doubtnut
India's Number 1 Education App

PHYSICS

BOOKS - PSEB

MOTION IN A PLANE

Exercise

1. State, for each of the following physical quantities, if it is a scalar or a vector : volume, mass, speed, acceleration, density, number of

moles, velocity, angular frequency, displacement, angular velocity.

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2. Pick out the two scalar quantities in the following list : force, angular momentum, work, current, linear momentum, electric field, average velocity, magnetic moment, relative velocity.

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3. Pick out the only vector quantity in the following list : Temperature, pressure, impulse, time, power, total path length, energy, gravitational potential, coefficient of friction, charge.

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4. State with reasons, whether the following algebraic operations with scalar and vector physical quantities are meaningful :- adding any two scalars,

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5. State with reasons, whether the following algebraic operations with scalar and vector physical quantities are meaningful :- adding a scalar to a vector of the same dimensions

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6. State with reasons, whether the following algebraic operations with scalar and vector

physical quantities are meaningful :- multiplying any vector by any scalar,

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7. State with reasons, whether the following algebraic operations with scalar and vector physical quantities are meaningful :- multiplying any two scalars,

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8. State with reasons, whether the following algebraic operations with scalar and vector physical quantities are meaningful :- adding any two vectors,

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9. State with reasons, whether the following algebraic operations with scalar and vector physical quantities are meaningful :- adding any two vectors,

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10. Read each statement below carefully and state with reasons, if it is true or false :- The magnitude of a vector is always a scalar,

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11. Read each statement below carefully and state with reasons, if it is true or false :- each component of a vector is always a scalar,

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12. Read each statement below carefully and state with reasons, if it is true or false :- the total path length is always equal to the magnitude of the displacement vector of a particle,

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13. Read each statement below carefully and state with reasons, if it is true or false :- the

average speed of a particle (defined as total path length divided by the time taken to cover the path) is either greater or equal to the magnitude of average velocity of the particle over the same interval of time,

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14. Read each statement below carefully and state with reasons, if it is true or false :- Three vectors not lying in a plane can never add up to give a null vector.

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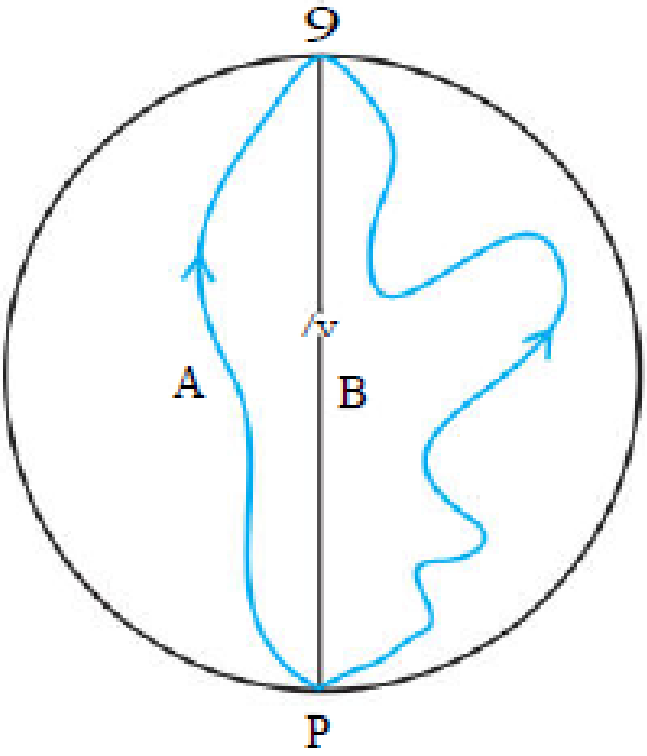
15. Three girls skating on a circular ice ground of radius 200 m start from a point P on the edge of the ground and reach a point Q diametrically opposite to Pfollowing different paths as shown in Fig. 4.20. What is the magnitude of the displacement vector for each ? For which girl is this equal to the actual

length of path skate?



