PREFACE

This book contains the Daily Practice Problems (DPPs) designed for the aspirants JEE(Main+Advanced). It is a collection of problems (Physics, Chemistry & Mathematics in separate booklets) from multiple topics to understand the application of concepts learned in theory. Each DPP is kind of a timed test with marking scheme and prescribed time to be spent on each problem. It is according to the latest pattern of JEE(Advanced) and serves as a great tool for the students to simulate examination conditions at home. It enables a student to practice time management while solving a problem which helps him/her to better prepare for the target exam.

Every effort has been taken to keep this book error free, however any suggestions to improve are welcome at ***smdd@resonance.ac.in.***

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DPP

DAILY PRACTICE PROBLEMS

PHYSICS

TARGET: JEE (Main + Advanced)

COURSE : VISHESH (01JD to 06JD) DPPs - A1 to A13

INDEX

NOTE : ✍ Marked Questions can be used as Revision Questions.

DPP No. : A1 (JEE-Main)

Total Marks : 65 **Max. Time : 44 min.**
Single choice Objective ('–1' negative marking) Q.1 to Q.19 **(3 marks, 2 min.)** **[57, 38]**
Match the Following (no negative marking) Q.20 **(8 marks, 6 min.)** **[08, 06]**

1. Convert 18 degree into radians.

(A) $\frac{\pi}{10}$ rad (B) $\frac{\pi}{180}$ rad (C) $\frac{\pi}{18}$ rad (D) $\frac{18}{\pi}$

2. sin 300º is equal to

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

3. If $\sin\theta = \frac{1}{3}$, then $\cos\theta$ will be -

(A) $\pm\frac{8}{9}$ (B) $\pm\frac{4}{3}$ (C) $\pm\frac{2\sqrt{2}}{3}$ (D) $\pm\frac{3}{4}$

4. Value of sin (37°) cos (53°) is -

(A) $\frac{9}{25}$ (B) $\frac{12}{25}$ (C) $\frac{16}{25}$ (D) $\frac{3}{5}$

5. sin (90º + θ) is -

(A) sin θ (B) cos θ (C) – cos θ (D) – sin θ

6. sec $(\pi + \theta)$ =

(A) cosθ (B) tanθ (C) sec θ (D) – sec θ

7. Value of tan225º is :

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

8. sin (750°) =

(A) $\frac{1}{2}$ (B) $-\frac{1}{2}$ (C) 0 (D) $\frac{\sqrt{3}}{2}$

9. $\cos\left(\frac{11\pi}{6}\right) =$

(A) $\frac{1}{2}$ (B) $-\frac{\sqrt{3}}{2}$ (C) 0 (D) $\frac{\sqrt{3}}{2}$

10. Value of sin15º. cos15º is:

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

11. If $y = e^x . \cot x$ then $\frac{dy}{dx}$ will be

(A) $e^x\cot x - \text{cosec}^2x$ (B) $e^x\text{cosec}^2x$
(C) $e^x[\cot x - \text{cosec}^2x]$ (D) $e^x\cot x$

12. Equation of straight line is 2x + 3y = 5. Slope of the straight line is:
(A) 3/2 (B) 2/3 (C) –2/3 (D) –3/2

13. Double differentiation of displacement w.r.t. time is:
(A) Acceleration (B) velocity (C) force (D) none of these

14. $\int x^3 dx$ is equal to:

(A) $3x^2$ (B) $\frac{x^4}{4}+C$ (C) $\frac{x^4}{4}$ (D) $4x^3$

15. $\int 2\sin(x)dx$ is equal to:

(A) –2cos x + C (B) 2 cosx + C (C) –2 cos x (D) 2 cosx

16. Find $\int \frac{dx}{ax+b}$

(A) $\log_e(ax + b) + C$ (B) $a \log_e(ax + b) + C$ (C) $C + \frac{1}{a}\log_e(ax + b)$ (D) $\frac{1}{b}\log_e(ax + b) + C$

17. If $y = x^2\sin(x^3)$, then $\int ydx$ will be :

(A) $-\cos(x^3) + C$ (B) $\left(-\frac{\cos x^3}{3}\right)+C$ (C) $\cos(x^3) + C$ (D) $\left(\frac{\cos x^3}{3}\right)+C$

18. Evaluate $\int_0^{2\pi} 2\sin(x)dx$

(A) 0 (B) $\frac{1}{3}$ (C) $\frac{2}{3}$ (D) 2

19. Value of $\int_0^{\pi/2} \cos 3t \, .dt$ is

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

20. Match the following columns:

(a) sin 37º	(P) $\frac{-3}{5}$
(b) cos 127º	(Q) $\frac{3}{5}$
(c) tan 307º	(R) $-\frac{4}{3}$
(d) cos 307º	(S) $\frac{4}{3}$
(e) cos (–53º)	(T) $\frac{3}{4}$

DPP No. : A2 (JEE-Advanced)

Total Marks : 41	**Max. Time : 33 min.**
Single choice Objective ('–1' negative marking) Q.1 to Q.4	**(3 marks, 2 min.) [12, 08]**
One or more than one options correct type ('–1' negative marking) Q.5 to Q.6	**(4 marks 2 min.) [08, 04]**
Comprehension ('–1' negative marking) Q.7 to Q.9	**(3 marks 2 min.) [09, 06]**
Subjective Questions ('–1' negative marking) Q.10 to Q.12	**(4 marks 5 min.) [12, 15]**

1. The displacement vector of the particle if it moves from A (3, 4, 5) to B(4, 5, 6) is

(A) $3\hat{i} + 4\hat{j} + 5\hat{k}$ (B) $4\hat{i} + 5\hat{j} + 6\hat{k}$ (C) $\hat{i} + \hat{j} + \hat{k}$ (D) $3\hat{i} + 5\hat{j} + \hat{k}$

2. A particle is moving with speed 6 m/s along the direction of $\vec{A} = 2\hat{i} + 2\hat{j} - \hat{k}$, then its velocity is :

(A) $(4\hat{i} + 2\hat{j} - 4\hat{k})$ units (B) $(4\hat{i} + 4\hat{j} - 2\hat{k})$ units

(C) $(4\hat{i} + 4\hat{j} - 4\hat{k})$ units (D) $(2\hat{i} + 4\hat{j} - 2\hat{k})$ units

3. Three forces P, Q and R are acting on a particle in the plane, the angle between P and Q & Q and R are 150° and 120° respectively. Then for equilibrium, forces P, Q and R are in the ratio

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

4. If $\vec{A}$ and $\vec{B}$ are two non–zero vectors such that $|\vec{A} + \vec{B}| = \frac{|\vec{A} - \vec{B}|}{2}$ and $|\vec{A}| = 2|\vec{B}|$ then the angle between $\vec{A}$ and $\vec{B}$ is:

(A) 37º (B) 53º (C) $\cos^{-1}(-3/4)$ (D) $\cos^{-1}(-4/3)$

5. Given vector sum of 4 vectors $\vec{a} + \vec{b} + \vec{c} + \vec{d} = 0$, which of the following statements are correct :

(A) $\vec{a}$, $\vec{b}$, $\vec{c}$ and $\vec{d}$ must each be a null vector

(B) The magnitude of ($\vec{a}$ + $\vec{c}$) equals the magnitude of ($\vec{b}$ + $\vec{d}$)

(C) The magnitude of $\vec{a}$ can never be greater than the sum of the magnitude of $\vec{b}$, $\vec{c}$ and $\vec{d}$.

(D) $\vec{b}$ + $\vec{c}$ must lie in the plane of $\vec{a}$ and $\vec{d}$ if $\vec{a}$ and $\vec{d}$ are not collinear, and along the line of $\vec{a}$ and $\vec{d}$, if they are collinear.

6. The magnitude of the displacement is equal to the distance covered in a given interval of time if the particle.

(A) moves with constant acceleration along any path

(B) moves with constant speed

(C) moves in same direction with constant velocity or with variable velocity

(D) have acceleration and velocity in same direction.

COMPREHENSION

At time t the position of a body moving such that its position varies with time and is given by $s = t^3 - 6t^2 + 9t$ m.

7. Find the body's acceleration each time the velocity is zero.

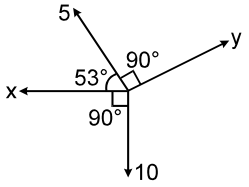
8. Find the body's speed each time the acceleration is zero

9. Find the total distance traveled by the body from t = 0 to t = 2

10. If $\vec{a} = 3\hat{i} + 4\hat{j}$ & $\vec{b} = 7\hat{i} + 24\hat{j}$ then find the vector having the same magnitude as $\vec{b}$ and same direction as $\vec{a}$ is _____.

11. A sail boat sails 2 km due East, 5 km 37° South of East and finally an unknown displacement. If the final displacement of the boat from the starting point is 6 km due East, the third displacement is _____.

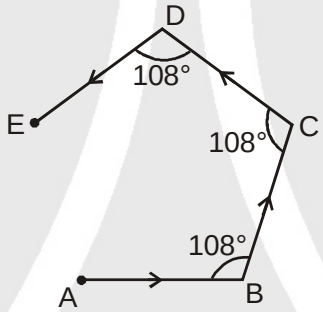
12. Find the magnitude of the unknown forces X and Y if sum of all forces is zero.



DPP No. : A3 (JEE–Main)

Total Marks : 61		**Max. Time : 40 min.**
Single choice Objective ('–1' negative marking) Q.1 to Q.19	**(3 marks, 2 min.)**	**[57, 38]**
Multiple choice objective ('–1' negative marking) Q.20	**(4 marks, 2 min.)**	**[04, 02]**

1. A particle moves in a plane from A to E along the shown path. It is given that AB = BC = CD = DE = 10 metre. Then the magnitude of net displacement of particle is :



(A) 10 m (B) 15 m (C) 5 m (D) 20 m

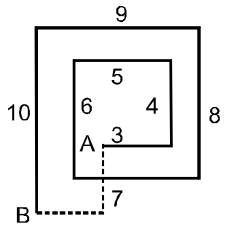
2. A car covers a distance of 2 km in 2.5 minutes. If it covers half of the distance with speed 40 km/hr, the rest distance it shall cover with a speed of:

(A) 56 km/hr (B) 60 km/hr (C) 48 km/hr (D) 50 km/hr

3. A clock has a minute-hand 10 cm long. Find the average velocity between 6.00 AM to 6.30 AM for the tip of minute-hand.

