PHYSICS

BOOKS - BHARATI BHAWAN PHYSICS (HINGLISH)

KINEMATICS

Others

1. A train moving at a constant speed of 72 Kmph move eastward for 40 minutes, then in a

direction 45° east of north for 20 minutes, and finally westwasrd for 50 minutes. What is the average velocity of the train during this run ?

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2. A car moving with constant acceleration covers the distance between two points $60m$ apart in 6 s. Its speed as it passes the seconds is $15ms^{-1}$. (a) What was its speed at the first point ? (b) What is its acceleration ? (c) At

what prior distance from the first point was the car at rest ?

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3. An elevator (lift) ascends with an upward acceleration of $1.2ms^{-2}$. At the instant when its upward speed is $2.4ms^{-1}$, a loose bolt drops from the ceiling of the elevator $2.7m$ above the floor of the elevator. Calculate (a) the time of flight of the bolt from the ceiling

to the floor and (b) the distance it has fallen relaative to the elevator shaft.

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4. A car start moving along a line, fisrt with acceleration $a = 5ms^{-2}$ starting from rest then uniformly and finally decelerating at the same rate a, comes to rest. The total time of motion is $\pi = 25s$. The average velocity during the time is equal to

$< v > = 72k\frac{m}{h}r.$ How long does the particle move uniformly ?

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5. At the moment t=0 a particle leaves the origin and moves in the positive direction of the x-axis.Its velocity at any time is $\vec{v} = \vec{v}_0\left(1 - \frac{t}{\tau}\right)$ where $v_0 = 10$ cm/s and τ =5 s. Find :

(a)the x-coordinates of the particle at the instant 6s, 10s and 20s.

(b)the instant at which it is a distance 10 cm from the origin.

(c)the distance s covered by the particle during the first 4s and 8s.

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6. A particle moves in the xy-plane with constant acceleration a directed along the negative y-axis. The equation of path of the particle has the form $y = bx - cx^2$, where b

and c are positive constants. Find the velocity of the particle at the origin of coordinates.

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7. A thief is running away on a straight road in a moving with a speed of $9ms^{-1}$. A policeman chases him on a motor cycle moving at a speed of $10ms^{-1}$. If the instantaneous separation of the jeep from the motor cycle is $100m$, how long will it take for the policeman to catch the thief ?.

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8. A man is $l = 9m$ behind the door of a train when it start moving with acceleration $a = 2\frac{m}{s^2}$. The man runs at full speed. How far does he have to run and after what time does he get into the train ? What is his speed ?

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9. Two bodies are thrown with the same velocity at angles α and $90^\circ - \alpha$ to the

horizontal. Calculate the ration of the maximum heights reached by the bodies.

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10. A body is thrown at an angle $\alpha$to the horizontal with initial velocity v_0.Assuming air drag to be negligible , find (i)the time of motion, (ii)maximum height of ascent and the horizontal range, (iii)the angle of projection at which they are equal , (iv)the angle of projection at which the horizontal range is

maximum and the angle at which the vertical range is maximum.

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13. A body describes the first half of the total distance with velocity v_1 and the second half and velocity v_2.Calculate the average velocity.

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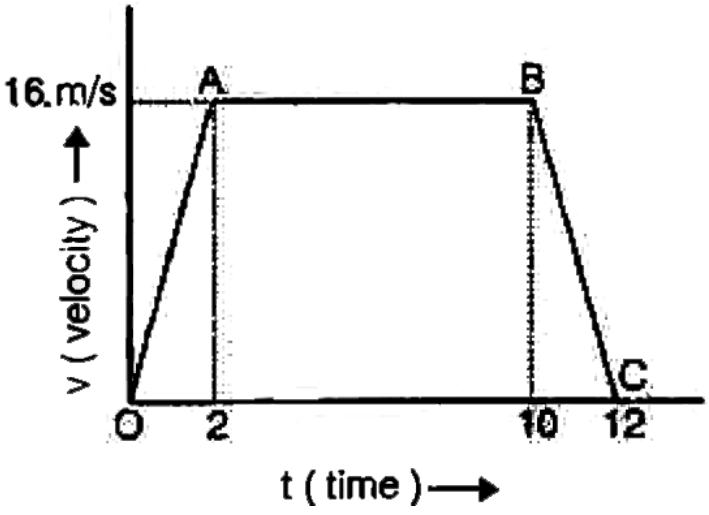
14. A particle moves along a horizontal line and its velocity changes with time as shown in the figure.



