MUHANGA DISTRICT **DATE: ...../03/2026**

ADVANCED LEVEL EXAMINATIONS OF PHYSICS

YEAR:2025- ACADEMIC 2026

TERM:2

COMBINATIONS:

- **MATH-PHYSICS-GEOGRAPHY (MPG)**
- **PHYSICS-CHEMISTRY-MATHEMAITCS (PCM)**
- **PHYSICS-CHEMISTRY-BIOLOGY (PCB)**
- **MATHEMATICS-PHYSICS-COMPUTER (MPC)**

DURATION: 3 HOURS

INSTRUCTIONS:

This paper has **2** sections **A** and **B**

SECTION A: Attempt **ALL** questions **(70 marks)**

SECTION B: Attempt any **THREE** questions **(30 marks)**

Constants:

- $K=9\times10^{9}Nm^{2}C^{-2}$
- $G = 6.67 \times 10^{-11}\ Nm^{2}kg^{-2}$
- $g = 10\ m/s^{2}$
- $e = 1.6 \times 10^{-19}C$,
- $me = 9.11 \times 10^{-31}kg$ and $h = 6.63 \times 10^{-34}Js$

-Silent non-programmable calculators may be used.

SECTION A: ATTEMPT ALL QUESTIONS/70MARKS

Choose the letter that corresponds to the correct answer

1) A) A black body is one that **(1Mark)**

a) Transmit all incident radiations b) Absorbs all incident radiations

c) Reflects all incident radiations d) Absorbs reflects and transmits all incident radiations

B) If light of frequency $\mathbf{2f_0}$ is incident on a metal of threshold frequency $\mathbf{f_0}$.the maximum kinetic energy of emitted electrons is proportional to: **(1Mark)**

a) f_0 b) $2f_0$ c) hf_0 d) $4f_0$

C) The stopping potential for a photoelectric emission process is 10V. The maximum kinetic energy of the electrons ejected in the process is: **(2Marks)**

a) 3.2×10^{-19}J b) 1.6×10^{-19}J c) 1.6×10^{-18}J d) 0J

D) As the temperature of a blackbody increases, the peak wavelength: **(1Mark)**

a) Increases b) Remains constant c) Decreases d) Becomes zero

E) An electron falls from rest through a potential difference of 100V. Its de Broglie wavelength in Angstrom? (Take m_e=9.11x10-^{31}kg, e=1.602x10^{-19}C) **(2Marks)**

a)1.23A^0 b)3.23A^0 c)4.23A^0 d)3.21A^0

2)A. If the length of a simple pendulum is doubled, its period will: **(1Mark)**

a) Halve b) Be greater by factor $\sqrt{2}$ c) Be less by factor of $\sqrt{2}$

d)Double

B. A particle in SHM passes through equilibrium with speed 2 m/s and amplitude 0.5 m. Its angular frequency is: **(1Mark)**

a) 2 rad/s b) 3 rad/s c) 4 rad/s d) 5 rad/s

C. The total mechanical energy of a 0.5 kg mass executing SHM with amplitude 0.1 m and ω = 10 rad/s is: **(1Mark)**

a) 0.25 J b) 0.50 J c) 0.75 J d) 1.00 J

D. In SHM, if displacement is given by $X = 0.1\sin 6t$.The maximum acceleration is:

a) 0.6 m/s^2 b) 3.6 m/s^2 c) 6.0 m/s^2 d) 36 m/s^2 **(1Mark)**

E. If one of two parallel springs breaks, the time period of oscillation will:

a) Increase b) Decrease c) Remain unchanged d) Become zero

F. The motion is underdamped when: **(2Marks)**

a) $b^2>4mk$ b) $b^2=4mk$ c) $b^2<4mk$ d) $b=0$

G. If the damping force is very large, the system becomes: **(1Mark)**

a) Underdamped b) Critically damped c) Overdamped

d) Simple harmonic

H. For overdamped motion, the solution of the displacement is: **(1Mark)**

a) Sinusoidal b) Exponentially increasing c) Sum of two real exponential terms

d) Pure cosine function

I) In critically damped motion, the system: **(1Mark)**

a) Oscillates with decreasing amplitude

b) Returns to equilibrium in the shortest time without oscillation

c) Never reaches equilibrium

d) Oscillates with constant amplitude

3)A. What type of fossil fuel is mined from the ground? **(1Mark)**

a) Copper b) Geothermal energy c) Coal d) Biomass

B. Which of the following produces greenhouse gases? **(1Mark)**

a) Burning fossil fuel b) Nuclear fission

c) Use of solar energy d) Use of electricity.

