Physicsaholics

Exercise

Kinematics -2D

(Physicsaholics)

Physicsaholics.com

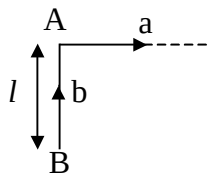
Unacademy

Exercise-3

(Miscellaneous Type)

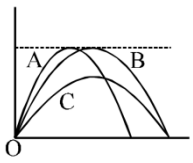
Column Matching

Q 1. In the shown figure, both cat and dog starts from rest. Cat has constant acceleration a in the shown direction. Dog also increases its speed at a constant rate 'b'. But the direction of its velocity is always towards A.
($a = 3\ m/s^2$, $b = 5\ m/s^2$, $l = 160\ m$)



Column I		**Column II**	
(A)	5	(P)	$\frac{\text{Time taken by the dog to catch the cat}}{5\,\text{sec}}$
(B)	1	(Q)	$\frac{\text{Total distance travelled by the dog}}{50\,\text{m}}$
(C)	2	(R)	$\frac{\text{Maximum velocity of approach}}{4\,\text{m/s}}$
(D)	4	(S)	$\frac{\text{Total distance travelled by the cat}}{150\ \text{m}}$
		(T)	$\frac{\text{Maximum velocity of dog}}{12.5\,\text{m/s}}$

Q 2. Trajectories are shown in figure for three kicked footballs. Initial vertical & horizontal velocity components are uy and ux respectively. Ignoring air resistance, choose the correct statement from **Column-II** for the value of variable in **Column-I**.

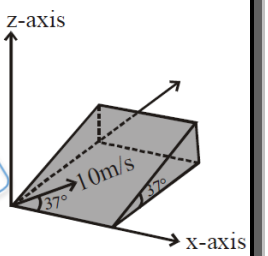


Column-I	**Column-II**
(A) time of flight	(P) greatest for A only
(B) u_y/u_x	(Q) greatest for C only
(C) u_x	(R) equal for A and B
(D) $u_x u_y$	(S) equal for B and C

Q 3. Trajectory of particle in a projectile motion is given as $y = x - \frac{x^2}{80}$ .Here, x and y are in meters.
For this projectile motion, match the following with $g = 10\ m/s^2$.

Column–I	Column–II
(A) Angle of projection (in degrees)	(P) 20
(B) Angle of velocity with horizontal after 4s (in degrees)	(Q) 80
(C) Maximum height (in metres)	(R) 45
(D) Horizontal range (in metres)	(S) 30
	(T) 60

Q 4. A small ball is projected along the surface of a smooth inclined plane with speed 10m/s along the direction shown at t = 0. The point of projection is origin, z-axis is along vertical. The acceleration due to gravity is 10 m/s^2. Column-I lists values of certain parameters related to motion of ball and column-II lists different time instants. Match appropriately.

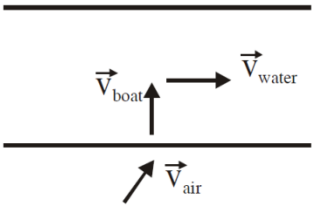


Column - I	Column - II
(A) Distance from x-axis is 2.25m	(P) 0.5 s
(B) Speed is minimum	(Q) 1.0 s
(C) Velocity makes angle 37° with x-axis	(R) 1.5 s
	(S) 2.0 s

Q 5.

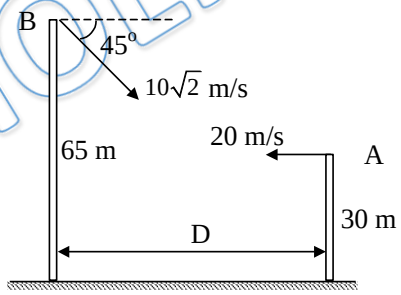
	Column I		Column II
(A)	Time for a boat to cross a river of width ℓ by the shortest distance ($\vec{v}$ -velocity of boat with respect to water; $\vec{u}$ -velocity of water)	(P)	$\frac{\ell}{\lvert\vec{v}+\vec{u}\rvert}$
(B)	Time for two particles moving with velocities $\vec{v}$ and $\vec{u}$ in opposite directions to meet each other. (Initial separation of particles is ℓ)	(Q)	$\frac{\ell}{\sqrt{v^2-u^2}}$
(C)	Time for a boat to cross a river of width ℓ in the shortest ($\vec{v}$ -velocity of boat with respect to water; $\vec{u}$ -velocity of water)	(R)	$\frac{\ell}{\lvert\vec{v}\rvert+\lvert\vec{u}\rvert}$
(D)	Time for a boat to travel a distance l downstream ($\vec{v}$ -velocity of boat with respect to water; $\vec{u}$ -velocity of water)	(S)	$\frac{\ell}{\lvert\vec{v}\rvert}$
		(T)	$\frac{\ell}{\sqrt{u^2+v^2}}$

