

2. Linear motion

1. Distance covered by Kinyua in $1\frac{2}{3}$ hrs

$$= 5 \times 90 = 150 \text{ km}$$

Distance traveled by Nyaboke during the rest = $(\frac{1}{3} \times 120) = 40 \text{ km}$

$$\frac{x}{90} = \frac{390 - x}{120} \Rightarrow 120x = 90(390 - x)$$

$$120x = 35100 - 90x$$

$$210x = 35100$$

$$x = 167.1 \text{ km}$$

$$\text{Time} = \frac{167.1}{90} = 1.86$$

$$90$$

$$8.33 + 1.86 = 10.19; \text{ they met at } = 10.11 \text{ a.m.}$$

$$580 - (150 + 167.1) = 262.9 \text{ km from M}$$

Before the rally driver started, Nyaboke had traveled for $1\frac{1}{2}$ hrs

$$(\frac{3}{2} \times 120) = 180 \text{ km}$$

$$\frac{x}{120} = \frac{x + 180}{80}$$

$$180x - 120x = 21600$$

$$x = 360 \text{ km}$$

$$\text{Distance from K} = 580 - (180 + 360)$$

$$x = 40 \text{ km}$$

$$\text{Time} = \frac{540}{180} = 3 \text{ hrs}$$

$$180$$

$$(9.30 + 3 \text{ hrs}) = 12.30 \text{ p.m.}$$

2. Distance covered by the car after 15 min = $(\frac{1}{4} \times 80) \text{ km} = 20 \text{ km}$

Distance covered together = 130 km

Relative speed = $(80 + 40) = 120 \text{ km/h}$

Time taken to meet

$$= \frac{130}{120} \text{ hrs}$$

$$120$$

$$= 1 \text{ hr } 5 \text{ min}$$

Time they met = 10:15 a.m. +

$$\frac{1:05}{11:20 \text{ a.m.}}$$

$$11:20 \text{ a.m.}$$

3. a) $\frac{1}{2} \times 50h + \frac{1}{2} \times 100h + 150h = 2700$

$$225h = 2700$$

$$H = \frac{2700}{225} = 12 \text{ m/s}$$

$$225$$

$$\text{Maximum speed} = \frac{12 \times 60 \times 60}{1000}$$

$$1000$$

$$= 43.2 \text{ km/h}$$

$$\text{b) Acceleration} = \frac{12}{50} \text{ m/s}$$

$$= \frac{6}{25} \text{ m/s}$$

$$\text{c) } \frac{1}{2} \times 50 \times 6$$

$$150 \text{ m}$$

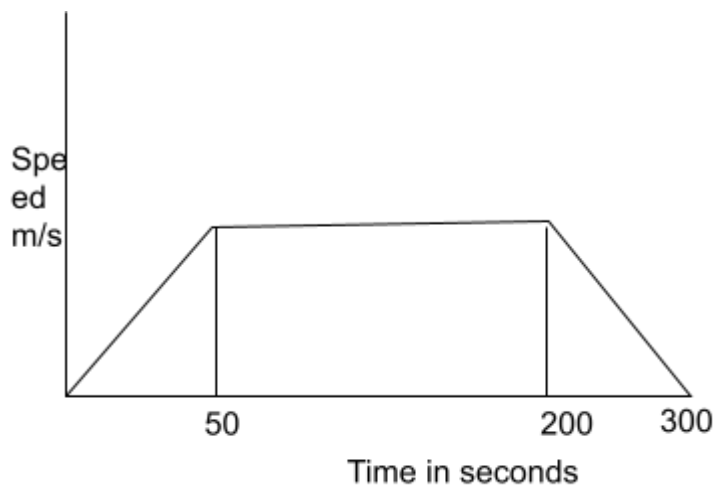
$$\text{d) Time for half of journey}$$

$$\frac{1}{2} \times 12(50 + t + t) = \frac{1}{2} \times 2700$$

$$6(50 + 2t) = \frac{1}{2} \times 2700$$

$$50 + 2t = 225$$

$$T = \frac{225 - 50}{2} = 87.5$$



2

$$\begin{aligned} \text{Total time} \\ = 50 + 87.5 = 137.5 \text{ sec} \end{aligned}$$

