College of Engineering Pune

Civil Engineering Department

F. Y. B. Tech. Semester II

(CE 101) Engineering Mechanics

Year: 2012-2013 — 28th April 2013

Time : 10 am to 1 pm — **End Semester Examination** — Max. Marks : 50

Instructions:

- All questions are compulsory. Each question carries 5 marks.
- Make suitable assumptions wherever required and state them clearly.
- Draw clear diagrams wherever necessary.

Q.1 Fig. Q.1 shows a space force system. Specify the magnitude of $\mathbf{F_3}$ and its coordinate direction angles α_3, β_3 and γ_3 so that the resultant force $\mathbf{F_R}$ = {9 j} kN. Angle made by $\mathbf{F_3}$ with X-axis = α_3, with Y-axis = β_3 and with Z-axis = γ_3.

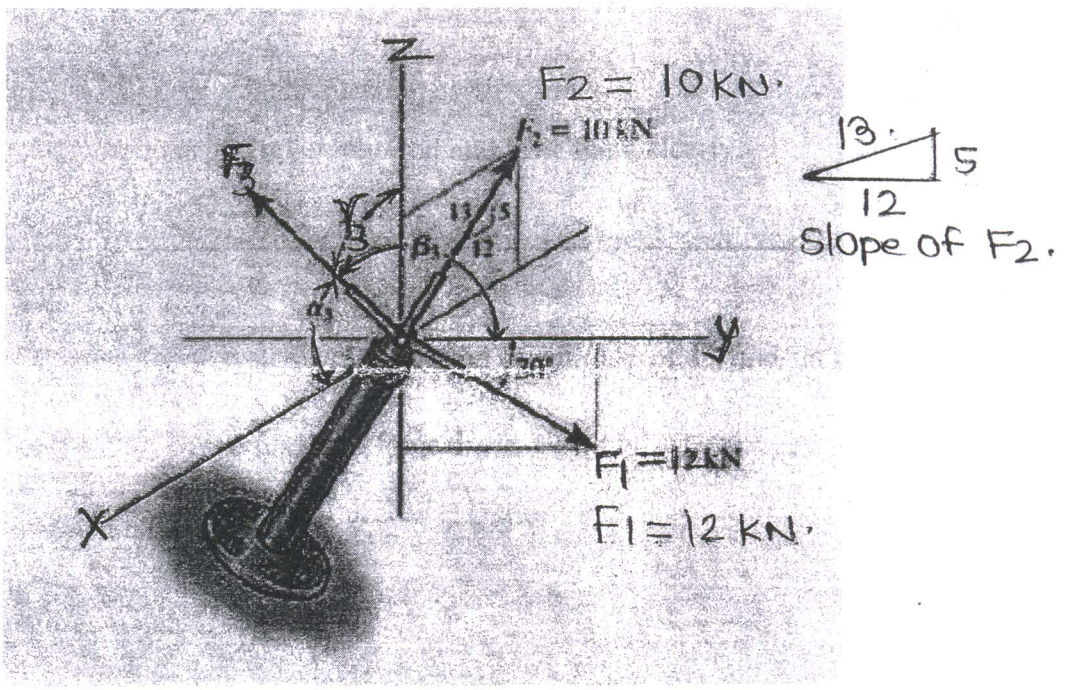


Fig.Q.1

Q.2 A compound beam is supported and loaded as shown in Fig. Q.2. An internal hinge is provided at **G**. Using virtual work method, find the reactions at supports **A, B** and **C.**

