k^{-4}$

    (g) Gravitational constant, $G = 6.67 \times 10^{-11} Nm^2 kg^{-2}$

    (h) Density of metallic sphere, $\rho = 8 g/cm^3$

    (i) Radius of the Earth, $R = 6.4 \times 10^6 m$

SECTION A (70 Marks)

Answer all questions in this section

1. (a) (i) Dimensional consistency is a necessary condition for an equation to be correct but not sufficient. Explain the statement giving two reasons. **[2 marks]**

   (ii) A student while doing an experiment finds that the velocity "V" of an object varies with time "t", and it can be expressed as per equation
   $V = xt^2 + yt + z$. If the units of "V" and "t" are expressed in terms of SI units, determine the units of "x", "y" and "z".
   [4 marks]

   (b) (i) During physics experiment, form five students were advised to indicate maximum errors in their final results, ignoring the negative. Explain. **(1 mark)**

   (ii) In a resonance tube experiment using an organ pipe dipped in a salt water using a turning fork of frequency (300 ± 3)Hz, the first and second resonance column lengths are 26.1cm and 81.1cm, and the inside radius of the pipe is 1.90cm. Determine the percentage error in a calculated value of velocity of sound in air.
   [3 marks]

2. (a) (i) One of the major achievements in modern science is the use of satellites which are placed in orbit by "rocket propulsion". Explain why such event is not regarded as example of projectile motion. **[02 marks]**

   (ii) A gun kept on a straight horizontal road is used to hit a car travelling along the same road away from the gun with a uniform speed of 72km/h. The car is at the distance of 500m from the gun, when the gun was fired at an angle of 45^0 with the horizontal. Find the distance of the car from the gun when the shell hit it. **[04 marks]**

   (b) (i) Centripetal force is a must condition for an object in describing circular motion as in electrons motion around the nucleus, planets around the sun. Suggest the cause of such a force for the two systems above. **[2 marks]**

   (ii) A car moving with a speed of 30ms^{-1} in a circular track of radius 500m. Its speed increases at the rate of 2m/s, determine the value of its acceleration.
   [2 marks]

3. (a) (i) According to Newton's law every two bodies in universe attract one another, then why we cannot feel gravitated toward massive building in our locality?
   [2 marks]

   (ii) Two friends are having conversation. Asha says satellite in orbit is in free fall because satellites keep falling toward the earth. Bilal says satellites are not in

free fall because the acceleration due to gravity is not 9.8m/s^2. Who do you agree with and why? **[3 marks]**

(b) A satellite is revolving around the earth in a circular orbit which is parallel to the equatorial plane of the earth at a height of 35,850km.

(i) Find its period of revolution. **[3 marks]**

(ii) In what direction is such satellite projected? And why must its orbit be parallel to the equatorial plane of the earth? **[2 marks]**

4. (a) Explain the following phenomena:

(i) You can shield a charge from electrical force by putting it inside a hollow conductor. Can you shield a body from gravitational influence of nearby matter by putting it inside a hollow sphere or some other means? **[2 marks]**

(ii) The escape speed of a body of 1g from the earth gravitational field is 11.2km/s. With the help of mathematics what will be the escape speed of an elephant 200kg from the earth? **[2 marks]**

(b) (i) A hungry boy is given with two eggs, one boiled and the other is not boiled. As a form six student how can you help the boy to distinguish them by rotating them in a turn table? **[2 marks]**

(ii) A solid cylinder of radius 4cm and mass of 250g rolls down an inclined plane (1 in 10). Find the linear acceleration and its total kinetic energy after 5 sec. **[4 marks]**

5. (a) (i) Briefly explain why animals in the forest find shelter from cold in holes in the snow? **[2 marks]**

(ii) If you have two spoons of same size, one silver and other one stainless, there is quick test to tell which is which. Hold the end of the spoon in each hand, and then lower them both into a cup of very hot water. One spoon will feel hot first. Is that the silver spoon or stainless spoon? Explain. **[2 marks]**

