SCIENCE CLASS IX
CHAPTER-8 MOTION

Q.1. Give one condition for motion of a body to be uniform.

Ans. The body should travel alng a straight line path in one direction.

Q.2.Why is the motion of a circulating fan non-uniform?

Ans. The motion of a circular fan is non-uniform because the direction of motion changes at every point.

Q.3. A body accelerates uniformly so that its velocity changes for u to v. what will be its average velocity?

Ans. The average velocity is $\frac{u+v}{2}$.

Q.4. Odometer measures displacement of the vehicle. Correct this statement.

Ans. Odometer measures distance covered by a vehicle.

Q.5. What is the importance of referece point in stating motion?

Ans. Reference point is important state the position of object correctly as motion is relative in nature.

Q.6. How do we measure magnitude of displacement from a v-t curve?

Ans. By measuring area under v-t curve.

Q.7. Does the speedometer of a car measure its average speed?

Ans. No, the speedometer of a car does not measure its average speed. It measures only instantaneous speed.

Q.8. When is the acceleration taken as negative?

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Ans. Acceleration is taken as negative if it is in the direction opposite to the direction of velocity.

Q.9. What would be acceleration of a body if its velocity-time graph is a line parallel to the time axis?

Ans. Acceleration of a body is zero as the body possesses uniform velocity.

Q.10. Is the motion of a body uniform uniform or accelerated if it goes round the sun with constant speed in a circular orbit?

Ans. The motion of a body is accelerated as its velocity changes due to change in direction.

Q.11. A body is thrown vertically upward with velocity u, find the greatest height h to which it will rise.

Ans. Initial velocity = u, final velocity v = 0 (at greatest height velocity becomes zero)

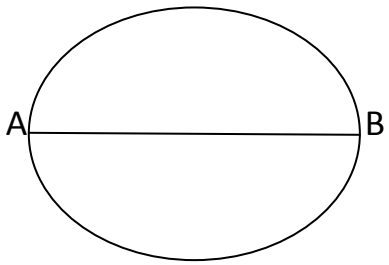
From third equation of motion under gravity

$$v^2 = u^2 - 2gh;\ 0 = u^2 - 2gh$$

$$h = \frac{u^2}{2g}$$

Q.12. A particle is moving in a circular path of radius r. what will be the displacement after half a circle?

Ans.



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After half the circle, the particle will reach the diametrically opposite point

i.e., from point A to point B

therefore Displacement after half circle = AB = r + r = 2r

Q.13. What may be the numerical ratio of displacement of distance for a moving object?

Ans. Displacement of an object can be less than or equal to the distance covered by the object, so the ratio of displacement to distance is always equal to or less than 1.

Q.14. If the displacement of an object is propotional to square of time, predict the motion of object.

Ans. From equation of motion

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

If object starts from rest i.e., u = 0

Then, $s = \frac{1}{2}at^2$

$S \propto t^2$, if a = constant.

Therefore the object moves with constant or uniform acceleration.

Q.15. Suppose a boy is enjoing a ride on a merry-go-round which is following with a constant speed of 10 ms^{-1}. What does it imply?

Ans. In merry-go-round, the speed is constant but velocity is not constant because its direction goes on changing i.e., there is acceleration in the motion. So, we can say that the boy is in accelerated motion.

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Q.16. Find the angular velocity of satellite which revolves in a circular orbit of radius 35000 km and completes one round in 12 h.

Ans. Angular velocity = $\frac{Angle\ subtended\ at\ centre}{Time\ taken}$

$= \frac{2\pi}{12} = \frac{\pi}{6}$ rad/h

Q.17. Suppose a ball is thrown vertically upwards from a position P above the ground. It rises to the highest point Q and returns to the same point P. What is the net displacement and distance travelled by the ball?

Ans. The net displacement is zero. The distance travelled by the ball is twice the distance between position P and Q.

.Q.18. What do you mean 5 m/s^2?

Ans. The velocity of the body increases by 5 m/s after every second.

Q.19. If the displacement of a body is zero, is it necessary that the distance covered by it is also zero?

Ans. No, When the body comes back to the same position after travelling a distance, its displacement is zero through it has travelled some distance.

Q.20. When do the distance and displacement of a moving object have the same magnitude?

Ans. The magnitude of distance and displacement of moving object are same when the object moves along the same straight line in the same fixed direction.

