[3861]-163

F. E. (Semester - II) Examination - 2010
ENGINEERING MECHANICS
(2008 Pattern)

Time : 3 Hours]   [Max. Marks : 100

Instructions :

    (1) *Answer Q.1 or Q. 2, Q. 3 or Q. 4, Q. 5 or Q. 6 from section I and Q. 7 or Q. 8, Q. 9 or Q. 10, Q. 11 or Q. 12 from section II.*

    (2) *Answers to the* **two sections** *should be written in* **separate answer-books**.

    (3) *Figures to the right indicate full marks.*

    (4) *Neat diagrams must be drawn wherever necessary.*

    (5) *Use of logarithmic tables, slide rules, electronic pocket calculator is allowed.*

    (6) *Assume suitable data, if necessary.*

SECTION - I

Q.1) (A) Explain Principle of Transmissibility of Force.   [02]

      (B) Determine components of the 1000N Force shown along the aa' and bb' axes shown in fig.   [08]
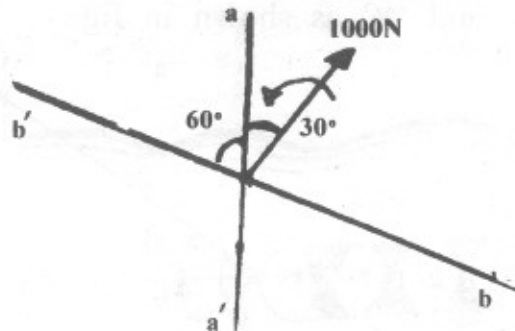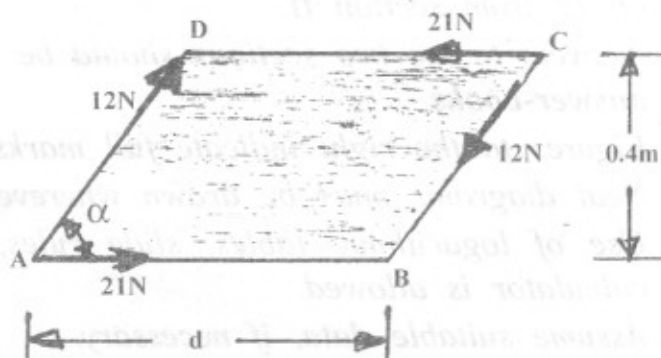
(C) A plate in the shape of a parallelogram is acted upon by two couples, as shown in fig.

Determine :

(a) The moment of the couple formed by the two 21N forces.

(b) The perpendicular distance between the 12N forces if the resultant of the two couples is zero.

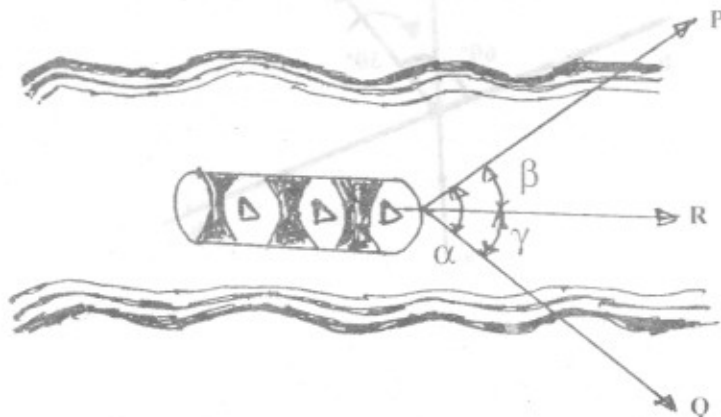(c) The value of 'α' if the resultant couple is 1.5N.m clockwise and d = 1.05m. [08]

OR

Q.2) (A) Explain Varignon's Theorem. [02]

