BACHELOR OF COMPUTER SCIENCE ENGINEERING EXAMINATION (Old), 2017

(1st Year, 1st semester)

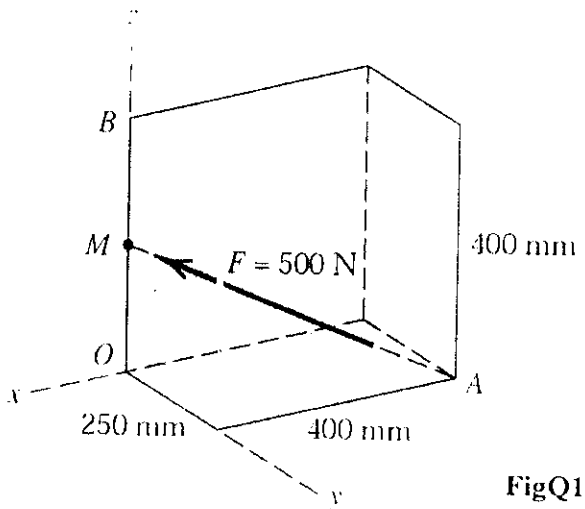
Engineering Mechanics

Time:3.0Hrs. **Full Marks:100**

Answer any Five (5) Questions

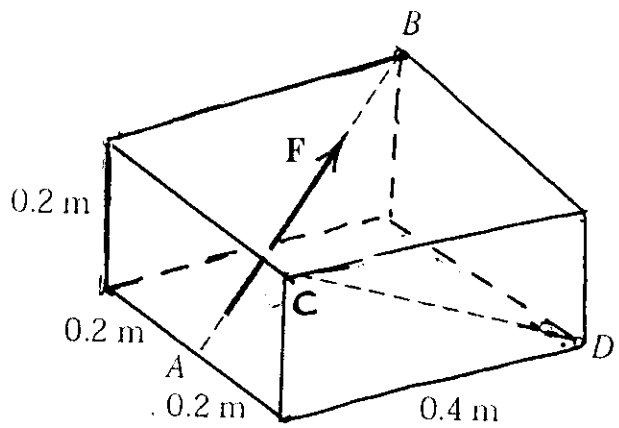
[*Assume missing data, if any, with proper justifications. Take* $g = 9.81\ m/s^2$ *unless mentioned otherwise.*]

Q1(a) The force F has a magnitude of **500 N** and acts along the line AM, where, M is the midpoint of the vertical side OB of the parallelepiped. Express F as its magnitude times the appropriate unit vector and determine its x, y and z scalar components. Refer to **FigQ1(a)**. 10



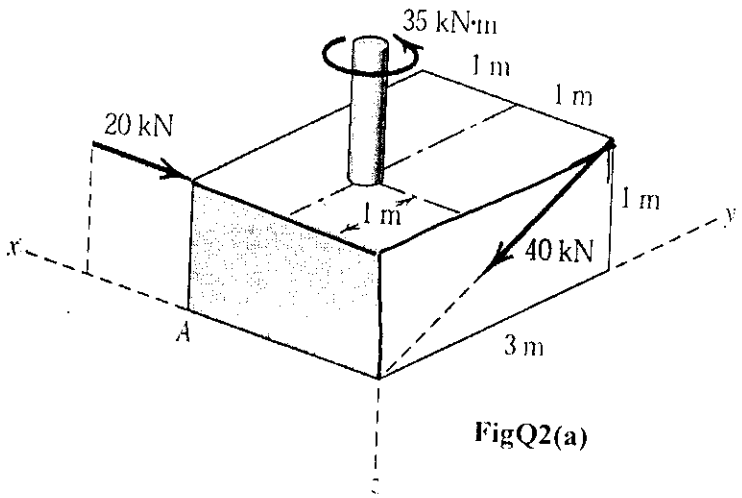
FigQ1(a)