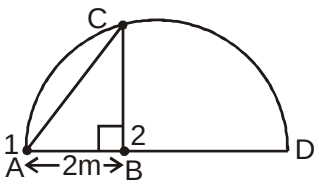
(A) $\frac{22}{21}$ cm min^{-1} (B) $\frac{2}{21}$ cm min^{-1} (C) $\frac{12}{21}$ cm min^{-1} (D) $\frac{2}{3}$ cm min^{-1}

4. A particle travels from A to B path shown in figure, then the displacement of particle is :



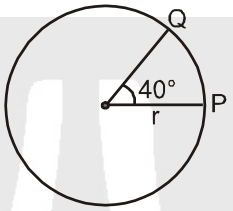
(A) $2\sqrt{2}$ m (B) $4\sqrt{2}$ m (C) 52 m (D) None of these

5. A semicircle of radius R = 5m with diameter AD is shown in figure. Two particles 1 and 2 are at points A and B on shown diameter at t = 0 and move along segments AC and BC with constant speeds u_1 and u_2 respectively. Then the value of $\frac{u_1}{u_2}$ for both particles to reach point C simultaneously will be :



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

6. A particle is moving in a circle of radius r with speed v as shown in the figure. The magnitude of change in velocity in moving from P to Q is:



(A) 2 v cos 40º (B) 2 v sin 20º (C) 2 v cos 20º (D) none of these

7. The instantaneous velocity of a particle is equal to time derivative of its position vector and the instantaneous acceleration is equal to time derivative of its velocity vector. Therefore:
(A) the instantaneous velocity depends on the instantaneous position vector
(B) instantaneous acceleration is independent of instantaneous position vector and instantaneous velocity
(C) instantaneous acceleration is independent of instantaneous position vector but depends on the instantaneous velocity
(D) instantaneous acceleration depends both on the instantaneous position vector and the instantaneous velocity.

8. The velocity of a car moving on a straight road increases linearly according to equation, v = a + b x, where a & b are positive constants. The acceleration in the course of such motion: (x is the distance travelled)
(A) increases (B) decreases (C) stay constant (D) becomes zero

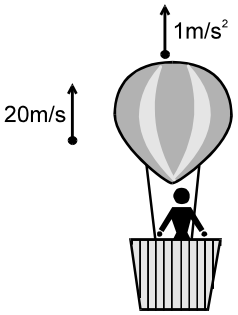
9. A boy starts running from rest with constant acceleration. If he covers a distance of S_1 in the first 10 seconds and S_2 in the next 10 seconds, then choose the correct option.
(A) $S_2 = S_1$ (B) $S_2 = 2S_1$ (C) $S_2 = 3S_1$ (D) $S_2 = 4S_1$

10. Each of the four particles move along the x axis. Their coordinates (in meters) as function of time (in seconds) are given by
Particle 1 : $x(t) = 3.5 - 2.7t^3$ Particle 2 : $x(t) = 3.5 + 2.7t^3$
Particle 3 : $x(t) = 3.5 + 2.7t^2$ Particle 4 : $x(t) = 2.5 - 3.4t - 2.7\ t^2$
which of these particles is speeding up for t > 0?
(A) All four (B) only 1 (C) only 1, 2 and 3. (D) only 2, 3 and 4

11. A body covers first $\frac{1}{3}$ part of its journey with a velocity of 2 m/s, next $\frac{1}{3}$ part with a velocity of 3 m/s and rest of the journey with a velocity 6m/s. The average velocity of the body will be

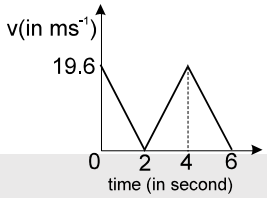
(A) 3 m/s (B) $\frac{11}{3}$ m/s (C) $\frac{8}{3}$ m/s (D) $\frac{4}{3}$ m/s

12. A balloon is moving with constant upward acceleration of 1 m/s^2. A stone is thrown from the balloon downwards with speed 10 m/s with respect to the balloon. At the time of projection balloon is at height 120 m from the ground and is moving with speed 20 m/s. The time required by the stone to fall on the ground after the projection will be - (g = 10 m/s^2)



(A) 4 sec.
(B) 5 sec.
(C) 6 sec.
(D) None of these

13. The velocity - time graph of a particle is as shown in figure



(A) It moves with a constant acceleration throughout
(B) It moves with an acceleration of constant magnitude but changing direction at the end of every two second
(C) The displacement of the particle is zero
(D) The velocity becomes zero at t = 4 second

14. At a particular instant velocity and acceleration of a particle are $(-\hat{i}+\hat{j}+2\hat{k})$m/s and $(3\hat{i}-\hat{j}+\hat{k})$m/s^2 respectively at the given instant particle's speed is :

(A) increasing (B) decreasing (C) constant (D) can't be say

15. A particle has initial velocity, $\vec{v}=3\hat{i}+4\hat{j}$ and a constant force $\vec{F}=4\hat{i}+3\hat{j}$ acts on the particle. The path of the particle is:

(A) straight line (B) parabolic (C) circular (D) elliptical

16. The position of a particle is given by, x = 3 t^2 – 5 & y = 2 t. Find the velocity vector of the particle.

(A) 6 t i + 2 j (B) – 6 t i + 2 j
(C) 6 t i – 2 j (D) none of these

17. A particle moves in x-y plane according to equations, x = 4 t^2 + 5 t + 16 & y = 5 t. The acceleration of the particle will be:

(A) 8 m/sec^2 (B) 13 m/sec^2 (C) 14 m/sec^2 (D) none of these

18. A particle has an initial velocity (i.e., at t = 0) of $3\hat{i}+4\hat{j}$ (m/s) and an acceleration of $0.4\hat{i}+0.3\hat{j}$ (m/s^2). The speed of particle at t = 10 sec is:

(A) 7 m/s (B) 7/ $\sqrt{2}$ m/s (C) $7\sqrt{2}$ m/s (D) $14\sqrt{2}$ m/s

19. A particle is projected with speed 10 m/s at angle 60° with the horizontal. Then the time after which its speed becomes half of initial -

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

20. If x = 3 t^2 – 8 t + 5, find the velocity of the particle when position of the particle is zero.

(A) – 2 (B) + 2 (C) 3 (D) none of these

DPP No. : A4 (JEE–Advanced)

Total Marks : 44	Max. Time : 36 min.
One or more than one options correct type ('–1' negative marking) Q.1 to Q.4	(4 marks 2 min.) [16, 08]
Comprehension ('–1' negative marking) Q.5 to Q.8	(3 marks 2 min.) [12, 08]
Subjective Questions ('–1' negative marking) Q.9 to Q.12	(4 marks 5 min.) [16, 20]

1. A particle moves with constant speed v along a regular hexagon ABCDEF in the same order. Then the magnitude of the average velocity for its motion from A to:

(A) F is $\frac{v}{5}$ (B) D is $\frac{v}{3}$ (C) C is $\frac{v\sqrt{3}}{2}$ (D) B is v.

2. A particle is moving along x-axis such that its position is given by $x = 4 - 9t + \frac{t^3}{3}$ where t is time in seconds, x is in meters. Mark the correct statement(s):

(A) Direction of motion is not changing at any of the instants
(B) Direction of the motion is changing at t = 3 seconds
(C) For $0 < t < 3$ sec. the particle is slowing down
(D) For $3 < t < 6$ sec. the particle is speeding up

3. A stone is projected vertically upwards at t = 0 second. The net displacement of stone is zero in time interval between t = 0 second to t = T seconds. Pick up the ***CORRECT*** statement.

(A) From time $t = \frac{T}{4}$ second to $t = \frac{3T}{4}$ second, the average velocity is zero.

(B) The change in velocity from time t = 0 to $t = \frac{T}{4}$ second is same as change in velocity from $t = \frac{T}{8}$ second to $t = \frac{3T}{8}$ second

(C) The distance travelled from t = 0 to $t = \frac{T}{4}$ second is larger than distance travelled from $t = \frac{T}{4}$ second to $t = \frac{3T}{4}$ second

(D) The distance travelled from $t = \frac{T}{2}$ second to $t = \frac{3T}{4}$ second is half the distance travelled from $t = \frac{T}{2}$ second to t = T second.

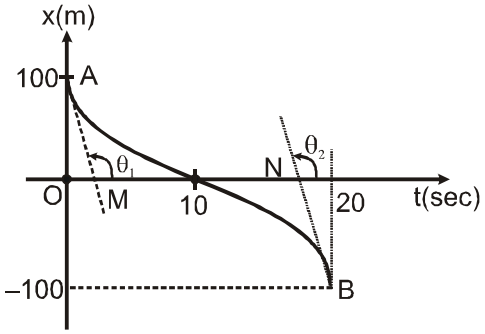
4. A particle of mass m moves along a curve $y = x^2$. When particle has x – co-ordinate as 1/2m and x-component of velocity as 4m/s then, at this instant:

(A) the position coordinate of particle are (1/2, 1/4)m
(B) the velocity of particle will be along the line 4x – 4y – 1 = 0.
(C) the magnitude of velocity at that instant is $4\sqrt{2}$ m/s
(D) the magnitude of angular momentum of particle about origin at that position is 0.

Comprehension # 1

Read the following write up and answer the questions based on that.

