NEET UG (2024)
Physics
Quiz-9

SECTION - A

1. A projectile can have the same range R for two angles of projection. If t_1 and t_2 be the times of flight in two cases, then the product of times of flight will be-

(1) $t_1t_2 \propto R$ (2) $t_1t_2 \propto R^2$

(3) $t_1t_2 \propto 1/R$ (4) $t_1t_2 \propto 1/R^2$

2. The height y and the distance x along the horizontal plane of a projectile on a certain planet (with no surrounding atmosphere) are given by $y = (8t - 5t^2)$ meter and $x = 6t$ meter where t is time in seconds. The velocity with which the projectile is projected is –

(1) 8 m/s

(2) 6 m/s

(3) 10 m/s

(4) Cannot be determined

3. At a height 0.4 m from the ground, the velocity of a projectile is, $\vec{v} = (6\hat{i} + 2\hat{j})$ m/s. The angle of projection is: (g = 10 m/s^2)

(1) 45° (2) 60°

(3) 30° (4) $\tan^{-1}(3/4)$

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

(1) $20\sqrt{2}$ m (2) 10 m

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

5. A body is thrown with a velocity of 9.8 m/s making an angle of 30° with the horizontal. It will hit the ground after a time -

(1) 1.5 s (2) 1 s

(3) 3 s (4) 2 s

6. An object is thrown along a direction inclined at an angle of 45° with the horizontal direction. The horizontal range of the particle is-

(1) Four times the vertical height

(2) Thrice the vertical height

(3) Twice the vertical height

(4) Equal to vertical height

7. The position co-ordinates of a particle moving in a 3-D coordinate system is given by $x = a\cos\omega t$, $y = a\sin\omega t$ and $z = a\omega t$. The speed of the particle is

(1) $2a\omega$ (2) $\sqrt{3}a\omega$

(3) $\sqrt{2}a\omega$ (4) $a\omega$

8. The co-ordinates of a moving particle at any time t are given by $x = \alpha t^3$ and $y = \beta t^3$. The speed of the particle at time t is given by

(1) $3t\sqrt{\alpha^2\beta^2}$ (2) $3t^2\sqrt{\alpha^2+\beta^2}$

(3) $t^2\sqrt{\alpha^2+\beta^2}$ (4) $\sqrt{\alpha^2+\beta^2}$

9. Two guns A and B can fire bullets at speeds 1 km/s and 2 km/s respectively. From a point on a horizontal ground, they are fired in all possible directions. The ratio of maximum areas covered by the bullets fired by the two guns, on the ground is

(1) 1 : 2 (2) 1 : 16

(3) 1 : 4 (4) 1 : 8

10. A projectile is given an initial velocity of $(\hat{i} + 2\hat{j})$ m/s, where $\hat{i}$ is along the ground and $\hat{j}$ is along the vertical. If g = 10 m/s^{-2}, the equation of its trajectory is

(1) $4y = 2x - 25x^2$ (2) $y = x - 5x^2$

(3) $y = 2x - 5x^2$ (4) $4y = 2x - 5x^2$

11. A train covers the first half of the distance between two stations with a speed of 30 km/h and the other half with 70 km/h. Then its average speed is

(1) 50 km/h (2) 48 km/h

(3) 42 km/h (4) 100 km/h

12. Two bodies are projected with the same velocity if one is projected at an angle of 30° and the other at an angle of 60° to the horizontal, the ratio of the maximum heights reached is:

(1) 3 : 1 (2) 1 : 3

(3) 1 : 2 (4) 2 : 1

13. The velocity of projection of a projectile is $(6\hat{i} + 8\hat{j})$ ms^{-1}. The horizontal range of the projectile is:

(1) 4.9 m (2) 9.6 m

(3) 19.6 m (4) 14 m

14. The speed of a projectile at its maximum height is half of its initial speed. The angle of projection is

(1) 60° (2) 15°

(3) 30° (4) 45°

15. A particle has initial velocity $(3\hat{i} + 4\hat{j})$ m/s and has acceleration $(0.4\hat{i} + 0.3\hat{j})$ m/s^2. Its speed after 10s is: (in m/s)

(1) 7 unit (2) $7\sqrt{2}$ unit

(3) 8.5 unit (4) 10 unit

16. If air resistance is not considered in projectiles, the horizontal motion takes place with:
(1) constant velocity
(2) constant retardation
(3) constant acceleration
(4) variable velocity