(b) The force F has a magnitude of **2 kN** and is directed from A to B. Calculate the projection F_{CD} of **F** onto line CD and determine the angle θ between **F** and CD. Refer to **FigQ1(b)**. 10



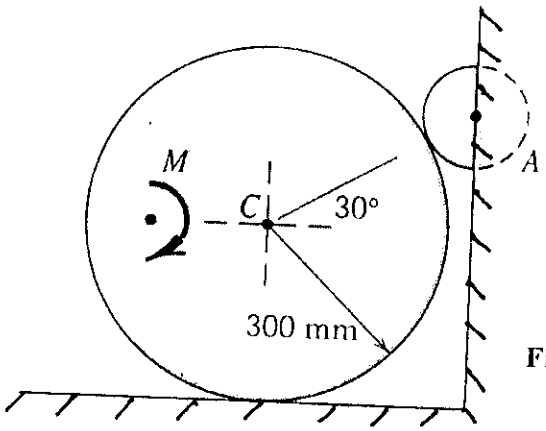
FigQ1(b)

Q2(a) Replace the two forces and single couple by an equivalent force-couple system at point *A*.



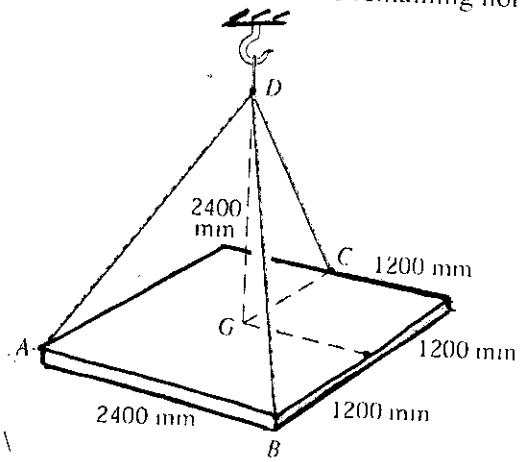
FigQ2(a)

(b) The 100 kg wheel rests on a rough surface and bears against the roller *A* when the couple *M* is applied. If *M*=60 N-m and the wheel does not slip, compute the reaction on the roller *A*. Refer to **FigQ2(b)**. 10



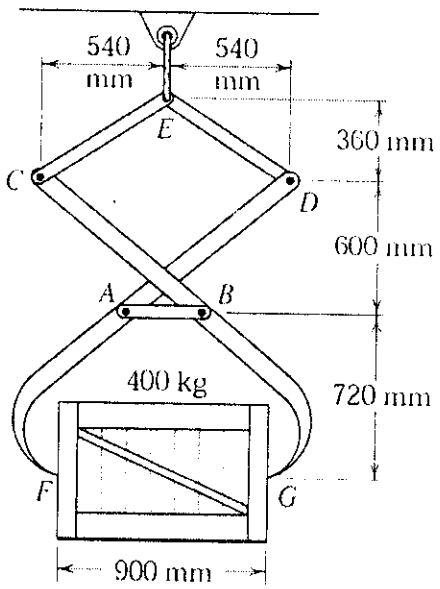
FigQ2(b)

Q3 The square steel plate has a mass of 1800 kg with mass center at its center G. Calculate the tension in each of the three cables with which the plate is lifted while remaining horizontal. Refer to **FigQ3.** 20



FigQ3

Q4(a) Compute the force in link AB of the lifting tongs which cross without touching. Refer to **FigQ4(a)**. 15

