PRESIDENT'S OFFICE

REGIONAL ADMINISTRATION AND LOCAL GOVERNMENT

ADVANCED CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

JOINT EXAMINATION SOUTHERN ZONE
(MTWARA AND LINDI)

131/1 **PHYSICS 1**

(For Both School and Private Candidates)

TIME: 3:00 HOURS **Monday, 04th, July, 2022 a.m**

Instructions

1. This paper consists of section 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-programable calculators may be used.
5. Write your **Examination Number** on every page of your answer booklet(s).
6. The following information may be useful
   (a) Acceleration due to gravity, $g = 9.8 m/s^2$
   (b) Pi, $\pi = 3.14$
   (c) Mass of Earth $M_E = 6.02 \times 10^{24} kg$
   (d) Universal gas constant, R = 8.3J/mol K
   (e) Charge on electron, e= $1.6 \times 10^{-19} C$
   (f) Gravitational constant, G= $6.67 \times 10^{-11} Nm^{-2} kg^{-2}$

This paper consist of five (05) printed pages

SECTION A (70 marks)

Answer **all** questions in this section.

1. (a) (i) We normally use square brackets around M, L and T, why? **(02 marks)**

   (ii) Identify the physical quantity X defined as $X=\frac{IFV^2}{wL}$, where I is moment of inertia, F is force, v is velocity, w is a work done and L is length **(03 marks)**

   (b) the equation of a wave is given by the ratio $y=a\sin\left[\frac{2\pi}{\lambda}(ct-b)\right]$, where t is time , λ is a wavelength of the wave motion. What are the dimensions of c and b. **(05 marks)**

2. (a) A person takes 10 observations in an experiment. If he repeats the same experiment by taking 50 observations, how is the probable error affected? **(02 marks)**

   (b) (i) A man measured the height of his brother and obtained (190 ± 0.3)cm. However his shoes were found to increase the height by (2 ± 0.35)cm. What is his true height? **(04 marks)**

   (ii) The period of oscillation of a simple pendulum is given by $T=2\pi\sqrt{\frac{\ell}{g}}$. In finding the value of g, which quantity should be measured most accurately and why? **(04 marks)**

3. (a) (i) How does projectile motion differ from uniform circular motion? **(02 marks)**

   (ii) A boy wants to throw a letter wrapped over a stone to his friend across the street 40m wide. The boy's window is 10m below friend's window. how should he throw the stone? **(04 marks)**

   (b) (i) In long jumping, what factors determine the span of jump? **(02 marks)**

   (ii) In projectile motion, what is the relation between the direction of acceleration and velocity? **(02 marks)**

4. (a) (i) Why do the dry leaves and fruits fall when we shake the tree?**(02 marks)**

   (ii) If several forces act simultaneously on a body, which direction will it move? **(02 marks)**

   (b) A wooden block moving to the East with velocity of 4m/s is hit by bullet travelling North-East with the velocity of 150m/s. If the mass of the block is 1.5kg and that of bullet is 200g and if the bullet remain embedded in the block. Determine;

   (i) the velocity and direction of the bullet after impact. **(04 marks)**

   (ii) the amount of heat liberated in the collision. **(02 marks)**

5. (a) (i) Briefly describe two practical examples of uniform circular motion. **(02 marks)**

(ii) The moon's nearly orbit about the earth has a radius of about 3.85×10^8m and a period of 27.3 days. Determine the acceleration of the moon toward the earth. **(03 marks)**

(b) A particle of mass 0.3kg moves with angular velocity of 10rad/s in a horizontal circle of radius 20cm inside a smooth hemispherical below. Find

(i) Reaction of the bowl of the particle. **(03 marks)**

(ii) Radius of the top of the bowl **(02 marks)**

6. (a) (i) Why do velocity and acceleration of a body executing S.H.M are out of phase? **(02 marks)**

(ii) Can simple pendulum experiment be done inside a satellite? Briefly explain your answer. **(03 marks)**

(b) A simple pendulum is executing S.H.M with a time period T. If the length of the pendulum is increases by 21%. Calculate the increase in the time period. **(05 marks)**

7. (a) (i) You use a thumb and finger to open a bottle cork but turn the door by a single finger. Why? **(02 marks)**

(ii) Energy of 484J is spent in increasing the speed of a flywheel from increasing the speed of flywheel from 60r.p.m to 360r.p.m. Find the moment of inertia of the wheel. **(03 marks)**

(b) (i) State the principle of conservation of angular momentum. **(02 marks)**

(ii) If the earth were to suddenly contract to half its presence radius (without any external torque acting on it), by how much would the day be decreased? **(03 marks)**

SECTION B (30 marks)

Answer any **two (02)** questions in this section.

8. (a) (i) State Newton's law of universal gravitation and write its expression. **(02 marks)**

(ii) The escape velocity from the earth for a single piece of 1.20g is 11.2km/s. What would it be for a piece of 11.17g? **(03 marks)**

(b) (i) A satellite of mass 200kg orbits the earth at a height 400km above the earth's surface. What will be its binding energy? **(04 marks)**

(ii) A small satellite revolves around a planet in an orbital just above the surface of the planet. The mean density of the planet is $8 \times 10^3 \text{kgm}^{-3}$, find the time period of the satellite. **(03 marks)**

(c) Determine the speed with which the earth would have to rotate on its axis so that a person on the equator would weight $\frac{3}{5}^{th}$ as much as at present.

(03 marks)

9. (a) (i) What is the meaning of temperature scale as applied in thermodynamic?

(01 marks)

(ii) A scientist from TANZANIA called Mapunda designed a thermometer scale called Mapunda scale. Each division is called degree Mapunda (°M). On this scale, the ice point is marked 15°M and the steam point is marked as 230°M. Derive an expression for the relationship between mapunda scale and Celsius scale **(04 marks)**

(b) A liquid in glass thermometer uses a liquid volume which varies with temperature according to the equation, $V_\theta = V_o(1 + a\theta + b\theta^2)$, where V_θ and V_o are the volume of the gas at $\theta°$ and 0°C respectively, **a** and **b** are constant. If $a = b \times 10^3$, what will be the reading of the liquid in glass scale when the actual temperature is 60°C? **(05 marks)**

(c) Show that the radial heat flow across the coaxial cylinder is given by $H = \frac{2\pi\kappa\ell(T_2 - T_1)}{\ln\left(\frac{r_2}{r_1}\right)}$, where κ is the thermal conductivity, ℓ is the length of the cylinder, r_1 and r_2 are radii of inner and outer parts of the cylinder.

(05 marks)

10. (a) (i) Briefly explain why it is not possible to cool a room by leaving the door of the refrigerator open. **(03 marks)**

(ii) What happen to the temperature of the room in which an air conditioner is left running an a table in the middle of the room? **(03 marks)**

(b) A one mole of an ideal mono atomic gas is carried around the thermodynamic cycle. The cycle consist of three parts:

An isothermal expansion from A, pressure 5 atm to B 1 atm at 300k.

An isobaric compression from B to C and

A constant volume increase in pressure from C to A.

(i) Sketch the PV diagram. **(02 marks)**

(ii) Determine the temperature of the gas at C **(02 marks)**

(iii) Determine the work done by the gas per cycle. **(03 marks)**

(c) How can you differentiate isothermal process from adiabatic process based on the slope of their curves? **(02 marks)**