PHYSICS

BOOKS - DISHA PUBLICATION PHYSICS (HINGLISH)

MOTION IN A PLANE

Jee Main 5 Years At A Glance

1. Let $\vec{A} = \left(\hat{i} + \hat{j}\right)$ and , $\vec{B} = \left(2\hat{i} - \hat{j}\right)$. The magnitude of a coplanar vector $\vec{C}$ such

that $\vec{A} \cdot \vec{C} = \vec{B} \cdot \vec{C} = \vec{A} \cdot \vec{B}$, is given by :

A. $\sqrt{\frac{5}{9}}$

B. $\sqrt{\frac{10}{9}}$

C. $\sqrt{\frac{20}{9}}$

D. $\sqrt{\frac{9}{12}}$

Answer: A

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2. A vector $\vec{A}$ ur is rotated by a small angle $\triangle\theta$ radian ($\triangle\theta < l$) to get a new vector $\overline{B}$ In that case $\left|\vec{B} - \vec{A}\right|$ is:

A. $\left|\vec{A}\right|\Delta\theta$

B. $\left|\vec{B}\right|\Delta\theta - \left|\vec{A}\right|$

C. $\left|\vec{A}\right|\left(1 - \frac{\Delta\theta^2}{2}\right)$

D. 0

Answer: A

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3. If a body moving in circular path maintains constant speed of 10 ms^{-1}, then which of the following correctly describes relation between acceleration and radius ?

A. 

B. 

C. 

D. 

Answer: C

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4. The initial speed of a bullet fired from a rifle is 630 m/s. . The rifle is fired at the centre of a target 700 m away at the same level as the target. How far above the centre of target, the rifle must be aimed in order to hit the target?

A. 1.0 m

B. 4.2 m

C. 6.1 m

D. 9.8 m

Answer: C

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5. The position of a projectile launched from the origin at t = 0 is given by $s=\left(40\hat{i}+50\hat{j}\right)m$ at $t=2s$. if the projectile was launched at an angle θ from the horizontal, then $\theta$is (take g = 10 ms^{-2}

A. $\tan^{-1}\frac{2}{3}$

B. $\tan^{-1}\frac{3}{2}$

C. $\tan^{-1}\frac{7}{4}$

D. $\tan^{-1}\frac{4}{5}$

Answer: C

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Exercise 1 Concept Builder Topicwise

1. Which of the following conditions are sufficient and essential for a quantity to be a vector?

A. Magnitude and direction only

B. Magnitude and addition, subtraction, multiplication by rules of algebra

C. Magnitude, direction, and addition, subtraction and multiplication by vector laws

D. Magnitude, direction and combination of vectors by rules of algebra

Answer: C

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2. Let $\vec{C} = \vec{A} + \vec{B}$

A. $\left|\vec{C}\right|$ is always greater than $\left|\vec{A}\right|$

B. it is possible to have $\left|\vec{C}\right| < \left|\vec{A}\right|$ and $\left|\vec{C}\right| < \left|\vec{B}\right|$

C. $\vec{C}$ is always equal to $\vec{A} + \vec{B}$

D. $\vec{C}$ is never equal to $\vec{A} + \vec{B}$

Answer: B

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3. $\vec{A}$ and $\vec{B}$ are two vectors and θ is the angle between them, if $\left|\vec{A} \times \vec{B}\right| = \sqrt{3}\left(\vec{A} . \vec{B}\right)$ the value of θ is:-

A. 45°

B. 30°

C. 90°

D. 60°

Answer: D

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4. If $\vec{a}, \vec{b}$ and $\vec{c}$ are unit vectors such that $\vec{a} + \vec{b} + \vec{c} = 0$, then the value of $\vec{a} . \vec{b} + \vec{b} . \vec{c} + \vec{c} . \vec{a}$ is

A. $\frac{3}{2}$

B. -1

C. 0

D. $-\frac{3}{2}$

Answer: D

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5. Two forces are acting as shown in figure. The resultant of the two forces is

A. $5\sqrt{3}N$

B. $10\sqrt{3}N$

C. $5\sqrt{5}N$

D. None of these

Answer: B

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6. What is the area of triangle formed by $\overrightarrow{A} = 2\hat{i} - 3\hat{j} + 4\hat{k}$ and $\overrightarrow{B} = \hat{i} - \hat{k}$ and their Resultant ?

A. $\sqrt{13.5}$ units

B. 13.5 units

C. $\sqrt{38.7}$ units

D. 38.7 units

Answer: A

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7. If $\vec{A} = 4\hat{i} + 6\hat{j}$ and $\vec{B} = 2\hat{i} + 3\hat{j}$. Then

A. $\vec{A} . \vec{B} = 29$

B. $\vec{A} \times \vec{B} = \vec{0}$

C. $\frac{\left|\vec{B}\right|}{\left|\vec{A}\right|} = \frac{2}{1}$

D. angle between $\vec{A}$ and $\vec{B}$ is 30°

Answer: B

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8. Following three forces keep a body in equilibrium.