Q.21. How are the distance travelled by an object related to the time taken when an object travels equal distances in equal intervals of time?

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Ans. In this case, distance travelled by the object is directly propotional to the time taken.

Q.22. What indicates the motion of the earth?

Ans. The phenomenon like day and night indicate the motion of earth.

Q.23. Give an example when we infer the motion indirectly.

Ans. We infer the motion of air by observing the movement of dust particles or leaves and branches of trees, or simply by feeling the blowing air on our face.

Q.24. When is a body said to have uniform velocity?

Ans. Velocity of an object is uniform if it has equal displacements in equal intervals of time.

Q.25. A physical quantity measured is -10 m/s. is it a speed or velocity?

Ans. It is velocity because velocity can be positive, zero or negative while speed is always positive.

Q.26. What do you understand by rest and motion?

Ans. If a body does not change its position with respect to time and the surrounding, it is said to be rest and else it is said to be in motion.

Q.27. Give an example of indirectly perceivable motion.

Ans. We cannot see the air moving, but at the same time we can perceive the motion of air directly by observing the movement of dust, leaves and branches of trees, or simply by feeling the blowing air on our face, hands, etc.

Q.28. Give an example of a body which may appear to be moving for one person and stationary for the other.

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Ans. The passengers in a moving bus observe that the trees, buildings as well as the people on the roadside appear to be moving backwards. Similarly, a person standing on the roadside observe that the bus (along with its passengers) in moving in forward direction.

But, at the same time, each passenger in a moving bus or train observes, his fellow passengers sitting and not moving. Thus, we can tell that motion is relative.

Q.29. How can we describe the locating of an object?

Ans. To describe the position of an object we need to specify a reference point called the origin.

e.g., suppose that a library in a city is 2 km north of the railway station. We have specified the position of the library with respect to the railway station i.e., in this case, the railway station acts the reference point.

Q.30. Differentiate between distance and displacement.

Ans. Differences between distance and displacement are

S.No.	Distance	Displacement
1.	It is the length of the actual path by travelled object, irrespective of its direction of motion.	Displacement is the shortest distance between the initial and final positions of an object in a given direction.
2.	Distance is a scalar quantity	Displacement is a vector quantity.
3.	Distance covered can never be negative. It is always positive or zero.	Displacement may be positive, negative or zero.

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4.	Distance between two given ponts may be same or different for different path chosen.	Displacement between two given points is always the same. $\left(\frac{1}{2} \times 4\right)$

Q.31. What do you mean by average speed? What are its units?

Ans. It is defined as the ratio of the total distance travelled by an object to the total time taken. It is expressed as

Average speed = $\frac{Total\ distance\ travelled}{Total\ time\ taken}$

$= \frac{s_1+s_2+s_3+\ldots}{t_1+t_2+t_3+\ldots}$

Q.32. What is acceleration? How will you express it mathematically?

Ans. Acceleration is defined as the rate of change of velocity with time, i.e.,

Acceleration = $\frac{Change\ in\ velocity}{Time\ taken}$

$= \frac{(Final\ velocity - Initial\ velocity}{Time\ taken}$

If the velocity of a body changes from u to v in time t, then mathematically , acceleration , a is given by or a = $\frac{(v-u)}{t}$.

Q.33. A bridge is 500 m long. A 100 m long train crosses the bridge at a speed of 30 m/s. Find the time taken by train to cross it.

Ans. Total length of path covered by train

= 500m + 100m

= 600m

Speed of train = 30 m/s

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Time taken by train to cover the bridge

$$= \frac{Distance}{Speed} = \frac{600}{30} = 20s$$

Q.34. A car covers first 50 km at a uniform velocity of 45 km/h and the next 50 km at 90 km/h. Find the average velocity of the car.

Ans. Total displacement

= 50km + 50km

= 100 km

Total time = $\frac{50}{45}\ h\ + \frac{50}{90}\ h$

$= 50\left(\frac{1}{30}\right) = \frac{5}{3}$ h

$$\left(since\ Time = \frac{Distance}{Speed}\right)$$

Average velocity = $\frac{Total\ displacement}{Time\ taken}$

$= \frac{100}{5/3} = 60$ km/h.

Q.35. A train starts from rest and accelerates uniformly for 30 s to attain a velocity of 72 km/h. find its acceleration.

