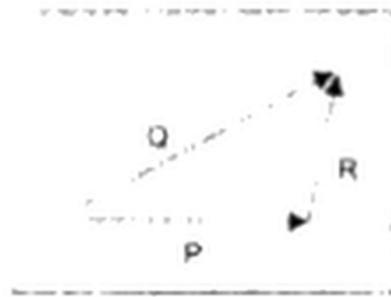


EXERCISE

Select the correct answer of the following questions.

1) Which is a correct equation for vector R



- a. $R = P - Q$ b. $R = Q - P$ c. $R = P + Q$ d. None

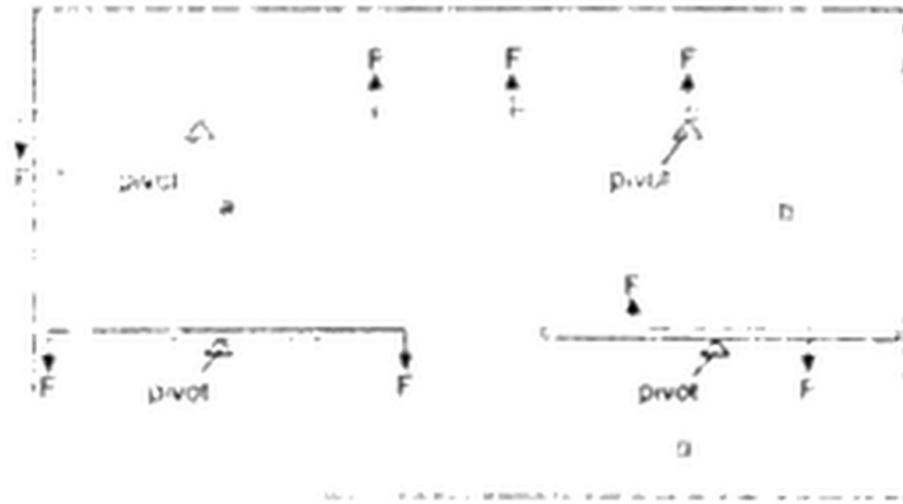
2) Which of the following represents a vector and a scalar respectively?

Options	Vector	Scalar
a	Speed	Velocity
b	Acceleration	Deceleration
c	Force power	Power
d	Work	Density

3) For which angle the equation $|\vec{A} \cdot \vec{B}| = \vec{A} \times \vec{B}$ is correct

- a. 30° b. 45° c. 60° d. 90°

4) The following diagrams show a uniform rod with its midpoint on a pivot. Two equal forces F are applied to the rod, as shown which diagram shows the rod in equilibrium?



5) Which of the following instrument works on the principle moments?

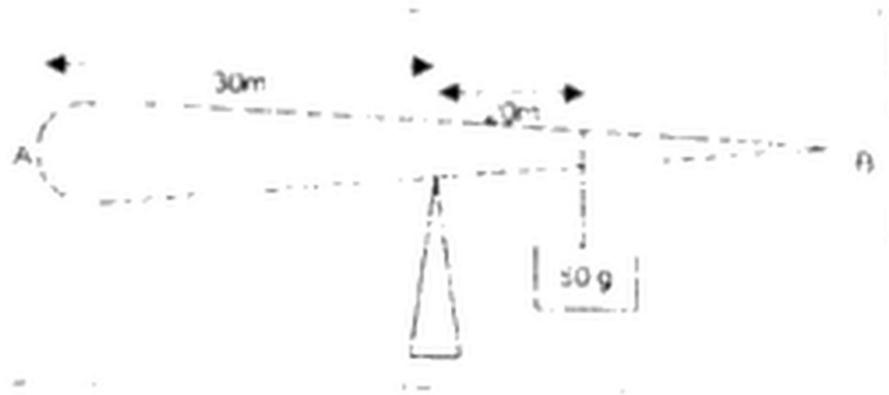
- a. Physical balance
- b. Spring balance
- c. Measuring Cylinder
- d. Vernier Calipers

6) What is the net torque acting on the wheel of radius 2 m?



