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

Question Paper Code : 20698

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2022.

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. State the principle of transmissibility.

2. Write the conditions for equilibrium of a particle in space.

3. A force F of magnitude 60 N is applied to the gear having pitch radius 100mm is shown in Fig.1. Determine the moment of F about point O

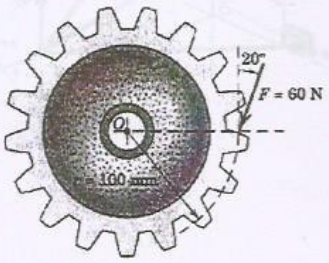

Fig. 1

4. State the Varignon's theorem.

5. What is use of perpendicular axis theorem?

6. Calculate the second moment of area for a rectangle of width 'b' and height 'h' about its base.

7. What is meant by perfectly elastic impact?

8. A sprinter reaches his maximum speed V_{max} in 2.5 seconds from rest with constant acceleration. He then maintains that speed and finishes 100 m in the overall time of 9.60 seconds. Determine his maximum speed V_{max}.

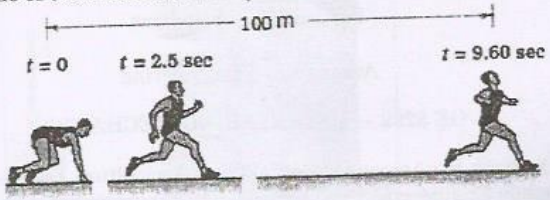

Fig. 2

9. Why coefficient of static friction is greater than the coefficient of kinetic friction?

10. Give practical examples for general plane motion.

PART B — (5 × 13 = 65 marks)

11. (a) Three cables are connected at A, where the forces P and Q are applied as shown in Fig.3. Knowing that Q = 0, find the value of P for which the tension in cable AD is 305 N.

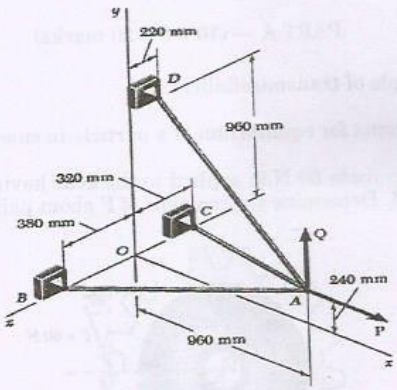

Fig. 3

Or

(b) The gusset plate subjected to the two forces as shown in Fig. 4. Replace them by two equivalent forces. F_x in the 'x' direction and F_a in the 'a' direction. Determine the magnitudes of F_x and F_a.

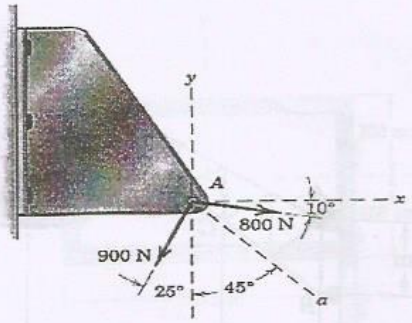

Fig. 4

12. (a) A force exerted on the grip of the exercise machine shown in Fig. 5 is F = 260i – 130j (N). What are the reactions at the fixed support at O?

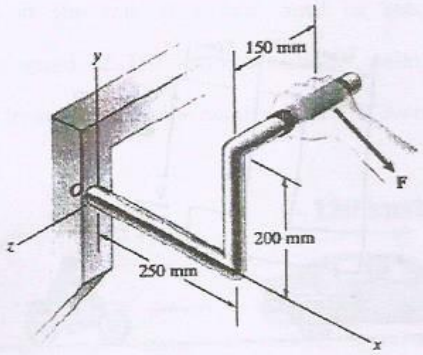

Fig. 5

Or

(b) A fixed crane has a mass of 1000 kg and is used to lift a 2400-kg load as shown in Fig. 6. It is held in place by a pin at A and a rocker at B. The center of gravity of the crane is located at G. Determine the components of the reactions at A and B.

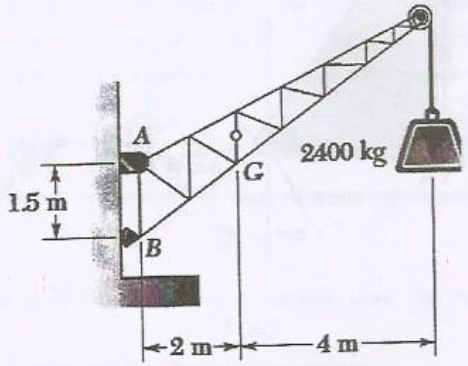

Fig. 6

13. (a) Find the moment of Inertia of the object given below.

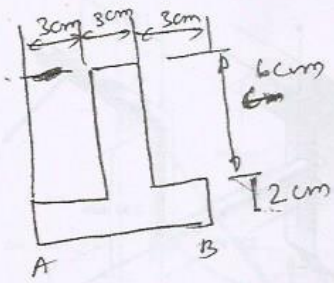

Fig. 7

Or

(b) Determine the moment of inertia of the shaded area shown in Fig.8 about the centroidal axes. The wall thickness is 20 mm on all four sides of the rectangle.

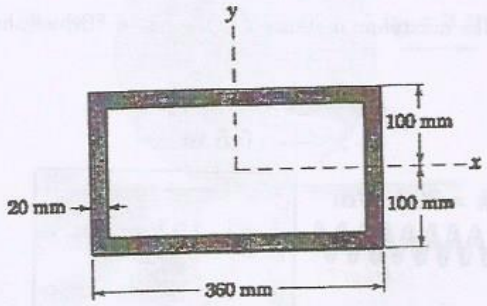

Fig. 8

14. (a) A motorcycle patrolman starts from rest at A two seconds after a car. The car is speeding at the constant rate of 120 km/h. If the patrolman accelerates at the rate of 6 m/s² until he reaches his maximum permissible speed of 150 km/h, which he maintains, calculate the distance 's' from point A to the point at which he overtakes the car.