$\overrightarrow{F}_1 = \hat{i} + 3\hat{j} + 2\hat{k}, \overrightarrow{F}_2 = 3\hat{i} - 4\hat{k}$ and $\overrightarrow{F}_3 = a\hat{i} - 3\hat{j} + 2\hat{k}$, then the value of a is

A. 1

B. -1

C. 2

D. -4

Answer: D

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9. Forces of 4 N and 5 N are applied at origin along X-axis and Y-axis respectively. The resultant force will be

A. $\sqrt{41}N, \tan^{-1}\left(\frac{5}{4}\right)$

B. $\sqrt{41}N, \tan^{-1}\left(\frac{4}{5}\right)$

C. $-\sqrt{41}N, \tan^{-1}\left(\frac{5}{4}\right)$

D. $-\sqrt{41}N, \tan^{-1}\left(\frac{4}{5}\right)$

Answer: A

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10. The vector $\vec{a} = \alpha\hat{i} + 2\hat{j} + \beta\hat{k}$ lies in the plane of vectors $\vec{b} = \hat{i} + \hat{j}$ and $\vec{c} = \hat{j} + \hat{k}$ and bisects the angle between $\vec{b}$ and $\vec{c}$. Then which one of the following gives possible values o α and β? (A)alpha=2, beta=1(B) alpha=1, beta=1(C)alpha=2, beta=1(D)alpha=1, beta=2`

A. $\alpha = 2, \beta = 2$

B. $\alpha = 1, \beta = 2$

C. $\alpha = 2, \beta = 1$

D. $\alpha = 1, \beta = 1$

Answer: D

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11. The linear velocity of a rotating body is given by $\vec{v} = \vec{\omega} \times \vec{r}$, where $\vec{\omega}$ is the angular velocity and $\vec{r}$ is the radius vector.

The angular velocity of a body is $\vec{\omega} = \hat{i} - 2\hat{j} + 2\hat{k}$ and the radius vector $\vec{r} = 4\hat{j} - 3\hat{k}$, then $\left|\vec{v}\right|$ is-

A. $\sqrt{29}$ units

B. $\sqrt{31}$ units

C. $\sqrt{37}$ units

D. $\sqrt{41}$ units

Answer: A

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12. The angles which the vector $A = 3\hat{i} + 6\hat{j} + 2\hat{k}$ makes with the co-ordinate axes are

A. $\cos^{-1}\frac{3}{7}, \cos^{-1}\frac{4}{7}, \cos^{-1}\frac{1}{7}$

B. $\cos^{-1}\frac{3}{7}, \cos^{-1}\frac{6}{7}, \cos^{-1}\frac{2}{7}$

C. $\cos^{-1}\frac{4}{7}, \cos^{-1}\frac{5}{7}, \cos^{-1}\frac{3}{7}$

D. None of these

Answer: B

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13. The resultant of $\vec{p}$ and $\vec{q}$ makes angle $\alpha$with $\vec{p}$ and β with $\vec{q}$. Then

A. θ_1 cannot be less than θ_2

B. If $\theta_1 < \theta_2$ then $\left|\vec{P}\right| < \left|\vec{Q}\right|$

C. If $\theta_1 < \theta_2$ then $\left|\vec{P}\right| > \left|\vec{Q}\right|$

D. If $\theta_1 = \theta_2$ then $\left|\vec{P}\right| = \left|\vec{Q}\right|$

Answer: C

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14. A vector of magnitude b is rotated through angle θ. What is the change in magnitude of the vector?

A. $2b\sin\frac{\theta}{2}$

B. $2b\cos\frac{\theta}{2}$

C. $2b\sin\theta$

D. $2b\cos\theta$

Answer: A

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15. Given $\vec{P} \cdot \vec{Q} = \left|\vec{P} \times \vec{Q}\right|$ and $\vec{R} = \vec{P} + \vec{Q}$ then $\left|\vec{R}\right|$ is

A. $\sqrt{P^2 + Q^2}$

B. P+Q

C. $\sqrt{P^2 + Q^2 + \frac{PQ}{\sqrt{2}}}$

D. $\left[P^2 + Q^2 + \sqrt{2}PQ\right]^{\frac{1}{2}}$

Answer: D

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16. P ,Q and R are three coplanar forces acting at a point and are in equilibrium. Given P=1.9318 kg wt, $\sin\theta_1$ = 0.9659, the value of R is (in kg wt)

A. 0.9659

B. 2

C. 1

D. $\frac{1}{2}$

Answer: C

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17. Three vectors $\vec{A}, \vec{B}$ and $\vec{C}$ satisfy the relation $\vec{A} . \vec{B} = 0$ and $\vec{A} . \vec{C} = 0$. The vector $\vec{A}$ is parallel to

A. $\vec{B}$ and $\vec{C}$

B. $\vec{A} \times \vec{B}$

C. $\vec{B} + \vec{C}$

D. $\vec{B} \times \vec{C}$

Answer: D

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18. If rain falls vertically with a velocity V_r and wind blows with a velocity V_w from east to west, then a person standing on the roadside should hold the umbrella in the direction

A. $\tan\theta = \frac{V_w}{V_r}$

B. $\tan\theta = \frac{V_r}{V_w}$

C. $\tan\theta = \frac{V_{rw}}{\sqrt{V_r^2 + V_w^2}}$

D. $\tan\theta = \frac{V_r}{\sqrt{V_r^2 + V_w^2}}$

Answer: A

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19. A river flows with a speed more than the maximum speed with which a person can swim in still water. He intends to cross the river by the shortest possible path (i.e., he wants to reach the point on the opposite bank which directly opposite to the starting point). Which of the following is correct ?

