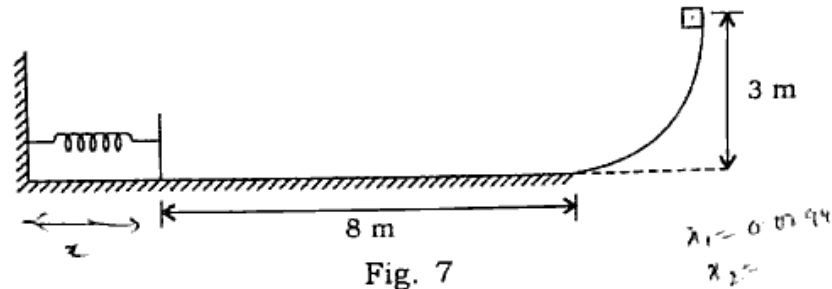9. A block of 3 kg mass slides down a frictionless loop of 3 m radius and enters a rough horizontal plane and compress a spring of stiffness 250 N/m as shown in Fig. 7.

Fig. 7

Determine the compression of the spring, the coefficient of friction between the block and plane being 0·25.

B.Tech 2nd Semester Exam., 2014

ENGINEERING MECHANICS

Time . 3 hours   *Full Marks* : 70

Instructions :

(i) *The questions are of equal value.*

(ii) *There are **NINE** questions in this paper.*

(iii) *Attempt **FIVE** questions in all.*

(iv) *Question No.* **1** *is compulsory.*

1. Choose the correct answer any *seven* of the following :   akubihar.com

   (a) The 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

   (b) Force couple is a

   (i) fixed vector

   (ii) sliding vector

   (iii) free vector

   (iv) unit vector

(c) A force couple system can be reduced to a single force only when the resultant force and couple are —— to each other

    (i) parallel akubihar.com

    (ii) perpendicular

    (iii) inclined at 45°

    (iv) inclined at 135°

(d) Three forces acting on a body can keep it in equilibrium, only when they are

    (i) collinear

    (ii) coplanar and concurrent

    (iii) coplanar and parallel

    (iv) coplanar and non-concurrent

(e) The tangent of the angle of friction is

    (i) angle of repose

    (ii) coefficient of friction

    (iii) cone of friction

    (iv) limiting friction

(f) A screw jack with lead angle θ and friction angle ϕ, is said to be in self-locking if

    (i) $\theta > \phi_s$ akubihar.com

    (ii) $\theta < \phi_s$

    (iii) $\theta = \phi_s$

    (iv) $\phi_s = 0$

(g) The centroid of an equilateral triangle of side a with a side parallel to the x-axis is

    (i) $a/2, a/\sqrt{6}$ akubihar.com

    (ii) $a/2, a/\sqrt{12}$

    (iii) $a/2, a/\sqrt{24}$

    (iv) $a/3, a/3$

(h) The product of inertia of a right-angled triangle of base b and height h about its centroidal axes is

    (i) $\dfrac{b^2h^2}{36}$ (ii) $-\dfrac{b^2h^2}{36}$

    (iii) $-\dfrac{b^2h^2}{72}$ (iv) $\dfrac{b^2h^2}{48}$

(i) A particle can move with constant velocity when motion is akubihar.com

    (i) rectilinear

    (ii) curvilinear

    (iii) rotational

    (iv) general motion

(j) In a conservative force field

    (i) work done is zero

    (ii) kinetic energy is constant

    (iii) potential energy is constant

    (iv) total mechanical energy is constant

2. (a) Define the terms—continuum, rigid body and particle

(b) Given the following vectors

$$\vec{a} = 2\hat{i} - 2\hat{j} + 3\hat{k}$$
$$\vec{b} = \hat{i} + \hat{j} + 3\hat{k}$$
$$\vec{c} = 2\hat{i} + \hat{j} + \hat{k}$$

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Determine whether they are coplanar or not

3. (a) Explain the principle of transmissibility of a force

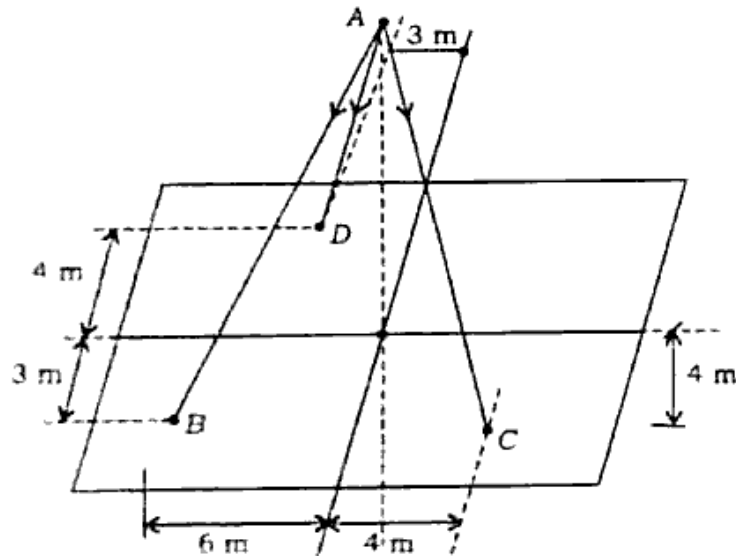(b) Find the resultant of the forces concurrent at A as shown in Fig. 1

Fig. 1

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The magnitudes of forces in cables AB, AC and AD are 1200 N, 1500 N and 1000 N respectively.

