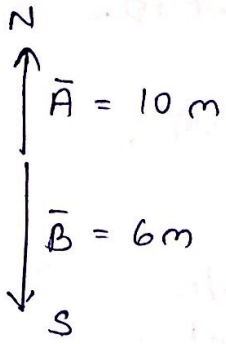
Level 1:

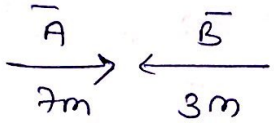
1) (d) light year is a unit of distance.

2) (a)

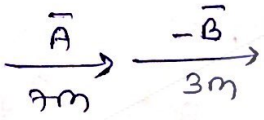
10 − 6 = 4m north



3) (b)



$\bar{R} = \bar{A} - \bar{B}$

$= \bar{A} + (-\bar{B})$ i.e. 

$= 10\ m$

4) (c)

speed	u	v
time	t/2	t/2
distance	$\frac{ut}{2}$	$\frac{vt}{2}$

total distance = $\frac{ut}{2} + \frac{vt}{2}$

$= \left(\frac{u}{2} + \frac{v}{2}\right)t$

$= \left(\frac{u+v}{2}\right)t$

total time = t

average speed = $\frac{\text{total distance}}{\text{total time}} = \frac{\left(\frac{u+v}{2}\right)t}{t} = \frac{u+v}{2}$

5) (b)

$u = 200\ m/s$, $a = 10\ m/s^2$, $v = ?$, $t = \frac{1}{4}\ min = 15\ s$

$v = u + at = 200 + 10 \times (15)$

$= 200 + 150$

$= 350\ m/s$

6) (d) zero displacement ~~for zero~~ when time is stopped.

7) (d) acceleration is a vector quantity. It can be positive, negative or zero.

8) (a) ~~For both~~ from the equation,

$$S = ut + \frac{1}{2}at^2$$

For rest or free fall, $u = 0$ m/s

$a = g$ m/s^2

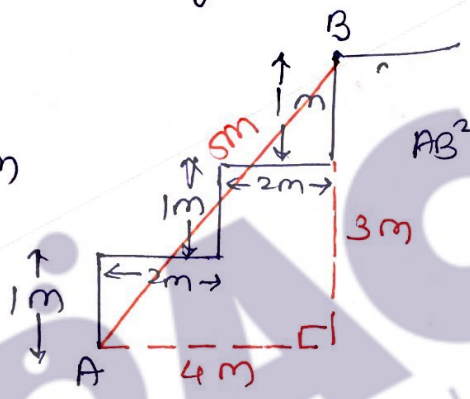
$$S = \frac{1}{2}gt^2$$

∴ time is independent of mass.

9) (a)

displacement = 5m

(By pythagoras theorem)



$AB^2 = 4^2 + 3^2$

$= 16 + 9$

$= 25$

$AB = 5$m

10) (c)

In 2min 20 seconds (140 seconds), athlete completes $3\frac{1}{2}$ rounds and reaches diametrically opposite end.

displacement = 2R

11) (c)

Speed is a scalar quantity as it is defined by using magnitude only.

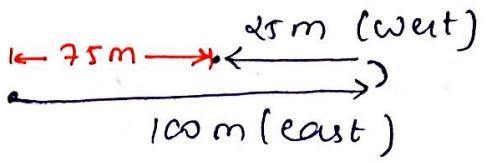
12) (a)

$u = 100$ m/s, $s = 100$ m, $v = 0$ m/s, $a = ?$

$v^2 = u^2 + 2as$; $(100)^2 = -2 \times a \times 100$; $-\frac{100 \times 100}{2 \times 100} = a$

$a = -50$ m/s^2 ; retardation = 50 m/s^2

13) (d)



distance = 125 m

displacement = 75 m (west)

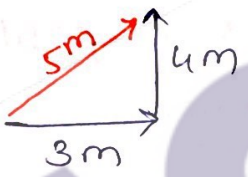
14) (a)

displacement is defined as shortest distance between initial and final position.