The graph below gives the coordinate of a particle travelling along the X-axis as a function of time. AM is the tangent to the curve at the starting moment and BN is tangent at the end moment ($\theta_1 = \theta_2 = 120°$).



5 The average velocity during the first 20 seconds is

(A) – 10 m/s (B) 10 m/s (C) zero (D) 20 m/s

6. The average acceleration during the first 20 seconds is

(A) – 1 m/s^2 (B) 1 m/s^2 (C) zero (D) 2 m/s^2

7. The direction ($\hat{i}$ or $-\hat{i}$) of acceleration during the first 10 seconds is _____ .

8. Time interval during which the motion is retarded.

(A) 0 to 20sec (B) 10 to 20sec. (C) 0 to 10sec. (D) None of these

9. A particle whose speed is 50 m/s moves along the line from A (2,1) to B (9, 25). Find its velocity vector in the form of $a\hat{i} + b\hat{j}$.

10. A particle moves in a straight line with an acceleration a ms^{-2} at time 't' seconds where $a = -\frac{1}{t^2}$. When t = 1 the particle has a velocity of 3ms^{-1} then find the velocity when t = 4

11. The velocity of a particle is given by $\vec{v} = 2\hat{i} - \hat{j} + 2\hat{k}$ in m/s for time interval t = 0 to t = 10 sec. Find the distance travelled by the particle in given time interval.

12. A point moves in the x–y plane according to the law x = a sinωt, y = a(1– cosωt). Find the distance travelled by particle in first t_0 seconds.

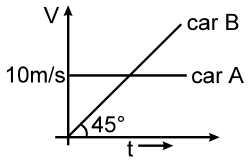
DPP No. : A5 (JEE–Advanced)

Total Marks : 47	**Max. Time : 37 min.**
Single choice Objective ('–1' negative marking) Q.1 to Q.5	**(3 marks, 2 min.) [15, 10]**
One or more than one options correct type ('–1' negative marking) Q.6 to Q.8	**(4 marks 2 min.) [12, 06]**
Subjective Questions ('–1' negative marking) Q.9 to Q.11	**(4 marks 5 min.) [12, 15]**
Match the Following (no negative marking) Q.12	**(8 marks, 6 min.) [08, 06]**

1. An ant is at a corner of a cubical room of side ' a '. The ant can move with a constant speed u. The minimum time taken to reach the farthest corner of the cube is:

(A) $\frac{3a}{u}$ (B) $\frac{\sqrt{3}\,a}{u}$ (C) $\frac{\sqrt{5}\,a}{u}$ (D) $\frac{\left(\sqrt{2}+1\right)a}{u}$

2. Initially car A is 10.5 m ahead of car B. Both start moving at time t = 0 in the same direction along a straight line. The velocity time graph of two cars is shown in figure. The time when the car B will catch the car A, will be



(A) t = 21 sec (B) t = $2\sqrt{5}$ sec

(C) 20 sec. (D) None of these

3. A car starts from rest & again comes to rest after travelling 200 m in a straight line. If its acceleration and deacceleration are limited to 10 m/s^2 & 20 m/s^2 respectively then minimum time the car will take to travel the distance is -

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

4. Two particles at a distance 5m apart, are thrown towards each other on an inclined smooth plane with equal speeds 'v'. It is known that both particle move along the same straight line. Find the value of v if they collide at the point from where the lower particle is thrown. Inclined plane is inclined at an angle of 30° with the horizontal. [take g = 10m/s^2]

(A) 2.5 m/sec (B) 5 m/sec (C) 7.5 m/sec (D) 10 m/sec

5. In ground to ground projection, if range 'R' is related to time of flight 'T' according to relation R = $\frac{15}{4}$ T^2, then the angle of projection θ with the horizontal direction is: (Take g = 10 m/s^2)

(A) 30° (B) 45° (C) 37° (D) 53°

6. The displacement ' x ' of a particle varies with time according to the relation, x = $\frac{a}{b}(1 - e^{-bt})$, where a & b are positive constants. Then:

(A) at t = 1/b, the displacement of the particle is a/b

(B) the velocity and acceleration of the particle at t = 0 are a & $-$ ab respectively

(C) the particle cannot reach a point whose distance is > a/b from its starting position

(D) the particle will never come back to its starting point.

7. A particle moves along a straight line and its velocity depends on time 't' as v = 4t – t^2. Here v is in m/sec. and t is in second. Then for the first 5 seconds:

(A) Magnitude of average velocity is $\frac{5}{3}$ m/s (B) Average speed is $\frac{13}{5}$ m/s

(C) Average speed is $\frac{11}{5}$ m/s (D) Average acceleration is – 1m/s^2|

8. A particle is thrown with velocity 10 m/sec at an angle of 37º with vertical, then at the time of projection: (g = 10m/s^2)

(A) Acceleration of particle in line of velocity is 8m/s^2

(B) Acceleration of particle perpendicular to line of velocity is 6m/s^2

(C) Velocity of particle in line of acceleration is 8m/sec

(D) Velocity of particle perpendicular to line of acceleration is 6m/sec.

9. Two balls are moving on the same smooth horizontal plane. Their velocity components along one edge of the square plane are $10\sqrt{3}$ & 20 m/s. Their velocity components along a perpendicular edge are 30 & 20 m/s. Find the angle between their directions of motion.

10. Two mosquitos move in space such that their x,y,z coordinate at any time are given as (3t + 1, 4t, 2t^2 – 1), (4t + 1, 3t + 3, 2t^2) all in meters. Find the minimum distance between these two and corresponding time.

11. Two particles A and B move in x-y plane such that both have constant acceleration $\vec{a}_A = -10\hat{j}$ m/s^2 and $\vec{a}_B = -5\hat{j}$ m/s^2 respectively.The velocities of particles at t = 0 are $\vec{u}_A = -5\hat{i} + 20\hat{j}$ m/s and $\vec{u}_B = 2.5\hat{i} + 10\hat{j}$ m/s. At time t=0, particle A is at origin and particle B is at point having coordinates (5 meters, 0). Find the instant of time in seconds at which angle between velocity of A and velocity of B is 180°.

12. **Match the following**

Column I	Column II
(a) Instantaneous speed	(P) is a vector quantity
(b) Instantaneous velocity	(Q) Its magnitude can decrease with time
(c) Average velocity	(R) Will remain constant for a particle moving uniformly in a circle
(d) Average speed	(S) Does not depend on the initial and final position only but depends on the motion in between

DPP No. : A6 (JEE–Main)

Total Marks : 60 **Max. Time : 40 min.**
Single choice Objective ('–1' negative marking) Q.1 to Q.20 **(3 marks, 2 min.) [60, 40]**

1. The position x of a particle varies with time (t) as $x = a t^2 - b t^3$. The acceleration will be equal to zero at time:

(A) $\frac{2a}{3b}$ (B) $\frac{a}{b}$ (C) $\frac{a}{3b}$ (D) zero

2. For a particle moving along a straight line, the displacement x depends on time t as $x=\alpha t^3 + \beta t^2 + \gamma t + \delta$. The ratio of its initial acceleration to its initial velocity depends:

(A) only on α & β (B) only on β & γ (C) only on α & γ (D) only on α

3. Mark the correct statement(s).

(A) if speed of a body is varying, its velocity must be varying and it must have zero acceleration
(B) if velocity of a body is varying, its speed must be varying
(C) a body moving with varying velocity may have constant speed
(D) a body moving with varying speed may have constant velocity if its direction of motion remains constant.

4. One car moving on a straight road covers one third of the distance with 20 km/h and the rest with 60 km/h. The average speed of the car is

(A) 40 km/h (B) 80 km/h (C) $46\frac{2}{3}$ km/h (D) 36 km/h

5. Which of the following is a correct relation?

(A) Speed = |Velocity| (B) Average speed = |Average velocity|
(C) $\frac{d}{dt}$ speed = $\left|\frac{d}{dt}\text{velocity}\right|$ (D) Distance = |Displacement|

6. The speed of a particle moving along a straight line becomes half after every next second (in every one second speed is constant). The initial speed is v_0. The total distance travelled by the particle will be -

(A) v_0 (B) $2v_0$ (C) ∞ (D) None

7. Position of a particle at any instant is given by $x = 3t^2 + 1$, where x is in m and t in sec. Its average velocity in the time interval t = 2 sec to t = 3 sec will be:

(A) 15 m/s (B) 12 m/s (C) 18 m/s (D) 6 m/s

8. For a particle undergoing rectilinear motion with uniform acceleration, the magnitude of displacement is one third the distance covered in some time interval. The magnitude of final velocity is less than magnitude of initial velocity for this time interval. Then the ratio of initial speed to the final speed for this time interval is:

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

9. A particle is thrown upwards from ground. It experiences a constant air resistance force which can produce a retardation of 2 m/s^2 . The ratio of time of ascent to the time of descent is: [g = 10 m/s^2]

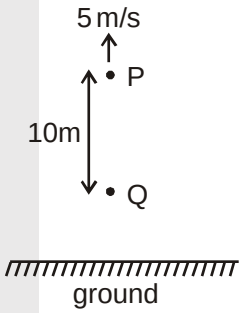
(A) 1 : 1 (B) $\sqrt{\frac{2}{3}}$ (C) $\frac{2}{3}$ (D) $\sqrt{\frac{3}{2}}$

10. For a particle moving along x-axis, the acceleration a of the particle in terms of its x-coordinate x is given by a = – 9x, where x is in meters and a is in m/s^2. Take acceleration, velocity and displacement in positive x-direction as positive. The initial velocity of particle at x = 0 is u = + 6 m/s. The velocity of particle at x = 2 m will be:

(A) + $6\sqrt{2}$ m/s (B) – $6\sqrt{2}$ m/s (C) 72 m/s (D) 0

11. A ball is thrown vertically upwards with an initial velocity of 5 m/sec from point P as shown. Q is a point 10 m vertically below the point P. Then the speed of the ball at point Q will be : (take g = 10 m/s^2 and neglect air resistance)

