1. A projectile is given an initial velocity of $\hat{i}+2\hat{j}$. The equation of its path is $\left(g=10\text{m/s}^2\right)$

(A) $y=2x-5x^2$ (B) $y=x-5x^2$ (C) $4y=2x-5x^2$ (D) $y=2x-25x^2$

2. A particle is projected from the surface of a planet. The horizontal and vertical displacements x and y (in metre) respectively vary with time t (in second) as $x=10\sqrt{3}t$ and $y=10t-t^2$ where t = 0 represents the time when the particle is projected . Then the maximum height attained by the particle is (acceleration on the planet can be assumed uniform)

(A) 200 m (B) 100 m (C) 50 m (D) 25 m

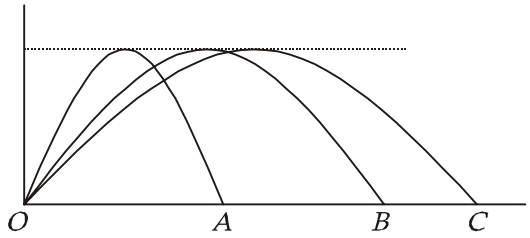
3. The speed of projectile at its highest point is observed to be half of its speed of projection u. Its range on horizontal plane is

(A) $\frac{3u^2}{g}$ (B) $\frac{\sqrt{3}}{2}\frac{u^2}{g}$ (C) $\frac{3}{2}\frac{u^2}{g}$ (D) $\frac{u^2}{3g}$

4. A large number of bullets are fired from the same point in all directions with the same speed v. The maximum area on the ground on which these bullets will spread is

(A) $\pi\frac{v^4}{g^2}$ (B) $\pi^2\frac{v^4}{g^2}$ (C) $\frac{v^4}{g^2}$ (D) $\frac{v^4}{4g^2}$

5. Three projectiles A, B and C are thrown from the same point in the plane. Their trajectories are shown in the figure. Then which of the following statements is true ?



(A) The time of flight is not the same for all three.

(B) The launch speed is greatest for A.

(C) The horizontal velocity component is greatest for particle C.

(D) None of these

6. A cannon ball has the same range R on a horizontal plane for two angles of projection. If h_1 and h_2 are the greatest height in the two paths for which this is possible, then

(A) $R=h_1h_2$ (B) $R=4\sqrt{h_1h_2}$ (C) $R=3\sqrt{h_1h_2}$ (D) $R=\left(h_1h_2\right)^{1/4}$

7. In projectile motion the range R is n times the maximum height. The angle of projection w.r.t. the horizontal is

(A) $\tan^{-1}\frac{n}{2}$ (B) $\tan^{-1}\frac{2}{n}$ (C) $\tan^{-1}\frac{4}{n}$ (D) $\tan^{-1}\frac{n}{4}$

8. A ball of mass m is projected from the ground with an initial velocity u making an angle θ with the horizontal. Then, choose the correct statement

(A) the change in velocity between the point of projection and the highest point is $-u\sin\theta\hat{j}$.

(B) the average velocity averaged over the time of flight is $u\cos\theta\hat{i}$ (horizontal).

(C) the change in velocity in the complete projectile motion is $-2u\sin\theta\hat{j}$.

(D) the rate at which momentum of the ball is changing is constant.

9. A boy can throw a stone to maximum height of 50 m. To what maximum range can he throw this stone and to what greatest height so that the maximum range is maintained, select the correct choice/choices

(A)maximum range is 100 m (B) maximum height for maximum range is 25 m

(C) maximum range is 200 m (D) maximum height for maximum range is 50 m

10. The initial velocity of a particle is $\vec{u}=\left(2\hat{i}+3\hat{j}\right)$ m/s. A constant force of $\vec{F}=\left(4\hat{i}+\hat{j}\right)$N acts on the particle it follows that

(A) its velocity is constant (B) its acceleration is constant

(C) its path is parabolic (D) it moves in a circular path

11. Two projectiles A and B are projected with same speed at angles 30° and 60° to the horizontal then

(A) $R_A=R_B$ (B) $H_B=3H_A$ (C) $H_A=3H_B$ (D) $T_B=\sqrt{3}T_A$

(R stands for range, H for maximum)

12. A projectile is projected from a point on the horizontal ground, at an angle with the vertical. If the air exerts a constant resistive force,

(A) the path of projectile will be a parabola

(B) at the highest point, the velocity is horizontal.

(C) the time for ascent equals the time for descent.

(D) the total mechanical energy of the projectile is not conserved.

13. A projectile shot at an angle of 45° above the horizontal strikes on building 30 m away at a point 15 m above the point of projection. Find :

(A) The speed of projection.

(B) The magnitude and direction of velocity of projectile when it strikes the building.

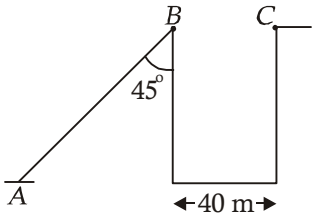
14. An object is projected so that it must clear two obstacles each 7.5 m height, which are situated 50 m from each other. If the time of passing between the obstacles is 2.5 sec, calculate the complete range of projection and the initial velocity of the projection. (g = 10m/s^2).

1. Which of the following is largest, when the height attained by the projectile is a maximum ?

(A) Range (B) Time of flight

(C) Angle of projectile with the vertical (D) None of these

2. A body is projected up a smooth inclined plane with velocity V from the point A as shown in the figure. The angle of inclination is 45° and the top is connected to a well of diameter 40 m. If the body just manages to cross the well, what is the value of V ? Length of inclined plane is $20\sqrt{2}$m.



