

①

Total distance = 60 km

$$\begin{array}{c|c} u_1 = 40 \text{ kmph} & u_2 = 30 \text{ kmph} \\ \hline A \quad \frac{1}{2} \text{ distance} & B \quad \frac{1}{2} \text{ distance} \quad C \end{array}$$

$$\langle \text{speed} \rangle = \frac{2u_1 u_2}{u_1 + u_2} = \frac{2 \times 40 \times 30}{40 + 30} = \frac{2 \times 40 \times 60}{60 + 30} = 26.6 \text{ kmph}$$

②

$$u_1 = 50 \text{ kmph}; t_1 = 0.22 \text{ h}$$

$$u_3 = 80 \text{ kmph}$$

$$u_2 = 30 \text{ kmph}; t_2 = 0.24 \text{ h}$$

$$t_3 = 0.12 \text{ hr}$$

$$\langle \text{speed} \rangle = \frac{\text{Total distance}}{\text{Total time}} = \frac{u_1 t_1 + u_2 t_2 + u_3 t_3}{t_1 + t_2 + t_3}$$

$$= \frac{50 \times 0.22 + 30 \times 0.24 + 80 \times 0.12}{0.22 + 0.24 + 0.12}$$

$$= \frac{11.0 + 7.2 + 9.6}{0.58} = \frac{16.8 + 11}{0.58} = 47.93 \text{ kmph}$$

③

first half of the

$$\text{total distance} = 20 \text{ m} + 40 \text{ m} + 55 \text{ m} = 115 \text{ m}$$

$$\text{total time} = 1 + 1 + 1 = 3 \text{ sec}$$

$$\langle \text{speed} \rangle = \frac{\text{total distance}}{\text{total time}} = \frac{115}{3} = 38.3 \text{ m/s}$$

(4)

$$v_1 = 60 \text{ kmph} : s_1 = 250 \text{ km [half of total distance]}$$

$$v_2 = 80 \text{ kmph} : s_2 = 250 \text{ km [next half of total distance]}$$

$$\therefore \text{ < speed > } = \frac{2v_1v_2}{v_1+v_2} = \frac{2 \times 60 \times 80}{60+80}$$

$$= \frac{2 \times 60 \times 80}{140} = \frac{60 \times 8}{7} = 68.57 \text{ kmph}$$

(5)

$$\text{distance} = 455 \text{ m} : t = 5 \text{ sec.}$$

$$\text{< velocity > } = \frac{\text{distance}}{\text{time}} = \frac{455}{5} = 91 \text{ m/s}$$

(6)



$$\text{Total distance} = S$$

$$\text{Total time} = t_1 + t_2 = \frac{2S}{5v_1} + \frac{3S}{5v_2} = \frac{S}{5} \left[\frac{2v_2 + 3v_1}{v_1v_2} \right]$$

$$\therefore \text{ < speed > } = \frac{\text{Total distance}}{\text{Total time}} = \frac{S}{\frac{S}{5} \left[\frac{2v_2 + 3v_1}{v_1v_2} \right]}$$

$$= \frac{5v_1v_2}{2v_2 + 3v_1}$$

(7)

$$v = 0 : t = 8 \text{ sec} : u = 50 \text{ kmph} = 50 \times \frac{5}{18} = \frac{125}{9} \text{ m/s}$$

$$\text{From definition of } a = \frac{v-u}{t} = \frac{0 - \frac{125}{9}}{8} = -\frac{125}{72}$$

$$a = -1.74 \text{ m/s}^2$$



②

$$u=0 ; t=20 \text{ sec} \quad v=72 \text{ kmph} = 72 \times \frac{5}{18} = 20 \text{ m/s}$$

From definition of acceleration $a = \frac{v-u}{t}$

$$\Rightarrow a = \frac{20-0}{20} = \frac{20}{20} = 1 \text{ m/s}^2$$

⑧

$$u=54 \text{ kmph} ; v=108 \text{ kmph} ; t=15 \text{ sec}$$

$$\therefore dv = v-u = 108-54 = 54 \text{ kmph} = 54 \times \frac{5}{18} = 15 \text{ m/s}$$

From definition of $a = \frac{v-u}{t} = \frac{15}{15} = 1 \text{ m/s}^2$

⑩

$$u=10 \text{ m/s} ; a=50 \text{ m/s}^2 ; t=3 \text{ sec}$$

From definition of $a = \frac{v-u}{t}$

$$\Rightarrow v = u+at = 10 + 50 \times 3$$

$$\Rightarrow v = 10 + 150 = 160 \text{ m/s}$$

Advanced

⑪

$$\langle \text{speed} \rangle = \frac{2v_1 v_2}{v_1 + v_2} = \frac{2 \times 200}{5+5} \frac{\text{Total distance}}{\text{Total time}}$$

$$= \frac{800 \text{ km} + 200 \text{ km}}{5 \text{ hr} + 5 \text{ hr}} = \frac{400 \text{ km}}{10 \text{ hrs}} = 40 \text{ kmph}$$

$$\text{Total time} = 5 \text{ hr} + 5 \text{ hr} = 10 \text{ hrs}$$

$\langle \text{velocity} \rangle = 0$ because the car come back to Delhi After 10 hrs i.e. Displacement = 0