(A) 7.5 m/sec
(B) 10 m/sec
(C) 15 m/sec
(D) 17.5 m/sec



12. If the position vectors of the particles A and B change with time as $\vec{r}_A = t\hat{i} + t^2\hat{j}$ and $\vec{r}_B = (t^2 - 1)\hat{i} + t\hat{j}$ the path of A as observed by B will be :

(A) circle (B) straight line
(C) rectangular hyperbola (D) parabola

13. A particle moves along the parabolic path y = ax^2 in such a way that the y-component of the velocity remains constant, say c. The x and y coordinates are in meters. Then acceleration of the particle at x = 1 m is

(A) $ac\hat{k}$ (B) $2ac^2\hat{j}$ (C) $-\frac{c^2}{4a^2}\hat{i}$ (D) $-\frac{c}{2a}\hat{i}$

14. A projectile has same range R for two angles of projection. If t_1 & t_2 be the time of flight for the two cases then :

(A) R = $\frac{gt_1t_2}{2}$ (B) R = $\frac{g\ (t_1+t_2)^2}{2}$ (C) R = $g\sqrt{t_1t_2}$ (D) R = $2g\frac{t_1t_2}{t_1+t_2}$

15. Two particles are thrown horizontally in opposite directions from the same point from a height 'h' simultaneously with velocities 4 ms^{-1} and 3 ms^{-1}. The time when their velocities are perpendicular is approximately

(A) 0.15 s (B) 0.25 s (C) 0.35 s (D) 0.45 s

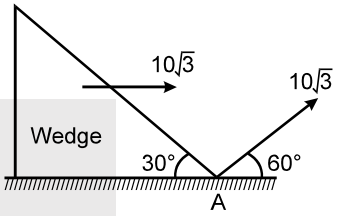
16. At a given instant two particles have position vectors $4\hat{i}-4\hat{j}+7\hat{k}$ meter and $(2\hat{i}+2\hat{j}+5\hat{k})$ meter respectively. If the velocity of the first particle be $0.4\hat{i}$ m/s, then velocity of the second particle in m/sec. If they collide after 10 seconds is:

(A) $6\left[\hat{i}-\hat{j}+\frac{\hat{k}}{3}\right]$ (B) $0.6\left[\hat{i}-\hat{j}+\frac{\hat{k}}{3}\right]$ (C) $6\left[\hat{i}+\hat{j}+\frac{\hat{k}}{3}\right]$ (D) $0.6\left[\hat{i}+\hat{j}-\frac{\hat{k}}{3}\right]$

17. Two stones are projected simultaneously from a tower at different angles of projection with same speed 'u'. The distance between two stones is increasing at constant rate 'u'. Then the angle between the initial velocity vectors of the two stones is:

(A) 30° (B) 60° (C) 45° (D) 90°

18. A particle is projected at angle 60º with speed $10\sqrt{3}$, from the point ' A ' as shown in the fig. At the same time the wedge is made to move with speed $10\sqrt{3}$ towards right as shown in the figure. Then the time after which particle will strike with wedge is (g = 10 m/sec^2):



(A) 2 sec (B) $2\sqrt{3}$ sec (C) $\frac{4}{\sqrt{3}}$ sec (D) none of these

19. The dependence of variable y on variable x is defined by the equation y = $\frac{\sqrt{x}}{2}$. Then the area occupied by this curve and the x-axis in between x = 1 to x = 4 will be:

(A) $\frac{5}{3}$ units (B) 2 units (C) $\frac{7}{3}$ units (D) 4 units

20. A swimmer crosses a river with minimum possible time 10 second. And when he reaches the other end starts swimming in the direction towards the point from where he started swimming. Keeping the direction fixed the swimmer crosses the river in 15 sec. The ratio of speed of swimmer with respect to water and the speed of river flow is (Assume constant speed of river & swimmer) -

(A) $\frac{3}{2}$ (B) $\frac{9}{4}$ (C) $\frac{2}{\sqrt{5}}$ (D) $\frac{\sqrt{5}}{2}$

DPP No. : A7 (JEE-ADVANCED)

Total Marks : 41	**Max. Time : 37 min.**	
One or more than one options correct type ('–1' negative marking) Q.1 to Q.3	**(4 marks 2 min.)**	**[12, 06]**
Comprehension ('–1' negative marking) Q.4 to Q.6	**(3 marks 2 min.)**	**[09, 06]**
Subjective Questions ('–1' negative marking) Q.7 to Q.11	**(4 marks 5 min.)**	**[20, 25]**

1. Mark the correct statements for a particle going on a straight line (x–position coordinate, v–velocity, a–acceleration) :

(A) If v and a have opposite sign, the object is slowing down.
(B) If x and v have opposite sign, the particle is moving towards the origin.
(C) If v is zero at an instant, then a should also be zero at that instant.
(D) If v is zero for a time interval, then a is zero at every instant within the time interval.

2. A particle is projected from a point on the ground with an initial velocity of u = 50 m/s at an angle of 53° with the horizontal (tan 53° = 4/3, g = 10 m/s^2 = acceleration due to gravity).

(A) The velocity of the particle will make angle 45° with the horizontal after time 1 s.
(B) The velocity of the particle will make angle 45° with the horizontal after time 7 s.
(C) The average velocity between the point of projection and the highest point on its path is horizontal.
(D) The average velocity between two points on same height will be horizontal.

3. A projectile of mass 1 kg is projected with a velocity of $\sqrt{20}$ m/s such that it strikes on the same level as the point of projection at a distance of $\sqrt{3}$ m. Which of the following options are correct?

(A) The maximum height reached by the projectile can be 0.25 m.

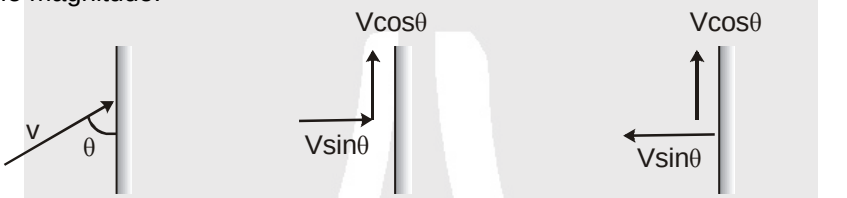
(B) The minimum velocity during its motion can be $\sqrt{15}$ m/s.

(C) The time taken for the flight can be $\sqrt{\frac{3}{5}}$ s.

(D) Maximum angle of projection can be 60°.

Comprehension # 1

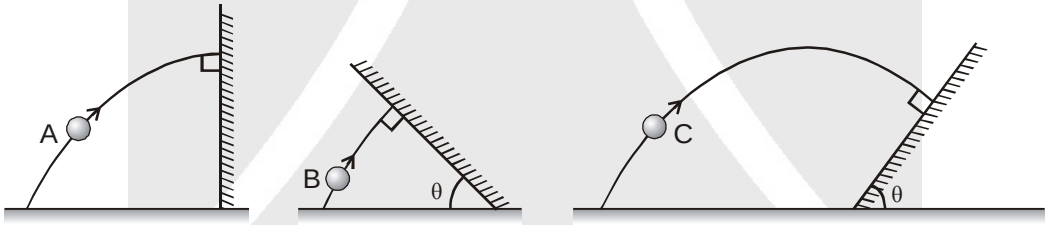
We know how by neglecting the air resistance, the problems of projectile motion can be easily solved and analysed. Now we consider the case of the collision of a ball with a wall. In this case the problem of collision can be simplified by considering the case of elastic collision only. When a ball collides with a wall we can divide its velocity into two components, one perpendicular to the wall and other parallel to the wall. If the collision is elastic then the perpendicular component of velocity of the ball gets reversed with the same magnitude.



Velocity just before collision | Components of velocity just before collision | Components of velocity just after collision

The other parallel component of velocity will remain constant if given wall is smooth.

Now let us take a problem. Three balls 'A' and 'B' & 'C' are projected from ground with same speed at same angle with the horizontal. The balls A,B and C collide with the wall during their flight in air and all three collide perpendicularly with the wall as shown in figure.



4. Which of the following relation about the maximum height H of the three balls from the ground during their motion in air is correct:

(A) $H_A = H_C > H_B$ (B) $H_A > H_B = H_C$ (C) $H_A > H_C > H_B$ (D) $H_A = H_B = H_C$

5. If the time taken by the ball A to fall back on ground is 4 seconds and that by ball B is 2 seconds. Then the time taken by the ball C to reach the inclined plane after projection will be:

(A) 6 sec. (B) 4 sec. (C) 3 sec. (D) 5 sec.

6. In previous question the maximum height attained by ball 'A' from the ground is:

(A) 10 m (B) 15 m (C) 20 m (D) Insufficient information

7. Two objects moving along the same straight line are leaving point A with an acceleration a, 2 a & velocity 2 u, u respectively at time t = 0. The distance moved by the object with respect to point A when one object overtakes the other is $\frac{\alpha u^2}{a}$. Here α is an integer. Find α:

8. A police jeep is chasing a culprit going on a moter bike. The motor bike crosses a turn at a speed of 72 km/h. The jeep follows it at a speed of 108 km/h, crossing the turn 10 seconds later than bike (keeping constant speed). After crossing the turn, jeep acclerates with constant accleration 2 m/s^2. Assuming bike travels at constant speed, after travelling a distance 20α m. from the turn, the jeep catches the bike. Where α is an integer. Find α.