(A) 40 ms^{-1} (B) $40\sqrt{2}$ ms^{-1} (C) 20 ms^{-1} (D) $20\sqrt{2}$ ms^{-1}

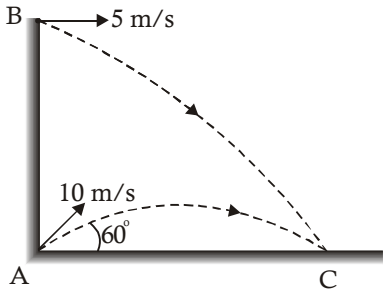
3. A particle has an initial velocity of $\left(3\hat{i}+4\hat{j}\right)$m/s and a constant acceleration of $\left(4\hat{i}-3\hat{j}\right)$m/s^2. Its speed after one second will be equal to

(A) 0 (B) 10 m/sec (C) $5\sqrt{2}$ m/sec (D) 25 m/sec

4. A ball rolls off the top of a staircase with a horizontal velocity u ms^{-1}. If the steps are h m high and w m wide the ball will hit the edge of the n^{th} step if

(A) $n=\frac{gw^2}{2hu^2}$ (B) $n=\frac{2hu^2}{gw^2}$ (C) $n=\frac{2u^2}{gw^2h}$ (D) $n=\frac{2hw^2u^2}{g}$

5. A particle A is projected from the ground with an initial velocity of 10 m/s at an angle of 60° with horizontal. From what height h should an another particle B be projected horizontally with velocity 5 m/s so that both the particles collide on the ground at the point C, assuming that both are projected simultaneously (g = 10 m/s^2)



(A) 10 m (B) 30 m (C) 15 m (D) 25 m

6. Select the correct alternative(s)

(A) In a projectile motion, H/R ratio is equal to (1/4) tanθ

(B) For angles of projection, which exceed or fall short of 45° by equal amounts, the ranges are equal.

(C) In projectile motion, velocity at initial and final points are same.

(D) None of these

7. **Assertion** : When a body is projected at an angle α with vertical and then for the same angle with horizontal, the range is same

Reason : For oblique projection range, $R = \frac{u^2 \sin^2 \alpha}{2g}$ with usual notations.

(A) If both assertion and reason are true and reason is a correct explanation of the assertion.

(B) If both assertion and reason are true but the reason is not a correct explanation of assertion.

(C) If assertion is true but reason is false.

(D) Both assertion and reason are false.

8. **Assertion** : A massy particle is under oblique projection the slope of the path adopted is a straight line having +ve, 0 and –ve values.

Reason : Equation of motion is $y = x\tan\theta - \frac{gx^2}{2u^2\cos^2\theta}$ with notations having usual meaning

(A) If both assertion and reason are true and reason is a correct explanation of the assertion.

(B) If both assertion and reason are true but the reason is not a correct explanation of assertion.

(C) If assertion is true but reason is false.

(D) Both assertion and reason are false.

9. A ball is thrown with a velocity of $7\sqrt{2}$ m/s at an angle to $45°$ with the horizontal. It just clears two vertical poles of height 90 cm each. Find the separation between the poles (g = 9.8 m/s).

10. At what angle should a body be projected with a velocity 24 m/s just to pass over an obstacle 16m high at a horizontal distance of 32 m ? (Assume g = 10m/s^2)

11. A food packet is dropped from the plane moving horizontally with velocity 50 ms^{-1} and at a height of 500 m. Find the angle with horizontal which the velocity vector makes at the time when it reaches the ground. Neglect air resistance

(A) $\tan^{-1}(-2)$ (B) $\tan^{-1}(1/2)$ (C) $-45°$ (D) $53°$

12. Figure shows a still photograph from a war movie. Bombs have been dropped from the plane B-52 at regular intervals. Air plane moves with constant speed in horizontal direction. Which figure may be true still photograph. [Assume that there is no wind] :-

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

13. A particle is projected with a velocity u, at an angle α, with the horizontal. At what time its vertical component of velocity becomes half of its net speed at the highest point ?

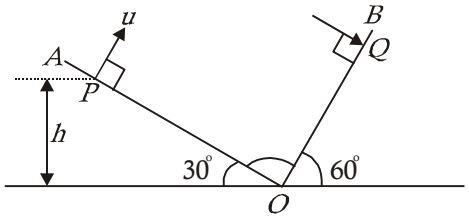
(A) $\frac{u}{2g}$ (B) $\frac{u}{2g}(\sin\alpha - \cos\alpha)$

(C) $\frac{u}{2g}(2\cos\alpha - \sin\alpha)$ (D) $\frac{u}{2g}(2\sin\alpha - \cos\alpha)$

14. A body is thrown with velocity 20 m/s at an angle of 60° with the horizontal. Find the time gap between the two positions of body where velocity of body makes an angle of 30° with horizontal

(A) 1.15 sec (B) 0.95 sec (C) 1 sec. (D) 1.5 sec.

I. Two inclined planes *OA* and *OB* having inclination of 30° and 60° with the horizontal respectively, intersect each other at *O* as shown in figure. A particle is projected from point *P* with velocity $u = 10\sqrt{3}$ m/s along a direction perpendicular to plane *OA*. If the particle strikes plane *OB* perpendicularly at *Q*, calculate



1. Velocity with which particle strikes the plane *OB* is

(A) 10 ms^{-1} (B) $10\sqrt{2}$ ms^{-1} (C) $10\sqrt{3}$ (D) $5\sqrt{2}$ ms^{-1}

2. Time of flight,

(A) 1 sec (B) $\sqrt{2}$ sec (C) 2 sec (D) $2\sqrt{2}$ sec

3. Vertical height *h* of *P* from *O*

(A) $10\sqrt{3}$ m (B) 10 m (C) $10\sqrt{2}$ m (D) 5m

4. Maximum height from *O*, attained by the particle

(A) 15 m (B) 16.25 m (C) 17.4 m (D) $10\sqrt{2}$

5. Distance *PQ*

(A) $10\sqrt{3}$ m (B) $10\sqrt{2}$ m (C) 20 m (D) 15 m

6. Two particles are projected from the same point with eh same speed, at different angles θ_1 and θ_2 to the horizontal. Their times of flight are t_1 and t_2 and they have the same horizontal range. Then

(A) $t_1/t_2 = \tan\theta_1$ (B) $t_1/t_2 = \tan\theta_2$ (C) $t_1/\sin\theta_1 = t_2/\sin\theta_2$ (D) $\theta_1 + \theta_2 = 90°$

7. A particle is projected vertically upward in vacuum with a speed *u*

(A) When it rises to half its maximum height, its speed is *u*/2

(B) When it rises to half its maximum height, its speed is $u/\sqrt{2}$

(C) The time taken to rise to half its maximum height is half of the time taken to reach its maximum height.

(D) The time taken to rise to three-fourths of its maximum height is half of the time taken to reach its maximum height.

