Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 40672

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2021.

Second/Third Semester

Aeronautical Engineering

GE 8292 — ENGINEERING MECHANICS

(Common to Aerospace Engineering/Agriculture Engineering/Automobile Engineering/Civil Engineering/
Environmental Engineering/Industrial Engineering/Industrial Engineering and Management/Manufacturing Engineering/Marine Engineering/Material Science and Engineering/Mechanical Engineering/Mechanical Engineering (Sandwich)/
Mechanical and Automation Engineering/Mechatronics Engineering/
Petrochemical Engineering/Production Engineering/Robotics and Automation/Safety and Fire Engineering/Petrochemical Technology/Petroleum Engineering)

(Regulations 2017)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. How can the force shown in Fig. Q 1 be represented in vector form?

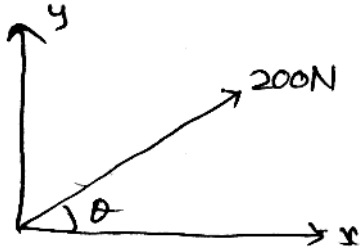

Fig. Q 1

2. State Lami's theorem and give its mathematical form.

3. What is a couple? Give example. What is the nature of its effect?

4. What is the moment about a point O (0, 0, 0) due to force vectors $F = F_x\vec{i} + F_y\vec{j} + F_z\vec{k}$ acting at a point $P(x, y, z)$? (Use vector form).

5. Give the statements of Papus Guldinus theorem (1) and (2).

6. For a cylinder and cone each of height 'h' and base radius 'R' find the centre of gravity and volume.

7. Write the 3 equations of motion of a point mass for a uniformly accelerated body.

8. The velocity of a particle is given by $V = 4t^3 - 5t^2$. When does the acceleration of the particle become zero?

9. What is instantaneous centre of rotation?

10. Why rolling friction is weaker than sliding friction?

PART B — (5 × 13 = 65 marks)

11. (a) A barge is pulled by 2 tugboats. If the resultant of the forced exerted by the tugboats is a 5 kN force directed along axis of the barge, find :

(i) the tension is each of the ropes knowing that $\alpha = 45°$

(ii) the value of α for which tension in rope 2 is minimum.

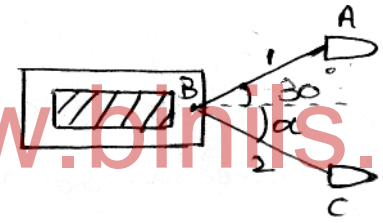

Fig. 11(a)

Or

(b) The sack hanging at A shown in Fig. 11(b) weighs 400 N. Determine the weight of the sack at D and the force in each rope to hold the system in equilibrium position.

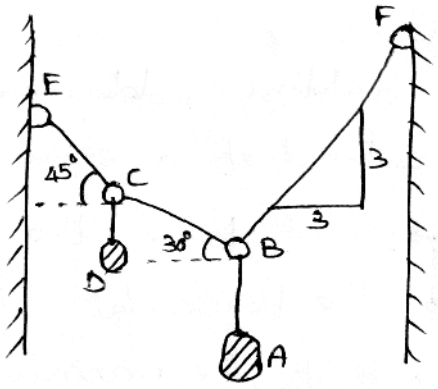

Fig. 11(b)

12. (a) A fixed crane has a mass of 1000 kg and it is used to lift a 2400 kg crate. It is held in place by a pin at A and a rooker at B. The center of gravity of the crane is located at G. Determine the components of reactions at A and B.

