

2012

ENGINEERING MECHANICS

Time : 3 hours

Full Marks : 70

Instructions :

- (i) **All** questions carry equal marks.
- (ii) There are **NINE** questions in this paper.
- (iii) Attempt **FIVE** questions in all.
- (iv) Question No. 1 is compulsory.

1. Choose the correct option :

- (a) Principle of transmissibility can be applied only when the body is treated as
 - (i) a particle
 - (ii) a rigid body
 - (iii) deformable
 - (iv) a continuum akubihar.com
- (b) Which of the following systems of forces cannot be reduced to a single force?
 - (i) Non-concurrent forces in space
 - (ii) Non-concurrent forces in a plane
 - (iii) Parallel forces in space
 - (iv) Parallel forces in a plane

- (c) When a block of weight w resting on a rough inclined plane of inclination θ does not slide, then the frictional force acting on it is
 - (i) $w \sin \theta$ akubihar.com
 - (ii) $w \cos \theta$
 - (iii) $\mu w \sin \theta$
 - (iv) $\mu w \cos \theta$
 where μ = coefficient of static friction.

- (d) The polar moment of inertia of a circular area of diameter D is
 - (i) $\frac{\pi D^4}{64}$
 - (ii) $\frac{\pi D^4}{32}$
 - (iii) $\frac{\pi D^4}{16}$
 - (iv) $\frac{\pi D^4}{8}$ akubihar.com

- (e) Which of the following physical quantities can be positive or negative?
 - (i) I_{xx}
 - (ii) I_{yy}
 - (iii) I_{xy}
 - (iv) I_p

(f) The area under acceleration and time curve represents

(i) average acceleration

(ii) instantaneous acceleration

(iii) change in position of the particle

(iv) change in velocity of the particle

(g) When a stone tied to one end of a string is whirled in a vertical circle, the tension in the string is the least at

(i) the lowest point

(ii) the highest point

(iii) the mid-height

(iv) 45° to the vertical

(h) The work done in stretching a spring of spring constant k by a length Δ is

(i) $k\Delta$

(ii) $k\Delta^2$

(iii) $k\Delta/2$

(iv) $k\Delta^2/2$

(i) If u_1 and u_2 are the initial velocities of two bodies making direct collision and if v_1 and v_2 are their respective velocities after collision, then the coefficient of restitution is

(i) $\frac{v_1 - v_2}{u_1 - u_2}$

(ii) $\frac{v_1 + v_2}{u_1 + u_2}$

(iii) $\frac{v_1 - v_2}{u_2 - u_1}$

(iv) $\frac{u_1 - u_2}{v_1 - v_2}$

(j) Instantaneous centre of rotation at that instant has

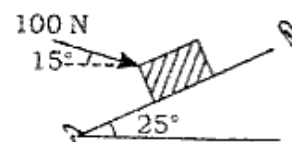
(i) zero linear velocity

(ii) zero angular velocity

(iii) Both (i) and (ii)

(iv) non-zero linear velocity

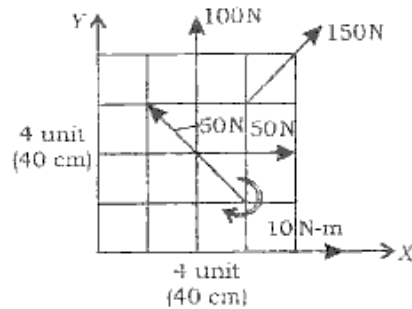
2. Determine the components of a force 100 N acting on a block along and normal to the plane as shown below :



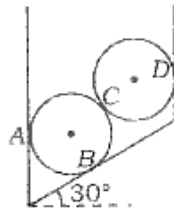
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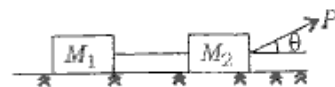
3. Replace the system of forces as shown below by an equivalent force couple system at the origin :



4. Two identical cylinders of radius v and weight w rest in a channel with inclined base as shown below. Determine the reactions at contact points A, B, C and D. The base width is $3.5v$ in the horizontal direction and its inclination is 30° :



5. Two blocks of mass M_1 and M_2 are connected by a string rest on a rough horizontal surface as shown below. Determine the force P which is applied at an angle θ to the horizontal to start the motion. Also find the tension in the string at the point of impending motion :



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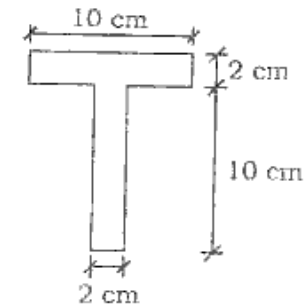
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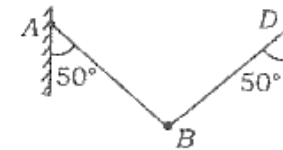
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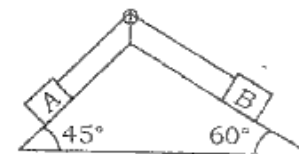
6. Determine the moment of inertia of the T-section about centroidal axes as shown below :



7. A small sphere of weight W is held as shown below by two wires AB and BD. Determine the tension in the wires. Also determine the acceleration of the sphere and tension in wire BD, if the wire AB is cut :



8. Two rough planes are inclined at 45° and 60° to the horizontal. Masses of 12 kg and 24 kg are placed on the surfaces that is $M_A = 12$ kg and $M_B = 24$ kg as shown below. The two masses are connected by a string. If $\mu_k = 0.4$, find the resulting acceleration :



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(Continued)

9. A linkage $ABCD$ as shown below moves in a vertical plane. At any instant crank AB has a clockwise angular velocity of δ rad/s. Determine the angular velocities of links BC and CD :

