CHAPTER

4

MOTION IN A STRAIGHT LINE

Exercise 1: NCERT Based Topic-wise MCQs

4.1 INTRODUCTION

1. Which of the following is a one dimensional motion ? NCERT Page-40 / N-13
   (a) Motion of snake (b) Motion of air particle
   (c) Motion of satellite (d) Motion of train running on a straight track

Position, Path Length and Displacement

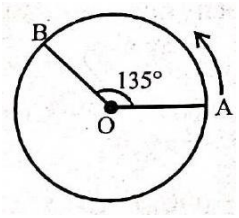
2. The location of a particle has changed. What can we say about the displacement and the distance covered by the particle? NCERT Page-41
   (a) Neither can be zero (b) One may be zero (c) Both may be zero (d) One is +ve, other is -ve

3. The displacement of a body is zero. The distance covered NCERT Page-41
   (a) is zero (b) is not zero
   (c) may or may not be zero (d) depends upon the acceleration

4. The numerical ratio of displacement to distance for a moving object is NCERT Page-41
   (a) always less than 1 (b) always equal to 1 (c) always more than 1 (d) equal to or less than 1

5. Which of the following can be zero, when a particle is in motion for some time? NCERT Page-41
   (a) Distance (b) Displacement (c) Speed (d) None of these

6. A person moved from A to B on a circular path as shown in figure. If the distance travelled by him is 60 m, then the magnitude of displacement would be : (Given $\cos 135^\circ = -0.7$)
   NCERT Page-41



   (a) 42 m (b) 47 m (c) 19 m (d) 40 m

7. An athlete completes one round of a circular track of radius R in 40sec. What will be his displacement at the end of 3 min. 20sec ? NCERT Page-41

(a) Zero (b) 2R (c) $2\pi R$ (d) $7\pi R$

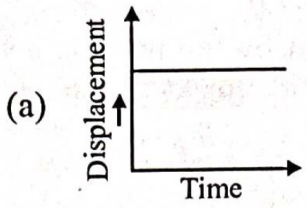
8. A particle moves 2 m east then 4 m north then 5 m west. The distance NCERT Page-40

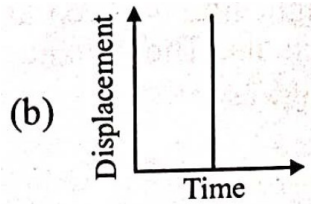
(a) 11 m (b) 10 m (c) -11 m (d) 5 m

9. A particle moves from (2,3)m to (4,1)m. The magnitude of displacement is NCERT Page-41

(a) 2 m (b) $2\sqrt{3}$ m (c) $2\sqrt{2}$ m (d) $3\sqrt{2}$ m

10. Which of the following is not possible for a body in uniform motion? NCERT Page-41

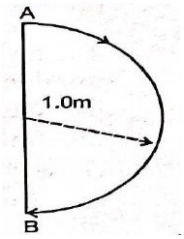




(c) Both (a) & (b) (d) None of these

Average Velocity and Average Speed

11. In 1.0 s, a particle goes from point A to point B, moving in a semicircle of radius 1.0 m (see Figure). The magnitude of the average velocity is NCERT Page-42



(a) 3.14 m/s (b) 2.0 m/s (c) 1.0 m/s (d) Zero

12. A body moves in straight line with velocity v_1 for $1/3^{rd}$ time and for remaining time with v_2. Find average velocity. NCERT Page-42

(a) $\frac{v_1}{3}+\frac{2v_2}{3}$ (b) $\frac{v_1}{3}+\frac{v_2}{3}$ (c) $\frac{2v_1}{3}+\frac{v_2}{3}$ (d) $v_1+\frac{2v_2}{3}$

13. A particle moves in straight line with velocity 6 m/s and 3 m/s for time intervals which are in ratio 1: 2. Find average velocity. NCERT Page-42

(a) 2 m/s (b) 3 m/s (c) 4 m/s (d) 5 m/s

14. A man leaves his house for a cycle ride. He comes back to his house after half-an-hour after covering a distance of one km. What is his average velocity for the ride? NCERT Page-42

(a) zero (b) 2 km h^{-1} (c) 10 km s^{-1} (d) $\frac{1}{2}$ km s^{-1}

15. A point traversed half of the distance with a velocity v_0. The half of remaining part of the distance was covered with velocity v_1 & second half of remaining part by v_2 velocity. The mean velocity of the point, averaged over the whole time of motion is NCERT Page-42

(a) $\frac{v_0+v_1+v_2}{3}$ (b) $\frac{2v_0+v_1+v_2}{3}$ (c) $\frac{v_0+.2v_1+2v_2}{3}$ (d) $\frac{2v_0(v_1+v_2)}{(2v_0+v_1+v_2)}$

4.2 Instantaneous Velocity & Speed

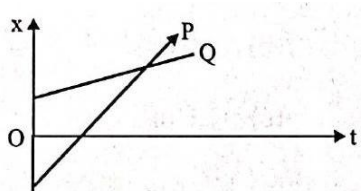
16. The instantaneous velocity of a particle moving in a straight line is given as $v = \alpha t + \beta t^2$, where α and β are constants. The distance travelled by the particle between 1 s and 2 s is: NCERT Page-43/N-14

(a) $3\alpha + 7\beta$ (b) $\frac{3}{2}\alpha + \frac{7}{3}\beta$ (c) $\frac{\alpha}{2} + \frac{\beta}{3}$ (d) $\frac{3}{2}\alpha + \frac{7}{2}\beta$

17. Two buses P & Q start from a point at the same time and move in a straight line and their positions are represented by $X_P(t) = \alpha t + \beta t^2$ and $X_Q(t) = ft - t^2$. At what time, both the buses have same velocity?

(a) $\frac{\alpha-f}{1+\beta}$ (b) $\frac{\alpha+f}{2(\beta-1)}$ (c) $\frac{\alpha+f}{2(1+\beta)}$ (d) $\frac{f-\alpha}{2(1+\beta)}$ NCERT Page-43 / N-14

18. The fig given shows the time displacement curve of two particles P and Q. Which of the following statement is correct? NCERT Page-52



(a) Both P and Q move with uniform equal speed

(b) P is accelerated Q is retarded

(c) Both P and Q move with uniform speeds but the speed of P is more than the speed of Q

(d) Both P and Q move with uniform speeds but the speed of Q is more than the speed of P.

19. The distance travelled by a body is directly proportional to the time taken. Its speed NCERT Page-42/N-14

(a) increases (b) decreases (c) becomes zero (d) remains constant

20. The slope of velocity-time graph for motion with uniform velocity is equal to NCERT Page-46, 47/N-16

(a) final velocity (b) initial velocity (c) zero (d) none of these

21. The ratio of the numerical values of the average velocity and average speed of a body NCERT -42/N-14

(a) unity (b) unity or less (c) unity or more (d) less than unity

22. The slope of the tangent drawn on position-time graph at any instant is equal to the instantaneous

(a) acceleration (b) force (c) velocity (d) momentum NCERT -43/N-14

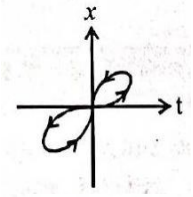
23. The displacement-time graphs of two particles A and B are straight lines making angles of $30°$ and $60°$ respectively with the time axis. If the velocity of A is v_A and that of B is v_B, the value of v_A/v_B is

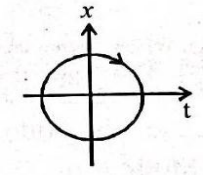
(a) ½ (b) $1/\sqrt{3}$ (c) $\sqrt{3}$ (d) $1/3$ NCERT Page-41/N-14

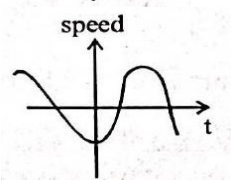
24. Choose the wrong statement from the following. NCERT Page-47/N-16

(a) The motion of an object along a straight line is a rectilinear motion.
(b) The speed in general is less than the magnitude of the velocity.
(c) The slope of the displacement-time graph gives the velocity of the body.
(d) The area under the velocity-time graph gives the displacement of the body.

25. Which of following graph cannot possibly represent 1D motion of a particle? NCERT -40/N-13

(a) 

(b) 

(c) 

(d) All of these

26. The total distance travelled by the body in the given time is equal to NCERT Page-47/N-16

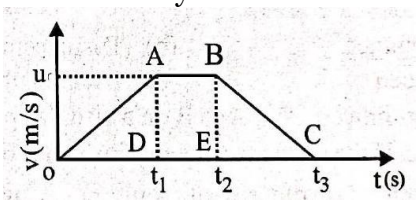
(a) the area which $v - t$ graph encloses with displacement axis
(b) the area which $x - t$ graph encloses with time axis
(c) the area which $\mathrm{v} - \mathrm{t}$ graph encloses with time axis
(d) the area which a - t graph encloses with axis

27. Choose the correct equation to determine distance in a straight line for a body with uniform motion.

(a) $s = \frac{v}{t}$ (b) $s = v^2t$ NCERT Page-47/N-16

(c) $s = ut + \frac{1}{2}at^2$ (d) $\mathrm{s} = \mathrm{v} \times \mathrm{t}^2$

28. The velocity time graph of the motion of the body is as shown below NCERT Page-47 / N-16



The total distance travelled by the body during the motion is equal to

(a) $\frac{1}{2}(\mathrm{AD} + \mathrm{BE}) \times \mathrm{OC}$ (b) $\frac{1}{2}(\mathrm{OA} + \mathrm{BC}) \times \mathrm{OC}$

(c) $\frac{1}{2}(\mathrm{OC} + \mathrm{AB}) \times \mathrm{AD}$ (d) $\frac{1}{2}(\mathrm{OA} + \mathrm{AB}) \times \mathrm{BC}$

4.3 ACCELERATION

29. What is the rate of change of velocity of an object in uniform motion? NCERT Page-47 / N-16
(a) Always equal to zero (b) Always less than one
(c) Always greater than one (d) Either less than or equal to one.

30. What determines the nature of the path followed by the particle? NCERT Page-45/N-16
(a) Speed (b) Velocity (c) Acceleration (d) Both (b) and (c)

31. The acceleration of a moving body can be found from NCERT Page-45/N-16
(a) area under velocity - time graph (b) area under distance -time graph
(c) slope of the velocity- time graph (d) slope of distance-time graph

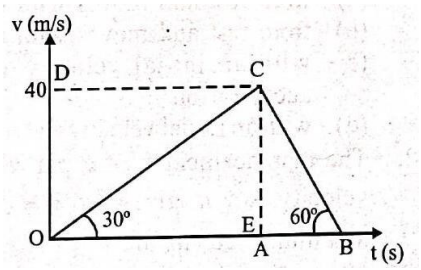
32. Acceleration of a particle changes when NCERT Page-45/N-16
(a) direction of velocity changes (b) magnitude of velocity changes
(c) speed changes (d) Both (a) and (b)

33. The area under acceleration time graph gives NCERT Page-45/N-16
(a) distance travelled (b) change in acceleration
(c) force acting (d) change in velocity

34. Which of the following is the correct expression of instantaneous acceleration? NCERT Page-45 / N-16
(a) $a = \frac{\Delta v}{(\Delta t)^2}$ (b) $a = \frac{dv}{dt}$ (c) $a = \frac{d^2v}{dt^2}$ (d) $a = \left(\frac{\Delta v}{\Delta t}\right)^2$

35. The displacement of a particle is represented by the following equation: $S = 3t^3 + 7t^2 + 5t + 8$ where 5 is in meter and t in second. The acceleration of the particle at $t = 15$ is NCERT Page-45/N-16
(a) $14\ \text{m/s}^2$ (b) $18\ \text{m/s}^2$ (c) $32\ \text{m/s}^2$ (d) zero

36. The velocity-time graph of a body is shown in fig. The ratio of average acceleration during the intervals OA and AB is NCERT Page-45/N-16



(a) 1 (b) $\frac{1}{2}$ (c) $\frac{1}{3}$ (d) 3

37. The distance time graph of a particle at time t makes angles $45°$ with the time axis. After one second, it makes angle $60°$ with the time axis. What is the acceleration of the particle? NCERT Page-46 / N-16
(a) $\sqrt{3} - 1$ (b) $\sqrt{3} + 1$ (c) $\sqrt{3}$ (d) 1

38. The displacement x of a particle along a straight line at time t is given by: $x = a_0 + \frac{a_1 t}{2} + \frac{a_2}{3}t^2$. The acceleration of the particle is NCERT Page-45/N-16

(a) $\frac{a_2}{3}$ (b) $\frac{2a_2}{3}$ (c) $\frac{a_1}{2}$ (d) $a_0 + \frac{a_2}{3}$

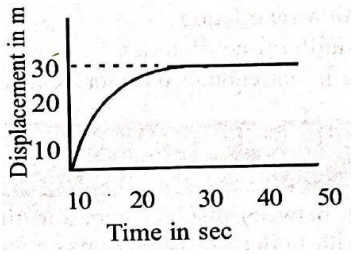
39. The dependence of velocity of a body with time is given by the equation $v = 20 + 0.1t^2$. The body is in NCERT 45/N-16

(a) uniform retardation (b) uniform acceleration
(c) non-uniform acceleration (d) zero acceleration.