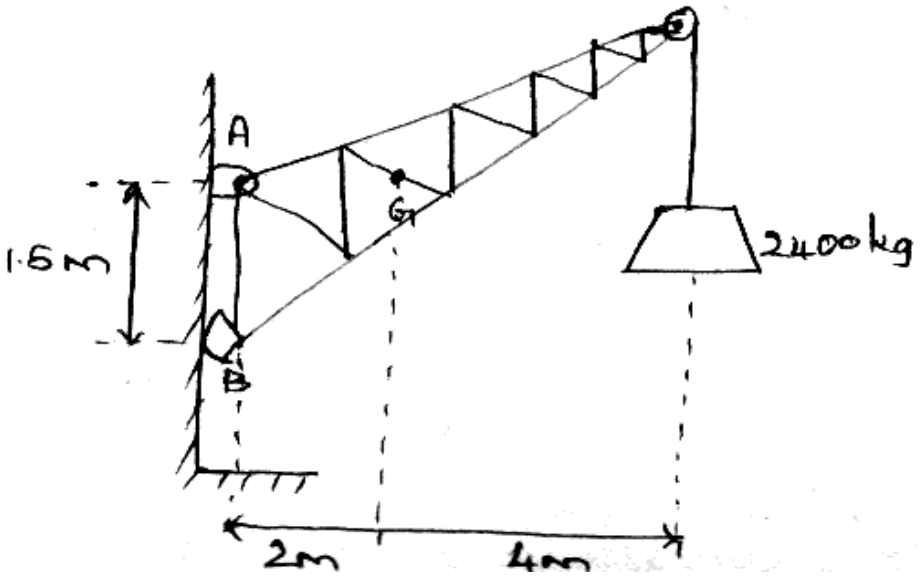

Fig. 12(a)

Or

(b) Four tugboats are used to bring an ocean liner to its pier. Each tugboat exerts 5 kN force in direction shown. Find

(i) The equivalent force couple system at the foremost O

(ii) The point on the hull where a single more powerful tugboat should push to produce. The same effect as original 4 tug boats.

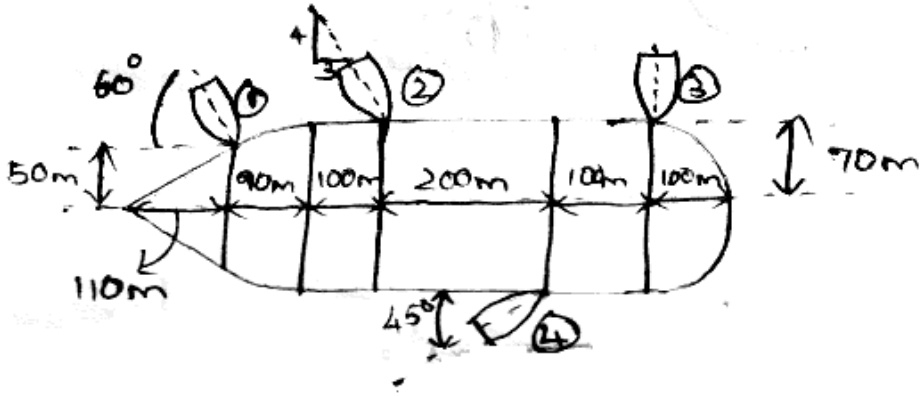

Fig. 12(b)

13. (a) For the plane area shown find :

(i) the first moments about x and y axes

(ii) the location of the centroid.

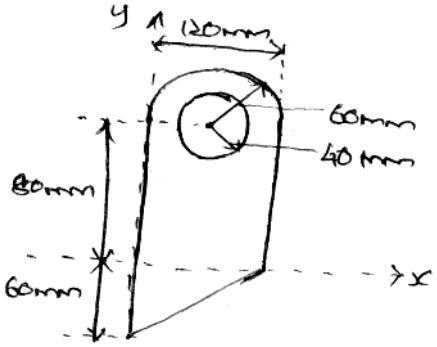

Fig. 13(a)

Or

(b) (i) Determine the area of the surface of revolution shown which is obtained by rotating a quarter circular arc about a vertical axes.

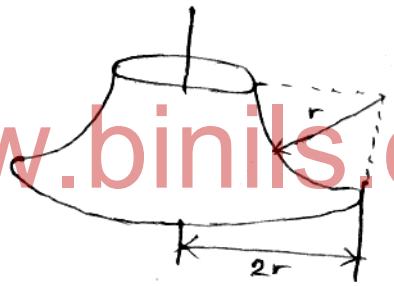

Fig. 13(b)(i)

(ii) Using theorems of Pappus Guldinus determine

(1) the centroid of a semicircular area

(2) the centroid of a semicircular arc.

