

TANZANIA HEADS OF ISLAMIC SCHOOLS COUNCIL

FORM SIX INTER ISLAMIC MOCK EXAMINATION

PHYSICS 2

131/2

(For both School and Private candidates)

Time: 3 Hours

Friday 8th March, 2024 p.m.

Instructions

1. This paper consists of **six (6)** questions.
2. Answer **five (5)** questions.
3. Each question carries twenty (20) marks.
4. Mathematical tables and non-programmable calculators may be used.
5. Cellular phones and any unauthorized materials are not allowed in the Examination Room.
6. Write your Examination Number on every page of your answer booklet(s).
7. The following information may be useful:
 - Acceleration due to gravity = 9.8ms^{-2}
 - Pie $\pi = 3.14$
 - Charge of an electron = 1.6×10^{-19}
 - Speed of sound in air = 340ms^{-1}
 - 1 a.m.u = 931MeV
 - Mass of electron = $9.1 \times 10^{-31}\text{kg}$
 - Permittivity of free space $\epsilon_0 = 8.854 \times 10^{-12}$
 - $R = 8.314 \text{ Jmol}^{-1}\text{K}^{-1}$
 - $K = 1.38 \times 10^{-23}\text{Jk}^{-1}$
 - Density of air 1.293kgm^{-3}
 - Young's modulus of rubber cord = $6 \times 10^8\text{Nm}^{-2}$
 - Avogadro's number $N_A = 6.02 \times 10^{23}\text{mol}^{-1}$
 - Permeability of free space $\mu_0 = 4\pi \times 10^{-7}\text{Hm}^{-1}$
 - Speed of light (c) = $3 \times 10^8\text{ms}^{-1}$
 - Density of water = 1000kgm^{-3}
 - $h = 6.62 \times 10^{-34}\text{Js}$

1. (a) Briefly explain:
 - (i) Why are machine parts jammed in winter? **[02 marks]**
 - (ii) Why does a bigger rain drop fall faster than a smaller rain drop? **[02 marks]**
 - (iii) Why parachute is used while jumping from an aeroplane? **[02 marks]**
- (b) (i) Explain how will you compare the viscosity of two liquids. **[03 marks]**
 - (ii) With what terminal velocity will an air bubble 0.8mm in diameter rise in a liquid of viscosity 0.15 Nsm^{-2} and specific gravity 0.9? And what is the terminal velocity of the same bubble in water if coefficient of viscosity of water is 10^{-3} Nsm^{-2} . **[05 marks]**
- (c) A large tank contains water to depth of 10m. Water emerge from a smaller hole on one side of the tank 20cm below the level of water surface. Estimate;
 - (i) The speed at which water emerges from the hole. **[03 marks]**
 - (ii) The distance from the base of the tank to where water strike the floor. **[03 marks]**
2. (a) (i) To what extent does stationary wave differ from progressive wave? Explain with two points. **[03 marks]**
 - (ii) A physics teacher taught his students that the fundamental frequency of sonometer wire increases by 5Hz if its tension is increased by 21%. How will the frequency be effected if its length is increased by 10%? **[04 marks]**
- (b) (i) At what temperature will the velocity of sound in air be twice of the velocity of sound in air at 0°C ? **[03 marks]**
 - (ii) A cyclist and a railway train were approaching each other in Morogoro. The cyclist was moving at 20 ms^{-1} . The engine driver sounds a warning siren at frequency of 480Hz. Estimate the frequency of the note by the cyclist before and after the train had passed by. **[05 marks]**
- (c) In verifying Newton's ring experiment a set of Newton's rings were produced between one surface of a biconvex lens and glass plate using green light of wavelength $5.46 \times 10^{-5} \text{ cm}$. The diameter of particular dark rings of the order m and $m + 10$ was found to be 5.72mm and 8.10mm respectively when observed through a travelling microscope. If the plate between the lens surface and the glass was filled with liquid L the corresponding diameter was found to change into 4.95mm and 7.02mm respectively.
 - (i) Determine the radius of curvature of the lens surface. **[03 marks]**
 - (ii) What is the refractive index of liquid L used in the experiment? **[03 marks]**
3. (a) (i) Explain clearly the meaning of the following term "Young Modulus" and hence deduce its dimensions. **[02 marks]**
 - (ii) A form one student has a rubber cord of a catapult having a cross-section area of 2 mm^2 and initially its length was 0.2m and he stretched it to 0.24m to fire a small bird on the tree by a stone of mass 10g. Estimate the initial velocity of the stone when it just leaves cord of catapult. Assume that the elastic limit was not exceeded. **[04 marks]**

(b) Explain the following observations:

- (i) The boots of soccer and hockey players have studs on their soles. **[02 marks]**
- (ii) When a piece of chalk is put in water, it emits bubbles in all directions. **[02 marks]**
- (iii) A drop of oil placed on the surface of water spreads out but a drop of water placed on oil contracts to a spherical shape. **[02 marks]**