A. He should start normal to the river bank

B. He should start in such a way that, he moves normal to the bank, relative to the bank.

C. He should start in a particular (calculated) direction making an obtuse angle with the direction of water current

D. The man cannot cross the river, in that way

Answer: D

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20. A ship A is moving westwards with a speed of $10kmh^{-1}$ and a ship B 100 km south of A, is moving northwards with a speed of $10kmh^{-1}$ The time after which the distance between them becomes shortest, is

A. 5 h

B. $5\sqrt{2}$ h

C. $10\sqrt{2}$ h

D. 0 h

Answer: A

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21. A boat is moving with a velocity 2i + 3j with respect to ground. The water in the river is moving with a velocity -2i - 3j with respect to ground. The relative velocity of the boat with respect to water is

A. 4j

B. $-4j+6j$

C. 4j+6j

D. 6j

Answer: C

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22. A boat which has a speed of 6km/h in still water crosses a river of width 1 km along the shortest possible path in 20 min. the velocity of the river water in km/h is

A. 5

B. 4

C. 3

D. 1

Answer: A

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23. A boat B is moving upstream with velocity 3 m/s with respect to ground. An observer standing on boat observes that a swimmer S is

crossing the river perpendicular to the direction of motion of boat. If river flow velocity is 4 m/s and swimmer crosses the river of width 100 min 50 sec, then

A. velocity of swimmer w.r.t ground is $\sqrt{13}$ m/s

B. drift of swimmer along river is zero

C. drift of swimmer along river will be 50 m

D. velocity of swimmer w.r.t ground is 2 m/s

Answer: A

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24. Two boys are standing at the ends A and B of a ground, where $AB = a$. The boy at B starts running in a direction perpendicular to AB with velocity v_1. The boy at A starts running simultaneously with velocity v and catches the other boy in a time t, where t is :

A. $\frac{a^2}{\sqrt{v^2 + v_1^2}}$

B. $\frac{a^2}{v^2 - v_1^2}$

C. $\frac{a^2}{v^2 + v_1^2}$

D. $\sqrt{\frac{a^2}{v^2 - v_1^2}}$

Answer: D

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25. A bus is moving on a straight road towards north with a uniform speed of 50 $km/hour$ turns through 90°. If the speed remains

unchanged after turning, the increase in the velocity of bus in the turning process is

A. 70.7 km/hour along south-west direction

B. zero

C. 50 km/hour along west

D. 70.7 km/hour along north-west direction.

Answer: A

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26. Two cars are moving in the same direction with the same speed $30km/hr$. They are separated by a distance of $5km$, the speed of a car moving in the opposite direction of it meets these two cars at an interval of 4 minutes, will be.

A. 40 km/hr

B. 45 km/hr

C. 30 km/hr

D. 15 km/hr

Answer: B

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27. A particle moves in a plane with constant acceleration in a direction different from the initial velocity. The path of the particle will be

A. straight line

B. arc of a circle

C. parabola

D. ellipse

Answer: C

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28. A particle reaches its highest point when it has covered exactly one half of its horizontal range. The corresponding point on the displacement -time graph is charecterized by :

A. negative slope and zero curvature

B. zero slope and negative curvature

C. zero slope and positive curvature

D. positive slope and zero curvature

Answer: C

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29. The range of a projectile, when launched at an angle of 15° with the horizontal is 1.5 km. what is the range of the projectile, when launched at an angle of 45° to the horizontal with the same speed ?

A. 1.5 km

B. 3.0km

C. 6.3 km

D. 0.75 km

Answer: B

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30. a body is thrown horizontally with a velocity $\sqrt{2gh}$ from the top of a tower of height h. It strikes the level gound through

the foot of the tower at a distance x from the tower. The value of x is :-

A. gh

B. $\frac{gh}{2}$

C. $2h$

D. $\frac{2gh}{3}$

Answer: C

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31. A projectile is thrown at an angle of 40° with the horizontal and its range is R_1. Another projectile is thrown at an angle of 40° with the vertical and its range is R_2. What is the relation between R_1 and R_2 ? (projection speed is same in both cases)

