EXERCISE-1

OBJECTIVE PROBLEMS (RECTILINEAR MOTIN) BATCH - CC

1. A motor car is going due north at a speed of 50 km/h. It makes a 90º left turn without changing the speed. The change in the velocity of the car is about

(A) 50 km/h towards west (B) $50\sqrt{2}$ km/h towards south-west

(C) $50\sqrt{2}$ km/h towards north-west (D) zero

2. A particle has a velocity u towards east at t = 0. Its acceleration is towards west and is constant, Let x_A and x_B be the magnitude of displacements in the first 10 seconds and the next 10 seconds.

(A) $x_A < x_B$ (B) $x_A = x_B$ (C) $x_A > x_B$

(D) the information is insufficient to decide the relation of x_A with x_B.

3. A ball takes t seconds to fall from a height h_1 and 2t seconds to fall from a height h_2. Then h_1/h_2 is

(A) 2 (B) 4 (C) 0.5 (D) 0.25

4. A body starts from rest and is uniformly acclerated for 30 s. The distance travelled in the first 10 s is x_1, next 10 s is x_2 and the last 10 s is x_3. Then $x_1 : x_2 : x_3$ is the same as

(A) 1 : 2 : 4 (B) 1 : 2 : 5 (C) 1 : 3 : 5 (D) 1 : 3 : 9

5. A stone is released from an elevator going up with an acceleration a. The acceleration of the stone after the release is

(A) a upward (B) (g-a) upward (C) (g-a) downward (D) g downward

6. A person standing near the edge of the top of a building throws two balls A and B. The ball A is thrown vertically downward and the ball B is thrown vertically upward with the same speed. The ball A hits the ground with a speed υ_A and the ball B hits the ground with a speed υ_B. We have

(A) $\upsilon_A > \upsilon_B$ (B) $\upsilon_A < \upsilon_B$ (C) $\upsilon_A = \upsilon_B$

(D) the relation between A and B depends on height of the building above the ground.

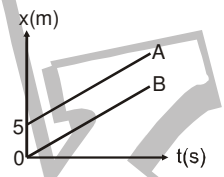
7. Figure shows position-time graph of two cars A and B.

(A) Car A is faster than car B.

(B) Car B is faster than car A.

(C) Both cars are moving with same velocity.

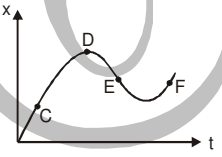
(D) Both cars have positive acceleration.



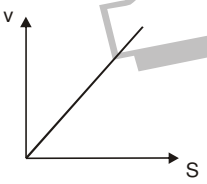
8. The displacement–time graph of a moving particle is shown below. The instantaneous velocity of the particle is negative at the point :

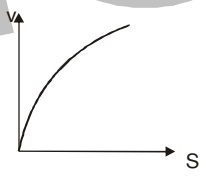
(A) C (B) D

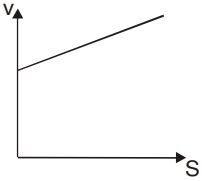
(C) E (D) F

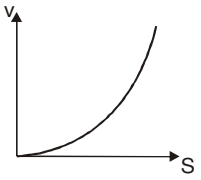


9. A particle starts from rest and moves along a straight line with constant acceleration. The variation of velocity v with displacement S is :

(A) 

(B) 

C) 

(D) 

10. The displacement time graphs of two particles A and B are straight lines making angles of respectively 30^0 and 60^0 with the time axis. If the velocity of A is v_A and that of B is v_B, then the value of $\frac{v_A}{v_B}$ is

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

11. The initial velocity of a particle is u (at t=0) and the acceleration f is given by (f = at). Which of the following relations is valid?

(A) $v = u + at^2$ (B) $v = u + \frac{at^2}{2}$ (C) $v = u + at$ (D) $v = u$

12. 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

(A) $T = 2h/v$ (B) $T = \sqrt{\frac{2h}{g}} + \frac{h}{v}$ (C) $T = \sqrt{\frac{2h}{g}} + \frac{h}{2v}$ (D) $T = \sqrt{\frac{h}{2g}} + \frac{2h}{v}$

13. A body is released from the top of a tower of height h metre. It takes T seconds to reach the ground. Where is the ball at the time T/2 seconds ?