17. If R is the maximum horizontal range of a particle, then the greatest height attained by it is:
(1) R (2) $2R$
(3) $R/2$ (4) $R/4$

18. A particle is projected with a velocity v, so that its range on a horizontal plane is twice the greatest height attained. If g is acceleration due to gravity, then its range is:
(1) $\frac{4v^2}{5g}$ (2) $\frac{4g}{5v^2}$
(3) $\frac{4v^3}{5g^2}$ (4) $\frac{4v}{5g^2}$

19. A ball is projected upwards. Its acceleration at the highest point is:
(1) zero
(2) directed upwards
(3) directed downwards
(4) such as cannot be predicted

20. A particle is fired with velocity u making an angle θ with the horizontal. What is the change in velocity when it is at the highest points?
(1) $u \sin\theta$ (2) u
(3) $u \cos\theta$ (4) $(u \cos\theta - u)$

21. A man walks for some time 't' with velocity (v) due east. Then he walks for same time 't' with velocity (v) due north. The average speed of the man is
(1) 2v
(2) $\sqrt{2}v$
(3) v
(4) $\frac{\sqrt{2}}{v}$

22. Range of projectile is R, when the angle of projection is 30°. Then, the value of the other angle of projection for the same range, is:
(1) 45° (2) 60°
(3) 50° (4) 40°

23. A person can throw a stone to a maximum distance of 100 m. The greatest height to which he can throw the stone is:
(1) 100 m
(2) 75 m
(3) 50 m
(4) 25 m

24. A ball is thrown upwards and it returns to ground describing a parabolic path. Which of the following quantities remains constant throughout the motion?
(1) Kinetic energy of the ball
(2) Speed of the ball
(3) Horizontal component of velocity
(4) Vertical component of velocity

25. Two paper screens A and B are separated by 150 m. A bullet pierces A and then B. The hole in B is 15 cm below the hole in A. If the bullet is travelling horizontally at the time of hitting A, then the velocity of the bullet at A is:
(Take $g = 10\ ms^{-2}$)
(1) $100\sqrt{3}\ ms^{-1}$ (2) $200\sqrt{3}\ ms^{-1}$
(3) $300\sqrt{3}\ ms^{-1}$ (4) $500\sqrt{3}\ ms^{-1}$

26. A man wishes to swim across a river 0.5 km wide. If he can swim at the rate of 2 km/h in still water and the river flows at the rate of 1 km/h. The angle (w.r.t the flow of the river) along which he should swim so as to reach a point exactly opposite his starting point, will be
(1) 60° (2) 120°
(3) 145° (4) 90°

27. A person takes an aim at a monkey sitting on a tree and fires a bullet. Seeing the smoke the monkey begins to fall freely; then the bullet will:
(1) hit the monkey always
(2) go above the monkey
(3) go below the monkey
(4) hit the monkey if the initial velocity of the bullet is more than a definite velocity

28. A projectile thrown with initial velocity $(a\hat{i} + b\hat{j})$ and its range is twice the maximum height attained by it then-
(1) $b = a/2$ (2) $b = a$
(3) $b = 2a$ (4) $b = 4a$

29. Object is moving with constant velocity the speed of object:

(1) May be variable
(2) May be constant
(3) Must be variable
(4) Must be constant

30. A particle starts from rest and moves with uniform acceleration. Then the ratio of distance covered in n^{th} second to n second is

(1) $\frac{n^2}{2n-1}$
(2) $\frac{2}{n}-\frac{1}{n^2}$
(3) $\frac{n^2}{n+1}$
(4) $\frac{2n+1}{n^2}$

31. If a car covers $2/5^{th}$ of the total distance with v_1 speed and $3/5^{th}$ distance with v_2 then average speed is:

(1) $\frac{1}{2}\sqrt{v_1v_2}$ (2) $\frac{v_1+v_2}{2}$
(3) $\frac{2v_1v_2}{v_1+v_2}$ (4) $\frac{5v_1v_2}{3v_1+2v_2}$

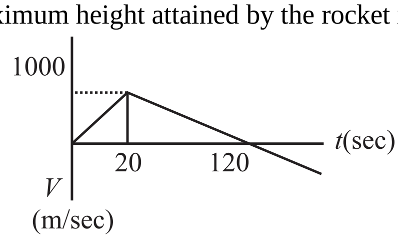
32. If velocity of object $V=\sqrt{25-4x}$ then find acceleration of object.