Calculate (i)initial acceleration, (ii)total distance described . Plot the x-t graph of the motion.

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18. A point traversed half the distance with a velocity v_0. The remaining part of the distance

was covered with velocity v_1 for half the time, and with velocity v_2 for the other half of the time. Find the mean velocity of the point averaged over the whole time of motion.

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100kmph flies off one train when they are 100km apart and heads directly to the other train. On reaching the other train it flies back to the first train and so forth. (a) How many trips can the bird make from one train to the other before they crash ? (b) How is the total distance the bird travels ?

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(i) maximum velocity reached , and

(ii) the total distance travelled .

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24. Two bodies start moving in the same straight line at the same instant of time from the same origin. The first body moves with a constant velocity of $40ms^{-1}$, and the second starts from rest with a constant acceleration of $4ms^{-2}$.Find the time that elapses before

the second catches the first body. Find the also the greatest distance between them prior to it and time at which this occurs.

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of t (c) the instant t_0 at which the velocity and acceleration are at $\frac{\pi}{4}$.

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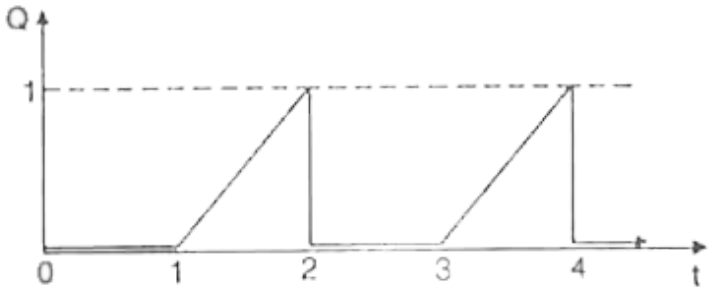
48. Draw graphs of the speeds and path lengths as functions of time if the graph of acceleration is as shown below . The initial

speed is zero .



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49. A particle moves in the x-y plane with constant acceleration α directed along the negative direction of the y-axis.the equation of the trajectory of the particle is y=ax-bx^2, where

a and b are constants. Find the velocity of the particle when it passes through the origin.

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which one of the following will be the average velocity of the body?

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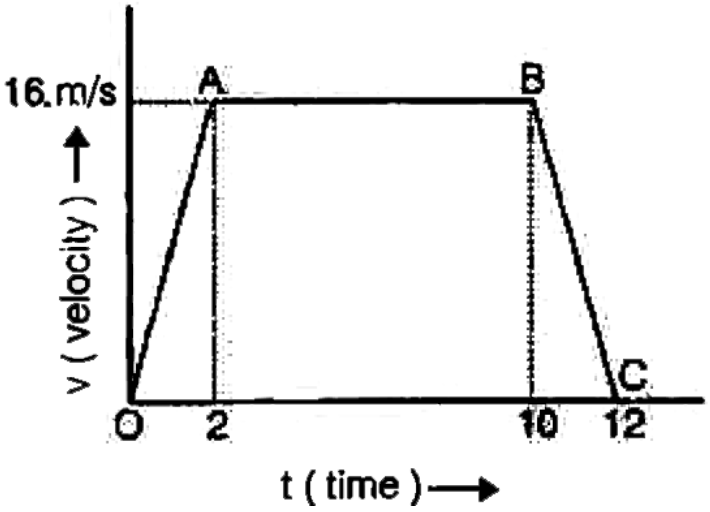

