BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY
Military Institute of Science and Technology
B.Sc. in Environmental, Water Resources, and Coastal Engineering
Level-1, Term-I, Final Examination: June 2016

Subject: EWC 111: Analytical Mechanics

Full Marks: 210

Time: 3.00 hours

INSTRUCTIONS:

a. Use **SEPARATE** answer scripts for each section.
b. Answer any **THREE** questions from each section.
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. In fig 1(a), R is the resultant of F, T and Q. let Q= 800-lb, α=30°, R= 2 kips. Find F and θ. **12**

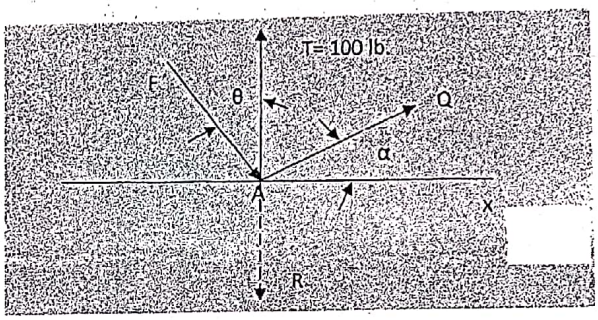


Figure: 1(a)

b. A 500-lb cylinder A rests on a smooth inclined plane, fig 1(b). For a tension in the rope of 250-lb, find the inclination of the plane. **10**

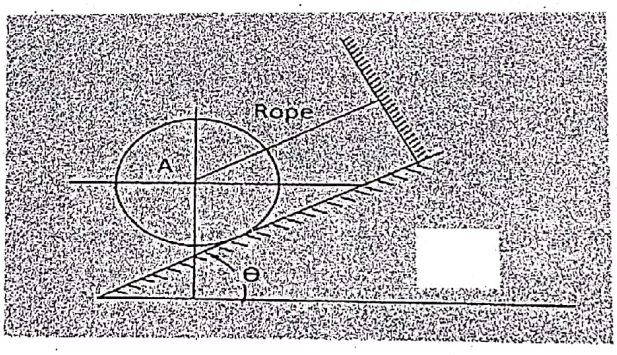


Figure: 1(b)

c. A homogeneous parallelepiped rests on an inclined plane as shown in fig 1(c). If θ= 30°, show by numerical computation that the moment about A, of the weight W=1000-lb, (of parallelepiped) which acts through the center of gravity, is the same as the moment of the components of W. **13**

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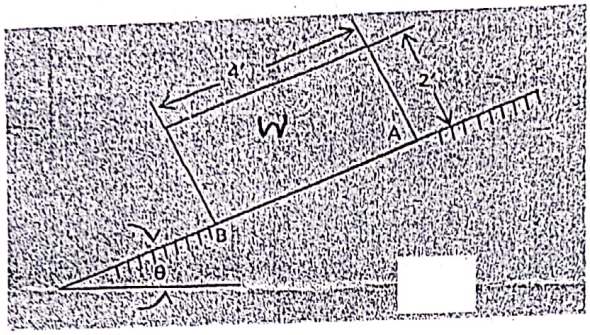


Figure: 1(c)

Question – 2

a. The beam AB is loaded as shown in fig 2(a). Equilibrium is maintained by weight w= 4000lb. suspended from a pulley. What should be the diameter of the pulley?

