BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. in Environmental, Water Resources, and Coastal Engineering
Student Group : 0 < Earned Credit Hour <= 36, Final Examination (Spring) : Feb 2021

Subject: EWCE 101, Analytical Mechanics

Total: 2.00 hours **Full Marks: 240**
Section A : 1.00 hour **Section A : 120**

INSTRUCTIONS:

a. Use **SEPARATE** answer scripts for each section.
b. **Question – 1 and Question – 4 (Viva Voce)** in **Section A** are compulsory.
c. Answer any **OTHER ONE** question from this section **(From Q - 2 & Q - 3)**.
d. Figures in the margin indicate full **marks**.
e. Assume reasonable data if necessary.
f. **Symbols** used have their usual meanings.

SECTION-A

Question – 1 (Compulsory)

a. State the theorems of Pappus and Guldinus. **6**

b. Evaluate the centroid of a right circular cone whose altitude is 'h' and radius is 'r'. **12**

c. The section of a column has the dimension shown in Figure-1. Estimate the least radius of gyration of this section. **22**

Question – 2

a. Find the height of the concrete dam shown in Figure-2, when water is considered to be always at the top, XY. Consider, the overturning moment of the pressure to be one-third of the moment of weight of the dam, resisting the overturning. Let the unit weights of water and concrete be 62.5 lb/ft^3 and 150 lb/ft^3 respectively. **20**

b. A 200 lb body is moving toward the left with a velocity v_1 = 50 fps (Figure-3) at the instant that a force Q = 50 lb (acting toward the right) is applied. There is a constant resistance to motion of F = 40 lb. What is the body's velocity after 20 sec ? **14**

c. Differentiate between parabolic and catenary cord. **6**

Question – 3

a. If a cable, 200 ft long and weighing 3 lb/ft is suspended from points on a horizontal line with a span of 150 ft. Estimate **12**

(i) the minimum tension
(ii) the maximum tension
(iii) the sag

Assume the cord is catenary.

b. A weight 'A' is supported from a cable which is wound about a 4 ft drum (C), is shown in Figure-4. An 8 ft fly wheel (B) turns with the drum. The total weight of the rotating part is 1288 lb and the radius of gyration is 2.5 ft. While 'A' travels 80 ft vertically downward, the speed of the rotating part changes from 10 rpm to 120 rpm. The frictional force in the bearings acting tangentially to the 6 inch shaft is F = 70 lb. What is the weight 'W' of 'A'? **18**

c. A 160 lb man is standing in a motionless boat. He walks the 20 ft length of the boat with a speed of 3 fps relative to the boat. The boat weights 2000 lbs. **10**
Estimate how far the frictionless boat move while the man is walking.

Question – 4 Viva-voce (Compulsory) **40**

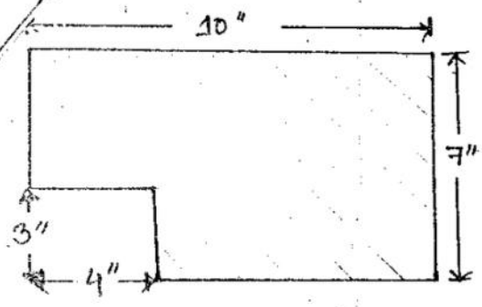


Figure: 1 for Ques no. 1(c)

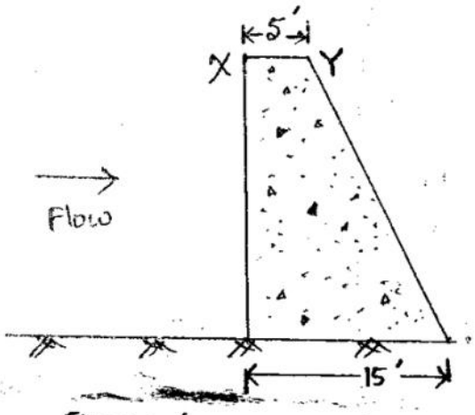


Figure: 2 for ques no 2(a)

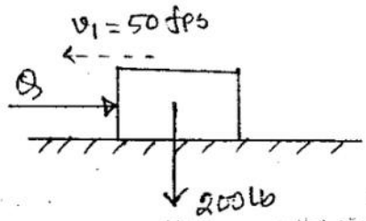


Figure: 3 for ques no 2(b)

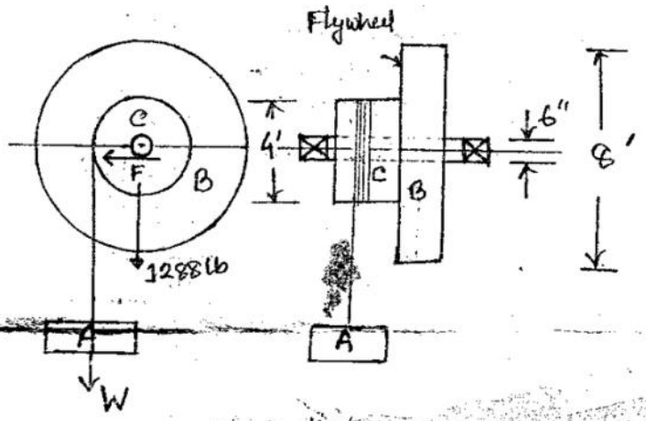


Figure: 4 for ques no 3(b)

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Total: 2.00 hours **Full Marks: 240**
Section B : 1.00 hour **Section B : 120**

INSTRUCTIONS:

a. Use **SEPARATE** answer scripts for each section.
b. **Question – 5 and Question – 8 (Viva Voce)** in **Section B** are compulsory.
c. Answer any **OTHER ONE** question from this section **(From Q - 6 & Q - 7)**.
d. Figures in the margin indicate full **marks**.
e. Assume reasonable data if necessary.
f. **Symbols** used have their usual meanings.