A. $R_1 = R_2$

B. $R_1 = 2R_2$

C. $2R_1 = R_2$

D. $RR_1 = 4R_2/5$

Answer: A

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32. The equation of a projectile is

$$y = \sqrt{3}x - \frac{gx^2}{2}$$

the angle of projection is:-

A. $\tan\theta = \frac{1}{\sqrt{3}}$

B. $\tan\theta = \sqrt{3}$

C. $\frac{\pi}{2}$

D. zero

Answer: B

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33. A gun fires two bulets at 60° and 30° with the horizontal The bullets strike at some horizontal distance. The ratio of maximum height for the two bullet is

A. $2:1$

B. $3:1$

C. $4:1$

D. $1:1$

Answer: B

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34. A projectile thrown with a speed v at an angle θ has a range R on the surface of earth. For same v and θ, its range on the surface of moon will be

A. R/6

B. R

C. 6R

D. 36R

Answer: C

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35. An object is projected with a velocity of $20\frac{m}{s}$ making an angle of 45° with horizontal. The equation for the trajectory is

$h = Ax - Bx^2$ where h is height, x is horizontal distance, A and B are constants. The ratio A:B is $(g = ms^{-2})$

A. $1:5$

B. $5:1$

C. $1:40$

D. $40:1$

Answer: D

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36. A particle is projected with a velocity v such that its range on the horizontal plane is twice the greatest height attained by it. The range of the projectile is (where g is acceleration due to gravity)

A. $\frac{4v^2}{5g}$

B. $\frac{4g}{5v^2}$

C. $\frac{v^2}{g}$

D. $\frac{4v^2}{\sqrt{5}g}$

Answer: A

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37. A ball is thrown from the ground with a velocity of $20\sqrt{3}$ m/s making an angle of 60° with the horizontal. The ball will be at a height of 40 m from the ground after a time t equal to $\left(g = 10ms^{-2}\right)$

A. $\sqrt{2}$ sec

B. $\sqrt{3}$ sec

C. 2 sec

D. 3 sec

Answer: C

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38. A bomb is dropped on an enemy post by an aeroplane flying. With a horizontal velocity of 60km/hr and at a height of 490 m. how far the aeroplane must be from the enemy post at the time of dropping the bomb, so that it may directly hit the target? $\left(g = 9.8m / s^2\right)$

A. $\frac{400}{3}$m

B. $\frac{500}{3}$ m

C. $\frac{1700}{3}$ m

D. 498 m

Answer: B

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39. A body is projected horizontally from a point above the ground and motion of the body is described by the equation x=2t, $y = 5t^2$ where x, and y are horizontal and

vertical coordinates in metre after time t. The initial velocity of the body will be

A. $\sqrt{29}$ m/s horizontal

B. 5m/s horizontal

C. 2m/s vertical

D. 2 m/s horizontal

Answer: D

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40. A projectile thrown with velocity v making angle θ with vertical gains maximum height H in the time for which the projectile remains in air, the time period is

A. $\sqrt{H\cos\theta/g}$

B. $\sqrt{2H\cos\theta/g}$

C. $\sqrt{4H/g}$

D. $\sqrt{8H/g}$

Answer: D

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41. A boy aims a gun at a bird from a point, at a horizontal distance of $100m$. If the gun can impart a velocity of $500m/\sec$ to the bullet, at what height above the bird must he aim his gun in order to hit it?

A. 10.4 cm

B. 20.35 cm

C. 50 cm

D. 100 cm

Answer: B

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42. A man standing on the roof of a house of height h throws one particle vertically downwards and another particle horizontally with the same velocity u . The ratio of their velocities when they reach the earth's surface will be

A. $\sqrt{2gh + u^2} : u$

B. $1:2$

C. $1:1$

D. $\sqrt{2gh+u^2}:\sqrt{2gh}$

Answer: C

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43. Initial velocity with which a body is projected is 10 m/sec and angle of projection is 60°, find the range R

A. $\frac{15\sqrt{3}m}{2}$

B. $\frac{40}{3}$ m

C. $5\sqrt{3}$ m

D. $\frac{20}{3}$ m

Answer: D

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44. A projectile can have same range R for two angles of projection. It t_1 and t_2 are the times

of flight in the two cases, then what is the product of two times of flight ?

A. $t_1 t_2 \propto R^2$

B. $t_1 t_2 \propto R$

C. $t_1 t_2 \propto \frac{1}{R}$

D. $t_1 t_2 \propto \frac{1}{R^2}$

Answer: B

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45. A ball rolls off top of a staircase with a horizontal velocity ums^{-1}. If the steps are h metre high and b mere wide, the ball will just hit the edge of nth step. Find the value of n.