15) (d)

$$\text{Speed} = \frac{2 \times \pi \times 14}{11} = \frac{2 \times \frac{22}{7} \times 14^{2}}{11_{1}} = 8 \text{ m/s}$$

16) (a)



average velocity

$$= \frac{\text{total displacement}}{\text{time}}$$

$$= \frac{5}{10} = \frac{1}{2} = 0.5 \text{ m/s}$$

17) (b)

$$\text{velocity} = \frac{360}{1/2} = 720 \text{ km/hr} = 720 \times \frac{5}{18} = 200 \text{ m/s}$$

18) (a)

$$\text{Speed} = 100 \text{ km/hr} = \frac{100 \times 5}{18} \text{ m/s}$$

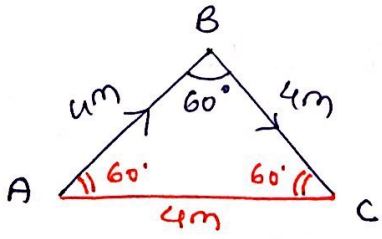
distance = 100 m

$$\text{time} = \frac{\text{distance}}{\text{speed}} = \frac{18}{5} = 3.6 \text{ s}$$

19) (b)

s denotes displacement.

20) (b)



21) (c)

acceleration is zero for uniform velocity.

22) (a)

$u = 0$ m/s

$t = 10$ s

$v = 36$ km/hr $= 36 \times \frac{5}{18} = 10$ m/s

$v = u + at$

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

23) (d)

Speed is a scalar quantity.

24) (b)

The minute hand is at the same position at 5.00 am and 2:00 am ie. zero displacement.

average velocity = 0 m/s

25) (a)

$$\text{average velocity} = \frac{v_1 t_1 + v_2 t_2}{t_1 + t_2}$$

velocity	v_1	v_2
time	t_1	t_2
displacement	$v_1 t_1$	$v_2 t_2$

26) (b)

velocity is a vector quantity. It can be positive, negative or zero.

27) (a)

distance $= 35 \times \frac{12}{60} = 7$ km

28) (d)

$$a = \frac{(50-20) \times \frac{5}{18}}{10} = 0.83 \text{ m/s}^2$$

29) (a)

$u = 0\ m/s,\ v = 3.2\ m/s,\ t = 2\ s$

$$a = \frac{v-u}{t} = \frac{3.2-0}{2} = 1.6\ m/s^2$$

$$v = u + at = 0 + 1.6 \times 5 = 8\ m/s$$

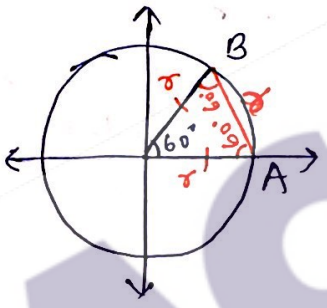
30) (b)

$u = 40\ m/s,\ v = ?,\ a = -10\ m/s^2,\ t = 2\ s$

$$v = 40 + (-10)(t) = 40 - 10 \times 2$$
$$= 40 - 20$$
$$= 20\ m/s$$

31) (b)

displacement = r



32) (c)

distance = 22 km

$\pi r = 22$

$\frac{22}{7} \times r = 22$

$r = 7$ km

displacement = $2r$

$= 2 \times 7$

$= 14$ km

$= 14000$ m

time = 200 s

$$\text{velocity} = \frac{14000}{200} = 70\ m/s$$

33) (b)

