REPUBLIC OF RWANDA WESTERN PROVINCE RUBAVU DISTRICT	**DISTRICT COMPREHENSIVE EXAMINATION** **SECOND TERM** **SCHOOL YEAR: 2023/2024** **SUBJECT**: PHYSICS (THEORY) **LEVEL**: SENIOR FIVE **COMBINAISONS**:PCB, PCM, MPG, PCG,PEM	**Date:** **13**/03/2021 **Duration:** 3Hrs **Time:** 08:30-11:30 **Max:** **100** Marks

Instructions:

1. **Write your names on your answer sheet.**
2. **This exam has 2 sections A and B.**
3. **Section A: This section is compulsory.**
4. **Choose only three questions from section B.**
5. **Calculators and mathematical instruments may be used.**
6. **Use a blue or black pen for writing.**

Useful constants:

$\frac{e}{m}$= 1.8× 1.8^{11} C/kg

Electric constant K=$9\times10^{9} Nm^{2}.C^{-2}$

The mass of electron $m_e = 9.11x10^{-31}$ *kg*
Planck's constant $h = 6.626x10^{-34}$ *J.s*
Speed of light in vacuum $C=3x10^{8} m/s$
Electron charge $e=1.6x10^{-19}C$
Acceleration due to gravity $g = 9.81\ m/s^2$

SECTION A: ATTEMPT ALL QUESTIONS (70 marks)

Question1

If the length of a simple pendulum is doubled, its period will:

A) Halve B) Be greater by a factor of $\sqrt{2}$ C) Be less by a factor of $\sqrt{2}$

D) Double (**1 marks)**

Question 2

Oscillations are damped due to**:** A) Linear motion B) Frictional force C) Restoring force D) Gravitational force **(1 mark)**

Question 3

When an outside driving force causes an object to oscillate at certain frequency, the resulting oscillations are called. **(1 mark)**

A) Resonant oscillations B) Forced oscillations C) Damped oscillations

D) Natural oscillations

Question 4

What type of fossil fuel is mined from the ground?

A) Copper B) Coal C) Geothermal energy D) Biomass **(1 mark)**

Question 5

Two objects, one with a mass m and other with a mass 4 m are attracted to each other by gravitational force. If the gravitational force on 4 m is F, what is the force on mass in terms of F?

A)16 F B) F/4 C) F D) 4 F (**1 mark)**

Question 6

The escape velocity of a projectile from the Earth can be calculated using the formula (where G: gravitational constant , r_E :radius of the Earth, M mass of the Earth, g acceleration due to gravity)

A) $v = \sqrt{g r_E}$ B) $v = \sqrt{\frac{2GM}{r_E}}$ C) $v = \sqrt{\frac{GM}{r_E^2}}$ D) $v = \frac{2GM}{r_E}$ **(1 mark)**

Question 7

a) Define the term diffraction (**2 marks**)

b) List two types of diffraction and explain them. (**4 marks)**

Question 8

a) The moon's radius is $(1/4)^{th}$ of that of earth and its mass is 1/80 times that of the earth. If g represents the acceleration due to gravity on the surface of the earth, what is acceleration due to gravity on the surface of the moon? (**3 marks)**

b) A satellite is revolving round the earth in circular orbit at some height above surface of the earth. It takes 5.26×10^3 seconds to complete a revolution while its centripetal

acceleration is 9.32 m/s^2 . What is the height of satellite above the surface of earth? (Radius of the earth 6.37×10^6m (**3 marks)**

Question 9

Define the following terms: **(6 marks)**

a) (i) Photoelectric effect

(ii) Compton effect

(iii) Quantum mechanics

b) What is the ratio between the energies of two radiations, one with a wavelength of 200 nm and the other with 600 nm? **(3marks)**

Question 10

(a) A light spiral spring is loaded with a mass of 50 g and it extends by 10 cm. Calculate the period of small vertical oscillations. **(3 marks)**

(b) When a family of four with a total mass of 200 kg step into their 1200-kg car, the car's springs compress 3.0 cm.

Car springs



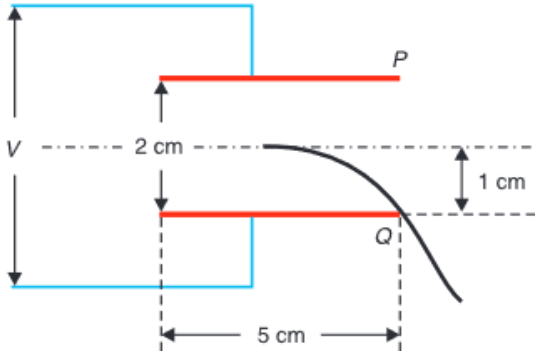
Figure 1: Photo of a car's spring.

(i) What is the spring constant of the car's springs (Fig. 1), assuming they act as a single spring? (**3marks**)

(ii) How far will the car lower if loaded with 300 kg rather than 200 kg? (**3marks**)

Question 11

A beam of electrons moving with velocity 1×10^7 m/s enters mid-way between two horizontal parallel plates P and Q in a direction parallel to the plates as shown on Figure. P and Q are 5 cm long and 2 cm apart, and have a p.d applied between them.



