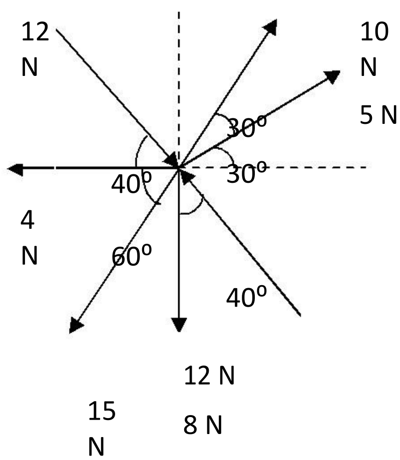
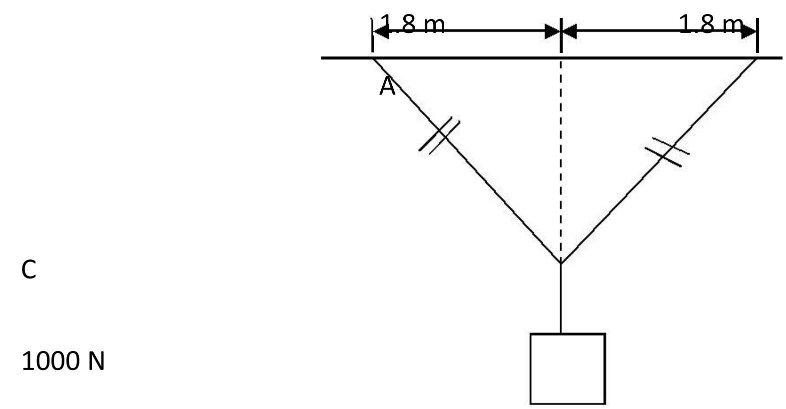
UNIT-1

TWO DIMENSIONAL FORCE ANALYSIS

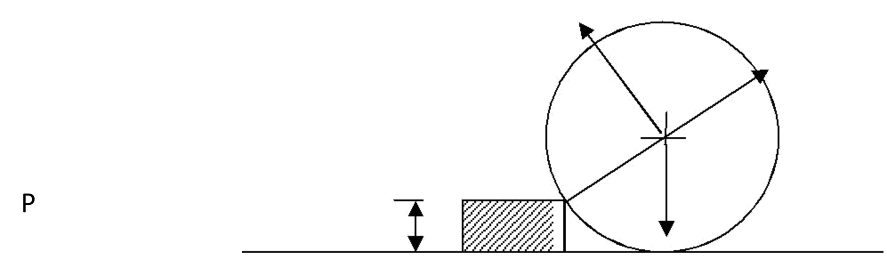
1. Explain various force systems giving examples.
2. State and explain Principle of transmissibility of a force.
3. State and prove Lami's theorem.
4. The forces 20N, 30N, 40N, 50N are acting at one of the angular points of a regular hexagon, towards the other five angular points, taken in order. Find the magnitude and direction of the resultant force.
5. Determine the resultant of following force system as shown in fig.



6. Determine the shortest length of cable which can be used to support a load of 1000 N if tension in the cable is not to exceed 720 N. Take Length of AC equal to BC



7. A uniform wheel of 0.4 m diameter, weighing 8 kN, rests against a rigid rectangular block 0.1 m thick as shown in fig.. Find the least pull through the centre of the wheel to just turn it over the corner of the block. All surfaces are smooth. Find the reaction of the block as well.



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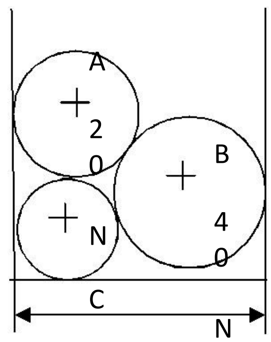
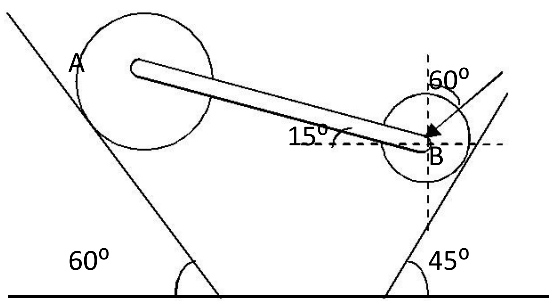
8. Three cylinders are piled in a rectangular ditch as shown in fig. Neglecting friction, determine the reaction between cylinder C and the vertical wall. The radius of cylinders A= 5cm, B=6 cm, C=4 cm.



