Rahul Science Academy

IIT JEE / NEET / CET Classes

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PHYSICS (05)

SYLLABUS : Relative Motion in One Dimension and Motion Under Gravity

Date : _____

1. A 120 *m* long train is moving in a direction with speed 20 *m/s*. A train *B* moving with 30 *m/s* in the opposite direction and 130 *m* long crosses the first train in a time

(a) 6 *s* (b) 36 *s*

(c) 38 *s* (d) None of these

2. The distance between two particles moving towards each other is decreasing at the rate of 6 *m/sec*. If these particles travel with same speeds and in the same direction, then the separation increases at the rate of 4 *m/sec*. The particles have speeds as

(a) 5 *m/sec* ; 1 *m/sec* (b) 4 *m/sec* ; 1 *m/sec*

(c) 4 *m/sec* ; 2 *m/sec* (d) 5 *m/sec* ; 2 *m/sec*

3. A train is moving towards east and a car is along north, both with same speed. The observed direction of car to the passenger in the train is

(a) East-north direction

(b) North-west direction

(c) South-east direction

(d) None of these

4. Two cars *A* and *B* are moving with same speed of 45 *km/hr* along same direction. If a third car *C* coming from the opposite direction with a speed of 36 *km/hr* meets two cars in an interval of 5 minutes, the distance of separation of two cars *A* and *B* should be (in *km*)

(a) 6.75 (b) 7.25

(c) 5.55 (d) 8.35

5. A boat moves with a speed of 5 *km/h* relative to water in a river flowing with a speed of 3 *km/h* and having a width of 1 *km*. The minimum time taken around a round trip is

(a) 5 *min* (b) 60 *min*

(c) 20 *min* (d) 30 *min*

6. A boat crosses a river from port *A* to port *B*, which are just on the opposite side. The speed of the water is V_W and that of boat is V_B relative to still water. Assume $V_B = 2V_W$. What is the time taken by the boat, if it has to cross the river directly on the *AB* line

(a) $\frac{2D}{V_B\sqrt{3}}$ (b) $\frac{\sqrt{3}D}{2V_B}$

(c) $\frac{D}{V_B\sqrt{2}}$ (d) $\frac{D\sqrt{2}}{V_B}$

RESPONSE GRID	1. ⓐⓑⓒⓓ 2. ⓐⓑⓒⓓ 3. ⓐⓑⓒⓓ 4. ⓐⓑⓒⓓ 5. ⓐⓑⓒⓓ 6. ⓐⓑⓒⓓ

7. A person walks up a stalled escalator in 90 *s*, when just standing on the same moving escalator, he is carried in 60 *s*, the time it would take him to walk up the moving escalator will be

(a) 27 s (b) 50 s

(c) 18 s (d) 36 s

8. Particle A is moving along X-axis. At time $t = 0$, it has velocity of 10 m/s and acceleration -4 m/s^2, Particle B has velocity of 20 m/s and acceleration -2 m/s^2, Initially, both the particles are at origin. At time $t = 2$ s, distance between the two particles is

(a) 24 m (b) 36 m

(c) 20 m (d) 42 m

9. A ball A is thrown up vertically with a speed u and at the same instant another ball B is released from a height h. At time t, the speed of A relative to B is

(a) u

(b) $2u$

(c) $u - gt$

(d) $\sqrt{(u^2 - gt)}$

10. A body is released from a great height and falls freely towards the earth. Another body is released from the same height exactly one second later. The separation between the two bodies, two seconds after the release of the second body is

(a) 4.9 m (b) 9.8 m

(c) 19.6 m (d) 24.5 m

11. A stone thrown upward with a speed u from the top of the tower reaches the ground with a velocity $3u$. The height of the tower is

(a) $3u^2/g$ (b) $4u^2/g$

(c) $6u^2/g$ (d) $9u^2/g$

12. Three particles A, B and C are thrown from the top of a tower with the same speed. A is thrown up; B is thrown down and C is horizontally. They hit the ground with speeds V_A, V_B and V_C respectively

(a) $V_A = V_B = V_C$ (b) $V_A = V_B > V_C$

(c) $V_B > V_C > V_A$ (d) $V_A > V_B = V_C$

13. A balloon is at a height of 81 *m* and is ascending upwards with a velocity of 12 *m/s*. A body of 2*kg* weight is dropped from it. If $g = 10\ m/s^2$, the body will reach the surface of the earth in

