BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. in Environmental, Water Resources, and Coastal Engineering
Term Final (Spring) Examination 2023: Aug-Sep 2023

Student Group: 0 < Earned Credit Hours ≤ 36

Subject: EWCE 101, Analytical Mechanics

Time: 3.00 hours **Full Marks: 180**

INSTRUCTIONS:

a. Use **SEPARATE** answer scripts for each section.
b. **Question-1**in **Section-A** and **Question-5** in **Section-B**are compulsory
c. Answer any other **TWO** questions out of **THREE** from each section.
d. Figures in the margin indicate full **marks**.
e. Assume reasonable data if necessary.
f. **Symbols** and **abbreviations** used have their usual meanings.

SECTION-A

Question 1 (Compulsory)

a. Find the weight of body A for the system shown in Figure 1(a), when body B is to have motion down the plane impending. Given, $f_c = 1/r$, $f_D = 0$, $f_B = 0.2$, $\theta = 30^\circ$, and $W_B = 100$lb. **15**

b. Three timbers AB, BC and BD, each 20′ long form a tripod as shown in Figure 1(b). The ends of timbers on the ground form an equilateral triangle ACD, the sides of which are each 20 ft long. If the safe compressive load for each timber is 20,000 lb, what safe load W may be suspended from point B? **15**

Question 2

a. A force F tends to pull a wheel of 2500 lb weight over the obstruction at A as shown in Figure 2(a). Determine the magnitude of force F at the instant the wheel is about to move. Here $\theta = 30^\circ$. **12**

b. Find the external reaction components at E and the loads on the members CG, CH and EH of the truss shown in Figure 2(b). **18**

Question 3

a. Find the tension in the boom cable and the compression in the boom when 0=30° from the derrick arrangement shown in Figure 3(a). **15**

b. Compute the reactions at A (components), B, C and D from Figure 3(b). A pipe is supported by hanger rods AE as shown in the figure. The hanger is pivoted at pin A and the pipe section weighs W = 800 lb. Neglect the weight of the hanger. **15**

Question 4

a. Two cables A and B terminate on a pole as shown in Figure 4(a) and exert forces in the horizontal plane at C. The guy cable CD makes an angle with the pole of 45° and the anchor at D is to be so located that the pole will have only a compressive load. Let, $\theta = 30^\circ$, A = 5000 lb, B = 8000 lb and CE = 25 ft. Find the value of angle α and the tension in the cable CD. **12**

b. For the impending clockwise motion of the pulley as shown in Figure 4(b), what is W_B? Let the bearing at C is smooth. Given, $W_A = 2000$ lb, $f_A = 1/3$ and $f_B = 0.15$. **18**

SECTION-B

Question 5 (Compulsory)

a. For the plane area shown in Figure 5(a), determine the location of the centroid. **14**

b. For the semicircle of radius r in Figure 5(b), find the moment of inertia and the radius of gyration with respect to (i) the centroidal axis (x_c), (ii) the x' axis and (iii) y axis. Use moment of inertia (I) for the semicircle with respect to diameter as a starting point. Also find polar moment of inertia (I_o). **16**

Question 6

a. Determine by direct integration the centroid of the area shown in Figure 6(a). Express your answer in terms of 'a' and 'h'. **16**

b. Determine the moment of inertia and the radius of gyration of the shaded area shown in Figure 6(b) with respect to y axis. **14**

Question 7

a. Determine the 'y' and 'z' co-ordinate of the centroid of the body shown in Figure 7(a). **15**

b. Determine the mass moment of inertia of a right circular cone shown in Figure 7(b) with respect to its longitudinal axis. **15**

Question 8

a. Determine the area generated by revolving the semicircular arc MPN as shown in Figure 8(a) through 270° about the 'x' axis.
If the MPN is semicircular area then determine the volume generated by revolving the semicircular area through 360° about its diameter. **18**

b. A 100 kg body is on a horizontal plane, where the coefficient of kinetic friction is f = 0.2. A force Q = 60 N acts as shown in Figure 8(b). Determine the impulse of force 'Q' in the horizontal direction during 2 sec. Also determine the net impulse on the body during the same time. **12**

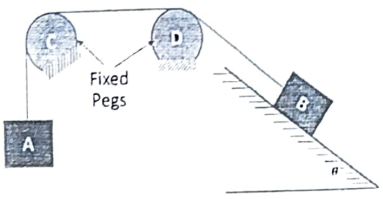


Figure 1(a) for Question 1(a)

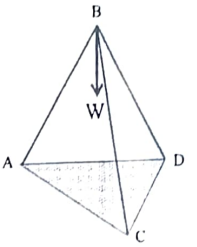


Figure 1(b) for Question 1(b)

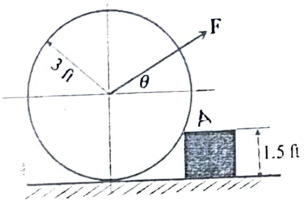


Figure 2(a) for Question 2(a)

