PRESIDENT'S OFFICE

REGIONAL ADMINISTRATION AND LOCAL GOVERNMENT

ADVANCED CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

FORM SIX MOCK EXAMINATION SOUTHERN ZONE
(MTWARA AND LINDI)

131/1 **PHYSICS 1**

(For Both School and Private Candidates)

TIME: 3:00 HOURS **2024**

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
   (i) Stefan's constant $\sigma = 5.67 \times 10^{-8}\text{Wm}^{-2}\text{K}^{-4}$
   (ii) Electronic charge $e = 1.6 \times 10^{-19}\text{C}$
   (iii) Thermo conductivity of copper $= 400\text{Wm}^{-1\circ}\text{C}^{-1}$
   (iv) Density of air$=1.23\text{kg/m}^3$
   (v) Acceleration due to gravity $=9.8\text{m/s}^2$
   (vi) Radius of the earth R$= 6.4 \times 10^6\text{m}$
   (vii) Density of water$=1000\text{kg/m}^3$
   (viii) Universal gas constant R$= 8.31$J/mol K
   (ix) Molar gas ratio constant for monoatomic gas $\gamma = \frac{5}{3}$

This paper consist of five printed pages

SECTION A (60 marks)

Answer **all** questions in this section.

1. (a) (i) Find the value of x, y and z, so that the quantity $Q = P^{(x-y)}M^{(y+z)}V^z$ is dimensionless given that P is pressure, M is mass and V is velocity. **(03 marks)**

   (ii) Show that the ratio of dimensions of plank's constant and that of moment of inertia are dimensions of frequency. **(03 marks)**

   (b) (i) Identify two ways of minimizing systematic error in measurements. **(02 marks)**

   (ii) Suppose the slope of the best fit line is 1.0 and slopes of maximum and minimum worst lines are 1.16 and 0.81 respectively. Estimate the value of slope of the graph. **(02 marks)**

2. (a) (i) If a car is moving with a constant speed in a straight line. Is there any net work done by the external forces on the car? If yes or no give one reason. **(01 marks)**

   (ii) What are head-on and oblique collisions?. **(01 marks)**

   (iii) What will be the maximum weight of the block A resting on the table. If the coefficient of static fraction between block A and the table is 0.25 and the mass of block B is 25N. **(03 marks)**

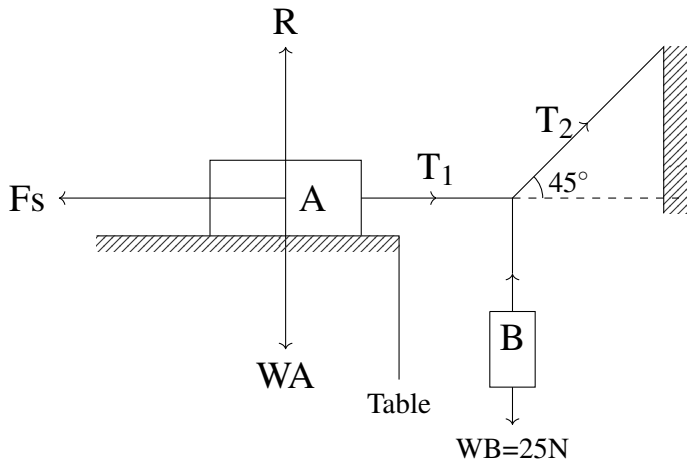

Figure 1:

   (b) (i) What is the difference between orbiltal velocity from parking orbit of a satellite. **(01 marks)**

   (ii) A rocket is launched vertically from the surface of the earth with an initial velocity $v_\circ$. Show that its velocity V at height h is given by $V = \sqrt{V_\circ - \frac{2gh}{(1+\frac{h}{R_e})}}$. **(04 marks)**

3. (a) (i) State the meaning of time of flight and write its equation. **(02 marks)**

(ii) An aeroplane flying in a horizontal direction with a velocity of 720km/h drops a bomb at a height of 1960m. Find the magnitude and direction of resultant velocity with which the bomb strikes the ground. **(03 marks)**