9. A person standing on the top of a cliff 30 m high has to throw a packet to his friend standing on the ground 40 m horizontally away. If he throws the packet directly aiming at the friend with a speed of $\frac{125}{3}$ m/s. Packet falls at a distance $\frac{20}{\alpha}$ m from the friend. Here α is an integer. Find α. [Use g = 10 m/s^2]

10. A particle is projected from a point (0, 1) on Y-axis (assume + Y direction vertically upwards) aiming towards a point (4, 9). It falls on ground on x axis in 1 sec. If the speed of projection is $\sqrt{\beta}$ m/s, where β is an integer. Find β**.** Taking g = 10 m/s^2 and all coordinate in metres.

11. If at an instant the velocity of a projectile be 60 m/s and its inclination to the horizontal be 30°, at what time interval (in sec) after that instant will the particle be moving at right angles to its former direction. (g = 10 m/s^2)

DPP No. : A8 (JEE-ADVANCED)

Total Marks : 52	**Max. Time : 46 min.**	
One or more than one options correct type ('–1' negative marking) Q.1 to Q.5	**(4 marks 2 min.)**	**[20, 10]**
Subjective Questions ('–1' negative marking) Q.6 to Q.11	**(4 marks 5 min.)**	**[24, 30]**
Match the Following (no negative marking) Q.12	**(8 marks, 6 min.)**	**[08, 06]**

1. A man standing on the edge of the terrace of a high rise building throws a stone vertically up with a speed of 20 m/s. Two seconds later an identical stone is thrown vertically downwards with the same speed of 20 m/s. Then:
(A) the relative velocity between the two stones remain constant till one hits the ground
(B) both will have the same kinetic energy when they hit the ground
(C) the time interval between their hitting the ground is 2 seconds
(D) if the collisions on the ground are perfectly elastic both will rise to the same height above the ground.

2. A ball is thrown vertically upward (relative to the train) in a compartment of a moving train. (train is moving horizontally)
(A) The ball will maintain the same horizontal velocity as that of the person (or the compartment) at the time of throwing.
(B) If the train is accelerating then the horizontal velocity of the ball will be different from that of the train velocity, at the time of throwing.
(C) If the ball appears to be moving backward to the person sitting in the compartment it means that speed of the train is increasing.
(D) If the ball appears to be moving ahead of the person sitting in the compartment it means the train's motion is retarding.

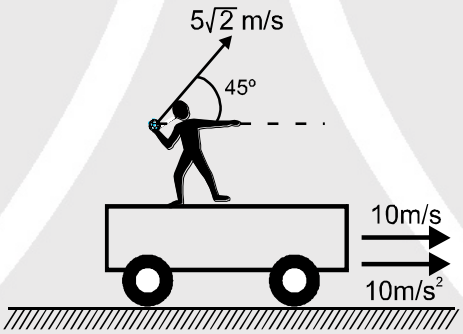
3. A person is standing on a truck moving with a constant velocity of 15 m/s on a horizontal road. The man throws a ball in such a way that it returns to his hand after the truck has moved 60 m. (g = 10 m/s^2)
(A) The speed of the ball as seen from the truck is 20 m/s
(B) The direction of initial velocity of ball is upward as seen from the truck
(C) The initial speed of the ball as seen from the ground is 25 m/s
(D) None of these

4. Two boats A and B having same speed relative to river are moving in a river. Boat A moves normal to the river current as observed by an observer moving with velocity of river current. Boat B moves normal to the river as observed by the observer on the ground. Choose the **incorrect** options.
(A) To a ground observer boat B moves faster than A
(B) To a ground observer boat A moves faster than B
(C) To the given moving observer boat B moves faster than A
(D) To the given moving observer boat A moves faster than B

5. An open elevator is ascending with zero acceleration and speed 10 m/s. A ball is thrown vertically up by a boy (boy is in elevator) when he is at a height 10 m from the ground, the velocity of projection is 30m/s with respect to elevator. Choose correct option(s) assuming height of the boy very small: ($g = 10\ m/s^2$)
(A) Maximum height attained by the ball from ground is 90 m.
(B) Maximum height attained by the ball with respect to lift from the point of projection is 45 m.
(C) Time taken by the ball to meet the elevator again is 6 sec
(D) The speed of the ball when it comes back to the boy is 20 m/s with respect to ground.

6. Two identical trains take 3 sec to pass one another when going in the opposite direction but only 2.5 sec if the speed of one is increased by 50%. Find the time (in sec) one would take to pass the other when going in the same direction at their original speed.

7. A man standing on a truck which moves with a constant horizontal acceleration a (= 10 m/s^2) when speed of the truck is 10 m/s. The man throws a ball with velocity $5\sqrt{2}$ m/s with respect to truck. In the direction shown in the diagram. Find the distance travelled of ball in meters in one second as observed by the man. ($g = 10\ m/s^2$)

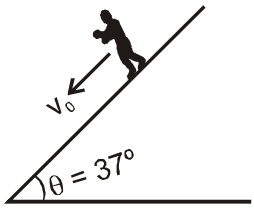


8. A boat moves relative to water with a velocity half of the river flow velocity. If the angle from the direction of flow at which the boat must move relative to stream direction to minimize drift is $\frac{2\pi}{n}$, then find n.

9. A swimmer crosses the river along the line making an angle of 45º with the direction of flow. Velocity of the river water is 5 m/s. Swimmer takes 6 seconds to cross the river of width 60 m. If the velocity of the swimmer with respect to water is $5\sqrt{n}$ m/s, then find n.

10. During a rainy day, rain is falling vertically with a velocity 2m/s. A boy at rest starts his motion with a constant acceleration of 2m/s^2 along a straight road. If the rate at which the angle of the axis of umbrella with vertical should be changed is $\frac{1}{n}$ at t = 5s so that the rain falls parallel to the axis of the umbrella, then find n.

11. A man is moving downward on an inclined plane ($\theta = 37^\circ$) with constant velocity v_0 and rain drops appear to him moving in horizontal direction with velocity $2v_0$ towards him. If man increases his velocity to $2v_0$, the velocity of rain drops as observed by man is $\sqrt{\frac{n}{5}}\, v_0$, then find n.



12. **Match the following:**

A ball is thrown vertically upward in the air by a passenger (relative to himself) from a train that is moving as given in column I ($v_{ball} << v_{escape}$). Correctly match the situation as described in the column I, with the paths given in column II.

Column I	**Column II**
(A) Train moving with constant acceleration on a slope then path of the ball as seen by the passenger.	(p) Straight line
(B) Train moving with constant acceleration on a slope then path of the ball as seen by a stationary observer outside.	(q) Parabolic
(C) Train moving with constant acceleration on horizontal ground then path of the ball as seen by the passenger.	(r) Elliptical
(D) Train moving with constant acceleration on horizontal ground then path of the ball as seen by a stationary observer outside.	(s) Hyperbolic
	(t) Circular

DPP No. : A9 (JEE-MAIN)

Total Marks : 60 **Max. Time : 40 min.**

Single choice Objective ('–1' negative marking) Q.1 to Q.20 **(3 marks, 2 min.)** **[60, 40]**

1. A body is projected vertically downwards from A, the top of the tower reaches the ground in t_1 seconds. If it is projected upwards with same speed it reaches the ground in t_2 seconds. At what time it will reach the ground if it is dropped from A.

(A) $\sqrt{t_1^3 / t_2}$ (B) $\sqrt{t_2^3 / t_1}$ (C) $\sqrt{t_1\ t_2}$ (D) $t_1 t_2$

2. 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 dropping the stone at 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) $T = \sqrt{\frac{h}{2g}} + \frac{2h}{v}$

3. Two particles held at different heights a and b above the ground are allowed to fall from rest. The ratio of their velocities on reaching the ground is:

(A) a : b (B) $\sqrt{a} : \sqrt{b}$ (C) $a^2 : b^2$ (D) $a^3 : b^3$

4. A body starts from the origin and moves along the X-axis such that the velocity at any instant is given by $(4t^3 – 2t)$, where t is in second and velocity is in m/s. What is acceleration of the particle, when it is at distance 2m from the origin.

(A) 28 m/s^2 (B) 22 m/s^2 (C) 12 m/s^2 (D) 10 m/s^2

5. Two balls of equal masses are thrown upward, along the same vertical line at an interval of 2 seconds, with the same initial velocity of 40 m/s. Then these collide at a height of (Take g = 10 m/s^2)

(A) 120 m (B) 75 m (C) 200 m (D) 45 m

6. 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) depends upon the mass of the ball

7. A ball is thrown upward at an angle of 30° with the horizontal and lands on the top edge of a building that is 20 m away. The top edge is 5m above the throwing point. The initial speed of the ball in metre/second is (take g = 10 m/s^2):

(A) $u = 40\sqrt{\frac{(4+\sqrt{3})}{13\sqrt{3}}}$ m/s (B) $u = 40\sqrt{\frac{4-\sqrt{3}}{13\ \sqrt{3}}}$ m/s

(C) $u = 40\sqrt{\frac{4+\sqrt{3}}{13}}$ m/s (D) $u = 40\frac{40}{\sqrt{\sqrt{3}\ (4+\sqrt{3})}}$ m/s

8. On an inclined plane of inclination 30º, a ball is thrown at an angle of 60º with the horizontal from the foot of the incline with a velocity of $10\sqrt{3}$ ms^{-1}. If g = 10 ms^{-2}, then the time in which ball will hit the inclined plane is -

(A) 1 sec. (B) 6 sec. (C) 2 sec. (D) 4 sec.

9. A plane flying horizontally at a height of 1500 m with a velocity of 200 ms^{-1} passes directly overhead an antiaircraft gun. Then the angle with the horizontal at which the gun should be fired for the shell with a muzzle velocity of 400 m s^{-1} to hit the plane, is -

(A) 90º (B) 60º (C) 30º (D) 45º

10. A projectile is thrown with velocity v making an angle θ with the horizontal. It just crosses the top of two poles, each of height h, after 1 second and 3 second respectively. The time of flight of the projectile is

(A) 1 s (B) 3 s (C) 4 s (D) 7.8 s.

