PHYSICS

BOOKS - MAXIMUM PUBLICATION

MOTION IN A PLANE

Exercise

1. Explain a zero vector using an example.

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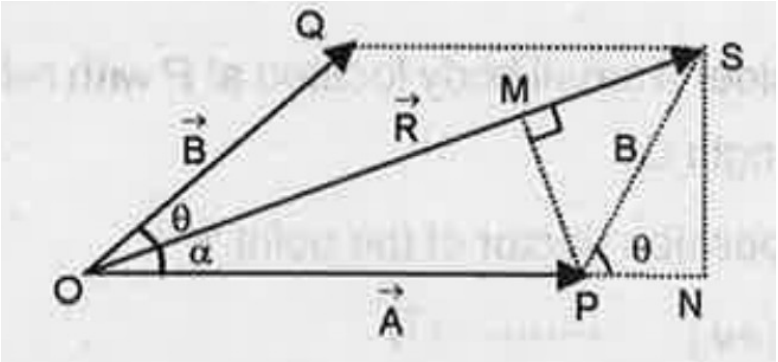
2. Find the magnitude and direction of the resultant of two vectors $\vec{A}$ and $\vec{B}$ in terms of their magnitudes and angle between them.



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3. What is the shape of path followed by the projectile? Show the path of projectile is

Parabola.

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4. A cricketer can throw a ball to a maximum horizontal distance of 100m. With the same speed how much high above the ground can the cricketer throw the same ball?

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5. If vectors $\hat{i} - 3\hat{j} + 5\hat{k}$ and $\hat{i} - 3\hat{j} - a\hat{k}$ are equal vectors, then the value of a is

A. 5

B. 2

C. -3

D. -5

Answer: D

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6. State which of the following algebric operations are not meaningful

A. Addition of scalar to a vector

B. Multiplication of any two scalars.

C. Multipication of vector by scalar

D. Division of a vector by scalar

Answer: A

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7. What is the acceleration of train travelling at $40ms^{-1}$ as it goes round a curve of $160m$ radius?

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8. What provides centripetal force in Electron revolving around nucleus?

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9. What provides centripetal force in Earth revolving around sun?

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10. Why a cyclist has to be bend inwards while going on a circular track?

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11. A body executing uniform circular motion has constant

A. velocity

B. acceleration

C. speed

D. angular velocity

Answer: C

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12. Name a quantity which remains unchanged during projectile motion.

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13. What is the effect of air resistance in time of flight and horizontal range?

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14. What is the angle between directions of velocity and acceleration at the highest point

of trajectory of projectile?

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15. Can a body have constant velocity and still have a varying speed?

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16. Can a body have zero velocity, still accelerating?

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17. A quantity has both magnitude and direction. Is it necessarily a vector? Give an example.

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18. What is the angle between $\vec{A} \times \vec{B}$ and $\vec{B} \times \vec{A}$?

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19. A particle is projected with a velocity u so that its horizontal range is twice the greatest height attained. The horizontal range is

A. $\frac{u^2}{g}$

B. $\frac{2u^2}{g}$

C. $\frac{4u^2}{5g}$

D. None of these

Answer: C

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20. If $\vec{A} \times \vec{B} = \vec{C} + \vec{D}$, then select the correct alternative

A. $\vec{B}$ is parallel to $\vec{C} + \vec{D}$

B. $\vec{A}$ is perpendicular to $\vec{C}$.

C. Component of $\vec{C}$ along $\vec{A}$ = component of $\vec{D}$ along $\vec{A}$

D. Component of $\vec{C}$ along $\vec{A}$ = $-$ component of $\vec{D}$ along $\vec{A}$

Answer: D

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21. A particle executing uniform circular motion. Then its

A. Velocity and accleration are radial.

B. Velocity and acceleration are tangential.

C. Velocity is tangential, acceleration is radial.

D. Velocity is radial, acceleration is tangential.

Answer: C

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22. In a circus, a rider rides in a circular track of radius 'r' in a plane. The minimum velocity at the highest point of the track will be

A. $\sqrt{2gr}$

B. $\sqrt{gr}$

C. $\sqrt{3gr}$

D. 0

Answer: D

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23. Two non-zero vectors $\vec{A}$ and $\vec{B}$ are such that $\left|\vec{A}+\vec{B}\right|=\left|\vec{A}-\vec{B}\right|$. Find the angle between them

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24. Consider a particle moving along the circumference of a circle of radius R with

constant speed with a time period T. During T, what is the distance and displacement covered?