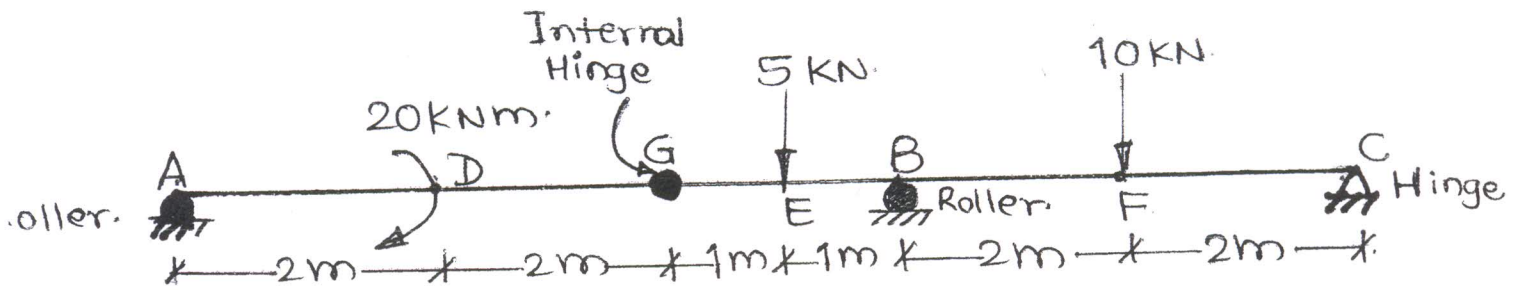


Fig.Q.2

Q.3 A plane frame is loaded as shown in Fig.Q.3. Determine components of forces acting on members **ABC, BE** and **CEF.** Draw free body diagram of each member and indicate forces acting at each pin.

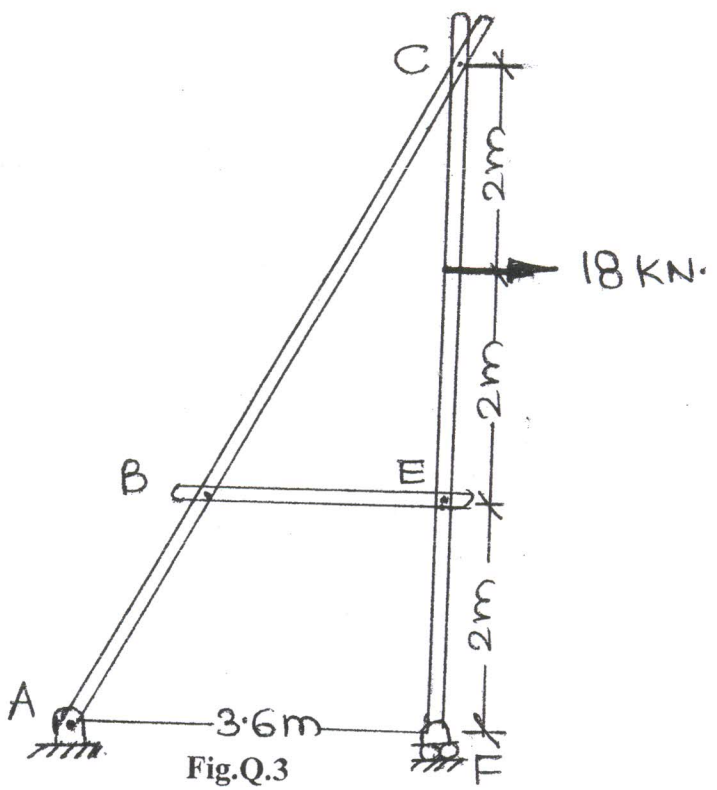


Fig.Q.3

Q.4 Small packages traveling on the conveyor belt fall off into a 1m long loading car, shown in Fig. Q.4. If the conveyor is running at a constant speed of Vc = 2 m/s, determine the smallest and largest distance **'R'** at which the end **A** of the car may be placed from the conveyor so that the packages enter the car. Inclination of the conveyor belt with the horizontal = 30^0.

