Exercise-1

PART - I ; ONLY ONE OPTION CORRECT TYPE

SECTION (A) : RELATIVE MOTION IN ONE DIMENSION

1. A motorcycle is moving with a velocity 80 km/hr ahead of a car moving with a velocity of 65 km/hr in the same direction. What is the relative velocity of the motorcycle with respect to the car-
(1) 15 km/hr towards car (2) 15 km/hr away from
(3) 25 km/hr away from car (4) 145 km/hr towards car

2. 50 m long trains are crossing each other in opposite direction with velocity of 10 m/s and 15 m/s. respectively Then time-taken by trains to cross each other will be-
(1) 2 sec. (2) 4 sec. (3) 6 sec. (4) 8 sec.

3. Theif's car is moving with a speed of 10 m/s. A police van chasing this car with a speed of 5 m/s fires a bullet at the theif's car with muzzle velocity 72 km/h. Find the speed with which the bullet will hit the car-
(1) 10 m/s (2) 20 m/s (3) 15 m/s (4) 25 m/s

4. A person standing on the floor of an elevator drops a coin. The coin reaches the floor of the elevator in a time t_1 if the elevator is stationary and in time t_2 if it is moving with constant velocity. Then-
(1) $t_1 = t_2$ (2) $t_1 < t_2$ (3) $t_1 > t_2$ (4) $t_1 < t_2$ or $t_1 > t_2$

5. A train in moving in the north at a speed 10 m/sec. Its length is 150 m. A parrot is flying parallel to the train in the south with a speed of 5m/s. The time taken by the parrot to cross the train will be-
(1) 12 sec. (2) 8 sec. (3) 15 sec. (4) 10 sec.

6. Two cars are moving in the same direction with the same speed 30 km/hr. They are separated by a distance of 5 km, the speed of a car moving in the opposite direction if it meets these two cars at an interval of 4 minutes, will be-
(1) 40 km/hr (2) 45 km/hr (3) 30 km/hr (4) 15 km/hr

7. A stone is thrown upwards from a tower with a velocity 50 ms^{-1}. Another stone is simultaneously thrown downwards from the same location with a velocity 50 ms^{-1}. When the first stone is at the highest point, the relative velocity of the second stone w.r.t. the first stone is (assume that second stone has not yet reachead the ground) :
(1) Zero (2) 50 ms^{-1} (3) 100 ms^{-1} (4) 150 ms^{-1}

8. A thief is running away on a straight road in a jeep moving with a speed of 9 m s^{-1}. A police man chases him on a motor cycle moving at a speed of 10 m s^{-1}. If the instantaneous separation of the jeep from the motorcycle is 100m, how long will it take for the police man to catch the thief?
(1) 1s (2) 19s (3) 90s (4) 100s

9. A body is thrown up in a lift with a velocity u relative to the lift and the time of flight is found to be 't'. The acceleration with which the lift is moving up will be-
(1) $\frac{u-gt}{t}$ (2) $\frac{u+gt}{t}$ (3) $\frac{2u-gt}{t}$ (4) $\frac{2u+gt}{t}$

10. Two trains A & B 100 km apart are travelling towards each other on different tracks with starting speed of 50 km/h for both. The train A accelerates at 20 km/h_2 and the train B retards at the rate 20 km/h_2 . The distance covered by the train A when they cross each other is :
(1) 45 km (2) 55 km (3) 65 km (4) 60 km

11. A bus is moving with a velocity 10 ms^{-1} on a straight road. A scooterist wishes to overtake the bus in 100s. If, the bus is at a distance of 1 km from the scooterist, with what velocity should the scooterist chase the bus?
(1) 50 ms^{-1} (2) 40 ms^{-1} (3) 30 ms^{-1} (4) 20 ms^{-1}

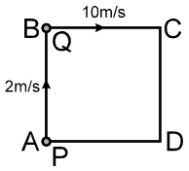
12. A 120 m long train is moving towards west with a speed of 10 m/s. A bird flying towards east with a speed of 5 m/s crosses the train. The time taken by the bird to cross the train will be -

(1) 16 sec (2) 12 sec (3) 10 sec (4) 8 sec

13. A particle is thrown up inside a stationary lift of sufficient height. The time of flight is T. Now it is thrown again with same initial speed v_0 with respect to lift. At the time of second throw, lift is moving up with speed v_0 and uniform acceleration g upward (the acceleration due to gravity). The new time of flight is–

(1) $\frac{T}{4}$ (2) $\frac{T}{2}$ (3) T (4) 2T

14. Two men P & Q are standing at corners A & B of square ABCD of side 8 m. They start moving along the track with constant speed 2 m/s and 10 m/s respectively. Find the time when they will meet for the first time.



