REPUBLIC OF RWANDA

GATSIBO DISTRICT

END OF THE SECOND TERM EXAMINATION MARCH 2024

SUBJECT:PHYSICS

DATE: ..../03/2024

CLASS: SENIOR SIX (S6)

DURATION: 3 hours

MAX: 100 MARKS

COMBINATIONS

- **MATHEMATIC-PHYSICS-GEOGRAPHY. (MPG)**
- **MATHEMATICS-PHYSICS-COMPUTER SCIENCE. (MPC)**
- **PHYSICS-CHEMISTRY-BIOLOGY. (PCB)**
- **PHYSICS-CHEMISTRY-MATHEMATICS. (PCM)**
- **PHYSICS-ECONOMICS-MATHEMATICS. (PEM)**

INSTRUCTIONS:

1. This paper consists of **two** sections: **A** and **B**.
   Section A: attempt all questions **(70 marks)**
   Section B: attempt only **three** questions. **(30 marks)**
2. Non- programmable scientific calculators and mathematical sets may be used.

Section A: attempt all questions **(70 marks)**

1) The correct statement about sound waves is that: **(1 mark)**
a. They are transverse waves
b. They can be polarized
c. They require material medium to propagate

2) a) By what factor would you have to multiply the tension in a stretched string in order to double the wave velocity? **(2 marks)**
b) A guitar string has a length of 64.5 cm, and a fundamental frequency of 110 Hz. What is the velocity of the waves on this string? **(2 marks)**

3) What do you understand by the following terms?
a) Climate change as applied in physics **(2 marks)**
b) Greenhouse Effect **(2 marks)**

4) Complete the chart below. If the left column is blank, give the correct term. If the right column is blank, give an example of economic activities taking place in the corresponding layer if possible. **(4 marks)**

Term	**An example of economic activities taking place in the corresponding layer if available.**
	Agricultural activities
Stratosphere	
	Most meteors burn up in there
Thermosphere	

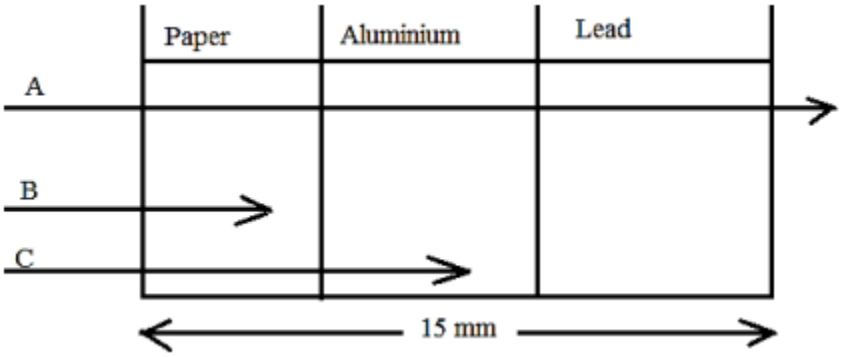
5) A) What is Mechanical weathering? **(2 marks)**
b) Explain why the temperature change is the cause of Mechanical weathering. **(2 marks)**

6) a) What is earthquake? **(2 marks)**
b) Distinguish landslide to the erosion. **(4marks)**
c) i) State two effects of erosion in Rwanda **(2 marks)**
ii) What can you do to minimize the dangers that may be caused by erosion at home. **(2 marks)**

7) Fill in the missing particle or nucleus.

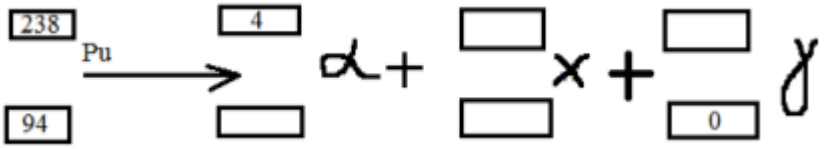
a) ${}^{45}_{20}Ca \rightarrow ? + e^{-} + \overline{\nu}_e$ **(1mark)**
b) ${}^{58}_{29}Cu \rightarrow ? + \gamma$ **(1mark)**
c) ${}^{46}_{24}Cr \rightarrow {}^{46}_{23}V + ?$ **(1mark)**
d) ${}^{234}_{94}Pu \rightarrow ? + \alpha$ **(1mark)**
e) ${}^{239}_{93}Np \rightarrow {}^{239}_{94}Pu + ?$ **(1mark)**