4. *Time taken at 10km*
 $= \frac{45}{10} = 4.5 \text{ hrs}$

Time taken at 15km/hr
 $\frac{45}{15} = 3 \text{ hrs}$

Total time taken $= (4.5 + 3) = 7.5$

$(4.5 + 3) = 7.5 \text{ hrs}$

Average speed

$= \frac{90}{7.5}$
 $= 12 \text{ km/hr}$

5. $D = \frac{5}{4} \times 80 + \frac{50}{1000}$

$= 100.05 \text{ km}$

Speed $= 120 - 80 = 40 \text{ km/h}$

$T = \frac{D}{S} = \frac{100.05}{40}$
 $= 2.50125 \text{ hours}$

(b) $D = S \times T = 120 + \frac{100.05}{4000} + \frac{199}{800}$
 $= \frac{120 \times 11000}{40000}$
 $= 330 \text{ km}$

(c) *Total time* $= \frac{330}{80}$

$= 4 \frac{1}{8} \text{ hrs}$

Time lapse $= 4 \frac{1}{8} - \frac{5}{4} + \frac{100.05}{40000} + \frac{199}{800}$

$= 4 \frac{1}{8} - 4$
 $= \frac{1}{8} \text{ hrs}$

6. a) *Distance traveled by bus before the matatu started off the journey is*

Distance $= \text{speed} \times \text{time}$

$= 60 \times 2 \frac{1}{2}$

$= 150 \text{ km}$

Relative speed $= 100 - 60 = 40 \text{ km/hr}$

The matatu would cover the bus head start of 150km in $150/40 \text{ hrs} = 3.75 \text{ hrs} = 3 \text{ hrs } 45 \text{ min}$

$\therefore$ *The matatu will overtake the bus after 3hrs 45 minutes*

This will be $1:15 + 3:45 = 5.00 \text{ pm}$

b) *Time taken by the matatu to complete the remaining 350km* $= 350/100 = 3 \frac{1}{2} \text{ hrs}$

$= 3 \text{ hours } 30 \text{ minutes}$

Time taken by the bus to complete the remaining 350

$$= \frac{350}{60} = 5\frac{5}{6} \text{ hrs} = 5 \text{ hours } 50 \text{ minutes}$$

Matatu waits for $5\text{hr } 50\text{min} - 3\text{hr } 30\text{min} = 2\text{ hrs } 20\text{ min}$

$$\begin{aligned} 7. \quad \text{Total distance} &= 100 + 140 + 150 = 490 \\ \text{Total speed} &= 88 + 164 = 252 \text{ km/hr} \\ 252 \text{ km/hr into m/h} &= \frac{252 \times 1000}{3600} = 70 \text{ m/h} \end{aligned}$$

$$\text{Time taken} = \frac{490}{70} = 7 \text{ sec}$$

$$\begin{aligned} 8. \quad \text{Distance} &= (5 + 15)\text{m} = 20\text{m} &= 0.02\text{km} \\ S \Rightarrow \text{Bus} &= 40 \text{ km/h} \\ \text{Trailer} &= x \text{ km/h} \\ \text{Relative speed} &= (40 - x) \text{ km/h} \\ T = 4.8 \text{ sec.} &= \frac{4.8\text{h}}{3600} \end{aligned}$$

$$S = \frac{D}{T}$$

$$\begin{aligned} (40 - x) &= \frac{0.02}{\frac{48}{3600}} \\ &= \frac{0.02 \times 3600}{48} \\ &= 15 \text{ km/h} \\ 40 - x &= 15 \\ x &= 25 \text{ km/h} \end{aligned}$$

