CHAPTER # 01

Type # 01

(Numerical based on concurrent force system- _Two forces only_)

Q1. Two forces 100 kN and 200 kN act on a particle and their line of actions are inclined to each other at an angle of 40^0 with each other. Find the resultant force in magnitude and direction. **[May-2009, 4 marks]** _(Ans: R = 283.97 kN, α = 26.92^0 with 100 kN force)_

Q2. If two forces of 60 kN each are required to be equivalent to a single force of 60 kN, what is the angle between the forces. **[Nov-2004, 4 marks]** _(Ans: θ = 120°)_

Q3. Find the angle between two equal forces P, if their resultant is equal to P/2 **[May-2004, 4 marks]** _(Ans: θ = 151.04°)_

Q4. Two forces of magnitude 12 N and 9 N are acting at a point. Their resultant is 15 N. determine the angle between the forces and also find the angle between the resultant and one of the forces. **[Nov-1994, 4 marks]** _(Ans: θ = 90°, a = 36.87° with 12 N force)_

Q5. Two forces at an angle of 120^0, the bigger force is of 40 N and the resultant is perpendicular to the smaller force. Find the smaller force. **[Nov-2013, 4 marks]** _(Ans: Smaller force is 20 N)_

Q6. If the sum of two forces is 9 N, their resultant which is perpendicular to the smaller force is of 6 N. find the magnitude of both the forces. _(Ans: Smaller force is 2.5 N and bigger force is 6.5 N)_

Q7. Calculate the resultant of two forces having magnitude 600 N and 400 N and acting at angle of 60° to one another when they have i) same sense ii) opposite sense **[Nov-2007, 4 marks]** _(Ans: α = 36.59° with 400N force, α = 79.10° with 400N force)_

Q8. Find the Maximum and Minimum resultant of two forces having magnitudes 10 N and 8 N respectively. _(Ans: R_{max} is 18 N and R_{min} is 2 N)_

Q9. The maximum resultant of two forces is 20 N and the minimum resultant is 10 N. find magnitudes of two forces. _(Ans: Q =5 kN P = 15 kN)_

Q10. The resultant of two forces P and Q is R. if Q is doubled, the new resultant is normal to P. Prove that R=Q

Q11. The resultant of two forces P and Q is of magnitude Q. Show that when the force Q is doubled, force P remaining the same, the new resultant will be right angle to P and its magnitude will be $\sqrt{(4Q^2-P^2)}$. **[Nov-2003, 4 marks]**

Q12. Find the magnitude of two forces such that , if they act at right angles then their resultant is $\sqrt{85}$ kN and when they act at an angle of 60^0 then their resultant is $\sqrt{127}$ kN. **[May-2012, 4 Marks]** _(Ans: Q =6 kN P = 7 kN)_

Type # 02

(Numerical based on concurrent force system- *More than Two forces*)

Q1. Determine the resultant of four forces acting on a hook as shown in the figure. *(Ans: R = 55.79 N and α = 83.98⁰)*
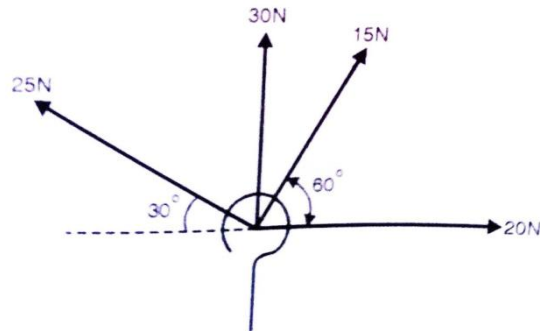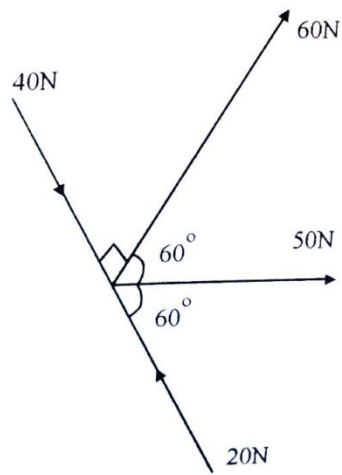