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25. Consider a particle moving along the circumference of a circle of radius R with constant speed with a time period T. What is the direction of the velocity at each point?

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26. Classify the following into scalars and vectors. Frequency, velocity gradient, instantaneous velocity, Area.

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27. A body is projected so that it has maximum range R. What is the maximum height reached during the flight?

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28. An electron of mass 'm' moves with a uniform speed v around the nucleus along a circular radius 'r'. Derive an expression for the acceleration of the electron.

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29. An electron of mass 'm' moves with a uniform speed v around the nucleus along a circular radius 'r'. Derive an expression for the acceleration of the electron.

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30. A boy pulls his friend in a home made trolley by means of a rope inclined at 30° to the horizontal. If the tension in the rope is $400N$. Draw the vertical and horizontal components of tension in the rope.

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31. A boy pulls his friend in a home made trolley by means of a rope inclined at 30° to the horizontal. If the tension in the rope is

$400N$. Find the effective force pulling the trolley along the ground.

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32. A boy pulls his friend in a home made trolley by means of a rope inclined at 30° to the horizontal. If the tension in the rope is $400N$. Find the force tending to lift the trolley off the ground.

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33. A stone tied to the end of a string is whirled in a horizontal circle with constant speed. Name the acceleration experienced by the stone.

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34. A stone tied to the end of a string is whirled in a horizontal circle with constant speed. Arrive at an equation for magnitude of acceleration experienced by the stone.

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35. Two balls are released simultaneously from a certain height, one is allowed to fall freely and other thrown with some horizontal velocity. Will they hit the ground together?

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36. Two balls are released simultaneously from a certain height, one is allowed to fall freely and other thrown with some horizontal

velocity. At any time during the fall will the velocities of the ball are same?

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37. Two balls are released simultaneously from a certain height, one is allowed to fall freely and other thrown with some horizontal velocity. How does the path of the balls appear to a person standing on the ground?

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38. A ball thrown straight up. Obtain a mathematical expression for the height to which it travels.

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39. A ball thrown straight up. What is its velocity and acceleration at the top?

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40. A ball thrown straight up. Draw the velocity time graph for the ball showing its motion up and down.

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41. Parallelogram law help to find the magnitude and direction of the resultant of two forces. State the law.

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42. For two vectors $\overrightarrow{A}$ and $\overrightarrow{B}$ are acting at a point with an angle α between them, find the magnitude and direction of the resultant vector.

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43. What will be the angle between two vectors of equal magnitude for their resultant to have the same magnitude as one of the vectors?

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44. A ball of mass m is projected at an angle with the ground and it is found that its kinetic energy at the highest point is $75\,\%$ of that at the point of projection.

a)Is it a one dimensional or a two dimensional motion?Why?

b)Find the angle of projection.

c)Determine another angle of projection which produces the same range.

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45. "The graphical method of adding vectors helps us in visualizing the vectors and the resultant vector.But, sometimes, it is tedious and has limited accuracy."

a)Name the alternative method of vector addition.

b)Write a mathematical expression to find resultant of two vectors.

c)A particle is moving eastward with a velocity of $5\frac{m}{s}$.If in $10s$,the velocity changes by $5\frac{m}{s}$ northwards,what is the average acceleration in this time.

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46. A projectile is an object projected into air with a velocity V so that it is moving under the influence of gravity.

a)What is the shape of the path of projectile?

b)As a projectile moves in its path,is there any point along the path where the velocity and acceleration vectors are perpendicular to each other.

c)If E is energy with a projectile is projected,

(i)What is the kinetic energy at the highest

point.

(ii)What is P. E at highest point?