40. The deceleration experienced by a moving motorboat after its engine is cut off, is given by $\frac{dv}{dt} = -KV^3$ where K is constant. If V_0 is the magnitude of the velocity at cut-off, the magnitude of the velocity at a time t after the cut-off is NCERT Page-45/N-16

(a) $\frac{V_0}{\sqrt{(2\,V_0^2 Kt+1)}}$ (b) $V_0 e^{-Kt}$ (c) $V_0/2$ (d) V_0

41. The displacement of a particle as a function of time is shown in figure. It indicates that NCERT-46/N-16



(a) the velocity of the particle is constant throughout
(b) the acceleration of the particle is constant throughout
(c) the particle starts with a constant velocity and is accelerated
(d) the motion is retarded and finally the particle stops

42. A particle moves along a straight line OX. At a time t (in second) the distance x (in metre) of the particle from O is given by $x = 40 + 12t - t^3$. How long would the particle travel before coming to rest?

(a) 24 m (b) 40 m. (c) 56 m (d) 16 m NCERT Page-43 / N-14

43. A particle moves a distance x in time t according to equation $x = (t+5)^{-1}$. The acceleration of particle is proportional to NCERT Page-45 / N-16

(a) (velocity)$^{3/2}$ (b) (distance)^2 (c) (distance) $^{-2}$ (d) (velocity) $^{2/3}$

44. A particle is moving eastwards with a velocity of $5\ ms^{-1}$. In 10 seconds the velocity changes to $5\ ms^{-1}$ northwards. The average acceleration in this time is NCERT Page-45 / N-16

(a) $\frac{1}{2}\ ms^{-2}$ towards north (b) $\frac{1}{\sqrt{2}}\ ms^{-2}$ towards north - east
(c) $\frac{1}{\sqrt{2}}\ ms^{-2}$ towards north – west (d) zero

45. It is given that $t = px^2 + qx$, where x is displacement and t is time. The acceleration of particle at origin is

(a) $-\frac{2p}{q^3}$ (b) $-\frac{2q}{p^3}$ (c) $\frac{2p}{q^3}$ (d) $\frac{2q}{p^3}$ NCERT Page-45/N-16

46. An object, moving with a speed of $6.25\ \text{m/s}$, is decelerated at a rate given by: $\frac{dv}{dt} = -2.5\sqrt{v}$ where v is the instantaneous speed. The time taken by the object, to come to rest, would be NCERT Page-45 / N-16

(a) $2\ \text{s}$ (b) $4\ \text{s}$ (c) $8\ \text{s}$ (d) $1\ \text{s}$

47. The position of a particle along the x-axis at certain times is given below NCERT Page-45 / N-16

$t(s)$	0	1	2	3
$x(m)$	-2	0	6	16

Which of the following describes the motion correctly?

(a) uniform acceleration
(b) uniform retardation
(c) non-uniform acceleration
(d) there is not enough data for generalization

4.4 Kinematic Equations for Uniformly Accelerated Motion

48. The graph between displacement and time for a particle moving with uniform acceleration is a/an NCERT Page-48/N-17

(a) straight line with a positive slope
(b) parabola
(c) ellipse
(d) straight line parallel to time axis

49. In a car race on straight road, car A takes a time t less than car B at the finish and passes finishing point with a speed ' v ' more than of car B. Both the cars start from rest and travel with constant acceleration a_1 and a_2 respectively. Then ' v ' is equal to: NCERT Page-48 / N-18

(a) $\frac{2a_1a_2}{a_1+a_2}t$ (b) $\sqrt{2a_1a_2}t$ (c) $\sqrt{a_1a_2}t$ (d) $\frac{a_1+a_2}{2}t$

50. Velocity time curve for a body projected vertically upwards is NCERT Page-50 / N-19

(a) parabola (b) ellipse
(c) hyperbola (d) straight line

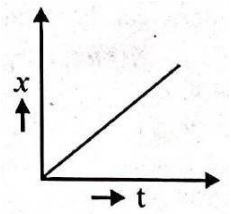
51. A bus starts moving with acceleration $2\ \text{m/s}^2$. A cyclist $96\ \text{m}$ behind the bus starts simultaneously towards the bus at $20\ \text{m/s}$. After what time will he be able to overtake the bus NCERT Page-48 / N-17

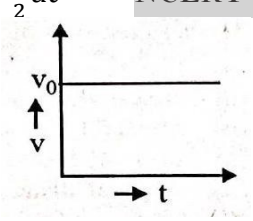
(a) 4sec (b) 8sec (c) 18sec (d) 16sec

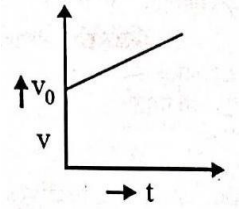
52. Stopping distance of a moving vehicle is directly proportional to NCERT Page-50/N-19

(a) square of the initial velocity
(b) square of the initial acceleration
(c) the initial velocity
(d) the initial acceleration

53. Which of the following graphs gives the equation $x = v_0 t + \frac{1}{2}at^2$ NCERT Page-48/N-17

(a) 

(b) 

(c) 

(d) None of these

54. If a train travelling at $20\ m/s$ is to be brought to rest in a distance of $200\ m$, then its retardation should be

(a) $1\ m/s^2$ (b) $2\ m/s^2$ NCERT Page-48/N-18

(c) $10\ m/s^2$ (d) $20\ m/s^2$

55. A body starts from rest and travels 's' m in 2^{nd} second, then acceleration is NCERT Page-47/N-18

(a) $2\ s\ m/s^2$ (b) $3\ s\ m/s^2$ (c) $\frac{2}{3}\ s\ m/s^2$ (d) $\frac{3}{2}\ s\ m/s^2$

56. A bullet fired into a wooden block loses half of its velocity after penetrating $40\ cm$. It comes to rest after penetrating a further distance of NCERT Page-48/N-18

(a) $\frac{22}{3}\ cm$ (b) $\frac{40}{3}\ cm$ (c) $\frac{20}{3}\ cm$ (d) $\frac{22}{5}\ cm$

57. A body covers $26,28,30,32$ meters in 10^{th}, 11^{th}, 12^{th} and 13^{th} seconds respectively. The body starts NCERT Page-48 / N-18

(a) from rest and moves with uniform velocity

(b) from rest and moves with uniform acceleration

(c) with an initial velocity and moves with uniform acceleration

(d) with an initial velocity and moves with uniform velocity

58. The displacement x of a particle at the instant when its velocity is v is given by $v = \sqrt{3x + 16}$. Its acceleration and initial velocity are NCERT Page-48/N-18

(a) 1.5 units, 4 units (b) 3 units, 4 units

(c) 16 units, 1.6 units (d) 16 units, 3 units

59. A particle experiences constant acceleration for 20 seconds after starting from rest. If it travels a distance s_1 in the first 10 seconds and distance s_2 in the next 10 seconds, then NCERT Page-48/N-18

(a) $s_2 = s_1$ (b) $s_2 = 2\ s_1$

(c) $s_2 = 3\ s_1$ (d) $s_2 = 4\ s_1$

60. The distance travelled by a particle starting from rest and moving with an acceleration $\frac{4}{3}\ ms^{-2}$, in the third second is: NCERT Page-48/N-18

(a) $6\ m$ (b) $4\ m$ (c) $\frac{10}{3}\ m$ (d) $\frac{19}{3}\ m$

61. If a car at rest accelerates uniformly to a speed of $144\ \text{km/h}$ in $20\ \text{s}$, it covers a distance of

(a) $2880\ \text{m}$ (b) $1440\ \text{m}$ NCERT Page-48/N-18

(c) $400\ \text{m}$ (d) $20\ \text{m}$

62. 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 the total time elapsed is t, then the maximum velocity acquired by the car is

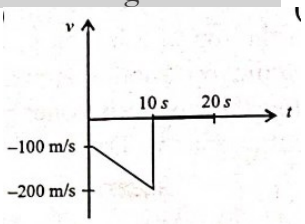
(a) $\left(\frac{\alpha^2+\beta^2}{\alpha\beta}\right)t$ (b) $\left(\frac{\alpha^2-\beta^2}{\alpha\beta}\right)$ NCERT Page-47/N-17

(c) $\frac{(\alpha+\beta)t}{\alpha\beta}$ (d) $\frac{\alpha\beta t}{\alpha+\beta}$

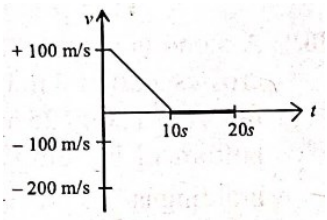
63. A bullet is shot vertically downwards with an initial velocity of $100\ \text{m/s}$ from a certain height. Within $10\ \text{s}$, the bullet reaches the ground and instantaneously comes to rest due to the perfectly inelastic collision. The velocitytime curve for total time $t = 20s$ will be: (Take $g = 10\ \text{m/s}^2$)

NCERT Page-49/N-19

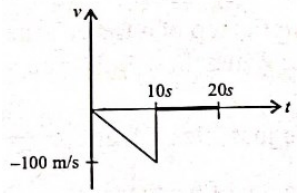
(a)



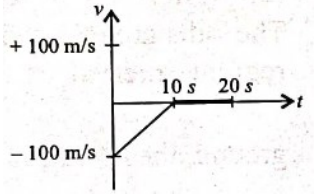
(b)



(c)



(d)



64. A bike accelerates from rest at a constant rate $5\ \text{m/s}^2$ for some time after which it decelerates at a constant rate $3\ \text{m/s}^2$ to come to rest. If the total time elapsed is 8 second, the maximum velocity acquired by the bike is given by NCERT Page-47/N-17

(a) $5\ \text{m/s}$ (b) $10\ \text{m/s}$ (c) $12\ \text{m/s}$ (d) $15\ \text{m/s}$

65. A metro train starts from rest and in $5\ \text{s}$ achieves $108\ \text{km/h}$. After that it moves with constant velocity and comes to rest after travelling $45\ \text{m}$ with uniform retardation. If total distance travelled is $395\ \text{m}$, find total time of travelling. NCERT Page-48/N-18