15 N

18 cm

9. In fig., two cylinders A of weight 400 N and B of weight 200 N, rest on smooth inclines. They are connected by a bar of negligible weight hinged to each cylinder at its geometric center by smooth pins. Find the force P acting as shown that will hold the system in the given position.



Friction

1. A uniform ladder of length 10 m and weighing 20 N is placed against a smooth vertical with its lower end 8 m from the wall. In this position the ladder is just to slip. Determine the coefficient of friction between the ladder and the floor.

2. A uniform ladder 20 m long weighs 1800 N. It is placed against a wall making an angle of 600 with floor. The coefficient of friction between the wall and the ladder is 0.38 and that between the floor and the ladder is 0.33. The ladder in addition to its own weight has to support a man weighing 900 N at the top of the ladder. Calculate the horizontal force F to be applied to the ladder at the floor level to prevent slipping.

3. A uniform ladder 5 m long weighs 300 N. It is placed against a wall making an angle 600 with floor. The coefficient of friction between the wall and the ladder is 0.25 and that between the floor and the ladder is 0.35. The ladder in addition to its own weight has to support a man weighing 900 N at the top of the ladder. Calculate the horizontal force F to be applied to the ladder at the floor level to prevent slipping.

4. A uniform ladder 3 m long weighs 18 N. It is placed against a wall making 600 with floor. The coefficient of friction between the wall and the ladder is 0.25 and that between the floor and the ladder is 0.35. The ladder in addition to its own weight has to support a man weighing 90 N at the top of the ladder. Calculate the horizontal force F to be applied to the ladder at the floor level to prevent slipping.

5. Calculate the push required to keep a ladder (length 8 m, weight = 750 N) in equilibrium, while a person (weight 1000 N) standing at the top. The ladder makes an angle of 200 with wall and take coefficient of friction for wall and surface = 0.3.

6. Determine the minimum angle which can be made by a ladder with the floor and leaning against a smooth wall without slipping under its own weight while supporting a person at top, whose weight is double the weight of the ladder. Take $\mu = 0.35$ wherever applicable.

7. The weight of a 12 m long ladder is 2000 N and it is placed against a wall making an angle of 580 with floor. The coefficient of friction between wall and ladder is 0.30 and floor and ladder is 0.32. Calculate up to what length a person of weight 800 N can climb the ladder.

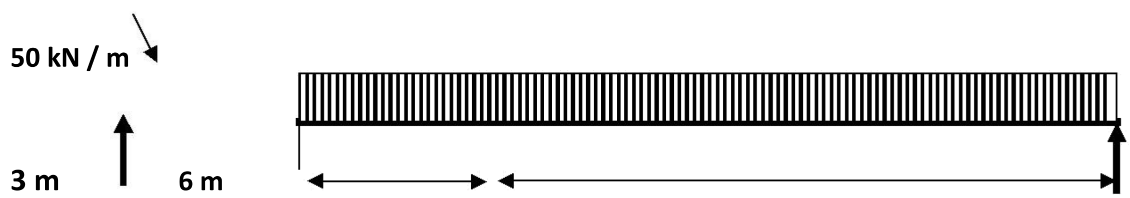
8. Derive $T1 / T2 = e\ \mu\theta$ for an open belt drive system.