velocity of bicycle = $18\ km/hr = 18 \times \frac{5}{18} = 5\ m/s$

velocity of athlete = $7\ m/s$

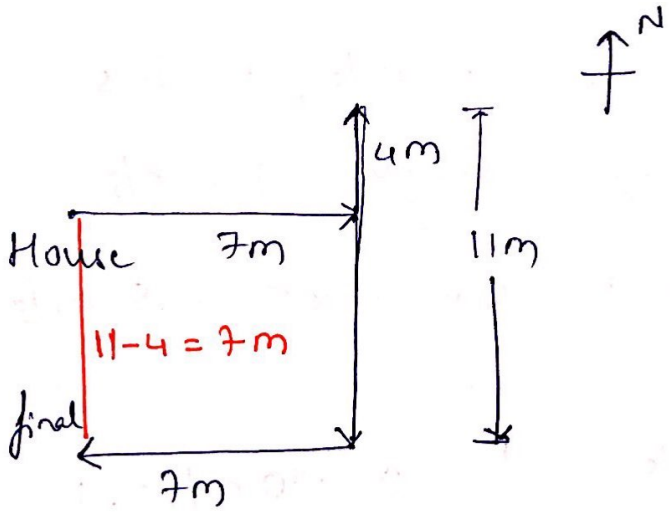
velocity of car = $2\ km/min = \frac{2000}{60} = 33.3\ m/s$

34) (d)

$u = 20\ m/s,\ a = 4\ m/s^2,\ t = 2\ s,\ v = ?$

$$v = u + at = 20 + 4 \times 2 = 20 + 8 = 28\ m/s$$

35) (a)



36) (C)

$U = 36$ km/hr

$V = 108$ km/hr

$t = 30$ s

$a = ?$

$$a = \frac{V-U}{t} = \frac{(108-36)}{30} \times \frac{5}{18}$$

$$= \frac{20}{30}$$

$$= \frac{2}{3} \text{ m/s}^2$$

Level II :

1) (a)

Let h be the height of the tower.

$u = 0$ m/s

$h = \frac{1}{2} g t^2 = \frac{1}{2} g x^2$ —①

Let t be time taken for $\frac{1}{4}h$ distance.

$$\frac{1}{4}h = \frac{1}{2} \times g t^2$$

$$\frac{1}{4}\left(\frac{1}{2} g x^2\right) = \frac{1}{2} g t^2$$

$$t^2 = \frac{x^2}{4}$$

$$t = \frac{x}{2}$$

2) (b)

$s = k$ m

$v = \frac{u}{2}$

$a = ?$

$v^2 = u^2 + 2as$

$\frac{u^2}{4} = u^2 + 2ak$

$2ak = -\frac{3}{4}u^2$

$\boxed{2a = -\frac{3}{4}\frac{u^2}{k}}$

$v = 0$ m/s

$s = ?$

$v^2 = u^2 + 2as$

$0 = u^2 + 2 \times a \times s$

$2as = -u^2$

$\left(-\frac{3}{4}\frac{u^2}{k}\right) s = -u^2$

$s = \frac{4k}{3}$

further distance

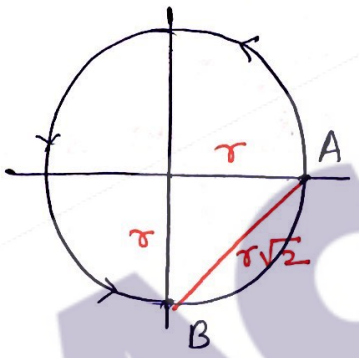
$= \frac{4}{3}k - k$

$= \frac{k}{3}$

3) (b)

displacement = $r\sqrt{2}$

(By pythagoras theorem)



distance = $\frac{3}{4} \times 2\pi r$

$= \frac{3}{2}\pi r$

4) (a)

average speed = $\frac{120}{1 + \frac{90}{x}}$

$60 = \frac{120}{1 + \frac{90}{x}}$

$1 + \frac{90}{x} = 2$

$\frac{90}{x} = 1$

$\boxed{90 = x}$

speed	30 km/hr	x
distance	30	90
time	$\frac{30}{30}$	$\frac{90}{x}$

5) (a)

Displacement in 14 s = (2 steps up i.e. 8-6) = 2m

For 10 m displacement,

time taken = $14 \times 5 = 70$ s

For next 8 m displacement, (8 steps upward)

time taken = 8 s

Total time taken = $70 + 8 = 78$ s

6) (c)

$$\text{time} = \frac{850+150}{45 \times \frac{5}{18}} = \frac{1000 \times 18}{45 \times 5} = 80 \text{ s}$$