(a) 1.5 *s* (b) 4.025 *s*

(c) 5.4 *s* (d) 6.75 *s*

14. A body projected vertically upwards with a velocity u returns to the starting point in 4 seconds. If $g = 10\ m/sec^2$, the value of u is

(a) 5 *m/sec* (b) 10 *m/sec*

(c) 15 *m/sec* (d) 20 *m/sec*

15. A body is thrown vertically up from the ground. It reaches a maximum height of 100*m* in 5*sec*. After what time it will reach the ground from the maximum height position

(a) 1.2 *sec* (b) 5 *sec*

(c) 10 *sec* (d) 25 *sec*

RESPONSE GRID	7. ⓐ ⓑ ⓒ ⓓ	8. ⓐ ⓑ ⓒ ⓓ	9. ⓐ ⓑ ⓒ ⓓ	10. ⓐ ⓑ ⓒ ⓓ	11. ⓐ ⓑ ⓒ ⓓ
	12. ⓐ ⓑ ⓒ ⓓ	13. ⓐ ⓑ ⓒ ⓓ	14. ⓐ ⓑ ⓒ ⓓ	15. ⓐ ⓑ ⓒ ⓓ	

16. A ball is dropped from top of a tower of 100 m height. Simultaneously another ball was thrown upward from bottom of the tower with a speed of 50 m/s ($g = 10 m/s^2$). They will cross each other after

(a) $1s$ (b) $2s$

(c) $3s$ (d) $4s$

17. Two balls are dropped from heights h and $2h$ respectively from the earth surface. The ratio of time of these balls to reach the earth is

(a) $1:\sqrt{2}$ (b) $\sqrt{2}:1$

(c) $2:1$ (d) $1:4$

18. An elevator car whose floor to ceiling distance is $2.7m$ starts ascending with a constant acceleration of $1.2\ m/s^2$. After 2 s of the start, a bolt falls from the ceiling of the car. The free time of the bolt is ($g = 9.8\ m/s^2$)

(a) $\sqrt{\frac{2.7}{9.8}}$s (b) $\sqrt{\frac{5.4}{9.8}}$s

(c) $\sqrt{\frac{5.4}{8.6}}$s (d) $\sqrt{\frac{5.4}{11}}$s

19. A body falls from rest in the gravitational field of the earth. The distance travelled in the fifth second of its motion is ($g = 10\ m/s^2$)

(a) 25 m (b) 45 m

(c) 90 m (d) 125 m

20. From a balloon rising vertically upwards at $5m/s$ a stone is thrown up at 10 m/s relative to the balloon. Its velocity with respect to ground after 2 s is (assume $g = 10\ m/s^2$)

(a) 0 (b) 20 m/s

(c) 10 m/s (d) 5 m/s

21. Two boys are standing at the ends A and B on 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 constant velocity v and catches the other boy in a time t, where t is

(a) $\frac{a}{\sqrt{v^2+v_1^2}}$ (b) $\sqrt{\frac{a^2}{v^2-v_1^2}}$

(c) $\frac{a}{(v-v_1)}$ (d) $\frac{a}{(v+v_1)}$

22. A body falling from a high Minaret travels 40 m in the last 2 seconds of its fall to ground. Height of Minaret in meters is (take $g = 10\ m/s^2$)

(a) 60 (b) 45

(c) 80 (d) 50

23. Two particles A and B having different masses are projected from a tower with same speed. A is projected vertically upward and B vertically downward. On reaching the ground

(a) Velocity of A is greater than that of B

(b) Velocity of B is greater than that of A

(c) Both A and B attain the same velocity

(d) The particle with the larger mass attains higher velocity

RESPONSE GRID	**16.** ⓐⓑⓒⓓ **17.** ⓐⓑⓒⓓ **18.** ⓐⓑⓒⓓ **19.** ⓐⓑⓒⓓ **20.** ⓐⓑⓒⓓ **21.** ⓐⓑⓒⓓ **22.** ⓐⓑⓒⓓ **23.** ⓐⓑⓒⓓ

24. A pebble is dropped from rest from the top of a tall cliff and falls 4.9 m after 1.0 s has elapsed. How much farther does it drop in the next 2.0 s ? (Take g = 9.8 m/s^2)

(a) 9.8 m (b) 19.6 m

(c) 39 m (d) 44 m

25. A ball is released from the top of a tower of height h meters. It takes T seconds to reach the ground. What is the position of the ball in $T/3$ seconds ?

