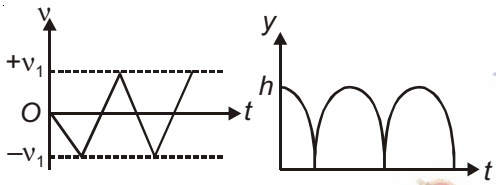
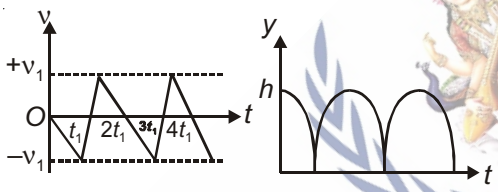
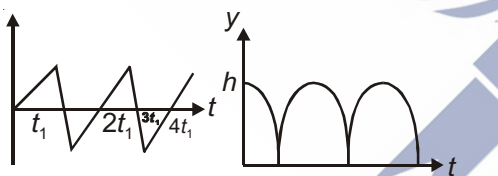
Motion in a Straight Line

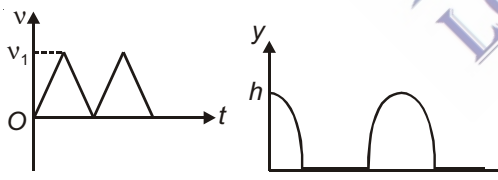
1. Consider a rubber ball freely falling from a height h = 4.9 m onto a horizontal elastic plate. Assume that the duration of collision is negligible and the collision with the plate is totally elastic.

   Then the velocity as a function of time and the height as a function of time will be **[AIEEE-2009]**

(1) 

(2) 

(3) 

(4) 

2. From a tower of height H, a particle is thrown vertically upwards with a speed u. The time taken by the particle, to hit the ground, is n times that taken by it to reach the highest point of its path. The relation between H, u and n is **[JEE (Main)-2014]**

   (1) $2gH = n^2u^2$

   (2) $gH = (n-2)^2u^2$

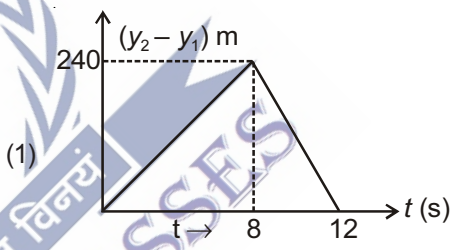
   (3) $2gH = nu^2(n-2)$

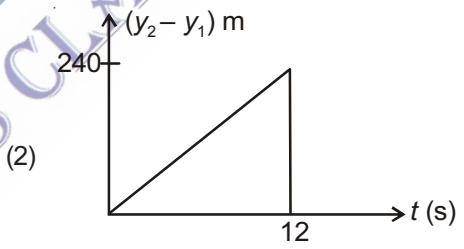
   (4) $gH = (n-2)u^2$

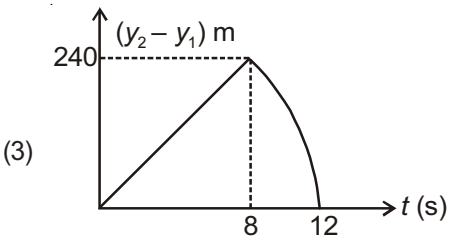
3. Two stones are thrown up simultaneously from the edge of a cliff 240 m high with initial speed of 10 m/s and 40 m/s respectively. Which of the following graph best represents the time variation of relative position of the second stone with respect to the first? **[JEE (Main)-2015]**

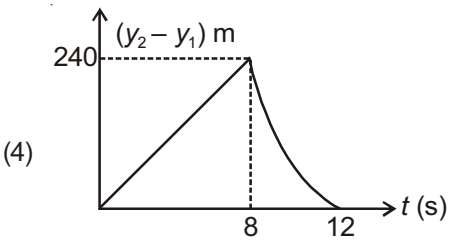
   (Assume stones do not rebound after hitting the ground and neglect air resistance, take g = 10 m/s^2)

   (The figures are schematic and not drawn to scale)

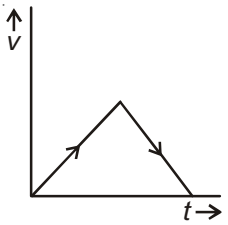
(1) 

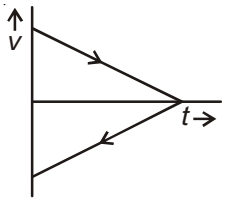
(2) 