Q2. Calculate the magnitude and direction of resultant for concurrent force system as shown in the figure. **[Nov-2007, 4 marks]** *(Ans: R = 69.32 N and α = 59.69⁰)*
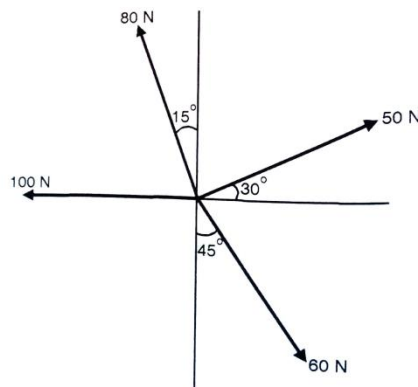
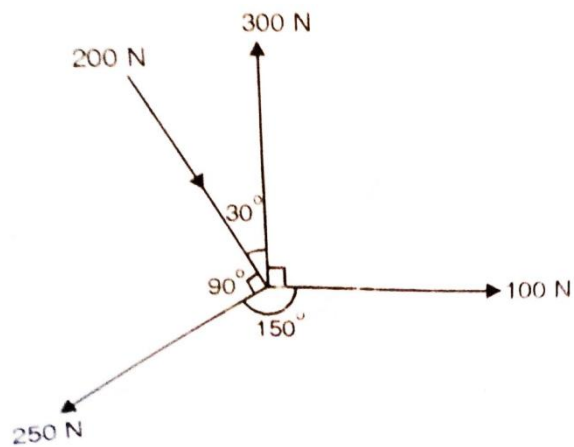Q3. Calculate the magnitude and direction of resultant for concurrent force system as shown in the figure. **[May-2010, 4 marks]** *(Ans: R = 10.53 kN and α = 9.29⁰)*
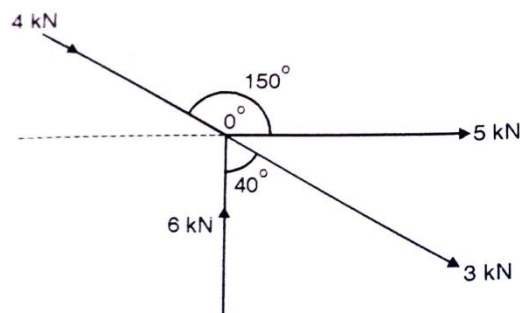

Q4. Calculate the magnitude and direction of resultant for concurrent force system as shown in the figure. **[Nov-2009, 4 marks]** *(Ans: R = 115.53 N and α = 25.22⁰)*

Q5. Find analytically the resultant of concurrent force system as shown in the figure. **[Nov-2008, 4 marks]** *(Ans: R = 16.60 N and α = 6.20⁰)*

Q6. Calculate the magnitude and direction of **Equilibrant force** for concurrent force system as shown in the figure. **[May-2010, 4 marks]** *(Ans: Eq =10.37 k N and α = 52.72⁰)*
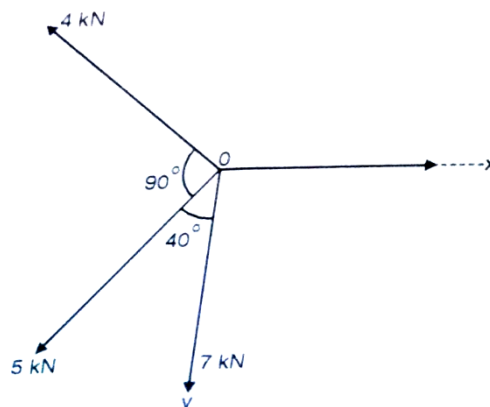
Q7. Five forces of 100N, 200N, 300N, 400N and 500N are acting at angle of 50^0, 110^0, 220^0, 290^0 and 340^0 in anticlockwise direction from the X-axis, at a point all acting away from the point. Find the resultant force in magnitude and direction. **[May – 2008, 4 marks]** *(Ans: R = 603.91 N and $\alpha = 51.89^0$)*

Q8. Find and locate the **equilibrant** of five concurrent forces of 100N, 200N, 300N. 500N and 600N acting towards origin and making angle of 20^0, 80^0, 150^0, 230^0 and 300^0 respectively along positive x-axis. **[Nov – 2010, 4 marks]** *(Ans: Eq = R = 543.31 N and $\alpha = 73.69^0$)*

Q9. Find analytically the resultant of concurrent force system. **[May- 2007, 2013, 4 marks]** *(Ans: R = 33.62 N and $\alpha = 24.06^0$)*

        a)   20 N inclined at 30^0 towards south of east.
        b) 25 N towards north
        c) 30 N towards N-W
        d) 35 N inclined at 40^0 south of west.

