Basic Maths, Kinematics, Units & Dimensions

14.04.2020

Total Ques : 30 **MM:120**

Origin
A JEE Prep Hub

1.

A particle moves in a straight line according to the relation
$x = t^3 - 4t^2 + 3t$
Find the acceleration of the particle at displacement equal to zero.

a. (-8,-2,10)

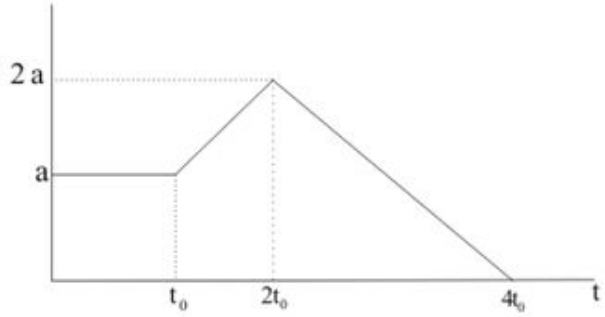
b. (-1,-2,10)

c. (8,2,10)

d. (1,2,10)

2.

A body starts at initial velocity v_0 in a straight line with acceleration as shown below in the graph.



Find the maximum velocity reached.

a. $v_0 + 4at_0$

b. $v_0 + \frac{9}{2}(at_0)$

c. $v_0 - \frac{9}{2}(at_0)$

d. $v_0 - 4at_0$

3.

A particle moves in a straight line with acceleration described by equation given below

$a = mx - \frac{v_0^2}{x_0}$

If the initial velocity and displacement are $(v_0, 0)$ and at any time t_0 velocity and displacement are $(0, x_0)$ the value of constant m is

a) $\frac{v_0^2}{x_0^2}$

b) $-\frac{v_0^2}{x_0^2}$

c) $\frac{2v_0^2}{x_0^2}$

d) $-\frac{2v_0^2}{x_0^2}$

4.

A boat moves with the stream of water from point A and B and it return back with the same speed. Velocity of boat relative to water is η times the velocity of the water. Velocity of the water is 1m/sec. Find out the average speed in the whole iternary

a) $\eta^2 - 1$

b) $\eta^2 + 1$

c) η^2

d) None of these

Paragraph type question

(A) A Man X drops a stone from the fifteen floor of the building .A Man Y ascending in an elevator at a constant speed v=10 m/s passed the Fifteen floor just as the stone is released

5.

Find the position, velocity of the stone as seen by the Man X at time t=2 sec

a. (19m ,19m/s)

b. (19.6m,19.6m/s)

c. (10m,10m/s)

d (11m,12m/s)

6.

Find the position, velocity of the stone relative to Man Y at 3 sec

a. (39m, 70m/s)

b. (19m, 70m/s)

c. (70m, 39 m/s)

d. (14 m, 29m/s)

7.

Find the acceleration of the stone with respect to Man X and Y.

a. (9.8 m/s^2, 9.8m/s^2)

b. (9 m/s^2, 10 m/s^2)

c. (10 m/s^2, 10m/s^2)

d. None of these

8.

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

(a) $x < 0, v < 0, a > 0$

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

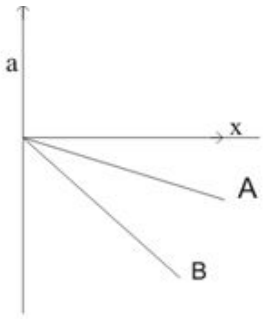
(c) $x > 0, v < 0, a > 0$

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

9.

In one dimensional motion, instantaneous speed v satisfies $0 \leq v < v_0$.
(a) The displacement in time T must always take non-negative values.
(b) The displacement x in time T satisfies $-v_0 T < x < v_0 T$.
(c) The acceleration is always a non-negative number.
(d) The motion has no turning points

10.



Two particle A and B start with the same velocity $v = v_0$ at x=0.They are accelerated per the graph shown above. Which particle has the maximum magnitude of the velocity at $x = x_0$
a. A
b. B
c. A & B will have same velocity
d. None of the above

11.

The greatest possible acceleration or deceleration a train may have is a and its maximum speed is v. Find the maximum time in which the train can get from one station to the next if the total distance is s

a) $\frac{s}{a} + 1$
b) $\frac{s}{v} + \frac{v}{a}$
c) $\frac{s}{v} + 1$
d) none of the above

12.

Displacement(y) of the particle is given by

$y = 2t + t^2 - 2t^3$

the velocity of the particle when acceleration is zero is given by

a. $\frac{5}{2}$

b. $\frac{9}{4}$

c. $\frac{13}{6}$

d. $\frac{17}{8}$

13.

It is possible to project an body with a given speed in two possible ways so that it has a same horizontal range. The product of time taken by it in tow possible ways is

a. $\frac{R}{g}$

b. $\frac{2R}{g}$

c. $\frac{3R}{g}$

d. $\frac{4R}{g}$

14.

The initial velocity of the particle is u=4**i**+3**j** m/s. It is moving with uniform acceleration a=.4**i**+.3**j** m/s^2.which of the following is true

a. the magnitude of the velocity after 10 sec is 10m/s

b. The velocity vector at time t is given by (4+.4t)**i** +(3+.3t)**j**

c. the displacement at time t is $(4t+.2^2)$**i** +$(3t+.15^2)$**j**

d . None of the above

(A). a & c **(B). a & b**

(C) b & c **(D) d**

15.