(1) 4 m/s^2 (2) 2 m/s^2
(3) 5 m/s^2 (4) 8 m/s^2

33. A particle experiences a constant acceleration for 20 sec after starting from rest. If it travels a distance S_1 in the first 10 sec and a distance S_2 in the next 10 sec, then:

(1) $S_1 = S_2$
(2) $S_1 = S_2/3$
(3) $S_1 = S_2/2$
(4) $S_1 = S_2/4$

34. A rocket is projected vertically upwards and its time velocity graph is shown in the figure. The maximum height attained by the rocket is D



(1) 1 km (2) 10 km
(3) 100 km (4) 60 km

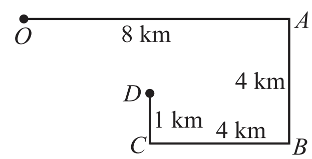
35. **Assertion:** The projectile has only vertical component of velocity at the highest point of its trajectory.

Reason: At the highest point, horizontal components of velocity present.

(1) If both (A) and (R) are true, and (R) is the correct explanation of (A).
(2) If both (A) and (R) are true but (R) is not the correct explanation of (A).
(3) If (A) is true but (R) is false.
(4) If (A) is false but (R) is true.

SECTION-B

36. A car moves from O to D along the path $OABCD$ shown in figure. What is distance travelled and net displacement.



(1) 16, 5 (2) 17, 5
(3) 20, 4 (4) 15, 3

37. Object is moving such that its velocity and acceleration are in opposite direction then

(1) Speed may be constant
(2) Speed may be increasing
(3) Speed must be decreasing
(4) Speed may be increasing or decreasing

38. A car accelerates from rest at a constant rate α for some time after which it decelerates at a constant rate β and comes to rest. If total time elapsed is t, then maximum velocity acquired by car will be

(1) $\frac{(\alpha^2-\beta^2)t}{\alpha\beta}$
(2) $\frac{(\alpha^2+\beta^2)t}{\alpha\beta}$
(3) $\frac{(\alpha+\beta)t}{\alpha\beta}$
(4) $\frac{\alpha\beta t}{\alpha+\beta}$

39. A stone dropped from the top of the tower reaches ground in 4 sec. Height of the tower is (g = 10 m/s^2)

(1) 20 m (2) 40 m
(3) 60 m (4) 80 m

40. A stone thrown upwards with a speed 'u' from the top of the tower reaches the ground with a velocity $3u$. The height of the tower is:

(1) $\frac{4u^2}{g}$ (2) $\frac{2u^2}{g}$

(3) $\frac{8u^2}{g}$ (4) $\frac{7u^2}{g}$

41. A body is thrown upwards and reaches half of its maximum height. At that position

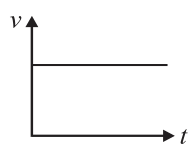
(1) its acceleration is constant

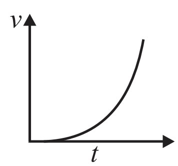
(2) its velocity is zero

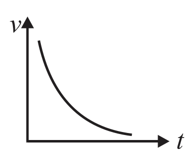
(3) its velocity is maximum

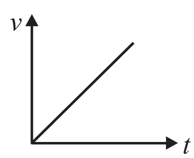
(4) its acceleration is minimum

42. Which of the following velocity-time graphs represent uniform motion?

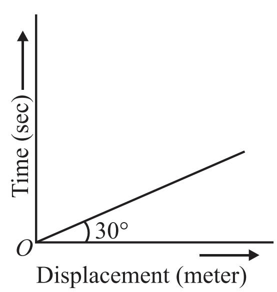
(1) 

(2) 

(3) 

(4) 

43. From the following displacement-time graph find out the velocity of a moving body



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

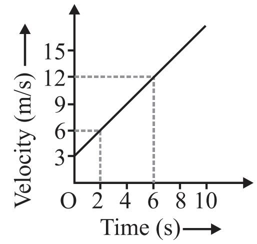
(3) $\sqrt{3}$ m/s (4) $\frac{1}{3}$ m/s

44. Object is projected up with speed u. It is at same height at 4 sec & 6 sec, then find velocity of projection

(1) 20 m/s (2) 30 m/s

(3) 50 m/s (4) 40 m/s

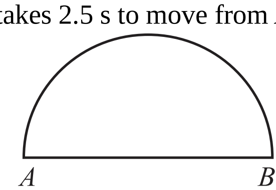
45. Calculate the acceleration using the graph shown below.



