KATHMANDU UNIVERSITY
End Semester Examination
June/July, 2023

Marks Scored:

Level : B.E./B.Tech.
Year : II
Course : MEEG 216
Semester : I
Exam Roll No. :
Time: 30 mins.
F. M. : 20
Registration No.:
Date : 09 JUL 2023

SECTION "A"
[20 Q. × 1 = 20 marks]

Encircle the most appropriate option.

1. An arbitrary-shaped body is under the action of three forces, all three passing through a common point. The magnitudes of forces F1 and F2 are 5N and 2N respectively. θ= 120 as shown in the Figure 1. Determine the force F3 such that the body remains in equilibrium.

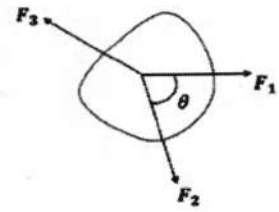

Figure 1

a. √39 N
b. √19 N
c. √29 N
d. 7N

2. Find the moment of the force (250N) about the center of the bolt applied on the handle of the wrench

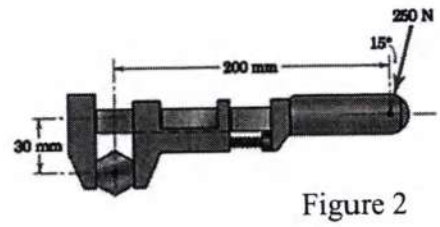

Figure 2

a. 46.4 N-m clockwise
b. 46.4 N-m Counter-clockwise
c. 50 N-m clockwise
d. 50 N-m Counter-clockwise

3. What is the reaction acting on point Q, for the simply supported beam shown in Figure 3?

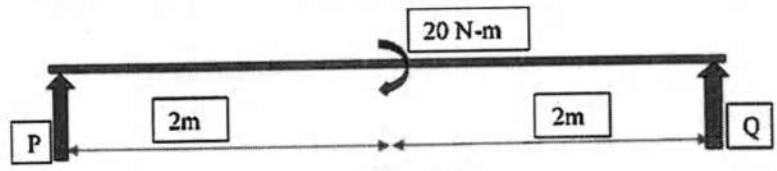

Figure 3

a. 5 N (↑)
b. 10 N (↑)
c. 10 N (↓)
d. 40 N (↓)

4. The disk rolls without sliding on the fixed horizontal surface. At the instant shown in Figure 4, the instantaneous center of zero velocity for rod AB would be located in which region?

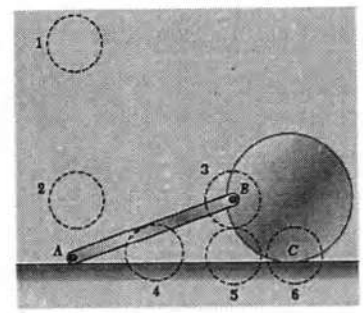

Figure 4

a. Region 1
b. Region 2
c. Region 3
d. Region 4

5. Which of the following laminas does not have a centroid at its geometrical center?
a. Circle
b. Right angle triangle
c. Equilateral triangle
d. Rectangle

6. For the concurrent force system, which of the following conditions becomes redundant for the condition of equilibrium?
   a. $\Sigma F_x = 0$
   b. $\Sigma F_y = 0$
   c. $\Sigma M = 0$
   d. All conditions are necessary

7. To design the trusses which of the following rules is followed?
   a. All the loads are applied by the use of cables
   b. All loads are applied at the joints
   c. All the loads are not applied at the joints
   d. The loads are not applied at all to the joints

8. In the method of sections for the analysis of trusses, the section line should
   a. cut not more than 3 members and separate them into two independent parts
   b. cut 3 members and separate them into two independent parts
   c. cut only three members
   d. cut at least 3 members

9. Coefficient of friction depends upon
   a. Surface area of contact
   b. Shape of the surface
   c. Nature of surface
   d. Weight of the body

10. A 1 kg block is resting on the surface with a coefficient of friction of 0.1. A force of 0.8N is applied to the block as shown in the Figure 5. The friction force is
    a. 0 N
    b. 0.4 N
    c. 0.8 N
    d. 1 N