(B) A boat is moved uniformly along a canal by two horses pulling with forces P = 890N and Q = 1068N acting at an angle α = 60° as shown in fig.
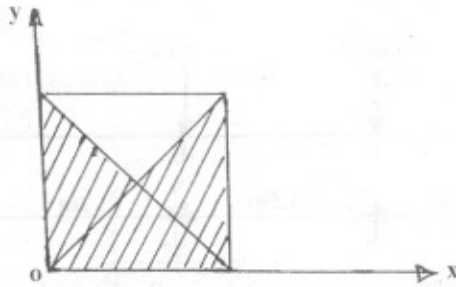
Determine magnitude of the resultant pull on the boat and the angle 'β' and 'γ' as shown in fig. [08]
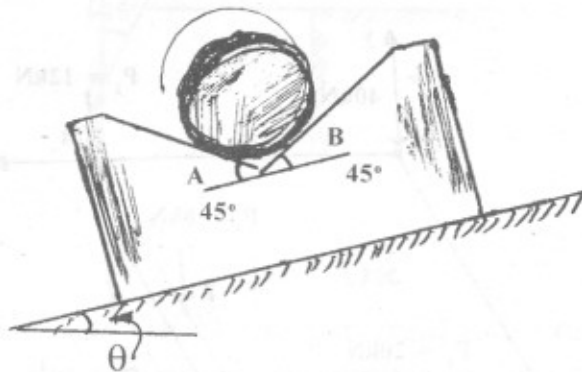
(C) Locate Centroid of the shaded three-quarters of the area of a square of dimension 'a' as shown in fig. [08]
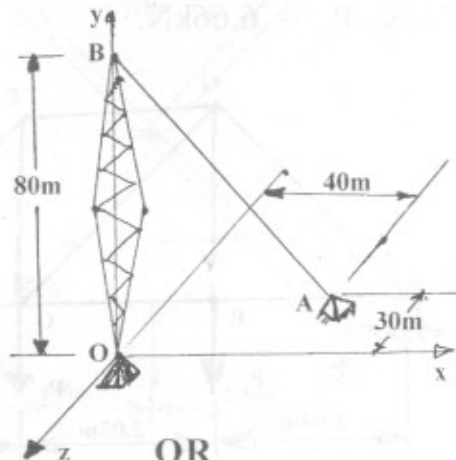

Q.3) (A) Find the angle of tilt 'θ' with the horizontal so that the contact force at 'B' will be one-half that at A for smooth cylinder. [08]

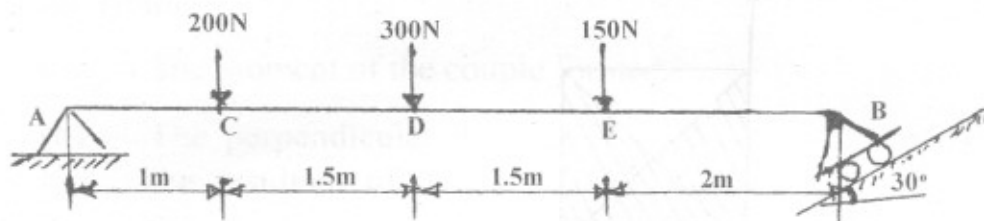(B) A tower guy is anchored by means of a bolt at 'A'. The tension in the wire is 2500N.

Determine :

(a) The components F_x, F_y and F_z of the force acting on bolt.

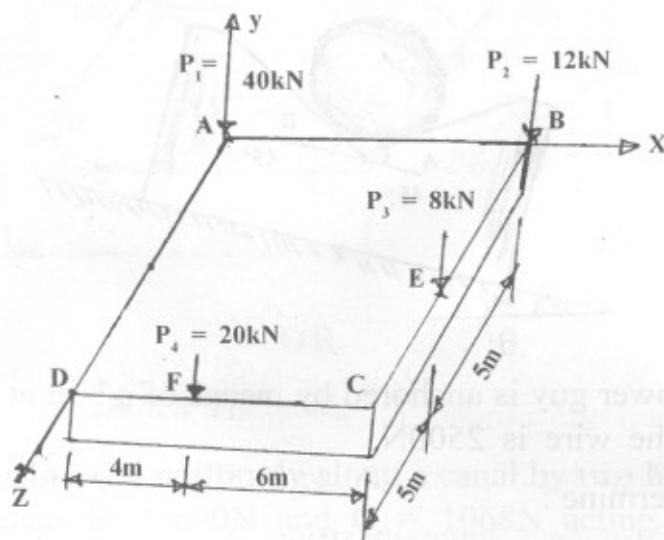(b) The angle Q_x, Q_y and Q_z defining direction of force. [08]

OR

Q.4) **(A)** Determine reactions R_A and R_B at support A and B of horizontal beam AB due to action of vertical loads applied as shown in fig. [08]


(B) A square foundation mat supports four columns as shown. Determine magnitude, direction and point of application of resultant of the four loads, as shown in fig. [08]