Two projectile A and B are having trajectory equation

$y = a_1x - b_1x^2$ and $y = a_2x - b_2x^2$

If the range is same for both the projectile A and B then which of the following option is true

a. $\frac{a_1}{b_1} = \frac{a_2}{b_2}$

b. $\frac{a_1}{b_2} = \frac{a_2}{b_1}$

c. $a_1a_2=b_1b_2$

d. None of these

16.

The horizontal and vertical displacement of the projectile at time t are

$x = 36t$

$y = 48t - 4.9t^2$

where x and y are in meters and t in second. Initial velocity of the projectile in m/s

a. 15

c. 30

b. 45

d. 60

17.

A projectile has a range R and time of flight T. If the range is tripled by the increasing the speed of the projection, without changing the angle of projection then the time of the flight will become

a $\frac{T}{\sqrt{3}}$

b $T\sqrt{3}$

c. $\frac{T}{3}$

d. $3T$

18.

Dimensional formula for torque is

(1) L^2MT^{-2}

(2) $L^{-1}MT^{-2}$

(3) L^2MT^{-3}

(4) LMT^{-2}

19.

A spherical body of mass *m* and radius *r* is allowed to fall in a medium of viscosity η. The time in which the velocity of the body increases from zero to 0.63 times the terminal velocity (v) is called time constant (τ). Dimensionally τ can be represented by

(1) $\frac{mr^2}{6\pi\eta}$

(b) $\sqrt{\left(\frac{6\pi mr\eta}{g^2}\right)}$

(c) $\frac{m}{6\pi\eta rv}$

(4) None of the above

20.

E, *m*, *l* and *G* denote energy, mass, angular momentum and gravitational constant respectively, then the dimension of $\frac{El^2}{m^5G^2}$ are

(1) Angle

(2) Length

(3) Mass

(4) Time

21. **The surface tension of a liquid is 70 dyne/cm. In MKS system its value is?**

(a) 70 N/m

(b) 7×10^{-2} N/m

(c) 7×10^{2} N/m

(d) 7×10^{3} N/m

22. A body is freely falling under the action of gravity. It covers half the total distance in the last second of its fall. If it falls for n second, then value of n is
    a. 2
    b. $2+\sqrt{2}$
    c. 3
    d. $2-\sqrt{2}$

23.
The displacement time equation for a particle in linear motion is given as

$x = \frac{a}{b}(1 - e^{-bt})$

which of the following option is correct

a. The velocity and acceleration of the particle at t=0 is a and $-ab$ respectively

b. The velocity will be decreasing as the time increases

c. The displacement of the particle will fall between

$0 \le x \le \frac{a}{b}$

d. The maximum acceleration in the motion is $-ab$

(A). A & B **(B) A, B & C**
(C) B, C & D **(D) A, B, C, D**

24.
If $F = ax + bt^2 + c$ where F is force, x is distance and t is time. Then what is dimension of $\frac{axc}{bt^2}$?

(A) $[M\ L^2\ T^{-2}]$ (B) $[M\ L\ T^{-2}]$ (C) $[M^0\ L^0\ T^0]$ (D) $[M\ L\ T^{-1}]$

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25.
The van-der Waals equation is

$$\left(P + \frac{a}{V^2}\right)(V - b) = RT,$$

where P is pressure, V is molar volume and T is the temperature of the given sample of gas. R is called molar gas constant, a and b are called van-der Wall constants.

26.

Consider three vectors

$\vec{A} = 2\hat{i} + 3\hat{j} - 2\hat{k}$ $\vec{B} = 5\hat{i} + n\hat{j} + \hat{k}$ $\vec{C} = -\hat{i} + 2\hat{j} + 3\hat{k}$

If these three vectors are coplanar, then value of n will be

(A) 0 (B) 12 (C) 16 (D) 18

27.

Frequency f of a simple pendulum depends on its length ℓ and acceleration g due to gravity according to the following equation

$$f = \frac{1}{2\pi}\sqrt{\frac{g}{\ell}}$$

Graph between which of the following quantities is a straight line?

(A) f on the ordinate and l on the abscissa

(B) f on the ordinate and $\sqrt{\lambda}$ on the abscissa

(C) f^2 on the ordinate and l on the abscissa

(D) f^2 on the ordinate and $1/\lambda$ on the abscissa

28.

Which of the following sets of concurrent forces may be in equilibrium?

(A) F_1=3N, F_2=5N, F_3=1N (B) F_1=3N, F_2=5N, F_3=6N

(C) F_1=3N, F_2=5N, F_3=9N (D) F_1=3N, F_2=5N, F_3=16 N

29.

The value of $\hat{i} \times (\hat{i} \times \hat{j}) + \hat{j} \times (\hat{j} \times \hat{k}) + \hat{k} \times (\hat{k} \times \hat{i})$ is

(A) $\hat{i} + \hat{j} + \hat{k}$ (B) $-\hat{i} - \hat{j} - \hat{k}$ (C) $\vec{0}$ (D) $-3\hat{i} - 3\hat{j} - 3\hat{k}$

30.

A particle moves along the curve $12y = x^3$. Which coordinate changes at faster rate at x=10 ?

(A) x–coordinate

(B) y–coordinate

(C) Both x and y–coordinate

(D) Data insufficient