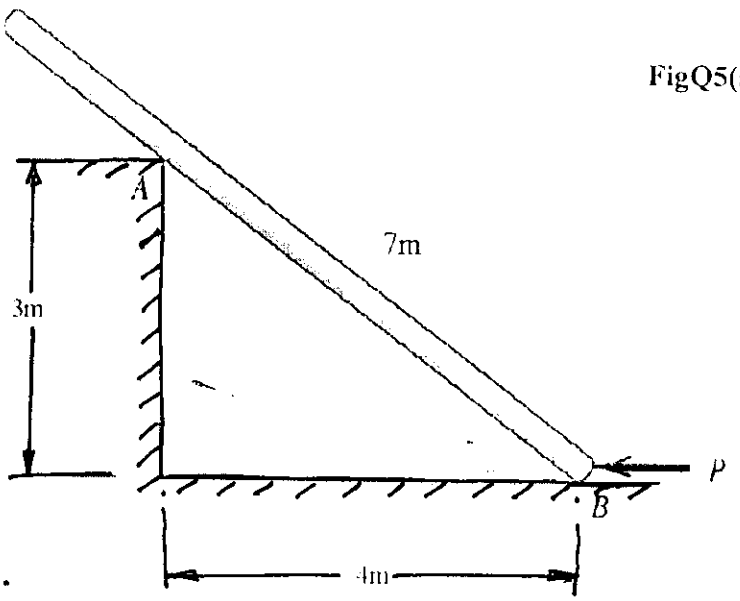


FigQ4(a)

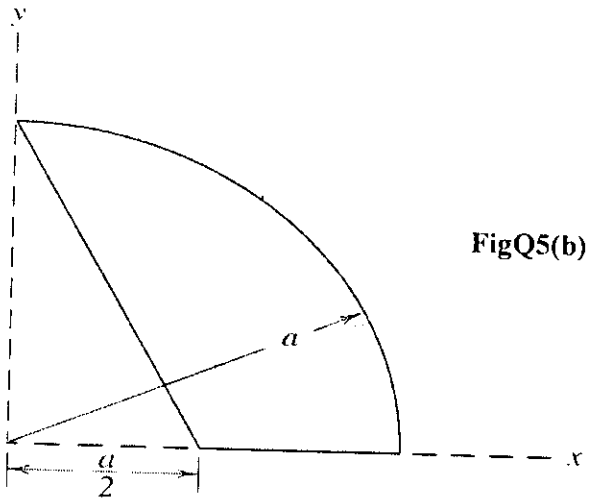
(b) State Pappus and Guldinus theorems with suitable explanations. 5

Q5(a) The uniform 7 m pole weighs 100 kg and is supported as shown. Calculate the force P required to move the pole if the coefficient of static friction for each contact location is 0.40. Refer to **FigQ5(a)**. 10

FigQ5(a)

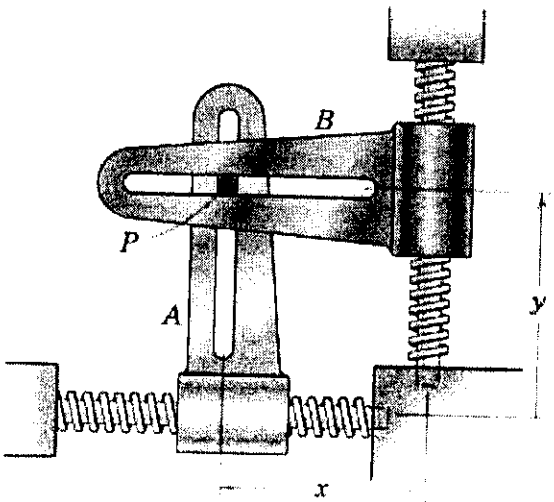


(b)Determine the x- and y-coordinates of the centroid of the shaded area. Refer to **FigQ5(b)**. 10



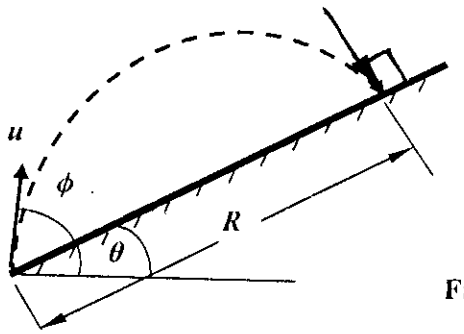
FigQ5(b)

