

Worksheet - 3

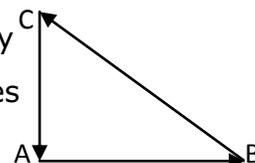
Topic: Vectors

1. The resultant of two equal forces acting at right angles to each other is 1414 N. find the magnitude of each force.
2. Two equal forces act at a point. The square of their resultant is 3 times their product. Find the angle between them.
3. Two forces of 5 kg wt and 10 kg wt are acting with an inclination of 120° between them. Find the angle made by resultant with 10 kg wt.
4. A vector is represented by $3\mathbf{i} + \mathbf{j} + 2\mathbf{k}$. What is the length in **X-Y** plane is?
5. The vector that must be added to the vector $\mathbf{i} - 3\mathbf{j} + 2\mathbf{k}$ and $3\mathbf{i} + 6\mathbf{j} - 7\mathbf{k}$ so that resultant vector is a unit vector along the Y- axis.
6. Find the value of m so that the vector $3\hat{i} - 2\hat{j} + \hat{k}$ is perpendicular to the vector $2\hat{i} + 6\hat{j} + m\hat{k}$.
7. For what value of a are the vectors $a\hat{i} - 2\hat{j} + \hat{k}$ and $2a\hat{i} + a\hat{j} - 4\hat{k}$ perpendicular to each other.
8. Determine a unit vector perpendicular to both $2\hat{i} + \hat{j} + \hat{k}$ and $\hat{i} - \hat{j} + 2\hat{k}$.
9. Prove that the vectors $\vec{A} = 4\hat{i} + 3\hat{j} + \hat{k}$ and $\vec{B} = 12\hat{i} + 9\hat{j} + 3\hat{k}$ are parallel to each other.
10. Find the value of a for which the vectors $3\hat{i} + 3\hat{j} + 9\hat{k}$ and $\hat{i} + a\hat{j} + 3\hat{k}$ are parallel to each other.
11. Find $\vec{A} \cdot \vec{B}$ if $|\vec{A}| = 2$, $|\vec{B}| = 5$ and $|\vec{A} \times \vec{B}| = 8$
12. If $\mathbf{A} = \mathbf{B} + \mathbf{C}$ and the magnitudes of \mathbf{A} , \mathbf{B} and \mathbf{C} are 5, 4 and 3 units. What is the angle between \mathbf{A} and \mathbf{C} is.
13. The magnitude of the sum of the two vectors is equal to the difference of their magnitudes. What is the angle between the vectors?
14. Given that $\mathbf{A} \cdot \mathbf{B} = 0$. Also $\mathbf{A} \times \mathbf{C} = 0$. What is the angle between \mathbf{B} and \mathbf{C} ?
15. What is the angle between two vectors $-2\mathbf{i} + 3\mathbf{j} + \mathbf{k}$ and $\mathbf{i} + 2\mathbf{j} - 4\mathbf{k}$?
16. The velocity of the particle 6 m/s eastwards changes to 8 m/s northwards in 10 s. what is the magnitude of the average acceleration during this interval of time?
17. If $\mathbf{A} = \lambda\mathbf{i} + 2\mathbf{j} - 3\mathbf{k}$, $\mathbf{B} = \mathbf{i} + \mathbf{j}$ and $\mathbf{C} = 2\mathbf{i} - \mathbf{j} + \mathbf{k}$. if vectors $(\mathbf{A} + \mathbf{B})$ and \mathbf{C} are perpendicular. What is the value of λ ?
18. Determine the area of parallelogram whose adjacent sides are formed by the vectors $\hat{i} - 3\hat{j} + \hat{k}$ and $\hat{i} + \hat{j} + \hat{k}$.
19. Determine the area of the triangle formed by the two vectors $\vec{A} = 3\hat{i} + 4\hat{j}$ and $\vec{B} = -3\hat{i} + 7\hat{j}$.
20. Determine the area of parallelogram whose diagonals are given by the vectors $3\hat{i} + 2\hat{j} - 7\hat{k}$ and $5\hat{i} + 6\hat{j} - 3\hat{k}$.

PHYSICS CLASSES

- 21.** A boat which has a speed of 5 km/hr in still water crosses a river of width 1 km along the shortest possible path in 15 minutes. What is the velocity of the river water in km/hr?
- 22.** A car runs along horizontal path at a speed of 20 m/s. The driver observes the rain hitting his car at 60° to the vertical. If the rain is actually falling vertically. What is the speed of the raindrop approximately?
- 23.** A train is moving with a velocity of 30 km/hr due east and a car is moving with a velocity of 40 km/hr due north. What is the velocity of the car as it appears to a passenger in the train?
- 24.** Mr X standing on a road has to hold his umbrella at 60° with the vertical to avoid rain. He throws his umbrella and starts running at 20 m/s. He finds that rain drops are hitting his head vertically. Find the speed of the rain drops with respect to (a) the road (b) the moving person
- 25.** Rain is falling vertically with a speed of 35 m/s. Kareena rides a bicycle with a speed of 12 m/s in east to west direction. What is the direction in which she should hold her umbrella?
- 26.** A person aiming to reach the exactly opposite point on the bank of a stream is swimming with a speed of 0.5 m/s at an angle of 120° with the direction of flow water. What is the speed of water in the stream?

- 27.** Three forces start acting simultaneously on a particle moving with velocity \mathbf{v} . These forces are represented in magnitude and direction by three sides of a triangle ABC (as shown). The particle will now move with velocity.



- 28.** Given that $\mathbf{A} + \mathbf{B} + \mathbf{C} = \mathbf{0}$. Two out of the three vectors are equal in magnitude. The magnitude of the third vector is $\sqrt{2}$ times that of either of the other two. Find the angle between these vectors.

Answers

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|--|---|------------------------------|---|--|--------------------------|-----------------|
| 1. 1000N | 2. 60° | 3. 30° | 4. $\sqrt{14}$ | 5. $-4\mathbf{i} - 2\mathbf{j} + 5\mathbf{k}$ | 6. 6 | 7. 2, -1 |
| 8. $3\hat{i} - 3\hat{j} - 3\hat{k}$ | 10. 1 | 11. ± 6 | 12. $\cos^{-1}(3/5)$ | 13. 180° | | |
| 14. 90° | 15. 90° | 16. 1ms^{-2} | 17. 2 | 18. 5.66 sq units | 19. 16.5 sq units | |
| 20. 22.56 sq units | 21. 3 | 22. 11.55 m/s | 23. 50 km/hr, $36^\circ 52'$ west of north | 25. 19° with the vertical | | |
| towards the west. | 24. (a) 23.1 Km/Hr (b) 11.55 Km/Hr | 27. \mathbf{v} | 28. $90^\circ, 135^\circ, 135^\circ$ | | | |