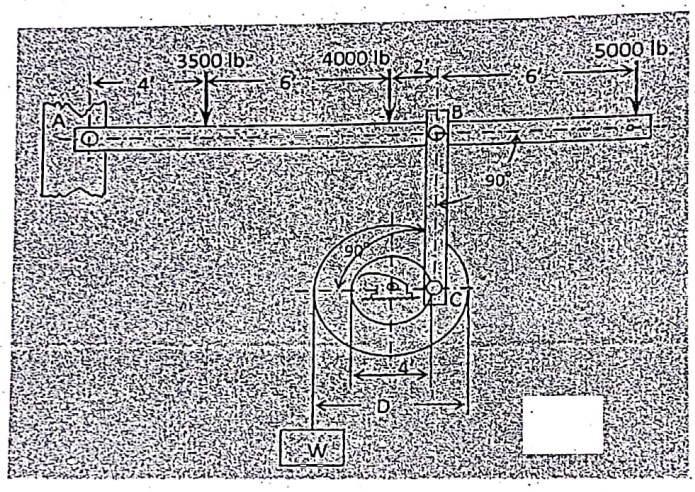


Figure: 2(a)

b. Two horizontal members AC and CE are supported as shown in fig 2(b). If a weight of w= 70-lb is supported at E and a= 20 in; what is the reaction at A? The members have a uniform weight of 5-lb per ft of length.

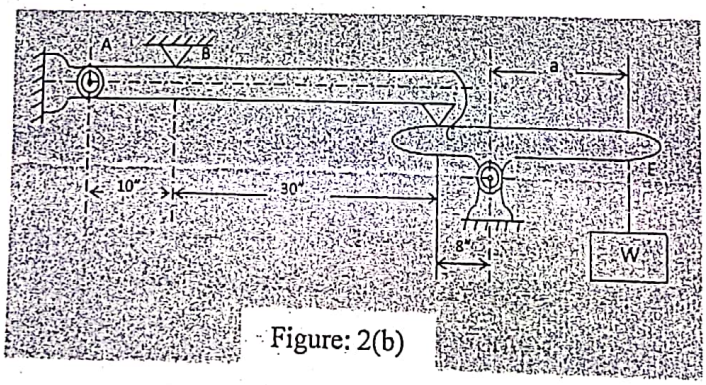


Figure: 2(b)

Question – 3

a. The framework in fig 3(a) is loaded by a 1000-lb force applied at D. the members AD weighs 1800-lb and the member AB weighs 1000 lb. what are the components of the pin reaction at A?

Question

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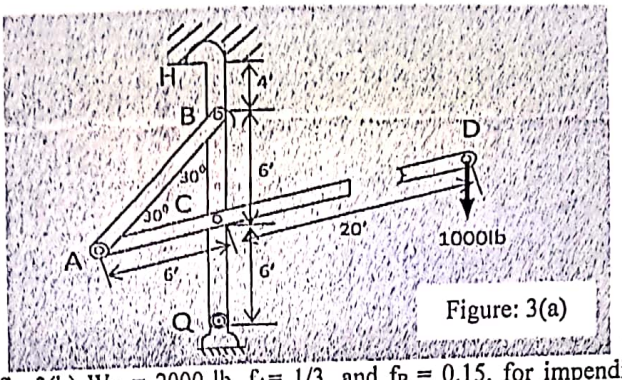


Figure: 3(a)

b. In fig 3(b) W_A = 2000-lb, f_A= 1/3, and f_B = 0.15, for impending clock-wise motion of the pulley, what is W_B? The bearing at C is smooth. 15

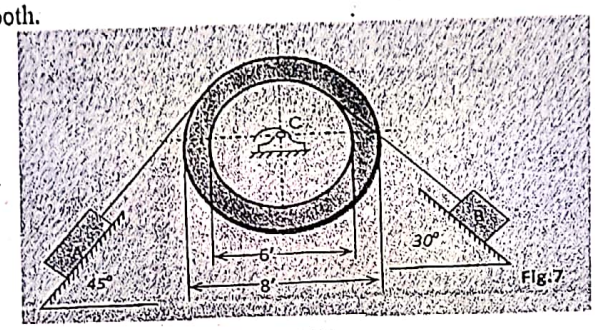


Figure: 3(b)

Question – 4

a. If f_s = 0.4, W= 100-lb and the horizontal force Q= 100-lb as shown in fig 4(a), find (a) the largest angle θ for equilibrium and (b) the smallest angle θ for equilibrium. 10

