THE UNITED REPUBLIC OF TANZANIA
NATIONAL EXAMINATIONS COUNCIL
ADVANCED CERTIFICATE OF SECONDARY EDUCATION EXAMINATIONS

131/1 **PHYSICS 1**
(For Both School and Private Candidates)

Time 3 Hours **Wednesday, 03rd May 2017 a.m.**

Instructions

1. This paper consists of **fourteen (14)** questions in sections A, B and C.

2. Answer **ten (10)** questions choosing **four (4)** questions from section A and **three (3)** questions from each of sections B and C.

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

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

5. Cellular phones are **not** allowed in the examination room.

6. Write your **Examination Number** on every page of your answer booklet(s).

7. The following information may be useful:

   (a) Acceleration due to gravity $g = 9.8 m/s^2$
   (b) Ratio of specific heat capacities, $\gamma = 1.4$
   (c) Density of water $\varrho = 1000 kg/m^3$
   (d) Mass of electron, $Me = 9.1 \times 10^{-31} kg$
   (e) Gravitation constant, $G = 6.7 \times 10^{-11} kg^{-1} m^3 s^{-2}$
   (f) Electronic charge, $e = -1.6 \times 10^{-19} C$
   (g) Pi, $\pi = 3.14$

SECTION A (40 Marks)

Answer any **four (04)** questions from this section.

1. (a) Give the meaning of the following terms as used in error analysis:
   (i) Absolute error. **(01 mark)**
   (ii) Relative error. **(01 mark)**

   (b) The force 'F' acting on an object of mass 'm', travelling at velocity 'V' in a circle of radius 'r' is given by; $F = \frac{mV^2}{r}$. If the measurements are recorded as: m =(3.5±0.1) kg, V = (20±1) m/s, r = (12.5±0.5) m; find the maximum possible
   (i) Fractional error. **(03 marks)**
   (ii) Percentage error in the measurement of force. **(02 marks)**

   (c) Show how you will record the reading of force, 'F', in part (b) **(03 marks)**

2. (a) (i) Define the term dimensions of a physical quantity. **(01 mark)**
   (ii) Identify two uses of dimensional equations. **(02 marks)**

   (b) (i) What is the basic requirement for a physical relation to be correct? **(01 mark)**
   (ii) List two quantities whose dimension is $[ML^2T^{-1}]$. **(01 mark)**

   (c) (i) The frequency 'f' of vibration of a stretched string depends on the tension 'F', the length 'l' and the mass per unit length μ of the string. Derive the formula relating the physical quantities by the method of dimensions. **(03 marks)**
   (ii) Use dimensional analysis to prove the correctness of the relation $\varrho = \frac{3g}{4RG}$, where by ϱ = density of the earth, g = acceleration due to gravity, R = radius of the earth and G = gravitational constant. **(02 marks)**

3. (a) (i) Why does the kinetic energy of an earth satellite change in the elliptical orbit? **(02 marks)**
   (ii) Give two factors which determine whether a planet has an atmosphere or not. **(02 marks)**

   (b) A spacecraft is launched from the earth to the moon. If the mass of the earth is 81 times that of the moon and the distance from the centre of the earth to that of the moon is about 4.0×10^5 km;
   (i) Draw a sketch showing how the gravitational force on the spacecraft varies during its journey. **(03 marks)**
   (ii) Calculate the distance from the centre of the earth where the resultant gravitational force becomes zero. **(03 marks)**

4. (a) (i) Justify the statement that 'If no external torque acts on a body, its angular velocity will not be conserved'. **(02 marks)**
   (ii) A car is moving with a speed of 30 ms^{-1} on a circular track of radius 500m. If its speed is increasing at the rate of $2ms^{-2}$; find its resultant linear acceleration. **(03 marks)**

(b) An object of mass 1kg is attached to the lower end of a string 1m long whose upper end is fixed and made to rotate in a horizontal circle of radius 0.6m. If the circular speed of the mass is constant, find the;

(i) Tension in the string. **(03 marks)**

(ii) Period of motion. **(02 marks)**

5. (a) A 75kg hunter fires a bullet of mass 10g with a velocity of $400ms^{-1}$ from a gun of mass 5kg. Calculate the;

(i) Recoil velocity of the gun. **(02 marks)**

(ii) Velocity acquired by the hunter during firing. **(03 marks)**

(b) A jumbo jet travelling horizontally at $50ms^{-1}$ at a height of 500m from sea level drops a luggage of food to a disaster area.