C. Which energy source uses photovoltaic cells? **(1Mark)**

a) Wind energy b) Solar energy c) Geothermal energy d) Nuclear energy

D. Which non-fossil fuel produces energy through nuclear fission? **(1Mark)**

a) Uranium b) Wind c) Geothermal d) Biomass

E. A material that absorbs neutrons and controls the reaction is called:**(1Mark)**

a) Shielding b) Coolant c) Control rod d) Fuel rod.

4)A. A uniform electric field means: **(1Mark)**

a) Field strength varies with position

b) Field strength is constant in magnitude and direction

c) Field lines diverge d) Charge is uniformly distributed

B. The electric potential due to a point charge decreases with: **(1Mark)**

a) Distance b) Square of distance c) Cube of distance d) Mass of charge

C. 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 m in terms of F? **(2Marks)**

a) 6 F b)4 F c) F d) F/4

D. The escape velocity of a projectile from the Earth can be calculated using the formula (Where G: gravitational constant,R_E: Radius of earth and M: Mass of Earth) **(1Mark)**

a)$V_e = \sqrt{\frac{GM}{R_E}}$ b) $V_e = \sqrt{\frac{2GM}{R_E}}$ c) $V_e = \sqrt{\frac{GM}{R_E}}$ d)$V_E = \frac{2GM}{R_E}$

5)A. If at a node, currents 4A and 6A enter, and current 3A leaves, the remaining current leaving the node is: **(2Marks)**

a) 5A b) 7A c) 10A d) 13A

B. Kirchhoff's Voltage Law **(KVL)** is based on the principle of conservation of: **(1Mark)**

a) Charge b) Energy c) Current d) Resistance

C. If the radius of a satellite's circular orbit is doubled, its total mechanical energy becomes: **(2Marks)**

a) Doubled b) Halved c) Four times larger d) Unchanged

D. For a satellite orbiting a planet in a circular orbit, Kepler's Third Law predicts that its period depends on: **(2Marks)**

a) Its own mass b) Radius of orbit only

c) Radius of orbit and mass of central planet d) Density of satellite

E. Kepler's Second Law implies that a planet moves fastest when it is: **(2Marks)**

a) At aphelion b) At perihelion c) At maximum distance from the Sun
d) At the semi-major axis

6) State whether the following by true or false: **(10marks)**

A. The solar system consists of eight planets: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune.

B. The second law of Kepler states that the square of the orbital period of a planet is directly proportional to the cube of its distance from the sun.

C. Mercury, being closest to the sun, has the longest orbital period of all the planets in the solar system

D. The other units of electric potential are N/C

E. A longitudinal is one in which the direction of motion of the medium particles is parallel to the direction of the wave energy.

F. At resonant frequency, the amplitude of a simple pendulum becomes minimum.

G. The velocity of a SHM is minimum at the equilibrium position.

H. The frequency of a spring-mass system is independent of the mass suspended.

I. Gravitational potential is a vector quantity.

J. Gravitational potential near a massive body is positive

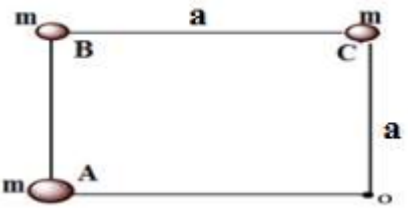
7) A. How does The field lines around a point mass and negative point charge are related **(4Marks)**

B. The field lines in a uniform gravitational and electric field are identical. With aid of diagram demonstrate and explain the situation where **(4Marks)**

(i) electric field are uniform

(ii) gravitational field are uniform

C. Three point masses each of mass 'm' are kept at three vertices of a square of side 'a' as shown in figure below



(a) **i)** Draw the net gravitational field strength vector and show its directions at point O. **(2Marks)**

(ii) Show that the resultant gravitational field strength at 0 is $E_g net = \left(\sqrt{2} + \frac{1}{2}\right)\frac{Gm}{a^2}$

(5Marks)

D. 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 6.37×10^6 m) **(3Marks)**

E. What is the depth at which the effective value of acceleration due to gravity is $\frac{g}{4}$ **(2Marks)**

SECTION B (ATTEMPT ANY THREE QUESTIONS)

Each counts out of 10 marks

8) An electron beam was directed horizontally and perpendicularly across the uniform electric field between parallel plates. The plates had a p.d of 4000 V across them and they were separated by 3.4 cm.