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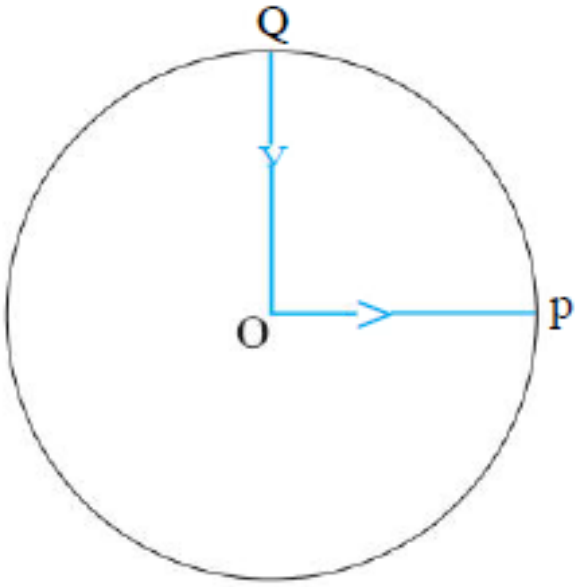
16. A cyclist starts from the centre Oof a circular park of radius 1 km, reaches the edge P of the park, then cycles along the circumference, and returns to the centre along QO as shown in Fig. 4.21. If the round trip takes 10 min, what is the:- net displacement,



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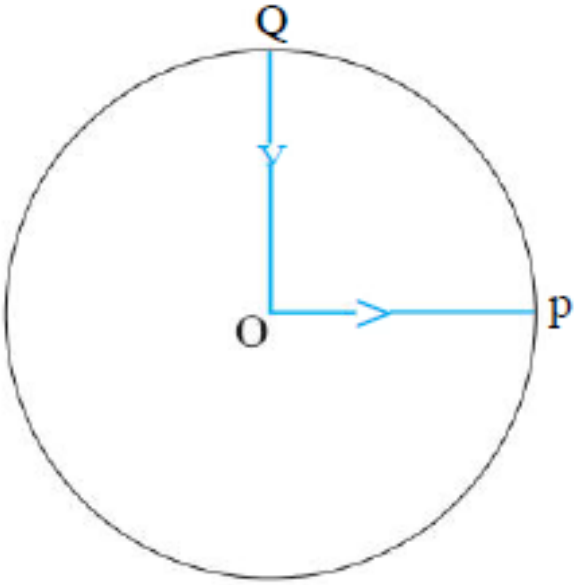
17. A cyclist starts from the centre Oof a circular park of radius 1 km, reaches the edge P of the park, then cycles along the circumference, and returns to the centre along QO as shown in Fig. 4.21. If the round trip

takes 10 min, what is the:- average velocity, and



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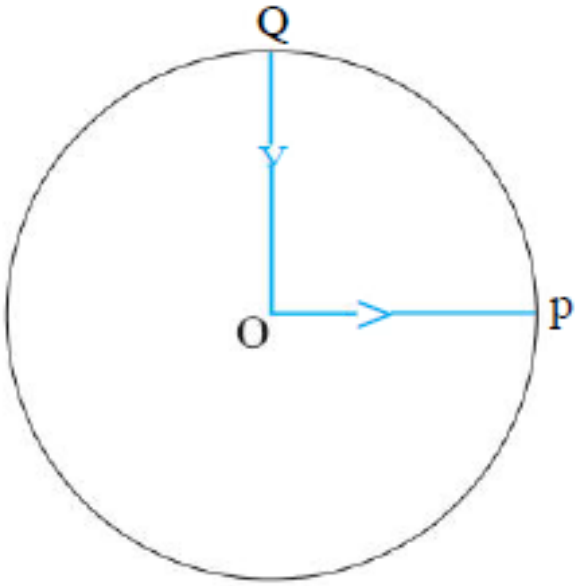
18. A cyclist starts from the centre Oof a circular park of radius 1 km, reaches the edge P of the park, then cycles along the

circumference, and returns to the centre along QO as shown in Fig. 4.21. If the round trip takes 10 min, what is the:- average speed of the cyclist ?