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47. An object is projected with velocity U at an angle θ to the horizintal

a)Obtain a mathematical expression for the range in the horizontal plane.

b)What are the conditions to obtain maximum horizontal range?

c)Find the maximum height of the object when

its path makes an angle of 30° with the horizontal (velocity of projection = $8ms^{-1}$)

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48. A particle moving uniformly along a circle, experiences a force directed towards the centre and an equal and opposite force directed away from the centre. Name the two forces directed towards and away from the centre.

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49. A body is projected with a velocity v in a direction making an angle θ with the horizontal.

a)Derive the mathematical equation of the path followed.

b)Draw the velocity - time graphs for the horizontal and vertical components of velocity of the projectile.

c)Obtain an expression for the time of flight of the projectile.

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50. An object projected into air with a velocity is called a projectile.

a)What will be the range when the angle of projections are zero degrees and ninety degrees?

b)Show that for a projectile,the upward time of flight is equal to the downward time of flight.

c)At what angles will a projectile have the same range for a velocity?

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51. "An object that is in flight after being thrown or projected is called a projectile"

a)Which of the following remains constant throughout the motion of the projectile?

(i)vertical component of velocity.

(ii)Horizontal component of velocity.

b)Derive an expression for a maximum range of a projectile.

c)Show that range of projection of a projectile for two angels of a projection α and β is same where $\alpha + \beta = 90^{\circ}$.

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52. A bullet is fired with a velocity u at an angle θ with the horizontal such that it moves under the effect of gravity.

a)What is the nature of its trajectory.

b)Arrive at an expression for time of flight of the bullet.

c)What is the relation between time of ascent and time of decent,when air resistance is neglected.

d)How the relation is affected when air resistance is considered.

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53. 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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54. 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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55. State,with reasons,whether the following algebraic operations with scalar and vector physical quantities are meaningful:

a)adding any two scalars,b)adding a scalar to a

vector of the same dimensions,c)multiplying any vector by any scalar,d)multiplying any two scalars,e)adding any two vectors,f)adding a component of a vector to the same vector.

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56. Pick out the only vector quantity in the following list:

temperature, pressure, impulse, time, power, total path length, energy, coefficient of fricton, charge.

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

a)the magnitude of a vector is always a scalar.

b)Each component of a vector is always a scalar.

c)The total path length is always equal to the magnitude of the displacement vector of a particle.

d)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.

e)three vectors not lying in a plane can never add up to give a null vector.

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58. A boy throws a cricket ball with a velocity u at an angle θ with the horizontal.Name the path followed by the ball.

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59. A car is moving along the circumferance of a circle of radius r.

a)What is the distance travelled in one revolution?

b)What is the displacement in one revolution?

c)What does the speedometer of the car measure?

d)Can a body have acceleration without velocity.Explain.

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60. a)Find whether the given vectors $2\hat{i}+3\hat{j}+4\hat{k}$ and $4\hat{i}+6\hat{j}+8\hat{k}$are parallel or not.

b)What are orthogonal unit vectors?

c)What is a zero vector?Give its significance in Physics with an example.

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61. a)Obtain expression for Time of flight for a projectile motion.

b)What is the angle of projection for

maximum horizontal range?

c)The ceiling of a long hall is $25m$ high.What is the maximum horizontal distance that the ball thrown with a speed of $40\frac{m}{s}$ can go without hitting the ceiling of the hall?

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62. An athlete jumps at an angle of 30° with a maximum speed of $9.4\frac{m}{s}$.

a)What is the shape of the path followed by the athlete in the jump?

b)Obtain an expression to calculate the horizontal range covered by the athlete.

c)Find the range covered by him in the above jump-Suggest the angle by which the athlete can attain the maximum range.

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63. A stone is thrown upward from a moving train.

a)Name the path followed by the stone.

b)A particle is projected with a velocity u in

the direction making an angle θ with the horizontal.Find:

(1)Time of flight,(2)Maximum height.

c)A man can jump on moon six times as high as on earth.Why?

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64. A and B are two objects moving with velocities $\overline{V}_A$ and $\overline{V}_B$. What is the velocity of A relative to B?

