

UNIVERSITY OF PUNE  
[4361]-111  
F. E.(Common)Examination - 2013  
ENGINEERING MECHANICS  
(2012 Pattern)

[Total No. of Questions:6]  
[Time : 2 Hours]

[Total No. of Printed Pages :6]  
[Max. Marks : 50]

- (1) Answer **Q1 or Q2, Q3 or Q4, Q5 or Q6** .
- (2) Answers to the **two sections** should be written in **separate answer-books**.
- (3) Black figures to the right indicate full marks.
- (4) Neat diagrams must be drawn wherever necessary.
- (5) Use of, electronics pocket calculator is allowed.
- (6) Assume suitable data, if necessary.
- (7) Use of cell phone is prohibited in the examination hall.

Q1 a) The resultant of two forces P and Q is 1200 N vertical. [4]

Determine the force Q and the corresponding angle  $\theta$  for the system of forces as shown in **Fig. 1a**.

b) The  $4.5 \times 10^6$  kg tanker is pulled with constant acceleration of  $0.001 \text{ m/s}^2$  using cable that makes an angle of  $15^\circ$  with the horizontal as shown in **Fig. 1 b**. Determine the force in the cable using Newton's second law of motion. [4]

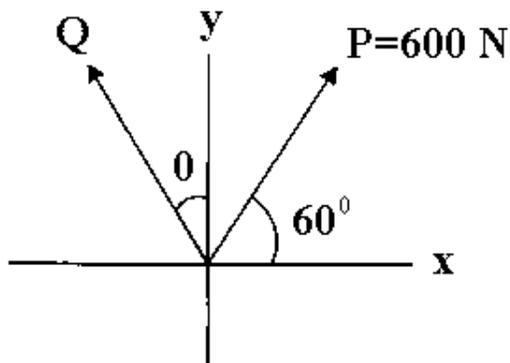


Fig. 1 a



Fig. 1 b

- c) During a race the dirt bike was observed to leap up off the small hill at [4]  
 A at an angle of  $60^\circ$  with the horizontal as shown in **Fig. 1c**. If the point  
 of landing is 6 m away, determine the approximate speed at which the  
 bike was travelling just before it left the ground.
- d) A woman having a mass of 70 kg stands in an elevator which has a [4]  
 downward acceleration of  $4 \text{ m/s}^2$  starting from rest. Determine the work  
 done by her weight and the normal force which the floor exerts on her  
 when the elevator descends 6 m.

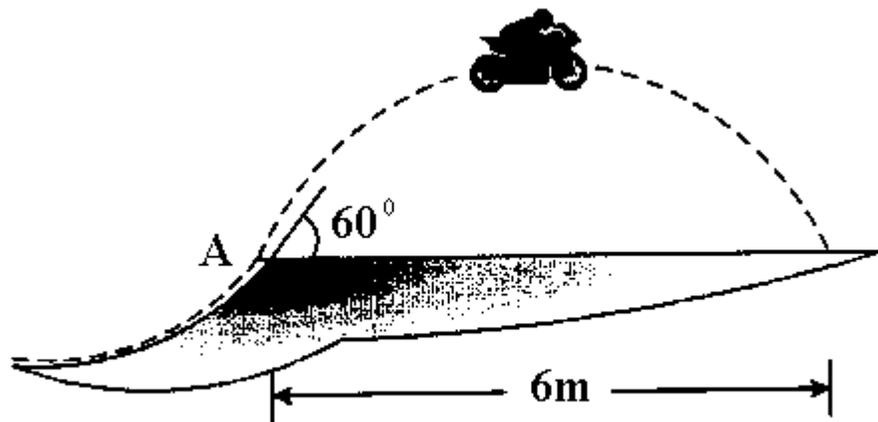


Fig. 1 c

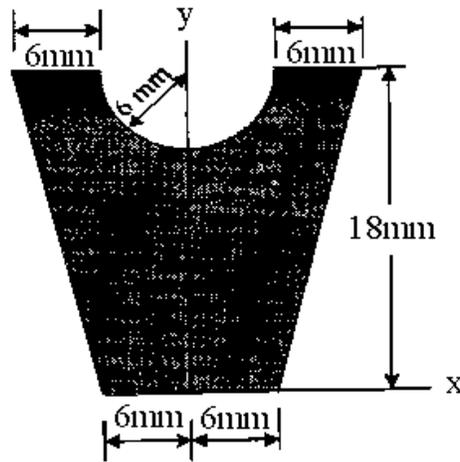
OR

- Q2 a) Determine the y coordinate of centroid of the shaded area as shown [4]  
 in **Fig. 2a**.
- b) A girl having mass of 25kg sits at the edge of the merry go-round so [4]  
 her centre of mass G is at a distance of 1.5 m from the centre of rotation

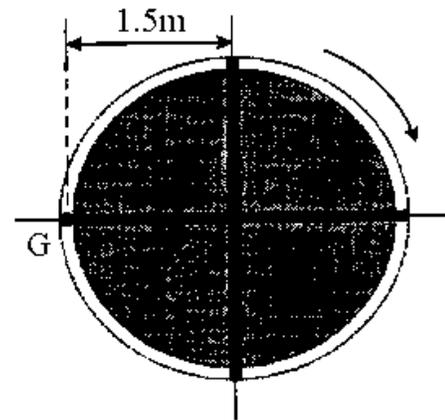
as shown in **Fig. 2b**. Neglecting tangential component of acceleration, determine the maximum speed which she can have before she begins to slip off the merry go-round. The coefficient of static friction is  $\mu_s = 0.3$ .