- a. 10 N anti-clockwise
- b. 10 N m anti-clockwise
- c. 10 N m clockwise
- d. 5 N m clockwise

7) Find the mass of the rod as shown in figure below. Its centre of gravity is 14 cm from end A.



- a. 100g b. 50g c. 80g d. 5g

8) The diagram shows four forces applied to a circular object. Which of the following describes the resultant force and resultant torque on the object?



Resultant Force

Resultant Torque

- a. Non-zero
 b. Non-zero
 c. Zero
 d. Zero

- Non-zero
 Zero
 Non-zero
 Zero

9) What is the angle between \vec{A} and \vec{B} for which $|\vec{A} - \vec{B}| = |\vec{A} + \vec{B}|$?

- a. 30° b. 45° c. 60° d. 90°

10) The sum of two forces acting at a point is 16N. If the resultant force is 8N and its direction is perpendicular to minimum force then the forces are:

- a. 6N and 10 N b. 8N and 8N c. 4N and 12N d. 2N and 14 N

11) A person walks first 10 Km north and 20 km east, then the resultant vector is

- a. 22.36 km b. 22.46 km c. 25.23 km d. 20.36 km

Answers:

1.	(b)	2.	(c)	3.	(b)	4.	(c)	5.	(a)
6.	(c)	7.	(a)	8.	(a)	9.	(d)	10.	(d)
11.	(a)								

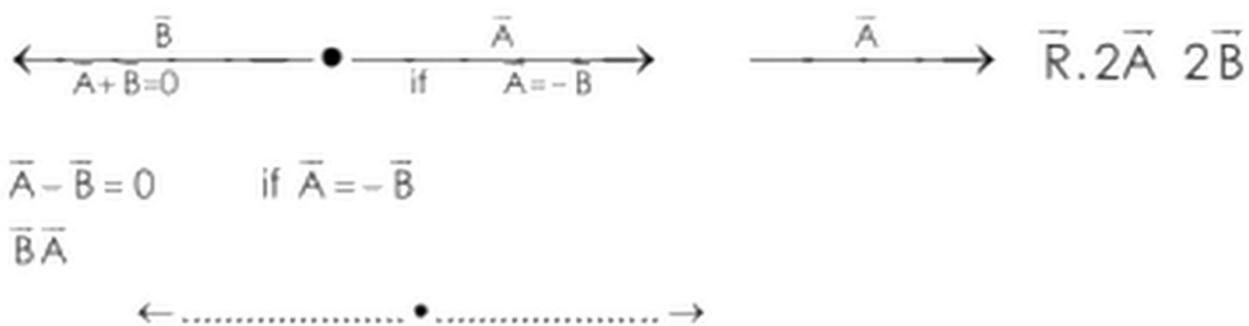
Write short answers of the following questions:

Q1. Explain with the help of an example, what is the range of possible values of the resultant of two vectors?

Answer

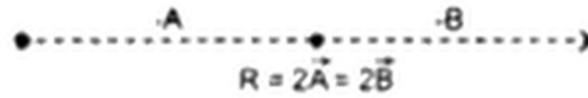
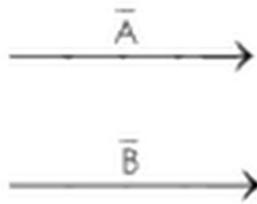
Consider two vectors \vec{A} & \vec{B}

(i) The resultant of vectors \vec{A} & \vec{B} will be a null vector if \vec{A} & \vec{B} have equal magnitude & opposite direction i.e.