(1) 1 m/s^2 (2) 5 m/s^2

(3) 3 m/s^2 (4) 1.5 m/s^2

46. What is the magnitude of the average velocity of the particle moving on a semi-circle track of radius 5 m if it takes 2.5 s to move from A to B?



(1) 1 km (2) 2.5 m/s

(3) 4 m/s (4) 10 m/s

47. A car travels first 60 km with a uniform speed of 30 km/h and then next 40 km with a uniform speed of 20 km/h. Calculate its average speed.

(1) 20 km/h (2) 25 km/h

(3) 30 km/h (4) 50 km/h

48. A bike travels with an initial velocity of 17.5 m/s and acceleration 5 m/s^2. Find the distance travelled by the bike in first 10 seconds of its motion.

(1) 150 m (2) 425 m

(3) 300 m (4) 200 m

49. A man walks at the rate of 3 km/hr. Rain appears to him falling in vertical direction at the rate of $3\sqrt{3}$ km/hr. Which of the following options is correct regarding the actual velocity of rain?

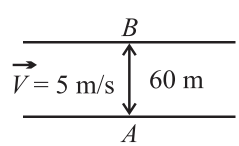
(1) 6 km/hr, inclined at an angle of 30° to the vertical towards the man's motion.

(2) 3 km/hr, inclined at an angle of 30° to the vertical towards the man's motion.

(3) 6 km/hr, inclined at an angle of 45° to the vertical towards the man's motion.

(4) 6 km/hr, inclined at an anlge of 60° to the vertical towards the man's motion.

50. A man is crossing a river flowing with velocity of 5 m/s. He reaches a point directly across at a distance of 60 m in 5 s. His velocity in still water should be

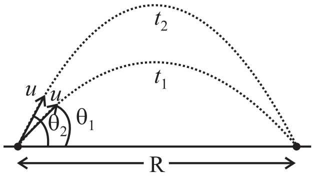


(1) 12 m/s (2) 13 m/s

Solution

1. **(1)**

$$R = \frac{2u^2 \sin\theta_1 \cos\theta_1}{g}$$



$$t_1 = \frac{2u\sin\theta_1}{g}$$

$$t_2 = \frac{2u\sin(90-\theta_1)}{g}$$

$$t_2 = \frac{2u\cos\theta_1}{g}$$

$$t_1 t_2 = \frac{4u^2 \sin\theta_1 \cos\theta_1}{g^2}$$

$$= \frac{2}{g}\frac{2u^2 \sin\theta_1 \cos\theta_1}{g}$$

$$t_1 t_2 = \frac{2R}{g}$$

$t_1 t_2 \propto R$

2. **(3)**

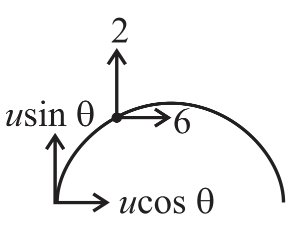
$x = 6t$, $y = 8t - 5t^2$

$V_x = \frac{dx}{dt} = 6\hat{i}$, $V_y = \frac{dy}{dt} = 8 - 10t$

$V_x = 6\hat{i}$, $V_{y_{t=0}} = 8\hat{j}$

$\vec{V}_i = 6\hat{i} + 8\hat{j} \Rightarrow |\vec{V}| = \sqrt{6^2 + 8^2}$ = 10 m/s

