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Paper Code : ES (AUE)-301/CE(ES)-301/ES(ME)-301

PUID : 03490 (To be mentioned in the main answer script)

ENGINEERING MECHANICS

Time Allotted : 3 Hours   Full Marks : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP – A
(Multiple Choice Type Questions)

1. Choose the correct alternatives for the following :

                                                    $10 \times 1 = 10$

i)   Two forces of 100N and 150N are acting simultaneously at a point. What is the resultant of these two forces, if the angle between them is 45° ?

   a)   212 N   b)   222 N

   c)   232 N   d)   242 N.

ii) The tendency of rotation of the body along any axis is also called

   a)   moment of inertia   b)   moment of couple

   c)   torque   d)   force.

iii) Forces are called coplanar when all of them acting on body lie in

   a)   one point

   b)   one plane

   c)   different planes

   d)   perpendicular planes.

iv) The ratio of limiting friction to normal reaction is known as

   a)   coefficient of friction

   b)   angle of friction

   c)   angle of repose

   d)   sliding friction.

v)   If I_x and I_y be the moment of inertia about any two axes at right angles to each other in the plane of the area and intersecting the pole, then the polar moment of inertia J will be

   a) $I_x + I_y$ b) $\dfrac{(I_x + I_y)}{2}$

   c) $I_x \times I_y$ d) $(I_x + I_y)^{1/2}$.

vi) According to principle of moments

   a)   if a system of coplanar forces is in equilibrium, then their algebraic sum is zero

   b)   if a system of coplanar forces is in equilibrium, then the algebraic sum of their moments about any point in their plane is zero

   c)   the algebraic sum of the moments of any two forces about any point is equal to moment of the resultant about the same point

   d)   positive and negative couples can be balanced.

vii) According to Lami's theorem

    a) three forces acting at a point will be in equilibrium

    b) three forces acting at a point can be represented by a triangle, each side being proportional to force

    c) if three forces acting upon a particle are represented in magnitude and direction by the sides of a triangle, taken in order, they will be in equilibrium

    d) if three forces acting at a point are in equilibrium, each force is proportional to the sine of the angle between the other two.

viii) D' Alembert's principle is used for

    a) reducing the problem of kinetics to equivalent statics problem

    b) determining stresses in the truss

    c) stability of floating bodies

    d) designing safe structures

    e) solving kinematic problems.

ix) If two bodies, one light and the other heavy, have equal kinetic energy, which one has a greater linear momentum ?

    a) The heavy body

    b) The light body

    c) Both have equal momentum

    d) Upredictable

    e) None of these.

x) If the momentum of a body is doubled, its kinetic energy will

    a) increase by 2 times

    b) increase by four times

    c) remain same

    d) get halved

    e) one fourh.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. Two forces of magnitudes 50 kN and 80 kN are acting on a particle, such that the angle between the two is 135°. If both the forces are acting away from the particle, calculate the resultant and find its direction.

3. A bullet is fired from a rifle with an initial velocity of 50 m/s so as to just clear a vertical wall of 20 m height and located at a distance of 30 m measured horizontally from the point of projection. Find the angles of projection with horizontal.

4. A particle of mass m moves linearly along x-axis under the action of force $F = kx$, where k is a constant. Find the velocity as a function of displacement x if the initial conditions of motion are, $x_0 = 0$, $\dot{x}_0 = 0$.

5. A car accelerates uniformly from a speed of 30 km/hr to a speed of 75 km/hr in 5 sec. Determine the acceleration of the car and the distance travelled by the car during 5 sec.
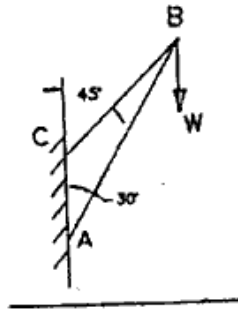
6. A stone is projected in space at an angle of 45° to horizontal at an initial velocity of 10 m/sec. Find the range of the projectile. http://www.makaut.com
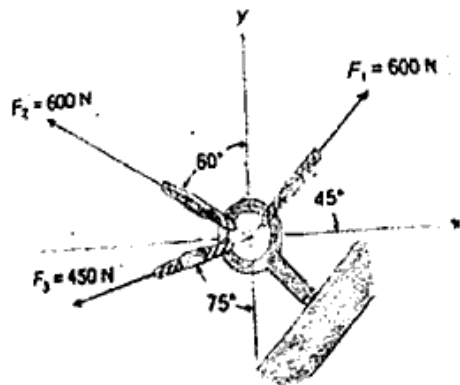
GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

