



# **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 =  $1000\text{kg/m}^3$

Youngs Modulus for steel =  $22 \times 10^{10} \text{Nm}^{-2}$

Atomic mass =  $1.66 \times 10^{-27} \text{kg}$

**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)**

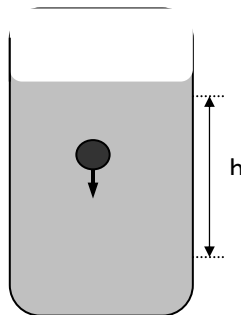
(ii) How were the limitations in (i) above addressed by Bohr's postulates **(3 Marks)**

(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  $\sigma$  and mass  $M$  is released in a viscous liquid of density  $\rho$  and allowed to fall vertically under gravity (see Fig. below),



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

$$T = -\frac{Z^2 m e^4}{8 h^2 \epsilon_0^2} \left( \frac{1}{n^2} \right)$$

Where  $n$  = orbital number

$h$  = Planck's constant

$Z$  = atomic number of the element

$m$  = atomic mass

$e$  = quantity of charge

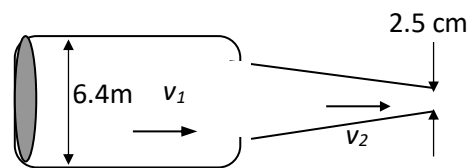
$\epsilon_0$  = permittivity in vacuum

**(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  $3.5 \times 10^5 \text{ Nm}^{-2}$  (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  $400\text{cm}^3$  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)**

**//END**