Q.5) **(A)** Determine force in each member of the joint 'G' of truss and state if the members are in tension or compression. Take $P_1 = 2.22kN$, $P_2 = 6.66kN$. [08]
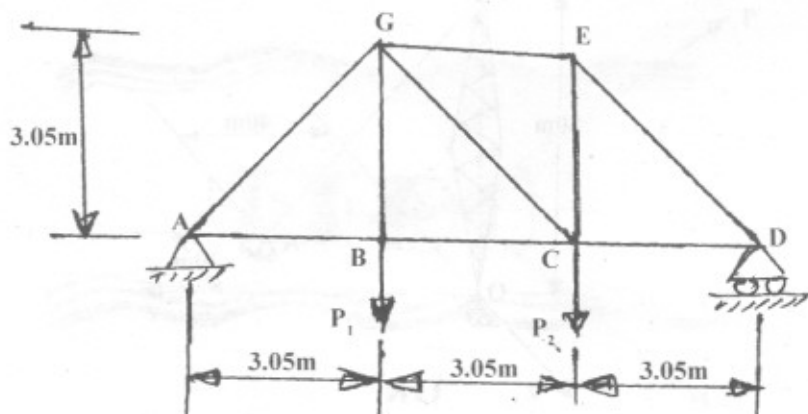
(B)   A heavy concrete block weighing 10kN is to be shifted away
      from the wall with the help of a 15° wedge as shown in fig.
      Calculate magnitude of the vertical force that has to be applied
      to the top of the wedge for achieving this objective, if the
      coefficient of friction between all the rubbing surfaces is
      0.25.   [08]
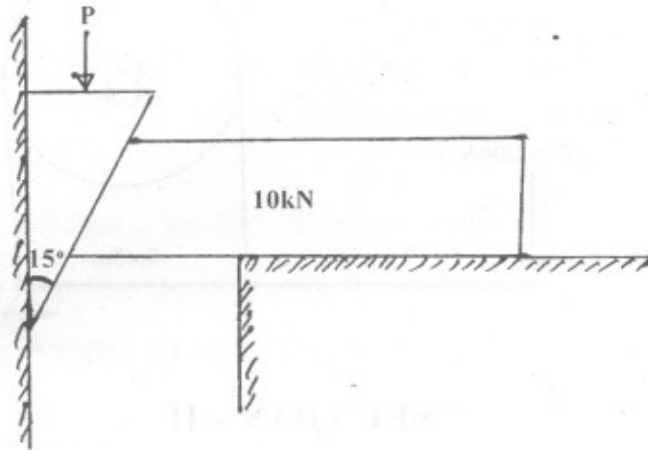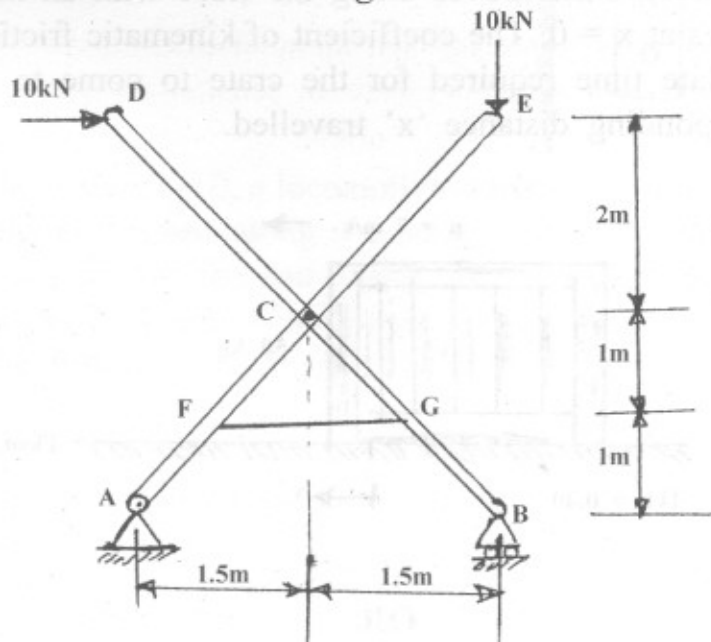

OR

Q.6) (A)   'ACE' and 'BCD' are two rigid rods connected by string 'FG'
           and the pin at 'C' as shown in fig.