Q10. **Four forces** of 2 kN, 4 kN, 6 kN and 8 kN starting from a corner of regular Pentagon acts towards other remaining corners in order.. Find the resultant. **[May-2011, Nov-2011, 4 marks]** *(Ans: R = 16.33 kN and $\theta = 34.42^0$)*

Q11. **Five forces** 2 N, 3 N, 4 N, 5 N and 6 N respectively acting along the lines joining towards the center of Pentagon. Determine the **equilibriant force.** *(Ans: Eq = 4.25 N and $\theta = 54^0$)*

Q12. **Five forces** 1 N, 3 N, 5 N, 7 N and 9 N starting from a corner of regular hexagon acts towards other remaining corners in order. Determine the resultant of the force system. **[Nov-2012, 4 marks]** *(Ans: R = 20.68 N and $\theta = 85.57^0$)*

Q13. **Six forces** 1 N, 2 N, 3 N,4 N, 5 N and 6 N respectively acting at the center of regular Hexagon, towards the angular points taken in order. Determine the resultant of the force system. **[May-2012, 4 marks]** *(Ans: R = 6 N and $\theta = 60^0$)*
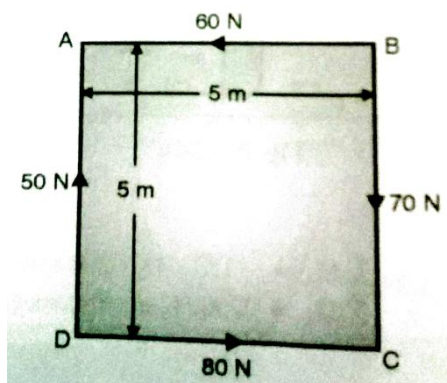
Type # 03

(Resolution of *non concurrent* force system)

Q1. A force of 1200 N acts on a bracket. Find only the moment of this force at A. *(Ans: M_A = 40707.66 N-mm clkwise)*
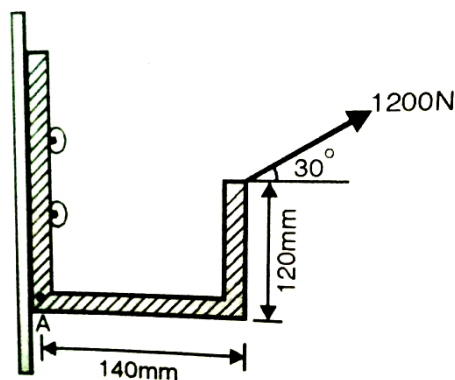
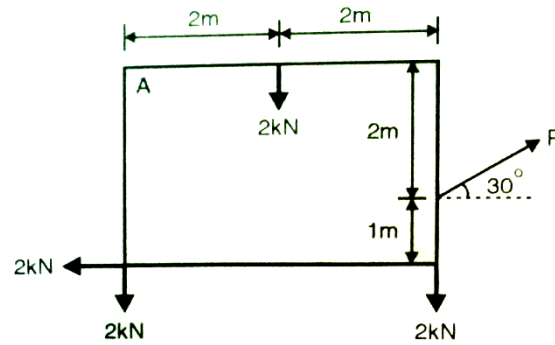Q2. Calculate the total moment about point A. **[Nov-2010, 4 marks]** *(Ans: M_A = 22500 N-m anticlkwise)*
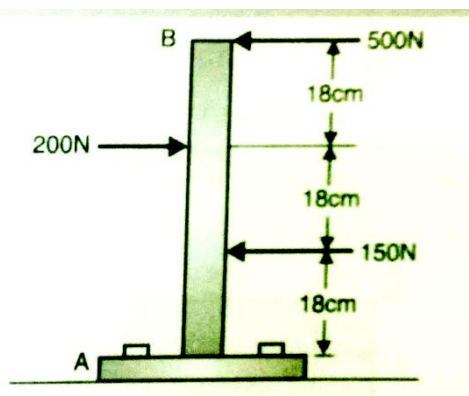
Q3. Calculate the moment of force system about point A. **[May-2010, 4 marks]** *(Ans: M_A = 50 N-m anticlkwise)*

