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 **Monday, 06th May 2019 P.M.**

Instructions

1. This paper consists of sections A, B and C with a total of **fourteen (14)** questions.
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 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 information may be useful:
   (a) Acceleration of free fall on the moon, $g_m = 1.67\ m/s^2$
   (b) Radius of Earth, R = 6400 km
   (c) Thermal conductivity of metal = 400 $Wm^{-1}K^{-1}$
   (d) Resistivity of gold, $\rho = 2.27 \times 10^{-8}\ \Omega m$
   (e) Stefan-Boltzmann constant, $\sigma = 5.67 \times 10^{-8}\ Wm^{-2}K^{-4}$
   (f) Acceleration due to gravity, $g = 9.8\ ms^{-2}$
   (g) Density of gold = 19300 kg m^{-3}
   (h) Pi, $\pi = 3.14$.

SECTION A (40 Marks)

Answer any **four (4)** questions from this section.

1. (a) (i) Identify two basic rules of dimensional analysis. **(02 marks)**

(ii) The frequency of n of vibration of a stretched string is a function of its tension F, the length l and mass per unit length m. Use the method of dimensions to derive the formula relating the stated physical quantities. **(03 marks)**

(b) (i) What causes systematic errors in an experiment? Give four points. **(02 marks)**

(ii) Estimate the numerical value of drag force $D = \frac{1}{2} C\rho AV^2$ with its associated error given that the measurements of the quantities C, A, ρ and V were recorded as (10 ± 0.00) unit less, (5 ± 0.2) cm^2, (15 ± 0.15) g/cm^3 and (3 ± 0.5) cm/sec^2 respectively. **(03 marks)**

2. (a) A rocket of mass 20 kg has 180 kg of fuel. If the exhaust velocity of the fuel is 1.6 km/sec, calculate:

(i) The minimum rate of fuel consumption that enable the rocket to rise from the ground. **(02 marks)**

(ii) The ultimate vertical speed gained by the rocket when the rate of fuel consumption is 2 kg/sec. **(03 marks)**

(b) (i) Determine the least number of pieces required to stop the bullet if a rifle bullet loses 1/20 of its velocity when passing through them. **(03 marks)**

(ii) A man of 100 kg jumps into a swimming pool from a height of 5 m. If it takes 0.4 seconds for the water in a pool to reduce its velocity to zero, what average force did the water exert on the man? **(02 marks)**

3. (a) (i) Justify the statement that projectile motion is two dimensional motion. **(02 marks)**

(ii) A rocket was launched with a velocity of 50 m/s from the surface of the moon at an angle of 40° to the horizontal. Calculate the horizontal distance covered after half time of flight. **(03 marks)**

(b) (i) Show that the angle of projection $\theta°$ for a projectile launched from the origin is given by $\theta° = \tan^{-1}(4h_m/R)$, where R stands for horizontal range and h_m is the maximum vertical height. **(03 marks)**

(ii) A person weighing 50 kg stands on a platform which oscillates with a frequency of 2 Hz and of amplitude 0.05 m. Find his/her minimum weight as recorded by a machine of the platform. **(03 marks)**

4. (a) (i) Provide two typical examples of simple harmonic motion (S.H.M.). **(02 marks)**

(ii) Why the velocity and acceleration of a body executing simple harmonic motion are out of phase? **(02 marks)**

(b) (i) The period of a particle executing simple harmonic motion (S.H.M.) is 3 seconds. If its amplitude is 25 cm, calculate the time taken by the particle to move a distance of 12.5 cm on either side from the mean position. **(03 marks)**

(ii) A person weighing 50 kg stands on a platform which oscillates with a frequency of 2 Hz and of amplitude 0.05 m. Find his/her minimum weight as recorded by a machine of the platform. **(03 marks)**

5. (a) (i) In which aspect does circular motion differ from linear motion? **(02 marks)**
(ii) Why there must be a force acting on a particle moving with uniform speed in a circular path? **(02 marks)**

(b) (i) Figure 1 shows a particle moving in a semi-circular path AB of radius 6 m with constant speed of 12 ms^{-1}. Calculate its average velocity. **(03 marks)**