3. **(3)**



$2 = \sqrt{u^2 \sin^2\theta - 2hg}$

or $4 = u^2 \sin^2\theta - 2\,(0.4)\,(10)$

or $u^2 \sin^2\theta = 12$

or $u \sin\theta = 2\sqrt{3}$

and $u \cos\theta = 6$

$\therefore \tan\theta = \frac{1}{\sqrt{3}}$ or $\theta = 30°$

4. **(4)**

$$R = \frac{u^2 \sin 2\theta}{g}, H = \frac{u^2 \sin^2\theta}{2g}$$

R_{max} *at* $2\theta = 90° \Rightarrow \theta = 45°$

$$H_{max} = \frac{u^2}{2g}$$

$$\frac{u^2}{2g} = 10 \Rightarrow u^2 = 10g \times 2$$

$$R = \frac{u^2 \sin 2\theta}{g} \Rightarrow R_{max} = \frac{u^2}{g}$$

$$R_{max} = \frac{10 \times g \times 2}{g} = 20 \text{ metre}$$

5. **(2)**

6. **(1)**

$R = \frac{u^2}{g}$

$H = \frac{u^2 \sin^2 45°}{2g} = \frac{u^2}{4g} = \frac{R}{4}$

$R = 4H$

7. **(3)**

$x = a\cos\omega t$; $v_x = -a\omega\sin\omega t$

$y = a\sin\omega t$; $v_y = a\omega\cos\omega t$; $z = a\,\omega t$; $v_z = a\omega$

Speed of particle,

$$v = \sqrt{v_x^2 + v_y^2 + v_z^2} = \sqrt{a^2\omega^2 + a^2\omega^2} = a\omega\sqrt{2}$$

8. **(2)**

$\because x = \alpha t^3 \therefore \frac{dx}{dt} = 3\alpha t^2 \Rightarrow v_x = 3\alpha t^2$

Again $y = \beta t^3 \therefore \frac{dy}{dt} = 3\beta t^2 \Rightarrow v_y = 3\beta t^2$

$\therefore v^2 = v_x^2 + v_y^2$

or $v^2 = (3\alpha t^2)^2 + (3\beta t^2)^2 = (3t^2)^2\,(\alpha^2 + \beta^2)$

or $v = 3t^2\sqrt{\alpha^2 + \beta^2}$

9. **(2)**

Range,

$$R = \frac{v_0^2 \sin 2\theta}{g}; \frac{A_1}{A_2} = \frac{\pi R_{1max}^2}{\pi R_{2max}^2} = \frac{v_1^4}{v_2^4} = \frac{1}{16}$$

10. **(3)**

Given: $u = \hat{i} + 2\hat{j}$

As: $\vec{u} = u_x\hat{i} + u_y\hat{j} \because u_x = 1$ and $u_y = 2$

Also, $x = u_x t$ and $y = u_y t - \frac{1}{2}gt^2$

$\therefore x = t$

and $y = 2t - \frac{1}{2} \times 10 \times t^2 = 2t - 5t^2$

Equation of Trajectory is $y = 2x - 5x^2$

11. **(3)**

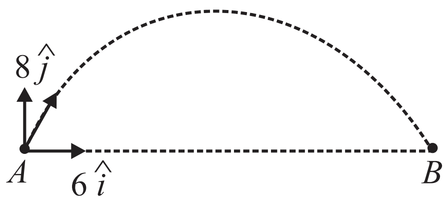
$$v_{avg} = \frac{2v_1v_2}{v_1+v_1} = \frac{2\times30\times70}{30+70} = 42 \text{ km/h}$$

12. **(2)**

$$h_{\max} = \frac{u^2\sin^2\theta}{2g} \propto \sin^2\theta$$

$$\frac{h_1}{h_2} = \frac{\sin^2\theta_1}{\sin^2\theta_2} = \frac{\sin^2 30^o}{\sin^2 60^o} = \frac{1/4}{3/4} = \frac{1}{3}$$

13. **(2)**



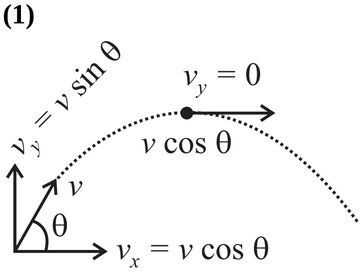
$\vec{u}_x = 6\hat{i} + 8\hat{j}$

$\vec{u}_x = 6\hat{i}$

$u_y = 8\hat{j}$

$$R = \frac{2u_xu_y}{g} = \frac{2\times6\times8}{10} = 9.6$$

14. **(1)**



$$v\cos\theta = \frac{1}{2}v$$

$$\cos\theta = \frac{1}{2}$$

$\theta = 60°$

15. **(2)**

$v = u + at$

$V_x = 3 + 0.4\times10 = 7$ m/s

$V_y = 4 + 0.3 \times 10 = 7$ m/s

$$\therefore\ V = \sqrt{V_x^2+V_y^2} = \sqrt{7^2+7^2} = 7\sqrt{2}$$

16. **(1)**

In the absence of air resistance, the projectile moves with constant horizontal velocity because acceleration due to gravity is totally vertical.