UNIT 2
Beam and Truss

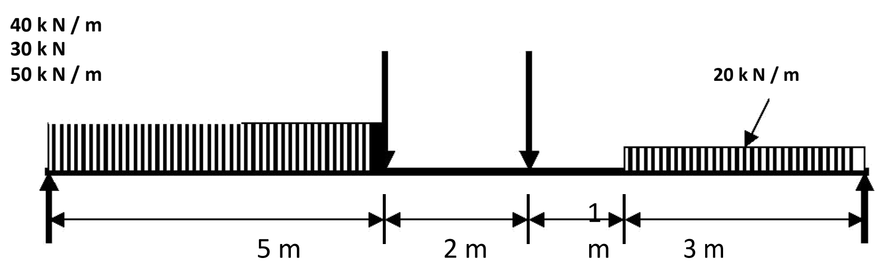
Numerical Questions:

1. A simply supported beam of span 12 m is loaded with a uniformly varying load of 50 kN / m at left end and 110 kN / m at right end. Find reactions at support.

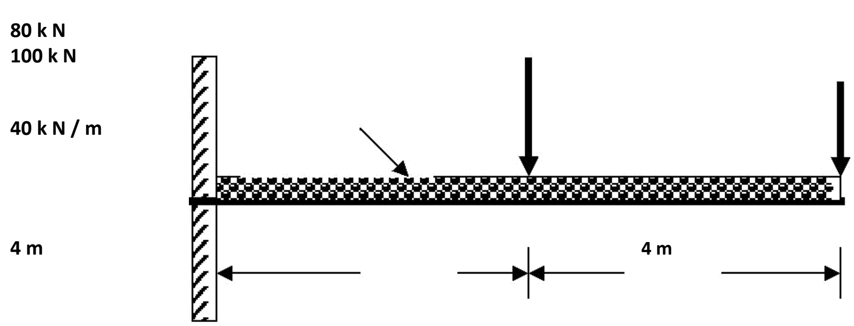
2. Find reactions at support for the following beam .



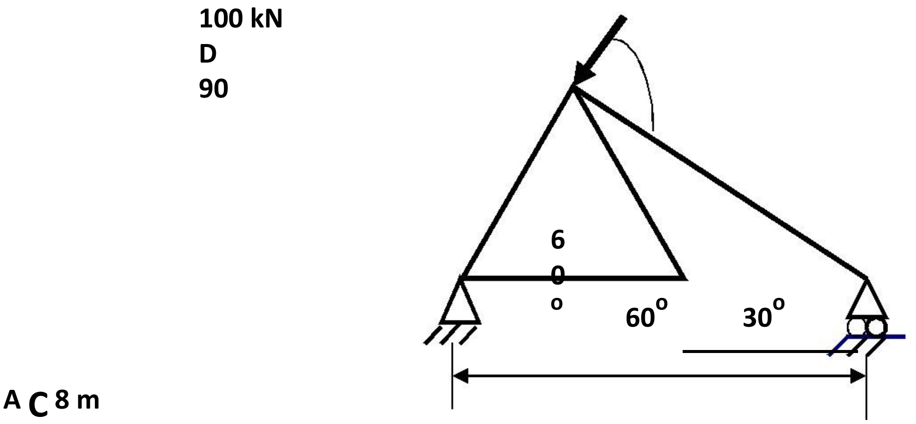
3. Find reactions at support for the following beam.