8. For maximum height H of a projectile when the maximum range is R the only valid relation is that H is 50% of R.

Reason : Range $R = \frac{u^2 \sin 2\theta}{g}$ and $H = \frac{u^2 \sin^2 \theta}{2g}$ with usual notations

(A) If both assertion and reason are true and reason is a correct explanation of the assertion.
(B) If both assertion and reason are true but the reason is not a correct explanation of assertion.
(C) If assertion is true but reason is false.
(D) Both assertion and reason are false.

9. **Assertion** : When a body is dropped or thrown horizontally from the same height, it would reach the ground at the same time

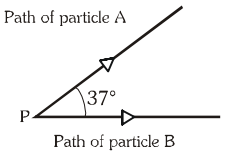
Reason : Horizontal velocity has no effect in the vertical direction.
(A) If both assertion and reason are true and reason is a correct explanation of the assertion.
(B) If both assertion and reason are true but the reason is not a correct explanation of assertion.
(C) If assertion is true but reason is false.
(D) Both assertion and reason are false.

10. A football player kicks the football so that it will have a "hang time" (time of flight) of 5s and lands 50 m away. If the ball leaves the player's foot 1.5 m above the ground, what is its initial velocity (magnitude and direction) ? (g = 10 m/sec^2)

11. If a jumper can give himself the same initial speed regardless of the direction he jumps (forward or straight up) how is his maximum vertical jump (high jump) related to his maximum horizontal jump ?

12. A stone thrown with the velocity v_0 = 12 m/s at an angle $\alpha = 45°$ to the horizontal, dropped to the ground at a distance s from the point where it was thrown. From what height h should the stone be thrown in a horizontal direction with the same initial velocity v_0 for it to fall at the same spot ?

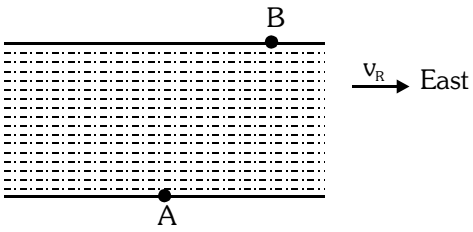
1. Two particles A and B start moving simultaneously from a point P on straight-line paths. Their paths make an angle of 37° with each other as shown in the figure. One of them moves with uniform speed of 10 m/s and the other with 8 m/s.



Distance between the particles 40 s after they leave point P is closest to

(A) 192 m (B) 240 m (C) 320 m (D) 426 m

2. Velocity of a boat relative to river current and river current velocity are equal in magnitude. Starting from point A on the southern bank, the boatman wants to reach a point B on the northern bank in north–east from A. In which direction he has to steer the boat ?



(A) North–east (B) North (C) North–west (D) Not possible.

3. A boy holding a flag when is standstill, the flag flutters in 53° north of west and when he starts running westwards with velocity 6 m/s, the flag flutters in the north. Wind velocity is closest to

(A) 8 m/s, 53° north of west (B) 8 m/s, 53° east of south

(C) 10 m/s, 53° north of west (D) 10 m/s, 53° east of south

4. A helicopter is flying due south with constant velocity 80 km/h and a train is running with the same speed due east. Direction of velocity of the helicopter relative to the train as observed by the passengers in the train is

(A) North-west (B) South-west (C) North-east (D) South-east

5. A boat which is moving downstream passes a raft and moves 10 km ahead of raft in next one hour and then returns upstream with same speed relative to river and meets the raft after the raft has moved 10 km. If the same boat wishes to cross the river without any drift then the angle boat should row with stream velocity is

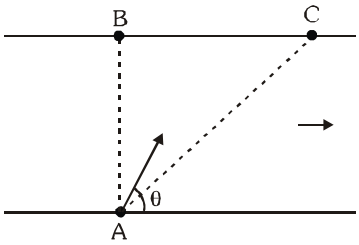
(A) $\frac{\pi}{2}+\tan^{-1}(2)$ (B) $\frac{\pi}{2}+\tan^{-1}\left(\frac{1}{2}\right)$ (C) $\frac{\pi}{2}+\sin^{-1}\left(\frac{2}{3}\right)$ (D) 120°

6. A ship X moving due north with a velocity v observes that another ship Y is moving due west with velocity v. The actual velocity of Y is

(A) v due east. (B) $\sqrt{2}$v towards northwest

(C) v towards southeast (D) $\sqrt{2}$v towards northeast

7. A river is flowing with a speed of 1 m/s. A swimmer wants to go to point C starting from A. He swims with a speed of 5 m/s, at an angle θ w.r.t. river flow. If AB = BC = 1000 m. Then the value of θ is



(A) 30° (B) 37° (C) 45° (D) 53°

8. A man can swim in still water with a speed of 25 m/min. If the speed of the stream is 15 m/min, and its width is 100 m, the time taken to cross the stream by shortest route and the quickest route is

(A) 3 min, 5 min (B) 5 min, 4 min (C) 3 min, 4 min (D) 4 min, 5 min

9. A monkey is climbing up a tree at a speed of 3 m/s. A dog runs towards the tree with a speed of 4 m/s. What is the relative speed of the dog as seen by the monkey?

(A) > 7 m/s (B) between 5 m/s and 7 m/s

(C) 5 m/s (D) < 5 m/s

10. As two boats approach the mumbai, the velocity of boat 1 relative to boat 2 is $10\sqrt{3}$ kmhr^{-1} in a direction of 60° north of east. If boat 2 has a velocity of 15 kmhr^{-1} due south. What is the velocity of boat 1 ?

