CLASS TEST

SECTION-I

Straight Objective Type **6 Q. [3(–1)]**

1. If $\vec{a} = 2\hat{i} + 3\hat{j} + 6\hat{k}$ and $\vec{b} = 3\hat{i} + 4\hat{j}$, then $\frac{\text{projection of } \vec{a} \text{ on } \vec{b}}{\text{projection of } \vec{b} \text{ on } \vec{a}} =$

(A) 7/5 (B) 5/7 (C) 4/9 (D) none

2. At t = 1 sec., a particle is at (1, 0, 0). It moves towards (4, 4, 12) with a constant speed of 65 m/s. The position of the particle is measured in metres and the time in sec. Assuming constant velocity, the position of the particle at t = 3 s is :

(A) $\left(13\hat{i} - 120\hat{j} + 40\hat{k}\right)$ m (B) $\left(40\hat{i} + 31\hat{j} - 120\hat{k}\right)$m

(C) $\left(13\hat{i} - 40\hat{j} + 12\hat{k}\right)$ m (D) $\left(31\hat{i} + 40\hat{j} + 120\hat{k}\right)$m

3. A particle is moving under the influence of force $\vec{F} = [\hat{i} - 2\hat{j}]$N, is now moved from the point (x, y, z) = (2, 1, 3) m to the point (x, y, z) = (3, 2, 4) m. How much work is done by the force $\vec{F}$ during this time period? ($W = \vec{F}.\vec{s}$)

(A) 0 J (B) –1 J (C) 1 J (D) None of these

4. An object of mass m is attached to a spring. The restoring force of the spring is $F = -\lambda x^3$, where x is the displacement. The oscillation period depends on the mass, λ and oscillation amplitude. Suppose the object is initially at rest. If the initial displacement is D then its period is τ. If the initial displacement is 2D, find the period. (Hint: use dimension analysis.)

(A) 8τ (B) 2τ (C) τ (D) $\tau/2$

5. According to Maxwell-distribution law, the probability function representing the ratio of molecules at a particular velocity to the total number of molecules is given by

$$f(v) = k_1\sqrt{\left(\frac{m}{2\pi kT^2}\right)^3}\,4\pi v^2 e^{-\frac{mv^2}{2kT}}$$

Where m is the mass of the molecule,
v is the velocity of the molecule,
T is the temperature
k and k_1 are constants.
The dimensional formulae of k_1 is

(A) L^2T^{-2} (B) $L^1T^{-1}K^{-3/2}$ (C) $L^1T^{-1}K^{+3/2}$ (D) $L^2T^{-1}K^{+3/2}$

6. In a new set of units, 1 unit of force is equal to 100 N, 1 unit of speed is equal to 10^3 m/s, 1 unit of time is equal to 10^{-5} sec, then 1 unit of mass in the new system will be equal to :-

(A) 1000 kg (B) 10^{-6} kg (C) 10^{-3} kg (D) 10^{+6} kg

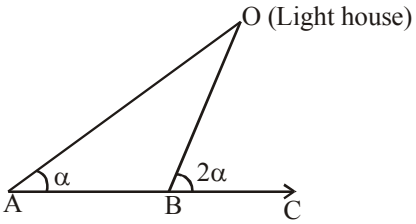
Linked Comprehension Type (Single option correct) 2 Para × 2 Q. [3(–1)]

Paragraph for Question Nos. 7 and 8

Doubling the angle on the Bow

When Captain 

asks Mr. Gibbs to find the location of his ship "The Black pearl" with respect to Queens light house, Mr. Gibbs uses a technique known as "Doubling the angle on the bow". Figure shows the straight track (ABC) of ship passing by the lighthouse. At point A, Mr. Gibbs measures the angle α between the line of sight to the lighthouse and the direction of motion of the ship. At point B the measured angle becomes to 2α.



7. Taking light house as the origin, which of the following is NOT equal to the magnitude of displacement of boat when it goes from A to B :-

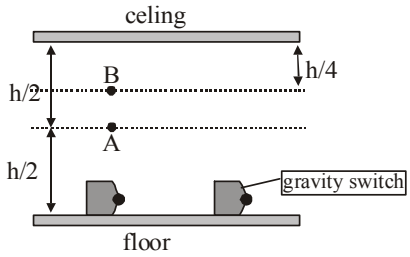
(A) $\left|\overrightarrow{OB}-\overrightarrow{OA}\right|$ (B) $\left|\overrightarrow{OB}\right|$ (C) $\left|\overrightarrow{OA}\right|$ (D) $\left|\overrightarrow{AB}\right|$

8. If the ship starts retarding as it passes from point B. What should be the retardation of the ship so that it stops at the point closest to the light house. Velocity of the ship at point B is 10 m/s, distance of the ship from light house at point B is 50 m. (Given $\alpha = 30°$)

(A) 4 m/s^2 (B) 2 m/s^2 (C) 1 m/s^2 (D) None of these

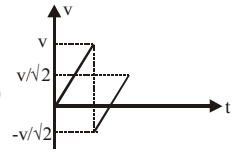
Paragraph for Question 9 and 10

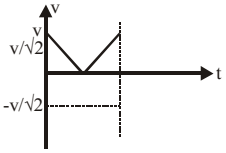
A student tosses a rubber ball vertically upward. When it reaches the top of its trajectory at a point A, another student flips the gravity switch so that acceleration due to gravity now becomes 10 m/s^2 upwards. The ball bounces back to point B, then to the ceiling and sticks there.