Q 6. A boat is being rowed in a river. Air is also blowing. Direction of velocity vectors of boat, water and air in ground frame are as shown in diagram.



Column I	Column II
(A) Direction in which boat is being steered	(P) 
(B) Direction in which a flag on the boat may flutter	(Q)
(C) Direction of velocity of water relative to boat	(R)
(D) Direction of velocity of air relative to a piece of wood floating on river.	(S) 

Q 7. Two cannon A and B situated at two cliffs fire as shown. Cannon A fires 1 sec after cannon B and they collide in the mid air.



Column I	Column II
(A) 1	(P) $\frac{D}{10\,m}$
(B) 2	(Q) $\frac{\text{Vertical distance travelled by B till the collision happens}}{10m}$
(C) 4	(R) $\frac{\text{Time of flight of B before collision}}{2sec}$
(D) 5	(S) $\frac{\text{Vertical distance travelled by A till the collision happens}}{1m}$
	(T) $\frac{\text{Horizontal distance travelled by A till the collision happens}}{1m}$

Paragraph based questions

Passage # 1 (Q.8 to Q.10)

The current velocity of a river grows in proportion to the distance from its bank and reaches the maximum value V_0 in the middle. Near the banks the velocity is zero. A boat is moving along the river in such a manner that it is always perpendicular to the current with respect to river and the speed of the boat in still water is U. Width of the river is C.

Q 8. Time taken by the boat to cross the river:

(A) C/U

(B) C/V_0

(C) $C/\sqrt{V_0^2+U^2}$

(D) $C/\sqrt{V_0^2-U^2}$

Q 9. Drift along the river in crossing the river:

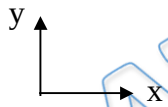
(A) $2CV_0/U$

(B) $CV_0/2U$

(C) zero

(D) none

Q 10. Equation of trajectory of the boat is



(A) $y^2=\frac{UC}{V_0}x$

(B) $x\frac{\sqrt{V_0^2+U^2}}{\sqrt{V_0^2-U^2}}C$

(C) hyperbola

(D) none

Passage # 2 (Q.11 to Q.13)

Two projectiles are thrown simultaneously in the same vertical plane from the same point. If their velocities of projection are v_1 and v_2 at angles θ_1 and θ_2 respectively from the horizontal, then answer the following questions

Q 11. The trajectory of particle 1 with respect to particle 2 will be

(A) a parabola

(B) a straight line

(C) a vertical straight line

(D) a horizontal straight line

Q 12. If $v_1\cos\theta_1 = v_2\cos\theta_2$, then choose the incorrect statement

(A) One particle will remain exactly below or above the other particle

(B) The trajectory of one with respect to other during the flight will be a vertical straight line

(C) Both will have the same range

(D) Both will attain same maximum height

Q 13. If $v_1\sin\theta_1 = v_2\sin\theta_2$, then choose the correct statement

(A) The time of flight of both the particles will be same

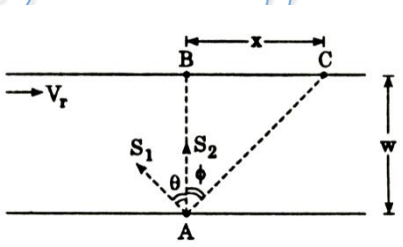
(B) The maximum height attained by the particles will be same

(C) The trajectory of one with respect to another during the flight will be a horizontal straight line

(D) None of these

Passage # 3 (Q.14 to Q.16)

On the bank of a river two swimmers made a challenge as "who will reach the point B on the other bank early?" So both of them start from point 'A' on one bank of the river to reach the winning point B on the other bank, lying directly opposite to point A. The stream velocity was known to be 2 km/hr and the velocity of both the swimmers in still water was 2.5 km/hr. Both of them follow different paths to reach point B. The swimmer S_2 crosses the river along straight line AB, while the other swimmer S_2 swims at rights to the stream and then walks the distance which he has been carried away by the stream to go to the point B. Assume the velocity (uniform) of his walking as (2/3) km/hr and the width of the river as W.



