Unit 2 · Vectors

HARDER PRACTICE QUESTIONS

Full marks 30

Write your answers on separate paper. Show your working.

1 Spot the error [3]

Find the mistake in the working and correct it.

Aayush finds the resultant of two forces of 10 N each acting at 120° to each other. He writes: "$R = \sqrt{10^2 + 10^2 + 2 \times 10 \times 10 \times \cos 120°} = \sqrt{100 + 100 + 100} = \mathbf{17.3\ N}$."

2 Pulling out a jeep [4]

Ignore the jeep's weight and the slope of the road.

A jeep is stuck in mud on a village road. Two ropes are tied to its front, and each is pulled with 2000 N, one at 30° to the left of the road and one at 30° to the right.

i. Find the resultant pull along the road.
ii. What happens to the side pulls, and why?
iii. What if the ropes were at 60° on each side? Find the pull along the road then.

3 Show that [3]

Show that if $|\vec{A} + \vec{B}| = |\vec{A} - \vec{B}|$, the vectors $\vec{A}$ and $\vec{B}$ are perpendicular.

4 Find the unknown [4]

$\vec{A} = 2\hat{\imath} + \lambda\hat{\jmath} + \hat{k}$ and $\vec{B} = 4\hat{\imath} - 2\hat{\jmath} - 2\hat{k}$.

i. Find λ if $\vec{A}$ and $\vec{B}$ are perpendicular.
ii. With that λ, find $\vec{A} \times \vec{B}$ and its magnitude.
iii. Explain why $|\vec{A} \times \vec{B}|$ here equals $|\vec{A}|\,|\vec{B}|$.

5 Read the data [5]

Find the wrong reading, and say how you know.

Nischal measures the resultant R of two forces P and Q (P larger) with spring balances, at different angles θ between them:

θ	0°	60°	90°	120°	180°
R (N)	10.0	8.7	7.2	6.3	2.0

i. Use the readings at 0° and 180° to find P and Q.
ii. Work out R at 60°, 90° and 120°, and find the reading that is wrong.
iii. Describe how R changes as θ grows from 0° to 180°.

6 Least and most [3]

Two forces of 5 N and 12 N act on a point.

i. Between which values can their resultant lie?
ii. At what angle between them is the resultant 13 N? What angle does it then make with the 12 N force?

7 Correct the misconceptions [3]

The paragraph has three mistakes. Write each mistake and correct it.

> Sanskriti wrote: "Speed is a vector, because a car always moves in some direction. Anything that has a size and a direction is a vector. And the resultant of two vectors is always larger than each of them."

8 Think [3]

Shreya says: "For two vectors, $\vec{A}\cdot\vec{B}$ can be negative while $|\vec{A}\times\vec{B}|$ is as large as it can be." Is she right? At what angle is $\vec{A}\cdot\vec{B} = -|\vec{A}\times\vec{B}|$?

9 Make your own [2]

Choose two forces of **different** sizes and an angle between them so that their resultant is exactly as large as the larger force. Show that your choice works.