

Challenge Set #2

1. If two forces of equal magnitude act at 60° to each other and their resultant has magnitude of 30 N, find the magnitude of the equal forces. **{17.3 N}**
2. Calculate the work done if a force of 100N at an angle of 40 degrees with the horizontal moves an object horizontally 40 m and then up a ramp 10 m long inclined at 15 degrees to the horizontal. **{3970.5 J}**
3. The parallelogram OACB has one vertex, O, at the origin and two non-parallel sides determined by $\vec{OA} = (3, -1)$ and $\vec{OB} = (2, 2)$. Calculate the angle between the diagonals. **{83° and 97°}**
4. Find a vector perpendicular to $\vec{u} = (-2, 5, 4)$. Check that it is correct by using the dot product.
5. Determine the coordinates of a parallelogram in 3-space so that the interior angles are as close to 40° and 140° as possible.
6. If \vec{a} and \vec{b} are perpendicular, show that $|\vec{a}|^2 + |\vec{b}|^2 = |\vec{a} + \vec{b}|^2$. What is the usual name for this result?
7. If \vec{a} and \vec{b} are not perpendicular and $\vec{c} = \vec{a} - \vec{b}$, express $|\vec{c}|^2$ in terms of \vec{a} and \vec{b} . What is the usual name for this result?
8. Under what conditions is $(\vec{a} + \vec{b}) \cdot (\vec{a} - \vec{b}) = 0$?
9. Prove that $|\vec{a} \cdot \vec{b}| \leq |\vec{a}| |\vec{b}|$. When does the equality hold?
10. Find a unit vector that is parallel to the xy -plane and perpendicular to the vector $4\hat{i} - 3\hat{j} + \hat{k}$.
11. The vectors $\vec{a} = (1, 3, -2)$ and $\vec{b} = (k, 2, 1)$ have an angle of 60° when placed tail to tail. Solve for k .
12. The equilibrant of the following four forces is 45.6 N at $E30^\circ S$. Determine the missing force

65 N at $S35^\circ E$
50 N at $E15^\circ N$
110 N at $N55^\circ W$