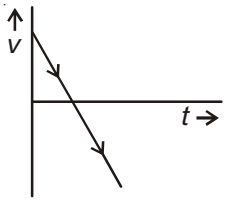
(3) 

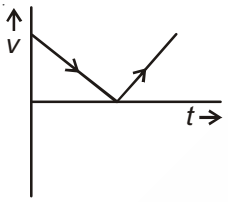
(4) 

4. A body is thrown vertically upwards. Which one of the following graphs correctly represent the velocity vs time? **[JEE (Main)-2017]**

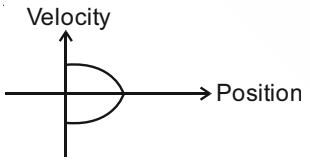
(1) 

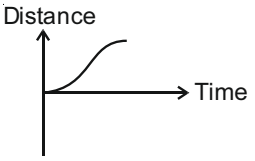
(2) 

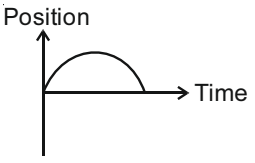
(3) 

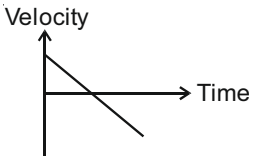
(4) 

5. All the graphs below are intended to represent the same motion. One of them does it incorrectly. Pick it up. **[JEE (Main)-2018]**

(1) 

(2) 

(3) 

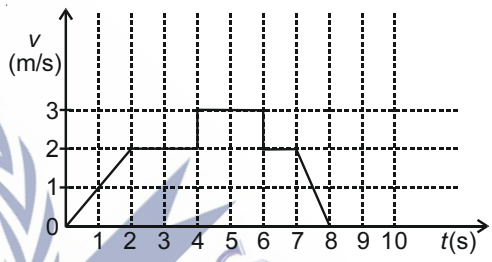
(4) 

6. In a car race on straight road, car *A* takes a time *t* less than car *B* at the finish and passes finishing point with a speed '*v*' more than that of car *B*. Both the cars start from rest and travel with constant acceleration a_1 and a_2 respectively. Then '*v*' is equal to **[JEE (Main)-2019]**

(1) $\frac{a_1 + a_2}{2} t$ (2) $\frac{2a_1a_2}{a_1 + a_2} t$

(3) $\sqrt{2a_1a_2}\, t$ (4) $\sqrt{a_1a_2}\, t$

7. A particle starts from the origin at time $t = 0$ and moves along the positive x-axis. The graph of velocity with respect to time is shown in figure. What is the position of the particle time $t = 5$ s?



[JEE (Main)-2019]

(1) 9 m (2) 6 m

(3) 10 m (4) 3 m

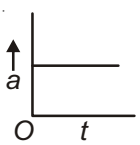
8. A passenger train of length 60 m travels at a speed of 80 km/hr. Another freight train of length 120 m travels at a speed of 30 km/hr. The ratio of times taken by the passenger train to completely cross the freight train when : (i) they are moving in the same direction, and (ii) in the opposite directions is **[JEE (Main)-2019]**

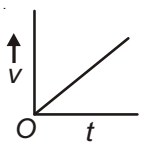
(1) $\frac{25}{11}$ (2) $\frac{5}{2}$

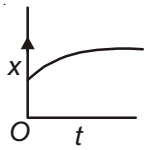
(3) $\frac{11}{5}$ (4) $\frac{3}{2}$

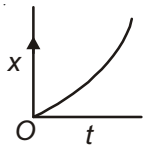
9. A particle starts from origin *O* from rest and moves with a uniform acceleration along the positive *x*-axis. Identify all figures that correctly represent the motion qualitatively. (a = acceleration, v = velocity, x = displacement, t = time)

[JEE (Main)-2019]

(A) 

(B) 

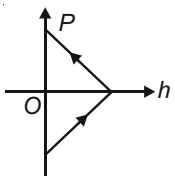
(C) 

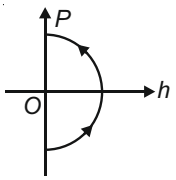
(D) 

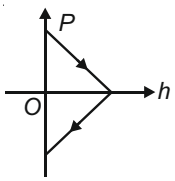
(1) (A) (2) (A), (B), (C)

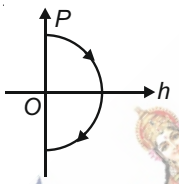
(3) (A), (B), (D) (4) (B), (C)