(a) $12.2\ \text{s}$ (b) $15.3\ \text{s}$ (c) $9\ \text{s}$ (d) $17.2\ \text{s}$

66. A car, starting from rest, accelerates at the rate f through a distance S, then continues at constant speed for time t and then decelerates at the rate $\frac{f}{2}$ to come to rest. If the total distance traversed is $15\ \text{S}$, then

(a) $\text{S} = \frac{1}{6}\text{ft}^2$ (b) $S = ft$ NCERT Page-48/N-18

(c) $\text{S} = \frac{1}{4}\text{ft}^2$ (d) $\text{S} = \frac{1}{72}\text{ft}^2$

67. A particle starting with certain initial velocity and uniform acceleration covers a distance of $12\ \text{m}$ in first 3 seconds and a distance of $30\ \text{m}$.in next 3 seconds. The initial velocity of the particle is NCERT-48/N-18

(a) $3\ \text{ms}^{-1}$ (b) $2.5\ \text{ms}^{-1}$ (c) $2\ \text{ms}^{-1}$ (d) $1\ \text{ms}^{-1}$

68. A body is thrown vertically upwards. If air resistance is to be taken into account, then the time during which the body rises is NCERT Page-49 / N-19

(a) equal to the time of fall (b) less than the time of fall
(c) greater than the time of fall (d) twice the time of fall

69. A body is thrown upwards and reaches half of its maximum height. At that position NCERT Page-49 / N-19

(a) its acceleration is minimum (b) its velocity is maximum
(c) its velocity is zero (d) its acceleration is constant

70. Velocity-time curve for a body projected vertically upwards is NCERT Page-50/N-20

(a) parabola (b) ellipse (c) hyperbola (d) straight line

71. An object accelerated downward under the influence of force of gravity. The motion of object is said to be

(a) uniform motion (b) free fall NCERT Page-49/N-20
(c) non uniformly accelerated motion (d) None of these

72. Free fall of an object (in vacuum) is a case of motion with NCERT Page-49/N-19

(a) uniform velocity (b) uniform acceleration
(c) variable acceleration (d) constant momentum

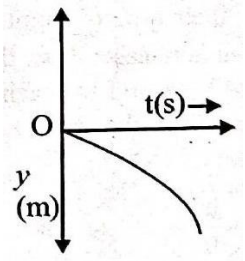
73. A ball thrown vertically upwards after reaching a maximum height h, returns to the starting point after a time of 10 s. Its displacement is NCERT Page-49/N-19

(a) h (b) $2h$ (c) $10h$ (d) zero

74. A ball is released from a height h. If t_1 and t_2 be the time required to complete first half and second half of the distance respectively. Then, choose the correct relation between t_1 and t_2. NCERT Page-49/N-19

(a) $t_1 = (\sqrt{2})t_2$ (b) $t_1 = (\sqrt{2}-1)t_2$ (c) $t_2 = (\sqrt{2}+1)t_1$ (d) $t_2 = (\sqrt{2}-1)t_1$

75. The equation represented by the graph below is : NCERT Page-50/N-20



(a) $y = \frac{1}{2}gt$ (b) $y = \frac{-1}{2}gt$ (c) $y = \frac{1}{2}gt^2$ (d) $y = \frac{-1}{2}gt^2$

76. A body is projected vertically upwards. If t_1 and t_2 be the times at which it is at height h above the projection while ascending and descending respectively, then h is NCERT Page-49/N-19

(a) $\frac{1}{2}gt_1t_2$ (b) gt_1t_2 (c) $2gt_1t_2$ (d) $2hg$.

77. From a tower of height 400 m, a particle is thrown vertically upwards with a speed of 10 m/s. If the time taken by if to reach the highest point is T then the time taken by the particle to hit the ground is

(a) 20 T (b) 15 T (c) 10 T (d) 5 T NCERT Page-49/N-19

78. A rocket is fired upward from the earth's surface such that it creates an acceleration of $19.6\ \text{ms}^{-2}$. If after $5\ \text{s}$, its engine is switched off, the maximum height of the rocket from earth's surface would be

(a) $980\ \text{m}$ (b) $735\ \text{m}$ (c) $490\ \text{m}$ (d) $245\ \text{m}$ NCERT Page-49/N-19

79. A man throws balls with same speed vertically upwards one after the other at an interval of 2sec. What should be the speed of throw so that more than two balls are in air at any time? NCERT Page-49/N-19

(a) Only with speed $19.6\ \text{m/s}$ (b) More than $19.6\ \text{m/s}$

(c) At least $9.8\ \text{m/s}$ (d) Any speed less then $19.6\ \text{m/s}$.

80. A ball is dropped from a high rise platform at $t = 0$ starting from rest. After 6 seconds another ball is thrown downwards from the same platform with a speed v. The two balls meet at $t = 18\ \text{s}$. What is the value of v ? (take $g = \frac{10\ \text{m}}{\text{s}^2}$) NCERT Page-49/N-19

(a) $\frac{75\ \text{m}}{\text{s}}$ (b) $\frac{55\ \text{m}}{\text{s}}$ (c) $\frac{40\ \text{m}}{\text{s}}$ (d) $\frac{60\ \text{m}}{\text{s}}$

81. A stone falls freely under gravity. It covers distances h_1, h_2 and h_3 in the first 5 seconds, the next 5 seconds and the next 5 seconds respectively. The relation between h_1, h_2 and h_3 NCERT Page-49/N-19

(a) $\text{h}_1 = \frac{\text{h}_2}{3} = \frac{\text{h}_3}{5}$ (b) $\text{h}_2 = 3\ \text{h}_1$ and $\text{h}_3 = 3\ \text{h}_2$

(c) $h_1 = h_2 = h_3$ (d) $\text{h}_1 = 2\ \text{h}_2 = 3\ \text{h}_3$

82. From a building two balls A and B are thrown such that A is thrown upwards and B downwards (both vertically). If T_A and T_B are their respective time of flights then NCERT Page-49/N-19

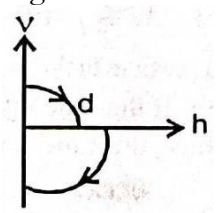
(a) $T_A > T_B$ (b) $T_A = T_B$ (c) $\text{T}_\text{A} < \text{T}_\text{B}$ (d) their time of flights depend on their masses.

83. A ball is released from the top of tower of height h metre. It takes T second to reach the ground. What is the position in (m) from the ground of the ball in $T/3$ second? NCERT Page-49 / N-19

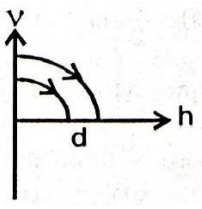
(a) $\frac{h}{9}$ (b) $\frac{7\ \text{h}}{9}$ (c) $\frac{8\ \text{h}}{9}$ (d) $\frac{17\ \text{h}}{18}$

84. A ball is dropped vertically from a height d above the ground. It hits the ground and bounces up vertically to a height $d/2$. Neglecting subsequent motion and air resistance, its velocity v varies with the height h above the ground as NCERT Page-49 / N-19

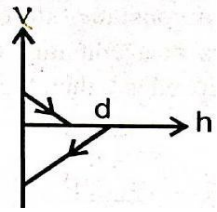
(a)



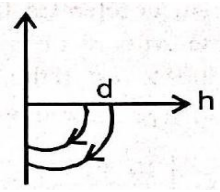
(b)



(c)



(c)



85. A stone is dropped into a well in which the level of water is h below the top of the well. If v is velocity of sound, the time T after which the splash is heard is given by NCERT Page-49 / N-19

(a) $\mathrm{T} = 2\,\mathrm{h/v}$ (b) $\mathrm{T} = \sqrt{\left(\frac{2\,\mathrm{h}}{\mathrm{g}}\right)} + \frac{\mathrm{h}}{\mathrm{v}}$

(c) $T = \sqrt{\left(\frac{2h}{v}\right)} + \frac{h}{g}$ (d) $\mathrm{T} = \sqrt{\left(\frac{\mathrm{h}}{2\,\mathrm{g}}\right)} + \frac{2\,\mathrm{h}}{\mathrm{v}}$

86. A stone is dropped from the top of a building. When it crosses a point $5\ \mathrm{m}$ below the top, another stone starts to fall from a point $25\ \mathrm{m}$ below the top. Both stones reach the bottom of building simultaneously. The height of the building is NCERT Page-49/N-19

(a) $35\ \mathrm{m}$ (b) $45\ \mathrm{m}$ (c) $25\ \mathrm{m}$ (d) $50\ \mathrm{m}$

87. The balls are released from the top of a tower of height H at regular interval of time. When first ball reaches at the ground, the n^{th} ball is to be just released and $\left(\frac{\mathrm{n}+1}{2}\right)^{\mathrm{th}}$ ball is at same distance ' h ' from top of the tower. The value of h is NCERT Page-49/N-19

(a) $\frac{2}{3}\mathrm{H}$ (b) $\frac{3}{4}\mathrm{H}$ (c) $\frac{4}{5}\mathrm{H}$ (d) $\frac{5\mathrm{H}}{6}$

88. A stone is dropped from a rising balloon at a height of $76\ \mathrm{m}$ above the ground and reaches the ground in $6\ \mathrm{s}$. What was the velocity of the balloon when the stone was dropped? Take $\mathrm{g} = 10\ \mathrm{m/s^2}$.

(a) $\left(\frac{52}{3}\right)\mathrm{m/s}$ upward (b) $\left(\frac{52}{3}\right)\mathrm{m/s}$ downward NCERT Page-49/N-19

(c) $3\ \mathrm{m/s}$ (d) $9.8\ \mathrm{m/s}$

89. Let A, B, C, D be points on a vertical line such that $AB = BC = CD$. If a body is released from position A, the times of descent through AB, BC and CD are in the ratio. NCERT Page-49/N-19

(a) $1:\sqrt{3}-\sqrt{2}:\sqrt{3}+\sqrt{2}$ (b) $1:\sqrt{2}-1:\sqrt{3}-\sqrt{2}$

(c) $1:\sqrt{2}-1:\sqrt{3}$ (d) $1:\sqrt{2}:\sqrt{3}-1$

90. Water drops fall at regular intervals from a tab which is hm above the ground. After how many seconds does the first drop reach the ground? NCERT Page-49 / N-19

(a) $\sqrt{\frac{2h}{g}}$ (b) $\sqrt{\frac{h}{2g}}$ (c) $\frac{\mathrm{h}}{2\,\mathrm{g}}$ (d) $\frac{2h}{\mathrm{g}}$

91. If two balls of masses m_1 and $m_2 (m_1 = 2m_2)$ are dropped from the same height, then the ratio of the time taken by them to reach the ground will be NCERT Page-49 / N-19

(a) $m_1 : m_2$ (b) $2\ \mathrm{m_2} : \mathrm{m_1}$ (c) $1:1$ (d) $1:2$

92. A boy standing at the top of a tower of $20\ \mathrm{m}$ height drops a stone. Assuming $g = 10\ \mathrm{ms^{-2}}$, the velocity with which it hits the ground is NCERT Page-49 / N-19

(a) $\frac{10.0\ \mathrm{m}}{\mathrm{s}}$ (b) $\frac{20.0\ \mathrm{m}}{\mathrm{s}}$ (c) $\frac{40.0\ \mathrm{m}}{\mathrm{s}}$ (d) $\frac{5.0\ \mathrm{m}}{\mathrm{s}}$

93. What will be the ratio of the distances moved by a freely falling body from rest on 4th and 5th seconds of journey? NCERT Page-49/N-19

