

[4456]-111

**F.E. (Common) (Semester - I & II)**  
**ENGINEERING MECHANICS**  
**(2012 Course)**

Time : 2 Hours]

[Max. Marks : 50

*Instructions to the candidates :*

- 1) Attempt Q.1 or Q.2 Q.3 or Q.4 and Q.5 or Q.6.
- 2) Answer should be written in one answer book.
- 3) Neat diagram must be drawn wherever necessary.
- 4) Figures to the right indicate full marks.
- 5) Assume suitable data, if necessary and clearly state.
- 6) Use of cell phone is prohibited in the examination hall.
- 7) Use of electronic pocket calculator is allowed.

- Q1)** a) The resultant of two forces P and Q is 1200 N horizontally leftward. Determine the force Q and the corresponding angle  $\theta$  for the system of force s as shown in **Fig. 1 a**. [4]
- b) The tanker is pulled with constant acceleration of  $0.001 \text{ m/s}^2$  using cable that makes an angle of  $10^\circ$  with the horizontal as shown in **Fig. 1 b**. If the force in the cable is 45.694 kN, determine the mass of tanker using Newton's 2<sup>nd</sup> law of motion. [4]

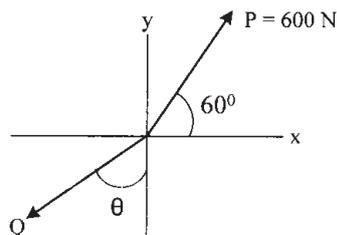


Fig. 1 a

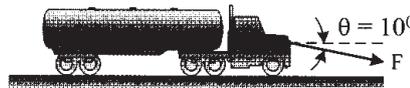


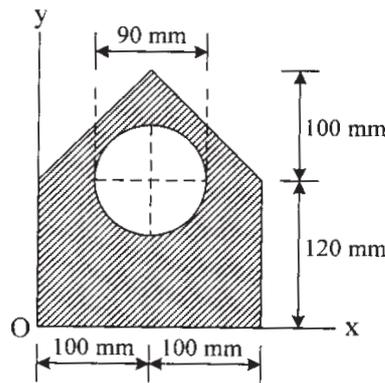
Fig. 1 b

- c) An outdoor track is 126 m in diameter. A runner increases her speed at a constant rate from 4.2 to 7.2 m/s over a distance of 28.5 m. Determine the total acceleration of the runner 2 s after she begins to increases her speed. [4]
- d) A 2 kg stone is dropped from a height h and strike the ground with a velocity of 24 m/s. find the kinetic energy of the stone as it strikes the ground and the height h from which it was dropped using work energy method. [4]

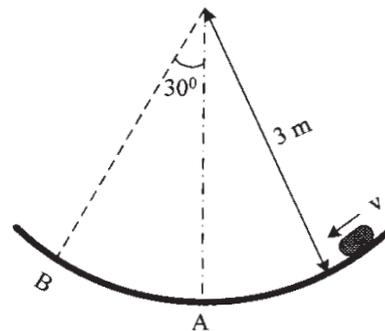
P.T.O.

OR

- Q2)** a) Determine the y coordinate of centroid of the shaded area as shown in **Fig. 2 a**. [4]
- b) A sphere is fired into a medium with a initial speed of 27 m/s. If it experience a deceleration  $a = (-6t) \text{ m/s}^2$ , where t is in seconds, determine the distance traveled before it stop. [4]
- c) The small 0.6 kg block slides on a smooth circular path of radius 3 m in the vertical plane. If the speed of the block is 5 m/s as it passes point A and 4 m/s as it passes point B, determine the normal force exerted on the block by the surface at each of these location. Refer **Fig. 2 c**. [4]
- d) A railroad car having a mass of 15 Mg is coasting at 1.5 m/s on a horizontal track. At the same time another car having a mass of 12 Mg is coasting at 0.75 m/s in the opposite direction. If the car meet and couple together, determine the speed of both cars just after the coupling. [4]

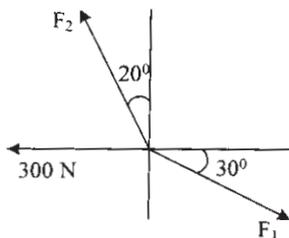


**Fig. 2 a**

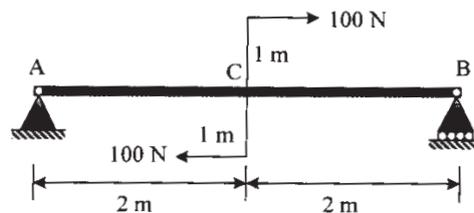


**Fig. 2 c**

- Q3)** a) Determine the magnitude of  $F_1$  and  $F_2$  so that the particle is in equilibrium. Refer **Fig. 3 a**. [6]
- b) Determine the reactions at support for the beam loaded and supported as shown in **Fig. 3 b**. [5]