(A) at h/4 metre from the ground (B) at h/2 metre from the ground
(C) at 3h/4 metre from the ground (D) depend upon the mass of the ball

14. A stone is thrown vertically upward with an initial velocity u from the top of a tower, reaches the ground with a velocity 3u. The height of the tower is:

(A) $\frac{3u^2}{g}$ (B) $\frac{4u^2}{g}$ (C) $\frac{6u^2}{g}$ (D) $\frac{9u^2}{g}$

15. A particle starts from rest with uniform acceleration a. Its velocity after n seconds is v. The displacement of the body in the last two seconds is :

(A) $\frac{2v(n-1)}{n}$ (B) $\frac{v(n-1)}{n}$ (C) $\frac{v(n+1)}{n}$ (D) $\frac{2v(2n+1)}{n}$

16. Consider the motion of the tip of the minute hand of a clock. In one hour
(A) the displacement is zero (B) the distance covered is zero
(C) the average speed is zero (D) the average velocity is zero

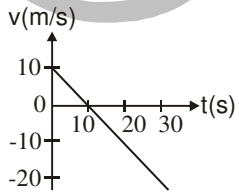
17. A particle moves along the X-axis as $x = u(t-2) + a(t-2)^2$
(A) the initial velocity of the particle is u (B) the acceleration of the particle is a
(C) the acceleration of the particle is 2a (D) at t =2s particle is at the origin.

18. Mark the correct statements for a particle going on a straight line:
(A) If the velocity and acceleration have opposite sign, the object is slowing down.
(B) If the position and velocity have opposite sign, the particle is moving towards the origin.
(C) If the velocity is zero at an instant, the acceleration should also be zero at that instant.
(D) If the velocity is zero for a time interval, the acceleration is zero at any instant within the time interval.

19. The velocity of a particle is zero at t = 0
(A) The acceleration at t = 0 must be zero
(B) The acceleration at t = 0 may be zero.
(C) If the acceleration is zero from t = 0 to t = 10 s, the speed is also zero in this interval.
(D) If the speed is zero from t = 0 to t = 10 s the acceleration is also in the interval.

20. Mark the correct statements:
(A) The magnitude of the velocity of a particle is equal to its speed.
(B) The magnitude of average velocity in an interval is equal to its average speed in that interval.
(C) It is possible to have a situation in which the speed of a particle is always zero but the average speed is not zero
(D) It is possible to have a situation in which the speed of the particle is never zero but the average speed in an interval is zero.

21. The velocity-time plot for a particle moving on a straight line is shown in fig.
(A) The particle has constant acceleration
(B) The particle has never turned around.
(C) The particle has zero displacement
(D) The average speed in the interval 0 to 10s is the same as the average speed in the interval 10s to 20s.



SUBJECTIVE PROBLEMS

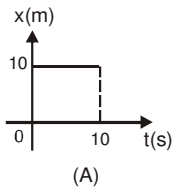
1. A particle covers each 1/3 of the total distance with speed v_1, v_2 and v_3 respectively. Find the average speed of the particle ?

2. The position of a particle moving on x-axis is given by $x = 4t^3 + 3t^2 + 6t + 4$. Find
(a) The velocity and acceleration of particle at t = 5 s.
(b) The average velocity and average acceleration during the interval t = 0 to t = 5 s, $x = 4t^3 + 3t^2 + 6t + 4$
(a) The velocity and acceleration of particle at t = 5 s.
(b) The average velocity and average acceleration during the interval t = 0 to t = 5 s.

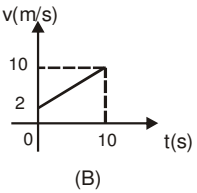
3. A train starts from rest and moves with a constant acceleration of 2.0 m/s^2 for half a minute. The brakes are then applied and the train comes to rest in one minute. Find (a) the total distance moved by the train, (b) the maximum speed attained by the train and (c) the position(s) of the train at half the maximum speed.

4. A particle starts from rest with a constant acceleration. At a time t second, the speed is found to be 100 m/s and one second later the speed becomes 150 m/s. Find (a) the acceleration and (b) the distance travelled during the $(t+1)^{th}$ second.

5. For a particle moving along x-axis, following graphs are given. Find the distance travelled by the particle in 10 s in each case.

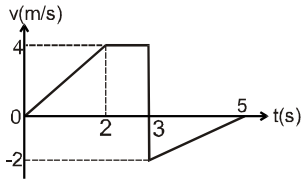


(A)

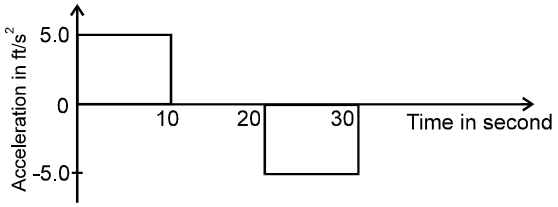


(B)

6. For a particle moving along x-axis, velocity-time graph is as shown in figure. Find the distance travelled and displacement of the particle? Also find the average velocity of the particle?