A. $n = \frac{2hu}{gb^2}$

B. $n = \frac{2hu^2}{gb}$

C. $n = \frac{2hu^2}{gb^2}$

D. $n = \frac{hu^2}{gb^2}$

Answer: C

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46. A water fountain on the ground sprinkles water all around it. If the speed of water coming out of the fountains is v, the total area around the fountain that gets wet is:

A. $\pi \frac{v^4}{g^2}$

B. $\frac{\pi}{2} \frac{v^4}{g^2}$

C. $\pi \frac{v^2}{g^2}$

D. $\pi \frac{v^2}{g}$

Answer: A

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47. A ball projected from ground at an angle of 45° just clears a wall infront. If point of projection is $4m$ from the foot of wall and ball strikes the ground at a distance of $6m$ on the other side of the wall, the height of the wall is

A. 4.4 m

B. 2.4 m

C. 3.6 m

D. 1.6 m

Answer: B

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48. A boy can throw a stone up to a maximum height of 10 m. The maximum horizontal distance that the boy can throw the same stone up to will be:

A. $20\sqrt{2}$ m

B. 10m

C. $10\sqrt{2}$ m

D. 20m

Answer: D

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49. A ball thrown down the incline strikes at a point on the incline 25m below the horizontal as shown in the figure. If the ball rises to a

maximum height of 20 m above the point of projection, the angle of projection α (with horizontal x-axis) is

A. $\tan^{-1}\frac{4}{3}$

B. $\tan^{-1}\frac{3}{4}$

C. $\tan^{-1}\frac{3}{2}$

D. $\tan^{-1}\frac{2}{3}$

Answer: A

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50. An artillary piece which consistently shoots its shells with the same muzzle speed has a maximum range R. To hit a target which is $R/2$ from the gun and on the same level, the elevation angle of the gun should be

A. 15°

B. 45°

C. 30°

D. 60°

Answer: A

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51. In uniform circular motion

A. both velocity and acceleration are constant

B. acceleration and speed are constant but velocity changes

C. both acceleration and velocity change

D. both acceleration and speed are constant

Answer: C

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52. A particle moves in a circle of radius 4 cm clockwise at constant speed 2 cm/s. If $\hat{x}$ and $\hat{y}$ are unit acceleration vectors along X and Y-axis respectively (in cm/s^2), the acceleration of the particle at the instant half way between

P and Q is given by

A. $-4(\hat{x}+\hat{y})$

B. $4(\hat{x}+\hat{y})$

C. $-(\hat{x}+\hat{y})/\sqrt{2}$

D. $(\hat{x}-\hat{y})/4$

Answer: C

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53. An aircraft executes a horizontal loop of radius 1 km with a steady speed of $900kmh^{-1}$. Compare its centripetal acceleration with the acceleration due to gravity.

A. 6.38

B. 9.98

C. 11.33

D. 12.13

Answer: A

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54. A particle moving along the circular path with a speed v and its speed increases by g in one second. If the radius of the circular path be r, then the net acceleration of the particle is:

A. $\frac{v^2}{r} + g$

B. $\frac{v^2}{r^2} + g^2$

C. $\left[\frac{v^4}{r^2} + g^2\right]^{1/2}$

D. $\left[\frac{v^2}{r} + g\right]^{1/2}$

Answer: C

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55. A particle P is moving in a circle of radius r with a uniform speed u. C is the centre of the circle and AB is diameter. The angular velocity of P about A and V are in the ratio :

A. $1:1$

B. $1:2$

C. $2:1$

D. $4:1$

Answer: B

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56. A particle moves in a circle of radius 25 cm at two revolutions per sec. The acceleration of the particle in m/s^2 is:

A. π^2

B. $8\pi^2$

C. $4\pi^2$

D. $2\pi^2$

Answer: C

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57. A wheel rotates with a constasnt acceleration of $2.0ra\frac{d}{s^2}$. If the wheel starts from rest, how many evolutions wil it make in the first 10 senconds?

A. 32

B. 24

C. 16

D. 8

Answer: C

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58. A car is moving in a circular path of radius $500m$ with a speed of $30m/s$. If the speed is

increased at the rate of $2m/s^2$, the resultant acceleration will be .

A. $4.7m/s^2$

B. $3.8m/s^2$

C. $3m/s^2$

D. $2.7m/s^2$

Answer: D

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59. A car runs at a constant speed on a circular track of radius 100m, taking 62.8s for every circular loop. The average velocity and average speed for each circular loop respectively is:

A. 0,10 m/s

B. 10 m/s , 10 m/s

C. 10 m/s , 0

D. 0 ,0

Answer: A

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60. A particle describes uniform circular motion in a circle of radius 2 m, with the angular speed of 2 rad s^{-1}. The magnitude of the change in its velocity in $\frac{\pi}{2}$ s is

A. $0ms^{-1}$

B. $2\sqrt{2}ms^{-1}$

C. $8ms^{-1}$

D. $4ms^{-1}$

Answer: C

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Exercise 2 Concept Applicator

1. The value of a for which the points A,B,C with position vectors $2\hat{i}-\hat{j}+\hat{k}, \hat{i}-3\hat{j}-5\hat{k}$ and $a\hat{i}-3\hat{j}+\hat{k}$ respectively are the vertices are the vetices of a righat angled triangle with $C=\frac{\pi}{2}$ are (A)

-2 and -1 (B) -2 and 1 (C) 2 and -1

(D) `2 and 1

A. 2 and 1

B. -2 and -1

C. -2 and 1

D. 2 and -1

Answer: A

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2. Two particles start simultaneously from the same point and move along two straight lines. One with uniform velocity v and other with a uniform acceleration a. if α is the angle between the lines of motion of two particles then the least value of relative velocity will be at time given by