14. (a) Two stones A and B are projected from the same point at 45° and 30° respectively inclined to the horizontal. Find the ratio of the velocities of projection of A and B if the maximum height reached by both is the same.

Or

(b) A steel ball of mass 600 g is dropped on to a horizontal A1 floor from a height of 90 m. What is the height that the steel ball will rebound if 45% K.E. is utilized to deform the contact surfaces permanently due to impact? Find also the reaction force exerted from the A1 floor. The ball is contact with the floor for a period of 0.065.

15. (a) A flat belt connects pulley A which drives a machine tool, to pulley B, which is attached to the shaft of an electric motor. The co-efficients of friction are $\mu_s = 0.25$ and $\mu_k = 0.20$ between both pulleys and the belt. Knowing that the maximum allowable tension in the belt is 600 N, determine the largest torque that can be exerted by the belt on pulley A.

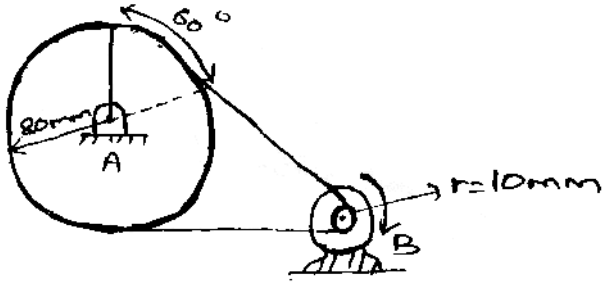

Fig. 15(a)

Or

(b) A grinding wheel is attached to the shaft on an electric motor of rated speed of 1500 rpm. When the power is switched on, the unit attains the rated speed in 5 S, and when the power is switched off. The unit comes to rest in 90 S. Assuming uniform accelerated motion, find the no. of revolutions the unit trans

(i) to attain the rated speed

(ii) to come to rest.

PART C — (1 × 15 = 15 marks)

16. (a) A road roller of weight 5 kN which is cylindrical in shape is pulled by a force F acting at an angle of 30°, with the horizontal, as in figure 16(a). It has to cross an obstacle of height 3 cm. Calculate the force F required to just cross this obstacle. Using both algebraic method and Lami's theorem. The radius of the roller is equal to 30 cm.

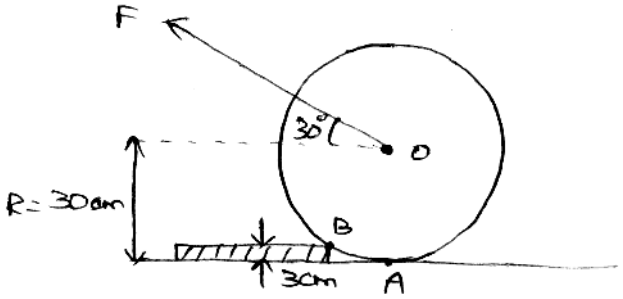

Fig. 16(a)

Or

(b) Determine the location of centroid of the right semi-circular cone shown in Fig. 16(b)

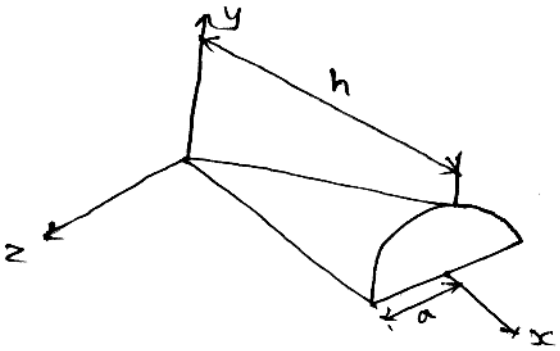

Fig. 16(b)

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