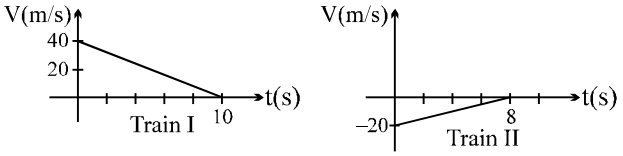
(A) $5\sqrt{3}$ kmhr^{-1} due south-east (B) 5 kmhr^{-1} due east

(C) 10 kmhr^{-1} due north (D) $5\sqrt{3}$ kmhr^{-1} due east

11. A bus starts moving with acceleration 1m/s^2 at the same time a person who is 11 m behind the bus starts chasing it with velocity 5m/s find how long will it take him to catch the bus

(A) 5+√3sec (B) 5–2√3sec (C) 15–√3sec (D) 5–√3sec

12. Two trains, which are moving along different tracks in opposite directions towards each other, are put on the same track by mistake. Their drivers, on noticing the mistake, start slowing down the trains when the trains are 300 m apart. Graphs given below show their velocities as function of time as the trains slow down. The separation between the trains after both have stopped, is:



(A) 120 m (B) 280 m (C) 60 m (D) 20 m

13. A man is running up the inclined plane (making an angle α from the horizontal) with a constant velocity. Rain is falling perpendicular to the incline plane. During motion man observes that rain is falling in vertical direction, when man doubles his velocity he observes that rain is making an angle α from the incline. Value of α is

(A) tan^{-1}(0) (B) tan^{-1}(√2) (C) tan^{-1}(1/√2) (D) tan^{-1}(1/2)

1. A car A is going north-east at 80km/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 an angle α such that $\tan\alpha$ is

(A) 1/7 (B) 3/4 (C) 4/3 (D) 3/5

2. A boat man could row his boat with a speed 10m/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 4m/sec. He should row his boat

(A) at right angle to the stream

(B) at an angle of $\sin^{-1}(2/5)$ with PQ up the stream

(C) at an angle of $\sin^{-1}(2/5)$ with PQ down the stream

(D) at an angle $\cos^{-1}(2/5)$ with PQ down the stream

3. A boat moves relative to water with a velocity which is 1/n times the river flow velocity. At what angle to the stream direction must be boat move to minimize drifting ?

(A) $\pi/2$ (B) $\sin^{-1}(1/n)$ (C) $\frac{\pi}{2} + \sin^{-1}(1/n)$ (D) $\frac{\pi}{2} - \sin^{-1}(1/n)$

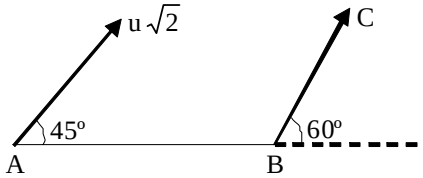
4. A man standing on a road has to hold his umbrella at 30º with the vertical to keep the rain away. He thrown the umbrella and starts running at 10 km/h. He finds that rain drop are hitting his head vertically. Find the speed of rain w.r.t. road

(A) 10 km/s (B) 20 km/h (C) $10\sqrt{3}$ km/s (D) $20\sqrt{3}$ km/h

5. A boat which has a speed of 5 km/hr in still water crosses a river of width 1 km along the shortest possible path in 15 minutes. The velocity of the river water in km/hr is

(A) 1 (B) 3 (C) 4 (D) $\sqrt{41}$

6. A particle is projected from a point A with velocity $u\sqrt{2}$ at an angle of 45º with horizontal as shown in figure. It strikes the plane BC at right angles. The velocity of the particle at the time of collision is



(A) $\frac{\sqrt{3}u}{2}$ (B) $\frac{u}{2}$ (C) $\frac{2u}{\sqrt{3}}$ (D) u

7. A man who can swim at a speed v relative to the water wants to cross a river of width d flowing with a speed u. The point opposite him across the river is A.

(A) He can reach the point A in time d/v

(B) He can reach the point A is time $\frac{d}{\sqrt{v^2 - u^2}}$

(C) The minimum time in which he can cross river is $\frac{d}{v}$

(D) He can not reach A if u > v

8. An aero plane flies along straight line from A to B with speed v (relative to wind) and back again with the same speed. There is a steady wind speed w. The distance between A and B is d. Total time for the round trip

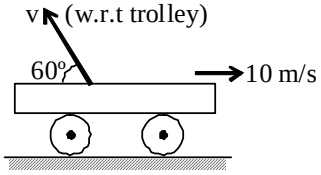
(A) is $\frac{2vd}{v^2 - w^2}$ if the wind blows along the line AB.

(B) is $\frac{2d}{\sqrt{v^2 - w^2}}$ if the wind blows perpendicular to the line AB

(C) is always increased by the presence of wind.

(D) depend on the direction of wind.

9. For an observer on trolley direction of projection of particle is shown in figure, while for observer on ground ball rises vertically. Maximum height (in meter) reached by ball minus 10 m is

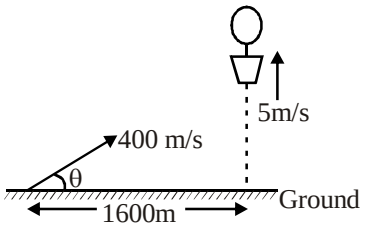


10. A man running on a horizontal road at 8 km/h finds the rain falling vertically. He increases his speed to 12 km/h and find that the drops are making 30° with vertical. Find the speed and direction of the rain with respect to the road.

11. Two cars A and B having velocities of 72 km/h and 18 km/h are running in the same direction, the car B being ahead of the A. The distance between the cars is 150 m. If the car A now starts retarding at a uniform rate of 1 m/s^2 while the car B moves along at a uniform velocity, will the car A overtake the car B ?

Paragraph for question nos. 12 to 14

An observer having a gun observes a remotely controlled balloon. When he first noticed the balloon, it was at an altitude of 800 m and moving vertically upward at a constant velocity of 5 m/s. The horizontal displacement of balloon from the observer is 1600 m. Shells fired from the gun have an initial velocity of 400 m/s at a fixed angle θ ($\sin\theta = 3/5$ and $\cos\theta = 4/5$). The observer having gun waits (for some time after observing balloon) and fires so as to destroy the balloon. Assume g = 10 m/s^2. Neglect air resistance.