A. $\frac{v}{a}\sin\alpha$

B. $\frac{v}{a}\cos\alpha$

C. $\frac{v}{a}\tan\alpha$

D. $\frac{v}{a}\cot\alpha$

Answer: B

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3. A projectile A is thrown at an angle of 30° to the horizontal from point P. At the same time, another projectile B is thrown with velocity v_2 upwards from the point Q vertically below the highest point. For B to collide with

A, $\frac{v_2}{v_1}$ should be

A. 1

B. 2

C. $\frac{1}{2}$

D. 4

Answer: C

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4. Let $\vec{u}, \vec{v}$ and $\vec{w}$ be such that $\left|\vec{u}\right| = 1, \left|\vec{v}\right| = 2$ and $\left|\vec{w}\right| = 3$ if the projection of $\vec{v}$ along $h\vec{u}$ is equal to that of $\vec{w}$ along $\vec{u}$ and vectors $\vec{v}$ and $\vec{w}$ are perpendicular to each other then $\left|\vec{u} - \vec{v} + \vec{w}\right|$ equals

A. 14

B. $\sqrt{7}$

C. $\sqrt{14}$

D. 2

Answer: C

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5. A man starts running along a straight road with uniform velocity observes that the rain is falling vertically downward. If he doubles his speed, he finds that the rain is coming at an angle θ to the vertical. The velocity of rain with respect to the ground is :

A. ui-uj

B. $u\hat{i} - \frac{u}{\tan\theta}\hat{j}$

C. $2u\hat{i} + u\cot\theta\hat{j}$

D. $ui + u\sin\theta\hat{j}$

Answer: B

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6. From a point on the ground at a distance of 2m from the fot of a verticle wal, a ball is thrown at an angle of 45° which just clears the top of the wall and then strikes the

ground at distance of 4m from the foot of the wall on the other side. The height of the wall is

A. $\frac{2}{3}$m

B. $\frac{3}{4}$m

C. $\frac{1}{3}$m

D. $\frac{4}{3}$m

Answer: D

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7. A particle is projected over a traingle from one end of a horizontal base and grazing the vertex falls on the other end of the base. If α and β be the base angles and θ the angle of projection, prove that $\tan\theta = \tan\alpha + \tan\beta$.

A. $\sin\theta = \cos\alpha + \tan\beta$

B. $\tan\theta = \tan\alpha + \tan\beta$

C. $\cos\theta = \cos\alpha + \cos\beta$

D. $\sin\alpha + \sin\theta + \sin\beta$

Answer: B

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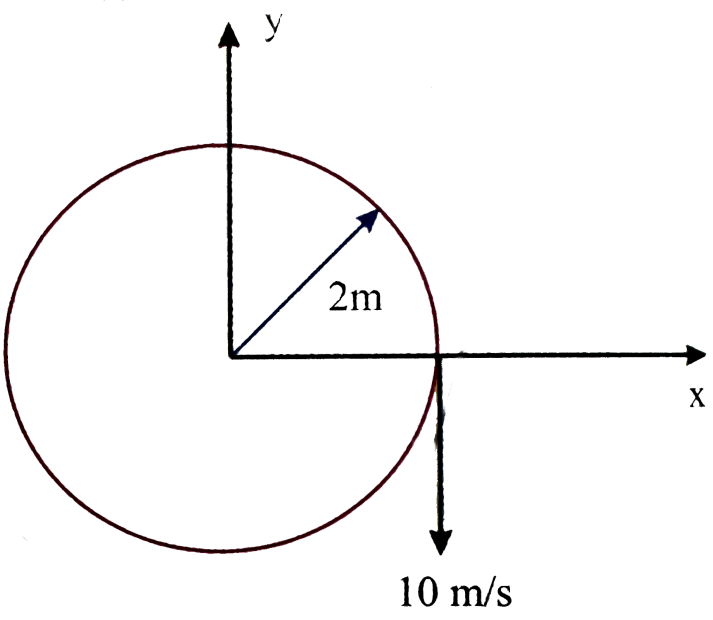
8. A particle is moving along a circular path in xy-plane.When its crosses x-axis,it has an acceleration along the path of $1.5m/s^2$, and is moving with a speed of $10m/s$ in $-ve$ y-

direction.The total acceleration is



A. $50\hat{i} - 1.5\hat{j}m/s^2$

B. $-50\hat{i} - 1.5\hat{j}m/s^2$

C. $10\hat{i} - 1.5\hat{j}m/s^2$

D. $1.5\hat{i} - 50\hat{j}m/s^2$

Answer: D

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9. An aircraft moving with a speed of 250 m/s is at a height of 6000 m, just overhead of an anti aircraft gun. If the muzzle velocity is 500 m/s, the firing angle θ should be:

A. 30°

B. 45°

C. 60°

D. None of these

Answer: C

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10. A cricket ball thrown across a field is at heights h_1 and h_2 from the point of projection at time t_1 and t_2 respectively after the throw. The ball is caught by a fielder at the same

height as that of projection. The time of flight of the ball in this journey is

A. $\frac{h_1 t_2^2 - h_2 t_1^2}{h_1 t_2 - h_2 t_1}$

B. $\frac{h_1 t_2^2 + h_2 t_1^2}{h_1 t_2 + h_2 t_1}$

C. $\frac{h_1 t_2}{h_2 t_1 - h_1 t_2}$

D. None

Answer: A

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11. If the equation for the displacement of a particle moving in a circular path is given by $(\theta) = 2t^3 + 0.5$, where θ is in radians and t in seconds, then the angular velocity of particle after $2s$ from its start is

A. 8 rad/s

B. 12 rad/s

C. 24 rad/s

D. 36 rad/s

Answer: C

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12. Let $\vec{a}$, $\vec{b}$ and $\vec{c}$ be the non zero vectors such that $\left(\vec{a} \times \vec{b}\right) \times \vec{c} = \frac{1}{3}\left|\vec{b}\right|\left|\vec{c}\right|\vec{a}$. if theta is the acute angle between the vectors $\vec{b}$ and $\vec{a}$ then theta equals (A) $\frac{1}{3}$ (B) $\frac{\sqrt{2}}{3}$ (C) $\frac{2}{3}$ (D) $2\frac{\sqrt{2}}{3}$

A. $\frac{2\sqrt{2}}{3}$

B. $\frac{\sqrt{2}}{3}$

C. $\frac{2}{3}$

D. $\frac{1}{3}$

Answer: A

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13. Two balls are projected simultaneously in the same vertical plane from the same point with velocities v_1 and v_2 with angle θ_1 and θ_2 respectively with the horizontal. If $v_1 \cos \theta_1 = v_2 \cos \theta_2$, the path of one ball as seen from the position of other ball is :

A. parabola

B. horizontal straight line

C. vertical straight line

D. straight line making 45° with the vertical

Answer: C

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14. Consider a collection of a large number of particles each with speed v in a plane.The direction of velocity is randomly distributed in the collection.The magnitude of the average relative velocity of a particle with velocities of all other particles is

A. $4v/\pi$

B. $3v/2\pi$

C. $5v/3\pi$

D. $2v/3\pi$

Answer: A

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15. A cannon on a level plane is aimed at an angle θ above the horizontal and a shell is fired with a muzzle velocity v_0 towards a vertical cliff a distance D away. Then the height from the bottom at which the shell strikes the side walls of the cliff is

A. $D\sin\theta - \frac{gD^2}{2v_0^2\sin^2\theta}$

B. $D\cos\theta - \dfrac{gD^2}{2v_0^2\cos^2\theta}$

C. $D\tan\theta - \dfrac{gD^2}{2v_0^2\cos^2\theta}$

D. $D\tan\theta - \dfrac{gD^2}{2v_0^2\sin^2\theta}$

Answer: C

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16. A wheel is subjected to uniform angular acceleration about its axis. Initially, its angular velocity is zero. In the first $2\,\text{sec}$, it rotates through an angle θ_1, in the next $2\,\text{sec}$, it

rotates through an angle θ_2. The ratio of θ_2 / θ_1 is

A. 1

B. 2

C. 3

D. 5

Answer: C

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17. A ball is thrown from a point with a speed 'v^(0)' at an elevation angle of θ . From the same point and at the same instant , a person starts running with a constant speed $\frac{'v_0'}{2}$ to catch the ball . Will the person be able to catch the ball ? If yes, what should be the angle of projection θ ?

A. No , 0°

B. Yes , 30°

C. Yes , 60°

D. Yes , 45°

Answer: C

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18. A boy playing on the roof of a 10 m high building throws a ball with a speed of 10 m/s at an angle 30° with the horizontal. How far from the throwing point will the ball be at the height of 10 m from the ground?

$(g = 10m/s^2)$

A. 5.20 m

B. 4.33 m

C. 2.60 m

D. 8.66 m

Answer: D

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19. If the vector $\vec{x}$ satisfying $\vec{x} \times \vec{a} + \left(\vec{x} . \vec{b}\right)\vec{c} = \vec{d}$ be given by

$\vec{x} = \lambda \vec{a} + \vec{a} \times \frac{\vec{a} \times \left(\vec{d} \times \vec{c}\right)}{\left(\vec{a} . \vec{c}\right) \vec{a}^2}$, then θ is equal to

A. $\frac{\vec{a} . \vec{c}}{a^2}$

B. $\frac{\vec{a} . \vec{c}}{b^2}$

C. $\frac{\vec{c} . \vec{d}}{c^2}$

D. $\frac{\vec{a} . \vec{x}}{a^2}$

Answer: D

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20. A projectile moves from the ground such that its horizontal displacement is $x = Kt$ and vertical displacement is $y = Kt(1 - \alpha t)$, where K and α are constants and t is time. Find out total time of flight (T) and maximum height attained $(Y_{\max})$