②

$$s_{Nithin} = 300 \text{ m} \quad t_{Nithin} = 15 \text{ sec.}$$

$$v_{Nithin} = \frac{s_{Nithin}}{t_{Nithin}} = \frac{300}{15} = 20 \text{ m/s}$$

$$s_{Jathin} = 600 \text{ m} \quad t_{Jathin} = 1 \text{ min} = 60 \text{ sec}$$

$$v_{Jathin} = \frac{s_{Jathin}}{t_{Jathin}} = \frac{600}{60} = 10 \text{ m/s}$$

Nithin will win the race.

③

$$v_{\text{athlete}} = 10 \text{ m/s}$$

$$v_{\text{bicycle}} = 20 \text{ m/min} = \frac{20 \text{ m}}{60 \text{ sec}} = \frac{1}{3} \text{ m/s}$$

$$v_{\text{scooter}} = 30 \text{ kmph} = 30 \times \frac{5}{18} = \frac{25}{3} = 8.33 \text{ m/s}$$

b, c, a.

⑥

$$(i) \quad u = 18 \text{ kmph} \quad v = 72 \text{ kmph} \quad t = 30 \text{ sec} = \frac{30}{3600} \text{ hr}$$

$$v - u = 72 - 18 = 54 \text{ kmph}$$

$$a = \frac{v - u}{t} = \frac{54 \times \frac{120}{3600}}{\frac{30}{3600}} = 54 \times 120 = 6480 \text{ kmh}^{-2}$$

(ii)

$$\text{Given } dv = 54 \text{ kmph} \quad t = 1 \text{ min} = \frac{1}{60} \text{ hr}$$

$$a = \frac{dv}{t} = \frac{54}{\frac{1}{60}} = 54 \times 60 = 3240 \text{ kmph}^2$$

(iii)

$$u = 108 \text{ kmph} \quad v = 36 \text{ kmph} \quad t = 4 \text{ s}$$

$$dv = v - u = -72 \text{ kmph} = -72 \times \frac{5}{18} = -20 \text{ m/s}$$

$$a = \frac{dv}{dt} = \frac{-20}{4} = -5 \text{ m/s}^2$$



(3)

(a)

$$u = 10 \text{ m/s}; v = 0 \text{ m/s}; t = 1 \text{ sec} \rightarrow a = \frac{v-u}{t} = \frac{0-10}{1} = -10 \text{ m/s}^2$$

(b)

$$u = 5 \text{ m/s}; v = 5 \text{ m/s}; t = 5 \text{ sec} \rightarrow a = \frac{v-u}{t} = \frac{5-5}{5} = 0 \text{ m/s}^2$$

(c)

$$u = 0 \text{ m/s}; v = 10 \text{ m/s}; t = 5 \text{ sec} \rightarrow a = \frac{v-u}{t} = \frac{10-0}{5} = 2 \text{ m/s}^2$$

(d)

$$u = 2 \text{ m/s}; v = 1 \text{ m/s}; t = 2 \text{ sec} \rightarrow a = \frac{v-u}{t} = \frac{1-2}{2} = -0.5 \text{ m/s}^2$$

(8)

$$u = 108 \text{ kmph}; v = 36 \text{ kmph}; t = 10 \text{ sec}$$

$$\Rightarrow v-u = 36-108 = -72 \text{ kmph} = -72 \times \frac{5}{18} = -20 \text{ m/s}$$

$$\text{acceleration} = \frac{v-u}{t} = \frac{-20}{10} = -2 \text{ m/s}^2$$

(9)

$$t = 2 \text{ min}; r = 120 \text{ m}$$

$$\text{half revolution} = \frac{1}{2} \times \text{Circumference}$$

$$= \frac{1}{2} \times 2\pi r = \pi r = \frac{22}{7} \times 120$$

$$\langle \text{speed} \rangle = \frac{\text{Total distance}}{\text{Total time}} = \frac{\frac{22}{7} \times 120}{2 \times 60}$$

$$= \frac{22}{7} = 3.14 \text{ m/s}$$

LTask CUQ'n

(8)

$$\text{Total distance} = 2 \text{ cm} + 1.5 \text{ cm} + 2.5 \text{ cm} + 3 \text{ cm} = 9 \text{ cm}$$

$$\text{Total time} = 4 \text{ sec}$$

$$\langle \text{speed} \rangle = \frac{\text{Total distance}}{\text{Total time}} = \frac{9}{4} = 2.25 \text{ cm/s} \\ = 2.25 \times 10^{-2} \text{ m/s}$$