(1) 2 sec (2) 3 sec (3) 1 sec (4) 6 sec

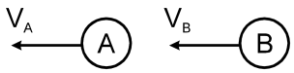
15. A coin is released inside a lift at a height of 2 m from the floor of the lift. The height of the lift is 10 m. The lift is moving with an acceleration of 9 m/s^2 downwards. The time after which the coin will strike with the lift is : (g = 10 m/s^2)

(1) 4 s (2) 2 s (3) $\frac{4}{\sqrt{21}}$s (4) $\frac{2}{\sqrt{11}}$s

16. A man in a balloon, throws a stone downwards with a speed of 5 m/s with respect to balloon. The balloon is moving upwards with a constant acceleration of 5 m/s^2. Then velocity of the stone relative to the man after 2 second is :

(1) 10 m/s (2) 30 m/s (3) 15 m/s (4) 35 m/s

17. Two particles are moving along a straight line as shown . The velocity of approach between A and B is

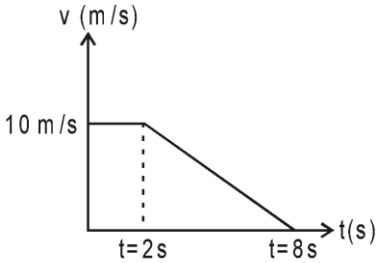


(1) $V_A + V_B$ (2) $|V_A - V_B|$ (3) $V_A - V_B$ (4) $V_B - V_A$

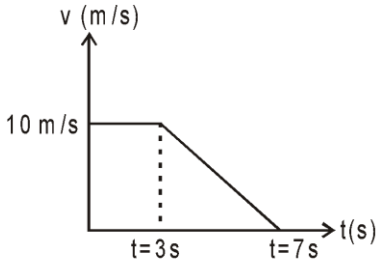
18. A jet airplane travelling from east to west at a speed of 500 km h^{-1} ejected out gases of combustion at a speed of 1500 km h^{-1} with respect to the jet plane. What is the velocity of the gases with respect to an observer on the ground ?

(1) 1000 km h^{-1} in the direction west to east (2) 1000 km h^{-1} in the direction east to west
(3) 2000 km h^{-1} in the direction west to east (4) 2000 km h^{-1} in the direction east to west

19. Car A and car B move on a straight road and their velocity versus time graphs are as shown in figure. Comparing the motion of car A in between t = 0 to t = 8 sec. and motion of car B in between t = 0 to t = 7 sec., pick up the correct statement.



Car A



Car B

(1) Distance travelled by car A is less than distance travelled by car B.
(2) Distance travelled by car A is greater than distance travelled by car B.
(3) Average speed of both cars are equal.
(4) Average speed of car A is less than average speed of car B.

SECTION : (B) RELATIVE MOTION IN TWO DIMENSIONS

1. A stone is just released from the window of a train moving along a horizontal straight track. The stone will hit the ground in-
(1) Straight line path (2) Circular path (3) Parabolic path (4) Hyperbolic path

2. The motion of one projectile as seen from another will always
(1) Straight line (2) Parabolic (3) Circular (4) Hyperbolic

3. A traveller while in a uniformly moving train throws a ball up in the air. The ball will return-
(1) In his hand (2) Ahead in the direction of motion of the train
(3) Trail behind (4) Deflected sideways

4. A boat is moving with a velocity 3i + 4j with respect to ground. The water in the river is moving with a velocity – 3i – 4j with respect to ground. The relative velocity of the boat with respect to water is -
(1) 8j (2) – 6i – 8j (3) 6i + 8j (4) $5\sqrt{2}$

5. A ball is thrown from rear end of the compartment to the front end which is moving at constant horizontal velocity. An observer A sitting in the compartment and another observer B standing on the ground draw the trajectory. They will have-
(1) Equal horizontal and equal vertical ranges.
(2) Equal vertical ranges but different horizontal ranges.
(3) Different vertical ranges but equal horizontal ranges.
(4) Different vertical and different horizontal ranges.

