Total Number of Pages: 03

2ⁿᵈ Semester Back Examination 2016-17
MECHANICS
BRANCH(S): ALL
Time: 3 Hours
Max Marks: 70
Q.CODE: Z1202
Answer Question No.1 which is compulsory and any five from the rest.
The figures in the right hand margin indicate marks.

Q1   **Answer the following questions:**   **(2 x 10)**

a) Find the magnitude of the resultant force, if 30,40,50 and 60N forces are acting along the lines joining the centre of a square to its vertices.

b) The moment of a force about any point is numerically equal to how much times the area of the triangle whose base is the line representing the force and vertex is the point about which the moment is taken.

c) Define angle of repose and prove that it is equal to angle of friction in magnitude.

d) Define a couple. Enumerates it's different characteristics.

e) What is the ratio of M.I. of a rectangle and that of a triangle, having same base and height with respect to their base.

f) Show the differences between 'method of section' and 'method of joints'. When do you think that 'method of sections' is preferable over 'method of joints'?

g) Write the equations of a freely falling body.

h) State and explain D'Alembert's principle.

i) State the work-energy theorem. Derive the equation of work-energy for rectilinear motion of a particle.

j) A glass marble drops from a height of 5m on to a horizontal floor. If the co-efficient of restitution is 0.75, find the height to which it rises?

Q2 **a)** A lamp weighing 5N is supported from the ceiling by a chain. It is pulled aside by a horizontal chord until the chain makes an angle of 60^0 with the ceiling. Determine the tensions in the chain and the chord.   **(2)**

b) Three smooth identical right circular cylinder, each of weight **W** and radius **r** are resting on a smooth inclined surface as shown in figure -1.Determine the least angle **θ** to prevent the stack from collapsing.   **(8)**
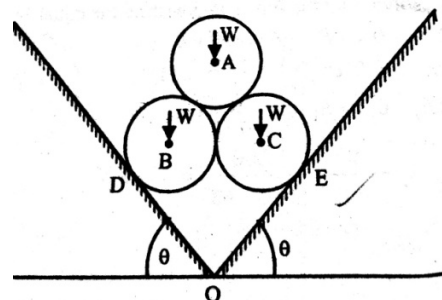

Fig-1

Q3 **a)** A smooth right circular cylinder of radius r rests on a horizontal plane and is **(5)** kept from rolling by an inclined string AC of length 2r as shown in the fig-2. A prismatic bar AB of length 3r and weight Q is hinged at point A and leans against the roller as shown. Find the tension S that will be induced in the string AC.

Fig-2
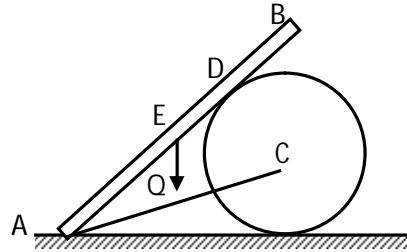
b) A block of weight W_1 = 960 N rests on the horizontal surface and supports on **(5)** top of it, another block of weight W_2=275 N as shown in figure-3 below. The block W_2 is attached to a vertical wall by the inclined string AB. Find the magnitude of the horizontal force P applied to the lower block as shown in the figure, that will be necessary to cause slipping to impend. Take coefficient of static friction for all contiguous surfaces is μ = 0.35.

Fig-3
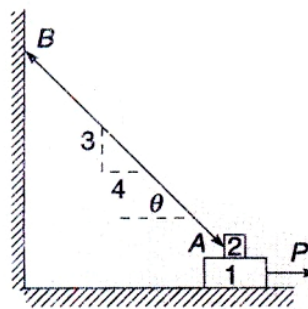
Q4 **a)** Determine the centroid of the area shown in figure-4 below by taking moment **(5)** of area about the given a-a axis and b-b axis.
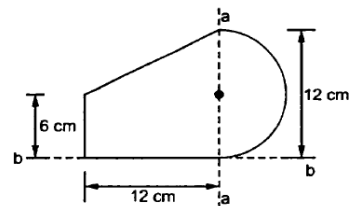

Fig-4

b) Find the forces in all the members of the pin jointed truss as shown in Fig- 5 **(5)** by method of joints. Check your result for the member 1 and 2 by method of sections.
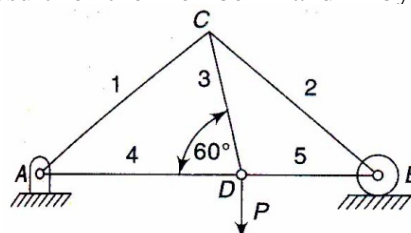

Fig-5

Q5 a) A cage descends in a mine shaft with an acceleration of 0.4 m/sec^2. After the cage has traveled 22 m, a stone is dropped from the top of the shaft. Determine: (a) the time taken by the stone to hit the cage and (b) the distance traveled by the cage before impact. **(5)**

b) A mass m_1 hanging at the end of a string moves a mass m_2 along the surface of a smooth table. If the mass m_2 on the table is doubled, tension in the string is increased by one-half. What is the ratio of m_1/m_2. **(5)**

Q6 a) Neglecting friction and inertia of the two-step pulley shown in following Fig-6, find the acceleration a of the falling weight P. Assume P = 100 N, Q = 180 N and $2r_1 = 3r_2$. **(5)**
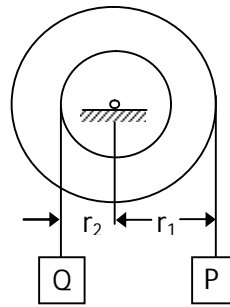

Fig-6

b) A man of height 1.5 m wishes to project a ball over the flat roof of a school house having 7.5 m height and 12 m width on the level plane. Determine at what distance from the wall he should through the ball so as to clear the roof with the least velocity. **(5)**

Q7 A small car of weight W starts from rest at A and rolls without friction along an inclined plane to B where it strikes a block also of weight W and initially at rest as shown in figure-7. Assuming a plastic impact at B, the car and block will move from B to C as one particle. If the coefficient of friction between block and plane is $\mu = 0.35$, calculate the distance x to point C where the bodies come to rest. **(10)**
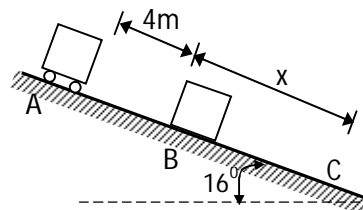

Fig-7

Q8 **Write short answer on any TWO:** **(5 x 2)**
a) Pappus theorems.

b) Laws of friction.

c) Parallel axis theorem.

d) D'Alembert's principle of Dynamics.