QB365 Question Bank Software Study Materials

Kinematics Important 2 Marks Questions With Answers (Book Back and Creative)

11th Standard

Physics

Total Marks : 60

2 Marks

30 x 2 = 60

1) Explain what is meant by Cartesian coordinate system?

Answer : (i) Cartesian Coordinate system is a frame of reference in which the position of an object at any given instant is described in terms of its distances along x, y and z axes.
(ii) Conventionally right - handed Cartesian Coordinate system where the x, y and z axes are drawn in anti clockurise direction is followed in physics.

2) Define a radian?

Answer : One radian is the angle subtended at the center of a circle by an arc that is equal in length to the radius of the circle.
1 rad = $\frac{180}{\pi}$ degree = 57.295°

3) What is non uniform circular motion?

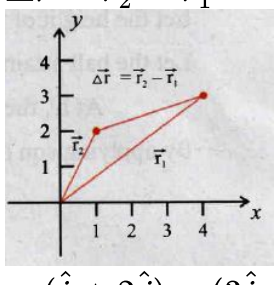
Answer : When a point object is moving on a circular path if the velocity of the object changes both in speed (magnitude) and direction the motion is said to be non uniform circular motion.

4) A particle has its position moved from $\overrightarrow{r_1} = 3\hat{i} + 4\hat{j}$ to $\overrightarrow{r_2} = \hat{i} + 2\hat{j}$ Calculate the displacement vector ($\Delta\vec{r}$) and draw the $\overrightarrow{r_1}$, $\overrightarrow{r_2}$ and $\Delta\vec{r}$ vector in a two dimensional cartesian coordinate system.

Answer : $\overrightarrow{r_1} = 3\hat{i} + 4\hat{j}$

$\overrightarrow{r_2} = \hat{i} + 2\hat{j}$

$\Delta\vec{r} = \overrightarrow{r_2} - \overrightarrow{r_1}$



$= (\hat{i} + 2\hat{j}) - (3\hat{i} + 4\hat{j})$

$\Delta\vec{r} = -2\hat{i} + \hat{j}$

5) An object at an angle such that the horizontal range is 4 times of the maximum height. What is the angle of projection of the object?

Answer : Max.height = $\frac{u^2 sin^2\theta}{2g}$

$Range\ R = \frac{u^2 sin2\theta}{2g}$

Here, R = 4 x Max.height

$\therefore \frac{u^2 sin2\theta}{g} = \frac{4 \times u^2 sin^2\theta}{2g}$

$sin2\theta = 2sin^2\theta$

$2sin\theta cos\theta = 2sin^2\theta$

$\therefore\ cos\theta = sin\theta$

$\therefore \theta = 45^\circ$

6) Two vectors $\vec{A}$ and $\vec{B}$ of magnitude 5 units and 7 units make an angle 60° with each other. Find the magnitude of the difference vector $\vec{A}$ - $\vec{B}$ and its direction with respect to the vector $\vec{A}$.

Answer : Using the equation,

$|\vec{A} - \vec{B}| = \sqrt{5^2 + 7^2 - 2 \times 5 \times 7 \cos 60^o} = \sqrt{25 + 49 - 35} = \sqrt{39}$ units

The angle that $\vec{A} - \vec{B}$ makes with the vector $\vec{A}$ is given by

$\tan\alpha_2 = \frac{7 \sin 60^o}{5 - 7 \cos 60^o} = \frac{7\sqrt{3}}{10-7} = \frac{7}{\sqrt{3}} = 4.041$

$\alpha_2 = tan^{-1}(4.041) = 76^o$

7) Two vectors $\vec{A}$ and $\vec{B}$ are given in the component form as $\vec{A} = 5\hat{i} + 7\hat{j} - 4\hat{k}$ and $\vec{B} = 6\hat{i} + 3\hat{j} + 2\hat{k}$. Find $\vec{A} + \vec{B}, \vec{B} + \vec{A}, \vec{A} - \vec{B}, \vec{B} - \vec{A}$

