TANZANIA HEADS OF ISLAMIC SCHOOLS COUNCIL

FORM SIX INTER ISLAMIC MOCK EXAMINATION

PHYSICS 2

(For Both School and Private Candidates)

131/2

**TIME: 3 HOURS**   **Friday, 7th March 2025 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 constants may be useful:-

   (a) Acceleration due to gravity, $g = 9.8 m/s^2$.

   (b) Speed of light, $C = 3 \times 10^8 m/s$.

   (c) Plank's constant, $h = 6.6 \times 10^{-34} Js$

   (d) Permeability of free space, $\mu_0 = 4\pi \times 10^{-7} Hm^{-1}$

   (e) Young modulus of steel, $Ys = 2 \times 10^{11} N/m^2$

   (f) Permittivity of free space free, $\varepsilon_0 = 8.854 \times 10^{-12} Nm^2C^{-2}$

   (g) Density of water, $\rho = 1000 kg/m^3$

   (h) Density of mercury, $\rho = 13600 kg/m^3$

   (i) Linear expansivity of steel, $\alpha = 1.21 \times 10^{-5}/c^0$

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1. (a) The Bernoulli's equation can be written in the form; $p + \frac{1}{2}\rho v^2 = $ constant.

    (i)   Explain the meaning of each term in the equation.   **[1 ½ marks]**

    (ii)   State two conditions which must apply for this equation to be true. **[1 ½ marks]**

    (iii)   What happens to the internal pressure in a fluid flowing in a horizontal pipe when its speed increases?   **[02 marks]**

  (b) Calculate the speed of water at which the velocity head of a stream of water is equal to 0.5m of mercury (Hg).   **[03 marks]**

  (c) (i)   The accumulation of snow on an aeroplane wing may reduce the lift force on an aeroplane. Explain.   **[03 marks]**

    (ii)   A tank having cross-section area "A" is filled with water to a height H_1. If a hole of cross-section area "a" is made at the bottom of the tank, then find the time taken by the water level to decrease from H_1 and H_2.   **[03 marks]**

  (d) (i)   When a fluid flows through a narrow constriction, its speed increases. How does it get energy for this extra speed?   **[02 marks]**

    (ii)   Three capillaries of same length but internal radii of 3R, 4R and 5R are connected in series and a liquid flows through them under streamline conditions. If the pressure across the third capillary is 8.1mm of liquid, find the pressure across the first capillary.   **[04 marks]**

2. (a) (i)   Hard work people often like taking soup in the morning before going to work. Explain why hot one is mostly preferred than the cold one.   **[02 marks]**

    (ii)   If you float two match-sticks on the surface of water and touch the surface of water between the matchsticks by a hot needle, the matchstick will fly apart. Explain.   **[03 marks]**

  (b) A soap bubble has a radius of 3cm and another soap bubble has a radius of 6cm. If the two bubbles are in vacuum and coalesce under isothermal condition, calculate the radius of common interface of the new formed bubble.   **[03 marks]**

  (c) (i)   A graph below shows, stress – strain curve for two materials A and B.
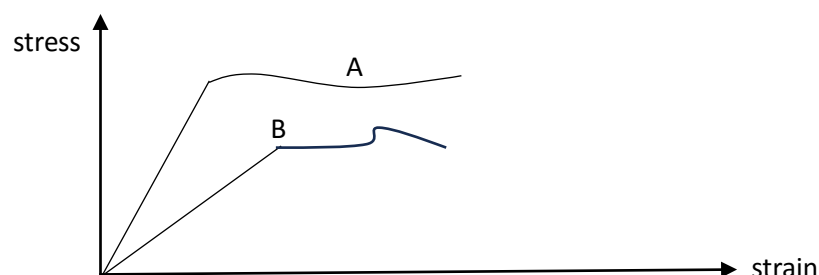
Referring to the graph which material is more ductile? Explain. **[02 marks]**

(ii) The elastic limit of the earth material is $3\times10^8 \text{N/m}^2$ and the density of the rock material is $3\times10^3 \text{kg/m}^3$. What is the maximum height a mountain on earth can possess? **[02 marks]**

(d) Nine (9) particles have speeds 5m/s, 12m/s, 12m/s, 12m/s, 8m/s, 14m/s, 14m/s, 17m/s and 20m/s.