Q4. Find the value of force 'P' so that the moment about the point 'A' is zero. . [**Nov-2009, 4 marks**] *(Ans: P = 4.83 kN)*


Q5. A force of 95 kN is acting at point C as shown in figure. Find the moment of this force at point A.
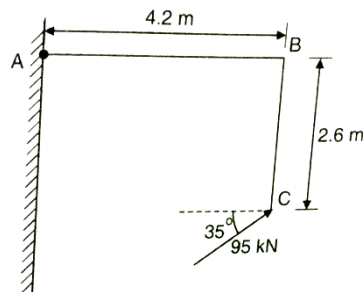

Q6. A square ABCD of 2m sides is subjected to forces of 10kN, 20kN and 30kN along AB, CB and BD. Find the magnitude , direction and position of resultant with respect to A. [**Nov-2009, 4 marks**] *(Ans: R = 11.28 kN, α = 6.16^0)*
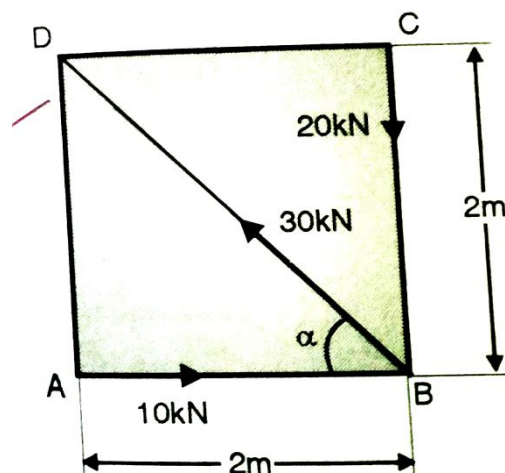
Q7. Four coplanar forces 2 kN, 3kN, 5kN, 7kN are acted as shown in the figure. Determine the magnitude and direction and also the position of **equilibrant force**. *(Ans: Eq = R = 6.65 kN, α = 20.5⁰)*
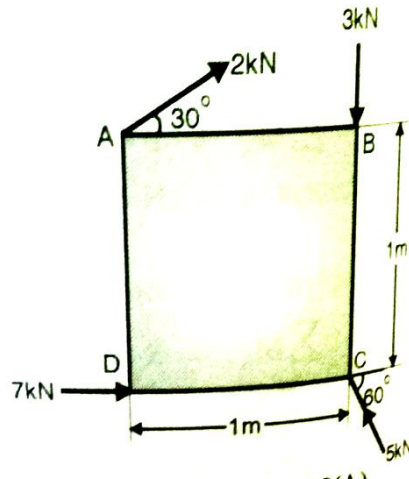