Answer : $\vec{A} + \vec{B} = \left(5\hat{i} + 7\hat{j} - 4\hat{k}\right) + \left(6\hat{i} + 3\hat{j} + 2\hat{k}\right) = 11\hat{i} + 10\hat{j} - 2\hat{k}$

$\vec{B} + \vec{A} = \left(6\hat{i} + 3\hat{j} + 2\hat{k}\right) + \left(5\hat{i} + 7\hat{j} - 4\hat{k}\right) = (6+5)\,\hat{i} + (3+7)\,\hat{j} + (2-4)\,\hat{k} = 11\hat{i} + 10\hat{j} - 2\hat{k}$

$\vec{A} - \vec{B} = \left(5\hat{i} + 7\hat{j} - 4\hat{k}\right) - \left(6\hat{i} + 3\hat{j} + 2\hat{k}\right) = -\hat{i} + 4\hat{j} - 6\hat{k}$

$\vec{B} - \vec{A} = -\hat{i} + 4\hat{j} - 6\hat{k}$

Note that the vector $\vec{A} + \vec{B}$ and $\vec{B} + \vec{A}$ are same and the vectors $\vec{A} - \vec{B}$ and $\vec{B} - \vec{A}$ are opposite to each other.

8) Given the vector $\vec{A} = 2\hat{i} + 3\hat{j}$ what is $3\vec{A}$?

Answer : $3\vec{A} = 3(2\hat{i} + 3\hat{j}) = 6\hat{i} + 9\hat{j}$

The vector $3\vec{A}$ is in the same direction as vector $\vec{A}$

9) Compare the components for the following vector equations

(a) $\vec{F} = m\vec{a}$

(b) $\vec{p} = 0$

Answer : (a) $\vec{F} = m\vec{a}$

$F_x i + F_y j + F_z k = ma_x i + ma_y j + ma_z k$

By comparing the components, we get

$F_x = ma_x, F_y = ma_y, F_z = ma_z$

This implies that one vector equation is equivalent to three scalar equations.

(b) $\vec{p} = 0$

$p_x\hat{i} + p_y\hat{j} + p_z\hat{k} = 0\hat{i} + 0\hat{j} + 0\hat{k}$

By comparing the components, we get

$p_x = 0, p_y = 0, p_z = 0$

10) Determine the value of the T from the given vector equation $5\hat{j} - T\hat{j} = 6\hat{j} + 3T\hat{j}$

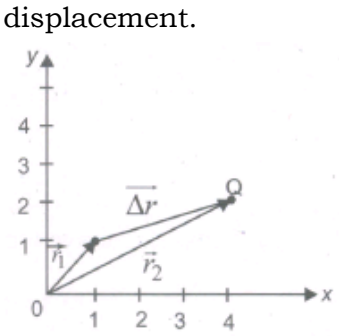
Answer : By comparing the components both sides, we can write

5 - 6 = 3T + T

-1 = 4T

T = $-\frac{1}{4}$

11) Calculate the displacement vector for a particle moving from a point P to Q as shown below. Calculate the magnitude of displacement.



Answer : The displacement vector $\Delta\vec{r} = \vec{r}_2 - \vec{r}_1$ with $\vec{r}_1 = \hat{i} + \hat{j}$ and $\vec{r}_2 = 4\hat{i} + 2\hat{j}$

$\therefore \Delta\vec{r} = \vec{r}_2 - \vec{r}_1 = (4\vec{i} + 2\vec{j}) - (\vec{i} + \vec{j}) = (4-1)\hat{i} + (2-1)\hat{j}$

$\therefore \Delta\vec{r} = 3\hat{i} + \hat{j}$

The magnitude of the displacement vector $\Delta r = \sqrt{3^2 + 1^2} = \sqrt{10}$ units.

12) Find the derivative with respect to t, of the function $x = A_o + A_1t + A_2t^2$ where A_0, A_1 and A_2 are constants.