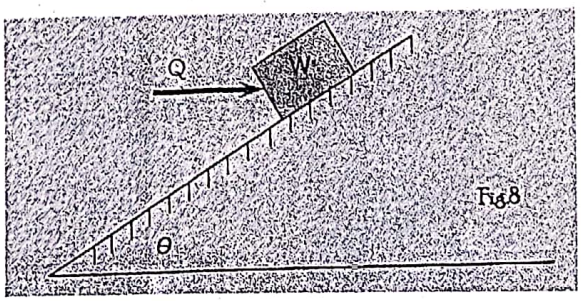


Figure: 4(a)

b. A block A, weight 300-lb, is acted upon by a force Q whose direction is at θ= 75° with the vertical as shown in fig 4(b). A weightless cable connects A to another block B, which weighs 500-lb. If f_A= f_B = 1/3, a) what forces Q will cause impending motion toward the left, what is the tension in the cable? 15

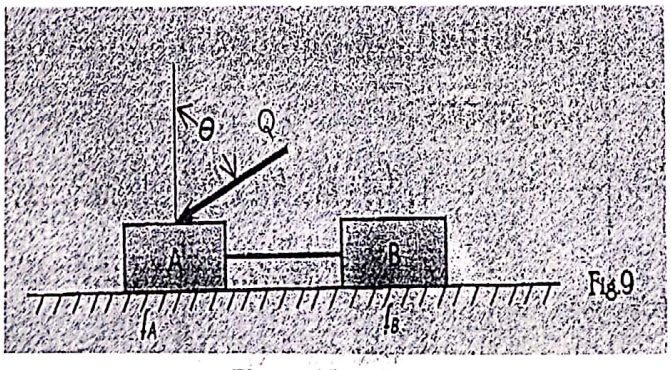


Figure: 4(b)

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c. The forces act on a body as shown in fig 4(c), if A= 80-lb, B= 80-lb, C= 80/ sin45°, and 0= 45°, find their resultant.

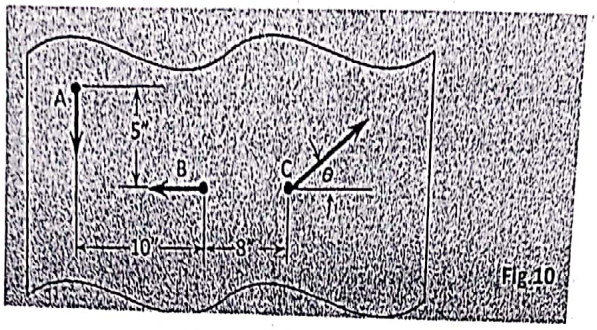


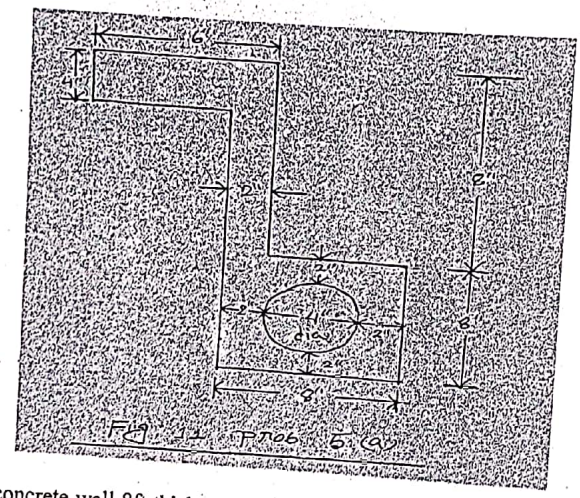
Figure: 4(c)