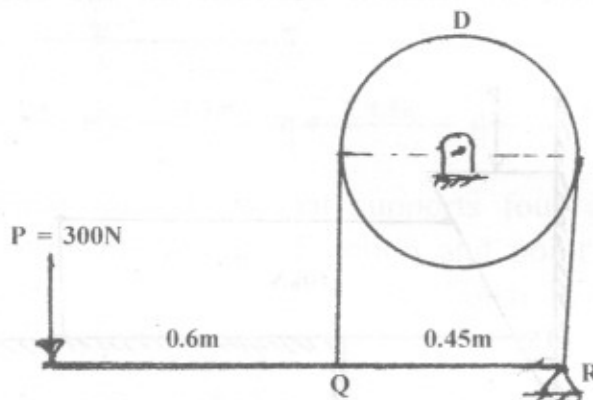   Find reaction at 'A' and 'B' and force on pin at 'C'.

           Also find force in string 'FG'.   [08]

(B) The brakeband encircles drum 'D' and is connected to the horizontal lever at 'Q' and 'R' as shown in fig.

Calculate braking torque if drum is rotating (i) clockwise (ii) anticlockwise. Take $\mu = 0.33$ for all the rubbing surfaces. [08]


SECTION - II

Q.7) (A) Acceleration of Particle is defined by relation $a = -4$ m/s².
If at $t = 0$, $v = 24$ m/s and $x = 0$, determine :
   (a) velocity and position when $t = 8$ sec.
   (b) time and position when $v = 0$. [08]

(B) The 50 kg crate moves along the floor with an initial speed of 7m/s at $x = 0$. The coefficient of kinematic friction is 0.40. Calculate time required for the crate to come to rest and corresponding distance 'x' travelled. [09]


OR

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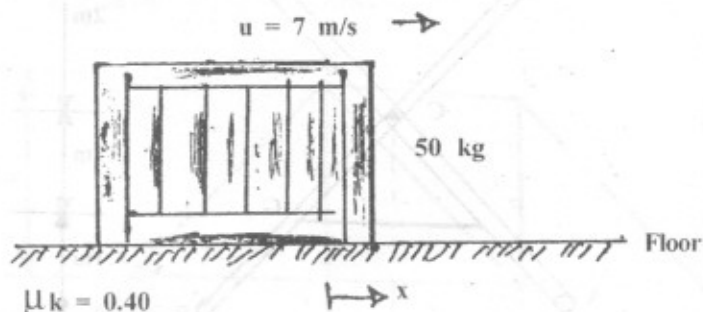
Q.8) **(A)** An automobile 'A' starts from '0' and accelerates at constant rate of 0.75 m/s². A short time latter it is passed by bus 'B' which is travelling in opposite direction at constant speed of 6m/s. Knowing that bus 'B' passes point '0' 20 sec. after automobile 'A' started from there, determine when and where vehicle passed each other. **[08]**

(B) Two blocks of weights 'P' and 'Q' are connected by a flexible but inextensible cord and supported as shown in fig. If the coefficient of friction between the block 'P' and the horizontal surface is 0.33, find :

(a) acceleration of the system.

(b) the tensile force in the cord.

Take P = 53.4N, Q = 26.7N **[09]**
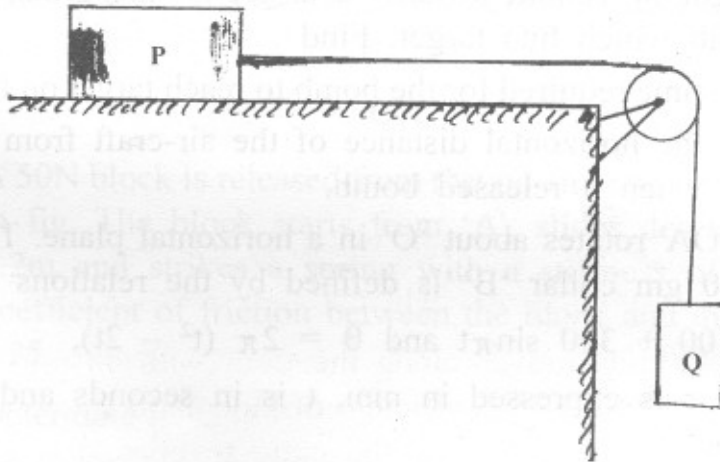
Q.9) **(A)** At the instant t = 0, a locomotive starts to move with uniformly accelerated speed along a circular curve of radius r = 600m and acquires by the end of the first 60 sec. of motion a speed equal to 24 kmph. Find tangential and normal acceleration at the instant t = 30 sec. **[08]**

