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, Spring Final Examination: June 2019

Subject: EWC 101, Analytical Mechanics

Time: 3.00 hours **Full Marks: 240**

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 **from EACH section.**
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

a. Identify two force members of the structure shown in figure 1. Draw the free body diagram of all members of the structure. **16**

b. Determine the tension in the boom cable and the compression in the boom for the derrick shown in figure 2, when $\theta = 30°$ **12**

c. A table whose top is triangular in shape has a load of 100 lb as shown in figure 3. What is the force on each leg at A, B and C? **12**

Question – 2

a. Two weights are suspended from a flexible cable as shown in figure 4. For $\theta = 120°$, determine the internal forces in the various parts of the cable and the weight W. **12**

b. What are the reactions at the supports for the truss loaded as shown in figure 5, when $F = 4000^{\#}$? **14**

c. For the frame and load condition shown in figure 6 determine the (a) value of F that will produce a thrust of $30{,}000^{\#}$ on the strut BC and (b) the vertical and horizontal components of the resulting pin load at A? Given $\theta = 60°$ **14**

Question – 3

a. For the truss and load condition shown in figure 7 find the loads on member BC, BH and AH. **22**

b. In figure 8, let $W_A = 500^{\#}$, $f_A = \frac{1}{3}$ and $f_B = \frac{1}{4}$. If the body is on the point of moving downward, determine the tension in the cable and the weight of B. **18**

Question – 4

a. Two cables A and B terminates on a pole as shown in figure 9 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. Find the value of angle α and the tension in the cable CD. Let $\theta = 30°$, $A = 5000^{\#}$, $B = 8000^{\#}$ and CE = 25ft. **16**

b. For the figure 10, what force Q produces impending motion of the block D towards the right? Let P = 20 kips, $W_C = 4000^{\#}$, $W_D = 6000^{\#}$, $f_{CD} = 0.2$ and $f_{DE} = 0.3$. Let $\theta = 30°$ **14**

c. In figure 11, let $f_C = \frac{1}{\pi}$, $f_D = 0$, $f_B = 0.2$, $\theta = 30°$ and $W_B = 100^{\#}$. Find the weight of A if B is to have impending downward motion. **10**

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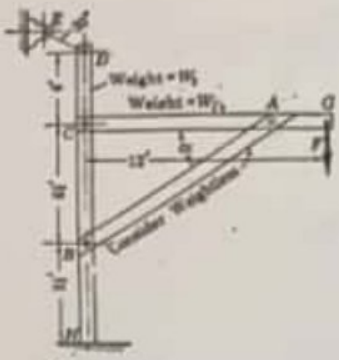


Fig: 1. (Ques 1/a)

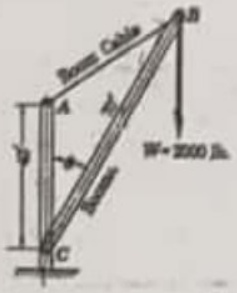


Fig: 2 (Ques 1/b)



Fig: 3 (Ques 1/c)



Fig: 4 (Ques 2/a)

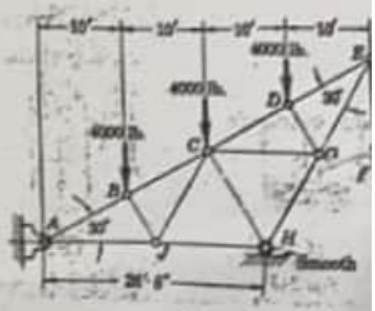


Fig: 5 (Ques 2/b)

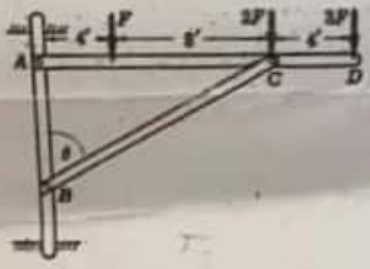


Fig: 6 (Ques 2/c)

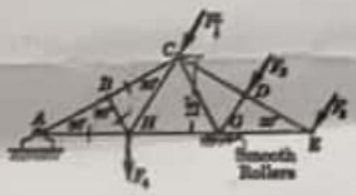


Fig: 7 (Ques 3/a)