Use Newton's second law of motion.

- c) A baseball is thrown downward from a 15 m tower with an initial speed of 5 m/s. determine the speed at which it hits the ground and the time of travel. [4]
- d) A ball has a mass of 30 kg and is thrown upward with a speed of 15 m/s. Determine the time to attain maximum height using impulse momentum principle. Also find the maximum height. [4]



**Fig. 2 a**



**Fig. 2 b**

- Q3 a) The motor at B winds up the cord attached to the 65 N crate with a constant speed as shown in **Fig. 3a**. Determine the force in cord CD supporting the pulley and the angle  $\theta$  for equilibrium. Neglect the size of pulley at C. [6]
- b) The boom supports the two vertical loads  $P_1 = 800$  N and  $P_2 = 350$  N as shown in **Fig. 3b**. determine the tension in cable BC and component of reaction at A. [6]

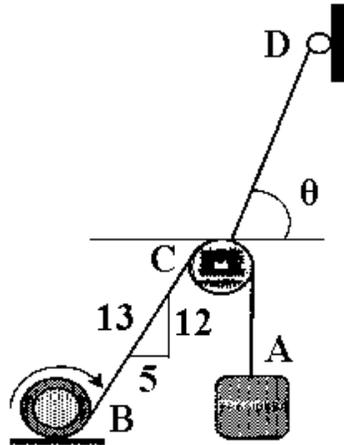


Fig.3 a

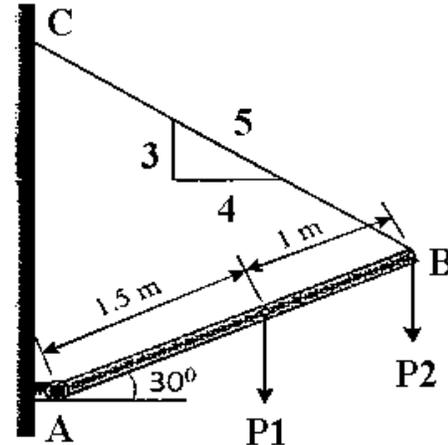


Fig. 3 b

- c) A concrete foundation mat in the shape of regular hexagon with 3 m side support column loads as shown in Fig. 3c. Determine the magnitude of the additional loads  $P_1$  and  $P_2$  that must be applied at B and F if resultant of all six loads is to pass through the centre of the mat.

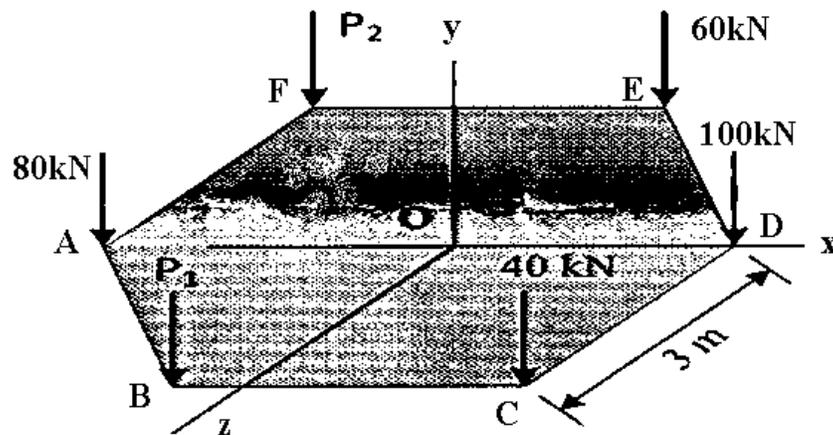
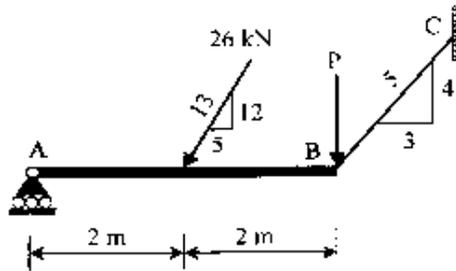