17. **(4)**

$$R = \frac{u^2}{g} \text{ and } H = \frac{u^2\sin^2\theta}{2g}$$

For the maximum range, $\theta = 45°$

$$\therefore H = \frac{u^2\sin^2 45°}{2g} = \frac{u^2}{4g} = \frac{R}{4}$$

18. **(1)**

$$H = \frac{v^2\sin^2\theta}{2g} \text{ and } R = \frac{v^2\sin2\theta}{g}$$

Since, $R = 2H$, so $\frac{v^2\sin2\theta}{g} = 2\times\frac{v^2\sin^2\theta}{2g}$

or $2\sin\theta\cos\theta = \sin^2\theta$ or $\tan\theta = 2$

$$\therefore\ R = v^2\times\frac{2}{g}\times\sin\theta\cos\theta$$

$$= \frac{2v^2}{g}\times\frac{2}{\sqrt5}\times\frac{1}{\sqrt5} = \frac{4v^2}{5g}$$

19. **(3)**

The acceleration is equal to g at every point of the path which is always directed downwards.

20. **(1)**

Velocity at the highest, $\vec{v_h} = \hat{i}\,(u\cos\theta)$

Velocity at the starting point

$$\vec{v_s} = \hat{i}\,(u\cos\theta) + \hat{j}\,(u\sin\theta)$$

$$\therefore\ |\Delta\vec{v}| = |\{\hat{i}\,(u\cos\theta) - i(u\cos\theta) - j(u\sin\theta)\}|$$

$$= u\sin\theta$$

21. **(3)**

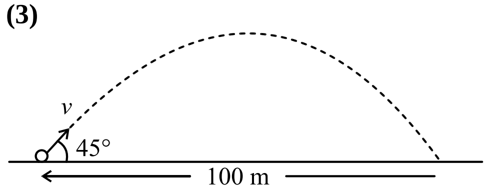
$$v_{avg} = \frac{d_1+d_2}{2t} = \frac{vt+vt}{2t} = v$$

22. **(2)**

for same Range

$\alpha = \theta$ and $\beta = 90° - \theta$

23. **(3)**



$$100 = \frac{v^2\sin(2\times45°)}{g} \Rightarrow \frac{v^2}{g}$$

for the greatest height to which he can throw, he must throw the stone vertically upward

$$H_{\max} = \frac{u^2}{2g} = \frac{100}{2} = 50 \text{ m.}$$

24. **(3)**

Horizontal component of velocity remains constant throughout the motion, as it is not affected by acceleration due to gravity which is directed vertically downward.

25. **(4)**

Range = 150 = ut and

$$h = \frac{15}{100} = \frac{1}{2} \times gt^2$$

or $t^2 = \frac{2 \times 15}{100 \times g} = \frac{30}{1000}$

$\therefore \quad t = \frac{\sqrt{3}}{10}$

$\therefore \quad u = \frac{150}{t} = \frac{150 \times 10}{\sqrt{3}} = 500\sqrt{3}\ \text{ms}^{-1}.$

26. **(2)**

$v_r = v_{mr} \sin\theta$

$\Rightarrow\ 1 = 2\sin\theta$

so $\theta = 30°$

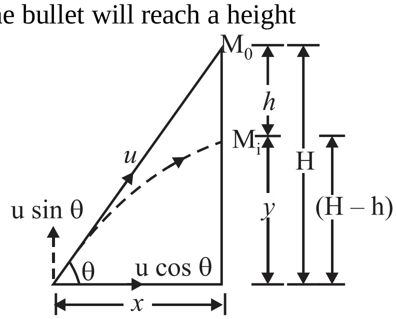
$\phi > = 90° + 30° = 120°$

27. **(4)**

If there were no gravity the bullet would reach height H in the time t taken by it to travel the horizontal distance x, i.e.