7) (a)

$a = 4 \text{ m/s}^2$
$t = 10$ s
$u = 0$ m/s
$s = ?$

$s = ut + \frac{1}{2}at^2$

$= 0 + \frac{1}{2} \times 4 \times 10^2$

$= 200$ m

8) (d)

$v^2 \propto s$ $(\because v^2 = u^2 + 2as)$

$$\frac{s_2}{s_1} = \left(\frac{v_2}{v_1}\right)^2$$

$$\frac{s_2}{6} = \left(\frac{100}{50}\right)^2$$

$$\frac{s_2}{6} = 4$$

$$s_2 = 24 \text{ m}$$

9) (b)

10) (c)

11) (c)

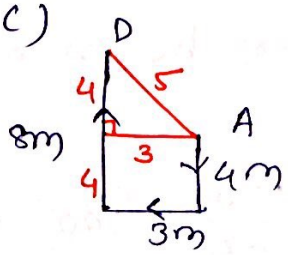
distance $= 0.50 \times \left(90 \times \frac{5}{18}\right) = 12.5$ m

Subjective Exercise

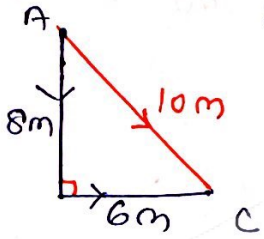
1) (a) distance = 15 m
displacement = 5 m (A to D)

(b) distance = 8 m
displacement = 4 m (A to C)

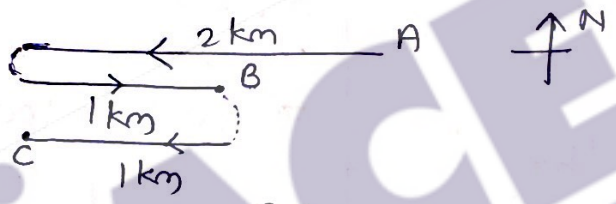
(c) distance = 15 m
displacement = 5 m



(d) distance = 14 m
displacement = 10 m

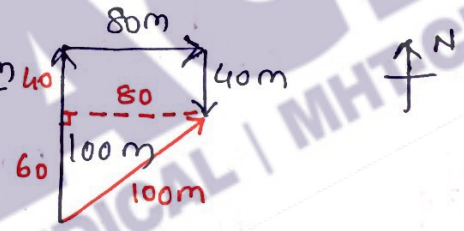


2) Displacement
= AC
= 2 km

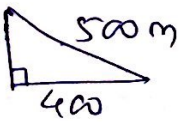


3) a) distance = 100 + 80 + 40 = 220 m

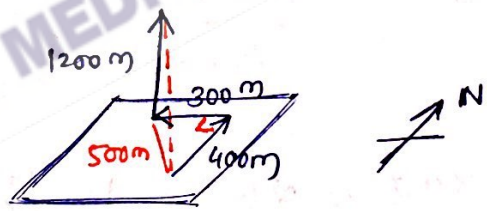
b) displacement = 100 m

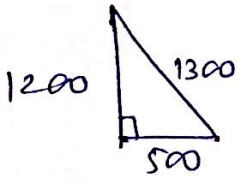


4) displacement = 1300 m



(base triangle)





(vertical triangle)

5) Yes, uniform velocity means same magnitude & direction.

6) No, as the direction is different.

7) velocity = $\frac{3.2}{20}$ = 0.16 km/min

= 0.16 × 60 = 9.6 km/hr

8)

velocity = 45 km/hr

(a) distance = $45 \times \frac{1}{60} = 0.75$ km

(b) distance = $45 \times \frac{1}{60 \times 60} = 0.0125$ km

9) Let speeds of the cars be x & y km/hr.