a) Draw a sketch of this arrangement. **(2 marks)**

b) The beam was produced when electrons were accelerated from rest by a p.d of 5000 V. Determine the kinetic energy gained by an electron in:

(i) electron volts and (ii) joules. **(2 marks)**

(b) Calculate the maximum speed of the electrons in the beam. **(1 mark)**

(c) If the plates were 6.0 cm long, what was the time taken for an electron to pass between them? **(1mark)**

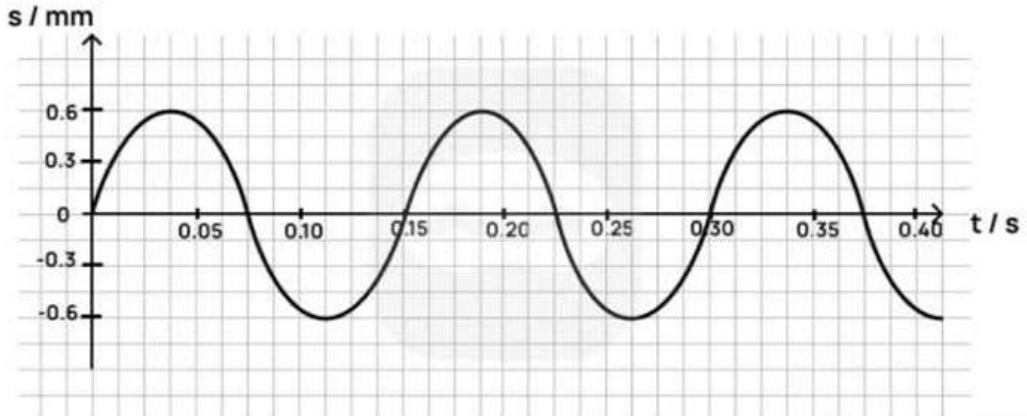
(d) Calculate the magnitude of the electric field between the plates. **(1 mark)**

(e) Determine the force on each electron. **(1 mark)**

(f) Calculate the acceleration of the electrons. **(1 mark)**

(g) Determine the deflection of the beam as it passed between the plates. **(1 mark)**

9) The graph shows the 4 kg particle displacement s in millimeters of a point on a string as a function of time t in seconds.



a. Find the phase constant. (**1 mark**)

b. Write down the equation of the displacement as a function of time (**2 marks)**

c. What is the spring constant? **(1 mark)**

d. What is the total energy? (**2 marks)**

e. What is the maximum speed? **(1 mark)**

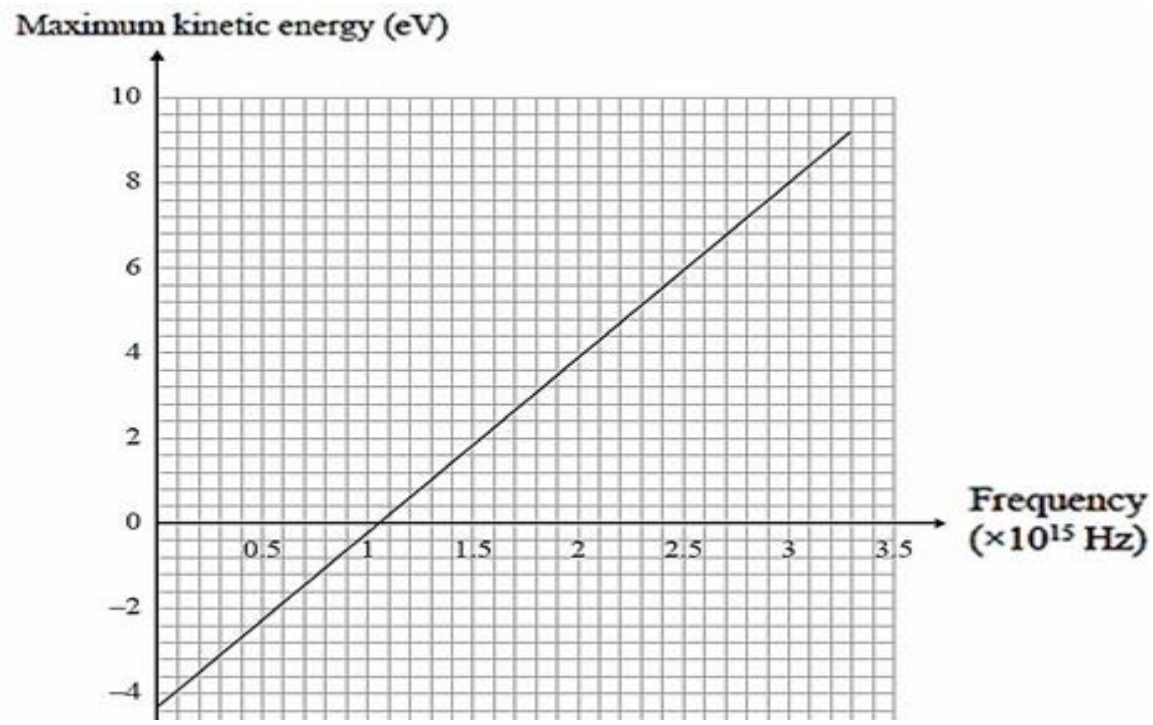
f. What is the maximum acceleration? **(1 mark)**