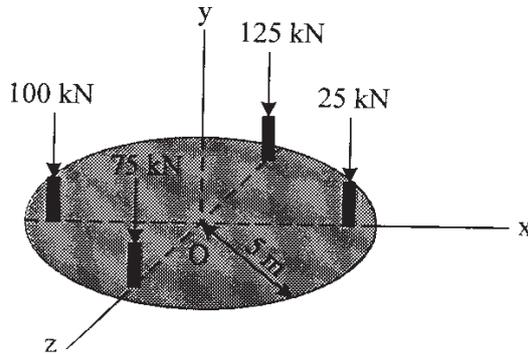


**Fig. 3 a**



**Fig. 3 b**

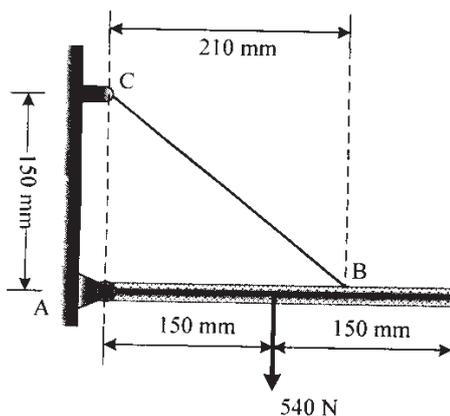
- c) A concrete foundation mat of 5 m radius supports four equally spaced columns, each of which is located 4 m from the centre of the mat. Determine the magnitude and point of application of the resultant of the four loads as shown in **Fig. 3 c**. [6]



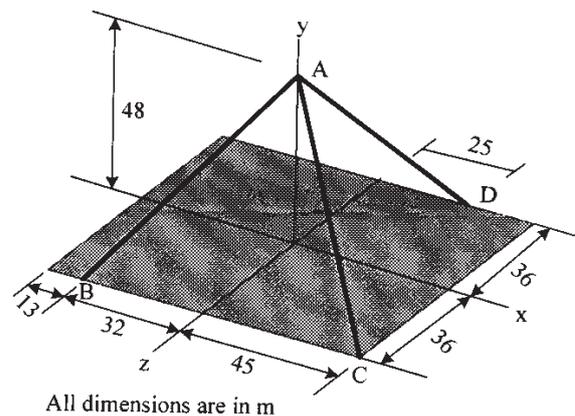
**Fig. 3 c**

OR

- Q4)** a) A 300 mm wooden beam weighing 540N is supported by a pin and bracket at A and by cable BC. Find the reaction at A and tension in cable BC. Refer **Fig. 4 a**. [6]
- b) A rectangular plate is supported by three cables at A as shown in **Fig. 4 b**. Knowing that the tension in cable AD is 120 N, determine the weight of the plate. [6]
- c) State and explain Two Force and Three Force Principle for equilibrium with sketches. [5]



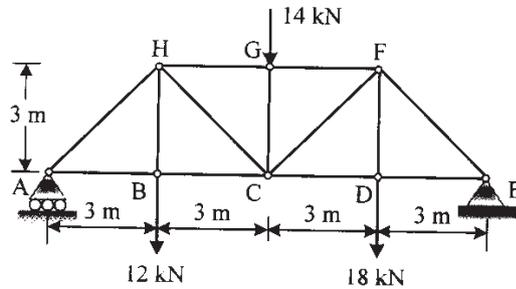
**Fig. 4 a**



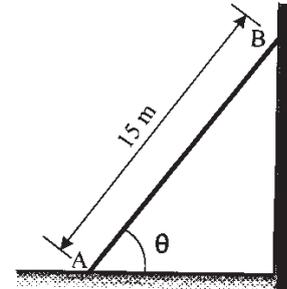
**Fig. 4 b**

- Q5)** a) Determine the magnitude and nature of forces in the members AB, AH and GC of the truss loaded and supported as shown in **Fig. 5 a**. [6]

- b) The 15 m ladder has a uniform weight of 80 N and rest against the smooth wall at B as shown in **Fig. 5 b**. If the coefficient of static friction between ladder and floor is  $\mu_s = 0.4$ , determine the smallest angle  $\theta$  at which the ladder will not slip. [6]
- c) Define angle of repose, angle of friction, coefficient of friction and cone of friction with sketches. [5]



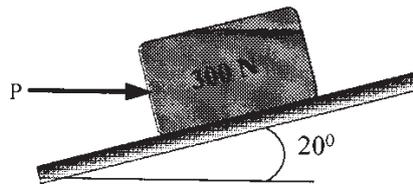
**Fig. 5 a**



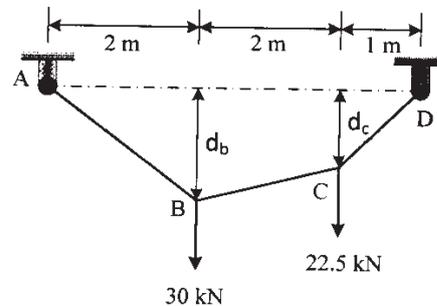
**Fig. 5 b**

OR

- Q6)** a) Determine the forces in member of HG, HC and BC in the truss as shown in **Fig. 5 a**. Use method of section. [6]
- b) Determine the horizontal force P needed to just moving the 300 N block up the plane. Take  $\mu_s = 0.3$  and refer **Fig. 6 b**. [5]
- c) Two loads are suspended as shown in **Fig. 6 c** from cable ABCD. Knowing that  $d_c = 0.75$  m and  $d_b = 1.125$  m, determine the component of reaction at A and maximum tension in the cable. [6]



**Fig. 6 b**



**Fig. 6 c**

