P510/1
PHYSICS PAPER 1
(Theory)
July /August 2024
2 ½ Hours

KAYUNGA SECONDARY SCHOOLS EXAMINATIONS COMMITTEE (KASSEC)
JOINT MOCK 2024
Uganda Advanced Certificate of Education

PHYSICS

Paper 1

2 hours 30 minutes

INSTRUCTIONS TO CANDIDATES:

*Answer **five** questions, including at least **one**, but not more than **two** from each of the sections **A,B** and **C**.*
Any additional question (s) answered will not be marked.
Non-programmable scientific calculators may be used.
Assume where necessary

Acceleration due to gravity, g,	$= 9.81 ms^{-2}$
Electron charge, e	$= 1.6 \times 10^{-19} C$
Electron mass	$= 5.97 \times 10^{31} kg$
Mass of the earth	$= 5.97 \times 10^{24}\ kg$
*Plank's constant, **h**,*	$= 6.6 \times 10^{34} Js$
Stefan's –Boltzmann's constant,σ	$= 5.67 \times 10^{-8} Wm^{-2}K^{-4}$
Radius of the earth	$= 6.4 \times 10^{6} m$
Radius of the sun	$= 7 \times 10^{8}\ m$
Radius of earth's orbit about the sun	$= 1.5 \times 10^{11} m$
*Speed of light in a vacuum, **c**,*	$= 3.0 \times 10^{8} ms^{-1}$
Thermal conductivity of copper	$= 390 Wm^{-1}K^{-1}$
Thermal conductivity of aluminum	$= 210 Wm^{-1}K^{-1}$
Specific heat capacity of water	$= 4200 Jkg^{-1}K^{-1}$
*Universal gravitational constant ,**G***	$= 6.67 \times 10^{-11} Nm^2kg^{-2}$
Avogadro's number ,N_A	$= 6.02 \times 10^{23} mol^{-1}$
Surface tension of water	$= 7.0 \times 10^{-2}\ Nm^{-1}$
Density of water	$= 1000 kgm^{-3}$
*Gas constant **R***	$= 8.31 Jmol^{-1}K^{-1}$
Charge to mass ratio, e/m	$= 1.8 \times 10^{11} Ckg^{-1}$
The constant $\frac{1}{4\pi\varepsilon_0}$	$= 9.0 \times 10^{9} F^{-1}m$
Faraday constant, F	$= 9.65 \times 10^{4}\ Cmol^{-1}$

Turn Over

SECTION A

1. (a) (i) State the principle of conservation of ***linear momentum.*** ***(01mark)***

(ii) A body of mass, m_1 moving with a velocity, u_1 collides with a stationary body of mass , m_2. The collision is elastic and the velocities of m_1 and m_2 after impact are V_1 and V_2 respectively. If the bodies move in the same direction and $\beta=\frac{m_2}{m_1}$, show that $u_1 = V_1\frac{(1+\beta)}{(1-\beta)}$ ***(04marks)***

(b) (i) What is meant by ***dimensions of a physical quantity?*** ***(01mark)***

(ii) The velocity, v, of a wave of wave length, $\propto$ on the surface of water of surface tension, γ and density ρ is given by $V^2 = \frac{\propto g}{2\pi} + \frac{2\pi\gamma}{\propto\rho}$ where g is the acceleration due to gravity.
Show that the equation is dimensionally consistent. ***(03marks)***

(c) (i) What is ***uniform acceleration?*** ***(01mark)***
(ii) Sketch a distance –time graph for a uniformly accelerated motion. ***(01 mark)***

(d) A body is projected vertically up wards from a point 980m above the ground with a velocity of 49ms $^{-1}$ .Find the time taken for the body to reach the ground. ***(03 marks)***

(e) With examples, explain ***Newton's laws*** of motion. ***(06 marks)***

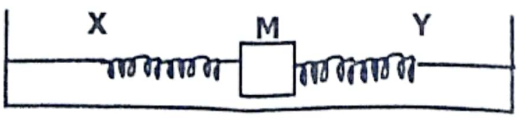
2. (a) State ***Hooke's law.*** ***(01mark)***

(b) Two wires A and B of the same material have equal length but the radius of A is greater than that of B. Which wire:
(i) Can with stand the greater load before breaking? ***(02marks)***
(ii) has the greater strain for a given load? ***(02marks)***