7. A crane shown in figure is required to lift a load of $W = 10$ kN. Find the forces in the members *AB* and *CB*.

8. a) Determine the magnitude of the resultant force and its direction, measured counter-clockwise from the positive *x*-axis as shown figure.

b) Referring to figure, determine the coordinates x_c and y_c of the centre of a 100 mm diameter, circular hole cut in a thin plate so that this point will be the centroid of the remaining area.
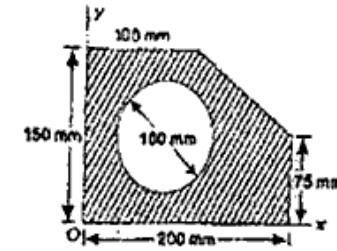
$7 + 8$

9. a) State laws of friction.

b) Two rectangular blocks of weights W_1 and W_2 are connected by a flexible string and rest upon a horizontal and an inclined plane, respectively with the string passing over a pulley as shown in figure. In the particular case where $W_1 = W_2$ and the coefficient of friction μ is same for all contiguous surfaces, find the angle α of inclination of the inclined plane at which motion of the system will impend.
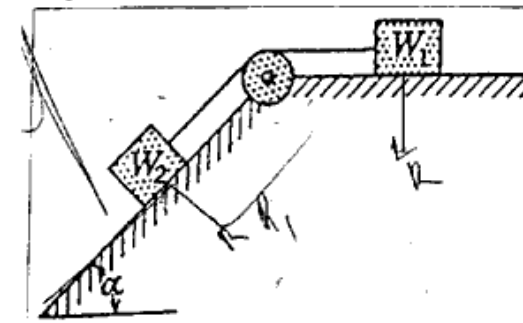

$5 + 10$

10. A boat is rowed with a velocity of 5 km/h straight across a river which flows at the rate of 1 km/h. If the breadth of the river is 300 m, determine how far the actual landing would be away from the original spot to which the boat was directed. Draw necessary sketch.

10 + 5

11. a) An automobile of weight W travels with a uniform speed v over a vertical curve ACB which is parabolic, as shown in the figure. Determine the total pressure exerted by the wheel of the car as it passes over the crest C.

Given $\delta = 1 \cdot 2$ m, $l = 60$ m and $v = 96$ km/hr.
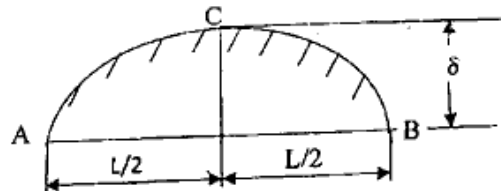
b) The block A of mass 5 kg resting on a 30° inclined plane as shown in given figure is released. The block after travelling a distance of 0·5 m along the inclined plane hits a spring of stiffness 15 N/cm.

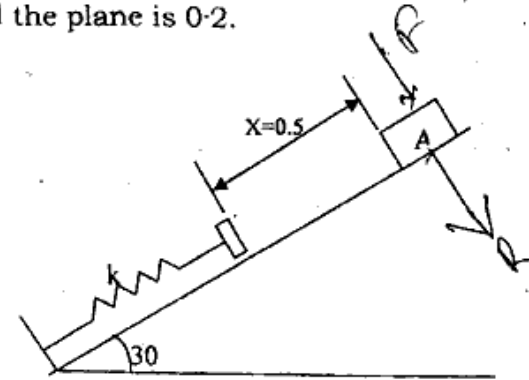Find the maximum compression of the spring. Assume the coefficient of friction between the block and the plane is 0·2.

8 + 7