

JULY 2023

ENGINEERING MECHANICS

Time Allowed: 2.5 Hours

Full Marks: 60

Answer to Question No. 1 is compulsory and Answer any Five (05) Questions from the rest.

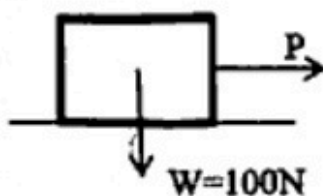
1. Answer the following questions (any five):

3×5=15

- (i) Explain the principle of transmissibility.
- (ii) Write the conditions for equilibrium of forces.
- (iii) Show with diagram: Uniformly distributed load and uniformly varying load.
- (iv) State the Coulomb's laws of friction.
- (v) What is cone of friction? Draw the cone.
- (vi) Write the advantages of friction.
- (vii) What is Reversible & Non-reversible machine?
- (viii) What do you mean by 'effort lost in friction' and 'frictional resistance'?
- (ix) A train was moving at a constant velocity of 80 km/h, as it approached a station, the loco-pilot applied brakes at a constant retardation of 0.74 m/sec^2 and stopped it at the station. How much time will it take to stop?
- (x) A ball is thrown vertically upwards from ground, with an initial velocity of 2m/s. Find the greatest height attained by the ball.

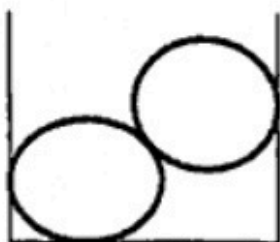
2. (a) State Varignon's theorem. Explain Bow's notation.
(b) Two forces of magnitude '2P' and 'P' act on a particle. If the first force be doubled and the second force is increased by 12 kN, the direction of their resultant remains unaltered. Find the value of P. [4+5]
3. (a) Define co-efficient of friction and limiting friction.
(b) A body of weight 500N is lying on a rough plane inclined at an angle of 25° with the horizontal. It is supported by an effort (P) parallel to the plane. Determine the **minimum** value of P, for which the equilibrium can exist, if the angle of friction is 20° . [4+5]
4. The law of wheel and axle machine is $P = 0.2 W + 50$. The diameter of wheel is 600 mm and radius of axle is 50 mm. Determine (a) Mechanical Advantage, (b) Effort required to lift a load of 2000 N, (c) Maximum Efficiency, (d) Maximum Mechanical Advantage and (e) Load to be lifted by an effort of 520 N. [9]

5.(a)



Find the friction force developed in the given figure for $P = 20\text{N}$, 50N and 60N . Coefficient of static friction $\mu_s = 0.5$ and Coefficient of kinetic (or dynamic) friction $\mu_d = 0.4$.

(b)

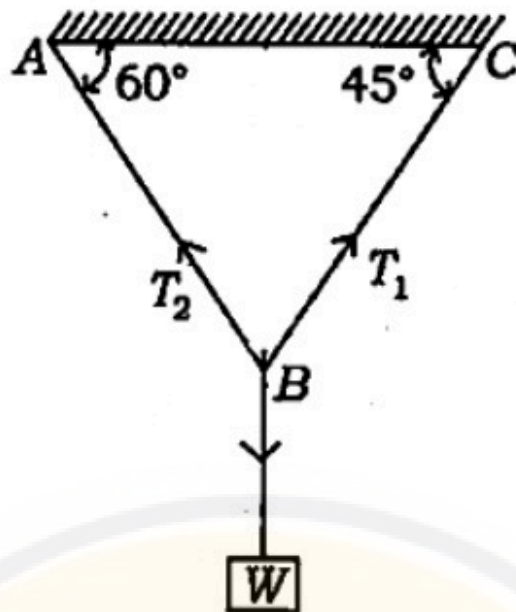


Two smooth spheres each of radius 100mm and weighing 100N, rest in a channel having smooth vertical walls, the distance between which is 360 mm. Find the reactions at the points of contacts.

[4+5]

6. (a) What is the difference between centre of gravity and centre of mass?
(b) Find the centroid of an I-section having the following dimensions:
Top flange = 160 mm X 20 mm, Web = 80 mm X 30 mm and bottom flange = 200 mm X 10 mm. [2+7]
7. (a) State the Newton's law of motion. Deduce the relationship $P = mf$.
(b) Derive a relationship for the distance travelled by a body in the n th second. [5+4]

8. (a) Define (i) Angle of Friction, (ii) Angle of Repose.
(b) What load will be lifted by an effort of 12 N, if the velocity ratio is 18 and efficiency of the machine at this load is 60%? If the machine has a constant friction resistance, determine the law of the machine. [4+5]
9. (a) Define work, power and energy with their SI units. Give one example of each of potential energy and kinetic energy.
(b)



A weight of 2 kN is supported by two strings as shown below. Find the tensions in the strings.

[5+4]