Republic Rwanda

Ministry of education

Eastern province

Kirehe District

Exam: PHYSICS II
Maximum: 100 MARKS
Class: SENIOR FIVE
Date: 14/03/2024
Duration: 3hours

SECOND TERM PHYSICS EXAMINATION /2023-2024

INSTRUCTION TO CANDIDATES:

-The test is composed of two sections A and B

-Attempt ALL questions for section A and any THREE for section B

COMBINATIONS:

PHYSICS-CHEMISTRY-MATHEMATICS (PCM)

MATHEMATICS- PHYSICS- COMPUTER SCIENCE (MPC)

PHYSICS –CHEMISTRY- BIOLOGY (PCB)

MATHEMATICS –PHYSICS- GEOGRAPHY (MPG)

PHYSICS-ECONOMICS-MATHEMATICS (PEM)

Useful constants: -Speed of light in vacuum: $c = 3\times10^{8} m/s$

-Planck's constant: $h = 6.63\times10^{-34} J.s$

-Relative permittivity in vacuum: $\varepsilon_r = 1$

-Absolute permittivity in vacuum: $\varepsilon_o = 8.85\times10^{-12} C^2 N^{-1} m^{-2}$

-Charge of electron: $e = 1.6\times10^{-19} C$

SECTION A: Choose the best answer from question 1 to question 8 (55 marks)

1. The sum of the currents into a junction equals the sum of the currents out of the junction, is a consequence of: **(2 marks)**
   A. Newton's third law
   B. Ohm's law
   C. Newton's second law
   D. conservation of energy
   E. conservation of charge

2. In a photoelectric effect experiment the stopping potential is: **(2 marks)**
   A. the energy required to remove an electron from the sample
   B. the kinetic energy of the most energetic electron ejected
   C. the potential energy of the most energetic electron ejected
   D. the photon energy
   E. the electric potential that causes the electron current to vanish

3. Chose the letter corresponding to the correct

a) A simple potentiometer is a device used for taking number of electrical measurements. It is used for : **(2 marks)**
   i. Finding current in the circuit only.
   ii. Making comparison of e.m.f , measurement of internal resistance and measurement of current.
   iii. Calculation of potential difference.
   iv. All are correct.
   v. None is correct.

4. The sound wave is: **(2 marks)**
   i. Electromagnetic wave
   ii. Mechanical wave
   iii. Sinusoidal wave
   iv. ii and iii are correct

5. Nuclear energy is produced from: **(2 marks)**
   i. Uranium 238
   ii. Plutonium 239
   iii. Barium 142
   iv. Uranium 235

6. Complex electric circuits are solved by using: **(2 marks)**
   i. Kirchhoff's laws
   ii. Potentiometer
   iii. Ammeter
   iv. Voltmeter

7. The antinodes are points of maximum displacement for a standing wave . If λ is the wavelength and x is horizontal displacement. Antinodes are obtained when: **(2 marks)**

i. The horizontal displacement x of waves are odd quarter values of wavelength
ii. The frequency is maximum and the amplitude is zero
iii. The horizontal displacement x is a half value of wavelength.
iv. None is correct

8. Fossil fuels are stored in heaps with concrete floor in order to: **(2 marks)**
   i. Reduce humidity
   ii. Allow well transportation
   iii. Prevent flow of air from bottom
   iv. Prevent washing of coal

9. Use your understanding of equivalent resistance to complete the following statements:
   a) Two 3Ω resistors placed in series would provide a resistance which is equivalent to one ___ Ω resistor **(3 marks)**
   b) three resistors with resistance values of 2Ω, 3Ω, and6Ω are placed in parallel. These would provide a resistance which is equivalent to one ___ Ω resistor. **(3 marks)**
   c) As more and more resistors are added in parallel to a circuit, the equivalent resistance of the circuit _____ (**increases, decreases**) and the total current of the circuit _____ (**increases, decreases**).**(3 marks)**

10. A wire of length 400 mm and mass 1.2×10^{-3} kg is under a tension of 120N. What is
   a) the fundamental frequency of vibration? **(3 marks)**
   b) the frequency of the third harmonic? **(3 Marks)**

11.
   a) What is meant by electromotive force? **(3 Marks)**
   b) battery has an emf of 12.0 V and an internal resistance of 0.05 Ω. Its terminals are connected to a load resistance of 3.00 Ω. Find the current in the circuit and the terminal voltage of the battery. **(2 Marks)**

12.
   a) Explain photoelectric effect **(2 Marks)**
   b) The laser in a compact disc player. It uses light with a wavelength of 7.8×10^{2} nm. Calculate the energy of a single photon of this light. Where the Planck's constant h =6.63×10−34J.s , (The speed of light is 3×108m/s) **(3 Marks)**

13.
   a) Enumerate four factors affecting the periodic time of the simple pendulum? **(2 Marks)**
   b) What happens to the period of a simple pendulum if the pendulum's length is doubled **(2 Marks)**
   c) What happens to the period if the mass of the suspended bob is doubled? **(1 Marks)**