6. An aeroplane is flying in a horizontal direction at 600 km/hr at a height of 6 km. and is advancing towards a point which is exactly over a target. At that instant the pilot releases a ball which on descending the earth strikes the target, the falling ball appears-
(1) To the pilot in the aeroplane, as falling along a parabolic path.
(2) To a person standing near the target, as falling exactly vertical.
(3) To a person standing near the target as describing a parabolic path.
(4) To the pilot siting in the aeroplane as falling in a zigzag path.

7. A train is standing on a platform, a man inside a compartment of a train drops a stone. At the same instant train starts to move with constant acceleration. The path of the particle as seen by the person who drops the stone is :
(1) parabola
(2) straight line for sometime & parabola for the remaining time
(3) straight line
(4) variable path that cannot be defined

8. Consider two cases:
(i) A cart moves horizontally with constant velocity and a stone is projected vertically upwards.
(ii) A cart slides down a smooth incline plane and a stone is projected in direction perpendicular to incline.
Stone will fall in the cart :

(1) in both the cases
(2) only in case (i)
(3) only in case (ii)
(4) as cart is moving in both cases, stone will fall behind the cart in both cases.

9. A bird is flying towards east with a velocity 40 km/hr and a train is moving with a velocity 40 km/hr towards east. A man in train drops a food packet. The path of food packet as seen by bird till it falls on ground is (ignore air resistance)
(1) parabola (2) circle (3) hyperbola (4) straight line

10. A body A is going from South to North and body B is going from West to East with identical velocity. Then direction of relative velocity of A with respect to B is-
(1) North-West (2) South-West (3) North-East (4) South-East

11. A car A is going North-East at 80 km/hr. and another car B is going South-East at 60 km./hr. Then the direction of the velocity of A relative to B makes with the North and angle α such that tan α is-
(1) $\frac{1}{7}$ (2) $\frac{3}{4}$ (3) $\frac{4}{3}$ (4) $\frac{3}{5}$

12. A ship is travelling due east at 10 km/h. A ship heading 30° east of north is always due north from the first ship. The speed of the second ship in km/h is -
(1) $20\sqrt{2}$ (2) $20\sqrt{3/2}$ (3) 20 (4) $20/\sqrt{2}$

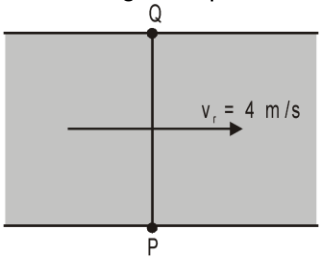
13. Two billiard balls are rolling on a flat table. One has velocity components v_x = 1m/s, $v_y = \sqrt{3}$ m/s and the other has components v_x = 2m/s and v_y = 2 m/s. If both the balls start moving from the same point, the angle between their path is -
(1) 60° (2) 45° (3) 22.5° (4) 15°

SECTION : (C) RELATIVE MOTION IN RIVER FLOW & AIR FLOW

1. The speed of a boat is 5 km/hr in still water. If it crosses a river of width 1 km along the shortest possible path in 15 min., then velocity of the river is-
(1) 4 km/hr (2) 3 km/hr (3) 2 km/hr (4) 1 km/hr

2. A boat P is moving at 40 km/hr and another boat Q is moving at 20 km/hr. Which one of the following is not a possible value for their relative velocity-
(1) 10 km/hr (2) 20 km/hr (3) 30 km/hr (4) 40 km/hr

3. A boat man could row his boat with a speed 10 m/sec. He wants to take his boat from P to a point Q just opposite on the other bank of the river flowing at a speed 4 m/sec. He should row his boat-



(1) At right angle to the stream
(2) At an angle of $\sin^{-1}\left(\frac{2}{5}\right)$ with PQ up the stream
(3) At an angle of $\sin^{-1}\left(\frac{2}{5}\right)$ with PQ down the stream
(4) At an angle of $\cos^{-1}\left(\frac{2}{5}\right)$ with PQ down the stream

4. A boat takes two hours to travel 8 km and back in still water. If the velocity of water is 4 km/h, the time taken for going upstream 8 km and coming back is -
(1) 2h (2) 2h 40 min
(3) 1h 20 min (4) Cannot be estimated with the information given