Q 14. The value of angle θ shown in the figure is

(A) $\cos^{-1}(4/5)$ (B) $\cos^{-1}(3/4)$

(C) $\sin^{-1}(4/5)$ (D) $\sin^{-1}(3/4)$

Q 15. The value of angle ϕ shown in the figure is

(A) $\sin^{-1}(4/5)$ (B) $\cos^{-1}(4/5)$

(C) $\tan^{-1}(4/5)$ (D) data insufficient

Q 16. Match column I with column II in reference to the passage

	Column I		Column II
I	Time for S_1 to reach B	(A)	$\left(\frac{4W}{5}\right)$
II	Time for S_2 to reach C	(B)	$\left(\frac{6W}{5}\right)$
III	Drift 'x' for S_2	(C)	$\left(\frac{2W}{3}\right)$
IV	Time for S_2 to reach B from C	(D)	$\left(\frac{14W}{15}\right)$
V	Difference in time, Δt, for S_1 and S_2 to reach B	(E)	$\left(\frac{2W}{5}\right)$

(A) I-C, II-E, III-A, IV-B, V-D (B) I-A, II-B, III-D, IV-C, V-E

(C) I-E, II-C, III-B, IV-D, V-A (D) I-B, II-A, III-D, IV-C, V-E

Passage # 4 (Q.17 to Q.19)

A particle leaves the origin with initial velocity $\vec{v}_0 = 11\hat{i} + 14\hat{j}$ m/s . It undergoes a constant acceleration given by $\vec{a} = -\frac{22}{5}\hat{i} + \frac{2}{15}\hat{j}$ m/s².

Q 17. When does the particle cross the y axis ?

(A) 2 sec (B) 4 sec (C) 5 sec (D) 7 sec

Q 18. At the instant when particle crosses y-axis, direction in which particle is moving is :-

(A) At angle 37° from +x-axis towards +y-axis

(B) At angle 37° from –x-axis towards +y-axis

(C) At angle 53° from +x-axis towards +y-axis

(D) At angle 53° from –x-axis towards +y-axis

Q19. How far is it from the origin, at that time ?

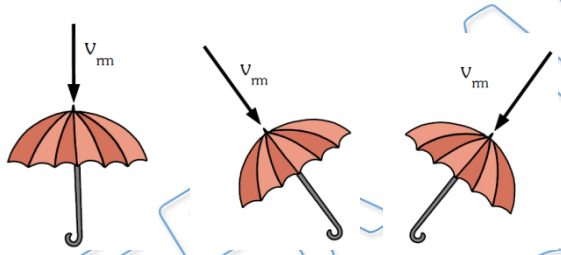
(A) 70 m (B) 71.67 m (C) 125 m (D) 15 m

Passage # 5 (Q.20 to Q.23)

By the term velocity of rain, we mean velocity with which raindrops fall relative to the ground. In absence of wind, raindrops fall vertically and in presence of wind raindrops fall obliquely. Moreover raindrops acquire a constant terminal velocity due air resistance very quickly as they fall toward the earth. A moving man relative to himself observes an altered velocity of raindrops, which is known as velocity of rain relative to the man. It is given by the following equation.

$$\vec{v}_{rm} = \vec{v}_r - \vec{v}_m$$

A standstill man relative to himself observes rain falling with velocity, which is equal to velocity of the raindrops relative to the ground. To protect himself a man should hold his umbrella against velocity of raindrops relative to himself as shown in the following figure.



Q 20. Rain is falling vertically with velocity 80 cm/s.

(a) How should you hold your umbrella?

(b) You start walking towards the east with velocity 60 cm/s. How should you hold your umbrella?

