PRACTICE SHEET : LEVEL - 2 & 3

1. If a car covers 2/5th of the total distance with v_1 speed and 3/5th distance with v_2 then average speed is

1) $\frac{1}{2}\sqrt{v_1 v_2}$ 2) $\frac{v_1+v_2}{2}$ 3) $\frac{2v_1v_2}{v_1+v_2}$ 4) $\frac{5v_1v_2}{3v_1+2v_2}$

2. If a car covers first $\frac{2}{5}$ th of the total distance with a speed V_1 and the remaining $\frac{3}{5}$ th of the total distance with a speed V_2, then its average speed is

1) $\frac{1}{2}\sqrt{V_1V_2}$ 2) $\frac{5V_1V_2}{2V_1+3V_2}$ 3) $\frac{2V_1V_2}{V_1+V_2}$ 4) $\frac{5V_1V_2}{3V_1+2V_2}$

3. A particle covers half of its journey with a constant speed of 'v', half of the remaining part of journey with a constant speed of 2v and the rest of the journey with a constant speed of 4v. Its average speed during the entire journey is

1) 4v 2) 3v 3) $\frac{16}{11}$v 4) 11v

4. If a body travels around the circular path then which of the physical quntity may possess zero value

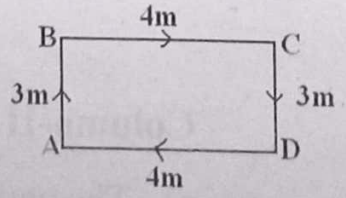
1) Speed 2) Velocity 3) Displacement 4) Accelaration

5. A body of mass m moving along a straight line covers half of the distance with a speed of 2 ms^{-1}. The remaining half of the distance is covered in two equal time intervals with a speed of 3 ms^{-1} and 5 ms-1 respectively. The average speed of the particle for the entire journey is _____

1) 3/8 ms^{-1} 2) 8/3 ms^{-1} 3) 4/3 ms^{-1} 4) 16/3 ms^{-1}

Matrix Match Type (M.M.T) :

A boy walks along rectangular path ABCD of length 4m & breadth 3m as shown in figure



7.

Coloumn-I		Coloumn-II
a) Along the path ABC, displacement Covered by a boy	( )	p) Zero
b) Along the path ABC, distance covered by a boy	( )	q) 5 m
c) Distance covered by a boy along the path ABCDA	( )	r) $3\sqrt{2}$
d) Displacement covered by along the path ABCDA	( )	s) 7m
		t) 14 m

20. Consider the motion of the tip of the hours hand of a clock. After 12 hours its____

1) Distance covered is zero
2) Displacement is zero
3) Average velocity is zero
4) Average speed is zero

21. A particle is projected vertically upwards with a velocity 'u' from a point O. Whe it returns to the point of projection

1) Its average velocity is zero
2) Its displacement is zero
3) Its average speed is zero
4) Its average speed is 2 u

Comprehension Type (C.T) :

In a car race, in a very busy road, a skilled driver has managed to drive his car wit a uniform velocity of 5 ms^{-1} for 10 minutes.

22. Average speed of the car in the first 2 minutes is

1) 2.5 ms^{-1}
2) 7.5 ms^{-1}
3) 10 ms^{-1}
4) 5 ms^{-1}

23. Speed of a car

1) Non uniform
2) Randomly varying
3) Increasing
4) Uniform

24. Average velocity of the car in the first 5 minutes is

1) 2.5 ms^{-1}
2) 7.5 ms^{-1}
3) 10 ms^{-1}
4) 5 ms^{-1}

Matrix Match Type (M.M.T) :

25.

Column-I		Column-II
a) Distance	( )	p) The path between two points
b) Displacement	( )	q) Displacement per time
c) Speed	( )	r) Distance/time
d) Velocity	( )	s) The shortest path between two points
		t) kmph

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3) Average velocity is zero
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		t) kmph

14. A train 60m long moving on a straight level track passes a pole in 5 sec. Find the speed of the train

1) 60 m/sec 2) 12 m/sec 3) 300 m/sec 4) 10 m/sec

15. A bus starting with a speed of 12 ms^{-1} slows down to 6 ms^{-1} in 3s. The average acceleration of the bus is

1) 2 ms^{-2} 2) 4 ms^{-2} 3) 3 ms^{-2} 4) –2 ms^{-2}

16. The speed of a body can never be

1) Positive 2) Negative 3) Zero 4) Both (1) & (2)

17. An athlete runs along a circular track of radius 14 m with a speed of 11ms^{-1} then the time taken by the athlete to complete 6 rounds is ____

1) 48 s 2) 0.8 min 3) 0.0133 hour 4) All of these

Assertion and Reason Type (A.R.T) :

18. ***Assertion*** : A body moving with uniform speed must have uniform velocity.