(a) $4:5$ (b) $7:9$ (c) $16:25$ (d) $1:1$

94. A ball released from a height falls $5\ \text{m}$ in one second. In 4 seconds it falls through NCERT Page-49/N-19

(a) $20\ \text{m}$ (b) $1.25\ \text{m}$ (c) $40\ \text{m}$ (d) $80\ \text{m}$

95. From a balloon moving upwards with a velocity of 12 ms^{-1}, a packet is released when it is at a height of $65\ \text{m}$ from the ground. Time taken by it to reach the ground is ($\text{g} = 10\ \text{ms}^{-2}$)NCERT Page-49/N-19

(a) $5\ \text{s}$ (b) $8\ \text{s}$ (c) $4\ \text{s}$ (d) $7\ \text{s}$

96. A ball dropped from a point A falls down vertically to C, through the midpoint B. The descending time from A to B and that from A to C are in the ratio NCERT Page-49/N-19

(a) $1:1$ (b) $1:2$ (c) $1:3$ (d) $1:\sqrt{2}$

97. A ball is dropped from the top of a tower of height $100\ \text{m}$ and at the same time another ball is projected vertically upwards from ground with a velocity $25\ \text{ms}^{-1}$. Then the distance from the top of the tower, at which the two balls meet is NCERT Page-49/N-19

(a) $68.4\ \text{m}$ (b) $48.4\ \text{m}$ (c) $18.4\ \text{m}$ (d) $78.4\ \text{m}$

98. A body released from the top of a tower falls through half the height of the tower in $2\ \text{s}$. In what time shall the body fall through the height of the tower? NCERT Page-49/N-19

(a) $4\ \text{s}$ (b) $3.26\ \text{s}$ (c) $3.48\ \text{s}$ (d) $2.828\ \text{s}$

99. Two bodies of masses m_1 and m_2 fall from heights h_1 and h_2 respectively. The ratio of their velocities, when they hit the ground is NCERT Page-49/N-19

(a) $\frac{\text{h}_1}{\text{h}_2}$ (b) $\sqrt{\frac{\text{h}_1}{\text{h}_2}}$ (c) $\frac{\text{m}_1\,\text{h}_1}{\text{m}_1\,\text{h}_2}$ (d) $\frac{{\text{h}_1}^2}{{\text{h}_2}^2}$

100. A stone falls from a balloon that is descending at a uniform rate of $12\ \text{m/s}$. The displacement of the stone from the point of release after 10sec is NCERT Page-49/N-19

(a) $490\ \text{m}$ (b) $510\ \text{m}$ (c) $610\ \text{m}$ (d) $725\ \text{m}$

101. A body thrown vertically so as to reach its maximum height in t second. Total time from the time of projection to reach a point at half of its maximum height while returning (in sec) is NCERT Page-49/N-19

(a) $\sqrt{2}t$ (b) $\left(1+\frac{1}{\sqrt{2}}\right)t$ (c) $\frac{3t}{2}$ (d) $\frac{t}{\sqrt{2}}$

102. The ratio of distances traversed in successive intervals of time when a body falls freely under gravity from certain height is NCERT Page-49/N-19

(a) $1:2:3$ (b) $1:5:9$ (c) $1:3:5$ (d) $\sqrt{1}:\sqrt{2}:\sqrt{3}$

103. A body dropped from top of a tower fall through $40\ m$ during the last two seconds of its fall. The height of tower is $(g = 10\ m/s^2)$ NCERT Page-49/N-19

(a) $60\ m$ (b) $45\ m$ (c) $80\ m$ (d) $50\ m$

104. 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 NCERT Page-49/N-19

(a) $3u^2/g$ (b) $4u^2/g$ (c) $6u^2/g$ (d) $9u^2/g$

105. A stone thrown vertically upwards with a speed of $5\ m/sec$ attains a height H_1. Another stone thrown upwards from the same point with a speed of $10\ m/sec$ attains a height H_2. The correct relation between H_1 and H_2 is NCERT Page-49/N-19

(a) $H_2 = 4H_1$ (b) $H_2 = 3H_1$ (c) $H_1 = 2H_2$ (d) $H_1 = H_2$

106. From a pole of height $10\ m$, a stone is thrown vertically upwards with a speed $5\ m/s$. The time taken by the stone, to hit the ground, is n times that taken by it to reach the highest point of its path. The value of n is [take $g = 10\ m/s^2$] NCERT Page-49/N-19

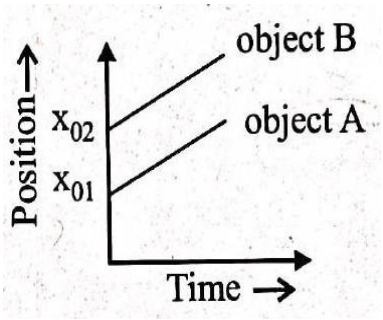
(a) 2 (b) 3 (c) 4 (d) .5

RELATIVE VELOCITY

107. Two trains, each $40\ m$ long are travelling in opposite direction with equal velocity $20\ m/s$. The time of crossing is NCERT Page-51

(a) $1\ s$ (b) $2\ s$ (c) $3\ s$ (d) Zero

108. The graph shown below represent NCERT Page-52



(a) A and B are moving with same velocity in opposite directions
(b) velocity of B is more than A in same direction
(c) velocity of A is more than B in same direction
(d) velocity of A and B is equal in same direction

109. The speed of a swimmer in still water is $16\ m/s$. The speed of river water is $8\ m/s$ and is flowing due east. If he is standing on the south bank and wiches to cross the river along the shortest path. The angle at which he should make his strokes w.r.t. north is given by NCERT Page-52

(a) $60°$ west (b) $45°$ west (c) $30°$ west (d) $0°$

110. A train of $150\ \text{m}$ length is going towards north direction at a speed of $10\ \text{ms}^{-1}$. A parrot flies at a speed of $5\ \text{ms}^{-1}$ towards south direction parallel to the railway track. The time taken by the parrot to cross the train is equal to NCERT Page-51

(a) $12\ \text{s}$ (b) $8\ \text{s}$ (c) $15\ \text{s}$ (d) $10\ \text{s}$

111. A boat takes 2 hours to travel $8\ \text{km}$ and back in still water lake. With water velocity of $4\ \text{km h}^{-1}$, the time taken for going upstream of $8\ \text{km}$ and coming back is NCERT Page-51

(a) 160 minutes (b) 80 minutes (c) 100 minutes (d) 120 minutes

112. An object has velocity $\vec{v}_1$ relative to the ground. An observer moving with a constant velocity $\vec{v}_0$ relative to the ground measures the velocity of the object to be $\vec{v}_2$ (relative to the observer). The magnitudes of these velocities are related by NCERT Page-51

(a) $v_0 \leq v_1 + v_2$ (b) $v_1 \leq v_2 + v_0$ (c) $v_2 \leq v_0 + v_1$ (d) All of these

113. Two trains are each $50\ \text{m}$ long moving parallel towards each other at speeds $10\ \text{m/s}$ and $15\ \text{m/s}$ respectively. After what time will they pass each other? NCERT Page-52,53

(a) $5\sqrt{\frac{2}{3}}\,\text{sec}$ (b) 4sec (c) 2sec (d) 6sec

114. A ship A is moving Westwards with a speed of $10\ \text{km h}^{-1}$ and a ship B $100\ \text{km}$ South of A, is moving Northwards with a speed of $10\ \text{km h}^{-1}$. The time after which the distance between them becomes shortest, is NCERT PAGE- 51

(a) $5\ \text{h}$ (b) $5\sqrt{2}\ \text{h}$ (c) $10\sqrt{2}\ \text{h}$ (d) $0\ \text{h}$

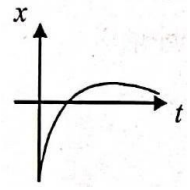
115. A bus is moving with a velocity of $10\ \text{ms}^{-1}$ on a straight road. A scootorist wishes to overtake the bus in one minute. If the bus is at a distance of $1.2\ \text{km}$ ahead, then the velocity with which he has to chase the bus is NCERT Page-51

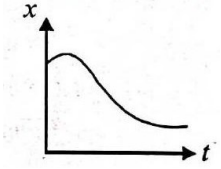
(a) $20\ \text{ms}^{-1}$ (b) $25\ \text{ms}^{-1}$ (c) $60\ \text{ms}^{-1}$ (d) $30\ \text{ms}^{-1}$

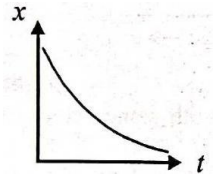
Exercise 2 : NCERT Exemplar & NEET

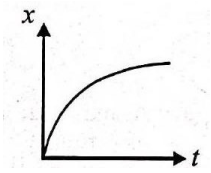
NCERT Exemplar Questions

1. Among the four graph shown in the figure there is only one graph for which average velocity over the time interval $(0, T)$ can vanish for a suitably chosen T. Which one is it? NCERT Page-46 / N-16

(a) 

(b) 

(c) 

(d) 

2. A lift is coming from 8th floor and is just about to reach 4th floor. Taking ground floor as origin and positive direction upwards for all quantities, which one of the following is correct?
NCERT Page-45/N-16

(a) $x < 0, v < 0, a > 0$ (b) $x > 0, v < 0, a < 0$
(c) $x > 0, v < 0, a > 0$ (d) $x > 0, v > 0, a < 0$

3. In one dimensional motion, instantaneous speed v satisfies $0 \leq v < v_0$ NCERT Page-43/N-14

(a) The displacement in time T must always take nonnegative values
(b) The displacement x in time T satisfies $-v_0T < x < v_0T$
(c) The acceleration is always a non-negative number
(d) The motion has no turning points

4. A vehicle travels half the distance l with speed v_1 and the other half with speed v_2, then its average speed is NCERT Page-42/N-14

(a) $\frac{v_1+v_2}{2}$ (b) $\frac{2v_1+v_2}{v_1+v_2}$ (c) $\frac{2v_1v_2}{v_1+v_2}$ (d) $\frac{L(v_1+v_2)}{v_1v_2}$

5. The displacement of a particle is given by $x = (t-2)^2$ where x is in metre and t in second. The distance covered by the particle in first 4 seconds is NCERT Page-43, 47/N-14, 17

(a) 4 m (b) 8 m (c) 12 m (d) 16 m

NEET

6. A particle of unit mass undergoes one-dimensional motion such that its velocity varies according to $v(x) = bx^{-2n}$ where b and n are constants and x is the position of the particle. The acceleration of the particle as d function of x, is given by:

(a) $-2nb^2x^{-4n-1}$ (b) $-2\ b^2x^{-2n+1}$ (c) $-2nb^2e^{-4n+1}$ (d) $-2nb^2x^{-2n-1}$

7. If the velocity of a particle is $v = At + Bt^2$, where A and B are constants, then the distance travelled by it between 1 s and 2 s is :

(a) $\frac{3}{2}$ A + 4 B (b) 3 A + 7 B (c) $\frac{3}{2}$ A + $\frac{7}{3}$ B (d) $\frac{A}{2} + \frac{B}{3}$

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

(a) $\frac{t_1t_2}{t_2-t_1}$ (b) $\frac{t_1t_2}{t_2+t_1}$ (c) $t_1 - t_2$
(d) $\frac{t_1+t_2}{2}$

9. The speed of a swimmer in still water is $20\ m/s$. The speed of river water is $10\ m/s$ and is flowing due east. If he is standing on the south bank and wishes to cross the river along the shortest path, the angle at which he should make his strokes w.r.t. north is given by: NCERT Page-52 |

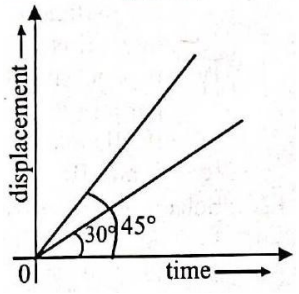
(a) 30° west (b) 0° (c) 60° west (d) 45° west