g. Sketch a graph of the velocity of the point against time, of one complete wavelength **(2marks)**

10)A. Copy and complete carefully each space of the following table using yes or no where necessary **/4marks**

Phenomena	***Can be explained in terms of waves***	***Can be explained in terms of particles***
Reflection of light		
Refraction of light		
Interference of light		
Diffraction of light		
Polarization of light		
Photoelectric effect		

B. In the experiment on the photoelectric effect, the graph between $Ek(max)$ and v is found to be a straight line as shown in figure1:



Find:

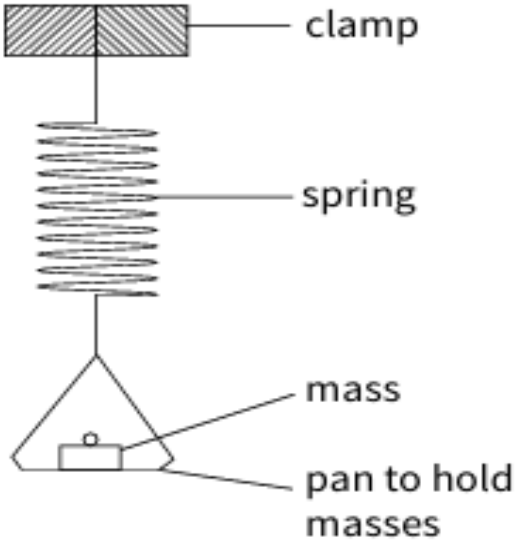
a) Planck's constant according to this graph. **/2marks**

b) Work function.

c)The threshold frequency ν_0 / **1mark**

d)What will happen is the light with frequency $\nu < \nu_0$ is incident on the metal used in this experiment? Explain. **/2marks**

11) An experiment explores the relationship between the period of a vibrating spring and the mass m in a pan holder. The student is instructed to set up the apparatus as in Figure 2, with a mass of 200 g in the pan. He is then told to move the pan downwards by approximately 1 cm and to release it so that it vibrates in a vertical direction.



The student is asked to record the time taken for 20 oscillations of the spring, and then to repeat the procedure, using masses between 20 g and 200 g until he has six sets of readings. Columns are provided in the table for $\sqrt{m}$ and T, the period of the pendulum.

Mass / g	Time for 20 oscillations / s	$\sqrt{m}$	T
20	12.2		
50	15.0		
100	18.7		
150	21.8		
200	24.5		
190	24.0		

a. Copy the table and include values for $\sqrt{m}$ and T.

b. Plot a graph of T on the y-axis against m on the x-axis. Draw the straight line of best fit.

c. Determine the gradient and y-intercept of this line.

d. The quantities T and m are related by the equation

$T = C + k\sqrt{m}$ where C and k are constants. Find the values of the two constants C and k. Give appropriate units.

12) A. In the equation x(t)=A cos(ωt+φ) = what does the phase constant (φ) determine? **/1mark**

a. The maximum displacement

b. The initial position of the oscillator

c. The frequency of oscillation

d. The angular frequency

B. Three sinusoidal vibrations of parallel amplitude are given below:

$$y_1 = 2sin(\omega t)\ m \quad ; \quad y_2 = 2sin\left(\omega t + \frac{\pi}{3}\right) m \ ; \quad y_3 = 2sin\left(\omega t + \frac{2\pi}{3}\right) m$$

(i)Calculate the amplitude A and initial phase φ of the sinusoidal vibration resulting from the superposition of y_1 and y_2

/2marks

(ii)Write down the expression of Y obtained by superposition of y_1 and y_2 .

/3marks

(iii) Calculate the amplitude A' and initial phase φ' of the sinusoidal vibration resulting from the superposition of Y and y_3 .

/2marks

(iv)Write down the expression of Y' obtained by superposition of Y and y_3

/2marks

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