SHORT QUESTIONS

Write the short answers of the following questions.

✱

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

Ans. The maximum possible range of resultant of two vectors is;

$$A - B \leq R \leq A + B$$

Example

Consider two vectors $\vec{A} = 9\,\hat{i}$ and $\vec{B} = 3\,\hat{i}$

When the two vectors are parallel, the resultant has maximum magnitude,

$\Rightarrow$ $\qquad R_{max} = A + B = 9\,\hat{i} + 3\,\hat{i} = 12\,\hat{i}$ (1)

$\Rightarrow$ $\qquad R = A + B$

When two vectors are anti-parallel, the resultant has minimum magnitude,

$\Rightarrow$ $\qquad R_{min} = A - B = 9\,\hat{i} - 3\,\hat{i} = 6\,\hat{i}$ (2)

$\Rightarrow$ $\qquad R < A + B$

Hence the range of possible values of resultant of two vectors is $R \leq A + B$.
Therefore we can write;

$$A - B \leq R \leq A + B$$

2. What is the minimum number of unequal vectors to result into a null vector? Explain with the help of a diagram.

Ans. The minimum number of unequal vectors to result into a null vector is three if acting along the sides of an equilateral triangle.

When the sides of a triangle represent vectors arranged in accordance with head to tail, the sum will be zero because the tail of first vector meets the head of last vector.

SHORT QUESTION #2

$$\vec{R} = \vec{A} + \vec{B} + \vec{C} = \vec{0}$$

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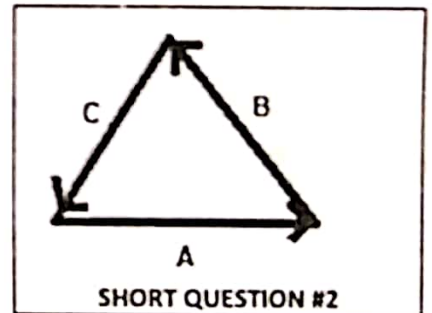
3. The resultant of two vectors, one is double in magnitude than the other, is perpendicular to the smaller force. What is the angle between the two forces?

Ans. Consider two vectors $\vec{V_1}$ and $\vec{V_2}$ as shown in figure.
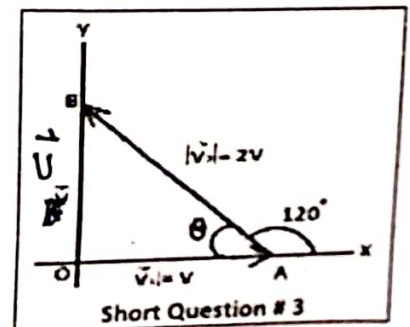Their magnitudes are given as:

$\qquad V_1 = V \qquad\qquad \& \qquad\qquad V_2 = 2\,V$

The resultant of these vectors is $\vec{V}$.
From triangle OAB;

Short Question # 3

$$Cos\,\theta = \frac{V}{2V} = \frac{1}{2}$$

$$\theta = 60°$$

Hence the angle between vectors $\vec{V_1}$ and $\vec{V_2}$ is $= 180° - 60° = 120°$

4.

**Ans.** Whenever a mobile crane has to lift a heavy weight, it requires additional support to prevent it from toppling over. This support is provided by;

    I.   Retractable outriggers and

    II.   Counters weights

Outrigger extend horizontally outward from the truck with a vertical leg that makes contact with the ground. In either case,

Outriggers

the outriggers must lift all the weight off the tires to provide maximum stability. Without the outriggers, the equipment is considered to be unstable.
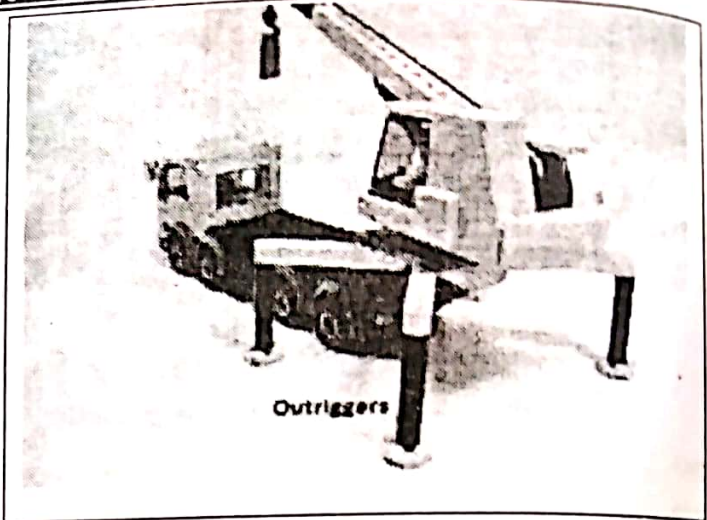
The counterweights are stabilizers placed near the cab's exterior that prevent the crane from becoming unbalanced when lifting heavy loads. These counter weights actually lowers the center of gravity and also the crane is designed in such a way that when it lifts the load, the line of action of force passes through the center of gravity thus avoiding it from being toppled.

5.

Ans. The gravitational force always acts along a line joining the center of the two bodies i.e. directed radially through the center of mass of earth and center of mass of satellite. Therefore gravitational force can exert no torque because the moment arm and force are anti-parallel.

Mathematically;

$$\tau = r\, F_g \sin 180° = r\, F_g\,(0) = 0$$

Satellite

$\theta = 180$

F_1

Earth

6.
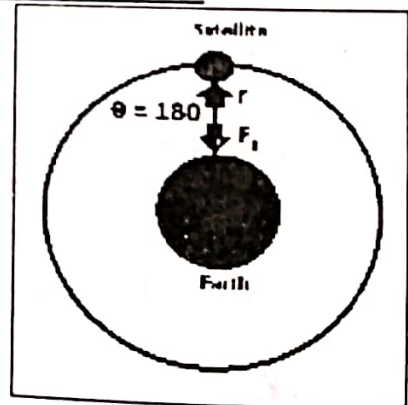
Ans. Since buses and heavy trucks have wheels of large size and also more massive than cars therefore they require more torque on steering shaft to turn the wheels. The rotation of steering wheel of a bus or car is because of couple force which produces torque. The torque of the steering wheel is given by

$$\vec{\tau} = \vec{L} \times \vec{F}$$

Where the perpendicular distance AB = L is called as couple arm.
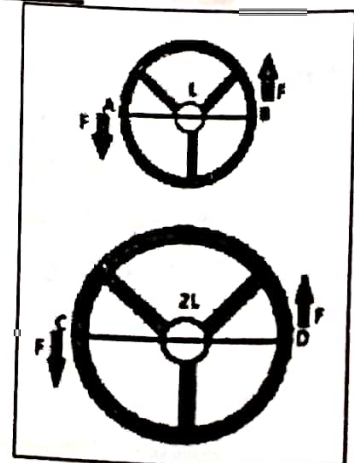
✗ Now if we increase the couple arm the driver can apply a larger torque on the steering shaft from the same force applied.

7. A point object acted on by forces 4 N, 5 N and 6 N is in equilibrium. If the 6 N forces is removed, what is the resultant force on the object?

Ans. It is given that the point object is in equilibrium under the action of all the three forces of magnitude 4 N, 5 N and 6 N.

Hence according to first condition of equilibrium

$$\Sigma F = 0$$

Hence the resultant of any of these two forces is equal to the third force.

Since 6 N force is counter-balanced by 5 N and 4 N force therefore when 6 N force is removed, then the resultant force acting on the object is still 6 N.