SECTION-B

Question – 5 (Compulsory)

a. A sphere of weight 250 lbs remains in equilibrium as shown in Figure-5. The diameter of the sphere is 8 ft. The length and weight of member AB are 30 ft. and 90 lbs respectively. All the contact surfaces are smooth. Calculate the tension in the cable BD and components of pin reactions at A. **20**

b. Determine the member forces of the member bl, cm, ef, pd and pq of the truss shown in Figure-6. **20**

Question – 6

a. Determine the support reactions of the beam shown in Figure-7. **16**

b. The body A weighing 400 N rests over the body B weighing 800 N as shown in Figure-8. The co-efficient of static friction between A and B is 0.3 and between B and the floor is 0.25. Calculate the value of the force P that will cause the body B having impending motion towards right. **24**

Question – 7

a. Figure 9 represents a boom constructed of two timbers AD and CD which are fastened together at D. The cable DE is holding the timbers in a horizontal plane and supporting a vertical load W. If compressive force in the timbers is 942.8 lbs, determine the value of W. Given, AB = BC = BD = 8′ and BE = 6 ′. **15**

b. The cantilever frame shown in Figure-10, consists of two horizontal members AC and DF, a vertical member BE and an inclined member. All the members have been assumed to be weightless. Calculate the components of pin reaction at A and axial force in member CF. **25**

Question – 8 Viva-voce (Compulsory) **40**

h

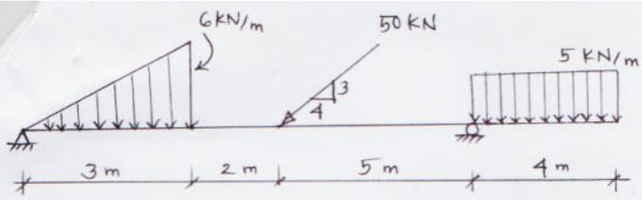


Figure: 7

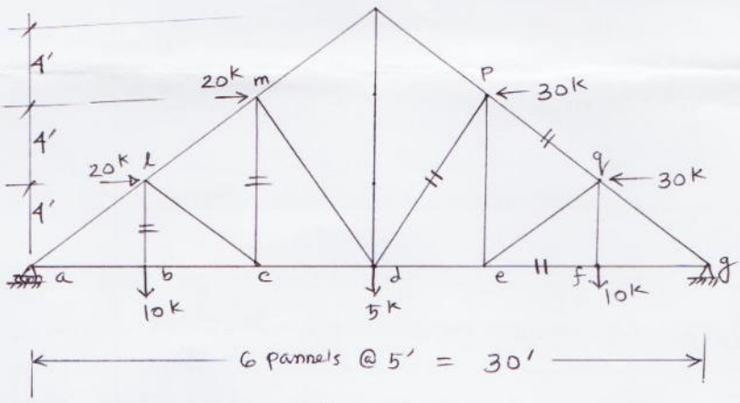


Figure: 6

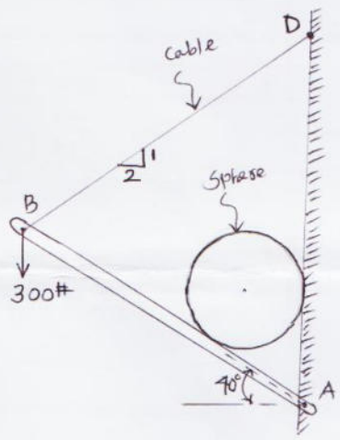


Figure: 5

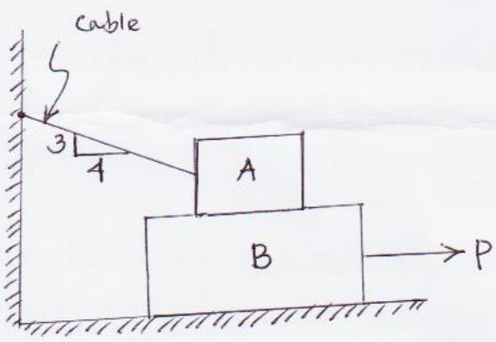


Figure: 8

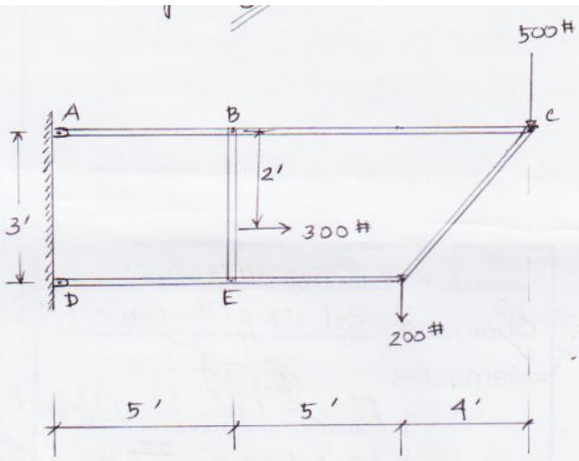


Figure: 10

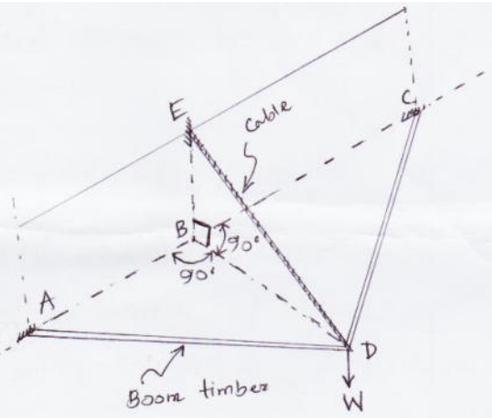


Figure: 9