$$H = u\sin\theta \times t \text{ with } t = \frac{x}{u\cos\theta}$$

However, because of gravity the bullet has an acceleration g vertically downwards, so in time t the bullet will reach a height



$$y = u\sin\theta \times t - \frac{1}{2}gt^2 = H - \frac{1}{2}gt^2$$

This is lower than H by $\frac{1}{2}gt^2$ which is exactly the amount the monkey falls in this time. So the bullet will hit the monkey regardless of the initial velocity of the bullet so long as it is great enough to travel the horizontal distance to the tree before hitting the ground. lesser will be the time of motion; so the monkey is hit near its initial position and for smaller u it is hit just before it reaches the figure floor. Bullet will hit the monkey only and only if $y > 0$

i.e., $H - \frac{1}{2}gt^2 > 0$

or $H > \frac{1}{2}gt^2$ or $H > \frac{1}{2}g \cdot \frac{x^2}{u^2\cos^2\theta}$

or $u > \frac{x}{\cos\theta}\sqrt{\frac{g}{2H}}$

$$u > \sqrt{\frac{g}{2H}\left(x^2 + H^2\right)} = u_0$$

If $u < u_0$, the bullet will hit the ground before reaching the monkey.

28. **(3)**

$R = 2H$

29. **(4)**

Conceptual.

30. **(2)**

$u = 0 \quad a = \text{constant}$

$$s_{n^{\text{th}}} = u + \frac{a}{2}(2n-1) = \frac{a}{2}(2n-1)$$

$$s(n\text{ seconds}) = u(n) + \frac{1}{2}a(n)^2$$

$$= \frac{1}{2}an^2$$

$$\text{Ratio} = \frac{\frac{a}{2}(2n-1)}{\frac{1}{2}an^2} = \frac{2n-1}{n^2} = \frac{2}{n} - \frac{1}{n^2}$$

31. **(4)**

Let total distance = x

$$V_{av} = \frac{x}{t_1 + t_2} = \frac{x}{\frac{\frac{2}{5}x}{v_1} + \frac{\frac{3}{5}x}{v_2}}$$

$$= \frac{v_1 v_2}{\frac{2}{5}v_2 + \frac{3}{5}v_1} = \frac{5v_1v_2}{2v_2 + 3v_1}$$

32. **(2)**

$v = \sqrt{25 - 4x}$

$v^2 = 25 - 4x$

Differentiate w.r.t x

$$2v\frac{dv}{dx} = 0 - 4$$

$2(a) = -4$

$\therefore \quad a = -2\text{m/s}^2$

$|a| = 2\text{ m/s}^2$

33. **(2)**

Using $S = ut + \frac{1}{2}at^2$

34. **(4)**

H = Area under curve.

35. **(4)**

Assertion is false. At the highest point, the projectile possesses velocity only along horizontal direction.

36. **(2)**

$$\text{Distance} = |\overrightarrow{OA}| + |\overrightarrow{AB}| + |\overrightarrow{BC}| + |\overrightarrow{CD}|$$

$$= 8 + 4 + 4 + 1 = 17 \text{ km}$$

Displacement

$$= \overrightarrow{OA} + \overrightarrow{AB} + \overrightarrow{BC} + \overrightarrow{CD}$$

$$= 8\hat{i} + (-4\hat{j}) + (-4\hat{i}) + \hat{j} = 4\hat{i} - 3\hat{j}$$

$$\Rightarrow^* \text{ displacement}^* = \sqrt{(4)^2 + (3)^2} = 5$$

So, Displacement = 5 km, 37° S of E

37. **(3)**

Acceleration = Rate of change of velocity. When acceleration is in opposite direction to velocity, it is called as negative acceleration or retardation. Retardation causes velocity to decrease.

38. **(4)**

Correct option is D)

Let maximum velocity = v

Now, $v = 0 + \text{at}_1$

Similarly, $0 = v - \beta \text{t}_2$

From the above equations we get,

$$t_1 = \frac{v}{\alpha} \;\&\; t_2 = \frac{v}{\beta}$$

$$t_1 + t_2 = t = \frac{v}{\alpha} + \frac{v}{\beta}$$

$$\Rightarrow v = \frac{\alpha\beta}{\alpha + \beta}t$$

39. **(4)**

Initial speed of the stone $u = 0$ m/s

Time taken by the stone to reach the ground $t = 4$ s

Height of the tower $H = ut + \frac{1}{2}at^2$

$$\therefore H = 0 + \frac{1}{2} \times 10 \times 4^2$$

$\Rightarrow$ H = 80 m

40. **(1)**

$v^2 = u^2 + 2gh$

$$h = \frac{v^2 - u^2}{2g} = \frac{9u^2 - u^2}{2g} = \frac{4u^2}{g}$$

41. **(1)**

During the complete journey, acceleration ($a = g$) remains constant.