(Continued)

4. (a) Define force couple and moment of a couple

(b) Reduce the system of forces as shown in Fig. 2 to an equivalent force and determine its magnitude and location with respect to A.
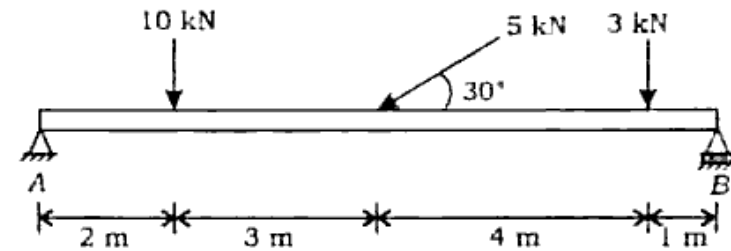

Fig. 2

5. (a) Define with sketch the different types of supports.

(b) A smooth pulley supporting a load of 3000 N is mounted at B on a horizontal beam ACF. A force of 4000 N is acting at free end F shown in Fig. 3
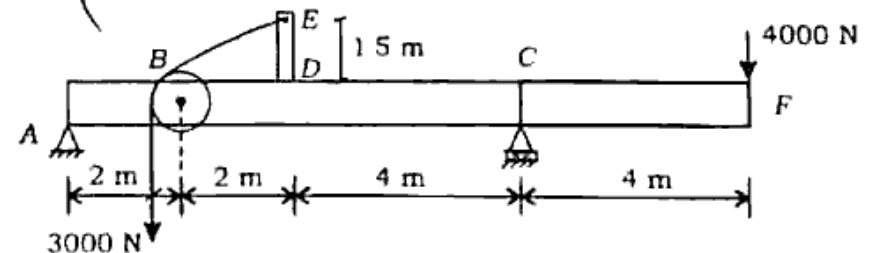

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Fig. 3

If the beam weighs 1000 N, find the support reactions. Neglect the weight of pulley and also its size

akubihar.com (Turn Over)

6. *(a)* Define angle of friction, angle of repose and cone of friction.

(b) As shown in Fig. 4, block A of 15 kg mass is connected to another block B of 10 kg mass by a string passing over a frictionless pulley
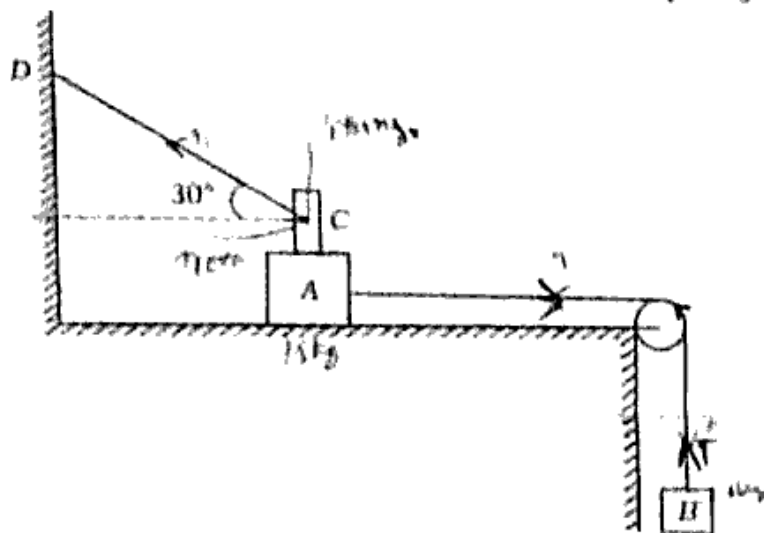

Fig. 4

Determine the minimum mass of the block C which is connected to the wall by a string CD and placed over block A to keep it from sliding. Take coefficient of friction between all contact surfaces to be 0.25.

7. *(a)* The mass moment of inertia gives a measure of resistance to rotation about an axis. Discuss.

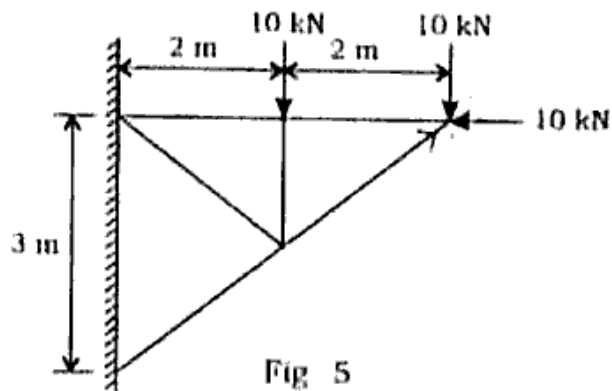*(b)* Determine the forces in the various members of a pin-jointed framework as shown in Fig. 5

Fig. 5

8. What is meant by instantaneous centre? A long rod AB is supported at the upper edge of a wall and on a horizontal floor as shown in Fig. 6
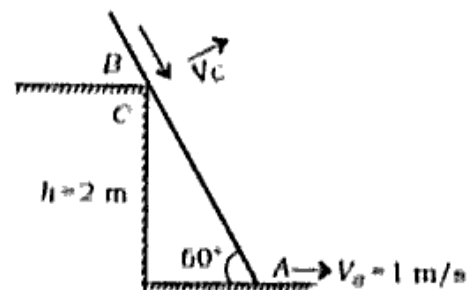

Fig. 6

If the lower end of the rod moves with a velocity 1 m/s, find the velocity of the contact point C and the angular velocity of the rod, when the rod is at 60° to the horizontal