(b) (i) A sphere, a cube and a thin circular plate all made of same material and having the same mass are initially heated to 200°C. When these objects are left in air at room temperature which will cool fastest and which one slowest? Explain why. **[2 marks]**

(ii) Two perfectly lagged material bars, X and Y are arranged (a) in series (b) in parallel, when the bars are in series hot end "X" is maintained at 90°C and cold end "Y" maintained at 30°C. When the bars are in parallel, hot end is at 90°C and cold end at 30°C. Calculate the ratio of total rate of flow of heat in parallel arrangement to that in series arrangement. The length of each is L and

x-section area of each is A. Thermal conductivity of x is 400wm^{-1}k^{-1} and that of Y is 200wm^{-1}k^{-1}. **[4 marks]**

6. (a) (i) The internal energy of a compressed gas is less than that of the rarified gas at the same temperature. Why? **[01 mark]**

   (ii) Milk is poured into a cup of tea and mixed with spoon. Is that example of reversible process? Explain. **[01 mark]**

   (b) (i) Why clear nights colder than cloudy nights? **[01 mark]**

   (ii) A metal spere with a black surface and radius 30mm is cooled to -73°C and placed inside an enclosure at a temperature of 27°C. Calculate the initial rate of temperature rise of the sphere, assuming the sphere is a black body.
   [3 marks]

   (c) If the excess temperature of a body over the surrounding is given as $\Delta T=T_b-T_s$. Using Stefan's law, obtain the Newton's law of cooling.

7. (a) (i) Greenhouse effect gas has negative impact on earth as it can lead to global warming. Despite its negative effect still it makes life possible to the earth. Explain why? **[3 marks]**

   (ii) If the temperature difference across a 43cm thick dry soil is 23°C, estimate the thermal flux and total heat transfer in three hours under steady conditions.
   [3 marks]

   (b) Give two causes and effects of thermal pollution. **[4 marks]**

SECTION B (30 Marks)
Answer **two (2)** questions in this section

8. (a) (i) Voltmeter is a common electrical device for measurement of electrical voltage, but in experimental measurement of e.m.f of a cell a potential meter is mostly preferred. Explain why. **[2 marks]**

   (ii) From the given circuit below, calculate the current passing through 3Ω

1Ω

1Ω   4Ω   3Ω

4V
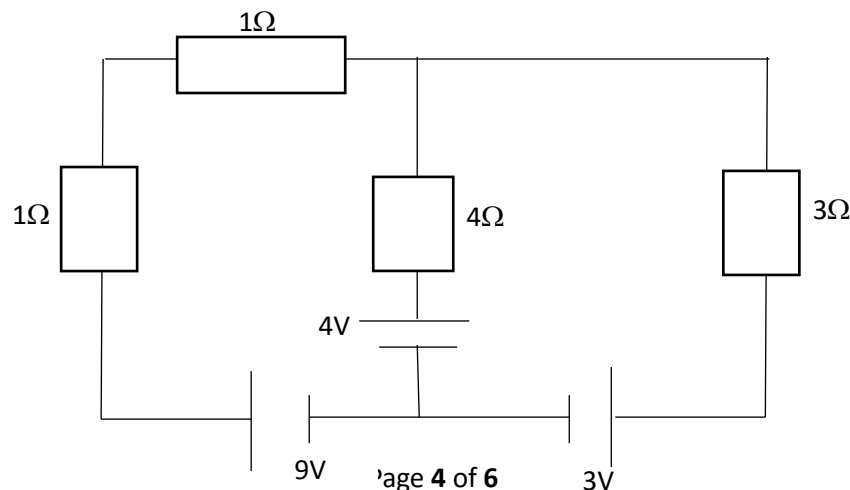
[03 marks]

(b) (i)   Explain why bending of a wire does not affect electrical resistance.