42. **(1)**

Uniform motion means that the velocity of the body is constant with time i.e v = constant Hence option 1 is correct.

43. **(3)**

In first instant you will apply $v = \tan\theta$ and say,

$$v = \tan 30^\circ = \frac{1}{\sqrt{3}} \text{ m/s.}$$

But it is wrong because formula $v = \tan\theta$ is valid when angle is measured with time axis. Here angle is taken from displacement axis. So angle from time axis 90° – 30°= 60°

Now $v = \tan 60^\circ = \sqrt{3}$.

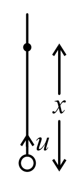
44. **(3)**

Given, upward velocity = u

Let x = displacement of particle at time $t = 6$ s and $t = 4$ s

Now, using equation of motion:

At $t = 4$ s,



$$S = ut + \frac{1}{2}at^2$$

$$x = u(4) - \frac{1}{2}g \times (4)^2$$

$x = 4u - 80$ …(i)

At $t = 6$s,

$$x = 6u - \frac{1}{2}g(6)^2$$

$x = 6u - 180$ …(ii)

On equating ens (i) & (ii) -.

or,

$4u - 80 = 6u - 180$

$100u = 2u$

or, we have, $u = 50$ m/s

45. **(4)**

Slope of the v-t graph gives acceleration,

$$a = \frac{12 - 3}{6 - 0} = 1.5 \text{ m/s}^2$$

46. **(3)**

Net displacement = 2r = 10 m

Time = 2.5 s

Average velocity = 10/2.5 = 4 m/s

47. **(2)**

$s = s_1 + s_2 = 60 + 40 = 100$ m

Total time take to cover this distance

$$T = \frac{s_1}{v_1} + \frac{s_2}{v_2}$$

$$= \frac{60}{30} + \frac{40}{20} = 4 \text{ h}$$

Average speed

$$u_{av} = \frac{\text{Total distance}}{\text{Total time}}$$

$$= \frac{100}{4} = 25 \text{ km/h}$$

48. **(2)**

$$s = ut + \frac{1}{2}at^2$$

$$s = (17.5 \times 10) + \left(\frac{1}{2} \times 5 \times 100\right)$$

$$= 175 + 250 = 425 \text{ m}$$

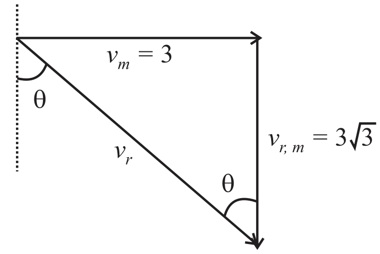
49. **(1)**

Inclined at an angle of 30° to the vertical towards the man's motion.

Let $\vec{V}_r$ be the actual velocity of rain.

Speed of rain w.r.t. man, $v_{r/m} = 3\sqrt{3}$ km/hr

Speed of man w.r.t. ground, $v_m = 3$ km/hr



$$\vec{v}_{r/m} = \vec{v}_r - \vec{v}_m$$

$$\vec{v}_r = \vec{v}_{r/m} + \vec{v}_m$$

$$|\vec{v}_r| = \sqrt{v_{r/m}^2 + v_m^2}$$

$$= \sqrt{(3)^2 + (3\sqrt{3})^2} = 6 \text{ km/hr}$$

$$\tan\theta = \frac{3}{3\sqrt{3}} = \frac{1}{\sqrt{3}} \Rightarrow \theta = 30°$$

50. **(2)**

His velocity in x direction should counter the flow so as to reach the point across, i.e. $v_x = 5$ m/s

Velocity in y should be such that the reaches 60 m in 5 seconds, i.e., $v_y = 12$ m/s

Thus total velocity, $v = \sqrt{v_x^2 + v_y^2} = 13$ m/s