MENGO SENIOR SCHOOL

MID TERM 2 EXAMS 2003

S.5 PHYSICS PAPER 1

TIME: 2 HOURS

INSTRUCTIONS;
- Draw a table indicating numbers attempted.

1. Attempt all the questions
2. Assume where necessary

- Gravitational acceleration g= 9.81ml
-Universal Gravitational content G=6.67 x 10^{-11} Nm^2kg^{-2}
-Radius of the earth = 6.4 x 10^3 km
-Mass of the Earth = 6.0 x 10^{24}kg

1(a) Find the resultant force for the following system of forces.

(b) State the conditions for a system of three coplanar forces to be in equilibrium.

(c)(i) Distinguish between scalar and vector quantities and give two examples of each.

(d)(i) State Newton's laws of motion.

(ii) The diagram below shows a block X of mass 2kg placed on a rough plane inclined at an angle of 30^0 to the horizontal. A string which is parallel to the plane and passes over a light smooth pulley connects X to another block Y of mass 3kg.

If the coefficient of friction between block X and the inclined plane is 0.3, Find:

(i) The acceleration of the system.

(ii) The tension in the string.

2(a) State what is meant by the following:

(i) Angular velocity

(ii) Period

(b) Derive an expression for the acceleration of a body moving along a horizontal circular path with a uniform speed V.

(c) A stone of mass 0.5kg is attached to a string of length 0.5m which will break if the tension exceeds 20N. The stone is whivled in a vertical circle, the axis of rotation being at a height of 1m above the ground. The angular speed is gradually increased until the spring breaks.

(i) In what position is this break likely to occur?

(ii) Find the angular speed at that instant.

(iii) Where will the stone hit the ground?

(d) Two strings of force constants K_1 and K_2 are suspended from a horizontal support. A mass M hangs from the lower ends of the springs as shown in the diagram.

If both springs have negligible mass, show that when m is displaced from its equilibrium position it describes SHM of frequencies

$$F = \frac{1}{2\pi}\frac{K_1 + K_2}{m}$$

3(a) State Newton's law of universal Gravitation and give the units of the gravitational constant.

(b) Use the law in a above to show that the square of the period of a satellite in orbit is proportional to the cube of the radius of the orbit.

(c) A satellite of mass 250kg moves in a circular equatorial orbit of a distance of 500km above the surface of the Earth. Find:

(i) Radius of its orbit
(ii) Its speed
(iii) Its period
(iv) The total energy of the satellite

(d) Define the term gravitational potential at a point.

(e)(i) Sketch a graph to show the variation of the acceleration due to gravity with distance from the centre, assuming the Earth is spherical.

(iii) At what distance away from the earth's surface will the acceleration due to gravity be one – eighth of its value at the earth's surface?

4(a)(i) State the principle of conservation of linear momentum.

(ii) Show how Newton's laws of motion can be applied to arrive at the principle stated in (a)(i).

(b) State two conditions for a body to be perfectly elastic.

(c) A spherical marble at rest, at a height of 10m above a concrete floor is released and falls vertically to the floor. If the coefficient of restitution of its impact is 0.8, Find:

(i) The height to which it rites after bouncing once.
(ii) The time between the first and second impacts with the floor.

(d)

An inelastic string OA has its end 0 fixed. A particle A of mass 100g is fixed at the other end and held to that the string is taught, and horizontal. A is released to that at its lowest position it collides directly with another particle B of mass 80g moving in the opposite direction at 3m/s, so that the two coalece. Find:

(i) The velocity first after the impact.
(ii) The maximum height above the point of collition to which the combination rites.

END