Find:

(i) The average speed

(ii) The root mean square speed (rms)

(iii) The most probable speed of particles. **[03 marks]**

3. (a) (i) The velocity of a sound in air at 27°C and a pressure of 76cm of Hg is 330m/s. What will be its velocity if the pressure is increased to 100cm Hg and temperature kept constant? **[02 marks]**

(ii) Why a diver under water is unable to hear sound produced in air? **[02 marks]**

(b) A steel wire of length 1m, mass 0.1kg and a uniform cross-section area of 10^{-6}m^2 is rigidly fixed at both ends. The temperature of the wire is lowered by 20°C. The transverse waves are set up by plucking the string in the middle. Calculate the frequency of the fundamental mode of vibration. **[05 marks]**

(c) Two sheets of Polaroid are lined up that their polarization directions are initially parallel when one sheet is rotated;

(i) how does the transmitted light intensity vary with the angle between the polarization directions of the polaroid? **[02 marks]**

(ii) what angle must the polaroid be rotated to reduce the light intensity by 50%? **[03 marks]**

(iii) what is the difference between plane of vibration and plane of polarization? **[02 marks]**

4. (a) (i) All vehicles in Tanzania carrying inflammable materials must have long chains by law that hang and drag on the ground. Explain why **[02 marks]**

(ii) Two point charges of 2μC and 6μC repel each other with a force of 12N. If each is given an additional charge of -4μC, what will be the new force? **[04 marks]**

(b) (i) Derive an expression giving the relationship between electric field strength (E) and electric potential (V). **[02 marks]**

(ii) Find the total energy of the system of charges in the diagram below;
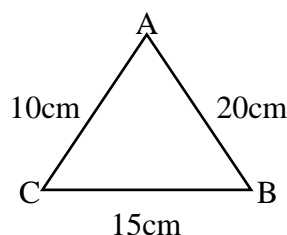
Where charge at;
A: +10μC
B: -75μC and **[04 marks]**
C: 25 μC

(c) A 5μF capacitor is charged by 12v supply and then discharged through a 2MΩ resistor. What will be the charge on a capacitor 5 seconds after the discharge starts? **[03 marks]**

5. (a) (i) Why energy and speed will remain same when a charged particle enters perpendicular and leaves a region containing magnetic field? **[02 marks]**

(ii) A uniform magnetic field is normal to the plane of a circular loop 15cm in diameter and made of copper wire of radius 0.18cm. Determine the rate of change of the magnetic field if an induced current of 7.3A is to appear in the loop. Resistivity of copper is $1.68 \times 10^{-8} \Omega m$. **[04 marks]**

(b) (i) Briefly explain all factors affecting voltage sensitivity of a moving coil instrument. **[03 marks]**

(ii) Estimate the magnetic field intensity of a magnetized substance in which the magnetization is 9×10^5 Am^{-1} and magnetic field density is 5.3T. **[02 marks]**

(c) Figure below shows the variation of intensity of magnetization (I) versus the applied magnetic field intensity (H) for two magnetic materials P and Q.
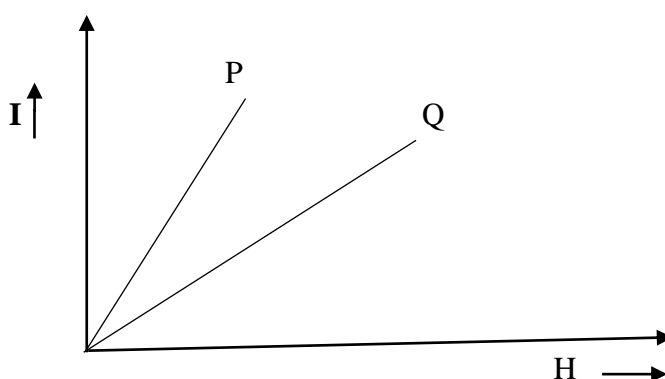
(i) Identify materials "P" and "Q" **[02 marks]**

(ii) Plot the variation of "I" with temperature "T" for materials "P" and "Q" **[04 marks]**

(d) The current in an inductor of inductance 3.4H is given by;
$$I = 6t^2 + 22t + 47 \text{ Amperes}$$
Find the expression for induced emf. **[03 marks]**

6. (a) (i) How many lines can be drawn in the energy level of hydrogen atom? Give a reason. **[02 marks]**

(ii) Radioactive process is "random" and "spontaneous". Comment on this statement. **[02 marks]**

(b) The current in water cooled x-ray tube operating at 60kv is 30mA. 99% of the energy supplied to the tube is converted into heat energy at the target and is removed by water flowing at the rate of 0.06kgs^{-1}. Calculate:

(i)   The rate at which energy being supplied to the tube   **[02 marks]**
(ii)   The increase in temperature of the cooling water.   **[03 marks]**

(c) The energy level of hydrogen atom is given by the expression;
En = - 2.16 x 10^{-18}/n^2 Joules. Where "n" is integer
(i) What is ionization energy of atom?   **[02 marks]**
(ii) What is wavelength of the line, which arises from transition between n = 3 and
n = 2 levels?   **[03 marks]**

(d) A small volume of a solution which is contained in a radioactive isotope of sodium
had an activity of 12,000 disintegration per minutes when it was injected into the
blood stream of a patient. After 30 hours the activity of $1cm^3$ of the blood was found
to be 0.5 disintegration per minutes. If the half life of sodium isotope is taken as 15
hours. Estimate the volume of the blood in the patient.   **[06 marks]**

Wabillah Tawfiiq