4. Find reactions at the fixed support for the following beam.

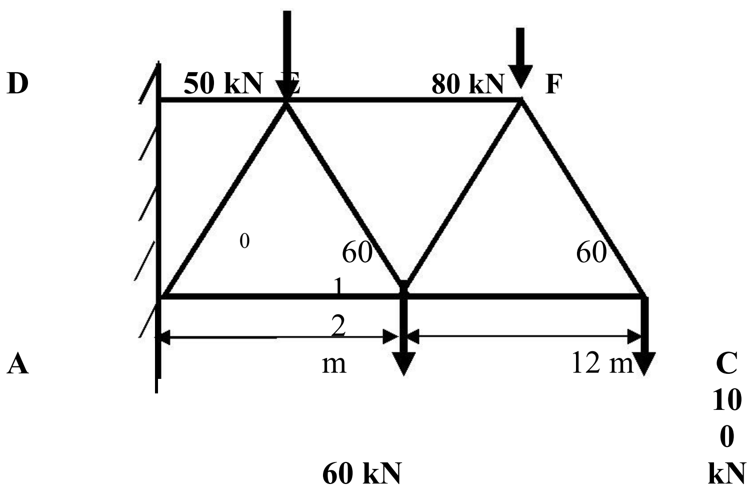


5. Determine the forces in all the members of the Truss by **Joint Method** as shown in figure.

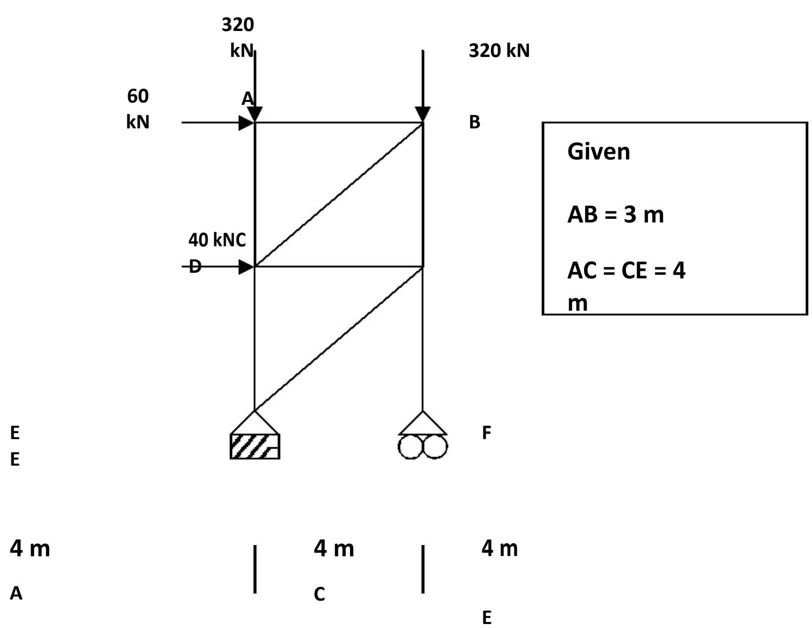


6. Determine the forces in the members of the truss by **Methods of Section**, shown in figure.

FE, AE, AB and DE, DB and BC



7. Find the forces of the members of following Truss.



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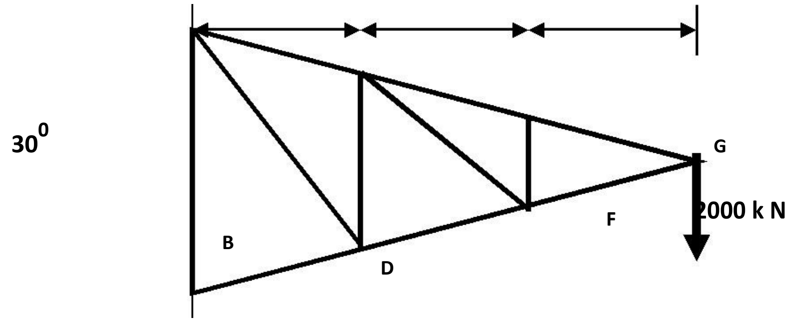

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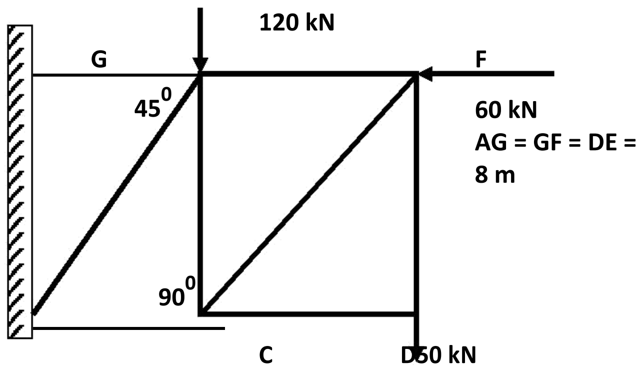
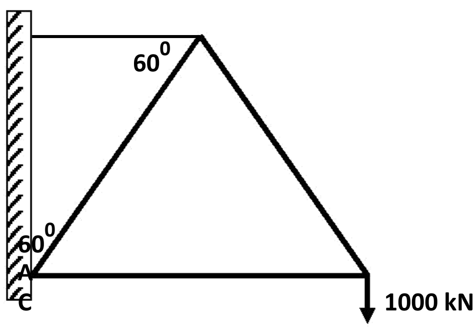
9) For the truss shown in the figure find the forces in GF, CD & CF members by section method.

