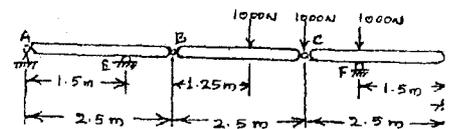D

B.Tech. Degree I & II Semester Examination in Marine Engineering May 2014

MRE 1105 ENGINEERING MECHANICS

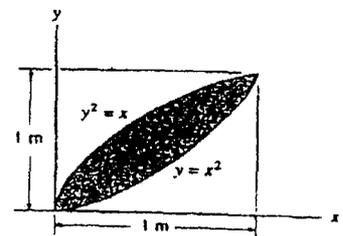Time: 3 Hours   Maximum Marks: 100

I. (a) Three beams AB, BC and CD are hinged at their ends and loaded and supported as shown below. Determine the reactions at the points A, E, F and D. (16)

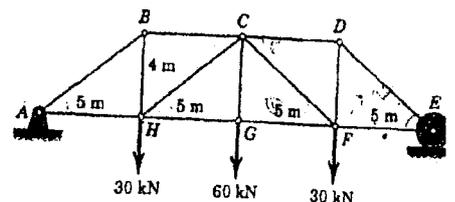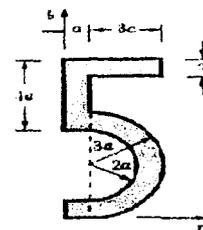   (b) Locate the centroid of the shaded area shown in the figure.

OR

II. (a) Determine the forces in all the members of the truss shown in the figure. (16)

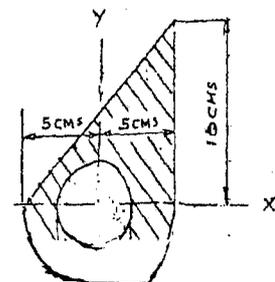   (b) Determine the coordinates of the centroid C of the number shown in the figure.

III. (a) Define product of inertia, principal axis and principal moment of inertia. (17)
     (b) Calculate the moment of inertia of the shaded area with respect to the centroidal axis parallel to the X axis shown in the figure.
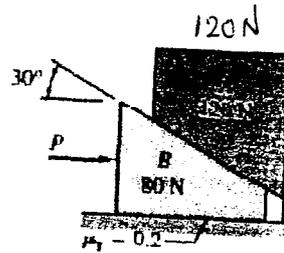
OR

IV. (a) Find the product of inertia I_{xy} of a circular quadrant of radius 'r'.   (17)

      (b) Referring to the figure find the necessary relation between r and b so that X and Y axes will be principal axes for the composite area.
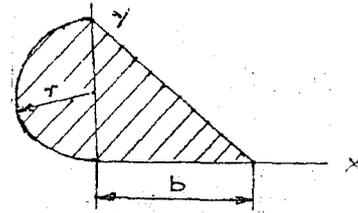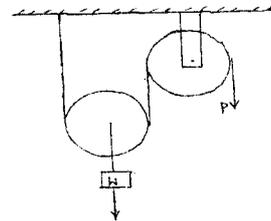
V. Determine the range of P for which the system of two blocks in the figure will be in equilibrium. Friction is negligible except for the surface under block B.   (17)
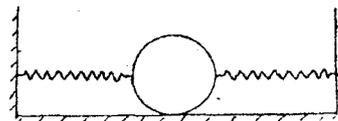
OR

VI. A weight 'W' of 1000N is to be raised by a system of pulleys as shown below. Using the principle of virtual work find the value of the force P which can hold the system in equilibrium.   (17)

VII. (a) Each of the two springs shown in the figure has a spring constant of 150N/m and the attached ball has a mass of 400g. Find the period of oscillation of the ball. Neglect friction. Also determine the velocity with which the ball passes the middle position if it was initially displaced 30mm to the right.   (16)