10. A ball is thrown vertically up (taken as + *z*-axis) from the ground. The correct momentum-height (*P*-*h*) diagram is **[JEE (Main)-2019]**

(1) 

(2) 

(3) 

(4) 

11. The position of a particle as a function of time *t*, is given by

$$x(t) = at + bt^2 - ct^3$$

where *a*, *b* and *c* are constants. When the particle attains zero acceleration, then its velocity will be **[JEE (Main)-2019]**

(1) $a + \frac{b^2}{4c}$ (2) $a + \frac{b^2}{3c}$

(3) $a + \frac{b^2}{2c}$ (4) $a + \frac{b^2}{c}$

12. A particle is moving with speed $v = b\sqrt{x}$ along positive *x*-axis. Calculate the speed of the particle at time $t = \tau$ (assume that the particle is at origin at $t = 0$). **[JEE (Main)-2019]**

(1) $b^2\tau$ (2) $\frac{b^2\tau}{4}$

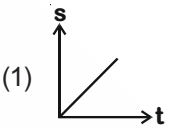
(3) $\frac{b^2\tau}{2}$ (4) $\frac{b^2\tau}{\sqrt{2}}$

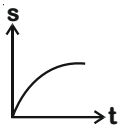
13. Train *A* and train *B* are running on parallel tracks in the opposite directions with speeds of 36 km/hour and 72 km/hour, respectively. A person is walking in train *A* in the direction opposite to its motion with a speed of 1.8 km/hour. Speed (in ms^{-1}) of this person as observed from train *B* will be close to (take the distance between the tracks as negligible) **[JEE (Main)-2020]**

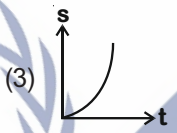
(1) 30.5 ms^{-1} (2) 29.5 ms^{-1}

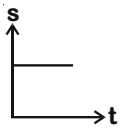
(3) 31.5 ms^{-1} (4) 28.5 ms^{-1}

14. A particle is moving unidirectionally on a horizontal plane under the action of a constant power supplying energy source. The displacement (*s*) - time (*t*) graph that describes the motion of the particle is (graphs are drawn schematically and are not to scale) **[JEE (Main)-2020]**

(1) 

(2) 

(3) 

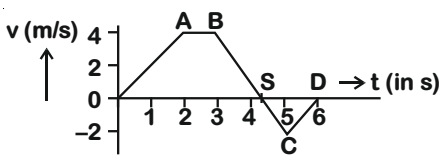
(4) 

15. A helicopter rises from rest on the ground vertically upwards with a constant acceleration *g*. A food packet is dropped from the helicopter when it is at a height *h*. The time taken by the packet to reach the ground is close to [*g* is the acceleration due to gravity] **[JEE (Main)-2020]**

(1) $t = 3.4\sqrt{\left(\frac{h}{g}\right)}$ (2) $t = 1.8\sqrt{\frac{h}{g}}$

(3) $t = \sqrt{\frac{2h}{3g}}$ (4) $t = \frac{2}{3}\sqrt{\left(\frac{h}{g}\right)}$

16. The velocity (*v*) and time (*t*) graph of a body in a straight line motion is shown in the figure. The point S is at 4.333 seconds. The total distance covered by the body in 6 s is **[JEE (Main)-2020]**



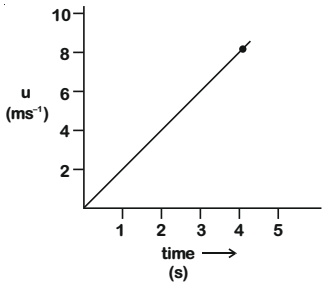
(1) $\frac{37}{3}$m (2) 11 m

(3) 12 m (4) $\frac{49}{4}$m

17. A ball is dropped from the to of a 100 m high tower on a planet. In the last $\frac{1}{2}$ s before hitting the ground, it covers a distance of 19 m. Acceleration due to gravity (in ms^{-2}) near the surface on that planet is _____. **JEE (Main)-2020]**

18. The distance x covered by a particle in one dimensional motion varies with time t as $x^2 = at^2 + 2bt + c$. If the acceleration of the particle depends on x as x^{-n}, where n is an integer, the value of n is _____. **[JEE (Main)-2020]**

19. The speed versus time graph for a particle is shown in the figure. The distance travelled (in m) by the particle during the time interval t = 0 to t = 5 s will be _____. **[JEE (Main)-2020]**



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