Reg. No. :

Question Paper Code : 71843

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2015

Second Semester

Civil Engineering

ME 2151/ME 25/080120002/CE 1151/10122 ME 205 — ENGINEERING MECHANICS

(Common to Aeronautical, Automobile, Marine, Mechanical, Production, Chemical, Petroleum Engineering, Biotechnology, Polymer, Textile, Textile (Fashion), Plastic Technology, Materials Science and Engineering, Manufacturing Engineering, Mechatronics Engineering, Industrial Engineering, Industrial Engineering and Management, Environmental Engineering, Geoinformatics, Mechanical and Automation Engineering, Petrochemical Engineering, Chemical and Electrochemical Engineering, Petrochemical Technology, Pharmaceutical Technology, Textile Chemistry and Mechanical Engineering (Sandwich))

(Regulation 2008/2010)

(Common to 10122 ME 205 – Engineering Mechanics for B.E. (Part-Time) First Semester – Mechanical Engineering – Regulation 2010)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Name the principle that is applicable for the conditions represented in Fig.Q.1.

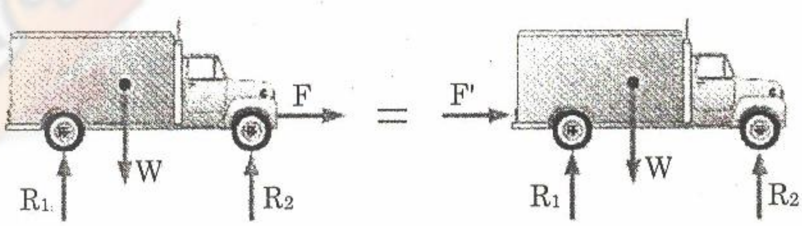

Fig.Q.1

2. Calculate the moment of the 250-N force on the handle of the monkey wrench about the center of the bolt (Fig.Q.2).

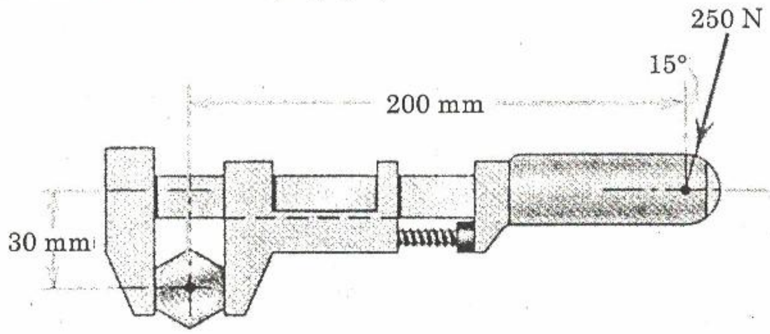

Fig.Q.2

3. What mechanics concept does the balanced teeter-totter (seesaw) signify?

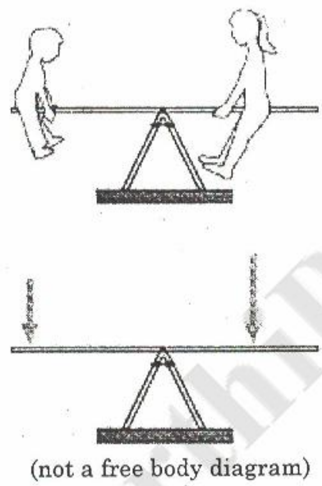

Fig.Q.3

4. Consider the forces of magnitude P acting on the sides of a regular hexagon with each side of length a. Find the equivalent force system of these forces at point B as shown in the figure.

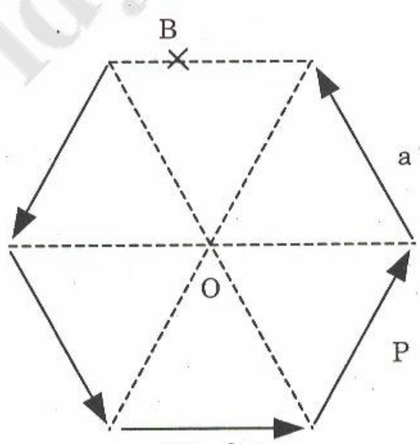

Fig.Q.4

5. State the parallel axis theorem used for finding the moment of inertia of an area.

6. Calculate the volume V of the solid (Fig.Q.6) generated by revolving the 60-mm right triangular area through 180° about the z-axis.