10. A ball is thrown vertically downward with a velocity of 20 m/s from the top of a tower. It hits the ground after some time with a velocity of $80\ m/s$. The height of the tower is : $(g = 10\ m/s^2)$

(a) $340\ m$ (b) $320\ m$ NCERT Page-49/ N-19, 20

(c) $300\ m$ (d) $360\ m$

11. The displacement-time graphs of two moving particles make angles of 30° and 45° with the x-axis as shown in the figure. The ratio of their respective velocity is: NCERT Page-44 / N-14 |



(a) $1:1$ (b) $1:2$ (c) $1:\sqrt{3}$ (d) $\sqrt{3}:1$

12. The ratio of the distances travelled by a freely falling body in the 1st, 2nd, 3rd and 4th second:

(a) $1:4:9:16$ (b) $1:3:5:7$ NCERT Page-50/N-19, 20

(c) $1:1:1:1$ (d) $1:2:3:4$

13. A vehicle travels half the distance with speed v and the remaining distance with speed $2v$. Its average speed is NCERT Page-42

(a) $\frac{v}{3}$ (b) $\frac{2v}{3}$ (c) $\frac{4v}{3}$ (d) $\frac{3v}{4}$

14. A bullet from a gun is fired on a rectangular wooden block with velocity u. When bullet travels $24\ cm$ through the block along its length horizontally, velocity of bullet becomes $\frac{u}{3}$. Then it further penetrates into the block in the same direction before coming to rest exactly at the other end of the block. The total length of the block is NCERT Page-48/N-18

(a) $27\ cm$ (b) $24\ cm$ (c) $28\ cm$ (d) $30\ cm$

15. A horizontal bridge is built across a river. A student standing on the bridge throws a small ball vertically upwards with a velocity $4\ m\ s^{-1}$. The ball strikes the water surface after $4\ s$. The height of bridge above water surface is (Take $g = 10\ m\ s^{-2}$) NCERT Page-49/N-19

(a) $56\ m$ (b) $60\ m$ (c) $64\ m$ (d) $68\ m$

Exercise 1 : (NCERT Based Topic-wise MCQs)

1	(d)	13	(c)	25	(d)	37	(a)	49	(c)	61	(c)	73	(d)	85	(b)	97	(d)	109	(c)
2	(a)	14	(a)	26	(c)	38	(b)	50	(d)	62	(d)	74	(d)	86	(b)	98	(d)	110	(d)
3	(c)	15	(d)	27	(c)	39	(c)	51	(b)	63	(a)	75	(d)	87	(b)	99	(b)	111	(a)
4	(d)	16	(b)	28	(c)	40	(a)	52	(a)	64	(d)	76	(a)	88	(a)	100	(c)	112	(d)
5	(b)	17	(d)	29	(a)	41	(d)	53	(c)	65	(d)	77	(c)	89	(b)	101	(b)	113	(b)
6	(b)	18	(c)	30	(d)	42	(c)	54	(a)	66	(d)	78	(b)	90	(a)	102	(c)	114	(a)
7	(a)	19	(d)	31	(c)	43	(a)	55	(c)	67	(d)	79	(b)	91	(c)	103	(b)	115	(d)
8	(a)	20	(c)	32	(c)	44	(c)	56	(b)	68	(b)	80	(a)	92	(b)	104	(b)		
9	(c)	21	(b)	33	(d)	45	(a)	57	(c)	69	(d)	81	(a)	93	(b)	105	(a)		
10	(c)	22	(c)	34	(b)	46	(a)	58	(a)	70	(d)	82	(a)	94	(d)	106	(c)		
11	(b)	23	(d)	35	(c)	47	(a)	59	(c)	71	(b)	83	(c)	95	(a)	107	(a)		
12	(a)	24	(b)	36	(c)	48	(b)	60	(c)	72	(b)	84	(a)	96	(d)	108	(d)		

Exercise 2 : (NCERT Exemplar & NEET)

1	(b)	3	(b)	5	(b)	7	(c)	9	(a)	11	(c)	13	(c)	15	(c)				
2	(a)	4	(c)	6	(a)	8	(b)	10	(c)	12	(b)	14	(a)						

Hints & Solutions

EXERCISE - 1

1. (d) Motion of a body along a straight line is one dimensional motion.

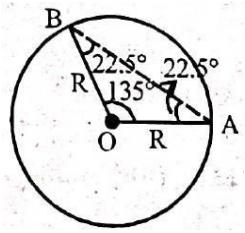
2. (a) When location of a particle has changed, it must have covered some distance and undergone some displacement.

3. (c)

4. (d) $\frac{\text{Displacement}}{\text{distance}} \leq 1$

5. (b)

6. (b) From $\triangle AOB$



$$\frac{AB}{\sin\ 135} = \frac{OB}{\sin\ .22.5}$$

$$AB = \frac{\sin\ 135}{\sin\ 22.5} OB$$

$$= \frac{\sin\ (135)}{\sin\ (22.5)} \frac{\text{arc}\ (AB)}{\frac{3\pi}{4}.} = \frac{\sin\ (45)}{\sin\ (22.5)} \times \frac{60 \times 4}{3\pi} = 47\ \text{m}$$

7. (a) Total time of motion is $3\ \text{min} 20\text{sec} = 20\text{sec}$.

As time period of circular motion is 40sec so in 20sec athlete will complete 5 revolution i.e., he will be at starting point i.e., displacemet = zero.

8. (a) 9. (c) 10. (c)

9. (b) $\left|\text{Average velocity}\right| = \frac{|\text{displacement}|}{\text{time}} = \frac{2r}{t} = 2 \times \frac{1}{1} = 2\ \text{m/s}$

12. (a) $v_{av} = \frac{v_1 t/3 + v_2(2t/3)}{t} = \frac{v_1}{3} + \frac{2v_2}{3}$

13. (c)

14. (a) Since displacement is zero.

15. (d) Let the total distance be d. Then for first half distance, time $= \frac{d}{2v_0}$, next distance $= v_1 t$ and last half distance $= v_2 t$

$\therefore v_1 t + v_2 t = \frac{d}{2}; t = \frac{d}{2(v_1 + v_2)}$

Now average speed $t = \frac{d}{\frac{d}{2v_0}+\frac{d}{2(v_1+v_2)}+\frac{d}{2(v_1+v_2)}} = \frac{2v_0(v_1+v_2)}{(v_1+v_2)+2v_0}$

16. (b) We have given, $v = \alpha t + \beta t^2$

$\Rightarrow \frac{ds}{dt} = \alpha t + \beta t^2 \Rightarrow \int_{s_1}^{s_2} ds = \int_1^2 (\alpha t + \beta t^2) dt \Rightarrow s_2 - s_1 = \left[\frac{\alpha t^2}{2} + \frac{\beta t^3}{3}\right]_1^2$

As particle is moving in a straight line,

$\therefore$ Distance = Displacement

17. (d) For bus P

$\therefore$ Distance $= \left[\frac{\alpha[4-1]}{2} + \frac{\beta[8-1]}{3}\right] = \frac{3\alpha}{2} + \frac{7\beta}{3}$

$x_p(t) = \alpha t + \beta t^2$

$V_p(t) = \alpha + 2\beta t \left[\therefore V_p = \frac{dx_p}{dt}\right]$

For bus **Q**

$x_q(t) = ft - t^2$

$V_q(t) = f - 2t \left[\because V_q = \frac{dx_q}{dt}\right]$

As, $V_p(t) = V_q(t) \Rightarrow \alpha + 2\beta t = f - 2t$

$\Rightarrow \alpha - f = -2\beta t - 2t \Rightarrow f - \alpha = 2\beta t + 2t$

$\Rightarrow t = \frac{f - \alpha}{(2\beta + 2)}$

18. (c) As $x - t$ graph is a straight line in either case, velocity of both is uniform. As the slope of $x - t$ graph for P is greater, therefore, velocity of P is greater than that of Q.

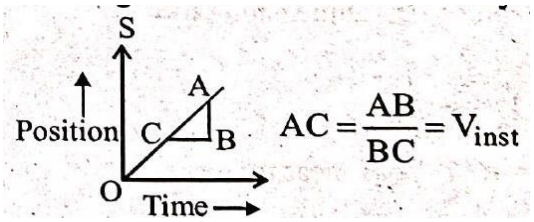
19. (d) When $s \propto t$, so $\frac{s}{t}$ = constant

20. (c) The velocity-time graph for a uniform motion is a straight. line parallel to time axis. Its slope is zero.

(b) $\frac{|\text{ Average velocity }|}{|\text{ Average speed }|} = \frac{|\text{ displacement }|}{|\text{ distance }|}$

because displacement will either be equal or less than distance. It can never be greater than distance travelled.

22. (c) The slope of the tangent drawn on position-time graph at any instant gives instantaneous velocity.



23. (d)

$v_A = \tan 30^\circ$ and $v_B = \tan 60^\circ$

$\therefore \frac{v_A}{v_B} = \frac{\tan 30^\circ}{\tan 60^\circ} = \frac{1/\sqrt{3}}{\sqrt{3}} = \frac{1}{3}$

24. (b) The speed in general $\geq$ the magnitude of velocity.

25. (d) In (a), at the same time particle has two positions which is not possible. In (b), particle has two velocities at the same time. In (c), speed is negative which is not possible.

26. (c)

27. (c)

28. (c)

29. (a)

30. (d) The nature of the path is decided by the direction of velocity, and the direction of acceleration. The trajectory can be a straight line, circle or a parabola depending on these factors.

31. (c) Slope of velocity-time graph shows acceleration.

32. (c) Because acceleration is a vector quantity.

33. (d)

34. (b)

35. (c)

36. (c) During OA, acceleration $= \tan 30^\circ = \frac{1}{\sqrt{3}}\ \mathrm{m/s^2}$ During AB, acceleration $= -\tan 60^\circ = -\sqrt{3}\ \mathrm{m/s^2}$ Required ratio $= \frac{1/\sqrt{3}}{\sqrt{3}} = \frac{1}{3}$

37. (a) Velocity at time t is $45^\circ = 1$. Velocity at time $(t = 1)$ is $\tan 60^\circ = \sqrt{3}$. Acceleration is change in velocity in one second $= \sqrt{3} - 1$.

38. (b) Differentiated twice.

39. (c) On differentiating, acceleration $= 0.2t$

$$\Rightarrow a = f(t)$$

40. (a)

41. (d) From displacement-time graph, it is clear that in equal intervals of time displacements are not equal infact, decreases and after 40s displacement constant i.e., the particle stops.

