SUBJECT: **PHYSICS THEORY**	**KARONGI DISTRICT**
CLASS: **SENIOR 5**	ACADEMIC YEAR: **2023-2024**
11/03/2024 08.30AM – 11.30AM	**SECOND TERM EXAMINATION**

COMBINATIONS:

- PHYSICS-CHEMISTRY-MATHEMATICS (PCM)
- PHYSICS-CHEMISTRY-BIOLOGY (PCB)
- MATHEMATICS-PHYSICS-GEOGRAPHY (MPG)
- MATHEMATICS-PHYSICS-COMPUTER SCIENCE (MPC)

INSTRUCTIONS

- This paper consists of two sections:
  SECTION A: **Attempt all questions (70marks)**
  SECTION B: **Attempt only three (3) questions of your choice (30marks)**
- **Non programmable** scientific calculators and mathematical sets may be used where appropriate
- Use only a **blue** or **black pen**

ADVICE

- Read every question carefully before you start to answer it.
- Try to answer every question as instructed.
- Check your answers if you have time at the end.
- Look at the marks as a guide to how much time to spend on each question.

USEFUL CONSTANTS:

Magnitude of the electronic charge = 1.6×10^{-19}C

Mass of electron = 9.1×10^{-31}kg

Speed of light in vacuum/air, c=3×10^{8}m/s

Permittivity of free space/air, $\varepsilon_o = 8.85 \times 10^{-12}$ C^2/Nm^2

Planck' s constant, h=6.63×10^{-34}J.s

Acceleration due to gravity, g= 9.81 m.s^{-2}

SECTION A: Compulsory Questions: Answer all questions (70marks)

1.Choose the letter that corresponds to the best statement about Planck's quantum theory: **(2marks)**

(a) Planck's quantum theory states that energy can neither be created nor be destroyed, it transforms itself into another form of energy.

(b) Planck's quantum theory states that energy is emitted or absorbed in discrete packets or "quanta" rather than continuously.

(c) Planck's quantum theory states that the light always follows its path on a straight line.

2. Fill in the blanks: When the frequency of excitatory is the same as that of resonator, then the process is called ……. This phenomenon is the quickly increasing of amplitude when the frequency of exciting force approaches the frequency of free……. **(2marks)**

3. Match the terms with their corresponding definitions: **(2marks)**

Terms	*Definitions*
(a)Frequency	(i)It is the time for one cycle to occur.
(b)Amplitude	(ii)It is the number of wavelengths that pass a point in space per second.
(c)Period	(iii)It is the power radiated by a source which is proportional to the square of the amplitude.
(d)Intensity	(iv)It is the maximum displacement measured from equilibrium or mean position.

4. Define fossil fuel and give at least two examples of it. **(3marks)**

5. Answer TRUE or FALSE: **(3marks)**

(a)The universal law of gravitation is an inverse square law.

(b)The gravitation force is always attractive.

(c)Gravity is the mysterious force that makes everything fall down towards the Earth.

6.In the list below, select a common laboratory instrument that provides accurate time and amplitude measurements of voltage signals over a wide range of frequencies: **(3marks)**

(a) Ammeter

(b)Rheostat

(c)Oscilloscope

(d)Stopwatch

7.Discuss how simple harmonic motion is used in real life. Use examples to explain. **(4marks)**

8.Explain the properties of waves. **(5marks)**

9.Illustrate the working principle of a simple potentiometer circuit. **(5marks)**

10.Compare the Coulomb's law and the Newton's universal law of gravitation. **(6marks)**

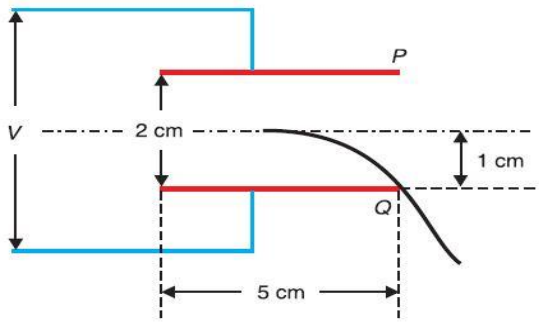
11.The laser in a compact disc player uses light with a wavelength of 7.8×10^{2}nm. Calculate the energy of a single photon of this light. **(6marks)**

12. (a)Distinguish 3types of damped oscillations. **(3marks)**

(b)(i)Analyze the equation $\ddot{x} + 4\dot{x} + 3x = 0$ to determine the damping constant δ and the angular frequency ω_0 of the damped oscillation. **(2marks)**

(ii) Which type of damped oscillations does the equation above represent? **(1mark)**

13. A beam of electrons moving with velocity $1x10^{7}$m/s enters mid-way between two horizontal parallel plates P and Q in a direction parallel to the plates as shown on *Fig.4*. P and Q are 5cm long and 2cm apart, and have a potential difference V applied between them



Calculate V if the beam is deflected so that it just grazes the edge of the lower plate Q. (Assume $\frac{e}{m}$ $=1.8\times10^{11}$ C/kg. **(7marks)**