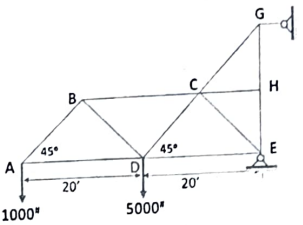


Figure 2(b) for Question 2(b)

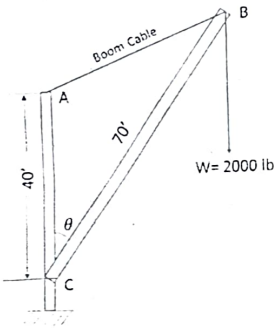


Figure 3(a) for Question 3(a)

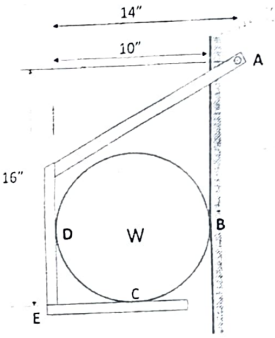


Figure 3(b) for Question 3(b)

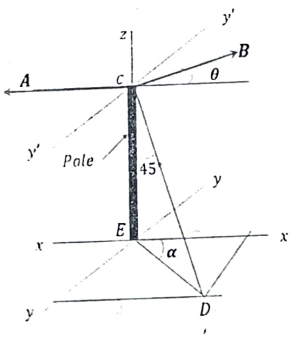


Figure 4(a) for Question 4(a)

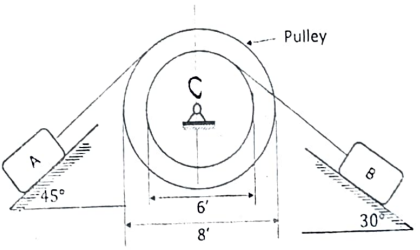


Figure 4(b) for Question 4(b)

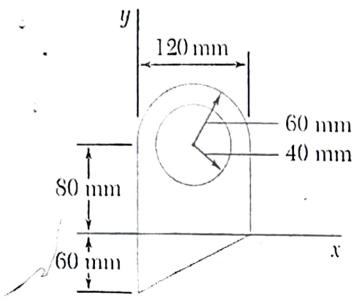


Figure 5(a) for Question 5(a)

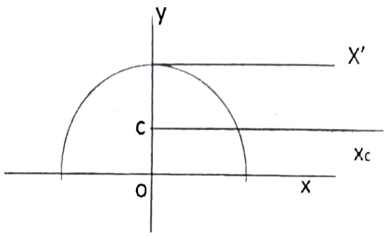


Figure 5(b) for Question 5(b)

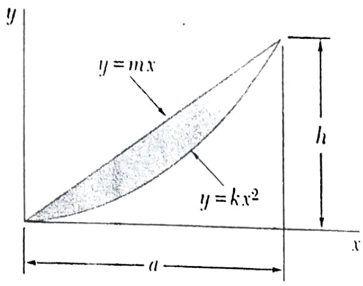


Figure 6(a) for Question 6(a)

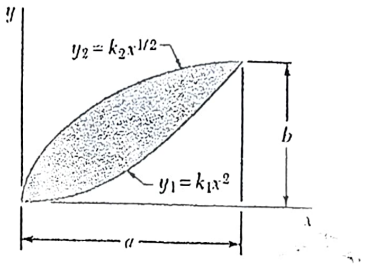


Figure 6(b) for Question 6(b)

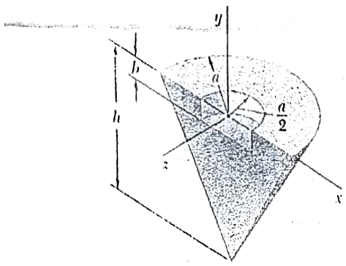


Figure 7(a) for Question 7(a)

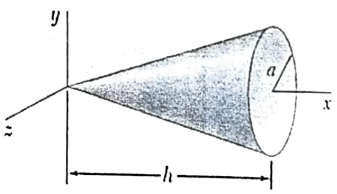


Figure 7(b) for Question 7(b)

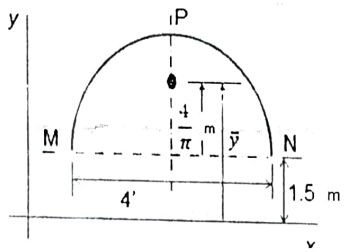


Figure 8(a) for Question 8(a)

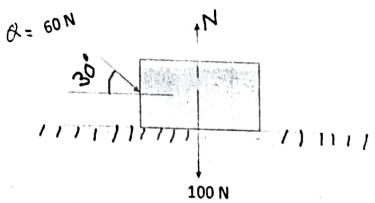


Figure 8(b) for Question 8(b)