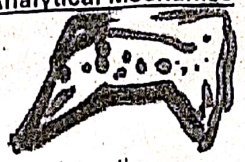
BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. In Environmental, Water Resources , And Coastal Engineering
Level-1,Term-I Final Examination: June - July 2018

Subject: EWC-101, Analytical Mechanics



Time: 3.00 hours

Full Marks: 280

INSTRUCTIONS:

a. Use SEPARATE answer scripts for each section.
b. Answer any THREE questions from each section out of FOUR.
c. Figures in the margin indicate full marks.
d. Assume reasonable data if necessary.
e. Symbols used have their usual meanings.

SECTION-A

Question – 1

a. The derrick shown in figure 1 supports a load of 2 kips. Find the tension in the cable and compression in the boom when $\theta=30°$. $12\frac{2}{3}$

b. The bell crank shown in figure 2 has a load F= 200#, If $\theta=90°$, what will be the reactions at B and C? (Find both magnitude and direction of resultant reactions). 14

c. Two cables A and B terminate on a pole as shown in figure 3 and exert forces in the horizontal plane at C. The guy cable CD makes an angle with the pole of 45° and the arches at D is to be so located that the pole will have only a compressive load. Let $\theta=30°$, A= 5000#, B=8000 # and CE= 25 ft. Find the value of angle α and the tension in the cable CD. 20

Question – 2

a. Two horizontal members AC and CE are supported as shown in figure 4. If a weight W=70# is supported at E and if a=20 inch, what is the reaction at A. The members have a uniform weight of 5 # per foot of length. 14

b. A load of W=4000 lb needs to be raised by a crowbar as shown in figure 5. If a 160# man rests full weight as force F, what will be the value of L to accomplish the job? Assume all surfaces are smooth. $12\frac{2}{3}$

c. Compute the external reactions and the loads on the members GH, CG and GJ for the truss shown in figure 6. Given, $F_1 = 3000\#, F_2 = 4000\ \#and\ F_3 = 5000\#$. 20

Question – 3

a. If the bucket and its contents have a total weight of 20#, determine the forces in the supporting cables DA, DB and DC. See figure 7. $11\frac{2}{3}$

b. An A frame is supported in a smooth track and loaded in the horizontal members BH with a 500 # load as shown ion figure 8. What are the horizontal and vertical components of the pin reactions at A, B, C, D and E? 20

c. In figure 9, if F=12000#, P=2000 #, T=3000#, what will be the value of W, when the body being on the point of moving over the obstruction A? 15

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Question – 4

a. In figure 10, $W_A = 2000$ #, $W_{All} = 6010$ #, $f_A = \frac{1}{3}$, $f_B = 0.15$. For impending clockwise motion of the pulley, what is the value of D? 16

b. In figure, 12, $f_A = 1/\pi$, $f_D = 0$, $f_B = 0.2$, $\theta = 45°$ and $W_B = 120$ #. If B is to have motion down the plane impending, find the weight of A. $12\frac{2}{3}$

c. A table whose top is triangular in shape as shown in figure 12, has a load of 100#, what is the force on each leg at A, B and C? 18

Fluid striking on blade = (area of section) (relative velocity) (specific mass)

SECTION-B

Question – 5

a. State the theorems of Pappus and Guldinus. $6\frac{2}{3}$

b. Find the minimum radius of gyration of the Z section shown in figure (5b). 24

c. Locate the centroid of the area included between the parabola $y^2 = 10x$, the y axis and the line y=10". Figure (5c) 16

Question – 6

a. Derive the expression for the moment of inertial of a right circular homogenous cone. 12
   (i) about an axis through its apex and parallel to the plane of the base and $\left(\frac{9}{5} m(4r^2\right.$
   (ii) about a parallel gravity (centroidal) axis. $\left(\frac{3}{10} mr^2\right)$

b. A particle whose acceleration $a = 3t - 12\ fps^2$ is moving at a certain instant in a straight line with an initial velocity of 15 fps in the same direction as the in initial acceleration. At time t=3 sec, what are the velocity and displacement of the particle? $14\frac{2}{3}$ 15

c. In figure (6c), the weightless cord wraps about a central groove 12" in diameter, and passes over a smooth peg ($f_c = 0$) to a 30 lb body B. The central groove is in a 24". disk A which weighs $W_A = 96.6\ lb$ and has radius of gyration with respect to its axis of $\bar{K}$=9". 20
   (i) if the disk rolls without slipping, what is the speed of B after 6 sec when the bodies start from rest? What is the tension in the cord?
   (ii) What is the frictional force F?