(B)   The bob of pendulum 3.5m long describes an arc of a circle in vertical plane as shown in fig. If the tension in the string is 2.5 times the weight of the bob for the position shown, find velocity and acceleration of the bob in that position.   [08]

OR
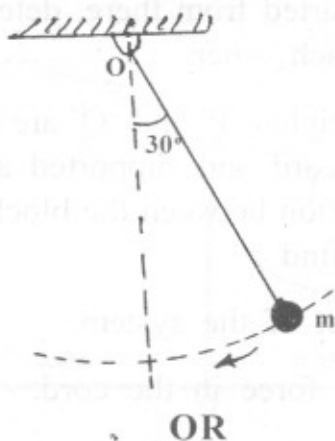
Q.10) (A)   An air-craft moving horizontally at a speed of 720 kmph at a height of 1000m towards a target on the ground, releases a bomb which hits target. Find :

(a)   time required for the bomb to reach target on the ground.

(b)   the horizontal distance of the air-craft from the target when it released bomb.   [08]

(B)   Rod 'OA' rotates about 'O' in a horizontal plane. The motion of 400 gm collar 'B' is defined by the relations -

$r = 500 + 300 \sin\pi t$ and $\theta = 2\pi (t^2 - 2t)$,

where r is expressed in mm, t is in seconds and 'θ' is in radians.

Determine radial and transverse components of the force exerted on the collar when t = 0.   [08]
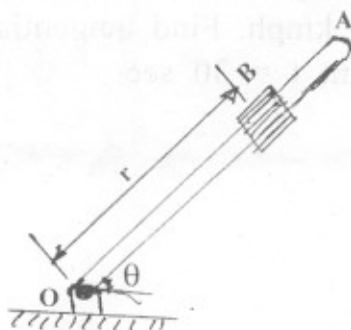
Q.11) (A) A 45 kg block is sliding a distance of 3m along horizontal surface by a constant force P = 200N, inclined at 30° to the horizontal as shown in fig. The coefficient of sliding friction is 0.30.

   (a) Determine total work done on the block.

   (b) Assuming that the block starts from rest, determine speed of the block when it has travelled 3m. [09]
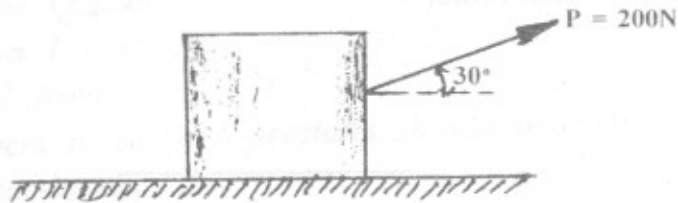
   (B) A bullet of mass 100 gm is fired into a freely suspended target of mass 10 kg. Due to impact, the bullet gets imbedded in the target and the target with bullet moves with a velocity of 7m/s. Find velocity of bullet before impact and the loss of kinetic energy. [08]

OR

Q.12) (A) A 50N block is released from rest on an inclined plane as shown in fig. The block starts from 'A', slides down a distance of 1.2m and strikes a spring with a stiffness of 8 kN/m. The coefficient of friction between the block and inclined plane is 0.25.

   Determine :

   (a) amount the spring gets compressed.

   (b) distance the block will rebound up the plane from the compressed position. [09]
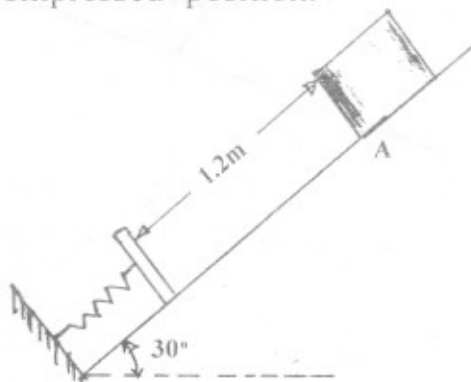
(B) A handball of mass m = 0.050 kg is dropped on a floor from a height h = 2m. The coefficient of restitution for the impact between the ball and the floor is 0.75.

(a) Determine velocity of the ball at the instant before it strikes the floor.

(b) Determine velocity of the ball at the instant it rebounds.   [08]

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