Ref. No.: Ex/AM/ME/T/A/2019 (Old)

B.E. CIVIL ENGINEERING
FIRST YEAR FIRST SEMESTER EXAM. 2019 (Old)
Subject: ENGG. MECHANICS

Full Marks: 100 Time: 3 Hrs.

Answer any five questions

1. (a) Replace the three forces acting on the bent pipe [shown in **Fig. 1a**] by a single equivalent force **R**. Specify the distance x from point *O* to the point on the x-axis through which the line of action of **R** passes.

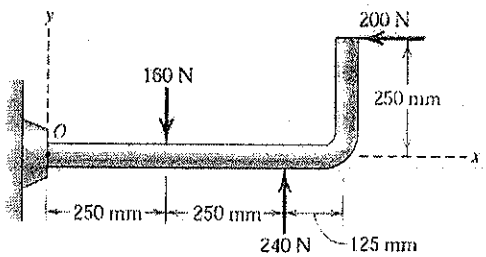

Fig. 1a

(b) Compute the moment M_o of the 1.2 kN force about the axis O-O [shown in **Fig. 1b**].

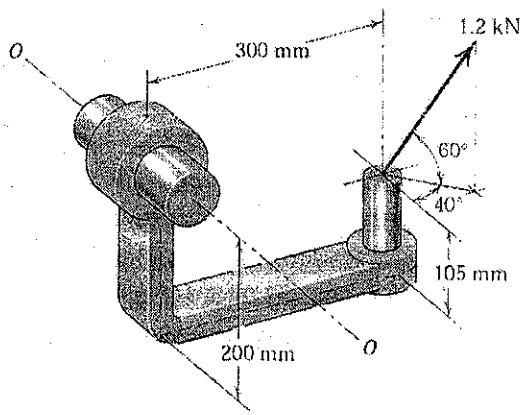

Fig. 1b

[10+10]

2. (a) Determine the force *P* required to begin rolling the uniform cylinder of mass *m* over the obstruction of height *h* [shown in **Fig. 2a**].

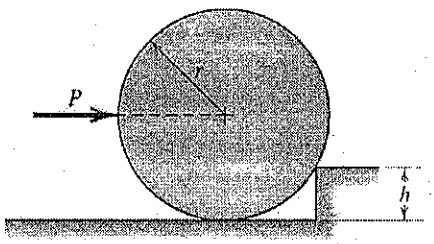

Fig. 2a

(b) Three cable are joined at the junction ring C as shown in **Fig. 2b**. Determine the tensions in cables AC and BC caused by the weight of the 30-kg cylinder.

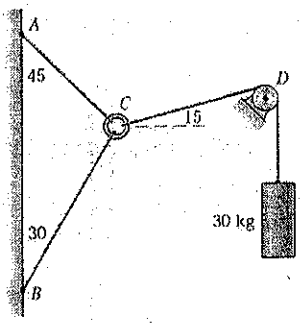

Fig. 2b

[10+10]

3. (a) Two blocks A and B which are identical are supported by a rod inclined to the horizontal as shown in **Fig. 3a**. If the blocks are in limiting equilibrium, find the coefficient of friction assuming it to be the same at both the floor and the wall.

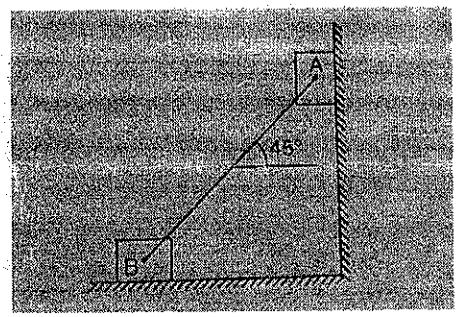

Fig. 3a

(b) A block A of weight 1000 N rests on a block B of weight 2000 N which rests on a rough horizontal floor. The block A is tied to a wall by a cable at 30^0 with the horizontal. Find the minimum horizontal force P required [as shown in **Fig. 3b**] to just move the block B to the right. Find also the tension in the cable. Take coefficients of friction of all contact surfaces 0.3.

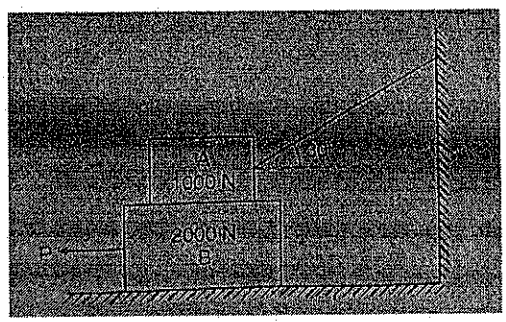

Fig. 3b

[10+10]

4. (a) Calculate the moment of inertia of the shaded area [as shown in **Fig. 4a**] about the *x*-axis.