14. A vertical spring fixed at one end has a mass of 2 kg attached at the other end. The spring constant k = 5 N/ mm. Calculate
   a) The spring extension **(2 Marks)**
   b) the elastic energy in the spring **(2 Marks)**

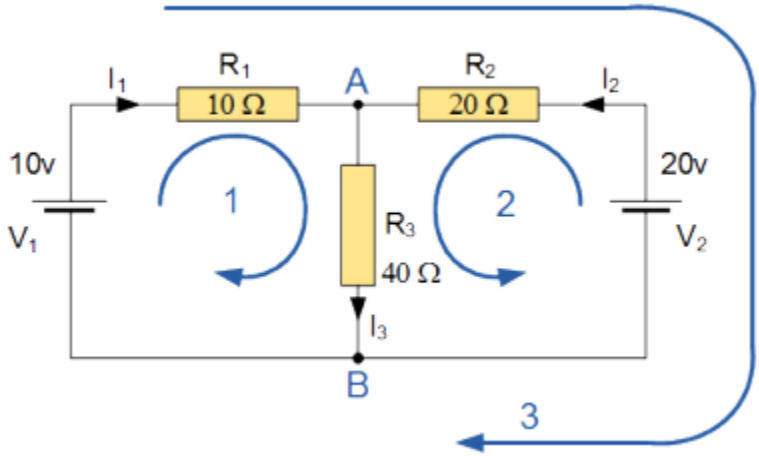
15. a) Distinguish between controlled and uncontrolled nuclear fission. **(2 Marks)**

b) Show safety issues and risks associated with nuclear power plant. **(3 Marks)**

c) what are advantages and disadvantages of using fossil fuels? **(2 Marks)**

SECTION B: ATTEMPT ONLY THREE QUESTIONS (45 marks)

16. The diagram below shows electric circuit where I_1, I_2 and I_3 are electrical currents passing through a branches of a circuit.



a) State Kirchhoff's rules **(4 marks)**

b) If R_1, R_2, and R_3, V_1 and V_2 are respective resistors and voltages in the circuit. Find values I_1, I_2 and I_3. **(8 marks)**

c) Calculate the potential difference between A and B **(3 marks)**

17. The equation of transverse simple harmonic progressive wave is

$$y = 3sin2\pi(\frac{t}{0.04} - \frac{x}{40})$$

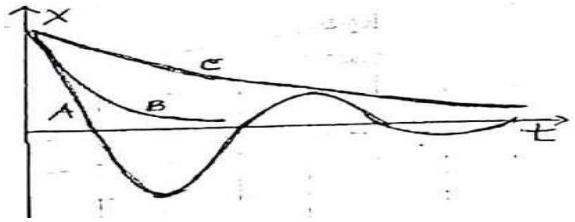
where the length is expressed in cm and time in seconds. Calculate

a) amplitude **(2 marks)**
b) wavelength **(2 marks)**
c) time period **(2 marks)**
d) frequency **(2 marks)**
e) angular frequency **(2 marks)**
f) angular wave number **(2 marks)**
g) the speed wave. **(3 marks)**

18. You are provided with four resistors R1, R 2, R3, R4 characterized by the resistances 2.O Ω , 3.O Ω, 6.0 Ω, 11.0 Ω respectively and a battery of electromotive force E=12.00 V. Assume that the internal resistance of the battery is negligible.

a) use the above electric components to design a labelled electric circuit comprising the battery such that the resistors R1, R2, R3 are connected in parallel and the resistor R4 is connected in series with the battery and in series with the parallel resistor network. **(5 marks)**The switch is closed.
b) Determine the total current flowing through the designed circuit. **(2 marks)**
c) Find the voltage across each resistor. **(4 marks)**
d) compute the electric current flowing in each resistor. **(4 marks)**

19. a) Examine figure below related to the graph lines A, B and C of damped oscillations and answer the questions that follow: **(5 marks)**



i) Identify the graph line showing the critical damped oscillation.
ii) What is the main cause of damped oscillations?
Iii) Name any one characteristic of damped oscillations.

b) A 0.5kg object attached to a spring with a force constant of 8N/m vibrates in simple harmonic motion with an amplitude of 10cm. Calculate
   i. the maximum value of its speed and acceleration,
   ii. the speed and acceleration when the object is 6cm from the equilibrium position. **(10marks)**

20. (i) A string has mass of3.0g and length 30cm what must be the tension so that vibrating transversally if its first overtone has a frequency of 200Hz **(4marks)**

(ii) A string vibrates at fundamental frequency of 30Hz the two fixed ends are at a distance of 60cm calculate the tension in the string if the mass of the string is 30g **(3marks)**

(iii)A string vibrates at the frequency 240Hz presents nodes and anti-nodes the distance between first nodes and the 5^{th} node is 40cm find the celerity of vibration **(3marks)**