(c) (i) Define ***Young's modulus.*** ***(01marks)***
(ii) Explain why a piece of rubber stretches much more that a metal wire of the same length and cross sectional area. ***(02marks)***

(d) A copper wire of length 4m and cross sectional area $1.0 \times 10^{-3}mm^2$ is fixed between two rigid supports x and y, 4m a part . Determine the mass which will produce a sag of 1.5m when suspended at the midpoint of the wire.
(young's modulus of copper = 1.2×10^{11}Pa) ***(04marks)***

(e) (i) What is meant by ***simple harmonic motion?*** ***(01mark)***
(ii)



Two springs x and Y of spring constants K_x and K_y respectively are connected to a mass m as shown in the figure above. The surface on which the mass slides is friction less.

Show that when the mass is displaced slightly, it oscillates with simple harmonic motion of frequency **f**, given by

$$f = \frac{1}{2\pi}\sqrt{\frac{K_x + K_y}{m}}$$ ***(04marks)***

(f) Explain why water flowing out of a small hole at the bottom of a wide tank results in a back ward force on the tank. ***(03marks)***

3. (a) (i) What is meant by ***stream line flow***? ***(02marks)***

(ii) With the aid of a labelled diagram, describe how the velocity of a fluid can be measured. ***(05 marks)***

(b) The depth of water in a tank of a large cross sectional area is maintained at 3.0m. If the water emerges out of the tank continuously through a hole of diameter 8mm drilled at a height of 12.0cm above the base of the tank, calculate the :-

(i) Speed at which water emerges out from the hole. ***(03marks)***
(ii) Rate of mass flow of water from the hole. ***(02marks)***

(c) (i) State Bernoulli's principle. ***(01 mark)***
(ii) Explain with the aid of a diagram, why air flowing over the wings of an air craft causes a lift. ***(03 marks)***

(d) An aeroplane had a mass of 9,000kg and total wing area of $9.0m^2$. When moving through still air, the ratio of its velocity to that of air at its lower surface is 1.0, where as the ratio of its velocity to that of the air above its wings is 0.25. At what velocity will the aerophane be able to just lift off the ground? (Density of air = $1.3kgm^{-3}$) ***(04marks)***

4. (a) Define the following:-
(i) ***Projectile motion*** ***(01 mark)***
(ii) ***Angle of projection*** ***(01mark)***

(b) An object X is projected vertically up wards from the ground with a speed of $40ms^{-1}$ .If object Y is dropped vertically above X from a height of 100m above the ground after 2 seconds, find the:-
(i) time when x and y collide, from the time x was thrown up wards. ***(07marks)***

(ii) height above the ground where x and y collide. ***(03 marks)***

(c) (i) Explain what is meant by ***centripetal force.*** ***(02marks)***

(ii) A body moving in a circular path of radius 0.5m makes 40 revolutions per second .Find the centripetal force if the mass is 1kg. ***(03marks)***

(d) Explain why more energy is required to push a wheel barrow up hill than on a level ground. ***(03 marks)***

SECTION B

5. (a) (i) Define a ***thermometric property.*** ***(01mark)***

(ii) Give **two** characteristics of a good thermometric property. ***(02 marks)***

(b) (i) Describe how a liquid-in-glass thermometer can be used to measure temperature in degrees Celsius. ***(04marks)***

(ii) State **four** disadvantages of a mercury –in-glass thermometer. ***(02marks)***

(c) Describe with the aid of a labelled diagram the operation of an optical pyrometer. ***(06marks)***

(d) When a gas is withdrawn from a tank of volume 60 litres, the reading of a pressure gauge attached to the tank drops from 2.14×10^6Pa to 7.8×10^5Pa. If the temperature of gas remaining in the tank falls from 30°c to 10°c, calculate the mass of oxygen withdrawn. ***(05marks)***

6. (a) (i) Differentiate between ***a diabetic*** and ***isothermal expansions.*** ***(02 marks)***

(ii) State **two** examples of a diabetic changes. ***(01marks)***

(b) A fixed mass of an ideal gas of volume $400cm^3$ at 15°c expands a adiabatically and its temperature falls to O°c. It is then compressed isothermally until the pressure returns to its original value. If the molar heat capacity at constant pressure is $28.6Jmol^{-1}K^{-1}$, calculate the final volume after isothermal compression. ***(05marks)***

(c) Define ***molar heat capacity*** at constant pressure and ***molar heat capacity*** at constant volume. ***(02marks)***

(d) Derive the expression $C_p - C_v = R$, where C_p is moalr heat capacity of a gas at constant pressure, C_v is molar heat capacity of a gas at constant volume and R is the gas constant. ***(05marks)***

(e) Use kinetic theory of matter to explain the following observations.