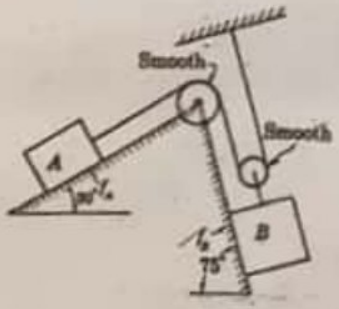


Fig: 8 (Ques 3/b)

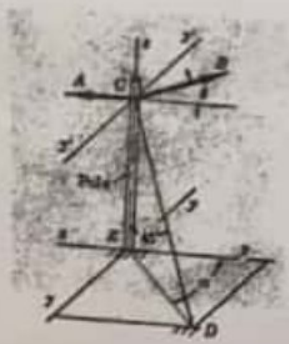


Fig: 9 (Ques 4/a)

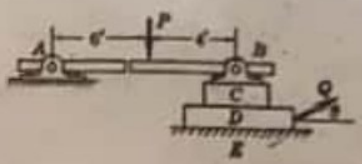


Fig: 10 (Ques 4/b)

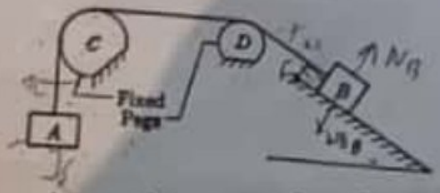


Fig: 11 (Ques 4/c)

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SECTION-B

Question – 5

a. Evaluate the centroid of a sector of a circle of radius 'r' whose angle is '2β'. 12

b. The section of a column has the dimension shown in (figure-5b). Estimate the least radius of gyration of this section. 28

Question –6

a. Deduce the expression for the moment of inertia of a sphere about a diameter. The density of material is constant.
Also, estimate the moment of inertia about a line tangent to the sphere. 15

b. A wire weighing 4 oz. per ft. is strung between two supports 300ft apart. One support is 15ft higher than the other, and the sag measured from the lower support is 5ft. Estimate the tension at each support and length of the wire. 15

c. Deduce the equation for the length of a parabolic chord. 10

Question –7

a. The section of a concrete dam is shown in the figure -7a. The water is considered to be always at the top, AB. Estimate the value of 'x' when the moment of the weight of the dam resisting overturning is twice the moment of water pressure which tends to overturn the dam. Let the weights of concrete and water be 150 and 62.5 lb. per cu. ft. respectively and neglect the effect of the restraints at the end of the dam. 20

b. In figure -7b, the fluid approaching the blade has absolute velocity of 1000 fps and specific weight of 0.5 lb/ft^3. The area of the section of the stream is 1 inch^2, while $\theta = 60°$ and $V_b = 500$fps. Estimate the horse power being developed. 20

Question–8

a. A body A is projected vertically downward from a 500ft cliff with an initial velocity of 10 fps. One second later, a body B is projected vertically upward from the bottom of the cliff with an initial velocity of 70 fps. Evaluate – 20
(i) When do these bodied pass one-another?
(Time is to be measured from the beginning of the motion of A.)
(ii) How far above the bottom of the cliff are the bodies when they pass?

b. In figure -8b the body A is a 5 lb cylinder which is 2ft in diameter. It is being rolled up the inclined plane where $\theta = 30°$ by a constant force Q = 3 lb acting parallel to the inclined plane. 20
Estimate,
(i) What is the speed of its centre of gravity after a displacement of 20ft from the rest?
(ii) What is the frictional force between the plane and the cylinder?
(iii) What coefficient of friction is necessary for rolling?

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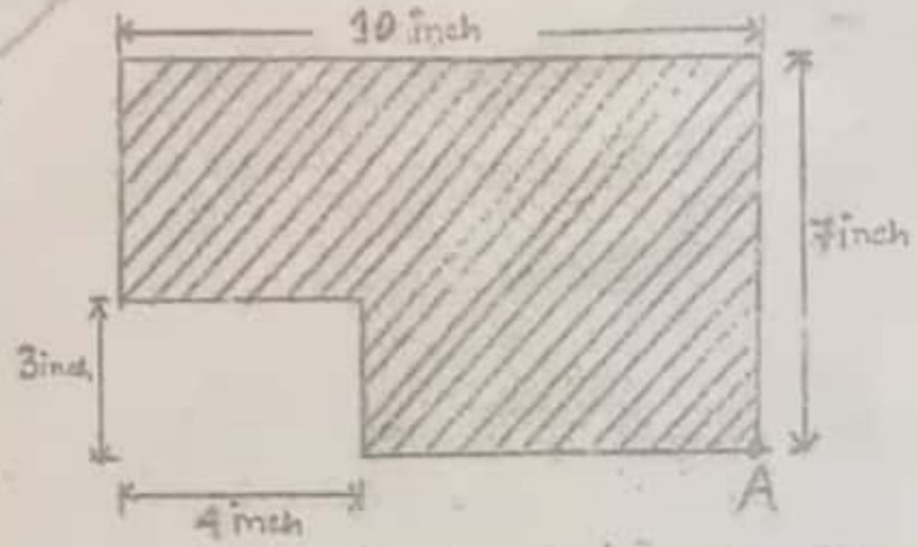