      (b) A hammer of mass 1200Kg is dropped from a height of 70cm on a pile of mass 400kg. Determine the average resistance of the ground if the pile comes to rest after penetrating 6cm into the ground.
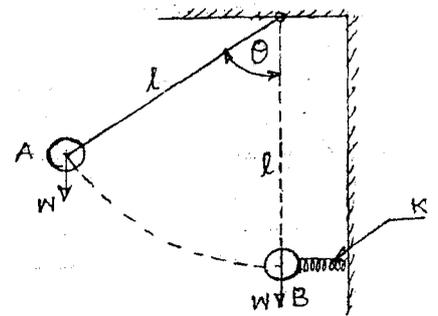
OR

VIII. (a) The initial velocity of a particle moving along a straight line is 6m/sec. The particle moves with an acceleration defined by the relation $a = b - ct$, where 'a' is in m/sec^2, 't' is in seconds and b and c are constants. The particle moves 96m in 12 seconds and comes to rest. Determine the constants b and c.   (16)

      (b) Neglecting friction and inertia of the two step pulley shown in the figure find the acceleration of the falling weight 'P' by D'Almbert's principle. Assume P = 8N, Q = 12N and $r_2 = 2r_1$.
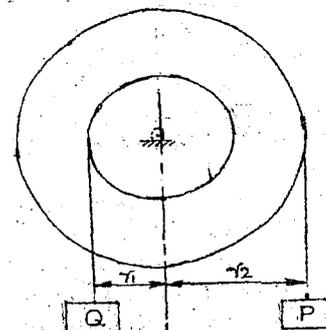
IX. (a) A simple pendulum of weight W = 10N and length l = 1.2M as shown in the figure is released from rest at A, when $\theta = 60°$, swing downward under the influence of gravity and strikes a spring of stiffness K = 10N/cm at B. Neglecting the mass of the spring determine the maximum compression of the spring. (17)
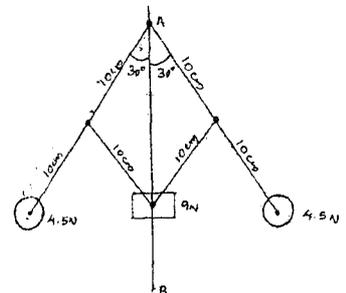
(b) Referring to figure calculate the minimum speed 'u' with which a motor cycle rider must leave the 15° ramp at B in order to clear the ditch.
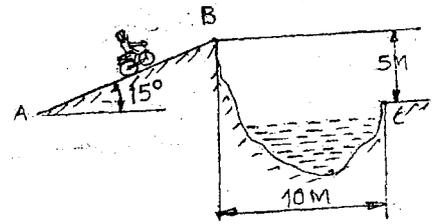
OR

X. The collar weighing 9N, of a governor as shown below can slide freely on a vertical shaft AB. At what uniform speed about the axis AB will the 4.5N fly balls lift the sliding weight free of its support?
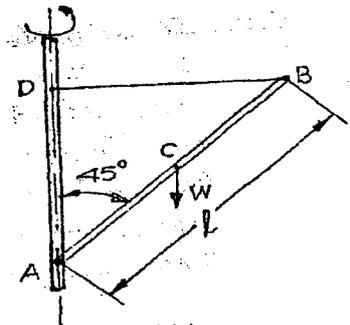Neglect the weights of the bars and friction. (17)

XI. (a) The armature of an electric motor has angular speed 1800 rpm at the instant the power is cut off. Find: (17)
   (i) The angular deceleration 'α' assuming that it is constant if the armature comes to rest in 6 seconds.
   (ii) How many complete revolutions does the armature make during this period?

(b) The rotor of a flywheel is governed by the equation $w = 3t^2 - 2t + 2$ where 'w' is in radian per second and 't' is in second. After one second from the start the angular displacement was 4 radians. Determine the angular displacement, angular velocity and angular acceleration of the fly wheel when $t = 3$ second.

OR

XII. A slender bar AB of length $l = 2M$, weight W = 25N is attached to a vertical shaft and supported with a horizontal string as shown in the figure. Calculate the tension 'T' in the string BD if the system rotates with constant angular velocity 600 rpm about the vertical axis AD. (17)

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