A. $T - \alpha, Y_{\max} - \frac{K}{2\alpha}$

B. $T = \frac{1}{\alpha}, Y_{\max} = \frac{2K}{\alpha}$

C. $T = \frac{1}{\alpha}, Y_{\max} = \frac{K}{6\alpha}$

D. $T = \frac{1}{\alpha}, Y_{\max} = \frac{K}{4\alpha}$

Answer: D

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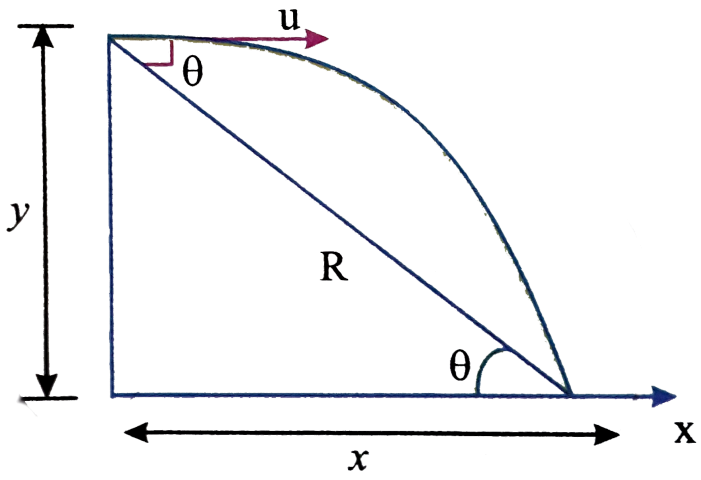
21. A particle is projected horizontally with a speed u from the top of plane inclined at an angle θ with the horizontal. How far from the point of projection will the particle strike the

plane ?



A. $2u^2 \tan\theta . \sec\theta / g$

B. $u^2 \sin\theta . \cos\theta / g$

C. $3u^2 \cos\theta . \sec\theta / g$

D. $2u^2 \sin^2\theta / g$

Answer: A

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22. A man can swim in still water with a speed of $2ms^{-1}$. If he wants to cross a river of water current speed $\sqrt{3}ms^{-1}$ along the shortest possible path, then in which direction should he swim ?

A. At an angle 120° to the water current.

B. At an angle 150° to the water current.

C. At an angle 90° to the water current.

D. None of these

Answer: B

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23. Which of the following plots correctly represents the variation of the magnitude of acceleration $|a_R|$ with time t for a particle projected at t=0 with speed v_0 at an angle θ above the horizontal?

A. 

B. 

C. 

D. 

Answer: A

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24. A point P moves in counter-clockwise direction on a circular path as shown in the figure. The movement of 'P' is such that it sweeps out a length $s = t^3 + 5$, where s is in metres and t is in seconds. The radius of the

path is 20 m. The acceleration of 'P' when t =2 s is nearly.

A. $13m/s^2$

B. $12m/s^2$

C. $7.2ms^2$

D. $14m/s^2$

Answer: D

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25. A particle of unit mass is projected with velocity u at an inclination α above the horizon in a medium whose resistance is k times the velocity. Its direction will again make an angle α with the horizon after a time

A. $\frac{1}{k}\log\left\{1-\frac{2ku}{g}\sin\alpha\right\}$

B. $\frac{1}{k}\log\left\{1+\frac{2ku}{g}\sin\alpha\right\}$

C. $\frac{1}{k}\log\left\{1+\frac{ku}{g}\sin\alpha\right\}$

D. $\frac{1}{k}\log\left\{1+\frac{2ku}{3g}\sin\alpha\right\}$

Answer: B

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26. The maximum range of a bullet fired from a toy pistol mounted on a car at rest is $R_0 = 40m$. What will be the acute angle of inclination of the pistol for maximum range when the car is moving in the direction of firing with uniform velocity $V = 20m/s$, on a horizontal surface? $\left(g = 10m/s^2\right)$

A. 30°

B. 60°

C. 75°

D. 45°

Answer: B

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27. A stone must be projected horizontally from a point P, which is h metre above the foot of a plane inclined at an angle θ with horizontal as shown in figure. What is the velocity v of the stone so that it may hit the

inclined plane perpendicularly?

A. $\sqrt{2gh/\left(2+\cot^2\theta\right)}$

B. $\sqrt{2gh\cot^2\theta}$

C. $\sqrt{2gh/\left(1+\tan^2\theta\right)}$

D. $\sqrt{2gh\tan^2\theta}$

Answer: A

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28. Two boats, A and B, move away from a buoy anchored at the middle of a river along the mutually perpendicular straight lines: the boat A along the river, and the boat B across the river. Having moved off an equal distance from the buoy the boats returned. Find the ratio of times of motion of boats τ_A / τ_B if the velocity of each boat with respect to water is $\eta = 1.2$ times greater than the stream velocity.

A. 2.3

B. 1.8

C. 0.5

D. 0.2

Answer: B

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