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65. Projectile is a particle which is projected into the air with an initial velocity against gravity.

a)What is the angle of projection for maximum horizontal range?

b)Draw the trajectory of a projectile.

c)Obtain the expression for time of flight.

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66. Uniform circular motion is a special case of two dimensional motion having centripetal acceleration.

a)Define centripetal acceleration.

b)Can a body have acceleration with constant speed?Explain.

c)Express angular velocity in terms of angular displacement.

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67. A body is projected into air at an angle θ with the horizontal.

a)What is the trajectory followed by this projectile?

(i) Ellipse,(ii)Parabola,(iii)Straight line,(iv)Circle.

b)Give a mathematical proof for your answer.

c)Trajectory of a body in a projectile motion is given by $y = x - \left(\frac{x^2}{80}\right)$.

x and y are in meters.Find maximum height of this projectile.

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68. When a body is projected into air with certain initial velocity making an angle with the horizontal,it will travel in a parabolic path.

a)What are the vertical and horizontal components of velocity?

b)With a diagram derive an expression for:

(i)maximum height

(ii) time of flight.

c)A ball is dropped through the window of a train travelling with high velocity,to a man standing near the track.The ball _____

(i)falls down vertically.

(ii)moves straight horizontally.

(iii)follows an elliptical path.

(iv)follows a parabolic path.

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69. a)Identify the scalar quantity from the following alternatives.

(i)Momentum,(ii)work,(iii)Torque,

(iv)Acceleration.

b)A man throws a stone up into air at an angle θ with the horizontal.Draw the path of the

projectile and mark directions of velocity and acceleration at the highest position.

c)Derive an expression for the maximum height reached by the stone.

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70. Choose the correct statement/statements related to uniform circular motion.

(i)The acceleration in uniform circular motion is tangential to the circle.

(ii)The acceleration in uniform circular motion

is directed radially inwards.

(iii)The velocity in uniform circular motion has constant magnitude.

(iv)The velocity in uniform circular motion is directed radially inwards.

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Example

1. Ramesh observes the motion of an insect in a circle. He finds that it travels 6 revolutions in

an anti-clockwise direction for a time of 31.6 sec. Find angular speed ω.

A. Find the angular velocity of the insect.

B. If the insects travel 4 revolutions in the clock wise directions for a time of 8.6 sec ,what will be the angular speed averaged over the total time?

C.

D.

Answer:

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2. Imagine yourself in a rain steadily falling vertically with a speed of 2ms-1

A. If you start moving with 1ms-1 due east, in which direction should you hold the umbrella to protect yourself from the rain?

B. On a sunny day at 12 noon you hold the umbrella vertically, If you can ran at

certain speed,do you need to incline the umbrella? justify your answer

C.

D.

Answer:

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3. A ball is thrown horizontally from the top of a tower with a velocity of 40ms-1 .' Take g = 10 ms^2 '

A. Find the horizontal and vertical displacement after 1,2,3,4,5 seconds, then plot the path of motion of the ball

B. If the ball reaches the ground in 4 seconds, find the hight of the tower

C.

D.

Answer:

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4. A stone is thrown up with a velocity u' whiwhich makes an angle theta with the horizontal.

A. What are the magnitudes of the horizontal and vertical components of velocity?

B. How do these components change with time?

C. After 't' second what will be the magnitude and direction of the

resultant velocity?

D.

Answer:

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5. Motion along a plane is called two dimensional montion.A body moving in two dimensions is found to have an acceleration in one dimension

A. Identify the motion

B. A ball thrown by a player in 2s. What is the maximum height attained by the ball above the point of projection (Take g = 10 ms-2)

C.

D.

Answer:

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6. A food packet is dropped from a plane flying horizontally.

A. Sketch the path of the falling food packet

B. If the time taken by the packet to reach the earth's surface is '6' seconds, calculate the height from which the packet is dropped '(Take g- 10m/s^2)'

C.

D.

Answer:

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7. A parallelogram law helps to find the magnitude and direction of the resultant of two forces. If the magnitude of two vectors and their resultant are the same, what is the angle between the two vectors?

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