5. A boat crosses a river with a velocity of 8 km/h. If the resulting velocity of boat is 10 km/h then the velocity of river water is -
(1) 4 km/h (2) 6 km/h (3) 8 km/h (4) 10 km/h

6. A man wearing a hat of extended length 12 cm is running in rain falling vertically downwards with speed 10 m/s. The maximum speed with which man can run, so that rain drops do not fall on his face (the length of his face below the extended part of the hat is 16 cm) will be :
(1) 7.5 m/s (2) 13.33 m/s (3) 10 m/s (4) zero

7. A boat is rowing in a river at the rate of 4.8 km/hr with respect to river. The river flows at the rate of 6 km/hr. The speed of boat in m/s can be :
(1) 3.1 (2) 2.1 (3) 4.5 (4) 5

8. Two boats A and B having same speed relative to river are moving in a river. Boat A moves normal to the river current as observed by an observer moving with velocity of river current. Boat B moves normal to the river as observed by the observer on the ground.
(1) To a ground observer boat B moves faster than A
(2) To a ground observer boat A moves faster than B
(3) To the given moving observer boat B moves faster than A
(4) To the given moving observer boat A moves faster than B

9. A man who can swim at the rate of 2 km/hr (in still river) crosses a river to a point exactly opposite on the other bank by swimming in a direction of 120_0 to the flow of the water in the river. The velocity of the water current in km/hr is
(1) 1 (2) 2 (3) 1/2. (4) 3/2

SECTION : (D) RELATIVE MOTION IN RAIN AND WIND

1. During a rainstorm, raindrops are observed to be striking the ground at an angle θ with the vertical. A wind is blowing horizontaly at the speed of 5.0 m/s. The speed of raindrops is
(1) 5 sin θ (2) $\frac{5}{\sin\theta}$ (3) 5 cos θ (4) $\frac{5}{\cos\theta}$

2. A car with a vertical wind shield moves along in a rain storm at speed of 40 km/hr. The rain drops fall vertically with a terminal speed of 20 m/sec. The angle at which the rain drops strike the wind shield is-
(1) $\tan^{-1}\left(\frac{5}{9}\right)$ (2) $\tan^{-1}\left(\frac{9}{5}\right)$ (3) $\tan^{-1}\left(\frac{3}{2}\right)$ (4) $\tan^{-1}\left(\frac{2}{3}\right)$

3. A man standing on a road hold his umbrella at 30º with the vertical to keep the rain away. He throws the umbrella and starts running at 10 km/hr. He finds that raindrops are hitting his head vertically, the speed of raindrops with respect to the road will be -
(1) 10 km/hr (2) 20 km/hr (3) 30 km/hr (4) 40 km/hr

4. It is raining vertically downwards with a velocity of 3 km h^{-1} . A man walks in the rain with a velocity of 4 kmh^{-1}. The rain drops will fall on the man with a relative velocity of ;
(1) 1 kmh^{-1} (2) 3 kmh^{-1} (3) 4 kmh^{-1} (4) 5 kmh^{-1}

5. A flag on a bus is fluttering in north direction & wind is blowing in east direction. Then which of the following will be true -
(1) bus is moving in south direction.
(2) bus is moving in north east direction.
(3) bus may be moving in any direction between south & east.
(4) bus may be moving in any direction between south & west.

6. Rain seems to be falling to a person sitting in a bus moving uniformly eastwards with 10 m/s. It appears to come from vertical and hit the bus windows at a velocity 20 m/s. Find the velocity of rain drops w.r.t. ground.
(1) $5\sqrt{5}$ m/s (2) $\sqrt{5}$ m/s (3) $10\sqrt{5}$ m/s (4) $10\sqrt{10}$ m/s

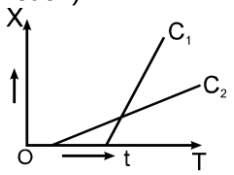
7. Rain is falling vertically with a velocity of 3 kmh^{-1}. A man walks in the rain with a velocity of 4 kmh^{-1}. The rain drops will fall on the man with a velocity of
(1) 5 kmh^{-1} (2) 4 kmh^{-1} (3) 3 kmh^{-1} (4) 1 kmh^{-1}

8. To a stationary man, rain appears to be falling at an angle 30º with the vertical. As he starts moving with a speed of 0.5 m/s he finds that the rain is falling vertically. Then the speed of rain w.r.t. the moving man is :

(1) 0.5 m/s (2) 1 m/s (3) $0.5\sqrt{3}$ m/s (4) $\sqrt{3}$ m/s

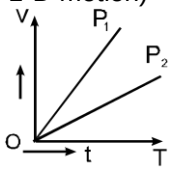
Exercise-2

1. Shown in the figure are the position time graph for two children going home from the school. Which of the following statements about their relative motion is true after both of them started moving ?
Their relative velocity : (consider 1-D motion)



(1) first increases and then decreases (2) first decreases and then increases
(3) is zero (4) is non zero constant.