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19. On an open ground, a motorist follows a track that turns to his left by an angle of 60° after every 500 m. Starting from a given turn, specify the displacement of the motorist at the third, sixth and eighth turn. Compare the magnitude of the displacement with the total path length covered by the motorist in each case.

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20. A passenger arriving in a new town wishes to go from the station to a hotel located 10 km away on a straight road from the station. A dishonest cabman takes him along a circuitous path 23 km long and reaches the hotel in 28 min. What is:- the average speed of the taxi,

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21. A passenger arriving in a new town wishes to go from the station to a hotel located 10 km away on a straight road from the station. A dishonest cabman takes him along a circuitous path 23 km long and reaches the hotel in 28 min. What is:- the magnitude of average velocity ? Are the two equal ?

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22. Rain is falling vertically with a speed of $30ms^{-1}$. A woman rides a bicycle with a speed of $10ms^{-1}$ in the north to south direction. What is the direction in which she should hold her umbrella ?

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23. A man can swim with a speed of $4.0km/h$ in still water. How long does he take to cross a river 1.0 km wide if the river flows steadily at

$3.0km/h$ and he makes his strokes normal to the river current? How far down the river does he go when he reaches the other bank ?

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24. In a harbour, wind is blowing at the speed of $72km/h$ and the flag on the mast of a boat anchored in the harbour flutters along the N-E direction. If the boat starts moving at a speed of $51km/h$ to the north, what is the direction of the flag on the mast of the boat ?

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25. Tire ceiling of a long hall is 25 m high. What is the maximum horizontal distance that a ball thrown with a speed of $40ms^{-1}$ can go without hitting the ceiling of the hall ?

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26. A cricketer can throw a ball to a maximum horizontal distance of 100 m. How much high

above the ground can the cricketer throw the same ball ?

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27. A stone tied to the end of a string 80 cnr long is whirled in a horizontal circle with a constant speed. If the stone makes 14 revolutions in 25 s, what is the magnitude and direction of acceleration of the stone ?

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28. An aircraft executes a horizontal loop of radius 1.00 knr with a steady speed of $900 km / h$. Compare its centripetal acceleration with the acceleration due to gravity.

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29. Read each statement below carefully and state, with reasons, if it is true or false :- The net acceleration of a particle in circular

motion is always along the radius of the circle towards the centre

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30. Read each statement below carefully and state, with reasons, if it is true or false :- The velocity vector of a particle at a point is always along the tangent to the path of the particle at that point

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31. Read each statement below carefully and state, with reasons, if it is true or false :- The acceleration vector of a particle in uniform circular motion averaged over one cycle is a null vector

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32. The position of a particle is given by $r = 3.0t\hat{i} - 2.0t^2\hat{j} + 4.0\hat{k}m$ where tis in seconds and the coefficients have the proper

units for r to be in metres:- Find the v and a of the particle?

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33. The position of a particle is given by $r = 3.0t\hat{i} - 2.0t^2\hat{j} + 4.0\hat{k}m$ where tis in seconds and the coefficients have the proper units for r to be in metres:- What is the magnitude and direction of velocity of the particle at t = 2.0 s ?

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34. A particle starts from the origin at t = 0 s with a velocity of $10.0\hat{j}m/s$ and moves in the x-y plane with a constant acceleration of $\left(8.0\hat{i}+2.0\hat{j}\right)ms^{-2}$,:- At what time is the x-coordinate of the particle 16 m? What is the y-coordinate of the particle at that time?

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35. A particle starts from the origin at t = 0 s with a velocity of $10.0\hat{j}m/s$ and moves in the

x-y plane with a constant acceleration of $\left(8.0\hat{i}+2.0\hat{j}\right)ms^{-2}$,:- What is the speed of the particle at the time ?