8) A) The following arrows (figure) show how far different types of nuclear radiations penetrates different materials. Identify the radiations A, B and C **(3 marks)**



b) When plutonium-238 decays, it emits an alpha and a gamma particle

i) Complete the decay equation below for plutonium-238 **(2 marks)**



ii) Identify the element X **(1 mark)**

c) The mass of proton is 1.007825 a.m.u and the mass of a neutron is equal to 1.008665 a.m.u. The mass of $^{14}_{6}c$ is 14.003242 a.m.u and 1 amu= 931.5 MeV/c^2

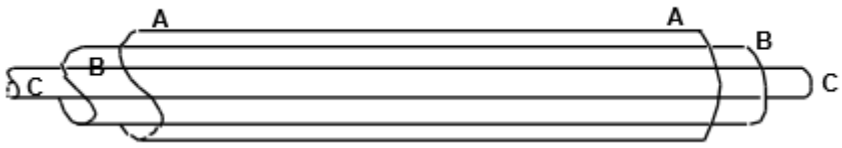
find the:

i) mass defect of $^{14}_{6}C$ **(2 marks)**

ii) The binding energy of $^{14}_{6}C$ **(1 mark)**

iii) The binding energy per nucleon of $^{14}_{6}C$ **(1 mark)**

9) This is a cross-section of an optical fibre:-



The materials used are:-

POLY METHYL METHACRYLATE of refractive index 1.59

POLYTHENE which is opaque

FLUORINATED POLYMER of refractive index 1.35

a) What letter is used for each of these materials in the diagram above? (***3marks)***

b) explain the function of each materials (***6marks)***

10) State two advantages of FM over AM. **(2 marks)**

11) a) What is meant by telecommunication system? **(2 marks)**
b) List two elements of telecommunication system **(2 marks)**

12) The charges of up, down and strange quarks are

$$up = +\frac{2}{3}e \; down = -\frac{1}{3}e \; strange = -\frac{1}{3}e$$

respectively where e is absolute value of the electron's charge. How many quarks make up a proton? Justify your answer. **(2 marks)**

13) lighter 'middle-weight' particles called mesons can be made from pairs of quarks. But they have to be made from a special combination: a quark and an antiquark. There are now four particles to play with: Up quark u: charge +2/3 e, Down quark d: charge –1/3 e, Antiupquark $\bar{u}$: charge –2/3 e. Antidown quark $\bar{d}$: charge + 1/3 e.

a) What is the charge on the combination $d\bar{d}$? **(1 mark)**
b) What is the charge on the combination $u\bar{d}$? **(1 mark)**

14) a) The process in which a particle and antiparticle unite annihilate each other and produce one or more photons is called…… **(1 marks)**
b) What happens when matter and antimatter collide? **(2 marks)**
c) Compare matter and antimatter **(3 marks)**

15) using the bellow table of quarks and their properties, respond to the bellow table

Quarks							
Name	Symbol	Charge Q	Baryon number B	Strangeness S	Charm c	Bottomnes b	TopnessT
Up	U	$+\frac{2}{3}e$	$\frac{1}{3}$	0	0	0	0
Down	D	$-\frac{1}{3}e$	$\frac{1}{3}$	0	0	0	0
Strange	S	$-\frac{1}{3}e$	$\frac{1}{3}$	-1	0	0	0
Charmed	C	$+\frac{2}{3}e$	$\frac{1}{3}$	0	$+1$	0	0
Bottom	B	$-\frac{1}{3}e$	$\frac{1}{3}$	0	0	-1	0
Top	T	$+\frac{2}{3}e$	$\frac{1}{3}$	0	0	0	$+1$

Relatively massive particles like the proton and neutron are made of combinations of three quarks.