$3t^2/2 - 12t$

Question – 7

a. In figure (7a), the fluid approaching the blade is steam, whose absolute velocity is $V_{w1} = 1000\ fps$ and whose specific weight is $0.05\ lb/ft^3$. The area of the section of the stream is 1 square inch; also $\theta = 60°$ and $V_B = 500\ fps$. Determine the horizontal and vertical components of the force on the blade and the horse power being developed. 18

$\frac{4}{5} = \frac{x}{20}$

20×4

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b. In figure (7b) the bodies A and B are moving toward the right at 20 fps. Neglect the weight of the cable and pulley, and the friction in the pulley. If $W_A = 600\ lb, W_B = 225\ lb$ and $f_A = \frac{1}{3}$; what constant force P will bring the bodies to rest in a distance of 30 ft? $16\frac{2}{3}$

c. Derive the expression for determining maximum and minimum tension in parabolic chord. 12

Question – 8

a. Find the height of the concrete dam (section is shown in figure 8a) when water is considered to be always at the top, XY. Here the overturning moment of water pressure is one-third of the moment of weight of the dam resisting overturning. Let the unit weights of the water and concrete be 62.5 lb/ft^3 and 150 lb/ft^3 respectively. 20

b. A 3/8"copper wire may be safely loaded to a maximum tension of 12,000 psi of cross sectional area. For a sag of 20 ft, what may be the maximum safe span when the points of supports are on the same level? Copper weighs 556 lb/ft^3. Also find the length of the chord. Assume the curve to be parabolic. 20

c. Write down the forces acting on a gravity dam. $6\frac{2}{3}$

mid → 60
CT → 60
ATTEND → 40
160 → 240

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coplanar

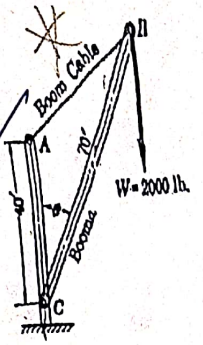


Fig-1 (Q-1a)

moment

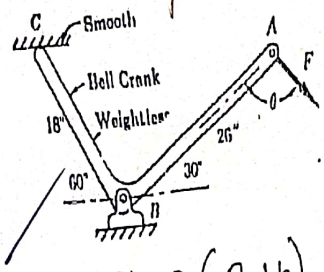


Fig-2 (Q 1b)

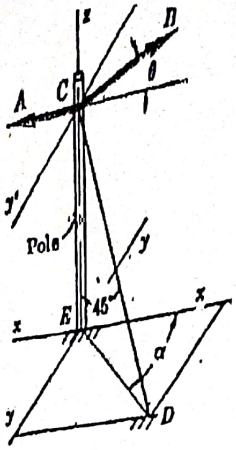


fig-3 (Q 1c)

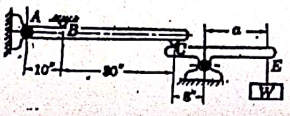


Fig-4 (Q-2a)

moment

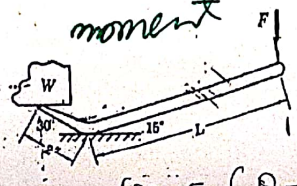


Fig-5 (Q-2b)

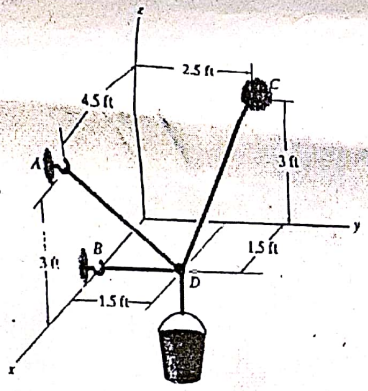


Fig-7 (Q-3/a)

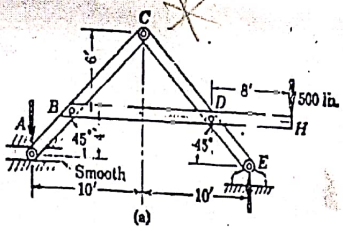


Fig-8 (Q 3b)

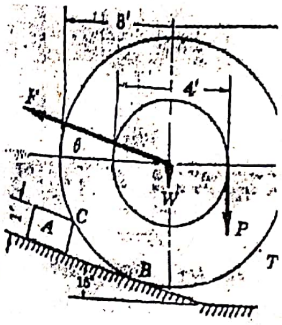


Fig 9 (Q 3c)

FRICTION

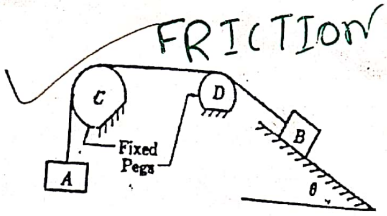


Fig 11 (Q 4b)