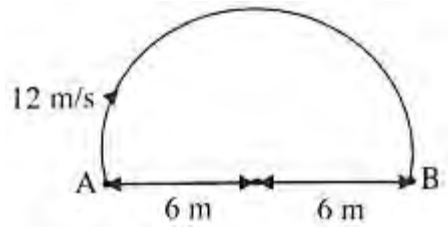


Figure 1

(ii) A stone tied to the end of string 80 cm long, is whirled in a horizontal circle with a constant speed making 25 revolutions in 14 seconds. Determine the magnitude of its acceleration. **(03 marks)**

6. (a) (i) Why the weight of a body becomes zero at the centre of the earth? **(02 marks)**
(ii) How far above the earth surface does the value of acceleration due to gravity becomes 36% of its value on the surface? **(02 marks)**

(b) (i) Compute the period of revolution of a satellite revolving in a circular orbit at a height of 3400 km above the earth's surface. **(03 marks)**
(ii) Prove that the angular momentum for a satellite of mass M_s revolving round the earth of mass M_e in an orbit of radius r is equal to $(GM_eM_s^2r)^{½}$. **(03 marks)**

SECTION B (30 Marks)

Answer **three (3)** questions from this section.

7. (a) (i) Why water is preferred as a cooling agent in many automobile engines? **(02 marks)**
(ii) A thermometer has wrong calibration as it reads the melting point of ice as -10°C. If it reads 40°C in a place where the temperature reads 30°C; determine the boiling point of water on this scale. **(03 marks)**

(b) (i) Analyse three practical applications of thermal expansion of solids in daily life situations. **(03 marks)**
(ii) A closed metal vessel containing water at 75°C, has a surface area of 0.5 m^2 and uniform thickness of 4.0 mm. If its outside temperature is 15°C, calculate the heat loss per minute by conduction. **(02 marks)**

8. (a) (i) Sketch the graph to illustrate how the energy radiated by a black body is distributed among various wavelengths. **(02 marks)**

(ii) What information would be drawn from the graph in 8 (a) (i)? Give three points. **(03 marks)**

(b) (i) Why stainless steel cooking pans are made with extra copper at the bottom? **(02 marks)**

(ii) At what temperature will the filament of a 10 W lamp operate if it is supposed to be a perfectly black body of area 1 cm^2? **(03 marks)**

9. (a) (i) Elaborate three significance of dielectric material in a capacitor. **(03 marks)**

(ii) Give the reason behind a loss of electrical energy when two capacitors are joined either in series or parallel. **(02 marks)**

(b) (i) A researcher has 2 g of gold and wishes to form it into a wire having a resistance of 80 Ω at 0°C. How long should the wire be? **(03 marks)**

(ii) What is the potential difference between two points if 5 Joules of work are required to move 10 Coulombs from one point to another? **(02 marks)**

10. (a) (i) Why does a room light turn on at once when the switch is closed? Give comment. **(02 marks)**

(ii) A current of 3.0 mA flows in a Television resistor R when a potential difference of 6.0 V is connected across its terminals. Determine the value of conductance. **(02 marks)**

(b) The circuit diagram in Figure 2 contains a capacitor, resistors and three cells of negligible internal resistance.

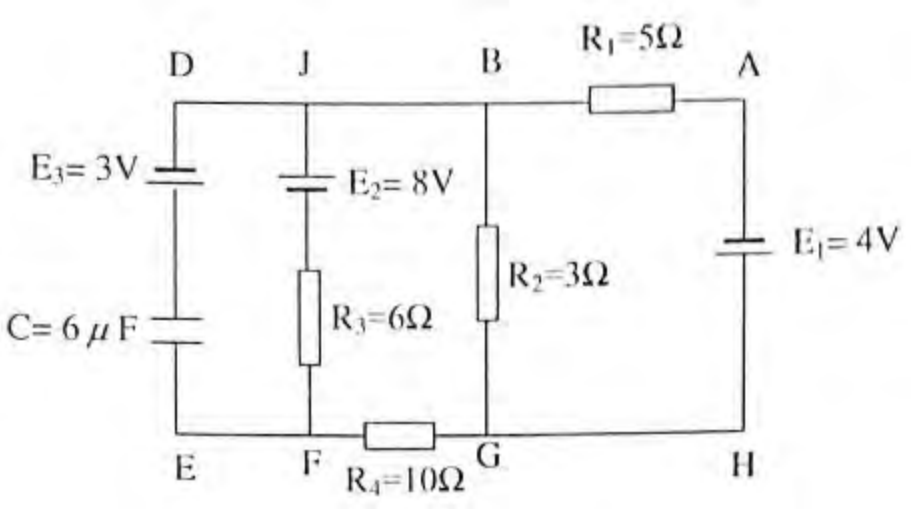


Figure 2

Compute:

(i) The current passing through 3 Ω resistor. **(04 marks)**

(ii) The charge on the capacitor. **(02 marks)**

SECTION C (30 Marks)

Answer any **three (3)** questions from this Section.