$$9. \quad L.C.M = 2^4 \times 3^2 \times 5^3 = 1800$$

$$G.C.D. = 2 \times 3 \times 5^2 = 150$$

$$\begin{aligned} 10. \quad \text{Total distance} &= 60 \text{ cm} \\ \text{Total time taken} &= 3\frac{1}{5} \text{ hrs} \\ \text{Let speed in still water be } x \text{ km/h} \\ \text{Speed upstream} &= (x - 5) \text{ km/h} \\ \text{Speed downstream} &= (x + 5) \text{ km/h} \end{aligned}$$

$$\frac{30}{x - 5} + \frac{30}{x + 5} = \frac{16}{5}$$

$$30x - 150 + 30x + 150 = \frac{16}{5} (x^2 - 25)$$

$$300x = 16x^2 - 400$$

$$x = -\frac{5}{4} \text{ or } 20$$

$\therefore$ Speed in still water is 20 km/hr

$$\begin{aligned} 11. \quad \text{When David left, Ojwang had covered } 15 \times \frac{3}{2} &= 22.5 \text{ km.} \\ \text{a) (i) Remaining dist.} &= 40 - 22.5 = 17.5 \text{ km} \end{aligned}$$

$$\text{Relative speed} = 15 + 25 = 40 \text{ km/h}$$

$$\text{Time taken before meeting} = \frac{17.5}{40} = 0.4375 \text{ hrs}$$

$$\text{Ojwang covered } 15 \times 0.4375 = 6.5625 \text{ km}$$

$$\begin{aligned} \text{Distance from Ojwang's house} &= 22.5 + 6.5625 \checkmark \\ &= \underline{29.0625 \text{ km}} \end{aligned}$$

$$(ii) \quad 0.4375 = 26 \text{ min } 15 \text{ sec}$$

$$\begin{aligned} \therefore \text{They met at } 10.30 + 26.15 \\ = 10.56.15 \text{ am.} \end{aligned}$$

$$(iii) \quad 40 - 29.0625 \checkmark = \underline{10.9375 \text{ km}} \checkmark$$

$$b) \quad \text{Time take} = \frac{10.9375}{12} \checkmark = 0.9115 \text{ hrs}$$

$$= 54 \text{ min, } 41 \text{ sec.}$$

$$\begin{aligned} \text{They arrived at } 10.56.15 + 54.41 + 10 \text{ min} \\ = \underline{12.00.56 \text{ pm.}} \checkmark \end{aligned}$$

12. (a) In 10 minutes Kamau has travelled

$$\frac{10}{60} \times 24 = 4 \text{ km}$$

$$\text{Distance left} = 42 - 4 = 38 \text{ km}$$

$$\begin{aligned} \text{Relative speed} &= 24 + 50.4 \text{ km/hr} \\ &= 74.4 \text{ km/hr} \end{aligned}$$

$$\begin{aligned} \text{Time taken to meet} &= \frac{38}{74.4} = 0.5107 \text{ hrs} \\ &= 30.64 \text{ minutes} \end{aligned}$$

$$\text{Time for meeting is } 6.10$$

$$\begin{aligned} &\underline{30.64} \\ &6.40 \text{ a.m} \end{aligned}$$

$$\frac{30.64}{60} \times 50.4 = 25.56 \text{ km from R or } 16.44 \text{ from S}$$

(b) Kamau arrival time

$$\frac{42 \text{ km}}{24 \text{ km/hr}} = 1.75 \text{ hrs}$$

$$1 \text{ hr } 45 \text{ minutes}$$

$$6.00 \text{ a.m}$$

$$\underline{1.45}$$

$$7.45 \text{ a.m}$$

(c) Mrs Ronoh speed = $\frac{D}{T}$

$$= 50.4 \text{ km/hr}$$

$$\text{Twice} = 50.4 \times 2 = 100.8$$

$$7.00 \text{ a.m, Mr. Kamau covered} = 1 \times 24 = 24 \text{ km}$$

$$\text{Relative speed} = 100.8 - 24 = 76.8 \text{ km/hr}$$

$$\text{So } 24 = 8.75$$

76.8

He was overtaken at 7.00

$$+ 18.75$$

7.18am

At distance of $D = S \times t$

$$= \frac{100.8 \times 189.75}{60}$$

60

31.5km from S or 10.5km from R

13. i) A gains on B at the rate of $(72 - 56)$ Km/hr or 16km/h

$\therefore$ in 1 hr A gains on B 16km

In 545 A gains on B

$$\frac{16 \times 1000 \times 54}{60 \times 60} = 240$$

60 X 60

The sum of the lengths of the two trains is 240m but the length of the first train is 100m