(a) $h/9$ meters from the ground

(b) $7h/9$ meters from the ground

(c) $8h/9$ meters from the ground

(d) $17h/18$ meters from the ground

NUMERICAL VALUE TYPE QUESTIONS

Questions from 26 to 30 are numerical value type according to the new pattern for JEE Main by NTA.

26. A 210 m long train is moving due North at a speed of 25m/s. A small bird is flying due South a little above the train with speed 5m/s. The time taken (in sec) by the bird to cross the train is

27. A train is moving slowly on a straight track with a constant speed of 2 ms^{-1}. A passenger in that train starts walking at a steady speed of 2 ms^{-1} to the back of the train in the opposite direction of the motion of the train. So, to an observer standing on the platform directly in front of that passenger, the velocity (in m/s) of the passenger appears to be

28. Two trains are moving with equal speed in opposite directions along two parallel railway tracks. If the wind is blowing with speed u along the track so that the relative velocities of the trains with respect to the wind are in the ratio 1 : 2, then the speed of each train is nu. Find the value of n.

29. A body falls freely from rest. It covers as much distance in the last second of its motion as covered in the first three seconds. The body has fallen for a time of

30. A very large number of balls are thrown vertically upwards in quick succession in such a way that the next ball is thrown when the previous one is at the maximum height. If the maximum height is 5m, the number of ball thrown per minute is (take $g = 10\ m/s^{-2}$)

RESPONSE GRID	24. ⓐ ⓑ ⓒ ⓓ	25. ⓐ ⓑ ⓒ ⓓ	26. ○○	27. ○○	28. ○○
	29. ○○	30. ○○			

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PHYSICS (06)

SYLLABUS : Uniform Circular Motion, Projectile Motion and Relative Motion in Two Dimensions

Date : _____

1. If the body is moving in a circle of radius r with a constant speed v, its angular velocity is

(a) v^2/r (b) vr

(c) v/r (d) r/v

2. What is the angular velocity of earth

(a) $\frac{2\pi}{86400} rad/sec$ (b) $\frac{2\pi}{3600} rad/sec$

(c) $\frac{2\pi}{24} rad/sec$ (d) $\frac{2\pi}{6400} rad/sec$

3. A body of mass 1 Kg is projected with velocity 50 m/s at an angle of 30° with the horizontal, At the highest point of its path a force 10 N starts acting on body for 5 s vertically upward besides gravitational force, what is horizontal range of the body ? $(g = 10\ m/s^2)$

(a) $125\sqrt{3}\,m$ (b) $200\sqrt{3}\,m$

(c) $500\,m$ (d) $250\sqrt{3}\,m$

4. A body is moving in a circular path with acceleration a. If its velocity gets doubled, find the ratio of acceleration after and before the change

(a) 1 : 4 (b) $\frac{1}{4}$: 2

(c) 2 : 1 (d) 4 : 1

5. A body of mass m moves in a circular path with uniform angular velocity. The motion of the body has constant

(a) Acceleration (b) Velocity

(c) Momentum (d) Kinetic energy

6. A cylindrical vessel partially filled with water is rotated about its vertical central axis. It's surface will

(a) Rise equally

(b) Rise from the sides

(c) Rise from the middle

(d) Lowered equally

RESPONSE GRID	1. ⓐⓑⓒⓓ 2. ⓐⓑⓒⓓ 3. ⓐⓑⓒⓓ 4. ⓐⓑⓒⓓ 5. ⓐⓑⓒⓓ 6. ⓐⓑⓒⓓ

7. A 100 *kg* car is moving with a maximum velocity of 9 *m/s* across a circular track of radius 30 *m*. The maximum force of friction between the road and the car is

(a) 1000 *N* (b) 706 *N*

(c) 270 *N* (d) 200 *N*

8. Radius of the curved road on national highway is R. Width of the road is b. The outer edge of the road is raised by h with respect to inner edge so that a car with velocity v can pass safe over it. The value of h is

(a) $\frac{v^2 b}{Rg}$ (b) $\frac{v}{Rgb}$

(c) $\frac{v^2 R}{g}$ (d) $\frac{v^2 b}{R}$

9. A car is going in south with a speed of 5 m/s. To a man sitting in car a bus appears to move towards west with a speed of $2\sqrt{6}$ m/s. What is the actual speed of the bus?