12. The flight time of the shell before it strikes the balloon is

(A) 2 sec (B) 5 sec (C) 10 sec (D) 15 sec

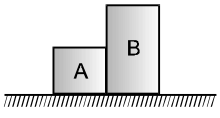
13. The altitude of the collision above ground level is

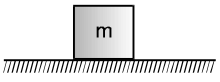
(A) 1075 m (B) 1200 m (C) 1250 m (D) 1325 m

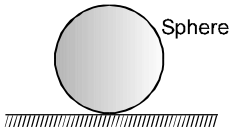
14. After noticing the balloon, the time for which observer having gun waits before firing the shell is

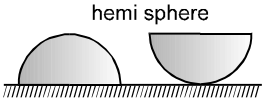
(A) 45 sec (B) 50 sec (C) 55 sec (D) 60 sec

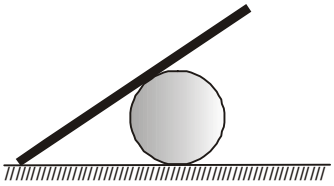
1. Identify the contact surface :

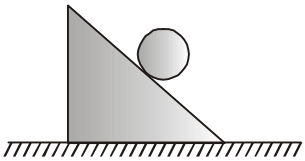
(a) 

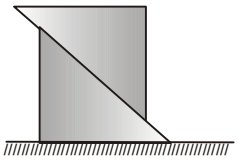
(b) 

(c) 

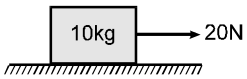
(d) 

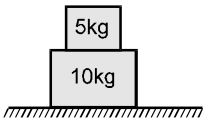
(e) 

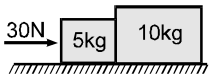
(f) 

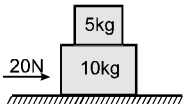
(g) 

2. Find all the normal reactions and the accelerations :
(All surfaces are friction less)

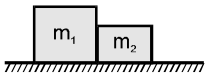
(A) 

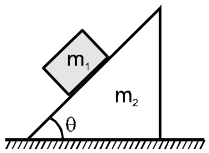
(B) 

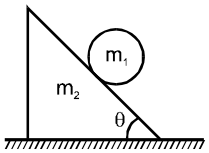
(C) 

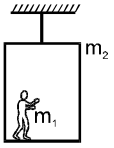
(D) 

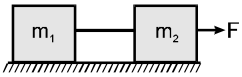
3. Draw the FBD for the following systems :

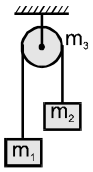
(a) 

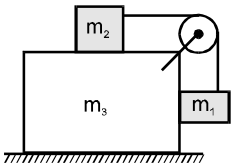
(b) 

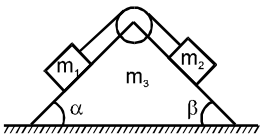
(c) 

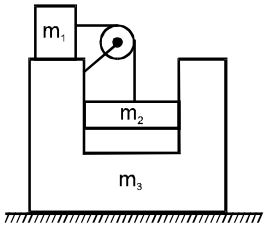
(D) 

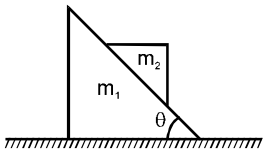
(e) 

(f) 

(g) 

(h) 

(i) 

(j) 

4. Two blocks of mass 4 kg and 6 kg are placed in contact with each other on a frictionless horizontal surface. If we apply a push of 5N on the heavier mass, the force on the lighter mass will be

(A) 2N (B) 4 N (C) 5 N (D) None of these

5. Two masses m_1 and m_2 are attached to a string which pass over a frictionless fixed pulley. Given that m_1 = 10 kg and m_2 = 6 kg and g = 10 ms^{-2}, What is the acceleration of the masses ?

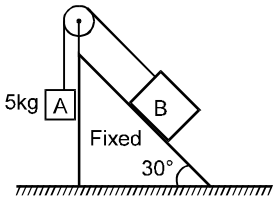
(A) 2.5 ms^{-2} (B) 5 ms^{-2} (C) 20 ms^{-2} (D) 40 ms^{-2}

6. A body is placed over an inclined plane of angle θ. The angle between normal reaction and the weight of the body is

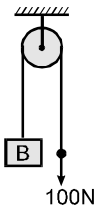
(A) θ (B) $\frac{\pi}{2} - \theta$ (C) $\pi - \theta$ (D) 0

7. Find out the mass of block B to keep the system at rest :

(A)



(B)



8. If the resultant of three forces $\mathbf{F}_1 = p\mathbf{i} + 3\mathbf{j} - \mathbf{k}$, $\mathbf{F}_2 = -5\mathbf{i} + \mathbf{j} + 2\mathbf{k}$ and $\mathbf{F}_3 = 6\mathbf{i} - \mathbf{k}$ acting on a particle has magnitude equal to 5 units, then the value(s) of p is (are)

(A) –6 (B) –4 (C) 2 (D) 4

9. Select the incorrect statement

(A) A powerful man pushes a wall and the wall gets deformed. The magnitude of force exerted by the wall on man will be equal to the magnitude of force exerted by man on the wall.

(B) Ten person are pulling horizontally an object on a smooth horizontal surface in different directions. The resultant acceleration of the object is zero. Then the pull of each man is equal to the pull of the other nine men.

(C) A massless object cannot exert force on any other object.

(D) All contact forces are electromagnetic in nature.

10.

(p) force between the earth and the falling stone	(i) Gravitational force
(q) The pressing force between one block and another block	(ii) Electromagnetic force
(r) The stretching force developed in a spring.	(iii) Strong nuclear force
(s) The force between the proton and the neutron in a nuclear	(iv) Weak nuclear force

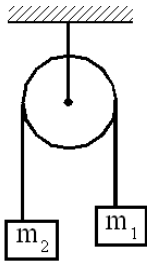
1. A book is lying on the table. What is the angle between the action of the book on the table and the reaction of the table on the book?

(A) 180° (B) 90° (C) 45° (D) 0°

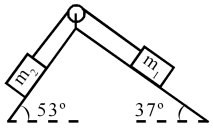
2. When we kick a stone, we get hurt. Due to which one of the following properties does it happens?

(A) velocity (B) momentum (C) inertia (D) reaction

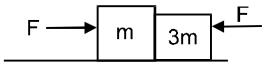
3. Two blocks of masses $m_1 = 5$ kg and $m_2 = 2$ kg hang on either side of a frictionless cylinder as shown in the figure . If the system starts at rest , what is the speed of m_1 after it has fallen 40 cm ?

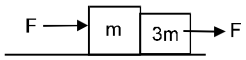


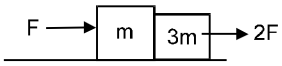
4. Two blocks with masses $m_1 = 4$ kg and $m_2 = 5$ kg are connected by a light rope and slide on a frictionless wedge as shown in the figure . Given that it starts at rest , what is the speed of m_2 after it has moved 40 cm along the incline ?