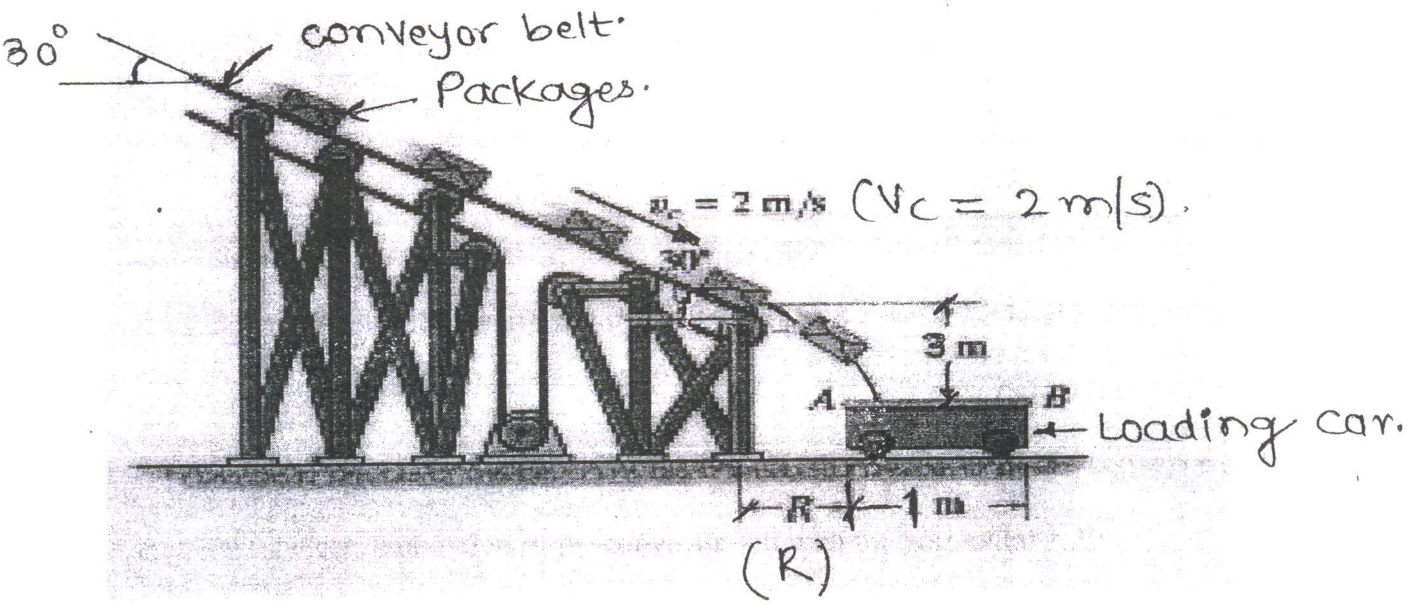


Fig. Q.4

Q.5 A system of pulleys is shown in Fig. Q.5. Determine the speed with which block **B** rises, if the end of the cord at **A** is pulled down at a speed of 12 m/s.

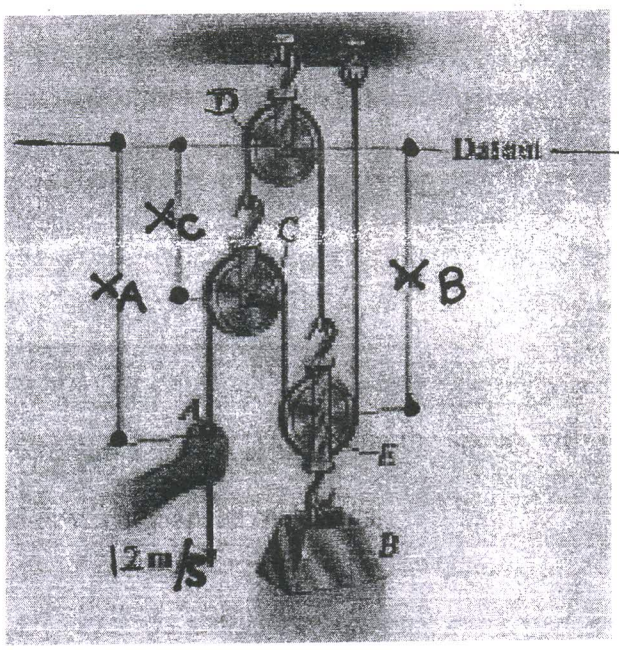


Fig.Q.5

Q.6 A 5 kg block is released from rest at **A** and slides down a smooth circular surface **AB.** It then continues to slide along the horizontal rough surface until it strikes the spring. For the rough surface **BC,** μ_k = 0.2. Determine how far the block compresses the spring before stopping. Refer Fig. Q.6. Stiffness of spring (k) = 80 N/m.