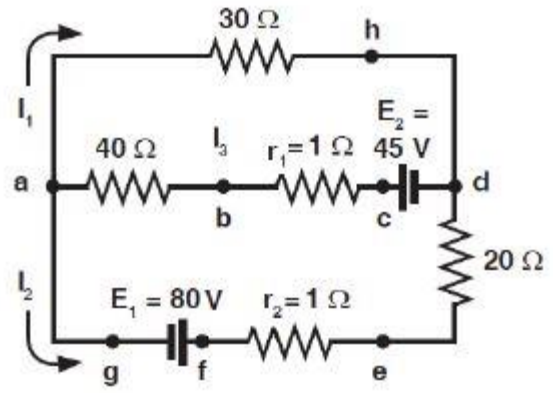
14. Einstein suggested that the energy of the incident radiation hf was partly used to free electrons from the binding forces on the metal and the rest of the energy appeared as kinetic energy of the emitted electrons. His famous equation is $hf = Wo + KEmax$.

Apply this Einstein's photoelectric equation to fill the following table. **(7marks)**

Metal	Work function, Wo/eV	Work function, Wo/Joule	Frequency used, f/Hz	Maximum K.E of ejected electrons, $KEmax$/Joule
Potassium		3.68×10^{-19}		0.32×10^{-19}
Lithium	2.9		1×10^{15}	
Aluminium	4.1		104×10^{15}	0.35×10^{-19}
Zinc	4.3			1.12×10^{-19}

15. (a)Give the statements of Kirchoff' s laws for complex circuits. **(4marks)**

(b)Analyze the circuit below to calculate the currents I_1, I_2 and I_3 in the three branches of it. **(5marks)**

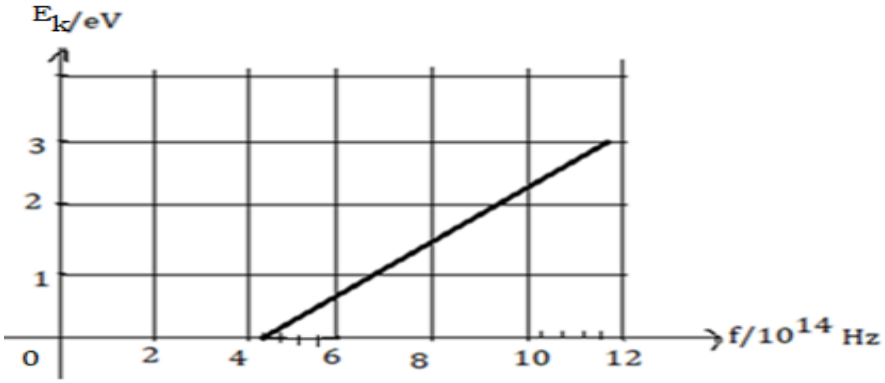


SECTION B: Attempt any three questions of your choice (30marks)

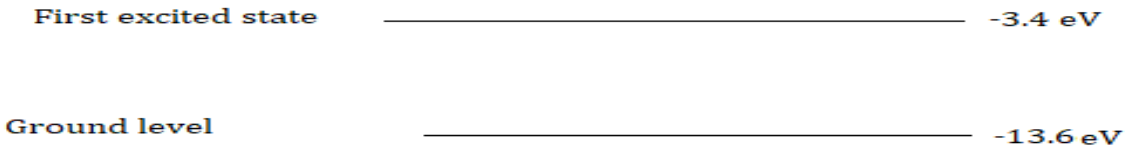
16.(a)State: (i) Any two factors affecting photoelectric emission. **(2marks)**

(ii)Any two postulates of Planck's quantum theory. **(2marks)**

(b)Analyze the figure below to find the threshold frequency and the work function of the metal in Joules (J). **(3marks)**



c) The lowest energy of a hydrogen atom is shown in figure below



Determine the energy of level n=3 (second excited state) of the hydrogen atom

($E_n = \frac{-13.6eV}{n^2}$) **(3marks)**

17. Given the Potential energy to be $P.E = ½m\omega^2x^2$ and Kinetic energy to be $K.E = ½mv^2$ where m is the mass, ω the angular speed, v the velocity, $x = Asin(\omega t + \varphi)$the displacement , t the time and φ the initial phase angle; Prove that the total mechanical energy of the oscillating system E is conserved. **(10marks)**

18. (a)State and explain Kepler' s laws of planetary motion. **(6marks)**

(b) The distance of a planet from the sun is 5times the distance between the earth and the sun. What is the time period of revolution of the planet? **(2marks)**

(c)Use Newton's universal law of gravitation and the centripetal force to justify Kepler' s third law of planetary motion. **(2marks)**

19.Formulate how the concept of wave-particle duality of light challenges our traditional understanding of the behavior of light, and support it with real life evidences? **(10marks)**

20.Compose an essay on fossil fuels describing how they can be used to produce an electrical power. **(10marks)**

END