11. (a) (i) Why transistors can not be used as rectifiers? **(02 marks)**

(ii) In NPN transistor circuit the collector current is 5 mA. If 95% of the emitted electrons reach the collector region, calculate the base current. **(03 marks)**

(b) (i) What causes damage to transistors? **(02 marks)**

(ii) Construct the truth table for the circuit diagram shown in Figure 3. **(03 marks)**

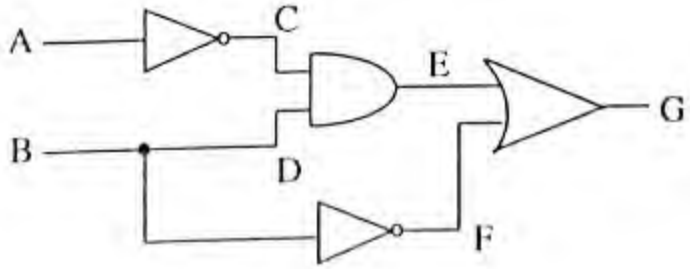


Figure 3

12. (a) (i) Distinguish between inverting OP-AMP and non-inverting OP-AMP. **(02 marks)**

(ii) Give one application of each type of OP-AMP described in part (i). **(02 marks)**

(b) Figure 4 shows the diagram of a non-inverting amplifier with input and output voltages.

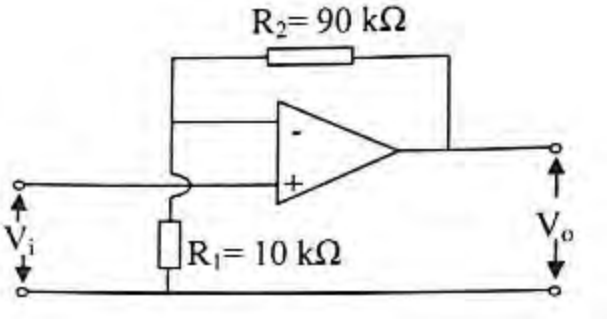


Figure 4

(i) Determine the closed loop voltage gain, G_{ain} of the amplifier given that; $G_{ain} = 1 + R_2 / R_1$. **(02 marks)**

(ii) Use Figure 4 to show how the given expression in 12 (b) (i) is derived. **(04 marks)**

13. (a) (i) Identify three basic elements of a communication system. **(03 marks)**

(ii) Why sky waves are not used for transmission of TV signals? **(02 marks)**

(b) Figure 5 shows the essential components of a transmitter for radio broadcasting.

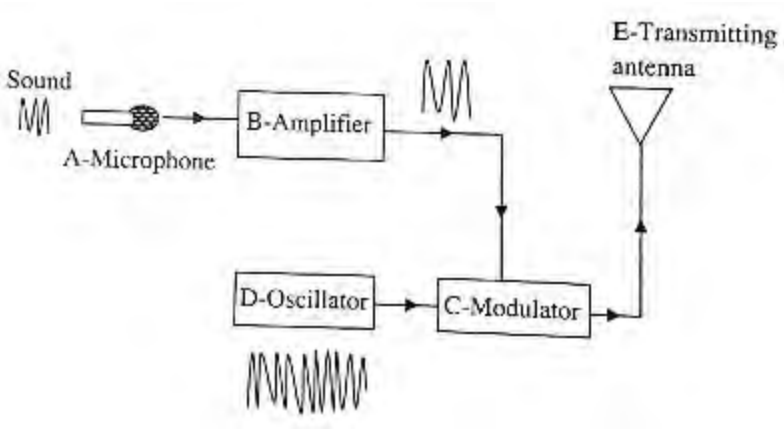


Figure 5

What role does each of the components labelled A, B, C, D and E play to facilitate the communication system? **(05 marks)**

14. (a) (i) What is meant by epicentre and wind belt as used in Geophysics? **(02 marks)**
(ii) Give two positive effects of wind on plant growth. **(02 marks)**

(b) (i) Identify three types of seismic waves **(03 marks)**
(ii) Outline two characteristics of each type of wave described in 14 (b) (i). **(03 marks)**