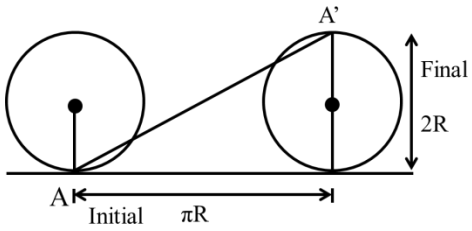
Day – 3

Question: A wheel of radius 1 m rolls forward half a revolution on a horizontal ground. The magnitude of the displacement of the point of the wheel initially in contact with the ground is : **(BCECE 2005)**

(a) 2π $(b)\sqrt{2\pi}$

$(c)\sqrt{\pi^2+4}$ (d) π

Solution: Horizontal distance covered by the wheel in half revolution = πR



So the displacement of the point which was initially in contact with ground

$= AA' = \sqrt{(\pi R)^2 + (2R)^2} = R\sqrt{\pi^2+4} = \sqrt{\pi^2+4}$ $[As R = 1m]$

Answer (c)

Question: 2. A body starts form rest with an acceleration a_1. After two seconds another body B starts form rest with an acceleration a_2. If they travel equal distances in fifth second after the starts of A, the ratio $a_1 : a_2$ will be equal to : **(AIIMS 2001)**

(a) 9 : 5

(b) 5 : 7

(c) 5 : 9

(d) 7 : 9

Solution: Distance traveled in fifth second for first body = distance travelled in 3rd second for second body.

$S_5 = S_3$

$S_{nth} = u + \frac{(2n-1)a}{2}$

$S_3 = 0 + \frac{5}{2}a_2$

$s_5 = 0 + \frac{9}{2}a_1$

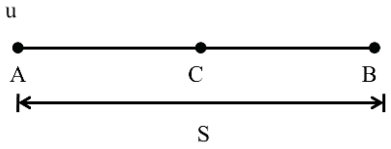
$\frac{9}{2}a_1 = \frac{5}{2}a_2 \Rightarrow \frac{a_1}{a_2} = \frac{5}{9}$

Answer (c)

Question: A Particle is moving with constant acceleration from A to B in a straight line AB, If u and v are the velocities at A and B respectively then its velocity at the midpoint C will be: **(Kerala 2011)**

$(a)\left(\frac{u^2+v^2}{2u}\right)$ $(b)\frac{u+v}{2}$ $(c)\frac{v-u}{2}$ $(e)\sqrt{\frac{v^2-u^2}{2}}$

Solution:



Let S be the distance between AB and a be constant acceleration of a particle . Then v^2-u^2 = 2aS

$or\ aS = \frac{v^2-u^2}{2}$ ... (i)

Let *v*c be velocity of a aprticle at midpoint C

$\therefore\ v_c^2 - u^2 = 2a\left(\frac{s}{2}\right)$

$v_c^2 = u^2 + aS = u^2 + \frac{v^2-u^2}{2}$ $[Using\ (i)]$ **Answer (d)**

$v_c = \sqrt{\frac{u^2+v^2}{2}}$

Question: Driving at a speed of 54 km/h and the brakes cause a declaration of 6.0 m /s^2, the distance by the car after he sees the need to put the brakes on is : **(AMU 2016)**

(a) 100 m

(b) 50 m

(c) 21.75 m

(d) 36.2 m

Solution: $u = 54 \times \frac{5}{18} = 15m/sec$

S_1 = u x Δt = 15 x 0.2 = 3m

For S_2 : $v^2 = u^2 + 2as \Rightarrow 0^2 = (15)^2 + 2\ (-6)\ (S_2)$

$s_2 = \frac{225}{12} = 18.75 \Rightarrow S_{Total} = S_1 + S_2$

= 3 + 18.75 = 21.75 m **Answer (c)**

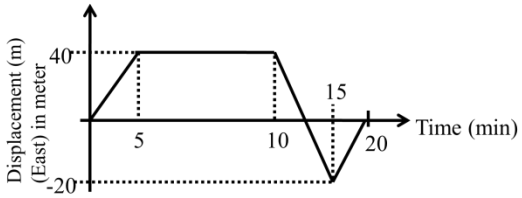
Question: A boy begins to walk eastwards along a street in front of his house and the graph of his displacement form home is shown in the following figure. His average speed for the whole time interval is equal to: **(BHU 2006)**

(a) 8 m min^{-1}

(b) 6m min^{-1}

$(c)\ \frac{8}{3} m\ min^{-1}$

(d) 2m min^{-1}



Solution:

Given, Distance from 0 to 5s = 40 m

Distance from 5 to 10s = 0

Distance from 15 to 20s = 20m

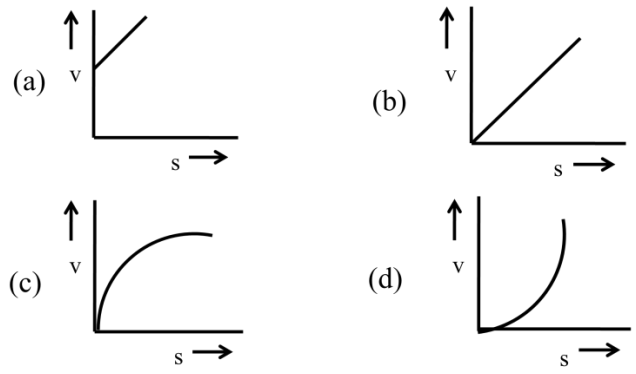
So, net distance = 40 + 0 + 60 + 20 = 120 m