(b) (i) State the most important characteristic of simple harmonic motion. **(02 marks)**

(ii) A pendulum clock shows correct time. If the length increases by 0.1%, find the error in time per day. **(03 marks)**

4. (a) (i) What is the reason for no atmosphere on the moon? **(02 marks)**

(ii) A satellite takes 24 hours to revolve on it's orbit around the earth. Find the height above the earth at which the satellite should be placed. **(03 marks)**

(b) (i) Show that the rotational kinetic energy of a ball rolling over a horizontal plane is $\frac{2}{7}$ of it's total kinetic energy. **($02\frac{1}{2}$ marks)**

(ii) Radius of gyration of a body about an axis at a distance 6cm from it's centre of mass is 10cm. Find it's radius of gyration about a parallel axis through it's centre of mass **($02\frac{1}{2}$ marks)**

5. (a) (i) Why birds often swell their feathers in winter? **(02 marks)**

(ii) A copper bar of length 1m and cross-sectional area $10 \times 10^{-2}m^2$ has its one end maintained at 100°C by means 0.4kW heater. Calculate the temperature of the other end in the steady state. **(03 marks)**

(b) (i) State the two laws of black body radiation. **(02 marks)**

(ii) At what temperature will the filament of a 100W lamp operate if it is supposed to be a perfectly black body of area $1cm^2$? **(03 marks)**

6. (a) (i) Explain why air pressure in a car tyre increases during driving. **(02 marks)**

(ii) What is adiabatic reversible change as used in thermodynamics? Give two examples of adiabatic processes. **(03 marks)**

(b) (i) A cylinder fitted with a piston which can move without friction contains 0.05mol of a monoatomic ideal gas at a temperature of 27°C and a pressure of 1 atm. The temperature of the gas is raised to 77°C, the pressure remaining constant. Calculate the total heat energy supplied. **(03 marks)**

(ii) State two conditions for isothermal process and plot its PV graph. **(02 marks)**

7. (a) What is the difference between barrage and the Tip Speed Ratio (TSR). **(04 marks)**

(b) (i) Explain three (3) importances of mulching as used to improve plant environment. **(03 marks)**

(ii) Calculate the power extractable by a wind turbine of blades' length 52m if the wind is blowing at a speed of 12m/s. Assume the power coefficient to be 0.4. **(03 marks)**

SECTION B (30 MARKS)

Answer **Two (2)** questions in this section

8. (a) (i) Can you verify ohm's law by using a filament? Give reason for your answer. **(02 marks)**

(ii) The thermal speeds of freed electrons are very large. Inspite of these high speeds, why they fail to escape from the surface of a conductor? **(02 marks)**

(b) (i) What does it mean by safe value of fuse wire current? **(02 marks)**

(ii) Three cells are connected in parallel with their like poles connected together with wires of negligible resistance. If the e.m.f.s of he cells are 2V, 1V and 4V respectively and their internal resistances are 4Ω, 3Ω and 2Ω respectively, find the current through each cell. **(04 marks)**

(c) (i) For a very high frequency a.c supply a capacitor behave as a pure conductor. Why? **(02 marks)**

(ii) In an R-L series circuit, a voltage of 100V at 25Hz produces one ampere while the same voltage at 75Hz produces half ampere. Find the value of R and L. **(03 marks)**

9. (a) (i) Why is a semiconductor virtually an insulator at room temperature? **(02 marks)**