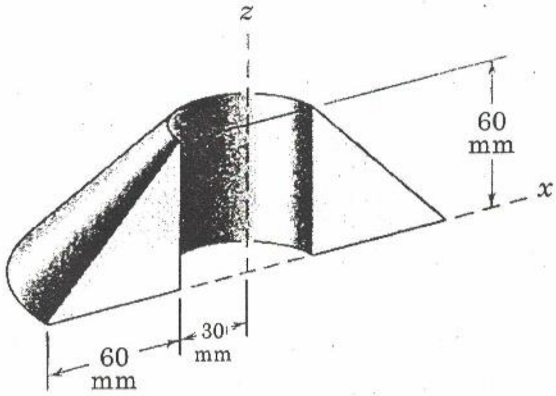

Fig.Q.6

7. Determine the smallest radius that should be used for a highway if the normal component of the acceleration of a car traveling at 54 km/h is not to exceed 1 m/s^2.

8. What are the conditions under which the motion of a projectile is parabolic?

9. The cylinder shown in Fig.Q.9 is of weight W and radius r, and the coefficient of static friction μ_s is the same at A and B. If the cylinder is in equilibrium, draw the free body diagram of the cylinder.

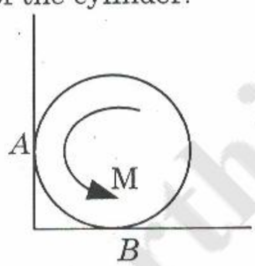

Fig.Q.9

10. Define angle of repose.

PART B — (5 × 16 = 80 marks)

11. (a) Determine the stretch in each spring for equilibrium of the weight W = 40 N block as shown in Fig.Q.11 (a). The springs are in equilibrium position. The stiffness of each spring is given as: k_1 = 40 N/m, k_2 = 50 N/m and k_3 = 60 N/m.

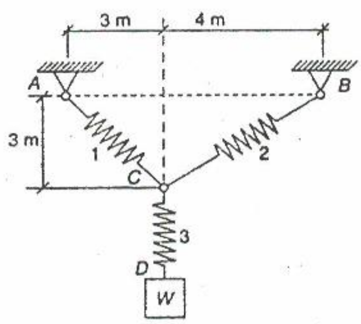

Fig.Q.11 (a)

Or

(b) The 200 kg crate in Fig.Q.11 (b) is suspended using the ropes AB and AC. Each rope can withstand a maximum of 10 kN before it breaks. If AB always remains horizontal, determine the smallest angle θ to which the crate can be suspended before one of the ropes breaks.

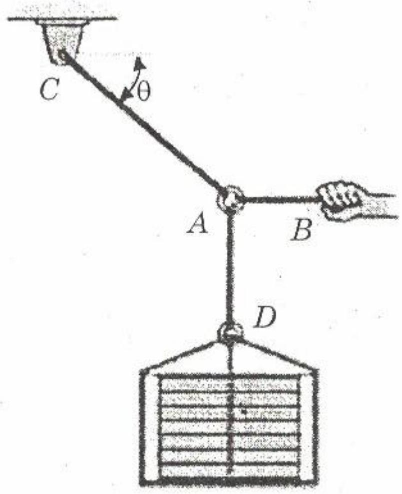

Fig.Q.11 (b)

12. (a) A 50-kg crate (Fig. Q 12(a)) is attached to the trolley-beam system shown. Knowing that a = 1.5 m, determine (i) the tension in cable CD, (ii) the reaction at B?