Answer : Note that here the independent variable is 't' and the dependent variable is 'x'.

The required derivative is $dx/dt = 0 + A_1 + 2A_2t$.

The second derivative is $d^2x/d^2t = 2A_2$.

13) Consider two masses of 10 g and 1 kg moving with the same speed 10 ms^{-1}. Calculate the magnitude of the momentum.

Answer : We use p = mv

For the mass of 10 g, m = 0.01 kg

$p = 0.01 \times 10 = 0.1$ kg m s^{-1}

For the mass of 1 kg

$p = 1 \times 10 = 0.1$ kg m s^{-1}

Thus even though both the masses have the same speed, the momentum of the heavier mass is. 100 times greater than that of the lighter mass.

14) A train was moving at the rate of 54 km h^{-1} when brakes were applied. It came to rest within a distance of 225 m. Calculate the retardation produced in the train.

Answer : The final velocity of the particle v = 0

The initial velocity of the particle

$u = 54 \times \frac{5}{18}\ ms^{-1} = 15\ ms^{-1}$

S = 225 m

Retardation is always against the velocity of the particle.

$v^2 = u^2 - 2aS$

$0 = (15)^2 - 2a(225)$

$450\ a = 225$

$a = \frac{225}{450}\ ms^{-2} = -0.5 ms^{-2}$

Hence, retardation = 0.5 m s^{-2}.

15) A swimmer's speed in the direction of flow of a river is 12 km h^{-1}. Against the direction of flow of the river the swimmer's speed is 6 km h^{-1}. Calculate the swimmer's speed in still water and the velocity of the river flow.

Answer : Let v_s and v_r represent the velocities of the swimmer and river respectively with respect to ground

$v_s + v_r = 12$ .....(1)

and $v_s - v_r = 6$ ..... (2)

Adding the both equations (1) and (2) $2v_s = 12 + 6 = 18$ km h^{-1} or $v_s = 9$ km h^{-1}

From equation (1),

$9 + v_r = 12$ or $v_r = 3$ km h^{-1}

When the river flow and swimmer move in the same direction, the net velocity of swimmer is 12 km h^{-1}.

16) A particle is in circular motion with an acceleration α = 0.2 rad s^{-2}.

(a) What is the angular displacement made by the particle after 5 s?

(b) What is the angular velocity at t = 5 s?. Assume the initial angular velocity is zero.

Answer : Since the initial angular velocity is zero $(\omega_0 = 0)$

The angular displacement made by the particle is given by

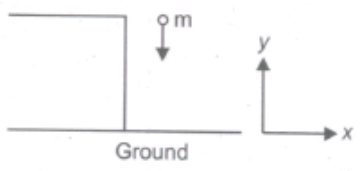
$\theta = \omega_0 t + \frac{1}{2}\alpha t^2$

$\theta = \frac{1}{2} \times 2 \times 10^{-1} \times 25 = 2.5\ rad$

In terms of degree $\theta = 2.5 \times 57.17^0 \approx 143^0$

17) An object is thrown vertically downward. What is the acceleration experienced by the object?

Answer :



We know that when the object falls towards the Earth, it experiences acceleration due to gravity g = 9.8 m s^{-2} downward. We can choose the coordinate system as shown in the figure. The acceleration is along the negative y direction.

$\vec{a} = g(-\hat{j}) - g\hat{j}$

18) An iron ball and a feather are both falling from a height of 10m

(a) What are the time taken by the iron ball and feather to reach the ground?

(b) What are the velocities of iron ball and feather when they reach the ground?