Total time taken = 20 min

Hence, average speed

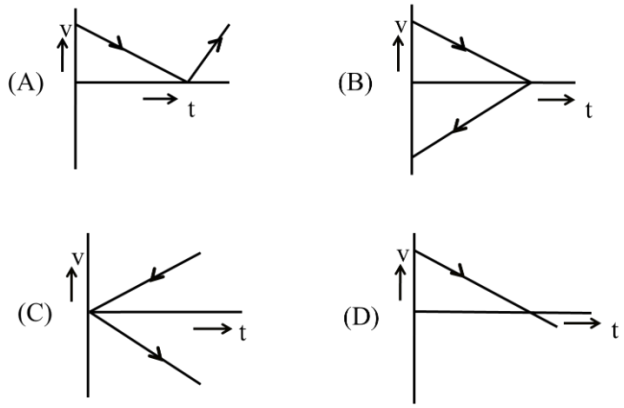
$= \frac{Distance\ (m)}{Time\ (min)} = \frac{120}{20} = 6\ m\ min.^{-1}$ **Answer (b)**

Question: A body starting form rest moves along straight line with a constant acceleration .The variation of speed (v) with distance (s) is represented by the graph: **(AIIMS 2003)**



Solution: $v^2 = u^2 + 2as$
$v^2 = 2as$ as u = 0
The graph between *v* and *s* will be of the from of parabola which will be symmetric with respect to *v*-axis. So curve (d) is the right answer. **Answer (d)**

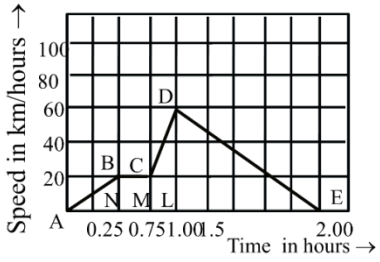
Question: A ball is thrown vertically upwards. Which of following graph/ graphs represent velocity-time graph of the ball during its flight? (air resistance is neglected)
(CPMT 1993; AMU 2000; J&K ET 2010)



Solution: In the positive region the velocity decreases linearly (during rise) and in the negative region velocity increases linearly (during fall) and the direction is opposite to each other during rise and fall, hence fall is shown in the negative region. **Answer (d)**

Question: A train moves form one station to another in 2 hours time. Its speed-time graph during this motion is shown in the figure. The maximum acceleration during the journey is:
(Kerala PET 2002)

(a) 140 km h^{-2}
(b) 160 km h^{-2}
(c) 100 km h^{-2}
(d) 120 km h^{-2}



Solution:
Maximum acceleration will be represented by CD part of the graph
$Acceleration = \frac{dv}{dt} = \frac{(60-20)}{0.25} = 160\ km/h^2$ **Answer (b)**

Question: A body is released from the top of the tower H metre high. It takes t second to reach the ground. Where is the body after *t* /2 second of release? **(AIIMS 2000)**

(a) at 3H/4 metre form the ground

(b) at H/2 metre form the ground

(c) at H/6 metre form the ground

(d) at H/4 metre form the ground

Solution: $Applying\ S = ut + \frac{1}{2}gt^2\ for\ the\ Ist\ case$

$H = \frac{1}{2}gt^2 \quad ....(i)$

Let H_1 be the height after t /2 seconds. So distance of fall = $H-H_1$

$H - H_1 = \frac{1}{2}g\left(\frac{1}{2}\right)^2$

$\Rightarrow H - H_1 = \frac{1}{8}gt^2 \quad ...(i)$

Dividing (i) and (ii),

$$\frac{H - H_1}{H} = \frac{1}{8}x\ \frac{2}{1} = \frac{1}{4}$$

$\Rightarrow 4H - 4H_1 = H \Rightarrow H_1 = \frac{3}{4}H$

Answer (a)

Question: A body is projected vertically up with velocity 'u' and after some time it returns to the starting point. The average speed and average velocity of the body is: **(AIIMS 2015)**

$(a)\ \frac{u}{2}, \frac{u}{2}$

$(b)\ \frac{u}{2}, 0$

(c) 0,0

(d) *u*, *u*

Solution: Average velocity = 0, As displacement is zero

Average speed $= \frac{2H_{max}}{T} = \frac{2u^2/2g}{2u/g} = \frac{u}{2}$ **Answer (b)**

Question: A ball is dropped from the top of the building 100m high. Simultaneously, another ball is thrown upwards form the bottom of the building with such a velocity that a balls collide exactly midway. What is the speed in m/s with which the second ball is thrown? (Take g= 10m/ s^2)

(a) 31.6

(b) 27.8

(c) 22.4

(d) 19.6

Solution: For first ball, time to reach mid-point

$t = \sqrt{\frac{2h}{g}} = \sqrt{\frac{2x\ 50}{10}} = \sqrt{10}s$

$As\ \ h = \frac{H}{2} = \frac{100}{2} = 50m$

For second ball, minimum speed needed at the bottom to reach mid- way in same time t = $\sqrt{10}$

$0 = u - 10 \times \sqrt{10} \Rightarrow u = 10\sqrt{10}$

$\Rightarrow$ u = 31.6 m/s **Answer (a)**