(c) (i) At what temperature will the r.m.s velocity of hydrogen molecules be doubled of its value at N.T.P? **[03marks]**

(ii) What is the average translational kinetic energy of an ideal gas molecule at 27°C? **[02marks]**

(iii) What is the total random translational kinetic energy of the molecules in 1mol of this gas at 27°C? **[02 marks]**

4. (a) (i) Although ordinary rubber is an insulator, the rubber tyres of air craft are made slightly conducting. Explain the reasons for that. **[02 marks]**

(ii) Two identical spheres A and B are situated some distance apart. Each has a charge of +q coulombs and they repel each other with a force of 10^{-5}N . A third identical conducting sphere C which is uncharged is first touched with A and then with B and then placed exactly midway between A and B. Find the resultant force on C. **[04 marks]**

(b) The figure 1 below shows two small spheres X and Y 1.0m apart in air which carries charges of $+2 \times 10^{-8}\text{C}$ and $-2 \times 10^{-8}\text{C}$ respectively. Find:

- (i) The potential at point A and B
- (ii) The electric field strength at point A and B

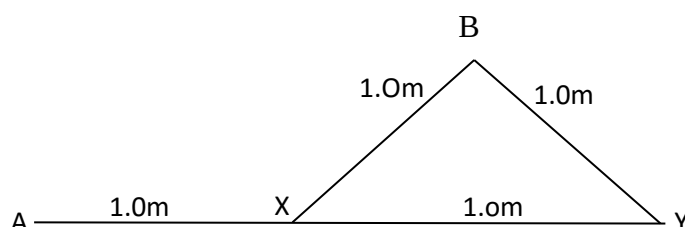


Fig.1

(c) (i) Describe the action of dielectric containing polar molecules on the capacitance of parallel plates capacitor. **[03 marks]**

(ii) For the arrangement of three capacitors in the figures 2 below, What value of C_1 will give a total equivalent capacitance of $3.3\mu\text{F}$? **[04 marks]**

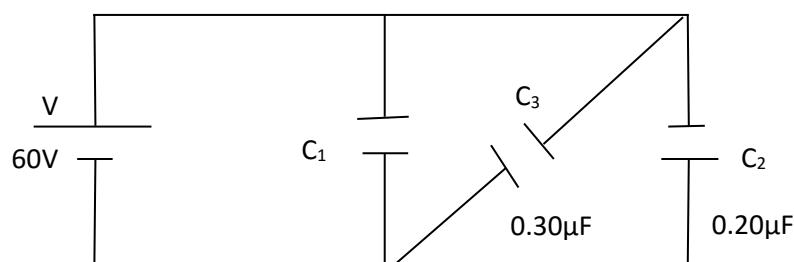


Figure 2

5. (a) (i) State Biot-savart law. **[02 marks]**
- (ii) A copper wire has 1.0×10^{29} free electrons per cubic metre a cross-section area of 2.0 mm^2 and carries a current of 5.0 A . The wire is placed at right angle to a uniform magnetic field of 0.15 T . Calculate the force acting on each electron. **[04 marks]**
- (b) (i) Explain why the coil of a resistance box made of doubled insulated wire especially here in Tanzania. **[03 marks]**
- (ii) An A.C generator consists of 100 turns and cross-section area of 3 m^2 , rotating at a constant angular speed of 60 rad s^{-1} in a uniform magnetic field of 0.04 T . The resistance of the coil is 500Ω . Estimate the maximum power dissipated in the coil. **[04 marks]**
- (c) (i) It was discovered that Geomagnetic field of the earth is described by three components. List these components. **[03 marks]**
- (ii) A cylinder made of soft-iron with cross-section area of $7.2 \times 10^{-4} \text{ m}^2$ is bent to form a ring of mean diameter of 0.17 m . The ring formed is wound with 2230 turns of conductor carrying current of 37 A . If the magnetic flux in the soft iron is $11.0 \times 10^{-3} \text{ Wb}$. What is the value of the relative permeability μ_r of the core? **[04 marks]**
6. (a) (i) Explain, how Rutherford's experiment on scattering of α -particles led to the estimation of the size of the nucleus. **[03 marks]**
- (ii) A 10 kg satellite circles each once every 2 hours in an orbit having a radius of 8000 km . Assuming that Bohr's angular momentum postulate applies to a satellite just as it does to an electron in the hydrogen atom. Find the quantum number of the orbit of satellite. **[04 marks]**
- (b) A photo-emissive surface has a threshold wavelength of 750 nm . Calculate:
- (i) Threshold frequency **[02 marks]**
- (ii) Work function **[02 marks]**
- (iii) Maximum speed of the electron emitted by light of wavelength 500 nm . **[02 marks]**
- (c) (i) Define the term mass defect. **[02 marks]**
- (ii) Estimate the mass defect and binding energy per nucleon for a helium nucleus. Given that mass of helium nucleus is 4.001509 a.m.u , mass of proton is 1.007277 a.m.u and mass of neutron is 1.008666 a.m.u . **[05 marks]**

Wabillah Tawfiq