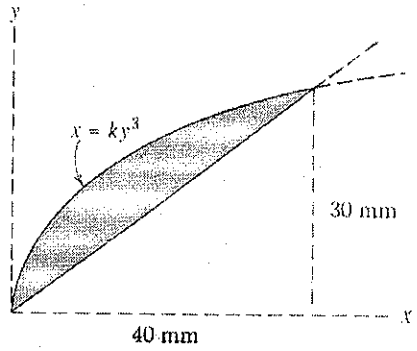

Fig. 4a

(b) Compute the volume of the solid generated by revolving the right triangle about the z axis through 180^0 [as shown in **Fig. 4b**].

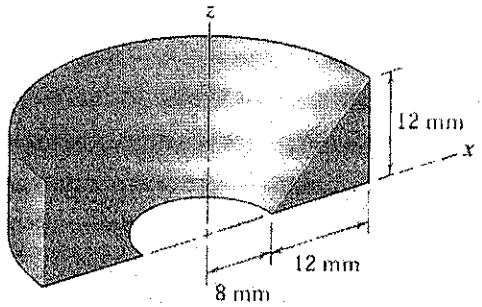

Fig. 4b

[10+10]

5. (a) A projectile is launched from point *A* as shown in **Fig. 5a** with an initial speed v_0 = 100 ft/sec. Determine the minimum value of the launch angle for which the projectile will land at point *B*.

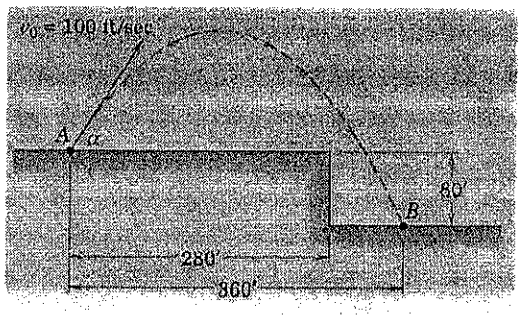

Fig. 5a

(b) The motion of the sliding block *P* in the rotating radial slot is controlled by the power screw as shown in **Fig. 5b**. For the instant represented, measurements show $\dot{\theta}$ =0.1 rad/s, $\ddot{\theta} = -0.4$ rad/s^2, r =300 mm. Also, the screw turns at a constant speed giving $\dot{r}$ = 40 mm/s. For this instant, determine the magnitudes of the velocity and acceleration of *P*.

[Turn over]

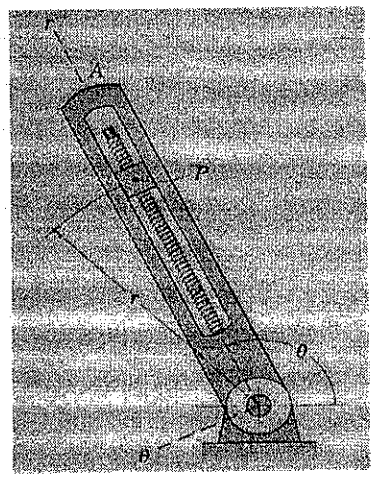

Fig. 5b

[10+10]

6. (a) Determine the vertical rise h of the load W [as shown in **Fig. 6a**] during 10 seconds if the hoisting drum draws in cable at the constant rate of 180 mm/s.

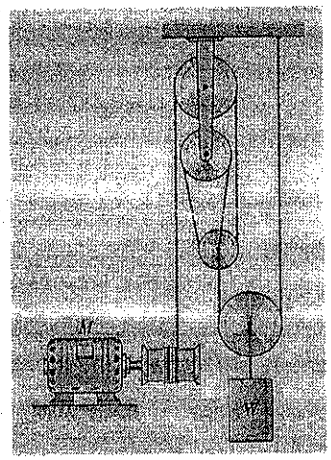

Fig. 6a

(b) A body moves in a straight line with a velocity whose square decreases linearly with the displacement between two points A and B, which are 300 ft apart as shown in **Fig. 6b**. Find the displacement Δs of the body during the last 2 seconds before arrival at B.

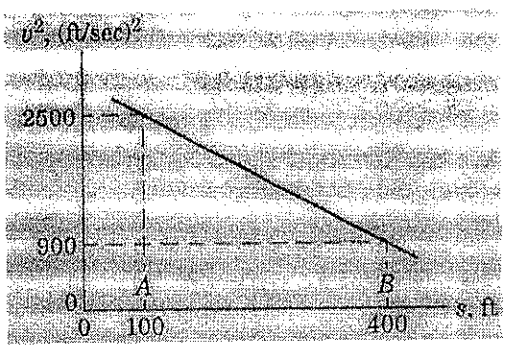

Fig. 6b

[10+10]

7. Write short notes: (Any four) [4 X 5 = 20]

(a) Varignon's theorem
(b) Equilibrium of two force and three force system
(c) Coulomb's laws of friction
(d) Pappus-Guldinus Theorems
(e) Parallel axis theorem
(f) D'Alembert's principle