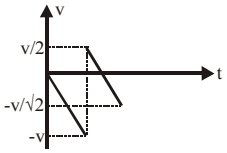


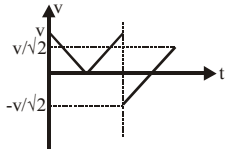
Point A is halfway between the floor and ceiling and point B is 1/4th of the way down from ceiling. Take y = 0 at the floor and positive y-axis upward.

9. v-t graph of ball is : (v is initial velocity)

(A) 

(B) 

(C) 

(D) 

10. If h = 40 m, then find the total time taken by ball to stick on ceiling after the flip of gravity switch

(A) $2+2\sqrt{2}$ sec (B) $2+\sqrt{2}$ sec (C) 2 sec (D) None of these

SECTION-III

Numerical Grid Type (Ranging from 0 to 9) **8 Q. [4(-0)]**

1. A boy A is standing 3 m west and 4 m north to a boy B. A starts moving along a vector $\vec{a} = 1.5\hat{i} + 2\hat{j}$ with a constant speed of 2 m/s for 5 s and stops. Its new position vector with respect to the boy B is $x\hat{i} + y\hat{j}$. Find $\frac{|x|+|y|}{3}$.

2. A sphere is fired downwards into a medium with an initial speed of 27 ms^{-1}. It experiences a deceleration of a = (–6t) ms^{-2}, where t is in seconds. If the distance(in metre) travelled before it stops is 9α. Then find the value of α.

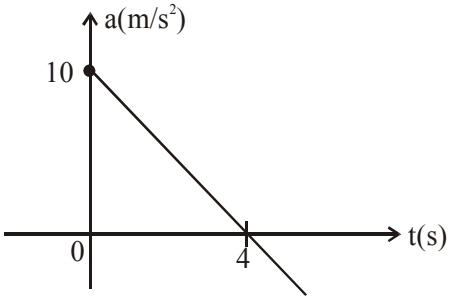
3. Starting from rest, a particle moving along a straight line is accelerated by the acceleration :

$a = 4 - t^2$ for $0 \le t \le 2$ sec

$a = \frac{1}{3}$ for $t > 2$ sec

What is the velocity (in m/s) after 4 sec?

4. The acceleration-time graph of a particle moving along a straight line is shown in figure. At what time (in sec) the particle acquires its initial velocity ?



5. A Diwali rocket moves up with a constant acceleration a_1 = 20/3 m/s^2. After some time its fuel gets exhausted and then it falls freely. If the maximum height attained is 50 m and if v (in m/s) is speed when the fuel is exhausted. Find the value of $\frac{v}{10}$.

6. Two forces $\vec{F}_1$ & $\vec{F}_2$ of magnitude 12 N & 5N respectively are exerted on a body. $|\vec{F}_1 + \vec{F}_2|$ = 13 N. If the angle between $\vec{F}_1$ & $\vec{F}_2$ is 15x (in degree) then fill the value of x in OMR sheet.

7. Forces acting on a particle have magnitudes of 14, 7 and 7 N act in the direction of vectors $6\hat{i} + 2\hat{j} + 3\hat{k}$, $3\hat{i} - 2\hat{j} + 6\hat{k}$ and $2\hat{i} - 3\hat{j} - 6\hat{k}$ respectively. The forces remain constant while the particle is displaced from point A(2, –1, –3) to B (5, –1, 1). Find the total work done (in joule) on the particle. The coordinates are specified in meters. If your answer is x fill value of x/15.

8. A particle starts moving from origin with velocity $u = 2\hat{i} + 4\hat{j}$ under an acceleration of $\vec{a} = 4t\hat{i} - 6\hat{k}$ where t is the time elapsed since it started from origin. Find the value of t at which acceleration is perpendicular to initial velocity.

CLASS TEST # 01			ANSWER KEY
SECTION-I			
Straight Objective Type			**6 Q. [3(–1)]**
1. Ans. (A)	**2. Ans. (D)**	**3. Ans. (B)**	**4. Ans. (D)**
5. Ans. (C)	**6. Ans. (D)**		
Linked Comprehension Type (Single option correct)			**2 Para × 2 Q. [3(–1)]**
7. Ans. (C)	**8. Ans. (B)**	**9. Ans. (D)**	**10. Ans. (A)**
SECTION-III			
Numerical Grid Type (Single digit Ranging from 0 to 9) 8 Q. [4(-0)]			
1. Ans. 5	**2. Ans. 6**	**3. Ans. 6**	**4. Ans. 8**
5. Ans. 2	**6. Ans. 6**	**7. Ans. 5**	**8. Ans. 0**