(Ignore air resistance and take g = 10 m s^{-2})

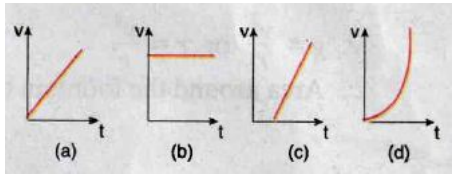
Answer : Since kinematic equations are independent of mass of the object, according to equation, the time taken by both iron ball and feather to reach the ground are the same. This is given by

$T = \sqrt{\frac{2h}{g}} = \sqrt{\frac{2\times10}{10}} = \sqrt{2}s$ = 1.414 s

Thus, both feather and iron ball reach ground at the same time. By following equation, both iron ball and feather reach the Earth with the same speed. It is given by

v = $\sqrt{2gh} = \sqrt{2 \times 10\times} = \sqrt{200}$ms^{-1}≈ 14.14 ms^{-1}

19) The following graphs represent velocity – time graph. Identify what kind of motion a particle undergoes in each graph.



Answer : (a) $\vec{a}$ = Constant

(b) $\vec{v}$ = Constant

(c) $\vec{a}$ = Constant but greater than first graph.

(d) $\vec{a}$ is variable.

20) 8. Define scalar and vector. Give examples.

Answer :

21) Calculate tha area of the triangle for which to of its sides are given by the vectors $\vec{A} = 5\hat{i} - 3\hat{j}, \vec{B} = 4\hat{i} - 6\hat{j}$

Answer : Sides of the triangle $\vec{A} = 5\hat{i} - 3\hat{j}$

$\vec{B} = 4\hat{i} - 6\hat{j}$

Area of the triangle, $A = \frac{1}{2}|\bar{A} \times \bar{B}| = \frac{1}{2}\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 5 & -3 & 0 \\ 4 & 6 & 0 \end{vmatrix}$

$\hat{i}[0-0] + \hat{j}(0-0) + \hat{k}(30+12) = 42\hat{k}$

$|\bar{A} + \bar{B}| = \sqrt{0^2 + 0^2 + 42^2} = \sqrt{42^2} = 42$

$\frac{1}{2}|\bar{A} \times \bar{B}| = \frac{1}{2}.42$

= 21.

22) Define velocity.

Answer : Velocity is equal to rate of change of position vector with respect to time. Velocity is a vector quantity.

23) Can the relative velocity of two bodies be greater than the absolute velocity of either body?

Answer : Yes. When two bodies move in opposite directions, the relative velocity of each is greater than the individual velocity of either body.

24) The magnitude and direction of the acceleration of a body are constant. Will the path of the body necessarily be a straight line?

Answer : If the magnitude, as well as direction of the acceleration of a body, is constant, it is not necessary that the path of the body is a straight line.

Eg: In projectile motion, the projectile is under g which has constant magnitude (9.8 m/s^2) and constant direction (vertically downward). The path of projectile is parabolic and not a straight line.

25) Suggest a situation in which an object is accelerated and have constant speed.

Answer : Uniform Circular Motion.

26) What is the vector sum of n coplanar forces, each of magnitude F, if each force makes an angle of $\frac{2\pi}{n}$ with the preceding force?

Answer : Resultant force is zero.

27) A boat is moving with a velocity $(3\hat{i} - 4\hat{j})$ with respect to ground. The water in river is flowing with a velocity $(-3\hat{i} - 4\hat{j})$ with respect to ground. What is the relative velocity of boat with respect to river?

Answer : $\vec{V}_{BW} = \vec{V}_B$

28) A railway engine is moving in an arc of radius 200 m with a velocity of 36 kmh^{-1}. Find the centripetal acceleration.

Answer : $a_c = \frac{v^2}{r}$

$v = 36 \times \frac{5}{18} = 10 \text{ ms}^{-1}$

v = 200 m

$\therefore a_c = \frac{10^2}{200} = 0.5 \text{ ms}^{-2}$

29) Which are dealt by physics?

Answer : Experiments and mathematics are dealt by physics.

30) What is the value of 'm' in i + mj + k its be unit vector?

Answer : For unit vector $|\vec{i} + m\vec{j} + \vec{k}| = \sqrt{1 + m^2 + 1} = 0$

$\therefore 1 + m^2 + 1 = 0$

m^2 = -2(m is imaginary).