MENGO SENIOR SCHOOL

MID TERM 3 EXAMS 2003

S.5 PHYSICS

PAPER 1

TIME: 2 ½ HOURS

INSTRUCTIONS:
-Attempt any five questions
-Where necessary take,
Acceleration due to gravity, g, = 9.81m/s^2
Electronic charge, e, = 1.6 x 10^{19}C
Avogadros number N_A = 6.02 x 10^{-23} mol^{-1}
Electron mass Me = 9.11 x 10^{-31}kg
Faraday's constant, F, = 96500C

1(a) What is meant by the terms stress, strain and Young's modulus?
(b) Derive in terms of stress and strain, an expression for the energy stored in a unit volume of a stretched wire.
(c) Explain briefly the physical process involved in a plastic deformation and work hardening of metals.
(d) Compare the elastic properties of steel and glass. Draw using the same axes, the stress-strain curves for the two materials.
(e)(i) State Hooke's law of elasticity.
(ii) A metal wire of length 2.75m and mass 2.0 x 10^3kg stretches by 1.0 x 10^{-3}m. When a force of 750N is applied. If the density of metal is 8.0 x 10^3kgm^{-3}. Calculate the Young's Modulus for the metal and the energy stored in the wire.

2(a)(i)State the laws of friction.
(ii)Explain the laws of friction
(iii)Describe how you determine the coefficient of dynamic friction.

(b) A particle A of mass 3kg rests on a rough plane inclined at 30^0 to the horizontal, the coefficient of friction between the particles and the plane being, 0.10. It is connected by a light inextensible string passing over a smooth pulley at the top edge of the plane to a particle B of mass, 2kg which hangs freely. Find the acceleration of the system when it's released from rest.

(c) State any three instances where friction is:
(i) a nuisance
(ii) helpful

3(a)(i) State Newton's laws of motion.
(ii) A car of mass m_1 moving with velocity u, on a straight line made a head on collision with a lorry of mass m_2 moving in the opposite direction with velocity u_2. After collision, the vehicles move with velocities v_1 and v_2 respectively in the direction of the lorry.

Use Newton's laws of motion to show that the total linear momentum is conserved.

(b) To one end of a light string passing over a fixed pulley is attached at a particle of mass 3kg and to the other end a light movable pulley over which particles of masses 6kg and 2kg are attached.

(i) Why is the string, light?
(ii) Draw a clear diagram of the forces acting.
(iii) Find the acceleration of each particle and the tension in the strings.

4(a)(i) Distinguish between Laminar and turbulent flow.
(ii) Write down Bernoulli's equation, defining all symbols used.

(b) Describe a simple experiment to demonstrate:
(i) Stream line flow
(ii) Bernoulli's effect

(c)(i) State Archimede's principle.
(ii) Use a rectangular block immersed in a liquid to verify Archimede's principle.

(d) A string supports a solid ball of mass 250g totally immersed in a liquid of density $780kgm^{-3}$. Calculate the tension in the string if the density of steel is $7800kgm^{-3}$.

5(a)(i) What are cathode rays?
(ii) State the properties of cathode rays.
(iii) Explain why the discharge tube is not a convenient way of producing and studying cathode rays.

(b) Show that the path of an electron beam in an electric field is parabolic.

(c) An electron gun operating at 3×10^3V is used to project, electrons into the space between two oppositely charged parallel plates of length 10cm and separation 5cm. Calculate the deflection of the electrons as they emerge from the region between the charged plates when the potential difference between the plates is 1×10^3V.

6(a)(i) What is a basic unit of charge.

(ii) Use faraday's law of electrolysis to show that $e = 1.60 \times 10^{-19}$C.

(b)(i) Describe Millikan's experiment for determining the charge on an oil drop.

(ii) An oil drop of mass 3.25×10^{-12}g falls vertically with uniform velocity between two parallel, vertical plates 2cm apart. When a potential difference of 1000V is applied between the plates, the path of the drop is inclined at 45^0 to the vertical. Calculate the charge on the drop.

(c) A charged oil drop of mass 3.27×10^{-15}kg is held stationary between two horizontal metal plates across which a p.d of 1.0kV is applied. If the separation of the plates is 1.5cm, find the number of electrons on the drop.

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