Ans. Given, Initial velocity, u = 0, Time taken t = 30 s,

Final velocity, v = 72km/h

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

Acceleration, a = $\frac{v-u}{t} = \frac{20-0}{30} = 0.67\ m/s^2$

Q.36. A bus retards uniformly at a rate of 3 m/s^2 and stops in 10 s. with what velocity was the bus travelling?

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Ans. Given, Final velocity v = 0, a = -3 m/s^2.

Time taken, t = 10s

From first equation of motion, we have

v = u + at

or u = v – at = 0 – (-3)(10)

= 30 m/s

Q.37. Velocity of a train changes from 20 m/s to 25 m/s^2. Find the distance covered by the train.

Ans. Initial velocity, u = 20 m/s,

Final velocity, v = 25 m/s,

Acceleration, a = 2 m/s^2

From second equation of motion

$v^2 - u^2 = 2as$

or $s = \frac{v^2-u^2}{2a}$

$= \frac{(25)^2-(20)^2}{2\times2} = 56.25$ m

Q.38. Suppose you go up a tower 80 m high and throw a ball horizontally with a velocity of 20m/s. What will be the shape of the path followed by the ball? While falling, the motion of the ball will be a combination of two independent motions. Name these motions.

Ans. The shape of the path followed by the ball is parabolic.

Vertical and downward motion due to gravitational acceleration. Horizontal motion due to zero acceleration.

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Q.39. A fan rotates at 100 rpm. Find its angular velocity and linear velocity if tip of its blades is 0.20 m away from the axis rotation.

Ans. w = 100 rpm = $100 \times \frac{2\pi}{60} = \frac{10\pi}{3}$ rad/s

r = 0.20 m

v = rw

$= 0.20 \times \frac{10\pi}{3} = \frac{2\pi}{3}$ rad/s

Q.40. How will the equations of motion for an object moving with a uniform velocity change?

Ans. Acceleration a = 0, v = u

So, the equations of motion will become

$s = ut$

$v^2 - u^2 = 0$

Q.41. When two bodies move uniformly towards each other the distance between them decreases by 8 m/s. If both the bodies move in the same direction with the same speeds, the distance between them increases by 4 m/s. what are the speed of two bodies?

Ans. Let u ad v be the speeds of two bodies

According to the question,

U + v = 8 an u – v = 4

Solving the above equations, we get

2u = 12

u = 6 m/s

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v = 8 – u = 8 – 6 = 2m/s

Q.42. Can an object be accelerated if it is moving with constant speed? Justify your answer with an example.

Or

Can a body have constant speed and still be accelerating? Give an example

Or

Explain how is it possible for an object to move with a constant speed but with uniform acceleration.

Ans. An object moving with constant speed can be accelerated if its direction of motion changes. For example, an object moving with a constant speed in a circular path has an acceleration because its direction of motion changes continuously.

Q.43. An object P is moving with a constant velocity for 5 min. Another object Q is moving with changing velocity for 5 min. out of these two objects, which one has acceleration. Explain.

Ans. Acceleration = $\frac{Change\ in\ velocity}{Time\ taken}$

Since, the velocity of object P is not changing or change in velocity of the object is zero, therefore, object P has no acceleration. On the other hand, there is change in velocity of the object Q, so it has acceleration.

Q.44. Two trains A and B start moving at the same time. The distances travelled by them in given intervals of time are shown below. State which train has uniform motion and which train has non- uniform motion.

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Time	Distance travelled by **train A** (in km)	Distance travelled by **train B** (in km)
6.00 pm	0	0
6.15 pm	10	15
6.30 pm	20	24
6.45 pm	30	32
7.00 pm	40	38
7.15 pm	50	42
7.30 pm	60	47

Ans. Since train A travels equal distances in equal intervals of time i.e., in every 15 min, so the motion of train A is uniform motion.

On the other hand, train B travels unequal distances in equal intervals of time i.e., in every 15 min, so the motion of train B is non-uniform motion.

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Q.45. A train accelerates uniformly from 36km/h to 72 km/h in 20 s. find the distance travelled.