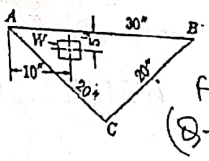
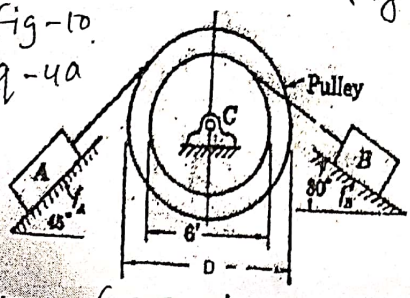


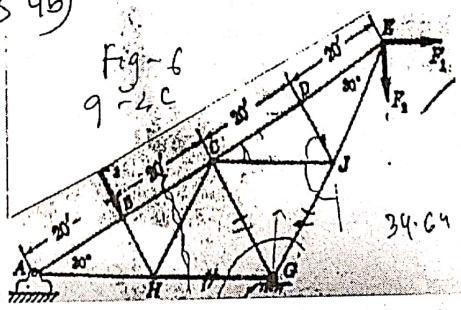
Fig-
(Q-4c)

Fig-10
q-4a



Friction

Fig-6
q-4c



34.64

Truss

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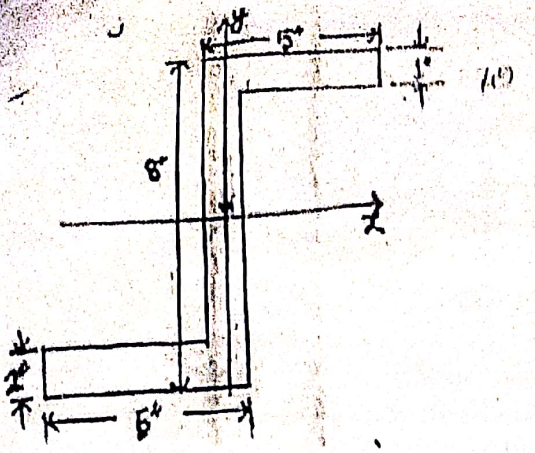


Figure : 5b for ques 5b

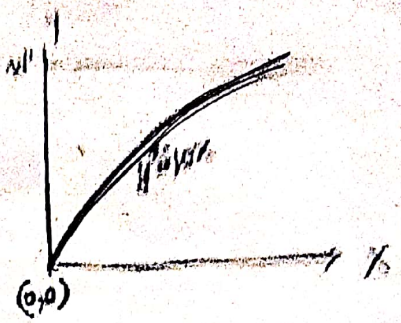


Figure: 5c for ques 5c

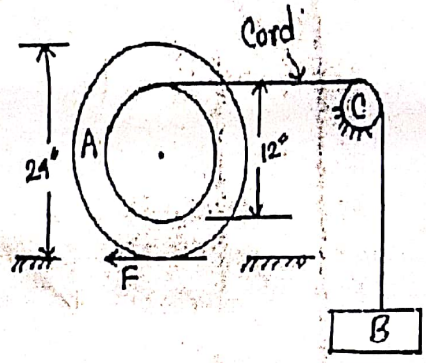


Figure: 6c for ques 6c

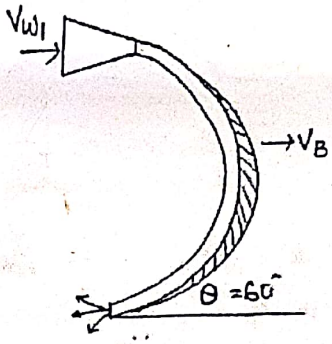


Figure: 7a for ques 7a

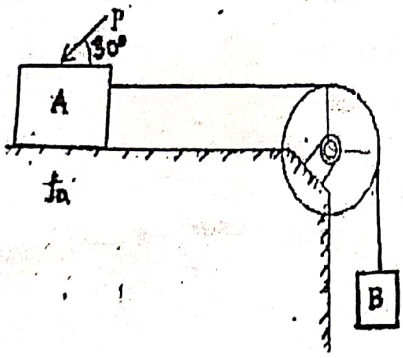


Figure : 7b for ques 7b

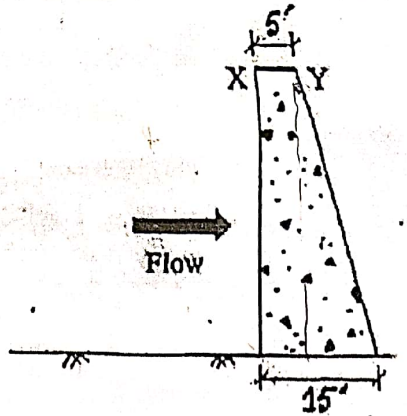


Figure: 8a for ques 8a

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