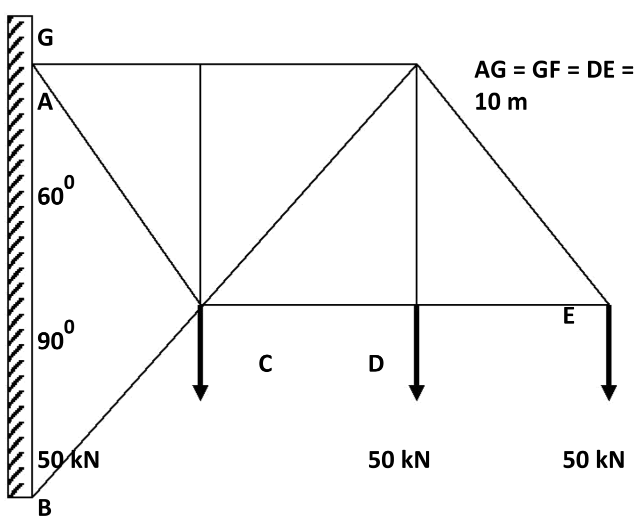


10) Analyse the following truss by Joint method.

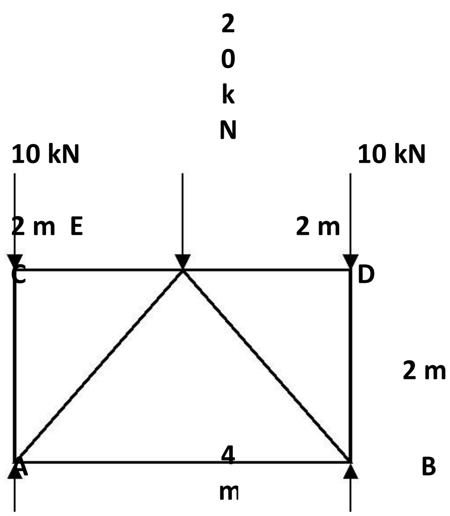


11. For the truss shown in the figure find the forces in AC, AG & BC and GF, CD & CF.

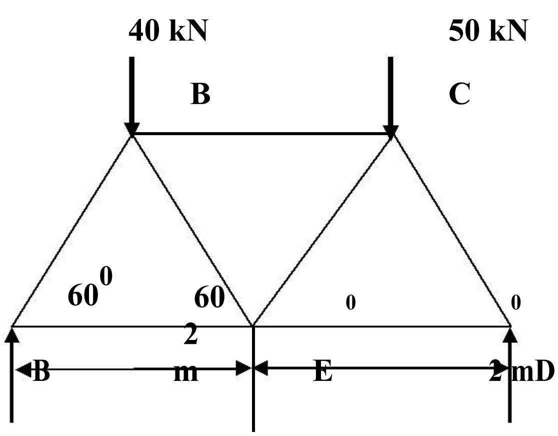
F



12. Find out the forces in all members of the following truss: (10 marks)



13. Find out the forces in BC, CE and DE members of the following truss:



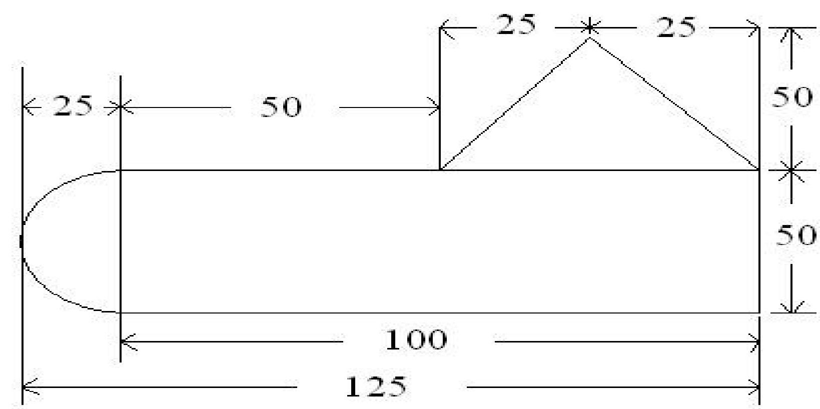
Unit III

(CG, Centroid & Moment of Inertia)