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36. $\hat{i}$ and $\hat{j}$ are unit vectors along x- and y-axis respectively. What is the magnitude and direction of the vectors $\hat{i}+\hat{j}$, and $\hat{i}-\hat{j}$? What are the components of a vector $A=2\hat{i}+3\hat{j}$ along the directions of

$\hat{i} + \hat{j}$ and $\hat{i} - \hat{j}$? [You may use graphical method]

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37. For any arbitrary motion in space, which of the following relations are true :-

$v_a vera \geq = \left(\frac{1}{2}\right)(v(t_1)) + (v(t_2))$(The 'average' stands for average of the quantity over the time interval $t_1 \to t_2$)

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38. For any arbitrary motion in space, which of the following relations are true :-

$v_a vera \geq = \left[r(t_2) - r \frac{t_1}{t_2 - t_1}$(The 'average' stands for average of the quantity over the time interval $t_1 \rightarrow t_2$)

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39. For any arbitrary motion in space, which of the following relations are true :-

$v(t) = v(O) + at$(The 'average' stands for

average of the quantity over the time interval $t_1 \rightarrow t_2$)

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40. For any arbitrary motion in space, which of the following relations are true :- $r(t) = r(O) + v(O)t + \left(\frac{1}{2}\right)at^2$(The 'average' stands for average of the quantity over the time interval $t_1 \rightarrow t_2$)

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41. For any arbitrary motion in space, which of the following relations are true :- $a_averag\frac{v(t_2)-v(t_1)}{t_2-t_1}$(The 'average' stands for average of the quantity over the time interval $t_1 \to t_2$)

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42. Read each statement below carefully and state, with reasons and examples, if it is true or false :-A scalar quantity is one that:- is conserved in a process

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43. Read each statement below carefully and state, with reasons and examples, if it is true or false :-A scalar quantity is one that:- can never take negative values

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44. Read each statement below carefully and state, with reasons and examples, if it is true

or false :- A scalar quantity is one that:- must be dimensionless

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45. Read each statement below carefully and state, with reasons and examples, if it is true or false :- A scalar quantity is one that:- does not vary from one point to another in space

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46. Read each statement below carefully and state, with reasons and examples, if it is true or false :- A scalar quantity is one that:- has the same value for observers with different orientations of axes.

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47. An aircraft is flying at a height of 3400 m above the ground. If the angle subtended at a ground observation point by the aircraft

positions 10.0 s apart is 30°, what is the speed of the aircraft ?

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48. A vector has both magnitude and direction. Does it mean that anything that has magnitude and direction is necessarily a vector ?The rotation of a body can be specified by the direction of the axis of rotation, and the angle of rotation about the axis. Does that make any rotation a vector ?

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49. Can you associate vectors with:- the length of a wire bent into a loop, Explain.

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50. Can you associate vectors with:- a plane area, Explain.

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51. Can you associate vectors with:-a sphere ? Explain.

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52. A bullet fired at an angle of 30° with the horizontal hits the ground 3.0 km away. By adjusting its angle of projection, can one hope to hit a target 5.0 km away ? Assume the muzzle speed to be fixed, and neglect air resistance.

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53. A fighter plane flying horizontally at an altitude of 1.5 km with speed $720km/h$ passes directly overhead an anti-aircraft gun. At what angle from the vertical should the gun be fired for the shell with muzzle speed $600ms^{-1}$ to hit the plane ? At what minimum altitude should the pilot fly the plane to avoid being hit ? (Take g = $10ms^2$).

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54. A cyclist is riding with a speed of $27km/h$. As he approaches a circular turn on the road of radius 80 m, he applies brakes and reduces his speed at the constant rate of $0.50m/s$ every second. What is the magnitude and direction of the net acceleration of the cyclist on the circular turn ?

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55. Shows that the projection angle θ_o for a projectile launched from the origin is given by

$\theta_o = \tan^{-1}\left(\frac{4h_m}{R}\right)$ where the symbols have their usual meaning.

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