(i) At what horizontal distance from the target should the luggage be dropped? **(03 marks)**

(ii) Find the velocity of the luggage as it hit the ground. **(02 marks)**

6. (a) The equation of simple harmonic motion is given as $x = 6\sin 10\pi t + 8\cos 10\pi t$, where x is in centimeter and t in second. Determine the;

(i) Amplitude. **(03 marks)**

(ii) Initial phase of motion. **(02 marks)**

(b) (i) Show that the total energy of a body executing simple harmonic motion is independent of time. **(2.5 marks)**

(ii) Find the periodic time of a cubical body of side 0.2m and mass 0.004kg floating in water then pressed and released such that it oscillates vertically. **(2.5 marks)**

SECTION B (30 Marks)

Answer **three (03)** questions from this section.

7. (a) (i) Give a common example of adiabatic process. **(01 mark)**

(ii) What happens to the internal energy of a gas during adiabatic expansion? **(02 marks)**

(b) A mass of an ideal gas of volume $400cm^3$ at 288K expands adiabatically. If its temperature falls to 273K;

(i) Find the new volume of the gas. **(02 marks)**

(ii) Calculate the final volume of the gas if it is then compressed isothermally until the pressure returns to its original value. **(04 marks)**

8. (a) State the following according to heat exchange:

(i) Prevost's theory. **(1.5 marks)**

(ii) Wien's displacement law. **(1.5 marks)**

(b) Briefly explain why;

(i) Steam pipes are wrapped with insulating materials? **(1.5 marks)**

(ii) Stainless steel cooking pans fitted with extra copper at the bottom are more preferred? **(1.5 marks)**

(c) The value of the property X of a certain substance is given by;
$X_\theta = X_\sigma\ 0.5\theta + 2 \times 10^{-4}\theta^2$, Where θ is the temperature in degrees celsius. What would be the celsius temperature defined by the property X which corresponds to a temperature of 50°C on this gas thermometer scale? **(04 marks)**

9. (a) (i) What is the advantage of using a greater length of potentiometer wire? **(02 marks)**
(ii) Why is a Wheatstone bridge not suitable for measuring very high resistance? **(02 marks)**

(b) Study the circuit diagram in Figure 1 then answer the questions that follow:

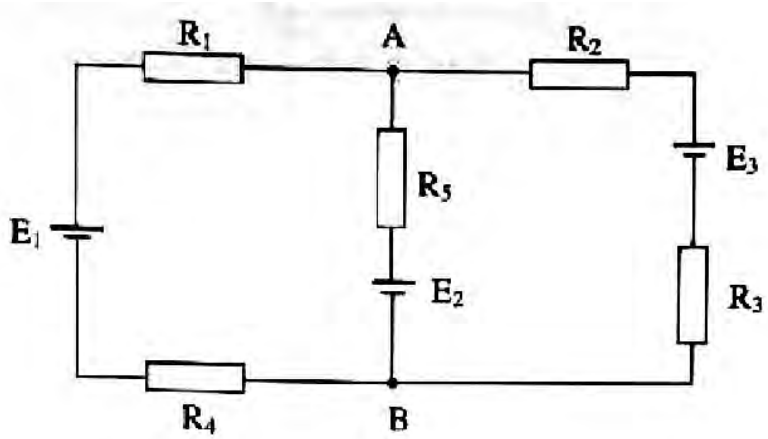


Figure 1

If the value of $R_1 = R_2 = R_3 = R_4 = 1.0\Omega$, $R_5 = 2\Omega$, $E_2 = E_3 = 4V$, $E_1 = 2.0V$, calculate the;
(i) Current flowing through the circuit. **(04 marks)**
(ii) Potential difference, V_{ab}. **(02 marks)**

10. (a) (i) List two factors on which the resistivity of a material depends. **(01 mark)**
(ii) A wire of resistivity ϱ is stretched to double its length, what will be its new resistivity? Give reason for your answer. **(1.5 marks)**

(b) (i) Why a high voltage supply should have high internal resistance? **(02 marks)**
(ii) Justify the statement that 'it is not possible to verify Ohm's law by using a filament lamp'. **(1.5 marks)**