2. Shown in the figure are the velocity time graphs of the two particles P_1 and P_2. Which of the following statements about their relative motion is true?
Their relative velocity : (consider 1-D motion)



(1) is zero (2) is non-zero but constant
(3) continuously decreases (4) continuously increases

3. Two particles are moving with velocities v_1 and v_2. Their relative velocity is the maximum, when the angle between their velocities is :

(1) zero (2) π/4 (3) π/2 (4) π

4. To cross the river in shortest distance, a swimmer should swim making angle θ with the upstream. What is the ratio of the time taken to swim across in the shortest time to that in swimming across over shortest distance. [Assume speed of swimmer in still water is greater than the speed of river flow]

(1) cosθ (2) sin θ (3) tan θ (4) cot θ

5. A man walks in rain with a velocity of 5 kmh^{-1}. The rain drops strike at him at an angle of 45° with the horizontal. Velocity of rain if it is falling vertically downward -

(1) 5 kmh^{-1} (2) 4 kmh^{-1} (3) 3 kmh^{-1} (4) 1 kmh^{-1}

6. Raindrops are falling vertically with a velocity of 10 m/s. To a cyclist moving on a straight road the raindrops appear to be coming with a velocity of 20 m/s. The velocity of cyclist is :

(1) 10 m/s (2) $10\sqrt{3}$ m/s (3) 20 m/s (4) $20\sqrt{3}$ m/s

7. Two identical trains take 3 sec. to pass one another when going in opposite direction. But takes only 2.5 sec, if the speed of one is increased by 50%. The time one would take to pass the other when going in the same direction at their original speed is-

(1) 10 sec. (2) 12 sec. (3) 15 sec. (4) 18 sec.

8. For four particles A, B, C & D, the velocities of one with respect to other are given as $\vec{V}_{DC}$ is 20 m/s towards north, $\vec{V}_{BC}$ is 20 m/s towards east and $\vec{V}_{BA}$ is 20 m/s towards south. Then $\vec{V}_{DA}$ is

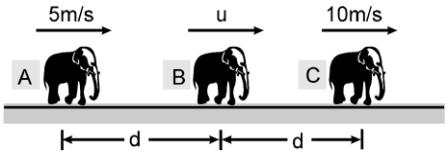
(1) 20 m/s towards north (2) 20 m/s towards south

(3) 20 m/s towards east (4) 20 m/s towards west

9. Person A observes B moving in east direction with speed 10 m/s, B observes C moving in south direction with speed 20 m/s, C observes D moving in west direction with speed 30 m/s & D observes a tree moving with speed 40 m/s in north direction. Then the actual direction of motion of person 'A' will be -

(1) north - west (2) north - east (3) south - east (4) none of these

10. Three elephants A, B and C are moving along a straight line with constant speed in same direction as shown in figure. Speed of A is 5 m/s and speed of C is 10 m/s. Initially separation between A & B is 'd' and between B & C is also d. When 'B' catches 'C' separation between A & C becomes 3d. Then the speed of B will be -



(1) 7.5 m/s (2) 15 m/s (3) 20 m/s (4) 5 m/s

11. A particle A is at rest and particle B moves in a circle with A at it's centre. The particle A will appear :

(1) at rest if seen from B (2) to move in straight line if seen from B

(3) to move in a circle if seen from B (4) to move in parabola if seen from B

12. An open elevator is ascending with zero acceleration and speed 10 m/s. A ball is thrown vertically up by a boy when he is at a height 10 m from the ground, the velocity of projection is 30m/s with respect to elevator. Choose incorrect option, assuming height of the boy very small : ($g = 10\ m/s_2$)

(1) Maximum height attained by the ball from ground is 90 m.

