B.Arch. (Architecture) First Semester Final Examination, November 2011

ENGINEERING MECHANICS (AM 101A)

Time: 3 hours **Full Marks: 70**

*Answer any **Six** questions taking **Three** from each half*

Each question carries equal marks

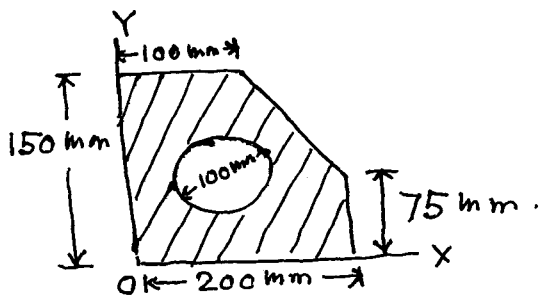
2 marks kept reserved for neatness in each half

Assume suitable data, if required

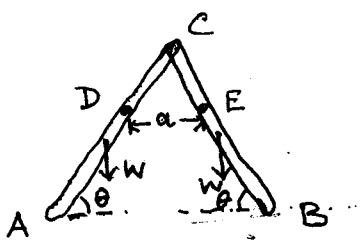
Notations used have their conventional meaning

FIRST HALF

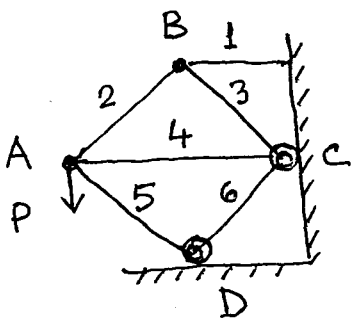
Q.1. Determine the co-ordinates x_c and y_c of the center of a 100 mm diameter circular hole cut in a thin plate so that this point will be the centroid of the remaining shaded area.



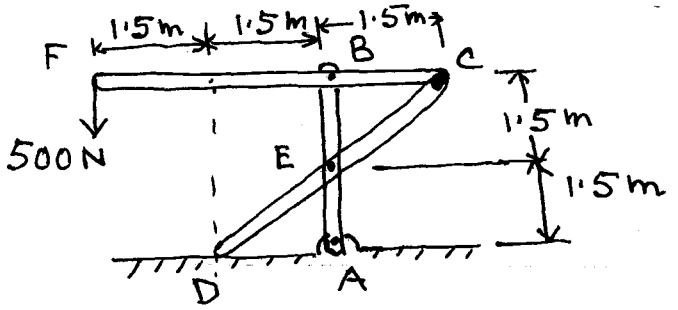
Q.2. Two slender prismatic bars AC and BC, each of length, l and weight W are hinged together at C and supported in a vertical plane by two pegs at D and E. Neglecting all friction, find the angle, θ that each bar will make with the horizontal in the condition of equilibrium.



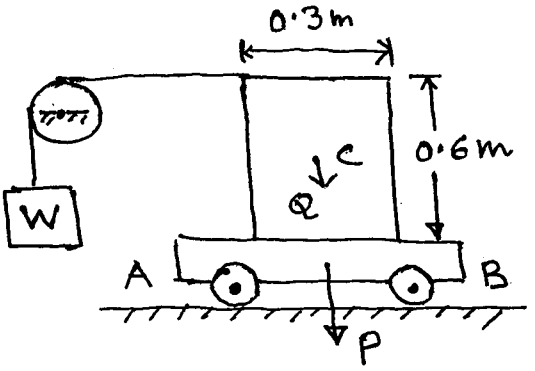
Q.3. Determine the magnitude and nature of axial force in each bar of the plane truss supported and loaded as shown in figure. ABCD is a square and AC is horizontal. Show result in tabular form.



Q.4. Calculate the shear forces on the pins A, B, C and E of the plane frame supported and loaded as shown in the figure. Neglect weight of the members and assume smooth horizontal floor. At A there is hinge support.