42. (c) When particle comes to rest,

$$V = 0 = \frac{dx}{dt} = \frac{d}{dt}(40 + 12t - t^3)$$

$$\Rightarrow 12 - 3t^2 = 0 \Rightarrow t^2 = \frac{12}{3} = 4 \ \therefore t = 2\text{sec}$$

Therefore distance travelled by particle before coming to rest,

$$x = 40 + 12t - t^3 = 40 + 12 \times 2 - (2)^3 = 56m$$

43. (a) $x = \frac{1}{t+5} \ \therefore \ v = \frac{dx}{dt} = \frac{-1}{(t+5)^2}$

$$\therefore a = \frac{d^2x}{dt^2} = \frac{2}{(t+5)^3} = 2x^3$$

Now $\frac{1}{(t+5)} \propto v^{\frac{1}{2}} \therefore \frac{1}{(t+5)^3} \propto v^{\frac{3}{2}} \propto a$

44. (c) Average acceleration $= \frac{\text{change in velocity}}{\text{time interval}} = \frac{\Delta\vec{v}}{t}$

$\vec{v}_1 = 5\hat{\imath}, \vec{v}_2 = 5\hat{\jmath}$

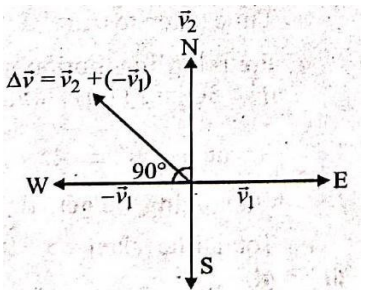
$\Delta\vec{v} = (\vec{v}_2 - \vec{v}_1)$

$= \sqrt{v_1^2 + v_2^2 + 2v_1v_2\cos\ 90}$

$= \sqrt{5^2 + 5^2 + 0}$

$[\text{As}|v_1| = |v_2| = 5\ \text{m/s}]$

$= 5\sqrt{2}\ \text{m/s}$



Avg. acc. $= \frac{\Delta\vec{v}}{t} = \frac{5\sqrt{2}}{10} = \frac{1}{\sqrt{2}}\ \text{m/s}^2 \Rightarrow \tan\theta = \frac{5}{-5} = -1$

which means θ is in the second quadrant. (towards northwest)

45. (a) Differentiate two times and put $x = 0$.

(a) $\frac{dv}{dt} = -2.5\sqrt{v} \Rightarrow \frac{dv}{\sqrt{v}} = -2.5dt$

Integrating,

$$\int_{6.25}^{0} v^{-1/2}dv = -2.5\int_{0}^{t} dt \Rightarrow \left[\frac{v^{+1/2}}{(1/2)}\right]_{6.25}^{0} = -2.5[t]_0^t$$
$$\Rightarrow -2(6.25)^{1/2} = -2.5t \Rightarrow t = 2\text{sec}$$

47. (a) $x = x_0 + \left(ut + \frac{1}{2}at^2\right)$ At $t = 0, x = -2, \therefore -2 = x_0 + 0$

or $x_0 = -2$

Thus, $0 = -2 + \left(u \times 1 + \frac{1}{2} \times a \times 1^2\right)$

and $6 = -2 + \left(u \times 2 + \frac{1}{2} \times a \times 2^2\right)$

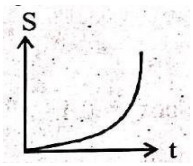
After solving equations, we get $u = 0, a = 4\ \text{m/s}^2$.

Now for $t = 3$,

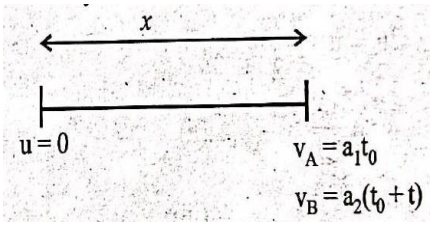
$x = -2 + \left(u \times 3 + \frac{1}{2} \times 4 \times 3^2\right) = 16\ \text{m}.$

Clearly it represents motion with constant acceleration.

48. (b) For a particle moving with uniform acceleration the displacement-time graph is a parabola.



49. (c) Let time taken by A to reach finishing point is t_0 ∴ Time taken by B to reach finishing point $= t_0 + t$



$v_A - v_B = v$

$\Rightarrow v = a_1 t_0 - a_2(t_0 + t) = (a_1 - a_2)t_0 - a_2 t$

$x_B = x_A = \frac{1}{2} a_1 t_0^2 = \frac{1}{2} a_2 (t_0 + t)^2$

$\Rightarrow \sqrt{a_1} t_0 = \sqrt{a_2}(t_0 + t) \Rightarrow (\sqrt{a_1} - \sqrt{a_2}) t_0 = \sqrt{a_2 t}$

$\Rightarrow t_o = \frac{\sqrt{a_2 t}}{\sqrt{a_1} - \sqrt{a_2}}$

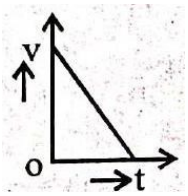
Putting this value of t_0 in equation (i)

$v = (a_1 - a_2) \frac{\sqrt{a_2 t}}{\sqrt{a_1} - \sqrt{a_2}} - a_2 t$

$= (\sqrt{a_1} + \sqrt{a_2})\sqrt{a_2} t - a_2 t = \sqrt{a_1 a_2 t} + a_2 t - a_2 t$

or, $v = \sqrt{a_1 a_2 t}$

50. (d) Velocity time curve will be a straight line as shown:



51. (b) At the highest point $v = 0$.

52. (a) Let s be the distance travelled by the vehicle before it stops.

Final velocity $v = 0$, initial velocity $= u$

Using equation of motion $v^2 - u^2 = 2aS$

$0^2 - u^2 = 2aS$

53. (c)

Stopping distance, $S = -\frac{u^2}{2a}$

54. (a) $v^2 - u^2 = 2as \Rightarrow a = \frac{u^2}{2as} = \frac{(20)^2}{2\times 200} = 1\ m/s^2$

55. (c) $S_n = u + \frac{a}{2}(2n-1)$

or, $S = \frac{a}{2}(2\times 2 - 1) \Rightarrow a = \frac{2}{3}\ m/s^2$

56. (b) For first part of penetration, by equation of motion

$$\left(\frac{u}{2}\right)^2 - (u)^2 = 2aS \text{ or } a = -\frac{3u^2}{8\,S}$$

For latter part of penetration

$$(0)^2 - \left(\frac{u}{2}\right)^2 = 2aS', S' = \frac{u^2}{8a}$$

$$S' = -\frac{u^2}{8}\left(\frac{8\,S}{-3u^2}\right)$$

(Using (i))

$S' = \frac{S}{3}$ or $S' = \frac{40}{3}$ cm

57. (c) The distance covered in n^{th} second is

$$S_n = u + \frac{1}{2}(2n-1)a$$

where u is initial velocity $\&a$ is acceleration

then $26 = u + \frac{19a}{2}$

$$28 = u + \frac{21a}{2}$$

$$30 = u + \frac{23a}{2}$$

$$32 = u + \frac{25a}{2}$$

From eqs. (i) and (ii) we get $u = 7\ m/sec, a = 2\ m/sec^2$

$\therefore$ The body starts with initial velocity $u = 7\ \text{m/sec}$ and moves with uniform acceleration $a = 2\ \text{m/sec}^2$

58. (a) $v = \sqrt{3x + 16} \Rightarrow v^2 = 3x + 16 \Rightarrow v^2 - 16 = 3x$ Comparing with $v^2 - u^2 = 2aS$, we get, $u = 4$ units, $2a = 3$ or $a = 1.5$ units

59. (c) Let a be constant acceleration of the particle. Then $s = ut + \frac{1}{2}at^2$ or $s_1 = 0 + \frac{1}{2} \times a \times (10)^2 = 50a$

$$\text{and } s_2 = \left[0 + \frac{1}{2}a(20)^2\right] - 50a = 150a$$

$$\therefore s_2 = 3\, s_1$$

60. (c) Distance travelled in the nth second is given by

$$t_n = u + \frac{a}{2}(2n - 1)$$

$$\text{put } u = 0, a = \frac{4}{3}ms^{-2}, n = 3$$

$$\therefore\ d = 0 + \frac{4}{3 \times 2}(2 \times 3 - 1) = \frac{4}{6} \times 5 = \frac{10}{3}m$$

61. (c) Initial velocity of car $(u) = 0$

Final velocity of car $(v) = 144\ \text{km/hr} = 40\ \text{m/s}$

Time taken $= 20\ \text{s}$

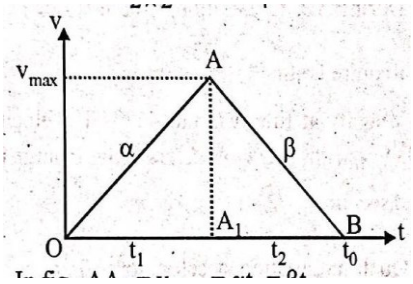
We know that, $v = u + at$

$40 = a \times 20 \Rightarrow a = 2\ \text{m/s}^2$

Also, $v^2 - u^2 = 2as \Rightarrow s = \frac{v^2 - u^2}{2a}$

$\Rightarrow s = \frac{(40)^2 - (0)^2}{2 \times 2} = \frac{1600}{4} = 400\ \text{m}.$

62. (d)



In fig., $AA_1 = v_{max} = \alpha t_1 = \beta t_2$

But $\mathrm{t} = \mathrm{t}_1 + \mathrm{t}_2 = \frac{\mathrm{v_{max}}}{\alpha} + \frac{\mathrm{v_{max}}}{\beta}$

$$= v_{\max}\left(\frac{1}{\alpha} + \frac{1}{\beta}\right) = v_{\max}\left(\frac{\alpha+\beta}{\alpha\beta}\right)$$

$$\text{or, } v_{\max} = t\left(\frac{\alpha\beta}{\alpha+\beta}\right)$$

63. (a) at $t = 0, u = 100\ \mathrm{m/s}$ downwards

for 0 to 10 sec

$\mathrm{v} = u - gt = -100 - 10 \times 1.0 = -200\ \mathrm{m/s}$

As $v = -100 - gt$ is straight line equation between v and t. So the curve will be straight line with -100 as intercept

64. (d)

for 10 to $20\mathrm{sec}, v = 0$, so option (a) is correct.

65. (d) Given : $u = 0, t = 5\mathrm{sec}, v = 108\ \mathrm{km/hr} = 30\ \mathrm{m/s}$ By eq $^{\mathrm{n}}$ of motion $\mathrm{v} = \mathrm{u} + \mathrm{at}$

or

$$\mathrm{a} = \frac{\mathrm{v}}{\mathrm{t}} = \frac{30}{5} = 6\ \mathrm{m/s^2}\ [\because \mathrm{u} = 0]$$

$$\mathrm{S}_1 = \frac{1}{2}\mathrm{at}^2 = \frac{1}{2} \times 6 \times 5^2 = 75\ \mathrm{m}$$

Distance travelled in first $5\mathrm{sec}$ is $75\ \mathrm{m}$.

Distance travelled with uniform speed of $30\ \mathrm{m/s}$ is S_2

$395 = \mathrm{S}_1 + \mathrm{S}_2 + \mathrm{S}_3 \Rightarrow 395 = 75 + \mathrm{S}_2 + 45 \Rightarrow \mathrm{S}_2 = 275\ \mathrm{m}$

Time taken to travel $275\ \mathrm{m} = \frac{275}{30} = 9.2\mathrm{sec}$

For retarding motion, we have

$0^2 - 30^2 = 2(-a) \times 45$, we get $a = 10\ \mathrm{m/s^2}$

$$\mathrm{S} = \mathrm{ut} + \frac{1}{2}\mathrm{at}^2 \Rightarrow 45 = 30\mathrm{t} + \frac{1}{2}(-10)\mathrm{t}^2 \Rightarrow 45 = 30\mathrm{t} - 5\mathrm{t}^2$$

On solving we get, $t = 3\mathrm{sec}$

Total time taken $= 5 + 9.2 + 3 = 17.2\mathrm{sec}$.

66. (d)

67. (d) Let u be the initial velocity that have to find and a be the uniform acceleration of the particle.

For $t = 3$ s, distance travelled $S = 12$ m and for $t = 3 + 3 = 6$ s distance travelled $S' = 12 + 30 = 42$ m
From, $S = ut + 1/2at^2$

$$12 = u \times 3 + \frac{1}{2} \times a \times 3^2$$

or $24 = 6u + 9a$

Similarly, $42 = u \times 6 + \frac{1}{2} \times a \times 6^2$

or $42 = 6u + 18a$

On solving, we get $u = 1\ \text{m s}^{-1}$.