(2) Maximum height attained by the ball with respect to lift from the point of projection is 45 m.

(3) Time taken by the ball to meet the elevator again is 5 sec

(4) The speed of the ball when it comes back to the boy is 20 m/s with respect to ground.

Exercise-3

PART - I : NEET/AIPMT QUESTION (PREVIOUS YEARS)

1. A ship A is moving Westwards with a speed of 10 km h^{-1} and a ship B 100 km South of A, is moving Northwards with a speed of 10 km h^{-1}. The time after which the distance between them becomes shortest, is: **[AIPMT-2015]**

(1) 5 h (2) $5\sqrt{2}$ h (3) $10\sqrt{2}$ h (4) 0 h

2. Two particles A and B, move with constant velocities $\vec{v}_1$ and $\vec{v}_2$. At the initial moment their position vector are $\vec{r}_1$ and $\vec{r}_2$ respectively. The condition for particles A and B for their collision is:

[AIPMT_2015]

(1) $\vec{r}_1 \cdot \vec{v}_1 = \vec{r}_2 \cdot \vec{v}_2$ (2) $\vec{r}_1 \times \vec{v}_1 = \vec{r}_2 \times \vec{v}_2$

(3) $\vec{r}_1 - \vec{r}_2 = \vec{v}_1 - \vec{v}_2$ (4) $\frac{\vec{r}_1 - \vec{r}_2}{|\vec{r}_1 - \vec{r}_2|} = \frac{\vec{v}_2 - \vec{v}_1}{|\vec{v}_2 - \vec{v}_1|}$

3. Preeti reached the metro station and found that the escalator was not working. She walked up the stationary escalator in time t_1. On other days, if she remains stationary on the moving escalator, then the escalator takes her up in time t_2. The time taken by her to walk up on the moving escalator will be :

[NEET-2017]

(1) $\frac{t_1 + t_2}{2}$ (2) $\frac{t_1 t_2}{t_2 - t_1}$ (3) $\frac{t_1 t_2}{t_2 + t_1}$ (4) $t_1 - t_2$

4. The speed of a swimmer in still water is 20 m/s. The speed of river water is 10 m /s and due east. If he is standing on the south bank and wishes to cross the river along the shortest path the angle at which he should make his stroke w.r.t. north is given by :- **[NEET-2019-I]**

(1) 45º west (2) 30º west (3) 0º (4) 60º west

PART - II : JEE (MAIN) / AIEEE PROBLEMS (PREVIOUS YEARS)

1. A body is at rest at x = 0. At t = 0, it starts moving in the positive x-direction with a constant acceleration. At the same instant another body passes through x = 0 moving in the positive x-direction with a constant speed. The position of the first body is given by $x_1(t)$ after time 't' and that of second body by $x_2(t)$ after the same time interval. Which of the following graphs correctly describes $(x_1 - x_2)$ as a function of time 't' ? **[AIEEE 2008]**

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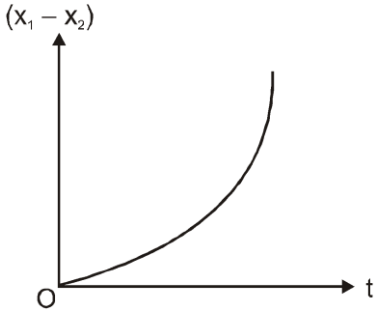
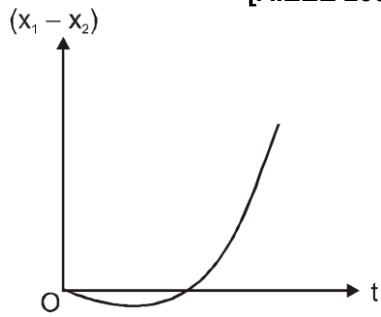
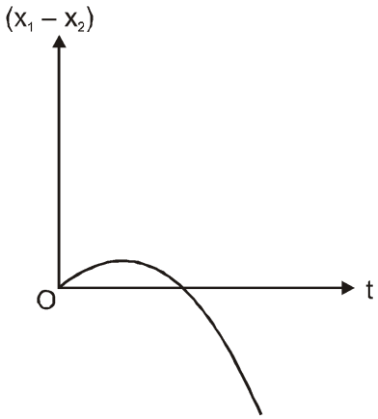
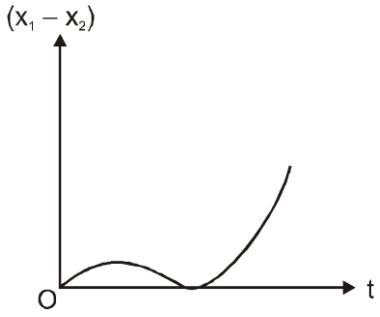
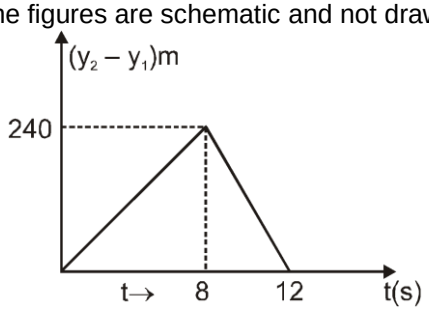