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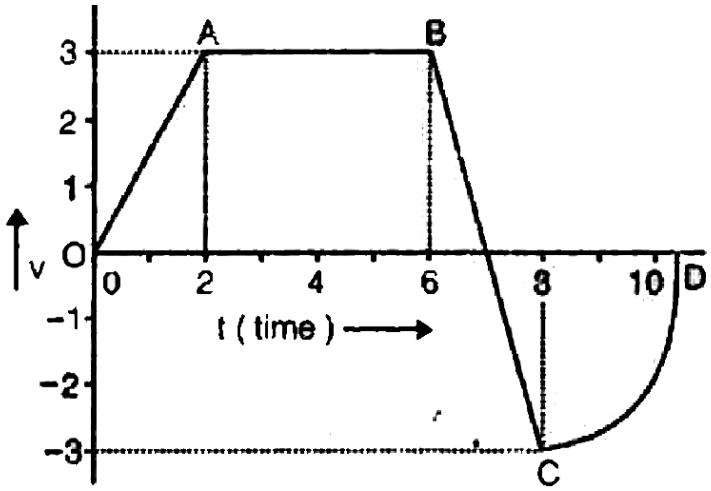
59. A plot of velocity versus time for a body in rectilinear motion is as shown in the figure.indicate whether acceleration is positive, negative , zero , variable or constant in the region OA, AB, BC and CD.Calculate the distance described up to the point C.What is

the displacement up to point C ?



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60. If the same plot is of displacement (x) versus time (t), indicate whether the body is at rest or in motion and whether it has uniform velocity or variable velocity in the rigions OA,

AB, BC and CD.Find the distance described in 8 s.What is the displacement of the body in 8 s ?

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61. Two cars are moving in the same direction with the same speed with separation 40 m.In order to overtake, the driver of the second car accelerates and he overtakes the first car in 5 seconds.What is the acceleration produced by the accelerator ?

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62. A piece of stone is allowed to fall from a balloon floating in air. It goes down past a tower 30 m in height in the last quarter of the last second of its flight.Find the height of the stone at the instant when it was dropped and its velocity as it reaches the ground. $\left(g = 9.8ms^{-2}\right)$

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63. A body travels half of its total path in the last second of its fall from rest.Find the height from which it falls and the time of flight.

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64. A point traverses half a circle of radius R during the interval τ.Calculate the following quantities averaged over that time

(a)the mean velocity that is speed ltvgt ,

(b)the modulus of the mean vector lt v gt ,

(c)the modulus of the average acceleration a if its tangential acceleration is constant.

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66. The driver of a train moving at a speed v_1 sights another train at a disane d, ahead of him moving in the same direction with a slower speed v_2. He applies the brakes and gives a constant teradation a to his train. Show that here will be no collision if $d > (v_1 - v_2)^2 / 2a$.

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67. A particle travels with constant speed along a circle of radius $3m$ and completes one revolution in $20s$. Starting with the lowest point as origin, find (a) the magnitude and direction of the displacement vectors 5 s, 7.5s and 10 s later , (b) the magnitude and direction of the displacement in the 5 s interval from the fifth to the lenth second, (c) average velocity in this interval, (d) the instantaneous velocity at the begining and at the end of the interval.

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72. A body begins to move with an initial velocity of $2ms^{-1}$ and continues to move at a

constant acceleration a.Ten seconds later a second body begins to move from the same point with an initial velocity of $12ms^{-1}$ in the same direction with the same acceleration.What is the maximum acceleration at which it would be possible for the second body to overtake the first ?

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View Text Solution

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92. A particle is projected with a velocity u from a point at ground level. Show that it cannot clear a wall of height h at a distance x

from the point of projection if $u^2 < g\left(h + \sqrt{h^2 + x^2}\right)$.

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93. A particle is projected at an angle α with the horizontal.Show that if α is greater than $\frac{\cos^{-1} 1}{3} = 70.5^\circ$, the distance of the projectile from the point of projection increases to a maximum above the horizontal plane.

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94. A projectile is required to hit a target whose coordinates relative to the horizontal and vertical axes through the point of projectile are (a,b) . If the muzzle velocity is $\sqrt{2ga}$, show that it is impossible to hit the target if $b \geq \frac{3}{4}a$.

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95. Two particles are projected at the same instant from the same point of inclinations α

and β to the horizontal.if they simultaneously hit the top and the bottom of a vertical pole subtending an angle γ at the point of projection, show that $\tan - \alpha \tan \beta = \tan \gamma$.

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96. A target situated on a hill can be seen from the foot at angle α above the horizontal .The distance of the target along the horizonal is R. if a shell is fired from the foot at an angle β

with the horizontal, find the velocity required for it to strike the target.

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