(c) You are walking towards the west with velocity 60 cm/s. How should you hold your umbrella?

(d) You are walking towards the north with velocity 60 cm/s. How should you hold your umbrella?

(e) You are walking towards the south with velocity 80 cm/s. How should you hold your umbrella?

Q 21. When you are standstill in rain, you have to hold your umbrella vertically to protect yourself.

(a) When you walk with velocity 90 cm/s, you have to hold your umbrella at 53° above the horizontal.

What is velocity of the raindrops relative to the ground and relative to you?

(b) If you walk with speed 160 cm/s, how should you hold your umbrella?

Q 22. A man walks in rain at 72 cm/s due east and observes the rain falling vertically. When he stops, rain appears to strike his back at 37° from the vertical. Find velocity of raindrops relative to the ground.

Q 23. When you walk in rain at 75 cm/s, you have to hold your umbrella vertically and when you double your speed in the same direction, you have to hold your umbrella at 53° above the horizontal. What is the rain velocity?

Passage # 6 (Q.24 to Q.26)

When you are standstill holding a flag, the flag flutters in the direction of wind. When you start running the direction of fluttering of the flag changes in to the direction of the wind relative to you. In all case a flag flutters in the direction of the wind relative to the flag.

Q 24. When you are standstill holding a flag the flag flutters in the north and when you run at 8 m/s due east, the flag flutters in direction 37° north of west. Find the wind velocity.

Q 25. Wind is blowing uniformly due north everywhere with velocity 12 m/s. A car mounted with a flag starts running towards east. After 9 s from start the flag flutters in 53° north of west and after 16 s from the start the flag flutters in 37° north of west.

(a) Find velocity of the car 9 s after it starts.

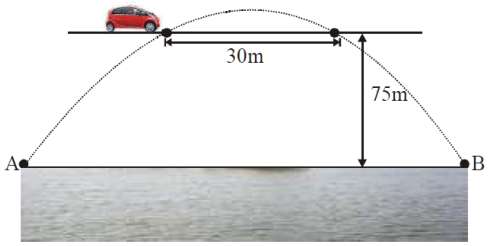
(b) Find velocity of the car 16 s after it starts.

(c) If the car maintains uniform acceleration, find acceleration of the car.

Q 26. Holding a flag, when you run at 8 m/s due east, the flag flutters in the north and when you run at 2 m/ s due south, the flag flutters in the northeast. If the wind velocity is uniform and remain constant, find the wind velocity.

Passage # 7 (Q.27 to Q.29)

In the figure shown there is a long horizontal bridge over a river 75 m high from water surface. A strong man throws a stone in the parallel plane of the bridge. A observer in a car travelling on the bridge finds the stone going pass by the car while ascending and also while descending between two points on the road 30 m away. The car is travelling at a speed of 15 m/s. The stone is thrown from the bank of river just at the same level of water.



Q 27. What is the angle the velocity makes with the bridge when it goes past the car while ascending?

(A) 30° (B) 45° (C) $\tan^{-1}\left(\frac{2}{3}\right)$ (D) $\tan^{-1}\left(\frac{3}{2}\right)$

Q 28. Horizontal distance AB travelled by stone is :-

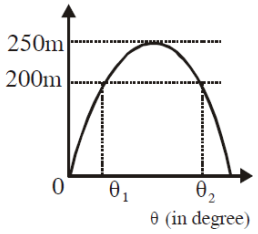
(A) 0 m (B) 75 m (C) 120 m (D) 240 m

Q 29. What is the distance between car and stone at the instant when particle reaches at point B ?

(A) 0 m (B) 75 m (C) 120 m (D) 240 m

Passage # 8 (Q.30 to Q.31)

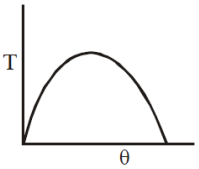
From the ground level, a ball is to be shot with a certain speed. Graph shows the range (R) of the particle versus the angle of projection from horizontal (q).