The length of the second train is 140m

ii) Relative speed = $(72 + 56)$ km/h = 128km/hr

Distance between A and B decrease at the rate of 128km/hr

The distance decreases by 240m

$$\frac{60 \times 60 \times 240}{128 \times 1000} \text{ s} = \frac{27}{4} \text{ seconds}$$

$$= 6 \frac{3}{4} \text{ s}$$

14. (a) Time = $\frac{D}{S}$

S

$$= \frac{5}{x}$$

x hrs

(ii) Time = $\frac{7}{x+24}$ hrs

x + 24 hrs

$$(b) \frac{5}{x} - \frac{36}{60} = \frac{7}{x+24}$$

$$\frac{5}{x} - \frac{36}{60} = \frac{7}{x+24}$$

$$\frac{7}{x+24} = \frac{25-3x}{5x}$$

$$35x = 25x - 3x^2 + 600 - 72x$$

$$3x^2 + 82x - 600 = 0$$

$$(3x + 100)(x-6) = 0$$

$$x = \frac{-100}{3} \text{ or } 6$$

3

His speed = 6km/hr

(c) Time = $S \times T$

$$= \frac{5}{6} \times 60$$

6

$$= 50 \text{ mins}$$

15. a) Relative speed = 80 - 60

$$= 20 \text{ km/h}$$

$$\text{Time} = \frac{40}{20} \text{ hrs}$$

$$20 \\ = 2 \text{ hrs}$$

$$(b) 1.50 \text{ p.m.} = 13.50 \text{ hrs.} \\ \text{Time} = 13.50 + 2 = 15.50 \text{ hrs}$$

$$16. \quad (a) \text{ Nairobi} \quad 400\text{km} \quad \text{Kisumu} \\ \text{Speed} = 120\text{km/h} \\ \text{Distance} = 400\text{km} \\ \text{Time taken} = \frac{400}{120} = 10 = 3\text{hrs } 20\text{min} \\ 8.30 + 3\text{hrs } 20\text{min} = 11:50\text{a.m}$$

$$(b) \text{ at } 8.30\text{a.m distance covered by bus} = \frac{1}{2} \times 80 = 40\text{km} \\ \text{Dist. Left} = 360\text{km speed} = 200\text{km/h} \\ \text{Time taken} = \frac{360}{200} = 1\text{hr } 48\text{mins} \\ \text{They met at } 8:30 + 1\text{hr } 48\text{mins} \\ = 10:18\text{a.m}$$

$$(c) 8 - 10.18\text{a.m is } 2\text{hrs } 18\text{mins distance} = 2 \times 80 + \frac{18}{60} \times 80 \\ = 160 + 24\text{km} = 184\text{ from Nairobi}$$

$$(d) \text{ car arrived in Nairobi after } 3\text{hrs } 20\text{mins} \\ \text{Bus traveled a time of } 3\text{hrs } 20\text{mins} + 30\text{mins} \\ 3\text{hrs } 50\text{mins} \\ \text{Dist.} = 3 \times 80 + 50 \times 80 = 240 + 66 \frac{2}{3} \\ 60$$

$$\text{Distance from Kisumu} = 93 \frac{1}{3} \text{ km}$$

$$17. \quad \left. \begin{array}{l} \text{Total distance} = 25\text{m} \\ \text{Relative speed} = 54\text{km/hr} \\ \text{To m/s} = \left[\quad \quad \quad \right] = 15\text{ms} \end{array} \right\} \\ \text{Time they met} = \left[\quad \quad \quad \right] \\ = 1 \frac{2}{3} \text{ sec}$$