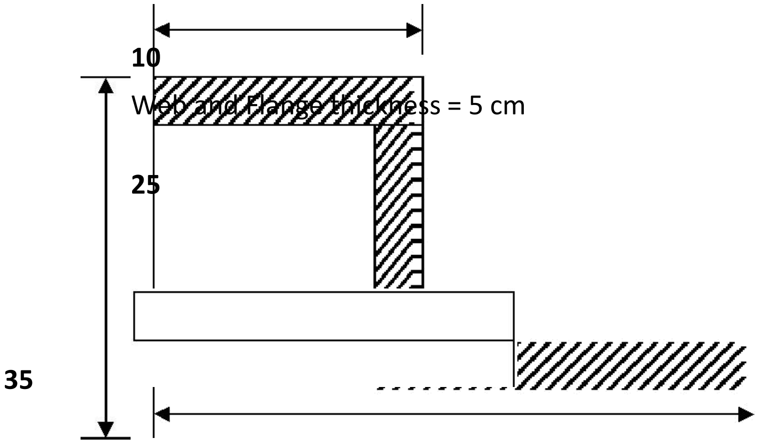
1. Define Centriod, Centre of gravity, and moment of inertia.
2. Derive the equtaion of mass moment of inertia for a circular Ring.
3. Derive the equation for the Mass MOI for a uniform Circular plate.
4. Derive an expression for the mass moment of inertia of a solid uniform circular cone.
5. Derive an expression for the mass moment of inertia of a Sphere.
6. Derive an expression of the moment of inertia of a rectangular section about an axis passing through its centroid.
7. Two equal circular plates of maximum possible diameters are being cut from a square metalic sheet (size 800 x 800 mm). Calculate the moment of inertia of the reamining shape.
8. Calculate the Polar MOI of an equilateral triangle (side = 20 cm) about its vertex.
9. Locate the centroidal of a "Z" section as shown in the figure. All dimensions are in cm.
10. Calculate the Polar MOI of an equilateral triangle (side = 20 cm) about its vertex.

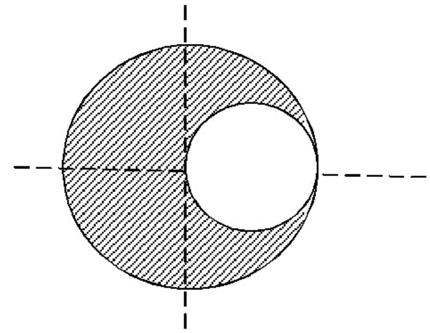
11. Show that the product of inertia of an area about two mutually perpendicular axes is zero, if the area is symmetrical about one of these axes.

12. A uniform lamina as shown in fig. on page no.5 consists of a rectangle, a semicircle & a triangle. Determine the CG of the lamina. All dimensions are in mm.



13. Locate the centroidal of a “Z” section as shown in the figure. All dimensions are in cm.





14. A circle is cut from a circle of diameter 450 mm as shown in the above figure. Calculate the polar moment of Inertia of the remaining shape.
15. Find the moment of inertia of an **“L”** shaped body of height and base as 200 mm each and web and flange thickness 20 mm about X axis.