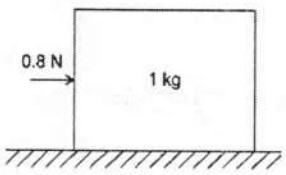

Figure 5

11. Moment of inertia about an axis perpendicular to the plane of an area is known as
    a. First moment b. Second moment c. Polar moment d. Mass moment

12. The moment of inertia of a rectangular lamina with respect to its base is ..... Take width of rectangle as 150 mm and height as 200mm.
    a. 2.6×10^8 mm^4 b. 4.0×10^8 mm^4 c. 3.6×10^8 mm^4 d. 2.4×10^8 mm^4

13. The displacement of a ball is described by the equation $X= 2t^3 - t^2-1$. What is the acceleration at t = 1s?
    a. 12 m/s^2 b. 10 m/s^2 c. 8 m/s^2 d. 0 m/s^2

14. Ball A is thrown straight up. Which of the following statements about the ball are true at the highest point in its path?
    a. The velocity and acceleration are both zero.
    b. The velocity is zero, but the acceleration is not zero.
    c. The velocity is not zero, but the acceleration is zero.
    d. Neither the velocity nor the acceleration is zero.

15. The ball rolls without slipping on the fixed surface as shown in Figure 6. What is the direction of the tangential velocity of point A?

a →	b ↗
c ↓	d ↑

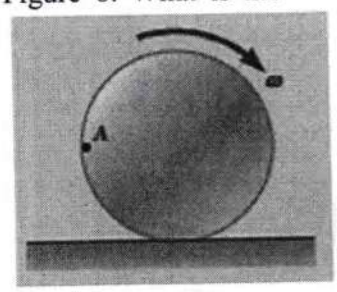

Figure 6

16. A force vs extension graph of spring is shown in Figure 7. The work done in extending the spring is
    a. 5 J
    b. 10J
    c. 15J
    d. 20J

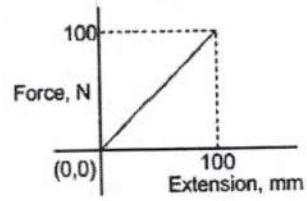

Figure 7

17. A 40-Mg railroad car moving at a speed of 0.5 m/s to the right collides with an 80-Mg car at rest. After the collision, the 35-Mg car moves to the right at a speed of 0.5 m/s. the velocity of the 20-Mg car after the collision will be
    a. 0.25 m/s to the right
    b. 0.25 m/s to the left
    c. 0.5 m/s to the right
    d. 0.5 m/s to the left

18. In a statically determinate plane truss, the number of joints (n) and number of members (m) are related by
    a. $m = 2n + 3$
    b. $m = 2n - 3$
    c. $n = 2m + 3$
    d. $n = 2m - 3$

19. Impulse is equal to
    a. Change in velocity
    b. Change in momentum
    c. Change in force
    d. Change in mass

20. A hexagon is made up of six different parts of density $\rho 1$, now; one of the parts of the hexagon is removed and replaced with material having density $\rho 2$. Choose the correct option.
    a. Both center of mass and centroid changes
    b. Both center of mass and centroid remains same
    c. Centroid changes but center of mass remains same
    d. Centroid remains same but center of mass changes

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SECTION "B"

Attempt *ALL* questions. Assume data with justification if necessary.

1. Determine the force P required to maintain the 200 kg engine in the position for which θ=30°. The diameter of the pulley at B is negligible. [3]

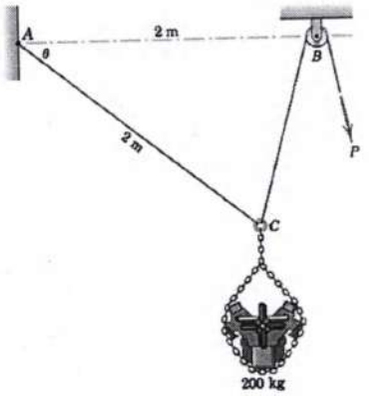

Figure 1

2. A 50-kg crate is attached to the trolley-beam system shown inf Figure 2. Knowing that a=1.5 m, determine (a) the tension in cable CD, (b) the reaction at B. [5]