[02 marks]

    (ii)   What is the drift velocity of electrons in a silver wire of length 1m, area of cross-section $3.14 \times 10^{-6}m^2$ and carrying a current of 10A? Given that Avogadro's number $N_A = 6.02 \times 10^{23}$ atomic weight of silver is 108g and density of silver is $10.5gcm^3$. **[04 marks]**

(c) In a particular R-L series circuit a voltage of 10V at 50Hz produces a current of 700mA while same voltage at75Hz produces 500 mA. What are values of "R" and "L" in a circuit? **[04 marks]**

9. (a) (i)   Germanium materials are easily found and mere cheaper than Silicon, but in many electronics devices silicon is used. Account for the reason behind, giving two reasons. **[02 marks]**

    (ii)   Give four (4) differences between intrinsic and extrinsic semiconductors.

[02 marks]

    (iii)   The resistivity of N-type Germanium semiconductor is $0.01\Omega m$ at room temperature. Find the donor concentration if the mobility of electrons is $0.39m^2 v^{-1}s^{-1}$. **[03 marks]**

  (b) (i)   Give reason why the collector region of a transistor is relatively lightly doped compared to the emitter region? **[02 marks]**

    (ii)   An N-P-N transistor is connected in a common emitter configuration in which the collector supply is 8V and the voltage drop across the load of 800Ω connected in the collector circuit is 0.8V. If the current amplification factor is 25, determine collector - Emitter voltage and base current. If the internal resistance of the resistance of the transistor is 200Ω. Calculate voltage and power gain. **[06 marks]**

10. (a) (i)   Explain what is meant by open-loop configuration. **[01 mark]**

    (ii)   What factors determine the output voltage of an ideal OPAMP in an open-loop-configuration? **[03 marks]**

(b) The circuit in the figure below shows the OPAMP used as a voltage comparator. The resistance of the thermistor shown decreases with increasing temperature. With resistance cold, the output voltage is at maximum -15v, the power supply being $\pm$ 15v.
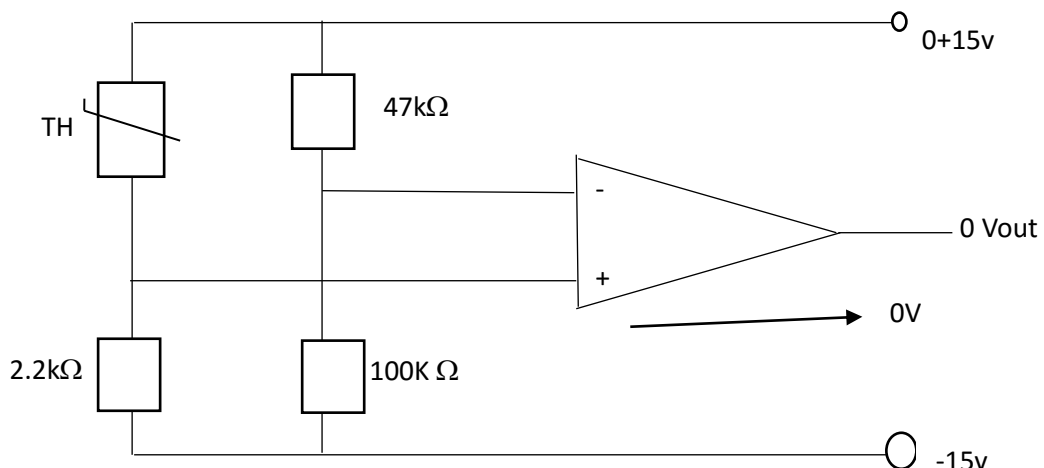
(i)   What is the voltage at the inverting input of the OPAMP?   **[02 marks]**

(ii)   What voltage would the non-inverting input have to reach, for the output to switch to +15v?   **[02 marks]**

(iii)   What would be the resistance of the thermistor at this point? **[02 marks]**

(c) (i)   An audio signal 12KHz modulates a carrier generated by a tank circuit containing 100μH inductor and 100PF capacitor. Calculate the frequency of first pair of side band.

(ii)   From the truth table below, establish Boolean function and from it design a logic circuit to operate the system.

A	B	Q
0	0	1
0	1	0
1	0	1
1	1	1

[03 marks]

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