MENGO SENIOR SCHOOL

3RD TERM EXAMINATION – 2000
S.5 PHYSICS
PAPER I

TIME: **2 :30 MINUTES**

INSTRUCTIONS

- *Attempt **5** numbers, with atleast 2 from each section.*
- *Graph papers are provided*
- *Where necessary, assume;*
  Acceleration due to gravity $g = 9.81ms^{-2}$
  Density of water = $1.0 \times 10^3\ kgm^{-3}$
  Density of steel = $7.80 \times 10^3\ kgm^{-3}$.

SECTION A

1. a) i) What is Young's Modulus of elasticity? *1 mark*

ii) Draw and explain the features of a stress strain curve for a ductile material. *5 marks*

b)

One end of a spring S is fixed at point P and the other fixed on a block B of mass 1kg, which lies on a smooth horizontal plane. The block is pulled to stretch S through as extension of 20 cm. If S has a force constant of 400Nm^{-1}.

i) What is the potential energy stored is S when stretched? 1 *marks*

ii) What is the velocity the block will move with when it is just released? 1 *mark*

c) The ends of a uniform wire of cross-sectional area 3 x 10-6m2 and negligible mass are attached to 2 fixed points A and B, 1m apart. The wire is initially straight and unstretched. A mass of 0.5kg is attached to the midpoint of the wire and hangs in equilibrium with the midpoint at a distance 10mm below AB. Calculate YM for the wire. *5 marks*

d) i) Derive an expression for the energy stored is a wire of Young's modulus E, length L, when stretched through a distance e. (3 *marks*)

ii) Describe the experiment used to determine Young's modulus of a wire and state any precations taken. *(3 marks)*

2. a) What is meant by the terms:

i) Terminal velocity

ii) Coefficient of viscosity *(1 mark)*

b) Derive an expression for the terminal velocity of a steel ball bearing of radius r and density …. , falling through a liquid of density ….. and coefficient of viscosity ….. . *3 marks*

c) The table below gives the time of fall of steel spheres of different diameters falling through a distance of 60cm is a viscous fluid of density 1.26 x 10^3 kgm^{-3}.

Timet (S) x 10^{-2}	8.36	6.89	5.80	4.93
Diameter, d(mm)	2.0	2.2	2.4	2.6

i) Calculate the uniform speed Vo of each steell ball. *2 marks*

ii) Plot a graph of Vo against d^2. *4 marks*

iii) Use the graph in (ii) above to find the viscosity of the liquid 3 *marks*

d) i) Explain the origin of viscosity in a gas.
ii) Describe the effect of temperature on the viscosity of the gas.

3. a) i) Define the term pressure at a point in a fluid *1 mark*
iii) Show that the pressure at a given depth is a liquid contained in a vessel is independent of the cross sectional area of the vessel.

b) A block of metal of dimension 8cm by 8cm by 8 cm floats vertically at the interface between water and mercury as shown.

The lower surface of the block is 1.0cm below the interface.
Calculate the density of the metal, given that the densities of water and mercury are 1000kgm-3 and 13.6 x 10-3 respectively. *3 marks*

c) The figure below shows a soap bubble formed at the end E of a tube connected to a manometer.

i) Describe how the diameter of the bubble and the pressure h of the liquid in the manometer can be measured. *3 marks*

ii) Given that the density of the liquid in the manometer is $8.0 \times 10^{2} kgm^{-3}$, the surface tension of the soap solution is $5.0 \times 10^{-4} m$. Calculate the value of h. Assume the angle of contact between the glass and liquid to be zero. *3 marks*

d) Explain briefly how the molecular theory of matter accounts for the existence of surface tension. What is the effect of temperature on surface tension, and how is it accounted for? *6 marks*

4. a) i) Define the moment of a force. *1 mark*
iii) What conditions are necessary for a body to be in equilibrium? *1mark*
iv) A uniform beam AB, 3.0m long and weighing 6kg is hinged to a wall at A, and is held horizontally by a rope attached to B and joined to a point

C is the wall, 4.0m vertically above A. Find the tension T in the Rope, and the reaction R of the hinge, if tan θ = ¾ *5 marks*

b) What is meant by the terms:

i) Free fall *1 mark*

ii) Relative velocity *1 mark*

iv) A ball is dropped from a tall building. One second later, another ball is thrown with a speed of $30ms^{-1}$ vertically downwards. Determine when and where the 2 balls meet. *4 marks*

c) A stone of mass 0.5kg is whirled round on the end of a 0.8 long string is a vertical circle. If the speed of the stone is $4ms^{-1}$.

i) At which point in the circle is the tension in the string a minimum and what is its value? *2 marks*

ii) At which point in the circle is the tension in the string a maximum and what is its value? *2 marks*

d) Show that the path followed by a projectile is a parabola. *2 marks*

SECTION B:

5. a) i) What qualities make a particular thermometric property suitable for use in a practical thermometer? *2 marks*

iii) List four thermometric properties which are used in thermometry 2 marks

b) i) With reference to an electrical resistance thermometer, outline the essential steps involved in the setting up of a celsius temperature scale *3 marks*

iii) What advantages and disadvantages are there in using a platinum resistance thermometer? *3 marks*

c) i) The temperature on a resistance thermometer is given by: $R\theta = R_o (1 + \alpha \theta)$, where is the temperature coefficient of resistance of the metal of the resistance thermometer.

The resistance of the thermometer is 3.49… at 40°C and 3.56…. at 50°C. What is α ?

What is the temperature of a liquid in which the thermometer has a resistance of 3.79….? *4 marks*

i) Calculate the minimum detectable change of temperature, given that the least change in resitance of the thermometer that can be detected is 0.02 ….? *4 marks*

6. a) i) Define specific Heat capacity and give the units in which it is measured *2 marks*

ii) Explain how you would determine the specific Heat Capacity of a piece of copper. State any assumptions and precautions taken. *6 marks*

b) A metal of mass 500g is heated to 120^{o}C and dropped into 100g of water of 20^{o}C, contained in a copper can of mass 200g and specific Heat capacity 0.43KJkg^{-1}k^{-1}. The final temperature reached by the mixture was 45^{o}C. Due to heat losses, a cooling correction of 4.1C was recorded. What is the specific Heat Capacity of the metal? *4 marks*

c) i) The temperature of 0.45kg of water in a calorimeter of Heat capacity 80JK^{-1} is increased from 288K to 352K in 480S by an electrical heater. Neglecting heat losses, calculate the power of the heater. *3 marks*

iii) When the heater is placed in 0.50kg of paraffin in a similar vessel at the same temperature, the temperature rises to 341k in 240S. Calculate the specific Heat Capacity of paraffin. *3 marks*