Q.5. A rectangular block of weight, Q = 890 N rests on a flat car of weight, P = 445 N which may roll along the horizontal plane AB without friction. The car and block together are to be accelerated by the weight W arranged as shown in the figure. Assuming that there is sufficient friction between the block and the car to prevent sliding, find the maximum value of the weight W by which the car can be accelerated. What will this acceleration be ?



SECOND HALF

Q.6. Two smooth circular cylinders (refer to Fig. Q6), each of weight, $W = 445$ N and radius, $r = 152$ mm are connected at their centers by a string AB of length, $l = 406$ mm and rest upon a horizontal plane, supporting above them a third cylinder of weight, $Q = 890$ N and radius, $r = 152$ mm. Find the force, S in the string and the reactions at the points of contact D and E.

Q.7. A smooth right circular cylinder of radius, r rests on a horizontal plane and is kept from rolling by an inclined string AC of length, $2r$. A prismatic bar AB of length, $3r$ and weight, Q is hinged at point A and leans against the roller. Find the tension, S in the string AC. (refer to Fig. Q7)

Q.8. Two blocks having weights W_1 and W_2 are connected by a string and rest on horizontal planes. If the angle of friction for each block is ϕ, find the magnitude and direction of the least force, P applied to the upper block that will induce sliding. (refer to Fig. Q8)

Q.9. Two heavy right circular rollers of diameters D and d respectively rest on a rough horizontal plane. The larger roller has a string wound around it to which a horizontal force P can be applied. Assuming that the coefficient of friction μ has the same value for all surfaces of contact, determine the necessary condition under which the large roller can be pulled over the small one. (refer to Fig. Q9)

Q.10. Determine the coordinates x_c and y_c of the centroid C of the area between the parabola $y = \frac{x^2}{a}$ and the straight line $y = x$. (refer to Fig. Q10)

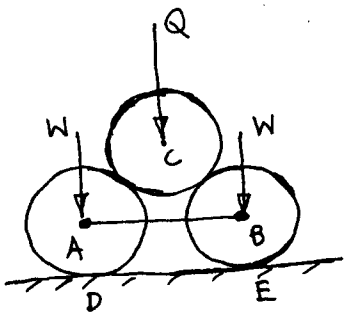


Fig. Q6

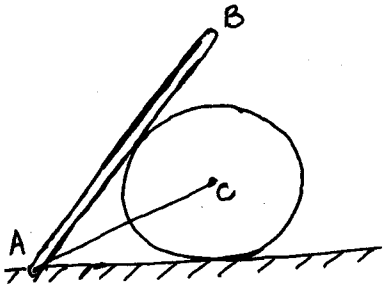


Fig. Q7

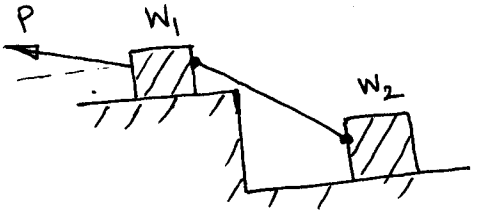


Fig. Q8

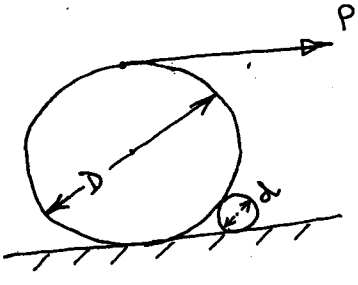


Fig. Q9

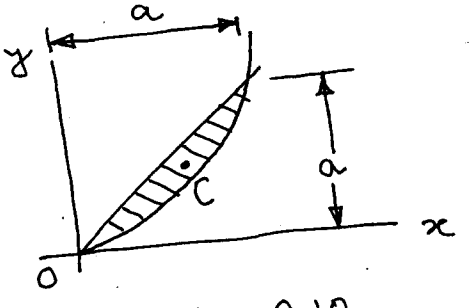


Fig. Q10