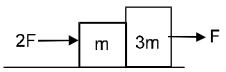


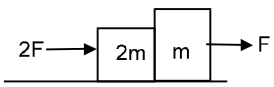
5. In all the given cases blocks are at rest, are in contact and the forces are applied as shown. All the surfaces are smooth. Then in which of the following cases, normal reaction between the two blocks is zero choose the most appropriate options.

(i) 

(ii) 

(iii) 

(iv) 

(v) 

(A) (i) , (iv) (B) (ii) , (iii) (C) (iii) (D) (v)

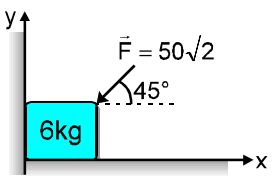
6. A block of 6 kg is put between two smooth walls. If $\vec{F} = 50\sqrt{2}$ is also applied as shown in figure, then

(A) Interaction force on the block due to walls = $50\hat{i} + 110\hat{j}$

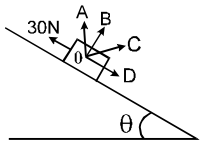
(B) Interaction force on the walls due to the block = $50\hat{i} + 110\hat{j}$

(C) If $\vec{F}$ were reversed, now interactron force on the block due to wall = $-50\hat{i} + 110\hat{j}$

(D) If $\vec{F}$ were reversed, now the acceleration of the block = $\frac{50}{6}\hat{i}$ m/sec^2.



7. A body of mass 10 kg is on a rough inclined plane of inclination $\theta = \sin^{-1}(3/5)$ with the horizontal. When a force of 30 N is applied on the block parallel to and upward the plane, the total reaction by the plane on the block is nearly along :



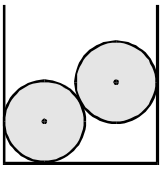
(A) OA (B) OB (C) OC (D) OD

8. A block of weight 9.8N is placed on a table. The table surface exerts an upward force of 10 N on the block. Assume $g = 9.8\ m/s^2$.

(A) The block exerts a force of 10N on the table (B) The block exerts a force of 19.8N on the table

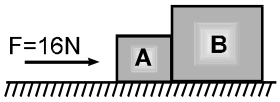
(C) The block exerts a force of 9.8N on the table (D) The block has an upward acceleration.

9. Two smooth spheres each of radius 5 cm and weight W rest one on the other inside a fixed smooth cylinder of radius 8 cm. The reactions between the spheres and the vertical side of the cylinder are :



(A) W/4 & 3W/4 (B) W/4 & W/4 (C) 3W/4 & 3W/4 (D) W & W

10. Two blocks A and B of masses 4 kg and 12 kg respectively are placed on a smooth plane surface. A force F of 16 N is applied on A as shown. The force of contact between A & B is

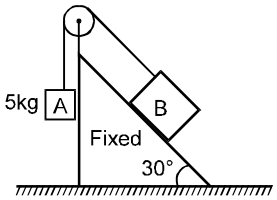


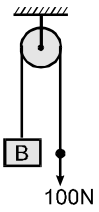
(A) 4 N (B) 8 N (C) 12 N (D) 16 N

1. A toy train consists of three identical compartment A, B and C. It is being pulled by a constant force F along C. The ratio of the tensions in the string connecting AB and BC is

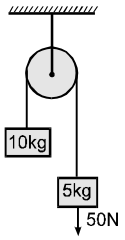
(A) 2 : 1 (B) 1 : 3 (C) 1 : 1 (D) 1 : 2

2. Find out the mass of block B to keep the system at rest :

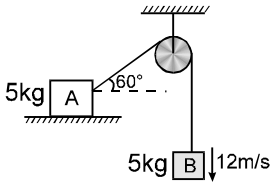
(A) 

(B) 

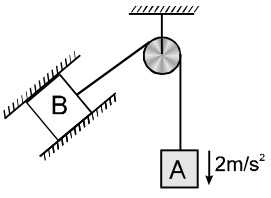
3. Find out the accelerations of the blocks and tensions in the strings.



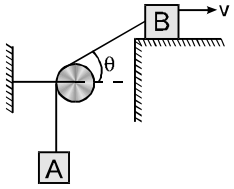
4. Find the velocity of A.



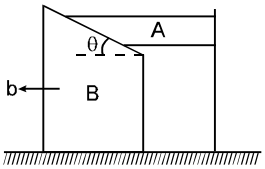
5. Find the acceleration of B.



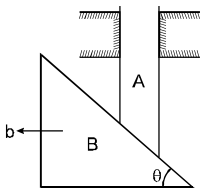
6. Find the velocity of A.



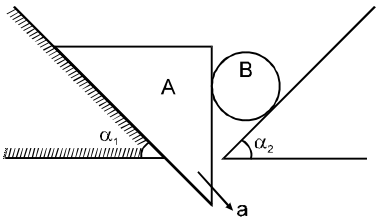
7. Find the acceleration of wedge A



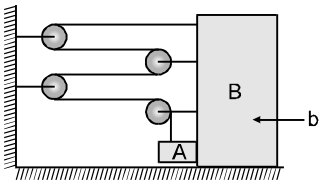
8. Find the acceleration of wedge A.



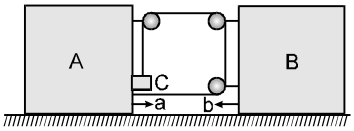
9. Find the acceleration of B.



10. Find the acceleration of A w.r.t. ground.



11. Find the acceleration of C w.r.t. ground

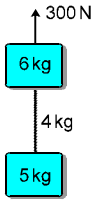


1. Inside a horizontally moving box, an experimenter finds that when an object is placed on a smooth horizontal table and is released, it moves with an acceleration of 10 m/s^2. In this box if 1 kg body is suspended with a light string, the tension in the string in equilibrium position. (w.r.t. experimenter) will be. (Take g = 10 m/s^2)

(A) 10 N (B) $10\sqrt{2}$ N (C) 20 N (D) zero

Comprehensions # 1

Two blocks (as shown in figure) are connected by a heavy uniform rope of mass 4 kg. An upward force of 300 N is applied on upper block. (g = 10 m/sec^2)



2. The acceleration of the system is equal to ;

(A) 20 m/sec^2 upward (B) 10 m/sec^2 upward

(C) 10 m/sec^2, downward (D) 30 m/sec^2, downward

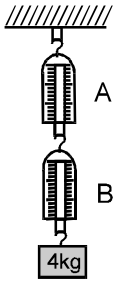
3. The tension at the top of the heavy rope is equal to