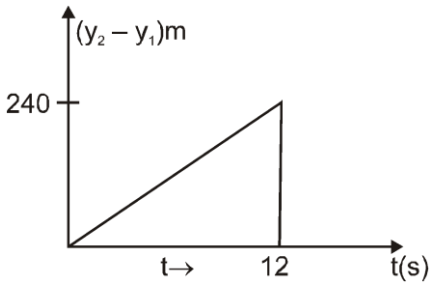
(2)


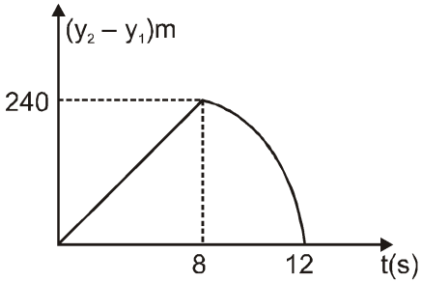
(3)


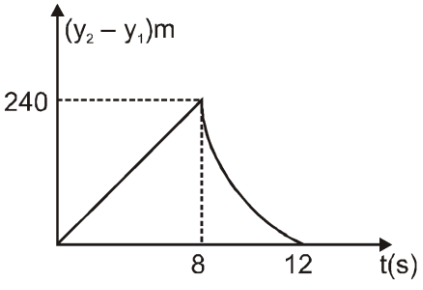
(4)


2. Two stones are thrown up simultaneously from the edge of a cliff 240 m high with initial speed of 10 m/s and 40 m/s respectively. Which of the following graph best represents the time variation of relative position of the second stone with respect to the first ? **[JEE-Main 2015]**
(assume stones do not rebound after hitting the ground and neglect air resistance, take g = 10 m/s^2)
(The figures are schematic and not drawn to scale.)

(1)


(2)


(3)


(4)


Answers

EXERCISE - 1

SECTION (A) :

1.	(1)	**2.**	(2)	**3.**	(3)	**4.**	(1)	**5.**	(4)	**6.**	(2)	**7.**	(3)
8.	(4)	**9.**	(3)	**10.**	(4)	**11.**	(4)	**12.**	(4)	**13.**	(2)	**14.**	(2)
15.	(2)	**16.**	(4)	**17.**	(4)	**18.**	(1)	**19.**	(4)				

SECTION : (B)

1.	(3)	**2.**	(1)	**3.**	(1)	**4.**	(3)	**5.**	(2)	**6.**	(3)	**7.**	(3)
8.	(1)	**9.**	(4)	**10.**	(1)	**11.**	(1)	**12.**	(3)	**13.**	(4)		

SECTION : (C)

1.	(2)	**2.**	(1)	**3.**	(2)	**4.**	(2)	**5.**	(2)	**6.**	(1)	**7.**	(2)
8.	(2)	**9.**	(1)										

SECTION : (D)

1.	(2)	**2.**	(1)	**3.**	(2)	**4.**	(4)	**5.**	(3)	**6.**	(3)	**7.**	(1)
8.	(3)												

EXERCISE - 2

1.	(4)	**2.**	(4)	**3.**	(4)	**4.**	(2)	**5.**	(1)	**6.**	(2)	**7.**	(3)
8.	(4)	**9.**	(3)	**10.**	(2)	**11.**	(3)	**12.**	(3)				

EXERCISE - 3

PART – I

1.	(1)	**2.**	(4)	**3.**	(3)	**4.**	(2)

PART – II

1.	(2)	**2.**	(3)