

## Mechanics

1. ✓ State Triangle law of vector addition. Obtain the expression for the resultant of two vectors  $\vec{P}$  and  $\vec{Q}$  inclined at an angle  $\theta$ .
2. a) ✓ State parallelogram law of vector addition.  
b) ✓ Derive the expression for the magnitude and direction of the resultant of two vectors inclined at an angle  $\theta$ .  
c) ✓ What are the conditions for maximum and minimum value of resultant?
3. a) ✓ At what angle two forces of magnitude  $(P + Q)$  and  $(P - Q)$  act, so that their resultant is  $\sqrt{3P^2 + Q^2}$ .  
b) ✓ The Magnitudes of two vectors are equal and the angle between them is  $\theta$ . Show that their resultant divides angle  $\theta$  equally.
4. ✓\* Two forces  $\vec{F}_1$  and  $\vec{F}_2$  act upon a body in such a manner that the resultant force  $\vec{R}$  has magnitude equal to that of  $\vec{F}_1$  and makes angle of  $90^\circ$  with  $\vec{F}_1$ . Let  $F_1 = R = 10\text{N}$ . Find the magnitude of the second force and its direction.
5. ✓ A spelunker is surveying a cave. She follows a passage 180m straight west then 210m in a direction  $45^\circ$  east of south, and then 280m at  $30^\circ$  east of north. After a fourth unmeasured displacement she finds herself back where she started. Find the magnitude and direction of the fourth displacement.
6. ✓ The sum and difference of two vectors are equal in magnitude i.e.  $|\vec{A} + \vec{B}| = |\vec{A} - \vec{B}|$  prove that vectors  $\vec{A}$  and  $\vec{B}$  are perpendicular to each other.
7. ✓ A particle moves from position  $(3\hat{i} + 2\hat{j} - 6\hat{k})$  to a position  $(14\hat{i} + 13\hat{j} - 9\hat{k})$  constant force  $(4\hat{i} + 2\hat{j} - 3\hat{k})$  newton acts on it. Calculate the work done in meter unites.
8. ✓ If unit vectors  $\hat{A}$  and  $\hat{B}$  are inclined at an angle  $\theta$ , then prove that  $|\hat{A} - \hat{B}| = 2 \sin \frac{\theta}{2}$ .
9. Determine the area of the parallelogram whose adjacent sides are  $2\hat{i} + \hat{j} + 3\hat{k}$  and  $\hat{i} - \hat{j}$ .
10. ✓ Can any of the two rectangular components of a given vector have a magnitude greater than the vector itself?
11. What is the angle between  $\vec{A}$  and  $\vec{B}$  if  $\vec{A}$  and  $\vec{B}$  denote the adjacent sides of a parallelogram drawn from point and the area of the parallelogram is  $\frac{1}{2} AB$ ?
12. a) What is the direction of  $\hat{k} \times \hat{j}$ ? p b ?  
n n b  
b) For the vectors if  $\vec{A} + \vec{B} = \vec{C}$  and  $A^2 + B^2 = C^2$ , prove that vectors  $\vec{A}$  and  $\vec{B}$  are perpendicular to each other.  
c) Can resultant magnitude of two vectors be smaller than the magnitude of either vector?