MAASAI   MARA UNIVERSITY

REGULAR UNIVERSITY EXAMINATIONS
2018/2019 ACADEMIC YEAR
FIRST YEAR SECOND SEMESTER

SCHOOL OF SCIENCE
BACHELOR OF SCIENCE

COURSE CODE: PHY 1207
COURSE TITLE: PROPERTIES OF MATTER

DATE: 17/04/2019   **TIME: 0830 – 1030 AM**

INSTRUCTIONS TO CANDIDATES
1. Answer Question **ONE** and any other **TWO** questions
2. Use of sketch diagrams where necessary and brief illustrations are encouraged.

3. Read the instructions on the answer booklet keenly and adhere to them.

USEFUL INFORMATION
Density of water = 1000kg/m³
Youngs Modulus for steel = 22×10^{10} Nm^{-2}
Atomic mass = 1.66x10^{-27} kg

QUESTION ONE (30 MARKS)
   (a)   State ONE main difference between 'Plum and Pudding' model and Rutherford's model of the atom
                (2 Marks)

   (b) (i) What limitations did Rutherford's model of the atom have

                                                                (3 Marks)

      (ii) How were the limitations in (i) above addressed by Bohr's postulates
            (3 Marks)

   (c)   Name ANY THREE assumptions that are put in consideration when modeling an ideal gas
                (3 Marks)

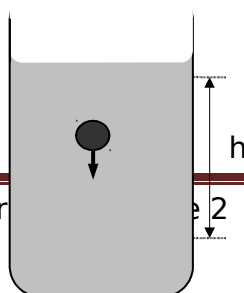   (d) Discuss ANY TWO areas where the Archimedes principle of floatation is applied
                (4 Marks)
   (e)   (i) State Stoke's Law for a viscous fluid
            (2Marks)
      (ii) A steel ball of radius r, density σ and mass M) is released in a viscous liquid of density ρ and allowed to fall vertically under gravity (see Fig. below),

h

Indicate all the forces acting on the ball as it falls down the fluid

(3 Marks)

(f) On the same plot, sketch the relationship between stress and strain of
   (i)   A barbed wire used for farm fencing   **(2 Marks)**
   (ii)   A rubber band used for clipping hair piece   **(2 Marks)**
   (iii)   A kitchen water glass   **(2 Marks)**

(g)   (i) Name ANY Two areas where X-rays are applied in day to day activities
         (2 marks)
   (ii) What is the main difference between solids and gases in terms of their material properties?
         (2 marks)

QUESTION TWO (20 MARKS)
(a) Name any THREE types of bonding that is found in solids **(3 Marks)** (b) (i) What is the meaning of Bond Strength of solids?
         (2 Marks)

   (ii) Show that from Bohr's second and third postulates, for an electron orbiting about a an orbital number n of radius r, the energy possessed by the electron is given by

$$T = -\frac{Z^2 m e^4}{8 h^2 \varepsilon_o^2} \left(\frac{1}{n^2} \right)$$

   Where n = orbital number
         h = Planck's constant
         Z = atomic number of the element
         m = atomic mass

e = quantity of charge

ε_o = permittivity in vacuum **(7 Marks)**

(c) A steel piano wire of length 1.8m and radius 0.3 mm is subjected to a tension of 70 N by a weight attached to its lower end. By how much does this wire stretch in excess of its initial length? (Young's modulus for steel is).
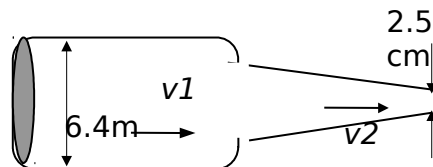
(8 Marks)

QUESTION THREE (20 MARKS) Fluid dynamics

(a) Name the three forms of energy a fluid in motions carries **(3 marks)**

(b) Discuss ANY THREE areas where Bernoulli's principle is applied in our day to day lives
   (6 Marks)

(c) The pressure in a firehose of diameter 6.4 cm is 3.5×10^5 Nm^{-2} (Figure below). The firehose ends in a metal strip of diameter 2.5cm.

(i) Determine the velocity of water at the nozzle if the flow rate in the hose is 400cm^3 per second
   (6 Marks)

(ii) Determine the pressure of the water in the tip. **(5 Marks)**

QUESTION FOUR (20 MARKS)

(a)(i) Briefly describe how heat transfer occurs by convection
   (4 Marks)

(ii) Briefly describe how the concept of heat transfer by convection is applied in harnessing wind power
   (6 Marks)

(b) Show that Pressure (P) –Temperature (T) – Volume (V) of an ideal gas is given by

$$PV = RT$$

Where R is the universal gas constant   **(6 Marks)**

(c) Calculate the root-mean-square speed of oxygen molecules in air at 27 °C.

(4 Marks)

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