Reason : When a body travelling in straight line both speed and velocity have same magnitude.

1) Both assertion & reason are true, reason is the correct explanation of assertion

2) Both assertion & reason are true, reason is not the correct explanation of assertion

3) Assertion is true but reason is false

4) Assertion is false but reason is true

Multi Correct Answer Type (M.C.A.T) :

19. Consider the tip of the seconds hand whose length is 7cm after one revolution, the speed and velocity of seconds hand are

1) S=11/15 m/s 2) S=11/15 cm/s 3) $V = \frac{11}{15}$ cm/s 4) V=0

Single Correct Answer Type (S.C.A.T) :

6. The length of seconds hand of a clock is 8 cm. The speed of tip of seconds hand is
   1) 0.48 cm/s 2) 0.64 cm/s 3) 0.84 cm/s 4) 0.96 cm/s
7. A passenger in a moving train tosses a coin. If the coin falls behind him, the train must be moving with
   1) An acceleration 2) A retardation
   3) A uniform speed 4) A uniform velocity
8. Velocity of a particle changes
   1) Only when the direction of velocity changes
   2) Only when the magnitude of velocity changes
   3) When either the magnitude or direction or both change
   4) When the acceleration is zero
9. A train is 100m long and is moving with a speed of 72 kmph. The time taken by the train to cross a bridge of length 0.5 km is
   1) 25 s 2) 35 s 3) 30 s 4) 28 s
10. In one second a particle goes from a point A to another point B moving in a semi circle of radius one meter as shown in the figure. The average speed is

   1) 3.14 ms^{-1} 2) 2 ms^{-1} 3) 1 ms^{-1} 4) 0 ms^{-1}
11. If a body is moving along a circular track covering one complete round of 60 m in 10s. Then what is its average speed.
   1) 6 ms^{-1} 2) 3 ms^{-1} 3) 10 ms^{-1} 4) 5 ms^{-1}
12. If a cyclist takes one minute to complete half of the revolution on a circular path of 120 m radius, then the average velocity of the person is
   1) 1 ms^{-1} 2) 2 ms^{-1} 3) 3 ms^{-1} 4) 4 ms^{-1}
13. A body moves with a velocity of 10 ms^{-1} due East. After 10 minutes, it moves with a velocity of 5 ms^{-1} due West. The change in the velocity of the body during this time interval is
   1) 15 ms^{-1} due East 2) 5 ms^{-1} due East
   3) 5 ms^{-1} due West 4) 15 ms^{-1} due West

16. Physical quantities involved in motion

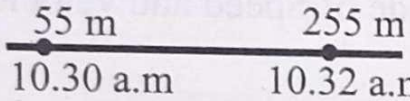
S.NO	NAME OF THE QUANTITY	S.I. UNIT	C.G.S. UNIT
1	Distance	m	cm
2	Displacement	m	cm
3	Speed	ms^{-1}	$cm\ s^{-1}$
4	Velocity	ms^{-1}	$cm\ s^{-1}$
5	Change of velocity	ms^{-1}	$cm\ s^{-1}$
6	Acceleration	ms^{-2}	$cm\ s^{-2}$
7	Retardation	ms^{-2}	$cm\ s^{-2}$

PRACTICE SHEET - 1

Conceptual Understanding Questions (C.U.Q) :

1. The rate of change of motion is called _____.

   1) Velocity 2) Speed 3) Distance 4) Acceleration

2. 

: The average speed of a body in the given diagram is

   1) 16.67 m/s 2) 1.67 m/s 3) 0.167 m/s 4) 166.7 m/s

3. The S.I. Unit of deceleration is

   1) m/s 2) m/s^2 3) m/s^3 4) All of these

4. When a body is moving along one direction, the magnitudes of velocity and speed are

   1) Same 2) Different

   3) independent to each other 4) None of these

5. Speed and velocity of a body travelling in curved line differ in

   1) Magnitude 2) Direction

   3) Units 4) Both (1) & (2)

Step 3: Let the change in velocity be $\Delta\vec{v}$

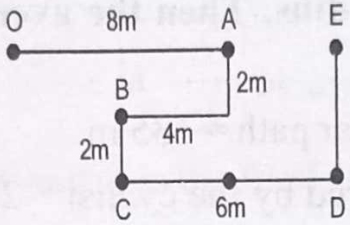
$$\Delta\vec{v} = (-80 \text{ kmph}) - (120 \text{ kmph}) = -200 \text{ kmph}$$

Step 4: Therefore the change in velocity of the train is 200 kmph towards West, because negative sign here indicates the opposite direction of East.