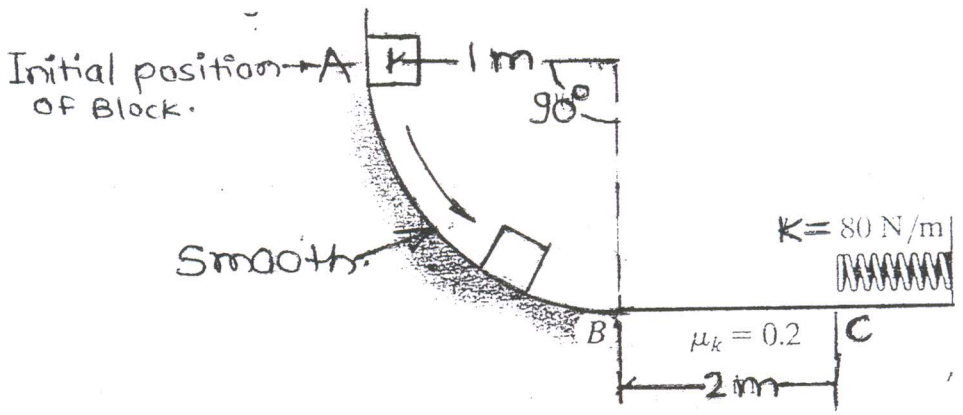


Fig. Q.6

Q.7 When the mechanism shown in Fig.Q.7 is in the position shown, the angular velocity of bar **AB** is ω_{AB} = 3 rad/s clockwise. Locate instantaneous center of rotation and calculate the angular velocity of bar **BC.** Also find the velocity of slider **C** for this position.

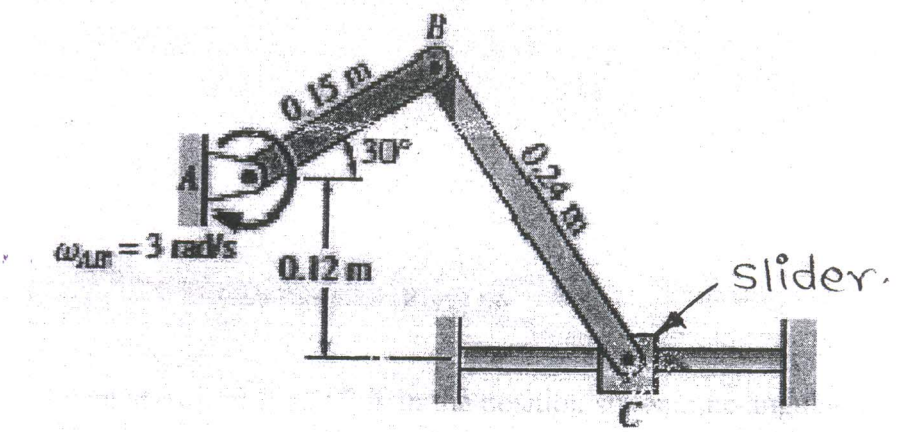
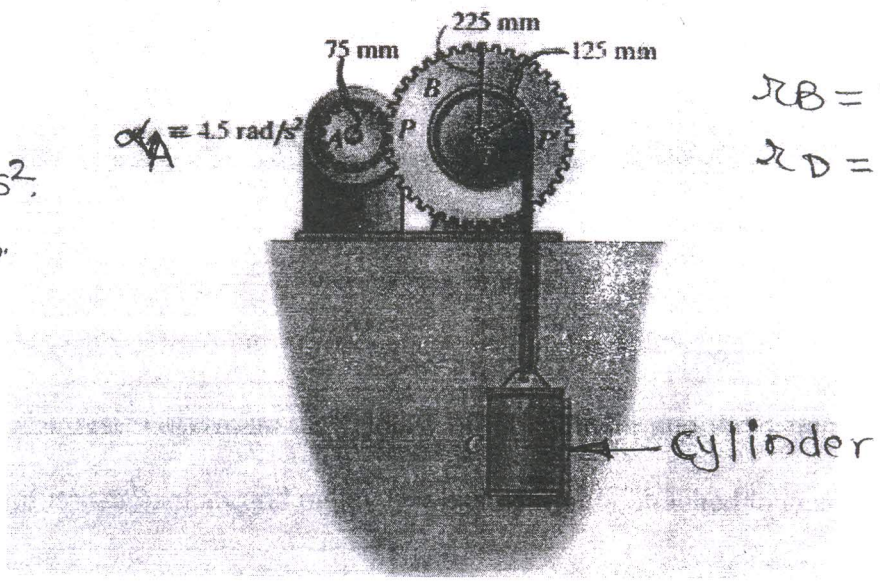