(4)

$$t_1 = 1 \text{ hr}, d_1 = 40 \text{ km}$$

$$\text{speed}_1 = \frac{d_1}{t_1} = \frac{40}{1} = 40 \text{ kmph}$$

$$t_2 = 15 \text{ min} \quad ; \quad d_2 = 10 \text{ km} \\ = \frac{1}{4} \text{ hr}$$

$$\text{speed}_2 = \frac{d_2}{t_2} = \frac{10}{\frac{1}{4}} = 40 \text{ kmph}$$

$\therefore \text{speed}_1 = \text{speed}_2$ $\therefore$ uniform speed.

(10)

$$r = 200 \text{ m}; \quad t = 5 \text{ min} = 5 \times 60 \text{ sec}$$

$$\langle \text{speed} \rangle = \frac{\text{Total distance}}{\text{Total time}}$$

$$= \frac{\frac{1}{2} \times 2\pi r}{t} = \frac{2 \times \frac{22}{7} \times 200}{5 \times 60} = \frac{44}{3} \text{ m/s}$$

See main level

(1)

$$v_1 = 30 \text{ kmph}, \quad v_2 = 50 \text{ kmph}$$

$$\langle \text{speed} \rangle = \frac{2v_1v_2}{v_1 + v_2} = \frac{2 \times 30 \times 50}{30 + 50}$$

$$= \frac{2 \times 1500}{80} = \frac{150}{4} = 37.5 \text{ kmph}$$



(4)

$$u_1 = 80 \text{ kmph}, \quad u_2 = 40 \text{ kmph}$$

if a body covers $\frac{1}{2}$ of time with a speed u_1 and remaining $\frac{1}{2}$ of time with a speed u_2 .

$$\langle \text{speed} \rangle = \frac{u_1 + u_2}{2} = \frac{80 + 40}{2} = \frac{120}{2} = 60 \text{ kmph}$$

option $\rightarrow$ A.

(3)

$$u_1 = 20 \text{ kmph}, \quad u_2 = 60 \text{ kmph}$$

if the car cover first $\frac{1}{3}$ of distance with u_1 and $\frac{2}{3}$ of distance with u_2 $\langle \text{speed} \rangle = \frac{3 u_1 u_2}{u_2 + 2 u_1}$

$$\langle \text{speed} \rangle = \frac{3 \times 20 \times 60}{60 + 2 \times 20} = \frac{60 \times 60}{60 + 40} = \frac{3600}{100} = 36 \text{ kmph}$$

(4)

5)

$$u = 4 \text{ m/s} ; a = -2 \text{ m/s}^2$$

$$a = \frac{v-u}{t} \Rightarrow -2 = \frac{0-4}{t}$$

$$\Rightarrow -2 = \frac{-4}{t}$$

$$\Rightarrow t = 2 \text{ sec}$$

6)

$$u = 5 \text{ m/s to } v = 8 \text{ m/s in } t = 2 \text{ sec.}$$

$$a = \frac{v-u}{t} = \frac{8-5}{2} = \frac{3}{2} = 1.5 \text{ m/s}^2$$

7)

$$u_1 = 20 \text{ kmph} ; u_2 = 40 \text{ kmph}$$

$$\langle \text{speed} \rangle = \frac{2u_1 u_2}{u_1 + u_2} = \frac{2 \times 20 \times 40}{20 + 40}$$

$$= \frac{40 \times 40}{30} = \frac{80}{3} \text{ kmph}$$

8)

$$t_1 = 10 \text{ min}$$

$$t_2 = 20 \text{ min}, t_3 = 5 \text{ min}$$

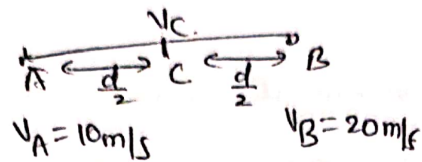
$$u_1 = 20(\hat{i} + \hat{j}) \text{ m/s} ; u_2 = 40(\hat{j}) \text{ m/s}$$

$$\langle \text{velocity} \rangle = \frac{u_1 t_1 + u_2 t_2}{t_1 + t_2 + t_3} = \frac{20\hat{i} \times 10 + 40\hat{j} \times 20}{10 + 20 + 5}$$

$$= \frac{200\hat{i} + 800\hat{j}}{35} = \frac{1000}{35} \hat{j} \text{ m/s}$$

$$= 28.57 \text{ m/s.}$$

(5)



$$v_c^2 - v_A^2 = 2a s_1 \quad ; \quad v_B^2 - v_c^2 = 2a s_2$$

$$\Rightarrow v_c^2 - v_A^2 = 2a \frac{d}{2} \rightarrow (1); \quad v_B^2 - v_c^2 = 2a \frac{d}{2} \rightarrow (2)$$