(ii) The resultant of vectors \vec{A} and \vec{B} will be double if \vec{A} and \vec{B} have equal magnitude and same direction i.e.

$$\vec{R} = 2\vec{A} = 2\vec{B}$$

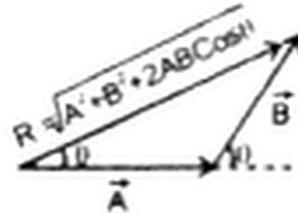


(iii) if vectors \vec{A} & \vec{B} make certain angle " θ " then resultant will be equal to $\vec{A} + \vec{B}$
i.e.

$$\vec{R} = \vec{A} + \vec{B}$$

Its magnitude can be given as

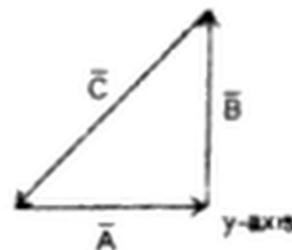
$$R = \sqrt{A^2 + B^2 + 2AB\cos\theta}$$



Q2. What is the minimum number of unequal vectors to result into a null vector? Explain your answer with the half of a diagram:

Answer

At least three vectors of unequal magnitudes are required to result into a null vector. Let \vec{A} , \vec{B} & \vec{C} be the three vectors of unequal magnitudes. They are combined in such a way that they make a closed triangle PQR as shown in fig.



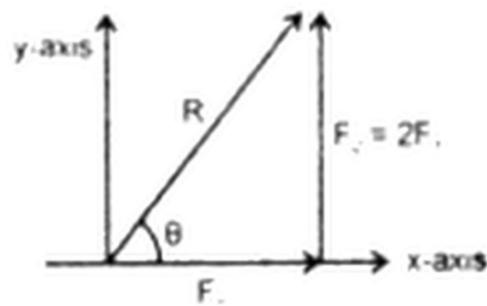
From head to tail rule

$$\vec{A} + \vec{B} = -\vec{C}, \quad \vec{A} + \vec{B} + \vec{C} = 0$$

Q3. The resultant of two vectors, one is double in magnitude than the other, is perpendicular to the smaller force. What is angle between the two forces?

Answer

Consider two forces \vec{F}_1 and \vec{F}_2 which are perpendicular to each other and let $\vec{F}_2 = 2\vec{F}_1$, according to the given conditions, as shown in fig.



Since,

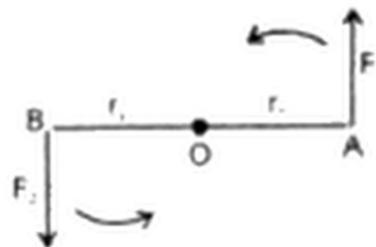
$$\theta = \tan^{-1} \left(\frac{F_2}{F_1} \right)$$

$$\theta = \tan^{-1} \left(\frac{2F_1}{F_1} \right) \quad \dots\dots F_2 = 2F_1$$

$$\theta = \tan^{-1} (2)$$

$$\theta = 63.43^\circ$$

The angle between them is 63.43° .



Q4. Explain how cranes are able to lift very heavy load without toppling?

Answer

In case of cranes, the weight attached with the crane and the heavy load required to be lifted are balanced in such a way that no torque is produced. Second factor is the moment arm which is adjusted to keep the balance

Q5. The gravitational force acting on a satellite is always directed towards the centre of the earth. Does this force exert torque on the satellite?

Answer

Torque is produced in rotatory body, not the circular motion. So gravitational force acting on a satellite directed towards the centre of the earth does not exert torque on the satellite.

Q6. Explain why do buses and heavy trucks have large steering wheels?