Question -

SECTION-B

Question – 5

a. Determine $\bar{x}$ and $\bar{y}$ for the area shown in fig 11



b. A concrete wall 8ft thick and 20 ft height is acted upon by water as shown in fig 12 which tends to overturn the wall. The weight of the wall tends to prevent overturning. Neglecting the effect of the end restraints, find the ration of resisting moment to overturning moment. Assume unit of weight of concrete as 150 pcf and unit of weight of water 62.5 pcf.

b

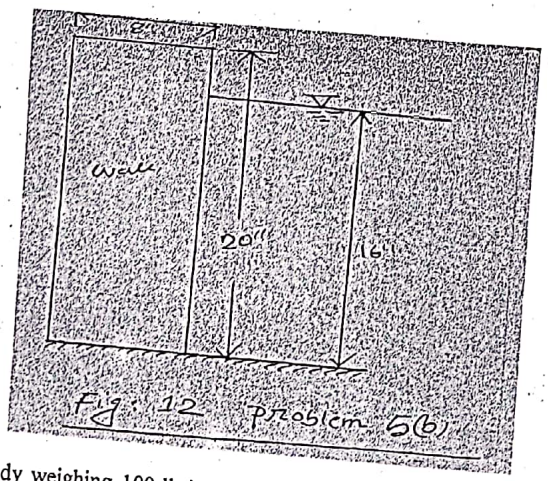


Fig: 12 Problem 5(b)

Question – 7

a.

c. A body weighing 100-lb is pulled up from rest on a 30° inclined plane by a force Q= 120-lb the body is pulled up to 8 ft. if β=15° and f= ¼. Determine the net work and velocity of the body after 5

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sec, see fig 13.

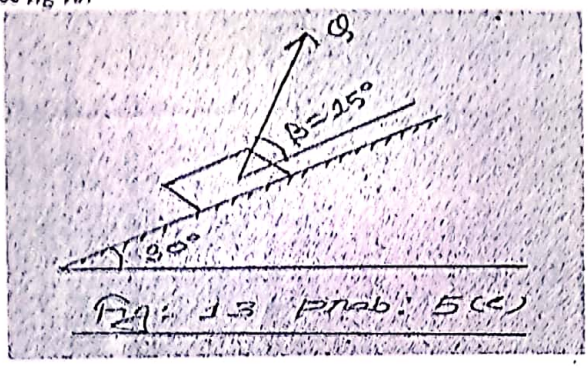


Fig: 13 Prob: 5(c)

Question – 6

a. A 4 ft diameter cylinder has a central 2 ft groove about which is wound a weightless inextensible cord as shown in fig 14. The cord passes parallel to 30° inclined and over a smooth post D, then vertically downward to a body B, which weight 300-lb. the cylinder weighs 500-lb and its radius of gyration about its axis C is 1 ft. determine the tension in the cord and velocity of cylinder after B moves 15 ft from rest. What is the acceleration of the body B? You may use principle of work and kinetic energy. **21**

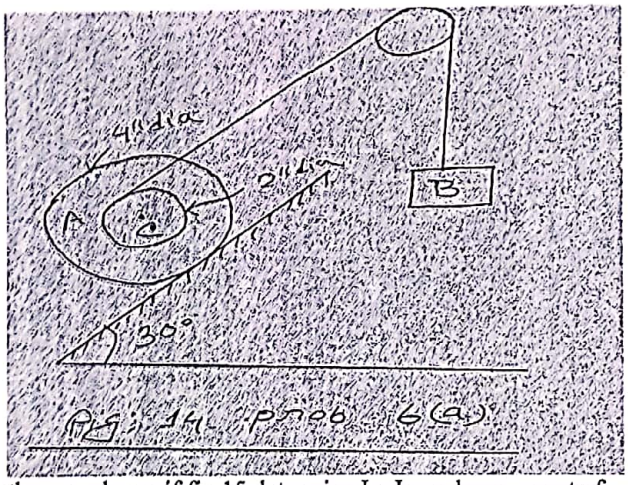


Fig: 14, Prob 6(a)

b. For the area shown if fig 15 determine Ix, Iy, polar moment of inertia and Kx , Ky (radius of gyration) about centroidal axix. . **14**