68. (b) Let the initial velocity of ball be u ∴. Time of rise $t_1 = \frac{u}{g+a}$ and height reached $= \frac{u^2}{2(g+a)}$

Time of fall t_2 is given by

$$\frac{1}{2}(g-a)t_2^2 = \frac{u^2}{2(g+a)}$$

$$t_2 = \frac{u}{\sqrt{(g+a)(g-a)}} = \frac{u}{(g+a)}\sqrt{\frac{g+a}{g-a}}$$

$\therefore\ t_2 > t_1$ because $\frac{1}{g+a} < \frac{1}{g-a}$

69. (d) Because acceleration due to gravity is constant so the slope of line will be constant i.e. velocity time curve for a body projected vertically upwards is straight line.

70. (b)

71. (b) Free fall of an object (in vacuum) is a case of motion with uniform acceleration.

72. (d) As ball returns to starting point so displacement is zero.

73. (d) From equation of motion, $s = ut + \frac{1}{2}g^2$

For first $\frac{\text{h}}{2}, \frac{\text{h}}{2} = \frac{1}{2}\text{gt}_1^2$

For total height h,

$$h = \frac{1}{2}g(t_1 + t_2)^2$$

Divide equation (ii) by (i) we have $\frac{1}{2} = \frac{t_1^2}{(t_1+t_2)^2}$

$$\frac{1}{\sqrt{2}} = \frac{t_1}{t_1+t_2}; 1+\frac{t_2}{t_1} = \sqrt{2}$$

$$\frac{t_1}{t_2} = \frac{1}{\sqrt{2}-1} \Rightarrow t_2 = (\sqrt{2}-1)t_1$$

75. (d)

76. (a) $h = ut_1 - \frac{1}{2}gt_1^2$ Also $h = ut_2 - \frac{1}{2}gt_2^2$

After simplify above equations, we get $h = \frac{1}{2}gt_1t_2$.

77. (c)

78. (b) Velocity when the engine is switched off $v = 19.6 \times 5 = 98\ \text{ms}^{-1}$

$h_{\max} = h_1 + h_2$ where $h_1 = \frac{1}{2}at^2 \& h_2 = \frac{v^2}{2a}$

$$h_{\max} = \frac{1}{2} \times 19.6 \times 5 \times 5 + \frac{98 \times 98}{2 \times 9.8} = 735\ \text{m}$$

79. (b) Height attained by balls in 2sec is

$= \frac{1}{2} \times 9.8 \times 4 = 19.6\ \text{m}$ the same distance will be covered in 2 second (for descent) Time interval of throwing balls, remaining same. So, for two balls remaining in air, the time of ascent or descent must be greater than 2 seconds. Hence speed of balls must be greater than $19.6\ \text{m/sec}$.

80. (a) Clearly distance moved by 1^{st} ball in $18\ \text{s}$ = distance moved by 2^{nd} ball in $12\ \text{s}$.

Now, distance moved in $18\ \text{s}$ by 1^{st} ball

$$= \frac{1}{2} \times 10 \times 18^2 = 90 \times 18 = 1620\ \text{m}$$

Distance moved in $12\ \text{s}$ by 2^{nd} ball

$$= ut + \frac{1}{2}gtt^2 \ \therefore 1620 = 12v + 5 \times 144$$

$$\Rightarrow \text{v} = 135 - 60 = 75\ \text{ms}^{-1}.$$

81. (a) $\because \text{h} = \frac{1}{2}\text{gt}^2 \ \therefore \text{h}_1 = \frac{1}{2}\ \text{g}(5)^2 = 125$

$$h_1 + h_2 = \frac{1}{2}g(10)^2 = 500 \Rightarrow h_2 = 375$$

$\therefore h_1 + h_2 + h_3 = \frac{1}{2}g(15)^2 = 1125 \Rightarrow h_3 = 625$

$h_2 = 3h_1, h_3 = 5h_1$ or $h_1 = \frac{h_2}{3} = \frac{h_3}{5}$

82. (a)

83. (c) In $\frac{T}{3}$ sec, the distance travelled $= \frac{1}{2}\ g\left(\frac{T}{3}\right)^2 = \frac{h}{9}$

$\therefore$ Position of the ball from the ground $= h - \frac{h}{9} = \frac{8h}{9}m$

84. (a) Before hitting the ground, the velocity v is given by $v^2 = 2gd$

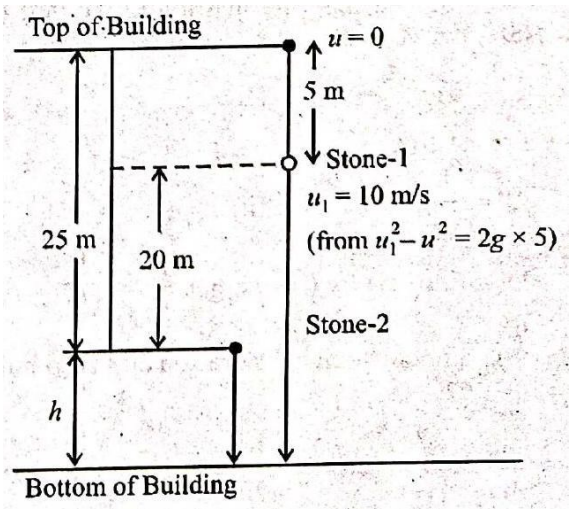
Further, $v'^2 = 2g \times \left(\frac{d}{2}\right) = gd$

$\therefore \left(\frac{v}{v'}\right) = \sqrt{2}$ or $v = v'\sqrt{2}$

As the direction is reversed and speed is decreased and hence graph (a) represents these conditions correctly.

85. (b) Timetaken by the stone to reach thewater level $t_1 = \sqrt{\frac{2h}{g}}$ Time taken by sound to come to the mouth of the well, $t_2 = \frac{h}{v}$ $\therefore$ Total time $t_1 + t_2 = \sqrt{\frac{2h}{g}} + \frac{h}{v}$:

86. (b)



Height of the building $= h + 25$

For stone- 1, $20 + h = 10t + \frac{1}{2}gt^2$

And for stone-2, $h = \frac{1}{2}gt^2$

Putting value of h from eq. (ii) in eq. (i)

$$20 + \frac{1}{2}gt^2 = 10t + \frac{1}{2}gt^2 \ \ \therefore t = 2s$$

Therefore, $h = \frac{1}{2}gt^2 = \frac{1}{2} \times 10 \times 2^2 = 20$ m

87. (b)

88. (a) $S = ut + \frac{1}{2}at^2$

$$-76 = 4 \times 6 - \frac{1}{2} \times 10 \times (6)^2 \Rightarrow u = \frac{52}{3} \text{ m/s}$$

89. (b) $\mathrm{S = AB = \frac{1}{2}\ gt_1{}^2 \Rightarrow 2\ S = AC = \frac{1}{2}\ g(t_1 + t_2)^2}$

and $3S = AD = \frac{1}{2}g(t_1 + t_2 + t_3)^2$

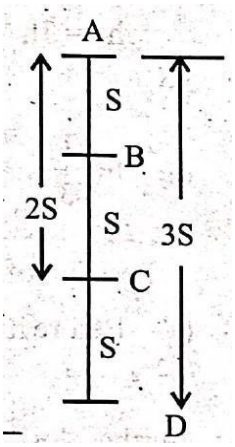
$$t_1 = \sqrt{\frac{2S}{g}}$$

$$t_1 + t_2 = \sqrt{\frac{4S}{g}}, t_2 = \sqrt{\frac{4S}{g}} - \sqrt{\frac{2S}{g}}$$

$$t_1 + t_2 + t_3 = \sqrt{\frac{6S}{g}}$$

$$t_3 = \sqrt{\frac{6S}{g}} - \sqrt{\frac{4S}{g}}$$

$t_1 : t_2 : t_3 : : 1 : (\sqrt{2} - \sqrt{1}) : (\sqrt{3} - \sqrt{2})$



90. (a) $h = ut + \frac{1}{2}gt^2 \Rightarrow h = \frac{1}{2}gt^2 [\because u = 0] \therefore t = \sqrt{2\,h/g}$

91. (c) 92. (b) 93 . (b)

92. (d) Since $S = ut + 1/2g^2$

where u is initial velocity $\&a$ is acceleration.

In this case $u = 0 \& a = g$

so distance travelled in $4sec$ is,

$S = 1/2 \times 10 \times 16 = 80\ m$

95. (a) $s = ut + \frac{1}{2}at^2$

$-65 = 12t - 5t^2$ on solving we get, $t = 5\ s$

96. (d) For A to B

$$S = \frac{1}{2}gt^2$$

For A to C

$$2S = \frac{1}{2}gt'^2$$

97. (d)

Dividing (i) by (ii) we get $\frac{t}{t'} = \frac{1}{\sqrt{2}}$

98. (d) For constant acceleration and zero initial velocity $h \propto t^2$

$$\frac{h_1}{h_2} = \frac{t_1^2}{t_2^2} \Rightarrow t_2 = \sqrt{\frac{h_2}{h_1}} t_1 = \sqrt{2} \times t_1 = \sqrt{2} \times 2s$$

99. (b) When a body fallsthrough a height h, it acquires a velocity $\sqrt{2gh}$.

100. (c) $\mathrm{u} = 12\ \mathrm{m/s}, \mathrm{g} = 9.8\ \mathrm{m/sec}^2, \mathrm{t} = 10\mathrm{sec}$

Displacement $= ut + \frac{1}{2}gt^2$

$$= 12 \times 10 + \frac{1}{2} \times 9.8 \times 100 = 610\ \mathrm{m}$$

101. (b)

102. (c) As we know, distance traversed in n^{th} second

$$S_n = u + \frac{1}{2}a(2n-1)$$

Here, $u = 0, a = g$

$$\therefore\ S_n = \frac{1}{2}g(2n-1)$$

Distance traversed in 1^{st} second i.e., $n = 1$

$$S_1 = \frac{1}{2}g(2 \times 1 - 1) = \frac{1}{2}g$$

Distance traversed in 2^{nd} second i.e., $n = 2$

$$S_2 = \frac{1}{2}g(2 \times 2 - 1) = \frac{3}{2}g$$

Distance traversed in 3^{rd} second i.e., $n = 3$

$$S_3 = \frac{1}{2}g(2 \times 3 - 1) = \frac{5}{2}g$$

$$\therefore S_1 : S_2 : S_3 = \frac{1}{2}g : \frac{3}{2}g : \frac{5}{2}g = 1:3:5$$

103. (b) Let the body fall through the height of tower in t seconds. From, $D_n = u + \frac{a}{2}(2n-1)$ we have, total distance travelled in last 2 second of fall is

$$D = D_t + D_{(t-1)}$$
$$= \left[0 + \frac{g}{2}(2t-1)\right] + \left[0 + \frac{g}{2}\{2(t-1)-1\}\right]$$
$$= \frac{10}{2} \times 4(t-1)$$
$$\text{or, } 40 = 20(t-1) + \frac{g}{2}(2t-3) = \frac{g}{2}(4t-4)$$

Distance travelled in t second is

$$s = ut + \frac{1}{2}at^2 = 0 + \frac{1}{2} \times 10 \times 3^2 = 45 \text{ m}$$

104. (b) The stone rises up till its vertical velocity is zero and again reached the top of the tower with a speed u (downward). The speed of the stone at the base is $3u$.

Hence $(3u)^2 = (-u)^2 + 2gh$ or $h = \frac{4u^2}{g}$ $\quad \downarrow, h$

(a) From third equation of mation $v^2 = u^2 + 2ah$

In first case initial velocity $u_1 = 5 \text{ m/sec}$

final velocity $v_1 = 0, a = -g$

and max. height obtained is H_1, then, $H_1 = \frac{25}{2g}$

In second case $u_2 = 10 \text{ m/sec}, v_2 = 0, a = -g$

and max. height is H_2 then, $H_2 = \frac{100}{2g}$.