11. A body has an initial velocity of 3 ms^{-1} and has a constant acceleration of 1 ms^{-2} normal to the direction of the initial velocity. Then its velocity, 4 second after the start is

(A) 7 ms^{-1} along the direction of initial velocity

(B) 7 ms^{-1} along the normal to the direction of the initial velocity

(C) 7 ms^{-1} mid-way between the two directions

(D) 5 ms^{-1} at an angle of $\tan^{-1}\frac{4}{3}$ with the direction of the initial velocity

12. A particle at a height ' h ' from the ground is projected with an angle 30° from the horizontal, it strikes the ground making angle 45° with horizontal. It is again projected from the same point at height h with the same speed but with an angle of 60° with horizontal. Find the angle it makes with the horizontal when it strikes the ground:

(A) $\tan^{-1}(4)$ (B) $\tan^{-1}(5)$ (C) $\tan^{-1}(\sqrt{5})$ (D) $\tan^{-1}(\sqrt{3})$

13. A stone is thrown upwards from a tower with a velocity 50 ms^{-1}. Another stone is simultaneously thrown downwards from the same location with a velocity 50 ms^{-1}. When the first stone is at the highest point, the relative velocity of the second stone with respect to the first stone is (assume that second stone has not yet reached the ground):

(A) Zero (B) 50 ms^{-1} (C) 100 ms^{-1} (D) 150 ms^{-1}

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

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

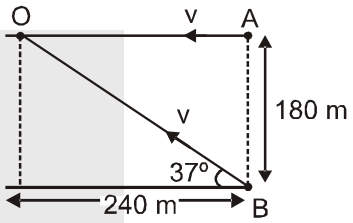
15. A particle is thrown up inside a stationary lift of sufficient height. The time of flight is T. Now it is thrown again with same initial speed v_0 with respect to lift. At the time of second throw, lift is moving up with speed v_0 and uniform acceleration g upward (the acceleration due to gravity). The new time of flight is–

(A) $\frac{T}{4}$ (B) $\frac{T}{2}$ (C) T (D) 2T

16. A flag on a bus is fluttering in north direction & wind is blowing in east direction. Then which of the following will be true -
(A) bus is moving in south direction.
(B) bus is moving in north east direction.
(C) bus may be moving in any direction between south & east.
(D) bus may be moving in any direction between south & west.

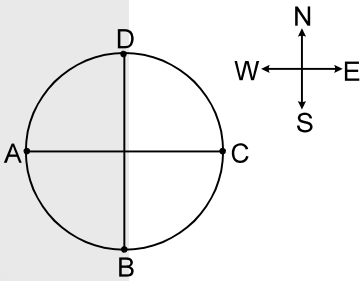
17. A train is standing on a platform, a man inside a compartment of a train drops a stone. At the same instant train starts to move with constant acceleration. The path of the particle as seen by the person who drops the stone is:
(A) parabola
(B) straight line for sometime & parabola for the remaining time
(C) straight line
(D) variable path that cannot be defined

18. Two persons P and Q start from points A and B respectively as shown in figure. P and Q have speed v = 12 m/s in shown directions towards point O. when the distance between P and Q is 120m, then Q increases its speed to 15 m/s. Then find out who will reach the point O first.



(A) P
(B) Q
(C) both P and Q reaches simultaneously
(D) Data is insufficient

19. Two aeroplanes fly from their respective positions 'A' and 'B' starting at the same time and reach the point 'C' simultaneously when wind was not blowing. On a windy day they head towards 'C' but both reach the point 'D' simultaneously in the same time which they took to reach 'C'. Then the wind is blowing in



(A) North-East direction
(B) North-West direction
(C) Direction making an angle $0 < \theta < 90$ with North towards East.
(D) North direction

20. A man who is wearing a hat of extended length of 12 cm is running in rain falling vertically downwards with speed 10 m/s. The maximum speed with which man can run, so that rain drops do not fall on his face (the length of his face below the extended part of the hat is 16 cm) will be:

(A) $\frac{15}{2}$ m/s (B) $\frac{40}{3}$ m/s (C) 10 m/s (D) zero

DPP No. : A10 (JEE–Advanced)

Total Marks : 36	**Max. Time : 38 min.**
Single choice Objective ('–1' negative marking) Q.1	**(3 marks, 2 min.) [03, 02]**
Comprehension ('–1' negative marking) Q.2 to Q.4	**(3 marks 2 min.) [09, 06]**
Subjective Questions ('–1' negative marking) Q.5 to Q.10	**(4 marks 5 min.) [24, 30]**

1. The displacement of a particle moving in a straight line is given by $x = 16t - 2t^2$ (where, x is in metres and t is in second). Find the distance travelled by the particle in 8 seconds [starting from t = 0] is:
(A) 24 m (B) 40 m (C) 64 m (D) 80 m

COMPREHENSION

Rain is falling with a velocity $(-4\hat{i}+8\hat{j}-10\hat{k})$. A person is moving with a velocity of $(6\hat{i}+8\hat{j})$ on the ground. x–axis and y–axis lies in horizontal plane and z–axis is vertically upward.

2. Find the velocity of rain with respect to man and the direction from which the rain appears to be coming.

3. The speed with which the rain drops hit the person is:
(A) 10 m/s (B) $10\sqrt{2}$ m/s (C) $\sqrt{180}$ m/s (D) $\sqrt{360}$ m/s

4. The velocity of man w.r.t. rain is:
(A) $-6\hat{i}-8\hat{j}$ (B) $4\hat{i}-8\hat{j}+10\hat{k}$ (C) $10\hat{i}-10\hat{j}$ (D) $10\hat{i}+10\hat{k}$

5. A balloon is ascending vertically with an acceleration of 0.4 m/s $^{-2}$. Two stones are dropped from it at an interval of 2 sec. Find the distance between them 1.5 sec. after the second stone is released.
($g = 10$ m/sec^2)

6. A projectile is thrown at an angle 30º from the horizontal ground with velocity 10 m/s. Find angle between displacement vector and velocity vector at time t = 1 sec .

7. A particle is projected from the ground level. It just passes through upper ends of vertical poles A, B, C of height 20 m, 30 m & 20 m respectively. The time taken by the particle to travel from B to C is double of the time taken from A to B. Find the maximum height attained by the particle from the ground level.

8. A radius vector of point A relative to the origin varies with time t as $\vec{r}=at\hat{i}-bt^2\hat{j}$ where a and b are constants. Find the equation of point's trajectory.

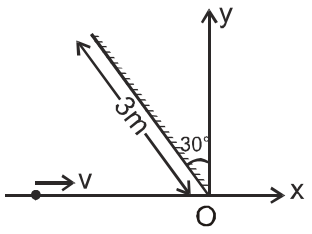
9. A body starts with an initial velocity of 10 m/s and moves along a straight line with a constant acceleration. When the velocity of the particle becomes 50 m/s the acceleration is reversed in direction without changing magnitude. Find the speed of the particle in m/s when it reaches the starting point.

10. A Bomber flying upward at an angle of 53º with the vertical releases a bomb at an altitude of 800 m. The bomb strikes the ground 20 sec after its release. Velocity of the bomber at the time of release of the bomb is V m/s. Find $\frac{V}{4}$ [Given sin 53º = 0.8; $g = 10$ ms^{-2}]

DPP No. : A11 (JEE–Advanced)

Total Marks : 35	**Max. Time : 26 min.**
Single choice Objective ('–1' negative marking) Q.1 to Q.2	**(3 marks, 2 min.) [06, 04]**
One or more than one options correct type ('–1' negative marking) Q.3 to Q.5	**(4 marks 2 min.) [12, 06]**
Comprehension ('–1' negative marking) Q.6 to Q.8	**(3 marks 2 min.) [09, 06]**
Subjective Questions ('–1' negative marking) Q.9 to Q.10	**(4 marks 5 min.) [08, 10]**

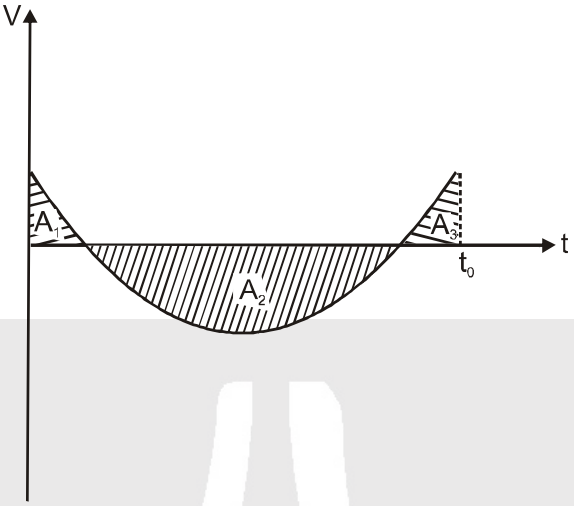
1. A plane mirror is placed with its plane at an angle 30° with the y-axis. Plane of the mirror is perpendicular to the xy-plane and the length of the mirror is 3 m. An insect moves along x-axis starting from a distant point, with speed 2 cm/s. The duration of the time for which the insect can see its own image in the mirror is:
(A) 300 s (B) 200 s
(C) 150 s (D) 100 s



2. A body travelling with uniform acceleration crosses two points A and B with velocities 20 m s^{-1} and 30 m s^{-1} respectively. The speed of the body at the mid-point of A and B is

(A) 24 ms^{-1} (B) 25 ms^{-1} (C) 25.5 ms^{-1} (D) $10\sqrt{6}$ ms^{-1}

3. The velocity time graph of a particle at the origin at time t = 0 and moving in a straight line along the x-axis is shown. If A_1, A_2, and A_3 are the shaded areas and $A_2 > 3A_1$ and $A_3 < 2A_1$, then:

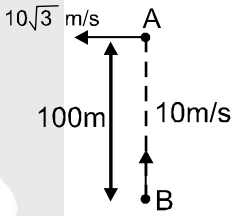


(A) For $0 < t < t_0$, the particle crosses the origin only once.
(B) For $0 < t < t_0$, the particle crosses the origin twice.
(C) The particle motion is non- uniform.
(D) Acceleration of particle becomes zero only once during $0 < t < t_0$

4. At what angle should a body be projected with a velocity 24 ms^{-1} just to pass over the obstacle 14 m high at a distance of 24 m. [Take g = 10 ms^{-2}]

(A) $\tan\theta = 3.8$ (B) $\tan\theta = 1$ (C) $\tan\theta = 3.2$ (D) $\tan\theta = 2$

5. Consider two cars moving perpendicular to each other as shown. Initially distance between them is 100 m. Velocity of A is $10\sqrt{3}$ m/s and velocity of B is 10 m/s. Then:



(A) magnitude of velocity of A w.r.t. B is 20 m/s
(B) minimum distance between them is 50 m
(C) minimum distance between them is $50\sqrt{3}$ m
(D) at t = 2 sec. they will be nearest to each other

COMPREHENSION

A stone is projected from level ground with speed u and at an angle θ with horizontal. Some how the acceleration due to gravity (g) becomes double (that is 2g) immediately after the stone reaches the maximum height and remains same thereafter. Assume direction of acceleration due to gravity always vertically downwards.