(A) 90 N (B) 60 N (C) 180 N (D) 240 N

4. The tension at the mid-point of the rope is equal to

(A) 240 N (B) 180 N (C) 70 N (D) 140 N

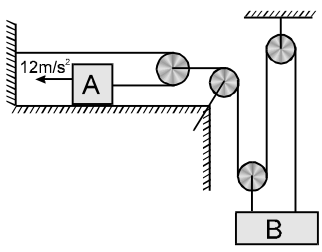
5. A block of mass 4kg is suspended through two light spring balances A and B. Then A and B will read respectively



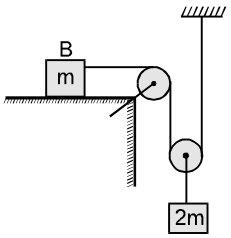
(A) The reading of A is 4kg (B) The reading of A is 0 kg

(C) The reading of B is 4kg (D) The reading of B is 2kg

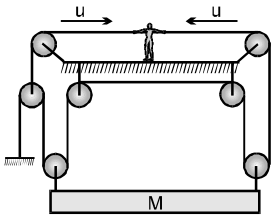
6. Find the acceleration of B.



7. Find out the accelerations of the block B in the following systems

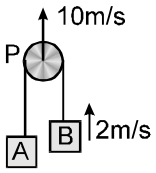


8. System is shown in the figure and man is pulling the rope from both sides with constant speed 'u'. Then the velocity of the block will be

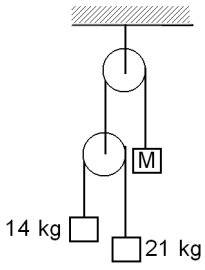


(A) $\frac{3u}{4}$ (B) $\frac{3u}{2}$ (C) $\frac{u}{4}$ (D) None of these

9. Find the velocity of A with respect to pulley P.

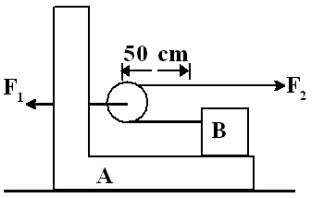


10. In the system of pulleys , the value of M such that 14 kg block remains at rest is :



(A) 28 kg (B) 35 kg (C) 24 kg (D) 42 kg

11. A 1 kg block 'B' rests as shown on a bracket 'A' of same mass . Constant forces F_1 = 20 N and F_2 = 8 N start to act at time t = 0 when the distance of block B from pulley is 50 cm . Time when block B reaches the pulley is



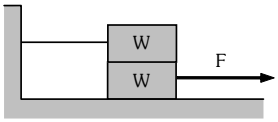
1. A block is pushed with some velocity up a rough inclined plane. It stops after ascending few meters and then reverses its direction and returns back to point from where it started. If angle of inclination is 37° and the time to climb up is one third of the time to return back then coefficient of friction is

(A) $\frac{1}{5}$ (B) $\frac{3}{5}$ (C) $\frac{4}{5}$ (D) $\frac{2}{5}$

2. A block of mass 1kg is resting on a rough horizontal surface where coefficient of friction is $\frac{1}{\sqrt{3}}$. The minimum force required to make the block move, is

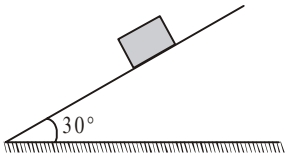
(A) $\frac{5}{\sqrt{3}}$N (B) 5N (C) $5\sqrt{3}$N (D) $\frac{10}{\sqrt{3}}N$

3. Two identical blocks of weight W are placed one on top of the other as shown in figure. The upper block is tied to the wall. The lower block is pulled to the right with a force F. The coefficient of static friction between all surfaces in contact is μ. What is the largest force F that can be exerted before the lower block starts to slip?



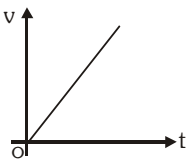
(A) μW (B) 2 μW (C) 3 μW (D) 4 μW

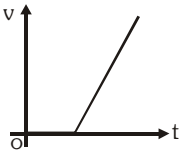
4. Figure shows a block kept on a rough inclined plane. The maximum external force down the incline for which the block remains at rest is 2N while the maximum external force up the incline for which the block is at rest is 10 N. The coefficient of static friction μ is

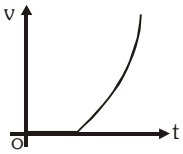


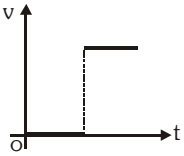
(A) $\frac{\sqrt{3}}{2}$ (B) $\frac{1}{\sqrt{6}}$ (C) $\sqrt{3}$ (D) $\frac{1}{\sqrt{3}}$

5. A metal block is resting on a rough wooden surface. A horizontal force applied to the block is increased uniformly. Which of the following curves correctly represents velocity of the block?

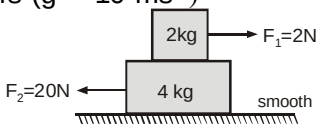
(A) 

(B) 

(C) 

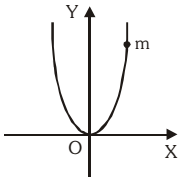
(D) 

6. In the arrangement shown in figure, coefficient of friction between the two blocks is μ = $\frac{1}{2}$. The force of friction acting between the two blocks is ($g = 10\ ms^{-2}$)



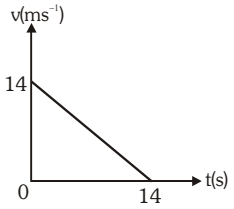
(A) 8 N (B) 10 N (C) 6 N (D) 4 N

7. A bead of mass m is located on a parabolic wire with its axis vertical and vertex directed towards downward as in figure and whose equation is $x^2 = ay$. If the coefficient of friction is μ, the highest distance above the x–axis at which the particle will be in equilibrium is :–



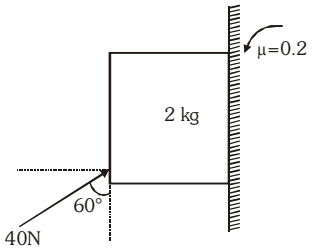
(A) μa (B) $\mu^2 a$ (C) $\frac{1}{4}\mu^2 a$ (D) $\frac{1}{2}\mu a$