Q8. A triangle ABC of 1m side is subjected to forces 10N, 20N and 30N along AB, BC and AC respectively. Find the magnitude, direction of resultant and locate its position from point A **analytically**. *(Ans: R = 45.82 kN, α = 70.89⁰)*
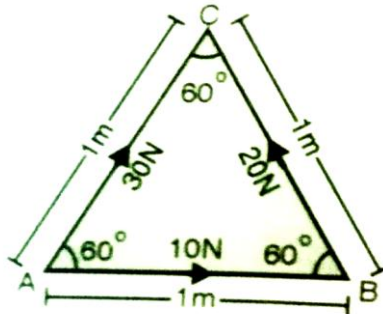
**Q9.** Determine the resultant of the parallel forces with reference to point O. **[Nov-2012, 4 marks]** *(Ans: R = 65N, α = 56.3⁰)*
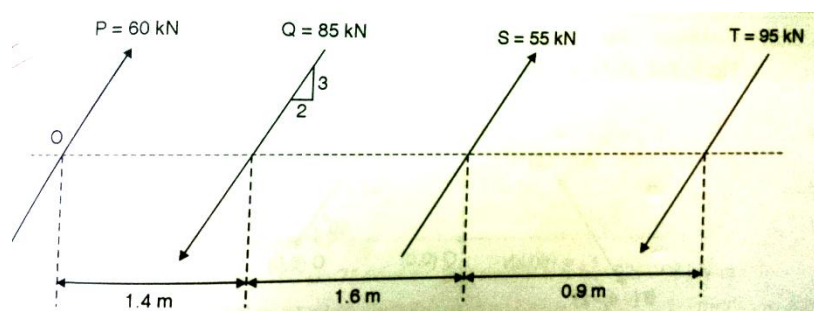
Q10. Determine the resultant of non-concurrent, non-parallel forces as shown in figure with reference to point O. **[Nov-2012, 4 marks]** *(Ans: R = 64.75 kN, α = 26.24^0)*
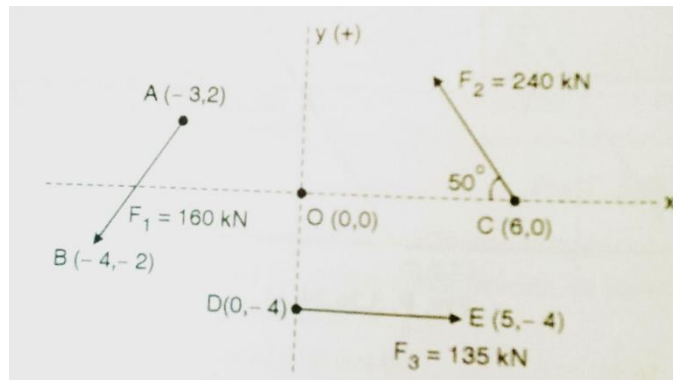
Q11. A triangle ABC has its side AB=30 cm along +tive x-axis and BC = 40 cm along –tive y-axis. Three forces of 30N, 40N and 50N acts along sides AB, BC and CA respectively. Determine magnitude and direction of resultant w.r.t point A. **[Nov-2013, 4 marks]** *(Ans: R = 0)*
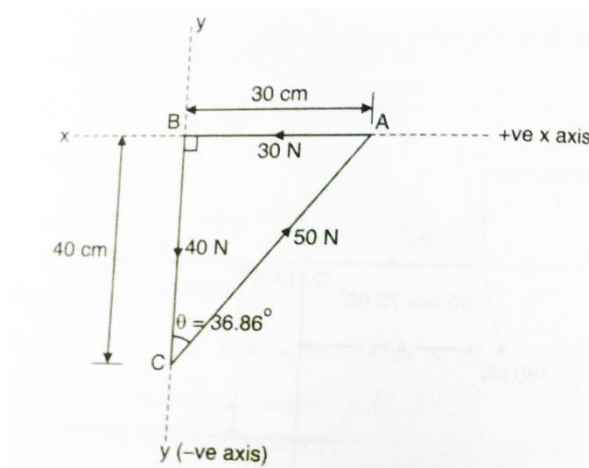
Q12. Five parallel forces of magnitude 2MN, 6MN, 12MN, 8MN and 10MN are acting at 2m, 4m, 5m, and 7m from the first force. Among these forces 1st, 2nd and 5th forces are acting upwards while other acting downwards. Find their resultant **analytically** and locate it with respect to 6 MN force. **[May-2014, 4 marks]** *(Ans: R = 2 MN, α = 90^0)*
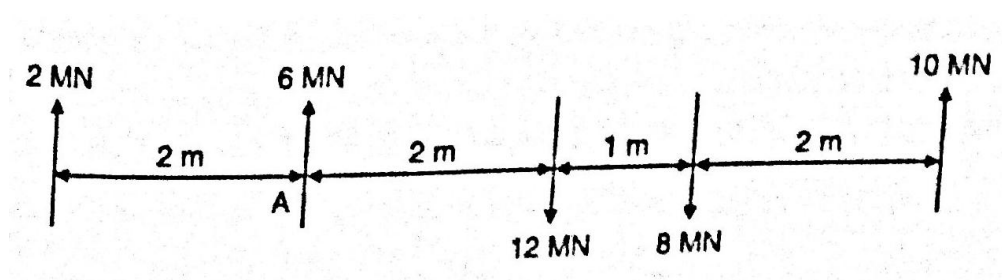
Type # 04

(Resolution of a single force into non-perpendicular components)

Q1. A force of 800 N is acting at a point. Resolve this force along 35° on its one side and 50° on its side. **[May-2009, 4 marks]** *(Ans: 615.18 N and 460.61 N)*

Q2. A force of 2000 N acts at an angle of 60° with x-axis. Find its components along 105° and 330° with x-axis **[Nov-1994, 4 marks]** *(Ans: 2000 N and 2828.43 N)*

Q3. What are the components of 60 N force acting horizontal, in two directions on either side, at angle 30° each. **[Nov-2005, 4 marks]** *(Ans: 34.64 N and 34.64 N)*