6. The total time of flight of particle is:

(A) $\frac{3}{2}\frac{u\sin\theta}{g}$ (B) $\frac{u\sin\theta}{g}\left(1+\frac{1}{\sqrt{2}}\right)$ (C) $\frac{2u\sin\theta}{g}$ (D) $\frac{u\sin\theta}{g}\left(2+\frac{1}{\sqrt{2}}\right)$

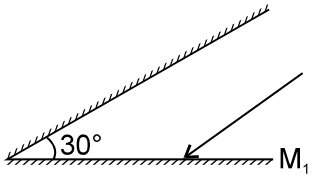
7. The horizontal range of particle is

(A) $\frac{3}{4}\frac{u^2\sin2\theta}{g}$ (B) $\frac{u^2\sin2\theta}{2g}\left(1+\frac{1}{\sqrt{2}}\right)$ (C) $\frac{u^2}{g}\sin2\theta$ (D) $\frac{u^2\sin2\theta}{2g}\left(2+\frac{1}{\sqrt{2}}\right)$

8. The angle ϕ which the velocity vector of stone makes with horizontal just before hitting the ground is given by:

(A) $\tan\phi = 2\tan\theta$ (B) $\tan\phi = 2\cot\theta$ (C) $\tan\phi = \sqrt{2}\tan\theta$ (D) $\tan\phi = \sqrt{2}\cot\theta$

9. Two plane mirrors are inclined to each other at 30^0. A ray is incident on M_1 at angle of incidence 40^o. Find deviation produced in it by three successive reflections due to mirrors.

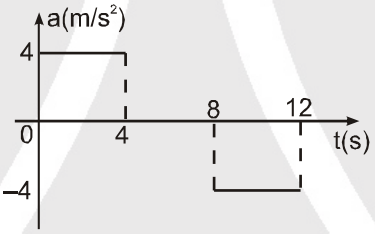


10. A point object is 10 cm away from a plane mirror while the eye of an observer (pupil diameter 5.0 mm) is 20 cm away. Assuming both the eye and point to be on the same line perpendicular to the mirror, the area of the mirror used in observing the reflection of the point is_____.

DPP No. : A12 (JEE–Main)

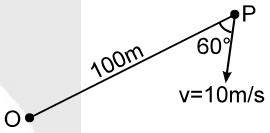
Total Marks : 60 **Max. Time : 40 min.**
Single choice Objective ('–1' negative marking) Q.1 to Q.20 **(3 marks 2 min.) [60, 40]**

1. A lift starts from rest. Its acceleration is plotted against time in the following graph. When it comes to rest its height above its starting point is:



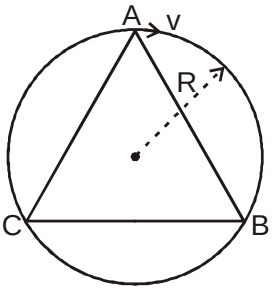
(A) 20 m (B) 64 m (C) 32 m (D) 128 m

2. P is a point moving with constant speed 10 m/s such that its velocity vector always maintains an angle 60° with line OP as shown in figure (O is a fixed point in space). The initial distance between O and P is 100 m. After what time shall P reach O.



(A) 10 sec. (B) 15 sec. (C) 20 sec. (D) 30 sec

3. A particle is moving with constant speed V m/s along the circumference of a circle of radius R meters as shown. A, B and C are three points on periphery of the circle and ΔABC is equilateral. The magnitude of average velocity of particle, as it moves from A to C in clockwise sense, will be:

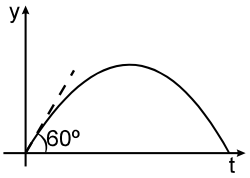


(A) $\frac{3V}{2\pi}$ (B) $\frac{3V}{4\pi}$ (C) $\frac{3\sqrt{3}V}{2\pi}$ (D) $\frac{3\sqrt{3}V}{4\pi}$

4. A point moves in a straight line under the retardation a v^2, where 'a' is a positive constant and v is speed. If the initial speed is u, the distance covered in ' t ' seconds is:

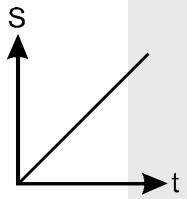
(A) a u t (B) ℓn (a u t) (C) $\frac{1}{a}$ ℓn (1 + a u t) (D) a ℓn (a u t)

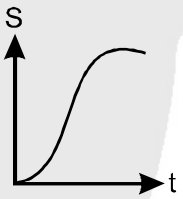
5. A particle is projected from the horizontal x-z plane, in vertical x-y plane where x-axis is horizontal and positive y-axis vertically upwards. The graph of 'y' coordinate of the particle v/s time is as shown. The range of the particle is $\sqrt{3}$ m . Then the speed of the projected particle is:

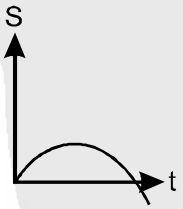


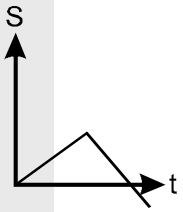
(A) $\sqrt{3}$ m/s (B) $\sqrt{\frac{403}{4}}$ m/s (C) $2\sqrt{5}$ m/s (D) $\sqrt{28}$ m/s

6. A particle is moving in x-y plane along curve y = $\frac{x}{2}$ and u_x = 4 – 2t. The displacement verses time graph of the particle would be (where all parameters are in S.I. units)

(A) 

(B) 

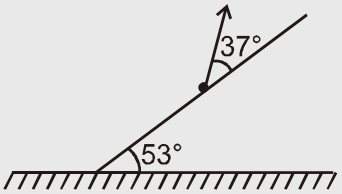
(C) 

(D) 

7. A particle starts from the origin at t = 0 and moves in the x-y plane with constant acceleration a which is in the y direction. Its equation of motion is y = bx^2. The x component of its velocity is :

(A) variable (B) $\sqrt{\frac{2a}{b}}$ (C) $\frac{a}{2b}$ (D) $\sqrt{\frac{a}{2b}}$

8. A particle is projected from the inclined plane at angle 37° with the inclined plane in upward direction with speed 10 m/s. The angle of inclined plane with horizontal is 53°. Then the maximum height attained by the particle from the incline plane from the point of projection will be :



(A) 3m (B) 4 m (C) 5 m (D) zero

9. A ship is moving westward with a speed of 10 km/h and a ship B , 100 km south of A is moving northwards with same speed. The time after which the distance between them is shortest and the shortest distance are:

(A) 2h, 100 km (B) 5h, $50\sqrt{2}$ km

(C) $5\sqrt{2}$ h , 50 km (D) $10\sqrt{2}$ h , $50\sqrt{2}$ km

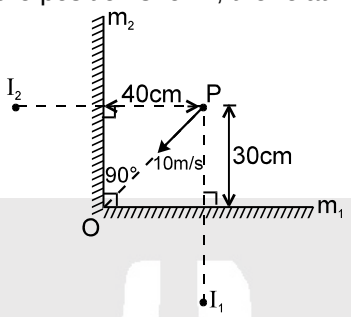
10. A frame of reference F_2 moves with velocity $\vec{v}$ with respect to another frame F_1. When an object is observed from both frames, its velocity is found to be $\vec{v}_1$ in F_1 and $\vec{v}_2$ in F_2. Then, $\vec{v}_2$ is given by:

(A) $\vec{v}_1 + \vec{v}$ (B) $\vec{v}_1 - \vec{v}$

(C) $\vec{v} - \vec{v}_1$ (D) $|\vec{v}_1 - \vec{v}|\ \frac{\vec{v}_1}{|\vec{v}_1|}$

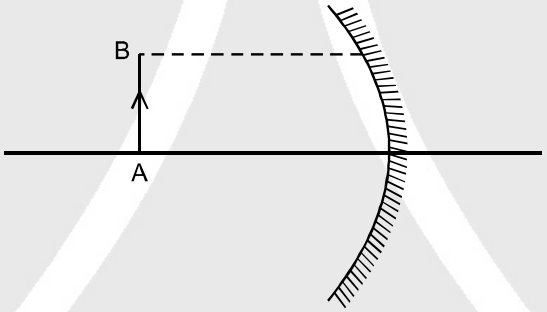
11. An object moves in front of a fixed plane mirror. The velocity of the image of the object is
(A) Equal in the magnitude and in the direction to that of the object.
(B) Equal in the magnitude and opposite in direction to that of the object.
(C) Equal in the magnitude and the direction will be either same or opposite to that of the object.
(D) Equal in magnitude and makes any angle with that of the object depending on direction of motion of the object.