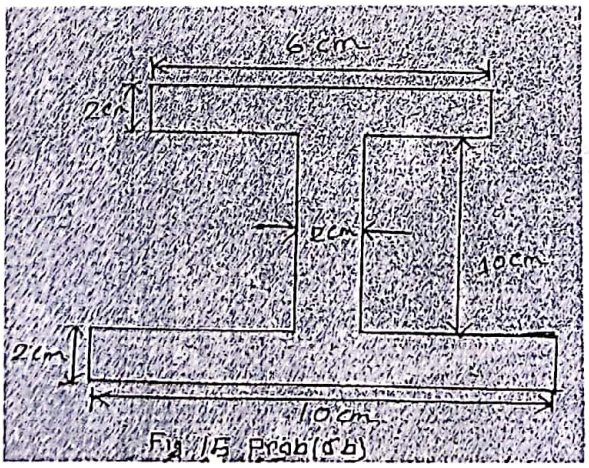


Fig 15 Prob(5.8)

Question – 7

a. A 50 N block is released from rest on an inclined plane making an angle 35° to the horizontal. The block starts from A, slides down a distance of 1.2 m and strikes a spring with a stiffness of 8 KN/m. The coefficient of friction between inclined plane and the block in 0.25. If the spring is further compressed by 77 mm (after striking by body) determine a) the scale of spring and b) the distance the block will rebound up the plane from compresses position (see fig 16). **12**

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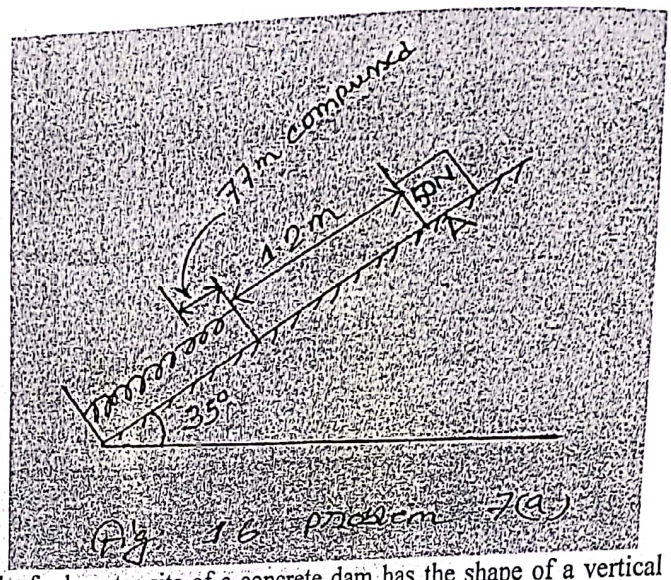


Fig. 16 problem 7(a)

b. The fresh water site of a concrete dam has the shape of a vertical parabola with vertex at A. if the resultant force of the water against the dam face acts through point B, then determine the amount of resultant force and distance of the base point B, see fig 17. Assume $\rho_{water} = 1000\ kg/m^3$.

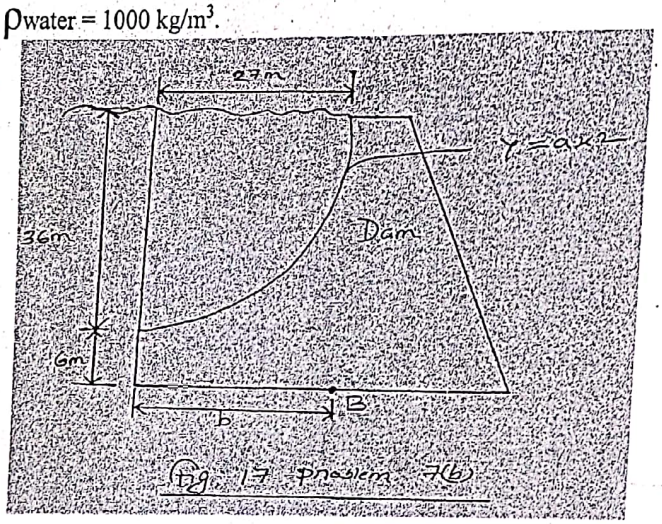


Fig. 17 problem 7(b)