Fig. 3 c

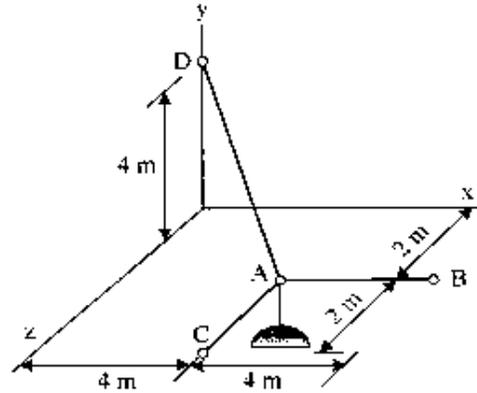
OR

- Q4 a) The rope BC will fail when the tension becomes 50 kN as shown [6]  
In Fig. 4a. Determine the greatest load P that can be applied to the beam  
At B and reaction at A for equilibrium.
- b) The three cables are used to support the 800 N lamp as shown in Fig. [6]  
4b. Determine the force developed in each cable for equilibrium.
- c) State and explain active forces, reactive forces and free body diagram [5]

with suitable example.

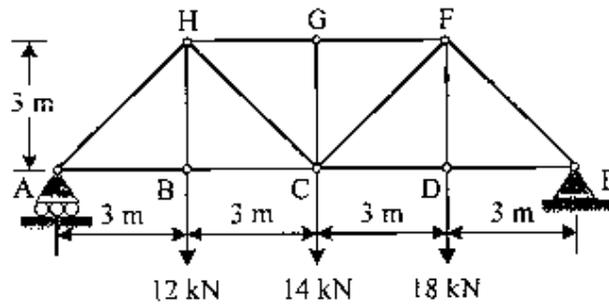


**Fig. 4 a**

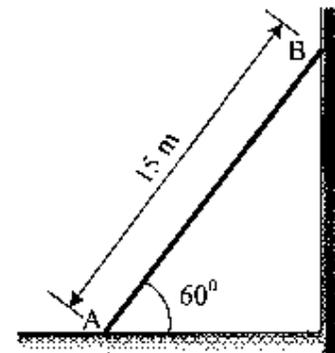


**Fig. 4 b**

- Q5 a) Determine the magnitude and nature of forces in the members BC, HC [6]  
 And HG of the truss loaded and supported as shown in **Fig. 5a**.
- b) The 15 m ladder has a uniform weight of 80 N and rest against the [6]  
 smooth wall at B as shown in **Fig. 5b**. If the coefficient of static friction  
 $\mu_s = 0.4$ , determine if the ladder will slip?
- c) Define angle of repose, angle of friction, coefficient of friction and [5]  
 cone of friction with sketches.



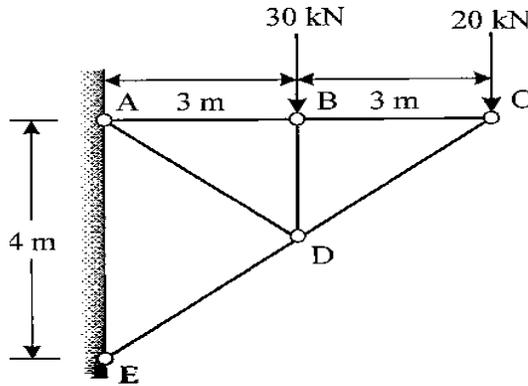
**Fig. 5 a**



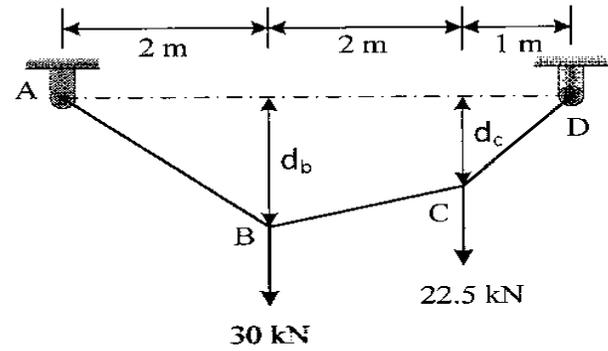
**Fig. 5 b**

OR

- Q6 a) Determine the forces in each member of the truss and state if the [6]  
 members are in tension or compression. Refer **Fig. 6a**.
- b) Two loads are suspended as shown in **Fig. 6 b** from cable ABCD. [6]  
 knowing that  $d_c = 0.75$  m and  $d_b = 1.125$  m, determine the component  
 of reaction at A maximum tension in the cable.

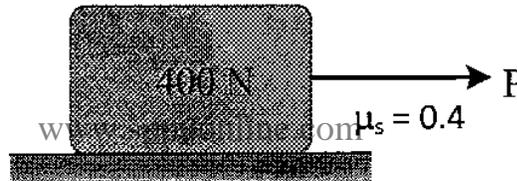


**Fig. 6 a**



**Fig. 6 b**

- c) A 400 N block is resting on a rough horizontal surface as shown in **Fig. 6c** for which the coefficient of friction is 0.4. Determine the force P required to cause motion if applied to the block horizontally. What minimum force is required to start motion? [5]



**Fig. 6 C**