(i) Saturated vapour pressure of a liquid increases with temperature. *(03marks)*

(ii) Saturated vapour pressure is not affected by a decrease in volume at constant temperature. *(02marks)*

7. (a) (i) Define ***thermal conductivity***. *(01mark)*

(ii) Explain the mechanism of heat transfer by convection. *(03marks)*

(b) A metal sphere whose surface acts as a black body is placed at the principal focus of a concave mirror of diameter 60cm, which is directed towards the sun. If the solar radiation falling normally on the earth is $1400Wm^{-2}$, and the meaning temperature of the surroundings is 30°c, find the diameter of the sphere when the maximum temperature it attains is 1870°c. *(06marks)*

(c) (i) State Newton's ***law of cooling***. *(01 mark)*

(ii) Describe briefly an experiment to verify Newton's law of cooling. *(05 marks)*

(d) Explain the greenhouse effect and how it leads to rise of the earth's temperature. *(04marks)*

SECTION C

8. (a) What is meant by the following:

(i) **Radio activity** *(01 mark)*

(ii) ***Isotopes.*** *(01 mark)*

(b) (i) Define mass defect *(01mark)*

(ii) State the condition for a heavy nucleus of an atom to be unstable. *(01mark)*

(iii) Explain your answer in (b)(ii) *(02marks)*

(c) Given that :

Mass of a proton	=	1.0073U
Mass of an electron	=	0.0005U
Mass of a neutron	=	1.0087U and
Mass of $^{227}_{87}Fr$	=	223.0198U

(i) Calculate the difference in the mass between $^{227}_{87}F$ nucleus and the sum of the masses of its nucleons. *(05marks)*

(ii) How is the difference in the masses in (c)(i) accounted for? *(02marks)*

(d) (i) Sketch a graph showing the variation of binding energy per nucleon with mass number, clearly showing the fusion and fission regions. *(02marks)*

(ii) Use the sketch in (d) (i) to explain how energy is released in each of the processes of fusion and fission. *(03marks)*

(e) State **two** uses of radioactive isotopes. ***(02marks)***

9. (a) (i) What are ***cathode rays***? ***(01 mark)***

(ii) With the aid of a diagram, describe an experiment to show that cathode rays travel in straight lines. ***(04marks)***

(b) (i) With the aid of a labelled diagram, describe how specific charge of positive rays may be determined. ***(06marks)***

(ii) Explain how the set up in (b) (i) can be used to determine the abundance of isotopes. ***(03 marks)***

(c) Two metal plates each 50mm long are held horizontally 40mm a part in a vacuum, one being vertically above the other. The upper plate is at a potential of 0.40kv while the lower one is earthed. Electrons with a velocity of $1.0 \times 10^{7} ms^{-1}$ enter horizontally mid-way between the plates and in direction parallel to the 50mm edge. Calculate the vertical deflection of the electron as it emerges from the plates. ***(04marks)***

(d) State four differences between ***cathode rays*** and ***positive rays*** ***(02marks)***

10. (a) What is ***photo electric emission***? ***(01 mark)***

(b) (i) Describe a simple experiment to demonstrate photo electric effect. ***(04marks)***

(ii) When a clean surface of a metal in a vacuum is irradiated with light of wave length $5.5 \times 10^{-7}m$, electrons just emerge from the surface. However when light of wave length $5 \times 10^{-7}m$ is incident on the metal surface, electrons are emitted each with energy $3.62 \times 10^{-20}J$. Find the value of plank's constant. ***(04 marks)***

(c) (i) What are ***X-rays***? ***(01 mark)***

(ii) With the aid of a labelled diagram, describe how x-rays are produced in an x-ray tube. ***(05marks)***

(d) An- X-ray tube operates at $1.5 \times 10^{3}V$ and the current through it is $1.0 \times 10^{-3}A$. Find the

(i) Number of electrons crossing the tube per second. ***(03marks)***

(ii) Kinetic energy gained by electron on traversing the tube. ***(02marks)***

END