For opp. direction,

$$x + y = \frac{120}{1 + \frac{12}{60}} = \frac{120}{1.2} = 100 \quad \text{— (1)}$$

For same direction,

$$x - y = \frac{120}{6} = 20 \quad \text{— (2)}$$

Adding (1) & (2),

$2x = 120$

$\boxed{x = 60 \text{ km/hr}}$

Eq (1) becomes,

$x + y = 100$

$60 + y = 100$

$\boxed{y = 40 \text{ km/hr}}$

Speed of the cars are 60 km/hr & 40 km/hr.

10) average velocity

speed	40 km/hr	20 km/hr
distance	30 km	30 km
time	$\frac{30}{40}$	$\frac{30}{20}$

$$= \frac{60}{\frac{30}{40} + \frac{30 \times 2}{20 \times 2}}$$

$$= \frac{60}{\frac{30+60}{40}} = \frac{60 \times 40}{90} = 26.67 \text{ km/hr.}$$

11)

$$\text{average speed} = \frac{60 \times 0.52 + 30 \times 0.24 + 70 \times 0.71}{0.52 + 0.24 + 0.71}$$

$$= \frac{88.1}{1.47} = 59.93 \text{ km/hr}$$

12) For Jogger

$u = 0$ m/s
$v = 3$ m/s
$t = 2$ s
$a = ?$

$a = \frac{v-u}{t} = \frac{3-0}{2} = 1.5$ m/s^2

For car

$u = 38$ m/s
$v = 41$ m/s
$t = 2$ s

$a = \frac{v-u}{t} = \frac{41-38}{2} = \frac{3}{2} = 1.5$ m/s^2

13) $u = 36$ km/hr $= 36 \times \frac{5}{18} = 10$ m/s

$v = 108$ km/hr $= 108 \times \frac{5}{18} = 30$ m/s

$t = \frac{1}{2}$ min $= 30$ s

$a = \frac{v-u}{t} = \frac{30-10}{30} = \frac{20}{30} = \frac{2}{3}$ m/s^2

14) $u = 0$ m/s

$v = 108$ km/hr $= 108 \times \frac{5}{18} = 30$ m/s

$t = \frac{1}{2}$ min $= 30$ s

$a = \frac{v-u}{t} = \frac{30-0}{30} = 1$ m/s^2

15) $u = ?$
$v = 0$ m/s
$t = 20$ s
$a = -2$ m/s^2

$v = u + at$
$0 = u + (-2)(20)$
$\boxed{u = 40 \text{ m/s}}$

16) $u = 0$ m/s

$v = 36$ km/hr $= 36 \times \frac{5}{18} = 10$ m/s

$t = 10$ s

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

$a = 1$ m/s^2

17) 1st case

$u = 0\ m/s$

$v = 6\ m/s$

$t = 30\ s$

$a = \frac{v-u}{t}$

$= \frac{6-0}{30}$

$= \frac{6}{30} = \frac{1}{5} = 0.2\ m/s^2$

$\boxed{a = 0.2\ m/s^2}$

2nd case

$u = 6\ m/s$

$v = 4\ m/s$

$t = 5\ s$

$a = \frac{v-u}{t}$

$= \frac{4-6}{5}$

$= \frac{-2}{5} = -0.4$

$\boxed{a = -0.4\ m/s^2}$

18) $u = 0\ m/s$

$v = 72\ km/hr = 72 \times \frac{5}{18} = 20\ m/s$

$t = 5\ min = 5 \times 60 = 300\ s$

$a = \frac{v-u}{t} = \frac{20-0}{300} = \frac{20}{300} = \frac{1}{15}\ m/s^2$

$s = ut + \frac{1}{2}at^2$

$= 0 + \frac{1}{2} \times \frac{1}{15} \times (300)^2$

$\boxed{s = 3000\ m}$

19) $u = 18\ km/hr = 18 \times \frac{5}{18} = 5\ m/s$

$v = 36\ km/hr = 36 \times \frac{5}{18} = 10\ m/s$

$t = 5\ s$

$a = \frac{v-u}{t} = \frac{10-5}{5} = \frac{5}{5} = 1$

$\boxed{a = 1\ m/s^2}$