12. In the figure shown. A particle 'P' moves with velocity 10 m/s towards the intersection point 'O' of the plane mirror kept at right angle to each other. I_1 and I_2 are the images formed due to direct reflection from m_1 and m_2 respectively. In the position shown, the relative speed of I_1 w.r. to I_2 will be:



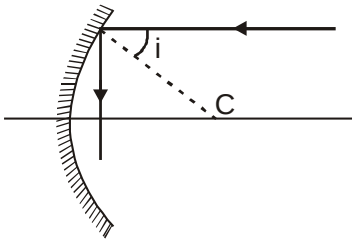
(A) 20 m/s (B) 12 m/s (C) $10\sqrt{2}$ m/s (D) 16 m/s

13. A converging mirror forms real image of object AB on screen. Now a hole is made on mirror just in front of point B, Select correct alternative:



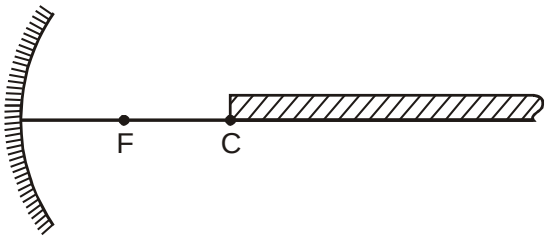
(A) Image of point B will be absent on screen
(B) Image of point B will be slightly below the previous position in screen.
(C) Image of point B will be just above the previous position in screen.
(D) Image of point B will be at the same place where it was formed earlier
(E) Two images of point B will be formed

14. Angle of incidence of the incident ray for which reflected ray intersect perpendiculaly the principal axis.



(A) 0° (B) 30° (C) 45° (D) 60°

15. An infinitely long rectangular strip is placed on principal axis of a concave mirror as shown in figure. One end of the strip coincides with centre of curvature as shown. The height of rectangular strip is very small in comparison to focal length of the mirror. Then the shape of image of strip formed by concave mirror is

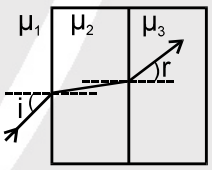


(A) Rectangle (B) Trapezium (C) Triangle (D) Square

16. A driving mirror on a car is never concave because:
(A) its field of view is too small
(B) the image would be inverted
(C) the image would be virtual and therefore useless for the driver
(D) only a plane mirror forms true images.

17. A plane mirror is made of glass slab (n = 1.5) 2.5 cm thick and silvered on back. A point object is placed 5 cm in front of the unsilvered face of the mirror. The position of final image is:
(A) 12 cm from unsilured face (B) 14.6 cm from unsilvered face
(C) 5.67 cm from unsilvered face (D) 8.33 cm from unsilvered face

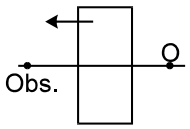
18. In the figure shown $\frac{\sin i}{\sin r}$ is equal to:



(A) $\frac{\mu_2^2}{\mu_3\ \mu_1}$ (B) $\frac{\mu_3}{\mu_1}$ (C) $\frac{\mu_3\ \mu_1}{\mu_2^2}$ (D) none of these

19. A bird is flying up at angle $\sin^{-1}(3/5)$ with the horizontal. A fish in a pond looks at that bird. When it is vertically above the fish. The angle at which the bird appears to fly (to the fish) is: [$n_{water} = 4/3$]
(A) $\sin^{-1}(3/5)$ (B) $\sin^{-1}(4/5)$ (C) 45º (D) $\sin^{-1}(9/16)$

20. In the figure shown a slab of refractive index $\frac{3}{2}$ is moved towards a stationary observer. A point 'O' is observed by the observer with the help of paraxial rays through the slab. Both 'O' and observer lie in air. The velocity with which the image will move is

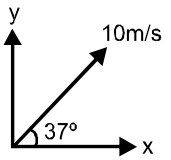


(A) 2 m/s towards left (B) $\frac{4}{3}$ m/s towards left
(C) 3 m/s towards left (D) zero

DPP No. : A13 (JEE–Advanced)

Total Marks : 36	Max. Time : 32 min.	
Single choice Objective ('–1' negative marking) Q.1	(3 marks 2 min.)	[03, 02]
One or more than one options correct type ('–1' negative marking) Q.2 to Q.3	(4 marks 2 min.)	[08, 04]
Comprehension ('–1' negative marking) Q.4 to Q.6	(3 marks 2 min.)	[09, 06]
Subjective Questions ('–1' negative marking) Q.7 to Q.10	(4 marks 5 min.)	[16, 20]

1. A stone is projected with a velocity of 10 m/s at angle of 37º with horizontal. Its average velocity till it reaches the highest position is : (Assume horizontal direction as x-axis and vertical upward direction as +y-axis)



(A) $4\hat{i}+3\hat{j}$ (B) $8\hat{i}+6\hat{j}$ (C) $8\hat{i}+3\hat{j}$ (D) $8\hat{i}$

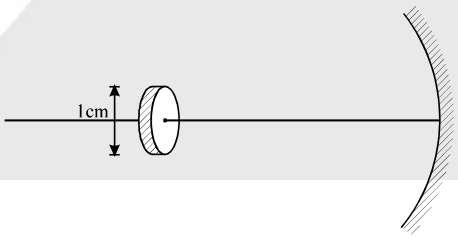
2. The displacement of a body from a reference point is given by, $\sqrt{x} = 2t - 3$, where 'x' is in metres and it is non negative number, t in seconds. This shows that the body:
(A) rest at t = 3/2 (B) is accelerated
(C) is decelerated (D) is in uniform motion

3. A person, standing on the roof of a 40 m high tower, throws a ball vertically upwards with speed 10 m/s. Two seconds later, he throws another ball again in vertical direction. (use g = 10 m/s^2) Both the balls hit the ground simultaneously.
(A) The first stone hits the ground after 4 seconds.
(B) The second ball was projected vertically downwards with speed 5 m/s.
(C) The distance travelled by the first ball is 10 m greater than the distance travelled by the second ball.
(D) Both balls hit the ground with same velocities.

COMPREHENSION

A concave mirror of radius of curvature 20 cm is shown in the figure. A circular disc of diameter 1 cm is placed on the principle axis of mirror with its plane perpendicular to the principal axis at a distance 15 cm from the pole of the mirror. The radius of disc starts increasing according to the law r = (0.5 + 0.1 t) cm/sec where t is time is second.

4. The image formed by the mirror will be in the shape of a :



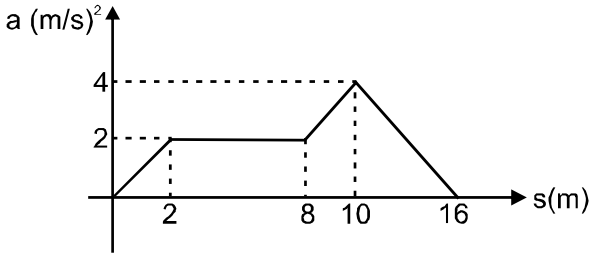
(A) circular disc (B) elliptical disc with major axis horizontal
(C) elliptical disc with major axis vertical (D) distorted disc

5. In the above question, the area of image of the disc at *t* = 1 second is:
(A) 1.2 π cm^2 (B) 1.44 π cm^2 (C) 1.52 π cm^2 (D) none of these

6. What will be the rate at which the radius of image will be changing
(A) 0.2 cm/sec increasing (B) 0.2 cm/sec decreasing
(C) 0.4 cm/sec increasing (D) 0.4 cm/sec decreasing

7. A particle moving in a straight line has an acceleration of (3t – 4) ms^{-2} at time t sec. The particle is initially at 1m from from O, a fixed point on the line. It starts with a velocity of 2ms^{-1}. Find the time when the velocity is zero. Find also the displacement of the particle from O when t = 3.

8. The acceleration-displacement graph of a particle moving in a straight line is as shown in figure, initial velocity of particle is zero. Find velocity (in m/s) of the particle when displacement of the particle is s = 16m.



9. When two bodies move uniformly towards each other, the distance between them diminishes by 16 m every 10 s. If bodies move with velocities of the same magnitude and in the same direction as before the distance between then will decrease 3 m every 5 s. Calculate the velocity of each body.

10. Two rays are incident on a spherical mirror of radius of R = 5 cm parallel to its optical axis at the distance h_1 = 0.5 cm and h_2 = 3 cm. Determine the distance Δx between the points at which these rays intersect the optical axis after being reflected at the mirror.

ANSWERS

DPP No. : A2

7. – 6m/s², 6m/s² **8.** 3m/s **9.** 6m **10.** $15\hat{i} + 20\hat{j}$ **11.** 3 km north
12. 5, 10

DPP No. : A4

9. $14\hat{i} + 48\hat{j}$ **10.** 2.25 m/s **11.** 30 m **12.** $D = V \times t_0 = a\omega t_0$

DPP No. : A5

9. 15^0 **10.** $\sqrt{\frac{11}{2}}$ m, $\frac{3}{2}$ **11.** 2

DPP No. : A7

7. 6 **8.** 20 **9.** 3 **10.** 20 **11.** 12

DPP No. : A8

6. 15 **7.** $\frac{5}{\sqrt{2}}$ m **8.** 3 **9.** 5 **10.** 26 **11.** 41

DPP No. : A10

5. 52 m **6.** 30º **7.** $\frac{125}{4}$ m **8.** $y = -\frac{b}{a^2}x^2$ **9.** 70 **10.** 25

DPP No. : A11

9. 160°CW, 200^0 ACW **10.** $\pi/144$ cm²

DPP No. : A13

7. $t = \frac{2}{3}$ or 2, s = 2.5 **8.** 8 m/s **9.** v_1 = 1.1 m/s and v_2 = 0.5 m/s.
10. 5/8 = 0.625 cm