Figure : 5b for ques no- 5b

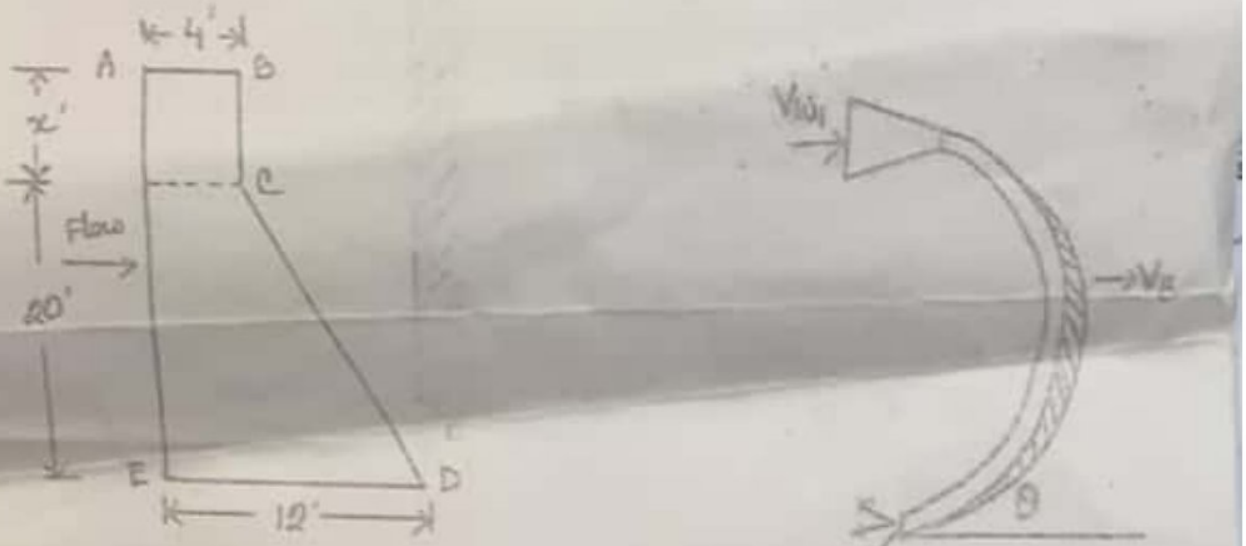


Figure: 7a for ques no 7a

Figure: 7b for ques no

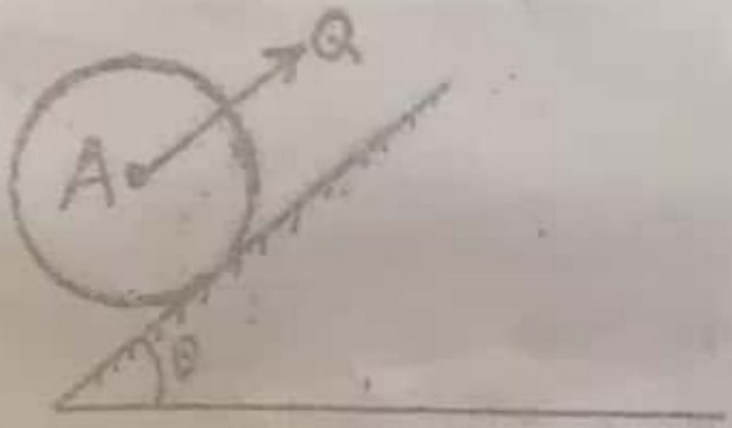


Figure 8b for ques no-8b

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