Q6(a) The x- and y-motions of guides A and B with right-angle slots control the curvilinear motion of t connecting pin P, which slides in both slots. For a short interval, the motions are governed by $x = 20 + t^2/4$ a $y = 15 - t^3/6$, where x and y are in mm and t is in seconds. Find the magnitudes of the velocity and accelerati of the pin for $t = 2$ s. Refer to **FigQ6(a)**. 1C



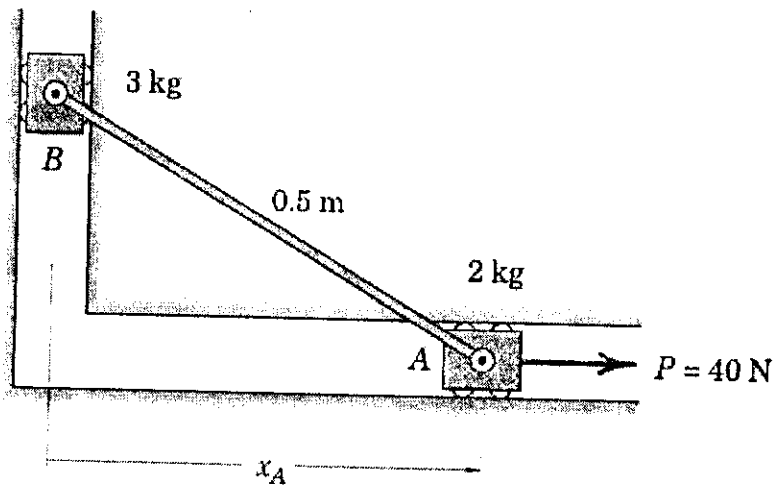
FigQ6(a)

(b)Derive the expression of range R measured along the inclined plane as shown in **FigQ6(b)**. Also, find the condition between the angles θ and ϕ so that the projectile comes and hits the plane squarely (i.e. it hits the inclined plane perpendicularly). 6+4=10



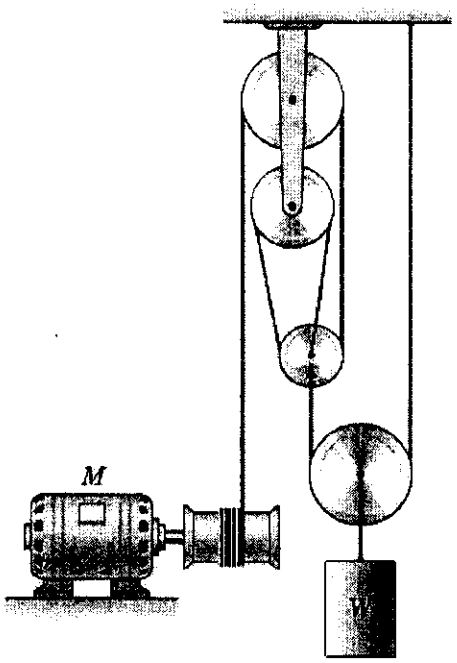
FigQ6(b)

Q7(a) The sliders **A** and **B** are connected by a light rigid bar of length **0.5 m** and move with negligible friction in the horizontal slots shown. For the position where $x_A = 0.4$ **m**, the velocity of **A** is **0.9 m/s** to the right. Determine the acceleration of each slider and the force in the bar at this instant. Refer to **FigQ7(a)**. 12



FigQ7(a)

(b) Determine the vertical rise h of the load W during **10 seconds** if the hoisting drum draws in cable at the constant rate of **180 mm/s**. Refer to **FigQ7(b)**. 8



FigQ7(b)

Q8 Write short notes (***any four***):- 4x5=20

(i) System of forces and their resultants

(ii) Parallel and perpendicular axis theorems on area moment of inertia

(iii) Trajectory of a projectile in air

(iv)Normal-Tangent co-ordinate system in kinematics of particles

(v) Analysis of frames

(vi)Motion of connected systems of particles

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