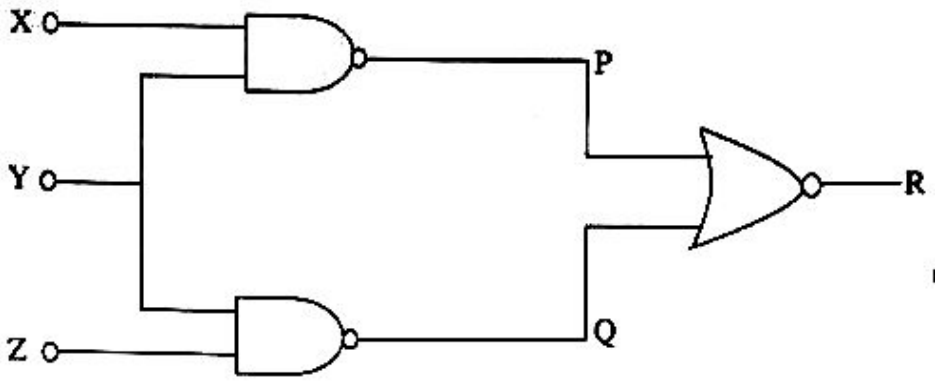
(c) A potential difference of 4V is connected to a uniform resistance wire of length 3.0m and cross-sectional area 9×10^{-9}, when a current of 0.2A is flowing in the wire. Find the;
(i) Resistivity of a wire. **(2.5 marks)**
(ii) Conductivity of a wire. **(01 mark)**

SECTION C (30 Marks)

Answer **three (03)** questions from this section.

11. (a) Briefly explain the function of the following:
    (i) Oscilloscope. **(01 mark)**
    (ii) Op-amps. **(01 mark)**

    (b) Study Figure 2 then construct a truth table showing the output P, Q and R.



(4.5 marks)

Figure 2

    (c) (i) List three basic elements of a communication system. **(1.5 mark)**
    (ii) Explain the advantage of using optical fibre systems than coaxial cable system in telecommunication processes. **(02 marks)**

12. (a) (i) Define the term semiconductor. **(01 mark)**
    (ii) Give three examples of semiconductor materials **(1.5 marks)**

    (b) (i) Outline two factors on which electrical conductivity of a pure semiconductor depends. **(02 marks)**
    (ii) How does the forbidden energy gap of an intrinsic semiconductor vary with increase in temperature? **(01 mark)**

(c) Figure 3 is a circuit diagram containing an ideal diode.

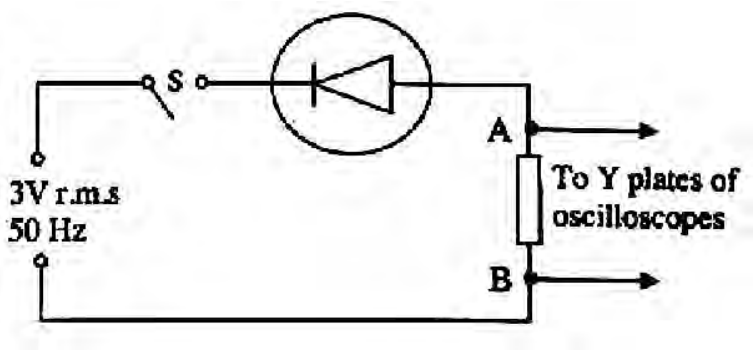


Figure 3

Calculate

(i) The peak voltage. **(2.5 marks)**

(ii) The period. **(02 marks)**

13. (a) Explain the meaning of the following terms:

(i) P-type semiconductor **(01 mark)**

(ii) N-type semiconductor **(01 mark)**

(b) (i) List three types of transistor configurations. **(03 marks)**

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

(c) A change of 100 μA in the base current produces a change of 3 mA in the collector current. Calculate:

(i) The current amplification factor, β **(1.5 marks)**

(ii) The current gain, α **(1.5 marks)**

14. (a) (i) State three sources of heat energy within the interior of the earth. **(03 marks)**

(ii) Discuss two advantages of windbreaks to plant environment. **(02 marks)**

(b) Briefly explain the major causes of the following types of environmental pollution:

(i) Water pollution. **(2.5 marks)**

(ii) Air pollution. **(2.5 marks)**