7. The acceleration of a cart started at t = 0, varies with time as shown in figure . Find the distance travelled in 30 seconds and draw the position-time graph.

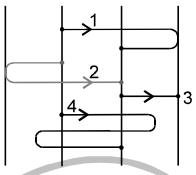


8. For a particle moving rectilinearly, acceleration as a function of speed is given as $a = 8v^2$. Find the speed as a function of x if the particle is having a speed of v_0 at x = 0?

9. Under what conditions does the magnitude of the average velocity equal to the average speed.

10. Can an object have increasing speed but its acceleration decreases? If yes, give an example; if not, explain why?

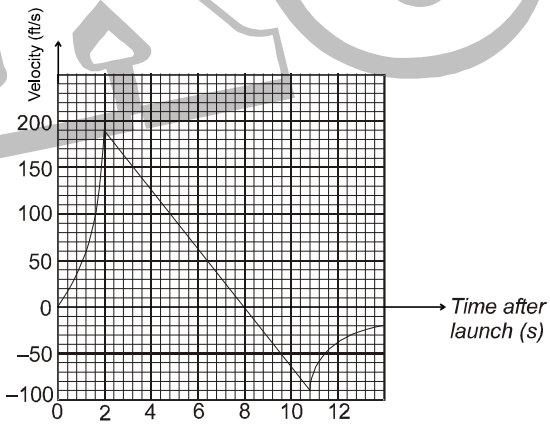
11. Figure shows four paths along which obejcts move from a starting point to a final point (particle is moving along the same straight line), all in the same time. The paths pass over a grid of equally spaced straight lines. Rank the paths according to
(a) the average velocity of the objects and
(b) the average speed of the objects, greatest first.



12. A man walking with a speed ' v ' constant in magnitude and direction passes under a lantern hanging at a height H above the ground. Find the velocity with which the edge of the shadow of the man's head moves over the ground, if his height is ' h '.

13. An elevator is descending with uniform acceleration. To measure the acceleration , a person in the elevator drops a coin at the moment the elavator starts. The coin is 6 ft above the floor of the elevator at time it is dropped. The person observes that the coin strikes the floor in 1 second. Calculate from these data the acceleration of the elevator. [Take g = 32 ft/s^2]

14. When a model rocket is launched, the propellant burns for a few seconds, accelerating the rocket upward. After burnout, the rocket moves upward for a while and then begins to fall. A parachute opens shortly after the rocket starts down. The parachute slows the rocket to keep it from breaking when it lands. The figure here shows velocity data from the flight of the model rocket. Use the data to answer the following.

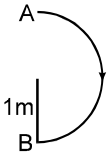


(a) How fast was the rocket climbing when the engine stopped?
(b) For how many seconds did the engine burn?
(c) When did the rocket reach its highest point? What was its velocity then?
(d) When did the parachute open up ? How fast was the rocket falling then?
(e) How long did the rocket fall before the parachute opened?
(f) When was the rocket's acceleration greatest?
(g) When was the acceleration constant? What was its value then (to the nearest interger)?

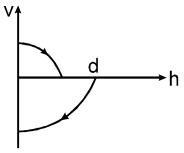
EXERCISE-2

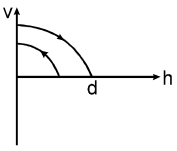
1. A particle of mass 10^{-2} kg is moving along the positive x–axis under the influence of a force $F(x) = -\frac{K}{2x^2}$ where $K = 10^{-2}$ N m^2. At time t = 0 it is at x = 1.0 m and its velocity is v = 0. Find
(i) its velocity when it reaches x = 0.50 m
(ii) the time at which it reaches x = 0.25 m. **[JEE '98, 8]**

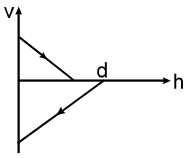
2. In 1.0 sec. a particle goes from point A to point B moving in a semicircle of radius 1.0 m. The magnitude of average velocity is: **[JEE '99, 2]**
(A) 3.14 m/sec (B) 2.0 m/sec
(C) 1.0 m/sec (D) zero

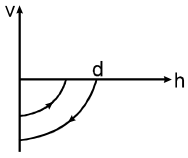


3. A ball is dropped vertically from a height d above the ground. It hits the ground and bounces up vertically to a height d/2. Neglecting subsequent motion and air resistance, its velocity v varies with the height h above the ground as **[JEE '2000, 3]**

(A) 

(B) 

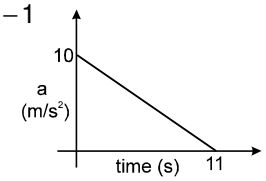
(C) 

(D) 