(ii) Identify four (4) properties of semiconductors. **(02 marks)**

(b) The figure below is a logic circuit

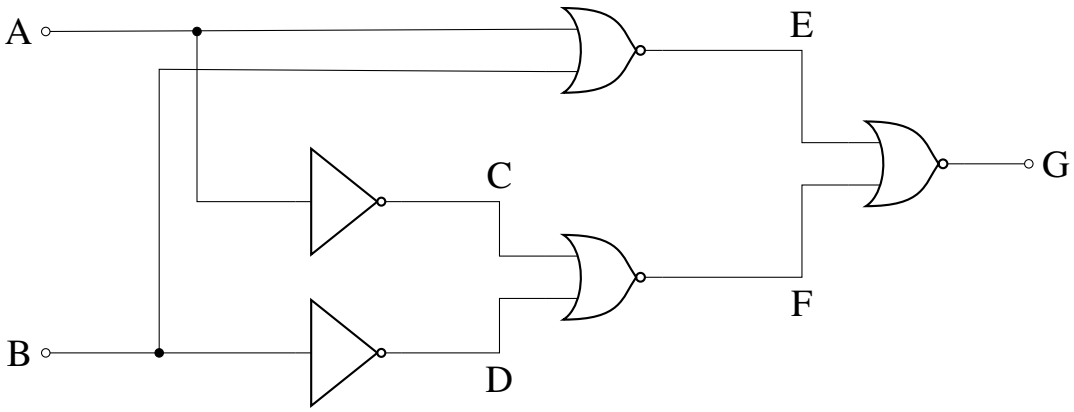

Figure 2:

From the circuit above in figure 2

(i) Draw the truth table for the logic circuit for which A and B are inputs and C, D, E, F and G are output. **(04 marks)**

(ii) What single gate is equivalent to the logic circuit above (b)? **(01 marks)**

(iii) Draw symbol for a logic gate mentioned in (b)(ii) **(01 marks)**

(c) (i) Why is collector of a transistor made wider than emitter and base? **(02 marks)**

(ii) In an NPN transistor, 10^{10} electrons enter the emitter in 10^{-6}s. If 2% electrons are lost in the base, calculate the current amplification factor. **(03 marks)**

10. (a) (i) What do you understand by the term OPAMP? State any three of its properties. **(02 marks)**

(ii) Briefly explain the three elements of communication system. **(03 marks)**

(b) The figure 3 below is an opamp circuit where V_1 and V_2 are independent input voltages. What values of R_2 and R_3 would give an output $V_o = -(4V_1 + 0.5V_2)$? **(04 marks)**

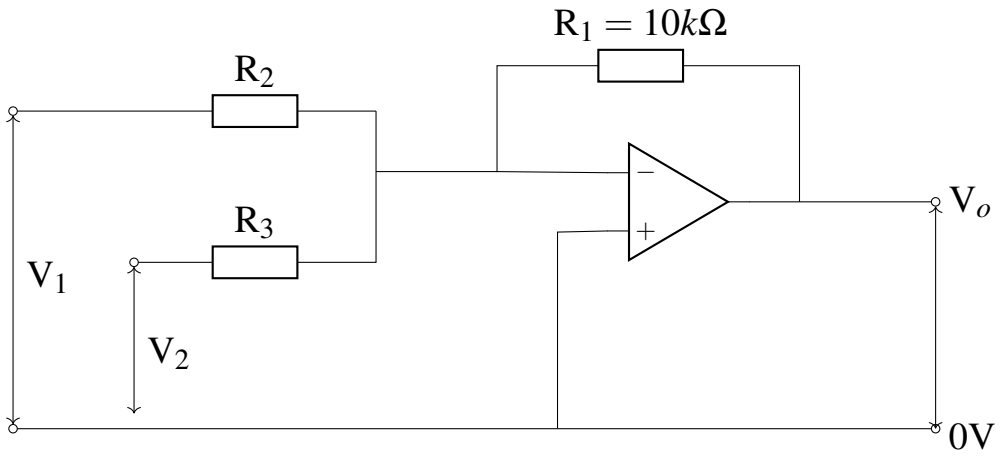

Figure 3:

(c) (i) State three factors for effective transmission of information (signals) **(01$\frac{1}{2}$ marks)**

(ii) Given the signal wave equation as $y = 10\cos(1800\pi t) + 20\cos(2000\pi t) + 10\cos(2200\pi t)$. Find the modulation index (μ) of the given signal wave and also calculate the frequencies of the modulated wave. **(04$\frac{1}{2}$ marks)**