Kinematics worksheet 5

1. Give an example of a body moving with uniform speed but having a variable velocity and an acceleration which remains constant in magnitude but changes in direction 1

Ans. A body moving in a circular path.

2. What is the direction of centripetal force when particle is following a circular path? 1

Ans. Towards the centre

3. Two vectors $\vec{A}$ *and* $\vec{B}$ are perpendicular to each other. What is the value of $\vec{A}.\vec{B}$? 1

Ans. $\vec{A}.\vec{B} = AB\cos\theta = AB\cos 90^0 = 0$

4. Two forces 5 and 10 kg wt are acting with an inclination of 120^o between them. What is the angle which the resultant makes with 10kg wt? 2

Ans. $A = 10kg.wt$

$B = 5kg.wt$

$\theta = 120^0$

$$\tan\beta = \frac{B\sin\theta}{A + B\cos\theta} = \frac{5\sin 120^0}{10 + 5\cos 120^0} = \frac{5\times\frac{\sqrt{3}}{2}}{10 + 5\left(-\frac{1}{2}\right)} = \frac{5\times\frac{\sqrt{3}}{2}}{\frac{15}{2}} = \frac{\sqrt{3}}{3} = \frac{1}{\sqrt{3}}$$

$\beta = 30^0$

5. A stone is thrown vertically upwards and then it returns to the thrower. Is it a projectile? Explain? 2

Ans. A stone cannot be considered as a projectile because a projectile must have two perpendicular components of velocities but in this case a stone has velocity in one direction while going up or coming downwards.

6. Which is greater the angular velocity of the hour hand of a watch or angular velocity of earth around its own axis? 2

Ans. $\omega = \frac{2\pi}{T}$

For hour hand of watch, $\omega_H = \frac{2\pi}{12}$

For earth, $\omega_E = \frac{2\pi}{24}$

Now, $\frac{\omega_H}{\omega_E} = \frac{\frac{2\pi}{12}}{\frac{2\pi}{24}} = 2$

$\omega_H = 2\omega_E$

7. Why does the direction of motion of a projectile become horizontal at the highest point of its 1

trajectory?

Ans. At the highest point vertical component of velocity becomes zero thus direction of motion of projectile becomes horizontal.

8 A vector $\vec{A}$ has magnitude 2 and another vector $\vec{B}$ have magnitude 3 and is perpendicular to each other. By vector diagram find the magnitude of $2\vec{A}+\vec{B}$ and show its direction in the diagram. 2

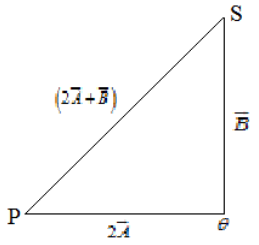
Ans.

$\overrightarrow{PQ} = 2\vec{A} = 4cm$

$\overrightarrow{QS} = \vec{B} = 3cm$

$\overrightarrow{PS} = 2\vec{A}+\vec{B} = 4\hat{i}+3j$

$\left|\overrightarrow{PS}\right| = \sqrt{4^2+3^2} = \sqrt{25} = 5cm$



9 Find a unit vector parallel to the resultant of the vectors $\vec{A} = 2\hat{i}+3j+4k$ and $\vec{B} = 3\hat{i}-5j+k$ 2

Ans. $\vec{A} = 2\hat{i}+3j+4k$

$\vec{B} = 3\hat{i}-5j+k$

$\vec{R} = \vec{A}+\vec{B} = 2\hat{i}+3j+4k+3\hat{i}-5j+k = 5\hat{i}-2j+5k$

$\left|\vec{R}\right| = \sqrt{5^2+(-2)^2+5^2} = \sqrt{54}$

$R = \dfrac{\vec{R}}{\left|\vec{R}\right|} = \dfrac{5\hat{i}-2j+5k}{\sqrt{54}}$

10. (a) What is the angle between $\vec{A}$ *and* $\vec{B}$ if $\vec{A}$ *and* $\vec{B}$ denote the adjacent sides of a parallelogram drawn form a point and the area of the parallelogram is $\frac{1}{2}AB$? 3

(b) State and prove triangular law of vector addition?

Ans. (a)

$Area\ of\ ||^{gm} = \left|\vec{A}\times\vec{B}\right|$

$\dfrac{1}{2}AB = AB\sin\theta$

$\sin\theta = \dfrac{1}{2}$

$\theta = 30^0$