UNIT 4

KINEMATICS (RECTILINEAR, CURVILINEAR AND ROTARY MOTION)

1. Distinguish between :
a) Statics and dynamics
b) Kinematics and kinetics
c) Rectilinear motion and curvilinear motion.
2. Express the acceleration of a particle in tangential and normal components.
3. The position of a particle in rectilinear motion is defined by the relation $x=t^3+t^2+t+1$, where x is in metres and t is in seconds. Determine its position, velocity and acceleration at time t=2 s.
4. The acceleration of a particle in rectilinear motion is defined by the relation $a=kt^2 -3$. Given that at $t=0$ s, $v=0$ m/s and $x=0$ and at $t=3$ s, $v=9$ m/s, determine its position, velocity and acceleration at $t=2$s.
5. Two trains start at same time from stations A and B (6 km apart) respectively in opposite tracks. Train A accelerates uniformly at the rate of 0.5m/s^2 until it reaches a speed of 54 kmph. While train B accelerates uniformly at the rate of 0.6 m/s^2 until it reaches a speed of 72 kmph and then travels at this speed. Determine when and where both will cross each other.

6. A balloon is ascending from the ground at a constant acceleration of 0.5 m/s^2. After 30 seconds from the start, a ball is released from the balloon. Determine the velocity with which it will strike the ground and the time taken to reach the ground.

7. Track repairs are going on a 2 km length of a railway track. The maximum speed of the train is 90 km/h. The speed over the repair track is 36 km/h. If the train on approaching the repair track decelerates uniformly from the full speed of 90 km/h to 36 km/h in a distance of 200 m and after covering the repair track accelerates uniformly to full speed from 36 km/h in a distance of 1600 m, find the time lost due to reduction of the speed in the repair track.

8. A wheel starting from rest is accelerated at the rate of 5 rad/s^2 for an interval of 10 sec. If it is then made to stop in the next 5 sec by applying brakes, determine

(i) The maximum velocity attained

(ii) Total angle turned.

9. A wheel rotates with uniform angular acceleration. If the angles turned during the third and the sixth second be 8 radians and 11 radians respectively, determine the initial angular velocity of the wheel and

10. The angular rotation in radians of an accelerated flywheel is given by $\Theta = 32^{9}t^{2}$. Find the linear velocity and acceleration of a point at a distance of 0.75m from the axis of rotation at the instant when its tangential and normal accelerations are equal.

11. The angular acceleration of the disc is defined by the relation $\alpha = 3t^2 - 2t$. Determine the expressions for angular velocity and displacement given that the disc is initially at rest at $\Theta = 0$.

12. A motorist is driving at 80 km/hr on a curved position of a highway of 400 m radius. He suddenly applies brakes and that causes the speed to decrease to 45 km/hr at a constant rate in 8 sec. Determine the tangential and normal components of acceleration immediately after the application of brakes and 4 seconds later.

UNIT5
KINETICS OF RIGID BODIES

a. Write brief note on

a) D'Alembert's Principle and its applications.

b) Principle of conservation of Energy and its application.

c) Principle of conservation of momentum and its applications.

b. Define the terms:

a) Work-energy principle

b) Impulse

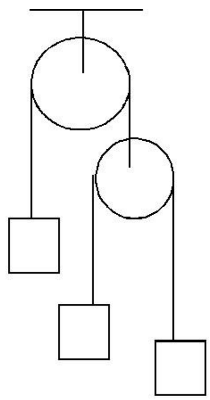
c) Momentum

3.Two bodies directly^0 in line and 10m apart are held stationery on an inclined plane having inclination of 20 . The coefficient of friction between plane and lower body is 0.08 and that between the plane and upper body is 0.05. If both the bodies are set in motion at the same instant, calculate the distance through which each body travels before they meet together.

10. An elevator together with the passengers weighing 2 tons is supported by a cable. Determine the acceleration of the lift when the tension in the cable is

a) 23 kN when the lift is moving upwards
b) 18 kN when it is moving upwards
c) 16kN when the lift is moving downwards
d) 21 kN when it is moving downwards

11. Determine the acceleration of the system of blocks shown in fig. Assume the pulleys to be massless and frictionless. Take m_1 = 8kg, m_2= 2 kg and m_3= 3 kg. Also, determine the tension in the strings connecting the blocks.



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coefficient of friction between the weight 40 N and the inclined surface is 0.2, determine. Acceleration of the system Tension in the string

c) Distance moved by the weight 25 N in 3 sec starting from rest