C.D.F POINTS (RELATED TO PRACTICE SHEET -2)

1. Basic unit of time is second.
2. Total distance covered per total time taken is called Average speed.
3. Speed of a particle at an instant is called instantaneous speed.
4. If a body covers equal distances in equal intervals of time is called uniform speed.
5. If the body covers unequal distances in equal intervals of time is called non uniform speed.
6. Whenever the particle is travelling with uniform speed, the average speed, instantaneous speed and uniform speed are equal.
7. If a body moves along a straight line then magnitude of Speed and velocity are equal.
8. Displacement per unit time is called velocity.
9. Velocity of a particle at an instant is called instantaneous velocity
10. If a body covers equal displacements in equal intervals of time is called uniform velocity.
11. If a body covers unequal displacements in equal intervals of time is called non uniform velocity
12. Whenever the particle is travelling with uniform velocity, the average velocity, instantaneous velocity and uniform velocity are equal.
13. The rate of change of velocity is called "Acceleration".
14. If the velocity of a body is decreasing with respect to time is called "Negative acceleration" or "Deceleration" or "Retardation".
15. The direction of velocity will be in the direction of change of velocity.

Example 5: The distance travelled by the particle in the following figure is _____



Solution : Distance travelled by the particle (OE)

$= OA + AB + BC + CD + DE$

$= 8 + (2 + 4) + 2 + 6 + (2 + 2)$

$= 8 + 6 + 2 + 6 + 4$

$= 26$ m

Example 6: A man runs at a constant speed on a circular path of radius 100 m and takes 1 min 20 s for every circular lap. The average speed of each circular lap is

Solution : Radius of the circular path = 140 m

Distance covered for one circular lap $= 2\pi r = 2 \times \frac{22}{7} \times 140 = 880$ m

Time taken for one circular lap = 1 min 20 s $= 1 \times 60 + 20 = 80$ s

As the man is running with constant speed, he will cover equal distance in equal interval of time.

$$\text{Average speed} = \frac{\text{Total distance}}{\text{Total time}} = \frac{880}{80} = 11\,\text{m/s}$$

Example7: A train in moving towards East with a velocity of 120 kmph. Its velocity is changed to 80 kmph towards west. Find the change in velocity of the train.

Solution : **Step 1:** Assume a direction towards East as positive

Step 2: The initial velocity of the train is $\vec{v}_i = +120$ kmph

The final velocity of the train is $\vec{v}_f = -80$ kmph

SOLVED EXAMPLES :

Example 2: A cyclist takes 30 sec to complete half of the revolution of a circular path of 135 m radius. Then the average velocity of the person is _____

Solution: Radius of the circular path = 135 m.

Displacement covered by the cyclist = $2r = 2 \times 135 = 270$ m

Time taken by the cyclist = 30 s

$$\text{Average velocity of the person} = \frac{\text{Total Displacement}}{\text{Total Time}}$$

$$= \frac{270}{30} = 9\,\text{m/s}$$

Example 3: A bus starting with a speed of 20 ms^{-1} slows down to 10 ms^{-1} in 2 s. Then the acceleration of the bus is _____

Solution: Initial speed of the bus (u) = 20 ms^{-1}

Final speed of the bus (v) = 10 ms^{-1}

Change in the magnitude of the velocity (speed) = v – u = (10 - 20)

= –10 ms^{-1}

$$\text{Acceleration of the bus (a)} = \frac{v-u}{t} = \frac{-10}{2} = -5\,ms^{-2}$$

Example 4: A train is 200 m long and is moving with a speed of 54 kmph. The time taken by the train to cross a bridge of 0.4 km length is _____

Solution : Length of the train = 200 m

Length of the bridge = 0.4 km = 400 m

Displacement of the train while crossing the bridge = 200 + 400 m

= 600 m

Speed of the train (Magnitude of velocity) = 54 kmph = $54 \times \frac{5}{18}$

= 15 m/s

We know that, velocity = $\frac{\text{Displacement}}{\text{Time}} = \frac{600}{15} = 40\,s$

ACCELERATION :

Rate of change of velocity is known as Acceleration.

$$\text{Acceleration} = \frac{\text{change in velocity}}{\text{time}} \qquad \boxed{\vec{a} = \frac{\Delta\vec{v}}{t}} \text{ or } \vec{a} = \frac{(\vec{v} - \vec{u})}{t}$$

Here, $\vec{u}$ is the initial velocity and $\vec{v}$ is the final velocity.

Acceleration is a vector quantity.

The direction of acceleration will be in the direction of change in velocity.

The dimensional formula of acceleration is $[M^0L^1T^{-2}]$.