(a) $4\,ms^{-1}$ (b) $3\,ms^{-1}$

(c) $7\,ms^{-1}$ (d) none of these

10. A ball is moving to and for about the lowest point A of a smooth hemispherical bowl. If it is able to rise up to a height of 20 *cm* on either side of A, its speed at A must be (Take $g=10\ m/s^2$, mass of the body 5 *g*)

(a) 0.2 *m/s* (b) 2 *m/s*

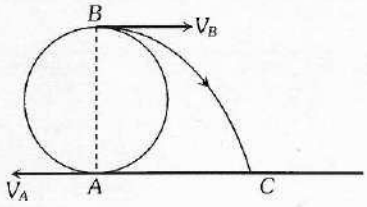
(c) 4 *m/s* (d) 4.5 *m/s*

11. A river is flowing due east with a speed $3\,ms^{-1}$. A swimmer can swim in still water at a speed of $4\ ms^{-1}$, If swimmer starts swimming due north, then resultant velocity of the swimmer is

(a) $3\ ms^{-1}$ (b) $5\,ms^{-1}$

(c) $7\ ms^{-1}$ (d) $2\ ms^{-1}$

12. An object is tied to a string of length l and is revolved in a vertical circle at the minimum velocity. When the object reaches the uppermost point, the string breaks and it describes a parabolic path as shown in the figure under the gravitational force. The horizontal range AC in the plane of A would be



(a) l (b) $2\,l$

(c) $\sqrt{2l}$ (d) $2\sqrt{2l}$

13. A stone of mass m is tied to a string and is moved in a vertical circle of radius r making n revolutions per minute. The total tension in the string when the stone is at its lowest point is

(a) mg

(b) $m(g+\pi nr^2)$

(c) $m(g+\pi nr)$

(d) $m\{g+(\pi^2 n^2 r)/900\}$

RESPONSE GRID	7. ⓐⓑⓒⓓ 8. ⓐⓑⓒⓓ 9. ⓐⓑⓒⓓ 10. ⓐⓑⓒⓓ 11. ⓐⓑⓒⓓ 12. ⓐⓑⓒⓓ 13. ⓐⓑⓒⓓ

14. The angular amplitude of a simple pendulum is θ_0. The maximum tension in its string will be

(a) $mg(1-\theta_0)$ (b) $mg(1+\theta_0)$

(c) $mg(1-\theta_0^2)$ (d) $mg(1+\theta_0^2)$

15. A man projects a coin upwards from the gate of a uniformly moving train. The path of coin for the man will be

(a) Parabolic

(b) Inclined straight line

(c) Vertical straight line

(d) Horizontal straight line

16. Two stones having different masses m_1 and m_2 are projected at an angle α and $(90^0-\alpha)$ With same speed from same point. The ratio of their maximum heights is

(a) 1 : 1 (b) $1 : \tan\alpha$

(c) $\tan\alpha : 1$ (d) $\tan^2\alpha : 1$

17. A bullet is to be fired with a speed of 2000 ms^{-1} to hit a target 200 m away on a level ground. If $g = 10 ms^{-2}$, the gun should be aimed

(a) Directly at the target

(b) 5 cm below the target

(c) 5 cm above the target

(d) 2 cm above the target

18. A ball is thrown from the ground to clear a wall 3m high at a distance of 6 m and falls 18 m away from the wall, the angle of projection of ball is

(a) $\tan^{-1}\left(\frac{3}{2}\right)$ (b) $\tan^{-1}\left(\frac{2}{3}\right)$

(c) $\tan^{-1}\left(\frac{1}{2}\right)$ (d) $\tan^{-1}\left(\frac{3}{4}\right)$

19. A ball is projected with velocity V_o at an angle of elevation 30°. Mark the correct statement

(a) Kinetic energy will be zero at the highest point of the trajectory

(b) Vertical component of momentum will be conserved

(c) Horizontal component of momentum will be conserved

(d) Gravitational potential energy will be minimum at the highest point of the trajectory

20. Two particles are projected, between a certain time gap. While both are in air, the velocity of one particle relative to the other:

(a) Varies linearly with time

(b) Is always constant in magnitude and direction

(c) Is always constant in magnitude only

(d) Is always constant in direction only

21. To the captain of a ship A travelling with velocity $\vec{v}_A = (3\hat{i} - 4\hat{j})$ km/h. a second ship B appears to have a velocity $(5\hat{i} + 12\hat{j})$ km/h. What is the true velocity of the ship B?