Question – 8

a. A 64.4 body A is suspended from a weightless cord that passes over smooth peg at C (f_c=0) and then wraps about a solid disk B which weight 644-lb and is 2 ft in diameter. Neglecting frictional effects, determine the time taken for A to attain a speed of 20 fps from an initial speed of 10 fps and determine the tension in the cord. See fig 18. You can use principle impulse and momentum.

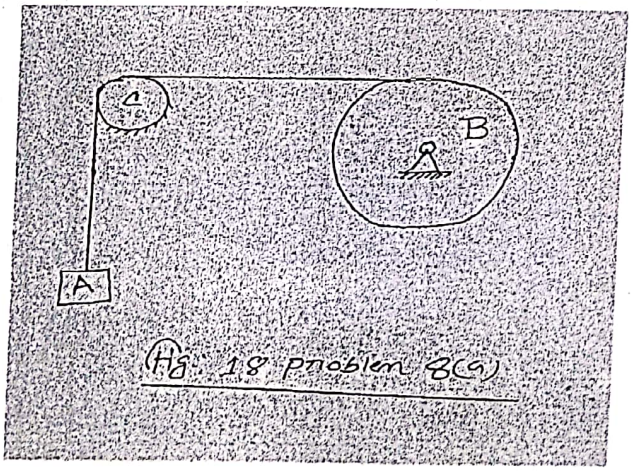
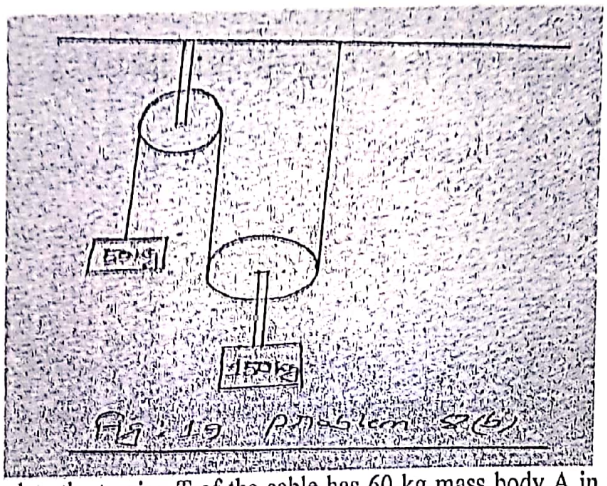


Fig. 18 problem 8(a)

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b. Determine the tension in the string and acceleration of two blocks of mass 150 kg and 50 kg connected by a string and a frictionless and a weightless pulley as shown in fig 19. 10



c. Calculate the tension T of the cable has 60 kg mass body A in the system shown in fig 20. The mass of body B is 20 kg and coefficient of friction f= 0.2, angle of friction 30°. Assume pullies are frictionless. 10

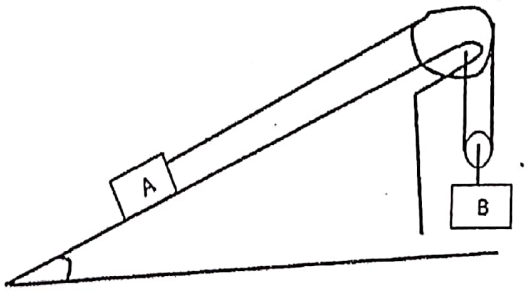


Fig: 20 Prob (8C)

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