Its SI unit is metre/second^2 abbreviated as m/s^2 (or) ms^{-2}

Average acceleration :

The average acceleration (a) of any object over a given interval of time (t) can be calculated using the equation $\vec{a}_{avg} = \frac{\vec{v}_2 - \vec{v}_1}{t_2 - t_1}$

Instantaneous acceleration :

The acceleration of the body at a particular instant of time is called its "Instantaneous acceleration". It is given by $a = \frac{dv}{dt}$

Uniform Acceleration or constant acceleration :

If the velocity of the body change by equal amounts in equal intervals of time, then it is said to be in uniform acceleration or constant acceleration. If the velocity of a uniformly accelerating body changes from u to v, then its acceleration is given by $a = \frac{v - u}{t}$ or $v = u + at$

Non-uniform acceleration :

If the velocity of the body changes by unequal amounts in equal intervals of time, then it is said to be in non-uniform acceleration or variable acceleration.

DECELERATION: (or) NEGATIVE ACCELERATION: If the speed of a particle decreases with time, we say that it is decelerating or it is under retardation. The acceleration of the body is opposite to that of velocity, and then the body decelerates.

SYNOPSIS - 4

CHANGE OF VELOCITY :

1. Velocity of a particle changes when

   i) Its magnitude is changed (or)

   ii) Its direction is changed (or)

   iii) Both magnitude and direction are changed.

2. Change in velocity $\Delta\vec{v} = \vec{v}_f - \vec{v}_i$ where $\vec{v}_f$ is final velocity $\vec{v}_i$ is initial velocity

3. Change in velocity is absolute in an inertial frame. So it does not depends on the observer.

SIGN CONVENTION REGARDING VELOCITY :

Step 1: Assume a direction as positive direction

Step 2: Write all the known quantities with proper signs

Step 3: Write the unknown quantity with positive sign

Step 4: Substitute the above values in the equation

SOLVED EXAMPLE:

Example 1: A car is moving towards East with a velocity of 20 ms^{-1}. Its velocity after 10 s is 40 ms^{-1} due East. Find the change in its velocity in this duration of 10s.

Solution : **Step 1:** Assume the direction towards East as positive

Step 2: The initial velocity of the car is $\vec{v}_i = +20\ ms^{-1}$.

The final velocity of the car is $\vec{v}_f = +40\ ms^{-1}$.

Step 3: Let the change in velocity be $\Delta\vec{v}$

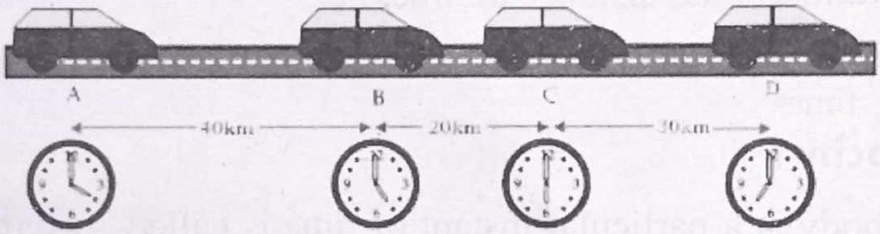
$$\Delta\vec{v} = +40\ ms^{-1} - \left(+20 ms^{-1}\right) = +20 ms^{-1}$$

Step 4: Therefore the change in velocity of the car is 20 ms^{-1} towards East, because the positive sign here indicates East direction.

We observe that the distance covered by the car during A to B is 30km and from B to C is also 30km. The time taken by the car from A to B is 1hour (5pm–4pm=1hour) and the time taken by the car from B to C is also 1hour (6pm –5pm). So we can say that the car covers equal displacements in equal intervals of time. Here the car is said to have **uniform velocity.**

NON-UNIFORM VELOCITY :

If a body covers unequal displacements in equal intervals of time (however small the time intervals may be), then the body is said to have non-uniform velocity or variable velocity.



We observe that the distance covered by the car during A to B is 40km, B to C is 20km and from C to D is 30 km. The time taken by the car from A to B is 1 hour (5.00pm– 4.00 pm = 1 hour), the time taken by the car from B to C is 1 hour (6.00pm– 5.00pm) and the time taken by the car from C to D is 1 hour (7.00pm – 6.00pm). We observe that the car covers unequal displacements in equal intervals of time (or equal displacements in unequal intervals of time). Here we say that the car is moving with ***non uniform velocity or variable velocity.***

NOTE: If the ratio of displacement travelled and time taken by a moving body is not constant, i.e., $\frac{\text{displacement}}{\text{time}} \neq$ constant , then we say that the body is moving with variable speed.