i. What is the charge on the combination uuu? **(1 mark)**
ii. What is the charge on the combination uud? **(1 mark)**
iii. What is the charge on the combination udd? **(1mark)**
iv. What is the charge on the combination ddd? **(1 mark)**

SECTION B: Attempt only three questions (30 marks)

16) Read the following passage and answer the accompanying questions. Nature is the source of life. We human beings are a part of nature, and our quality of life depends on all the living things that share this planet with us. We must take care of nature because our well-being depends on it. Nature is always moving and changing. This happens in different ways, for instance through natural phenomena the government manages people's lives in a hazardous place by learning how to prevent disasters that occur quite regularly. Some are natural while others are caused by human beings. Discuss as full as you can the impact of hazards natural and that caused by humans on the environment. **(10 marks)**

17) Discuss the impact of floods on human activities and suggest ways of minimizing their negative impact. **(10 marks)**

18) a) What is meant by **(3marks)**

i) half life of a radioactive decay?

ii) Nuclear fission

iii) Nuclear fusion

b) An atom of ^{222}Ra emits an α particle of energy $5.3MeV$ .Given that the half time of ^{222}Ra is 3.8days, use the decay law, $N = N_0 e^{-\lambda . t}$ to calculate: **2marks**

decay constant

c) Give three differences between alpha and beta particles? **(3 marks)**

d) The nucleus of $^{37}_{17}Cl$ emits an α particle followed by two β particles. Show that the final nucleus is an isotope of chlorine. **(2 marks)**

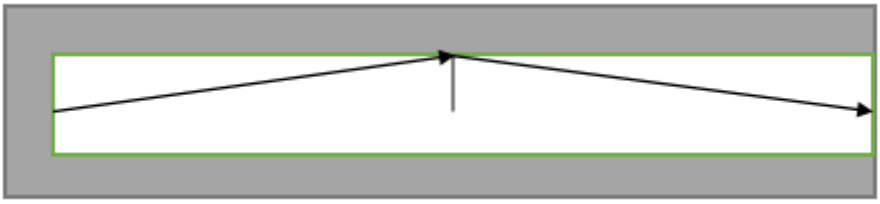
19) A) i) What is meant by Doppler Effect? **(2 marks)**

ii)Give two applications of the Doppler Effect in sound. **(2 marks)**

iii) A car sounding its horn as it travels at a stead speed of 15m/s, moving a straight road between two stationary observers A and B. the observer A hears a frequency of 353Hz while B hears a lower frequency. Calculate the frequency heard by B. **(3 marks)**

b)A pipe 90cm long is open at both ends. How long must a second pipe, closed at one end, be if it is to have the same fundamental resonance frequency as the open pipe? **(3 marks)**

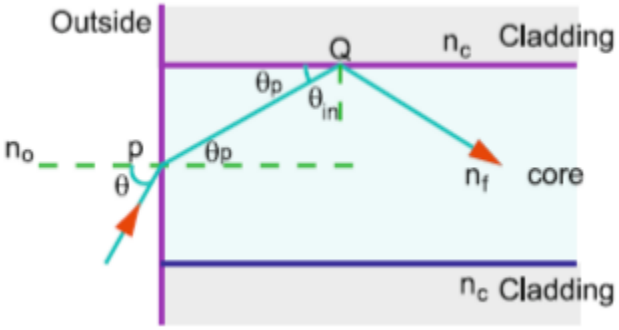
20) A) Figure below shows a ray of light travelling through an individual fiber consisting of cladding and a core. One part has a refractive index of 1.3 and the other has a refractive index of 1.5



i) State which part of the fiber has the higher refractive index and explain why. **(3 marks)**

ii) Calculate the critical angle for this fiber. **(2 marks)**

b) An optical fibre consists of an inner material (the fiber) with refractive index nf and an outer material of lower refractive index nc , known as cladding, as in Figure below.



Show that the maximum acceptance angle θmax is given by

$$n_o \sin\theta_{max} = \pm\sqrt{n_f^2 - n_c^2}$$ **(5 marks)**

-END-