

**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, $g_m = 1.67 \text{ m/s}^2$
 - (b) Radius of the earth, $R = 6400 \text{ km}$
 - (c) Thermal conductivity of metal $= 400 \text{ W m}^{-1}\text{K}^{-1}$.
 - (d) Resistivity of gold, $\rho = 2.27 \times 10^{-8} \Omega \text{ m}$
 - (e) Stefan-Boltzmann constant, $\sigma = 5.67 \times 10^{-8} \text{ W m}^{-2}\text{K}^{-4}$
 - (f) Acceleration due to gravity, $g = 9.8 \text{ m s}^{-2}$
 - (g) Density of gold $= 19300 \text{ kg m}^{-3}$
 - (h) Pie, $\pi = 3.14$.



SECTION A (40 Marks)

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

1. (a) (i) Identify two basic rules of dimensional analysis. (02 marks)
(ii) The frequency 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 $D = \frac{1}{2} C \rho A V^2$ with its associated error given that the measurements of the quantities C , A , ρ and V were recorded as (10 ± 0.00) unit less, $(5 \pm 0.2) \text{ cm}^2$, $(15 \pm 0.15) \text{ g/cm}^3$ and $(3 \pm 0.5) \text{ cm/sec}^2$ 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 $\frac{1}{20}$ 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 θ^0 for a projectile launched from the origin is given by $\theta^0 = \tan^{-1}\left(\frac{4h_m}{R}\right)$, where R stand for horizontal range and h_m is the maximum vertical height. (02 marks)

- (ii) Determine the angle of projection for which the horizontal range of a projectile is $4\sqrt{3}$ times its maximum height. (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)

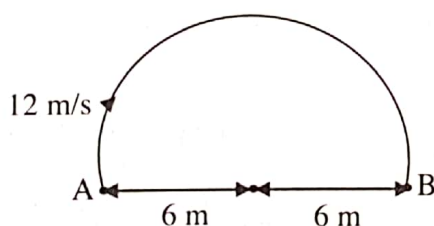


Figure 1

- (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 $(GM_e M_s^2 r)^{\frac{1}{2}}$. (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 illustrates 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 $80\ \Omega$ 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.

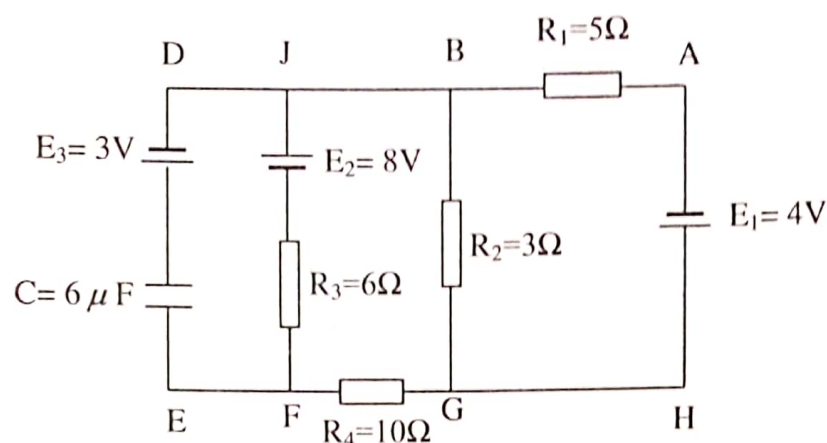


Figure 2

Compute;

- (i) The current passing through $3\ \Omega$ resistor.
- (ii) The charge on the capacitor.

(04 marks)

(02 marks)

SECTION C (30 Marks)

Answer **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)

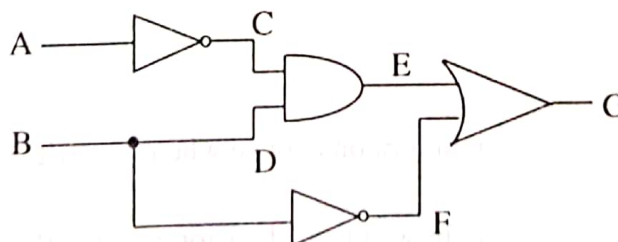


Figure 3

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). (02marks)

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

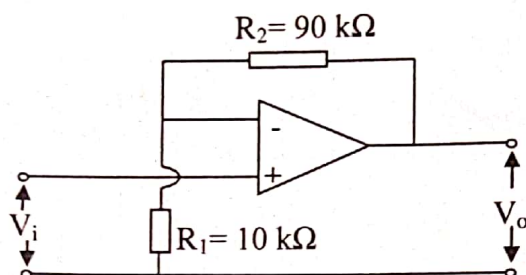


Figure 4

- (i) Determine the closed loop voltage gain, G_{ain} of the amplifier given that;

$$G_{ain} = 1 + \frac{R_2}{R_1} \quad (02 \text{ marks})$$

- (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.

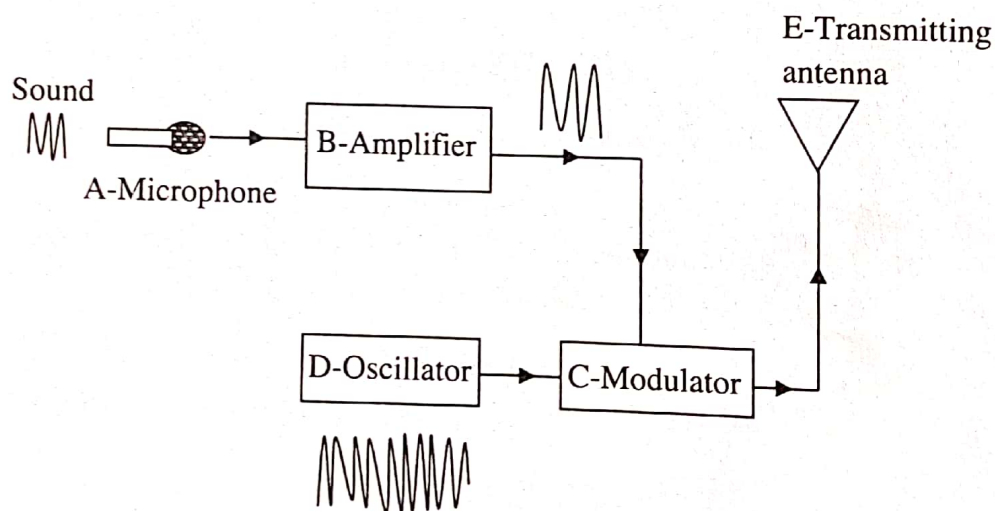


Figure 5

What role does each of the component 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)