Answer

Buses and heavy trucks have large steering wheels as the large moment arm causes to produce more torque even at normal applied force. So, it might be easy for the drivers to apply less force to produce more torque (rotation) in the

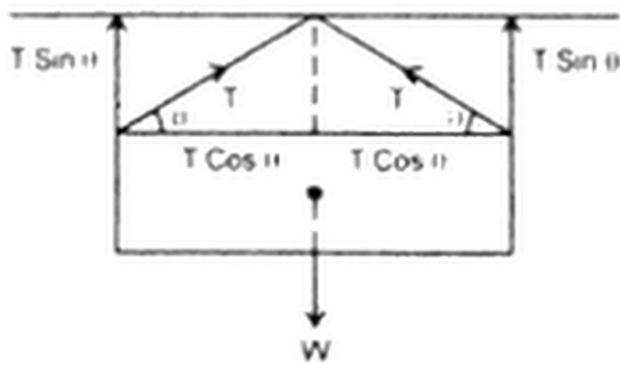


Fig (A)

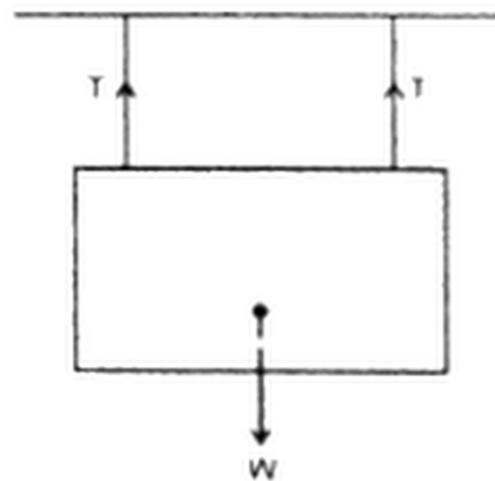


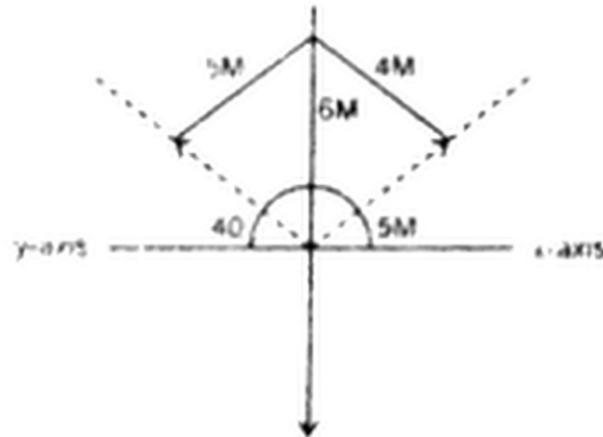
Fig (B)

steering wheel.

Q7. A point object acted on by forces 4N, 5N & 6N is in Equilibrium. If 6N force is removed, what is the resultant force on the object?

Answer

Consider a point object "O" on which 4N, 5N & 6N forces are acting as shown in fig. If the resultant of 4N & 5N forces balance "6N" Now if 5N is removed then the net forces acting on the object will be approximately equal to "6N".



Q8. Explain in detail whether for two vectors of equal magnitude is it possible to give a resultant equal to their individual magnitude. Justify your answer mathematically? **Answer**

Let \vec{F}_1 and \vec{F}_2 are two vectors and \vec{R} is their resultant.

Mathematically,

$$\vec{R} = \vec{F}_1 + \vec{F}_2$$

Magnitude of \vec{R} can be expressed as

$$R = \sqrt{F_1^2 + F_2^2 + 2F_1F_2 \cos \theta} \quad \dots\dots(2)$$

Now according to given condition

$$R = F_1 = F_2$$

Equation (2) becomes

$$R = \sqrt{R^2 + R^2 + 2R \cos \theta}$$

$$\Rightarrow R^2 = R^2 + R^2 + 2R \cos \theta$$

$$\Rightarrow 1 = 1+1+ 2 \cos \theta$$

$$\Rightarrow \cos\theta = 1/2$$

$$\Rightarrow \theta = \cos^{-1} (1/2)$$

$$\Rightarrow \theta = 120^\circ$$

If vectors F_1 & F_2 make angle "120°" w.r.t to reference axis then it is possible to give a resultant of magnitude equal to their individual magnitude.