4. A block is moving down a smooth inclined plane starting from rest at time t = 0. Let S_n be the distance travelled by the block in the interval t = n – 1 to t = n. The ratio $\frac{S_n}{S_{n+1}}$ is **[JEE Scr. 2004, 3]**

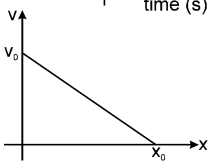
(A) $\frac{2n-1}{2n}$ (B) $\frac{2n-1}{2n+1}$ (C) $\frac{2n+1}{2n-1}$ (D) $\frac{2n}{2n-1}$

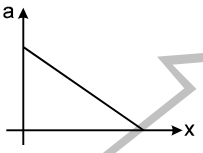
5. A particle is initially at rest, It is subjected to a linear acceleration a , as shown in the figure. The maximum speed attained by the particle is **[JEE Scr. 2004; 3]**

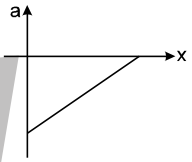


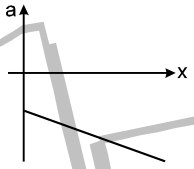
(A) 605 m/s (B) 110 m/s (C) 55 m/s (D) 550 m/s

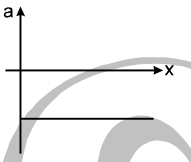
6. The velocity displacement graph of a particle moving along a straight line is shown. The most suitable acceleration-displacement graph will be **[JEE Scr. 2005; 3]**



(A) 

(B) 

(C) 

(D) 

ANSWER

EXERCISE # 1

OBJECTIVE PROBLEMS

1. B	**2.** D	**3.** D	**4.** C
5. D	**6.** C	**7.** C	**8.** C
9. B	**10.** D	**11.** B	**12.** B
13. C	**14.** B	**15.** A	**16.** A,D
17. C,D	**18.** A,B,D	**19.** B,C,D	**20.** A **21.** A,D

SUBJECTIVE PROBLEMS

1. $\frac{3v_1v_2v_3}{v_1v_2+v_2v_3+v_1v_3}$

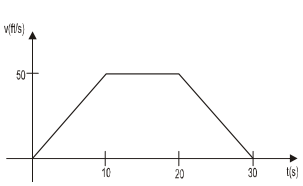
2. (a) $v_{t=5\,s}$ = 336 units, $a_{t=5\,s}$ = 126 units ; (b) <v> = 121 units, <a> = 66 units

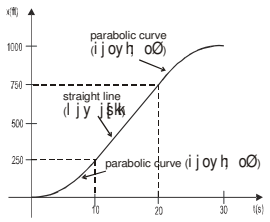
3. (a) 2.7 km , (b) 60 m/s, (c) 225 m and 2.25 km

4. (a) 50 m/s²; (b) 125 m **5.** (A) 0; (B) 60m

6. distance travelled = 10 m; displacement = 6 m; average velocity = 1.2 m/s

7. 1000 ft. ,





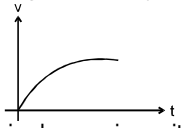
8. $v = v_0 e^{8x}$

9. $\langle \vec{v} \rangle = \langle v \rangle \quad \therefore \quad \frac{\text{displacment}}{\text{time}} = \frac{\text{distance travelled}}{\text{time}}$

When the distance travelled is equal to the displacement of the particle, i.e. particle moves along the straight line in the same direction without reversing the direction of motion.

10. Yes. Speed of object will increase if acceleration is in the direction of velocity, yet its magnitude may decrease.

$a = \frac{dv}{dt}$ = slope of the curve.



acceleration (slope of the curve) is decreasing with time yet the speed is increasing.

11. (a) $\langle \vec{v}_1 \rangle = \langle \vec{v}_2 \rangle = \langle \vec{v}_3 \rangle = \langle \vec{v}_4 \rangle$

(b) $v_{4,\,avg} > v_{1,\,avg} = v_{2,\,avg} > v_{3,\,avg}$

12. $\left(\frac{H}{H-h}\right)v$ **13.** 20 ft/s²

14. **(a)** 190 ft/s **(b)** 2 s **(c)** 8 s, 0 ft/s
(d) 10.8 s, 90 ft/s **(e)** 2.8 s
(f) greatest acceleration happens 2 s after launch
(g) constant acceleration between 2 and 10.8 s, – 32 ft/s².

EXERCISE # 2

1. **(i)** $\vec{V} = -1\,\hat{i}$ **m/s** **(ii)** $t = \frac{\pi}{3}+\frac{\sqrt{3}}{4}$

2. B **3.** A **4.** B **5.** C **6.** B