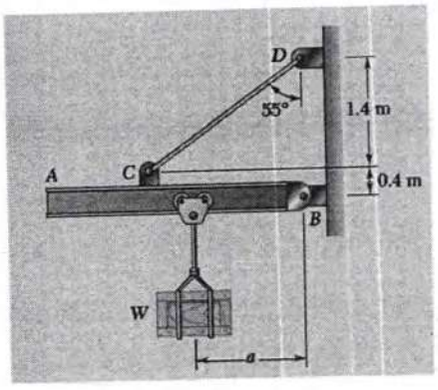

Figure 2

3. Determine the location of the centroid of a parabolic spandrel by direct integration. [4]

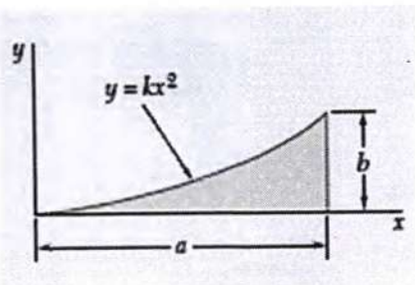

Figure 3

4. For the area indicated in the Figure 4, determine the moments of inertia with respect to the centroidal axes. [5]

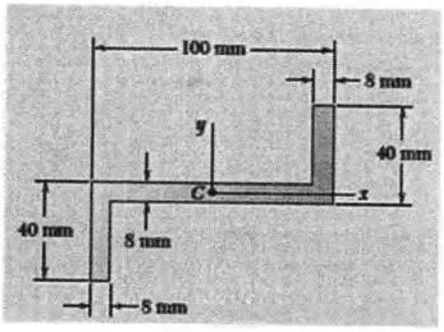

Figure 4

5. Determine the force in each member of the truss shown in Figure 5. State whether each member is in tension or compression. [5]

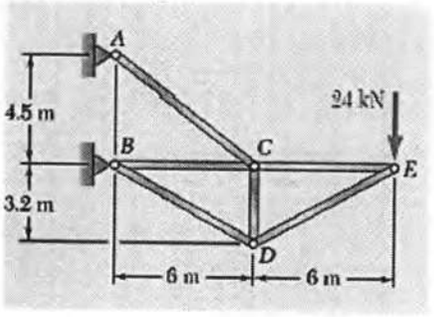

Figure 5

6. Determine the force in members CD and DF of the truss shown in Figure 6. [3]

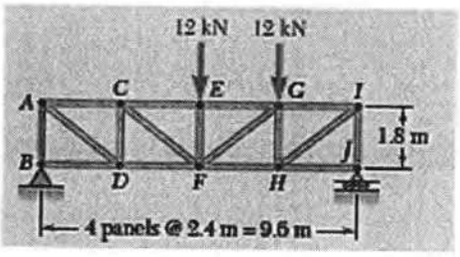

Figure 6

7. The horizontal position of the 500-kg rectangular block of concrete is adjusted by the 5° wedge under the action of the force P. If the coefficient of static friction for both wedge surfaces is 0.30 and if the coefficient of static friction between the block and the horizontal surface is 0.60, determine the least force P required to move the block. [7]

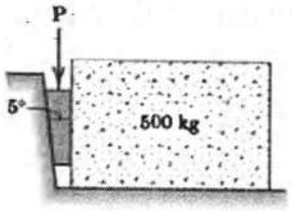

Figure 7

OR

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Determine the range of values which the mass m_0 may have so that the 100-kg block shown in the Figure 8 will neither start moving up the plane nor slip down the plane. The coefficient of static friction for the contact surfaces is 0.30. [7]

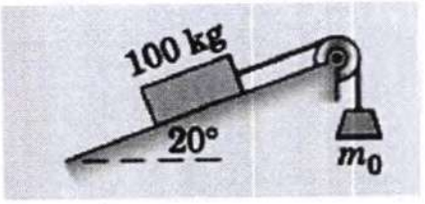

Figure 8

8. Starting from rest, a particle moving in a straight line has an acceleration of $a = (2t - 6)$ m/s^2, where t is in seconds. What is the particle's velocity when $t = 6$ s, and what is its position when $t = 11$ s? [3]