From (1) and (2)

$$\Rightarrow v_c^2 - v_A^2 = v_B^2 - v_c^2$$

$$\Rightarrow v_c^2 + v_c^2 = v_A^2 + v_B^2$$

$$\Rightarrow 2v_c^2 = v_A^2 + v_B^2$$

$$\Rightarrow v_c = \frac{1}{\sqrt{2}} \sqrt{v_A^2 + v_B^2} = \frac{1}{\sqrt{2}} \sqrt{10^2 + 20^2}$$

$$= 5\sqrt{10} \text{ m/s}$$

(10)

$$u = 36 \text{ kmph}; \quad v = 108 \text{ kmph} \quad t = \frac{1}{2} \text{ min} = 30 \text{ sec.}$$

$$v - u = 108 - 36 = 72 \text{ kmph} = 72 \times \frac{5}{18} = 20 \text{ m/s}$$

$$\text{Acceleration} = \frac{v - u}{t} = \frac{20}{30} = 0.66 \text{ m/s}^2$$

④

distance between the home and market = 2.5 km

total time = 40 min

speed = 5 kmph and 7.5 kmph

home → market time $t_1 = \frac{d}{v} = \frac{2.5}{5} = \frac{1}{2} \text{ hr} = 30 \text{ min}$

He returns back with a speed 7.5 kmph in rest of time that is 10 min. [out of 40 min, 30 min for home ^{distance} to market]

distance = speed × time = $7.5 \times \frac{10}{60} = 1.25 \text{ km}$

$$\text{speed} = \frac{\text{Total distance}}{\text{Total time}}$$

$$= \frac{2.5 + 1.25}{\left[\frac{40}{60}\right] \text{ hr}} = \frac{45}{8} = 5.625 \text{ kmph}$$

option D correct

Advanced

②

$u = 0$; $v = 75 \text{ kmph} = 75 \times \frac{5}{18}$; $t = 5 \text{ min} = 5 \times 60 = 300 \text{ s}$

$$\text{Acceleration} = \frac{v - u}{t} = \frac{75 \times \frac{5}{18} - 0}{300} = \frac{125}{6 \times 300} = \frac{5}{72} \text{ m/s}^2$$

$$\text{Distance} = v \times t = 75 \times \frac{5}{18} \times 300 = 6250$$

$$= 75 \times 5 \text{ min}$$

$$= 75 \times \frac{5}{60} \text{ km} = \frac{25}{4} \text{ km}$$

⑥

⑤, ⑥, ⑦

$$u=0; \quad a=0.5 \text{ m/s}^2; \quad v=54 \text{ kmph}$$

$$= 54 \times \frac{5}{18} = 15 \text{ m/s}$$

Time taken to reach ground is calculated

$$\text{from } v = u + at$$

$$\Rightarrow 15 = 0 + 0.5t$$

$$\Rightarrow 15 = \frac{1}{2}t \Rightarrow t = 30 \text{ sec}$$

$$\text{From } v = u + at \text{ after '5' sec}$$

$$\Rightarrow v = 0 + 0.5 \times 5$$

$$\Rightarrow v = 0 + 2.5 = 2.5 \text{ m/s}$$

$$\text{From } v = u + at \Rightarrow u = 0 + at$$

$$\Rightarrow u = at$$

$$\frac{u_{21}}{u_7} = \frac{a \times 21}{a \times 7} = \frac{3}{1}$$

⑧

$$u = 30 \text{ m/sec}; \quad v = 10 \text{ m/sec}; \quad t = 4 \text{ sec.}$$

$$\text{From } v = u + at$$

$$\Rightarrow 10 = 30 + a \times 4 \Rightarrow 4a = -20$$

$$\Rightarrow a = -5 \text{ m/s}^2$$



9

$$t_1 = \frac{1}{2} \text{ hr} = \frac{3}{2} \text{ hr} \quad x_1 = 0.25 \text{ miles}$$

$$t_2 = \frac{1}{2} \text{ hr} \rightarrow \quad x_2 = 0.2 \text{ miles}$$

$$\text{Average speed} = \frac{\text{Total distance}}{\text{Total time}} = \frac{x_1 + x_2}{t_1 + t_2}$$

$$= \frac{0.25 + 0.2}{\frac{3}{2} + \frac{1}{2}} = \frac{0.45}{2} = 0.225$$

$$= 0.45 \text{ mph.}$$