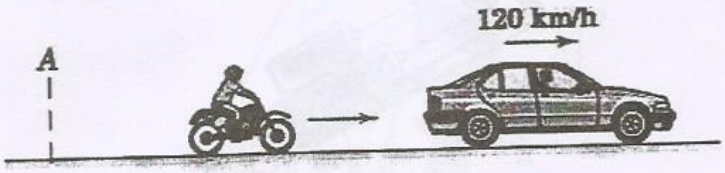

Fig. 9

Or

(b) The 10-kg block is released from rest on the horizontal surface at point B, where the spring has been stretched a distance of 0.5m from its neutral position A. The coefficient of kinetic friction between the block and the plane is 0.30. Calculate (i) the velocity of the block as it passes point A and (ii) the maximum distance x to the left of A which the block goes.

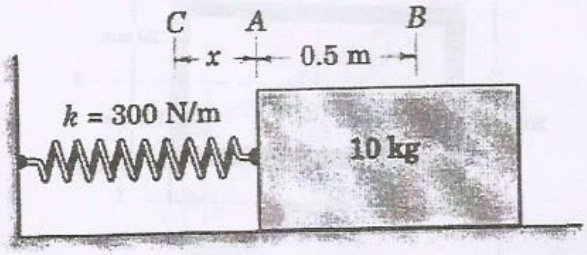

Fig. 10

15. (a) The 20-kg block A and the 30-kg block B are supported by an incline that is held in the position shown in Fig. 11. Knowing that the coefficient of static friction is 0.15 between all surfaces of contact, determine the value of "θ" for which motion is impending. Assume smooth pulley.

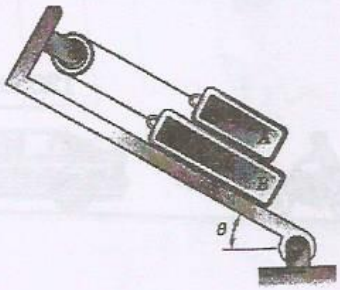

Fig. 11

Or

(b) The wheel of radius r = 300mm rolls to the right without slipping and has a velocity V_0 = 3m/s of its center O. Calculate the velocity of point A on the wheel for the instant represented in Fig.12.

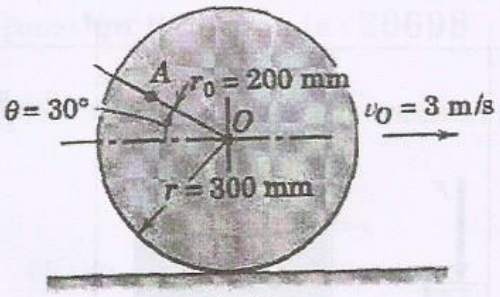

Fig. 12

PART C — (1 × 15 = 15 marks)

16. (a) A rectangular board over a store has a mass of 100 kg, with the center of mass in the center of the rectangle. The support against the wall at point C may be treated as a ball and socket joint. At corner D support is provided to restrict movement in x direction only. Calculate the tensions T_1 and T_2 in the supporting wires, the reaction forces at C, and the lateral reaction force at D.

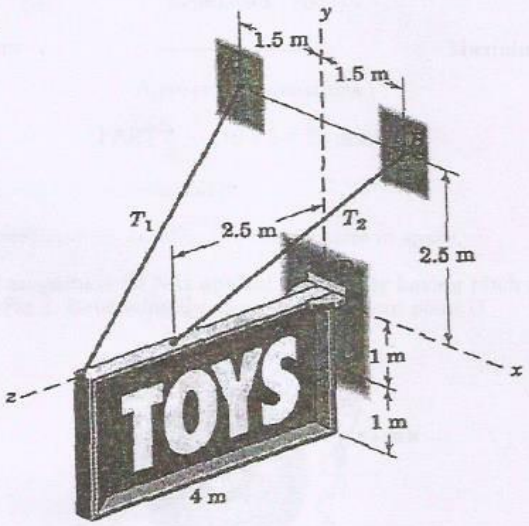

Fig. 13

Or

(b) The masses of A, B, and C are 8 kg, 12 kg, and 80 kg, respectively are shown in Fig. 14. Between all contacting surfaces, coefficient of friction $\mu_s = 0.4$. What force F is required to start 'C' moving upward?

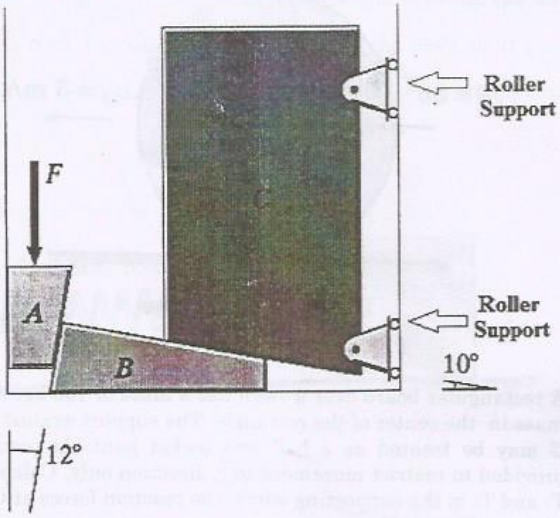

Fig. 14