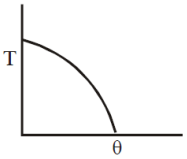


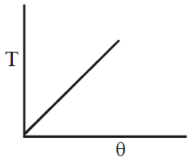
Q 30. Values of θ_1 and θ_2 are

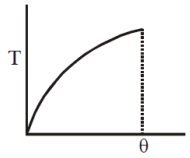
(A) 53° and 37° (B) 26.5° and 63.5° (C) 18.5° and 71.5 ° (D) 15° and 75°

Q 31. The corresponding time of flight vs θ graph is :-

(A) 

(B) 

(C) 

(D) 

Assertion/Reason Type Questions:

Each of the questions given below consist of Statement – I and Statement – II. Use the following Key to choose the appropriate answer.

(A) If both Statement- I and Statement- II are true, and Statement - II is the correct explanation of Statement– I.

(B) If both Statement - I and Statement - II are true but Statement - II is not the correct explanation of Statement – I.

(C) If Statement - I is true but Statement - II is false.

(D) If Statement - I is false but Statement - II is true.

Q 32. Statement-1: A body having uniform speed in circular path has a constant acceleration.

Statement-2: Direction of acceleration is always towards the centre.

(A) (A) (B) (B) (C) (C) (D) (D)

Q 33. Statement-1: Two bodies of masses *M* and *m* (*M* > *m*) are allowed to fall from the same height if the force of air resistance for each be the same then both the bodies will reach the earth simultaneously.

Statement-2: Acceleration due to gravity does not depend on the mass of the body.

(A) (A) (B) (B) (C) (C) (D) (D)

Q 34. Statement-1: During the motion, the magnitude of displacement may be equal to distance.

Statement-2: When the particle is moving on the straight line then displacement will be equal to distance.

(A) (A) (B) (B) (C) (C) (D) (D)

Q 35. Statement-1: Net acceleration of a particle, moving on a circle with constant tangential acceleration, remains constant.

Statement-2: $a_N = \sqrt{a_r^2 + a_T^2}$, where a_N is net acceleration, a_r is centripetal acceleration and a_T is tangential acceleration.

(A) (A) (B) (B) (C) (C) (D) (D)

Q 36. Statement-1: If $\vec{v}$ is the velocity of the particle in motion at time *t*, then $\left|\int \vec{v}\, dt\right| \le \int |\vec{v}|\, dt$

Statement-2: $\left|\int \vec{v} dt\right|$ = magnitude of displacement. $\int |\vec{v}| dt$ = distance covered.

(A) (A) (B) (B) (C) (C) (D) (D)

Q 37 **Statement-1 :** Separation between two particle is maximum when component of relative velocity of particles along line joining them is zero.

Statement-2 : At maximum separation velocity of two particles is same.

(A) (A) (B) (B) (C) (C) (D) (D)

Answer Key

Q.1) A-Q, R, B-S, C-P, D-T	**Q.2)** A-R; B-P; C-Q; D-S	**Q.3)** A-R; B-R; C-P; D-Q	**Q.4)** (A)-P,R; (B)-Q; (C)-S	**Q.5)** (A)-P,Q; (B)-R; (C)-S; (D)-P, R
Q.6) (A)-P; (B)-Q, S; (C)-S; (D)-P,R	**Q.7)** A-R; B-T; C-P,Q; D-S	**Q.8) A**	**Q.9) B**	**Q.10) A**
Q.11) B	**Q.12) C, D**	**Q.13) A, B, C**	**Q.14) C**	**Q.15) C**
Q.16) A	**Q.17) C**	**Q.18) D**	**Q.19) B**	**Q.20)** (a) Vertically (b) 53° above east (c) 53° above west (d) 53° above north (e) 45° above south
Q.21) (a) 120 cm/s vertically150 cm/s 53° above horizontal (b) 37° above the horizontal.	**Q.22)** 120 cm/s	**Q.23)** 125 cm/s at 37° from the vertical	**Q.24)** 6 m/s due north	**Q.25)** (a) 9 m/s (b) 16 m/s (c) 1 m/s^2
Q.26) 10 m/s, 37° north of east	**Q.27) C**	**Q.28) C**	**Q.29) B**	**Q.30) B**
Q.31) D	**Q.32) D**	**Q.33) D**	**Q.34) C**	**Q.35) D**
Q.36) A	**Q.37) C**			