(a) $2\hat{i} + 16\hat{j}$ km/h (b) $13\hat{i} + 8\hat{j}$ km/h

(c) $-2\hat{i} - 16\hat{j}$ km/h (d) $8(\hat{i} + \hat{j})$ km/h

22. Two second after projection, a projectile is travelling in a direction inclined at 30° to be horizontal. After 1 more second it is travelling horizontally. Then, (g = 10 m/s^2)

(a) the velocity of projection is $20\sqrt{3}$ m/s

(b) the angle of projection is 30^0 with horizontal

(c) Both (a) and (b) are correct

(d) Both (a) and (b) are wrong

RESPONSE GRID	
	14. ⓐⓑⓒⓓ **15.** ⓐⓑⓒⓓ **16.** ⓐⓑⓒⓓ **17.** ⓐⓑⓒⓓ **18.** ⓐⓑⓒⓓ
	19. ⓐⓑⓒⓓ **20.** ⓐⓑⓒⓓ **21.** ⓐⓑⓒⓓ **22.** ⓐⓑⓒⓓ

23. An arrow is shot into air. Its range is 200 m and its time of flight is 5 s. If $g = 10\, m/s^2$, then the horizontal component of velocity of the arrow is

(a) 12.5 m/s (b) 25 m/s

(c) 31.25 m/s (d) 40 m/s

24. A projectile is projected with a speed u making an angle 2θ with the horizontal. What is the speed when its direction of motion makes an angle θ with the horizontal

(a) $(u\cos 2\theta)/2$ (b) $u\cos\theta$

(c) $u(2\cos\theta - \sec\theta)$ (d) $u(\cos\theta - \sec\theta)$

25. A projectile can have same rage from two angles of projection with same initial speed, if h_1 and h_2 be the maximum heights, then

(a) $R = \sqrt{h_1 h_2}$ (b) $R = \sqrt{2h_1 h_2}$

(c) $R = 2\sqrt{h_1 h_2}$ (d) $R = 4\sqrt{h_1 h_2}$

NUMERICAL VALUE TYPE QUESTIONS

Questions from 26 to 30 are numerical value type according to the new pattern for JEE Main by NTA.

26. A particle describes a horizontal circle with speed of 0.5 m/s in a conical funnel whose inner surface is smooth. The height of the plane of circle from vertex of the funnel is $(n/10)$ cm. Find the value of n.

27. From the top of a tower, 80 m high from the ground, a stone is thrown in the horizontal direction with a velocity of $8ms^{-1}$. The stone reaches the ground after a time t and falls at a distance of d from the foot of the tower. Assuming $g = 10ms^{-2}$, the distance d (in m) is

28. A ball is projected from the ground at a speed of $10ms^{-1}$ making an angle of 30° with the horizontal. Another ball is simultaneously released from a point on the vertical line along the maximum height of the projectile. Both the balls collide at the maximum height of first ball. The initial height of the second ball in meter is $h/10$ $(g = 10ms^{-2})$. Find the value of h.

29. A man wishes to cross a river in a boat. If he crosses the river in minimum time, he takes 10 minutes with a drift of 120 m. If he crosses the river taking shortest route, he takes 12.5 minutes, find velocity of boat in m/min with respect to water.

30. A glass windscreen whose inclination with the vertical can be changed is mounted on a car. The car moves horizontally with a speed of 2 m/s. The rain drops falling vertically with velocity 6 m/s strike the wind screen perpendicularly. At this time the inclination of the screen with vertical is $\alpha = \tan^{-1}\theta$. Find the value of θ (in degree).

RESPONSE GRID					
	23. ⓐⓑⓒⓓ	**24.** ⓐⓑⓒⓓ	**25.** ⓐⓑⓒⓓ	**26.** ○○	**27.** ○○
	28. ○○	**29.** ○○	**30.** ○○		