

Solutionbank M1

Heinemann Modular Maths for Edexcel AS and A-level

4 Forces

Exercise C, Question 8

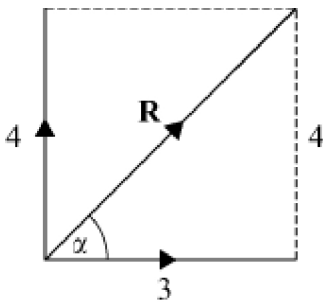
Question:

Three forces $(i + j) \text{ N}$, $(-5i + 3j) \text{ N}$ and $\lambda i \text{ N}$, where i and j are perpendicular unit vectors, act at a point. Express the resultant in the form $(ai + bj)$ and find its magnitude in terms of λ . Given that the resultant has magnitude 5 N , find the two possible values of λ .

Take the larger value of λ and find the tangent of the angle between the resultant and the unit vector i . [A]

Solution:

$$\begin{aligned}
 R &= (i + j) + (-5i + 3j) + \lambda i \\
 \text{i.e. } R &= [\lambda - 4]i + 4j \\
 \text{and } |R| &= \sqrt{(\lambda - 4)^2 + 4^2} \\
 \text{i.e. } |R| &= \sqrt{(\lambda^2 - 8\lambda + 16) + 16} \\
 \text{i.e. } |R| &= \sqrt{(\lambda^2 - 8\lambda + 32)} \\
 \therefore \text{ if } |R| = 5, \text{ then } \sqrt{\lambda^2 - 8\lambda + 32} &= 5 \\
 \lambda^2 - 8\lambda + 32 &= 5^2 \\
 \lambda^2 - 8\lambda + 7 &= 0 \\
 (\lambda - 7)(\lambda - 1) &= 0 \\
 \text{i.e. } \lambda = 7 \text{ or } \lambda &= 1 \\
 \therefore \text{ when } \lambda = 7 \text{ } R &= (7 - 4)i + 4j \\
 \text{i.e. } R &= 3i + 4j \\
 \text{i.e. } \tan \alpha &= \frac{4}{3}
 \end{aligned}$$



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