Calculate V if the beam is deflected so that it just grazes the edge of the lower plate Q. Hint ($\frac{e}{m}$= 1.8×1.8^{11} C/kg) **(3 marks)**

Question12

a. Define the term rocket. **(2 marks)**

b. How is it called the force which moves a rocket in forward direction? **(1 mark)**

c. Explain the 3 Classifications of rocket propulsion Systems **(6 marks)**

Question13

The work function for lithium is 4.6 × 10-19 J.

(a) Calculate the lowest frequency of light that will cause photoelectric emission.

(3 marks)

(b) What is the maximum energy of the electrons emitted when the light of frequency 7.3×10^{14} Hz is used? **(3 marks)**

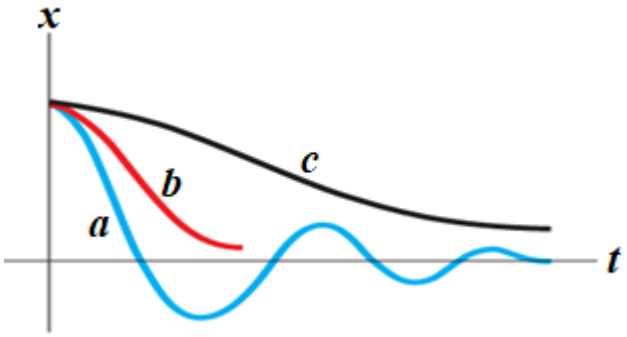
Question14

(a) Distinguish controlled fission from uncontrolled fission. **(4 marks)**

(b) If reactors are so safe, why don't home owners' insurance policies cover reactor accidents? Does this mean that insurance companies have no confidence in them? Explain. **(3 marks)**

Question 15

Have a clear look on the following figure showing the types of damped oscillation and answer the related questions:



a. Which type of damped oscillation represented by **a**, **b** and **c?** Justify your answer by giving the supporting ideas. (**6 marks**)

b. Explain briefly how the car's shock absorbers (dampers) prevent a car from undergoing an oscillation. (**3 marks**)

SECTION B: **ATTEMPT ONLY 3 QUESTIONS (30 marks)**

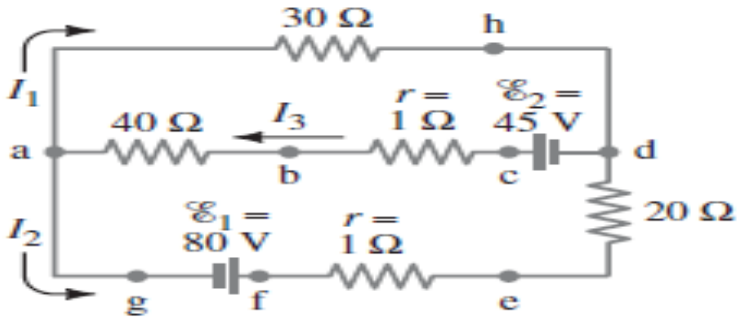
Question16

Discuss as fully as you can the problems associated with fossil fuels on the environment. (**N.B: use essay form**) **(10 marks)**

Question 17

a. State the kirchchoff's rules (**4 marks)**

b. Using Kirchhoff's rules**,** calculate the currents I_1, I_2 and I_3 in the three branches of the circuit in Figure below. (**6 marks)**



Question 18

A travelling wave is described by the equation y(x, t) = 0.003 cos (20x + 200t) where y and x are measured in metres and t in seconds.

(a) What is the direction in which the wave is travelling? (**1 mark**)
(b) Determine the angular wave number (**1 mark**)
(c) Determine angular frequency (**1 mark**)
(d) Determine the amplitude (**1 mark**)
(e) Find the Particle velocity when x = 0.3 m and t = 0.02 s (**3 marks**)
(f) Find the Particle acceleration when x = 0.3 m and t = 0.02 s (**3 marks**)

Question 19

In a photoelectric effect experiment, which of the following factors will increase, decrease or will not affect the maximum kinetic energy of the photoelectrons? In each case justify your answer on the basis of Einstein's photoelectric equation: $\frac{mv_m^2}{2} = hf - \emptyset$

(a) (i) Use light of greater intensity. **(1 mark)**

(ii) Use light of higher frequency. **(1 mark)**

(iii) Use light of longer wavelength. **(1 mark)**

(iv) Use a metal surface with a larger work function **(1 marks)**

(b) The photoelectric work function of potassium is 2.3 eV. The light having the wavelength of 250 nm falls on potassium.

i) Convert 2.3 eV in joules. **(2 marks)**
ii) Find the frequency of this light. **(2 marks)**
iii) Calculate the maximum kinetic energy of the photoelectrons. **(2 marks)**

Question 20

a) Differentiate between Rutherford's atomic model and Bohr's atomic model. **(4 marks)**

b) i) State Bohr's postulate of a hydrogen atom **(2marks)**

ii) Propose any three deficiencies of the Bohr model of a hydrogen atom. **(2 marks)**

c) The frequency associated with an energy change of a hydrogen atom is 6.166x $10^{14}H_Z$ and the final energy level is 14. Determine the initial energy level. **(2marks)**

BEST WISHES!!!