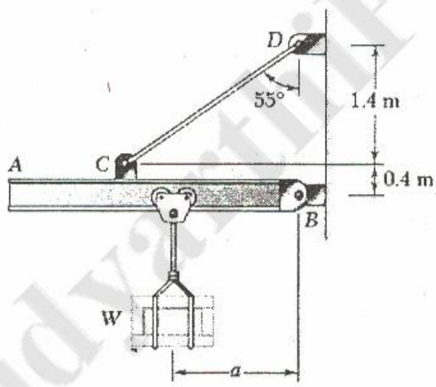

Fig. Q 12(a)

Or

(b) A roller or radius r = 304.8 mm and weight = 2225 N is to be pulled over a curb of height h = 152.4 mm by a horizontal force P applied to the end of a string wound around the circumference of the roller (Fig. Q 12(b)). Find the magnitude of P required to start the roller over the curb.

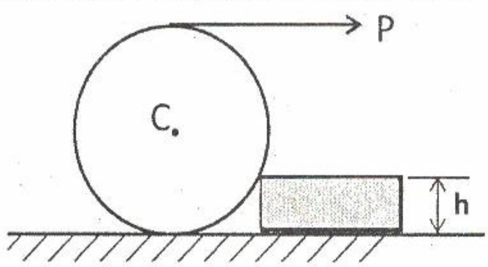

Fig. Q 12(b)

13. (a) (i) Determine the coordinates of the centroid of the shaded area (Fig. Q 13(a)(i)). (8)

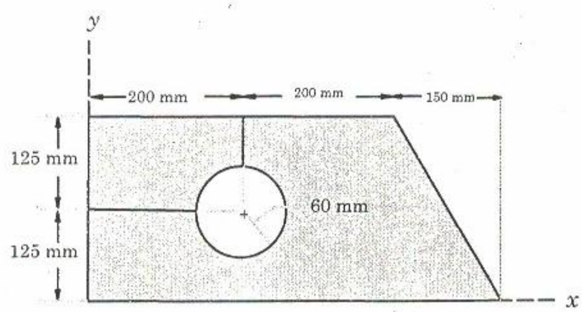

Fig. Q 13(a)(i)

(ii) Determine the moment of inertia of the cross-sectional area (I section) of the channel with respect to the y axis (Fig. Q 13(a)(ii)). (8)

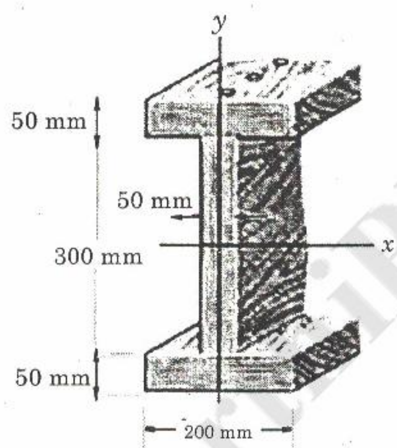

Fig. Q.13(a)(ii)

Or

(b) Determine the centroid of the area shown in Fig. Q.13(b).

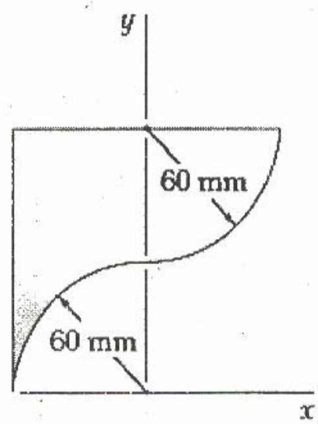

Fig. Q.13(b)

14. (a) Small steel balls fall from rest through the opening at A at the steady rate of two per second (Fig. Q.14(a)). Find the vertical separation h of two consecutive balls when the lower one has dropped 3 metres. Neglect air resistance.

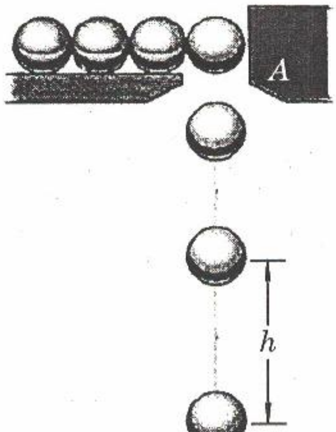

Fig. Q.14(a)

Or

(b) A baseball pitching machine (Fig.Q.14(b)) "throws" baseballs with a horizontal velocity v_0. Knowing that height h varies between 0.8 m and 1 m, determine (i) the range of values of v_0, (ii) the values of α corresponding to $h = 0.8$ m and $h = 1$ m.