8. The v–t graph of the motion of a wooden block of mass 1 kg is shown in figure. It is given an initial push at t = 0, along a horizontal table. The coefficient of friction between the block and table is (g= 10 ms^{-2})



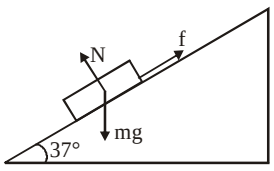
(A) 0.2 (B) 0.1 (C) 0.4 (D) 0.5

9. A block of mass 2 kg is pressed against the vertical wall of coefficient of friction μ = 0.2. The value of friction force acting on the wall



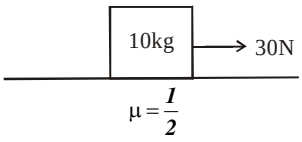
(A) $40\sqrt{3}$ N in upward direction (B) $40\sqrt{3}$ N in downward direction
(C) 20N in upward direction (D) No friction force acts on the block

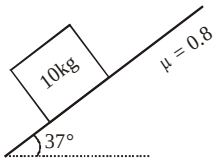
10. A block slides down an incline of angle 37° with an acceleration $\frac{g}{4}$. Find the kinetic friction coefficient.

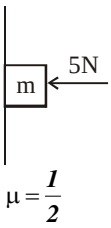


(A) $\frac{9}{16}$ (B) $\frac{1}{4}$ (C) $\frac{3}{4}$ (D) $\frac{7}{16}$

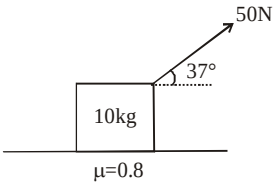
11. Find the friction on the block in the following cases

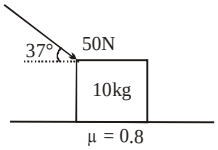
(A) 

(B) 

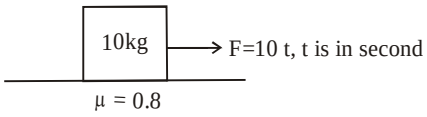
(C) 

If (i) m = 0.1 kg and (ii) m = 1 kg

(D) 

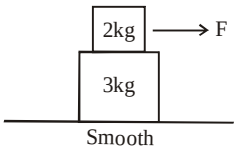
(E) 

12. Find the friction on the block in the following cases

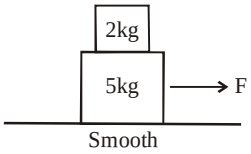


If (i) t = 4 and (ii) t = 9s

13. The friction coefficient between the blocks is 0.5. Find the acceleration of each block if F is equal to (a) 5 N and (b) 20N.



14. The coefficient of friction betwen the blocks is 0.5. Find the acceleration of each block if F is (a) 21N, (b) 35N and (c) 40N.



ANSWER KEY

RACE-11

1. (A) **2.** (D) **3.** (B) **4.** (A) **5.** (C) **6.** (B) **7.** (C) **8.** (ABCD) **9.** (AB)

10. (B) **11.** (ABD) **12.** (CD) **13.** (A) $10\sqrt{6}$ (B) $10\sqrt{3}$, Normal to wall **14.** 20

RACE-12

1. (B) **2.** (D) **3.** (C) **4.** (B) **5.** (C) **6.** (AB) **7.** (C) **8.** (A) **9.** 8m

10. $\tan^{-1}(3)$ & $\tan^{-1}\frac{3}{5}$ **11.** (A) **12.** (C) **13.** (D) **14.** (A)

RACE-13

1. (A) **2.** (C) **3.** (D) **4.** (B) **5.** (C) **6.** (ACD) **7.** (BD)

8. (B) **9.** (A) **10.** 35.1m/sec **11.** $\frac{R_{max}}{2}$ **12.** 7.2 m

RACE-14

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

10. (D) **11.** (D) **12.** (D) **13.** (C)

RACE-15

1. (A) **2.** (B) **3.** (C) **4.** (B) **5.** (B) **6.** (C) **7.** (BCD) **8.** (ABCD)

9. 5 **10.** $\sqrt{3}/2$ **11.** Car A can not overtake Car B **12.** (B) **13.** (A) **14.** (B)

RACE-16

2. (A) N = 100 N, a = 2 m/s^2 (B) N = 50 N, 150 N, a = 0

(C) N = 20 N, a = 2 m/s^{2l} (D) N = 50 N, 150 N, a = 2 m/s^2

4. (A) **5.** (A) **6.** (C) **7.** (a) 10 kg (b) 10 kg **8.** (BC) **9.** (C) **10.** (p-i), (q-ii), (r-ii), (s-iii)

RACE-17

1. (A) **2.** (D) **3.** $\sqrt{\frac{24}{7}}$ m/s **4.** 1.19 = 8/3$\sqrt{5}$ **5.** (B) **6.** (AD) **7.** (C)

8. (A) **9.** (C) **10.** (C)

RACE-18

1. (D) **2.** 10 kg **3.** Zero **4.** V_A = 24 m/s ($\rightarrow$) **5.** a_B = 2m/s^2 ($\nearrow$)

6. $V_A = V\cos\theta$ ($\uparrow$) **7.** $a_A = b\tan\theta$ **8.** $a = b\tan\theta$ **9.** $a_B = \frac{a\cos\alpha_1}{\cos\alpha_2}$ **10.** $-b\hat{i} - 4b\hat{j}$

11. $a\hat{i} - 2(a+b)\hat{j}$

RACE-19

1. (B) **2.** (B) **3.** (C) **4.** (D) **5.** (AC) **6.** a_B = 2 m/s^2 ($\uparrow$) **7.** a_B = 2g/3 **8.** (A)

9. V_{AP} = 8 m/s ($\uparrow$) **10.** (C) **11.** 0.5 sec

RACE - 20

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

10. (A)-30N (B)-60N (C) (i)-1N, (ii) 2.5N (D) 40N (E) 40N **11.** (i) 40N (ii) 80N

12. (a) 1m/s^2, 1m/s^2 (b) 5m/s^2 , 10/3m/s^2 **13.** (a) 3m/s^2, 3m/s^2 (b) 5m/s^2, 5 m/s^2 (c) 5 m/s^2 , 6m/s^2