Fig. Q.7

Q.8 For a short period of time, the motor turns gear **A** with a constant angular acceleration of α_A= 4.5 rad/s^2, starting from rest. Determine the velocity of the cylinder and the distance it travels in three seconds. The cord is wrapped around pulley D which is rigidly attached to gear **B**. Refer Fig. Q.8



$\alpha_A = 4.5$ rad/s^2
$r_A = 75$ mm.

$r_B = 225$ mm.
$r_D = 125$ mm.

Fig. Q.8

Q.9 The car **A** has a weight of 22.5 kN and is travelling to the right at 0.9 m/s. Meanwhile, car **B** of weight 15 kN is travelling at 1.8 m/sec. to the left as shown in Fig. Q. 9. If the cars collide against each other and get locked, determine their common velocity just after the collision. Assume that the brakes are not applied during collision.

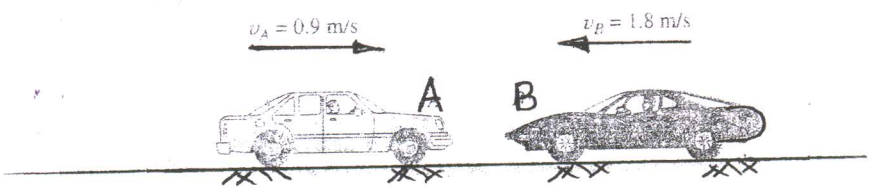


Fig. Q.9

Q. 10 A tray of mass '**m**' is attached to three springs as shown in Fig. Q.10. The period of vibration of the tray is 0.5 sec. After the center spring **C** has been removed, the period of vibration is observed to be 0.6 sec. If the stiffness of spring **C** is 125 N/m, determine the mass of the tray.

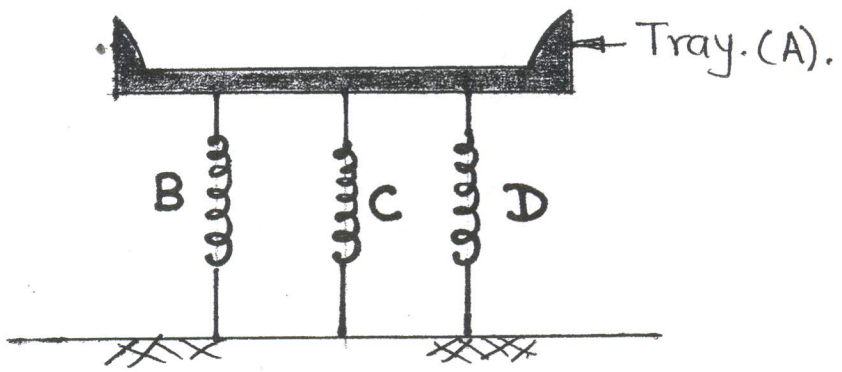


Fig. Q.10

Best wishes ..