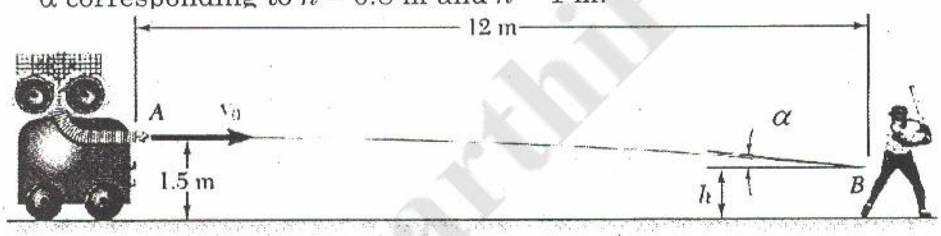

Fig.Q.14(b)

15. (a) Two blocks of weight W_1 and W_2 rest on a rough inclined plane (Fig.Q.15(a)) and are connected by a short piece of string as shown in Fig. If the coefficients of friction are $\mu_1 = 0.2$ and $\mu_2 = 0.3$, respectively, find the angle of inclination of the plane for which sliding will impend. Given: $W_1 = W_2 = 22.25$ N.

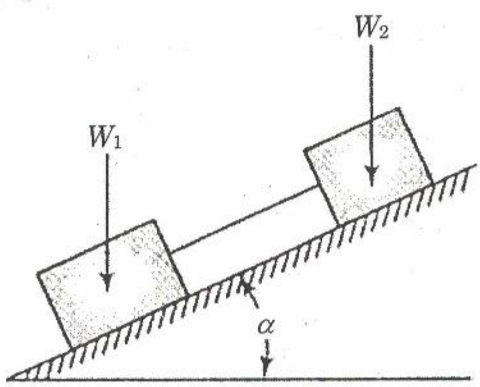

Fig.Q.15(a)

Or

(b) (i) Determine the distance s to which the 90 kg painter can climb without causing the 4-m ladder to slip at its lower end A (Fig.Q.15(b)(i)). The top of the 15-kg ladder has a small roller, and at the ground the coefficient of static friction is 0.25. The mass center of the painter is directly above her feet. (8)

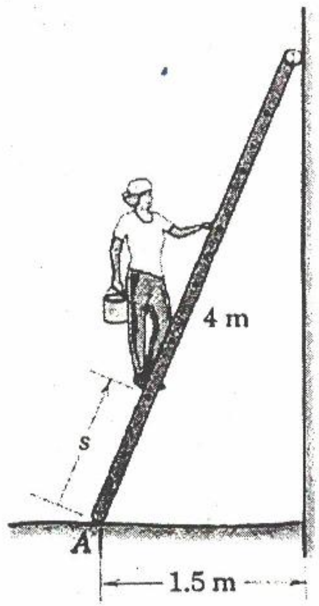

Fig.Q.15(b)(i)

(ii) A 120 kg block (Fig.Q.15(b)(ii)) is supported by a rope that is wrapped 1½ times around a horizontal rod. Knowing that the coefficient of static friction between the rope and the rod is 0.15, determine the range of values of P for which equilibrium is maintained. (8)

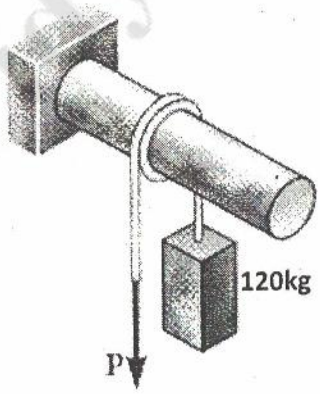

Fig.Q.15(b)(ii)