It implies that $H_2 = 4H_1$

106. (c)

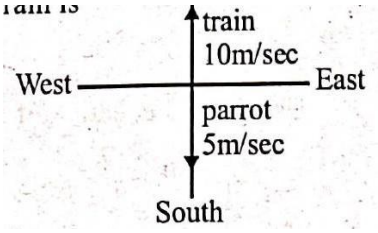
107. (a) Time $= \frac{\text{total length}}{\text{relative velocity}} = \frac{X+X}{20+20} = \frac{X}{40} s = 1 \text{ s}$

108. (d)

109. (c) $\sin\theta = \frac{\vec{v}_{RG}}{\vec{v}_{SR}} = \frac{8}{16} = \frac{1}{2}$

$$\therefore \theta = 30^\circ \text{ west}$$

110. (d) So by figure the velocity of parrot w.r.t. train is $= 5 - (-10) = 15 \text{ m/sec}$ so time taken to cross the train is $= \frac{\text{length of train}}{\text{relative velocity}} = \frac{150}{15} = 10\text{sec}$



111. (a) Velocity of boat $= \frac{8+8}{2} = 8\text{kmh}^{-1}$

Velocity of water $= 4\text{kmh}^{-1}$

$\text{t} = \frac{8}{8-4} + \frac{8}{8+4} = \frac{8}{3}\ \text{h} = 160$ minute

112. (d) By definition of relative velocity

$\vec{v}_1 = \vec{v}_0 + \vec{v}_2 \Rightarrow \vec{v}_0 + \vec{v}_2 + (-\vec{v}_1) = 0$

$\Rightarrow v_0, v_1$ and v_2 will be sides of a triangle and we know that the sum of any two sides is greater than third side of the triangle.

113. (b) Relative speed of each train with respect to each other be, $v = 10 + 15 = 25\ \text{m/s}$

Here distance covered by each train = sum of their lengths

$= 50 + 50 = 100\ \text{m}$

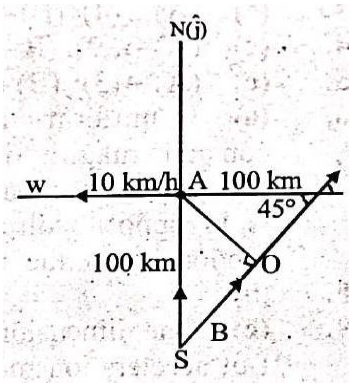
∴ Required time $= \frac{100}{25} = 4\text{sec}.$

114. (a) $\vec{\text{V}}_\text{A} = 10(-\hat{\text{i}})$

$\vec{\text{V}}_\text{B} = 10(\hat{\text{j}})$

$\vec{\text{V}}_\text{BA} = 10\hat{\text{j}} + 10\hat{\text{i}} = 10\sqrt{2}\ \text{km/h}$

Distance $OB = 100\cos\ 45° = 50\sqrt{2}\ \text{km}$



Time taken to each the shortest distance between

A and B $= \frac{OB}{V_{BA}} = \frac{50\sqrt{2}}{10\sqrt{2}} = 5$ h

115. (d) Speed to cover 1200 m by scootarist

$v_r \times 60 = 1200 \Rightarrow v_r = 20$

speed to overtake bus

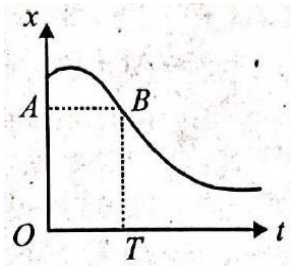
$v = v_r + 10 = 30$ m/s

EXERCISE - 2

1. (b) If we draw a line parallel to time axis from the point (A) on graph at $t = 0$sec. This line can intersect graph at B.

In graph (b) for one value of displacement there are two different points of time. so, for one time, the average velocity is positive and for other time is equivalent negative.
As there are opposite velocities in the inteval 0 to T hence average velocity can vanish in

(b). Thiscan be seen in the figure given below.

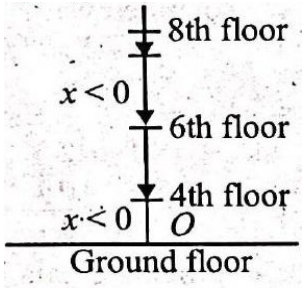


Here, $OA = BT$ (same displacement) for two different points of time.

2. (a) As the lift is moving downward directions so displacement is negative (zero). We have to see whether the motion is accelerating or retarding.

Due to downward motion displacement is negative the lift reaches 4 th floor is about to stop hence, motion is retarding $(-a)$ downward in nature hence, $x < 0; a > 0$.

As displacement is in negative direction, $x < 0$ velocity will also be negative i.e., $v < 0$ but net acceleration is +ve $a > 0$, that can be shown in the graph.



3. (b) In one dimensional motion, for the maximum and minimum displacement we must have the magnitude and direction of maximum velocity.

As maximum velocity in positive direction is v_0, hence maximum velocity in opposite direction is also $-v_0$.

Maximum displacement in one direction $= v_0 T$

Maximum displacement in opposite directions $= -v_0 T$.

Hence, $-v_0 T < x < v_0 T$

4. (c)

5. (b) As given that, $x = (t-2)^2$

velocity $v = \frac{dx}{dt} = \frac{d}{dt}(t-2)^2 = 2(t-2)\text{m/s}$

$$a = \frac{dv}{dt} = \frac{d}{dt}[2(t-2)] = 2[1-0] = 2\ \text{m/s}^2 = 2\ \text{ms}^{-2}$$

at $t = 0; v_0 = 2(0-2) = -4\ \text{m/s}$

$t = 2\ \text{s}; v_2 = 2(2-2) = 0\ \text{m/s}$

$t = 4\ \text{s}; v_4 = 2(4-2) = 4\ \text{m/s}$

$v - t$ graph is shown in diagram.

Distance travelled = area between time axis of the graph = area $OAC + \text{are}\ ABD$

$$= \frac{1}{2} OA \times OC + \frac{1}{2} AD \times BD = 8\ \text{m}$$

If displacement occurs $= -\frac{1}{2} \times OA \times OC + \frac{1}{2} \times AD \times BD = 0$

6. (a) According to question,

$V(x) = bx^{-2n}$

So, $\frac{dv}{dx} = -2nbx^{-2n-1}$

Acceleration of the particle as function of x,

$$a = v\frac{dv}{dx} = bx^{-2n}\{b(-2n)x^{-2n-1}\} = -2nb^2x^{-4n-1}$$

7. (c) Given : Velocity

$V = At + Bt^2 \Rightarrow \frac{dx}{dt} = At + Bt^2$

By integrating we get distance travelled

$\Rightarrow \int_0^x dx = \int_1^2 (At + Bt^2)dt$

Distance travelled by the particle between 1 s and 2 s

$x = \frac{A}{2}(2^2 - 1^2) + \frac{B}{3}(2^3 - 1^3) = \frac{3A}{2} + \frac{7B}{3}$

8. (b) Velocity of preeti w.r.t. elevator $v_1 = \frac{d}{t_1}$

Velocity of elevator w.r.t. ground $v_2 = \frac{d}{t_2}$ then velocity of preeti w.r.t. ground

$$v = v_1 + v_2$$

$\frac{d}{t} = \frac{d}{t_1} + \frac{d}{t_2} \Rightarrow \frac{1}{t} = \frac{1}{t_1} + \frac{1}{t_2}$

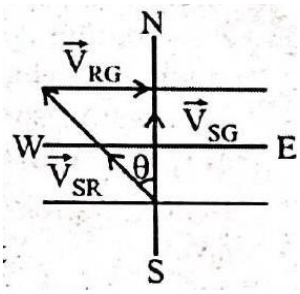
$\therefore t = \frac{t_1 t_2}{(t_1 + t_2)}$ (time taken by preeti to walk up on the moving escalator)

9. (a) Velocity of swimmer w.r.t. river $V_{SR} = 20$ m/s Velocity of river w.r.t. ground $V_{RG} = 10$ m/s

$$\vec{V}_{SG} = \vec{V}_{SR} + \vec{V}_{RG}$$

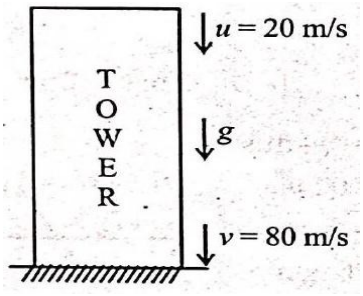
$$\sin\theta = \left|\frac{\vec{V}_{RG}}{\vec{V}_{SR}}\right| \Rightarrow \sin\theta = \frac{10}{20}$$

$$\Rightarrow \sin\theta = \frac{1}{2} \ \therefore \theta = 30^\circ \text{ west}$$



i.e., to cross the river along the shortest path, swimmer should make his strokes 30° west.

10. (c)



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

Height, $h = \frac{v^2 - u^2}{2g} = \frac{(80)^2 - (20)^2}{2 \times 10}$

$$= \frac{6400 - 400}{20} = 300 \text{ m}$$

11. (c) $V = \frac{ds}{dt}$ = slope of $s - t$ curve $= \tan\ \theta$

$$\frac{V_{80^\circ}}{V_{45^\circ}} = \frac{\tan\ 30^\circ}{\tan\ 45^\circ} = \frac{1}{\sqrt{3}}$$

12. (b) $Sn = u + \frac{a}{2}(2n - 1)$

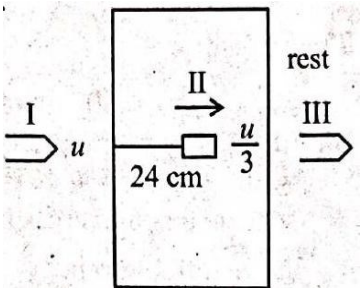
S1:S2: S3: S4 $= (2 \times 1 - 1): (2 \times 2 - 1): (2 \times 3 - 1): (2 \times 4 - 1) = 1: 3: 5: 7$

13. (c) Average speed, $v_{avg} = \frac{2v_1v_2}{v_1 + v_2}$

$$= \frac{2 \times v \times 2v}{v + 2v} = \frac{4v}{3}$$

14. (a) Using third equation of motion between I and II $v^2 - u^2 = 2$ as

$$\Rightarrow \left(\frac{u}{3}\right)^2 = u^2 - 2a \times 24$$



$$\Rightarrow 2a(24) = \frac{8u^2}{9}$$

Using third equation of motion again between II and III

$$0 = \left(\frac{u}{3}\right)^2 - 2as \Rightarrow \frac{u^2}{9} = 2as$$

From equation (i) and (ii)

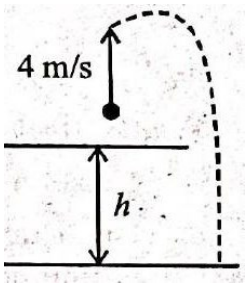
$$2a24 = 8(2as)$$

$\Rightarrow \mathrm{s} = 3\ \mathrm{cm}$

Length of wooden block $= 24 + 3 = 27\ \mathrm{cm}$

15. (c) Given,

Initial velocity of ball, $u = 4\ \mathrm{ms}^{-1}$



$$= 4 \times 4 - \frac{1}{2} \times 10 \times (4)^2 = -64\ \mathrm{m}$$

Height of bridge above water surface $= 64\ \mathrm{m}$

13. acceleration is not equal to zero $(\mathrm{g} = 9.8\ \mathrm{m/s^2})$.