9. The catapult is used to launch a ball such that it strikes the wall of the building at the maximum height of its trajectory. If it takes 1.5 s to travel from A to B, determine the velocity v_A at which it was launched, the angle of release θ, and the height h. [5]

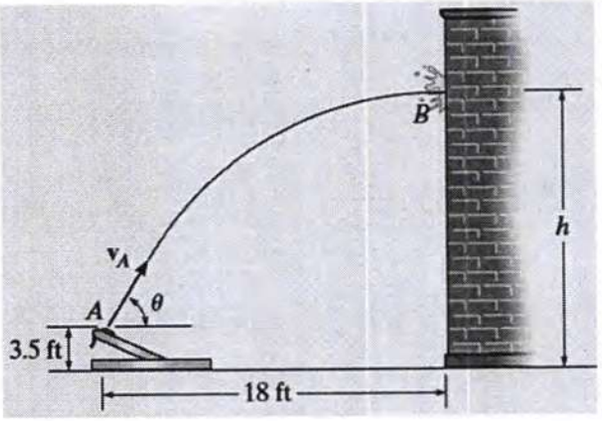

Figure 9

10. The disk is originally rotating at $\omega_0 = 12$ rad/s. If it is subjected to a constant angular acceleration of $\alpha = 20$ rad/s^2, determine the magnitudes of the velocity and the normal and tangential components of acceleration of point A at the instant $t = 2$ s. [3]

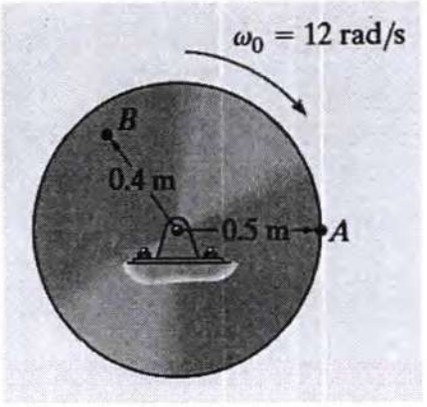

Figure 10

11. The disk is released from rest and rolls down the incline. Knowing that the speed of A is 1.2 m/s when $\theta=0°$, determine at that instant (a) the angular velocity of the rod, (b) the velocity of B. [5]

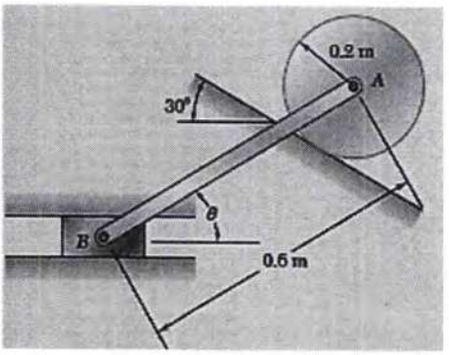

Figure 11

12. A 20-lb collar slides without friction along a vertical rod as shown in Figure 12. The spring attached to the collar has an undeformed length of 4 in. and a spring constant of 3 lb/in. If the collar is released from rest in position 1, determine its velocity after it has moved 6 in. to position 2. [7]

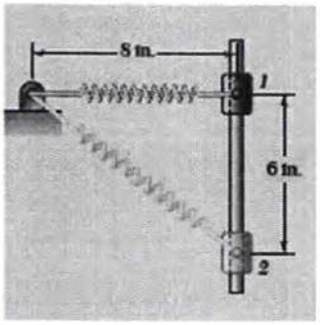

Figure 12

OR

The coefficient of restitution between the two collars is known to be 0.70. Determine (a) their velocities after impact, (b) the energy loss during impact. [7]

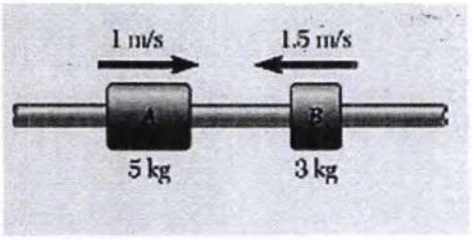

Figure 13