Ans. Given, initial velocity, u = 36 km/h

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

Final velocity, v = 72 km/h = $72 \times \frac{5}{18} = 20$ m/s

and time, t = 20 s

Acceleration, a = $\frac{v-u}{t} = \frac{20-10}{20} = 0.5$ m/s^2

From third equation of motion, s = $\frac{v^2-u^2}{2a}$

$= \frac{(20)^2-(10)^2}{2 \times 0.5} = 300$m

Q.46. A car moves with a speed of 30 km/h for half an hour, 25 km/h for one hour and 40km/h for two hours. Calculate average speed of the car.

Ans. Time taken to travel, $t_1 = 0.5$ h,

$t_2 = 1$ h, $t_3 = 2$h

$t = t_1 + t_2 + t_3$

$= 0.5 + 1 + 2 = 3.5$ h

Speeds, $v_1 = 30$km/h, $v_2 = 25$km/h, $v_3 = 40$ km/h

Distances, $s_1 = v_1 \times t_1 = 30 \times 0.5 = 15$ km

$s_2 = v_2t_2 = 25 \times 1 = 25$ km

$s_3 = v_3t_3 = 40 \times 2 = 80$ km

$s = s_1 + s_2 + s_3$

$= 15 + 25 + 80 = 120$ km

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

$= \frac{s}{t} = \frac{120}{3.5}$ = 34.3 km/h

Q.47. State three equations of motion. Which of them describes

(i) velocity – time relation?

(ii) Positon – time relation?

Ans. For a body moving along a straight line at velocity u and accelerating uniformly at a for time t to attain a velocity v and cover displacement s.

First equation v = u + at

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

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

(i) First equation represents velocity-time relation.

(ii) Second equation represents position-time relation.

Q.48. The brakes applied to a car produce an acceleration of 6 m/s^2 in the opposite direction to the motion. If the car takes 2 s to stop after the application of brakes, calculate the distance it travels during this time.

Ans. Final velocity, v = 0

(therefore car stops after applying the brakes)

a = - 6 m/s^2, t = 2 s

From first equation of v = u + at

Or u = v – at = 0 = (- 6) (2) = 12 m/s

$s = ut + \frac{1}{2}at^2 = (12)(2) + \frac{1}{2}(-6)(2)^2$

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Q.49. A train travels at a speed of 60 km/h for 0.5 h, 24 km/h for next 0.25 h and then at 72 km/h for the next 0.75 h. Calculate the distance travelled by train and its average speed.

Ans. Total time = 0.5 h + 0.25 h + 0.75 h = 1.5 h

Total distance = $v_1t_1 + v_2t_2 + v_3t_3$

= (60) (0.5) + (24) (0.25)

+ (72) (0.75)

= 90 km

Average speed = $\frac{Total\ distance}{Total\ time} = \frac{90\ km}{1.5\ h}$ = 60 km/h

Q.50. How will the equations of motion for an object moving with a uniform velocity change?

Ans. For a body moving with uniform velocity.

Acceleration, a = 0, v = u

So, the equation of motion will become

$s = ut$

$v^2 - u^2 = 0$

$v = u$

Q.51. Express average velocity when the velocity of a body changes at a non-uniform rate and a uniform rate.

Ans. When the velocity of a body changes at a non-uniform rate, its average fvelocity is found by dividing the net displacement covered by the total time taken.

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i.e., Average velocity = $\frac{Net\ displacement}{Total\ time\ taken}$

In case the velocity of a body changes at a uniform rate, then the average velocity is given the arithmetic mean if initial velocity and final velocity for a given period of time.

i.e., Average velocity = $\frac{Initial\ velocity + final\ velocity}{2}$

Q.52. An object is moving with uniform speed in a circle of radius r. Calculate the distance and displacement (i) when it completes half the circle (ii) when it completes full circle (iii) what type of motion does the object possess?

Ans. (i) When an object completes half the circle, the distance travelled by an object

$= \frac{1}{2} \times$ circumference of a circle

$= \frac{1}{2} \times 2\pi r = \pi r$

Displacement of an object = 2r

(ii) When an object completes full circle, then

Distance travelled by an object = $2\pi r$

Displacement travelled by an object = 0

[therefore initial and final position are same]

(iii) direction of motion of an object changes continuously in the circle, hence its velocity changes and its motion is accelerated motion.

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Q.53. An electron moving with a velocity of 5×10^4 m/s enters into a uniform electric field and acquires a uniform accelerations of 10^4 m/s^2 in the direction of its initial motion.

(i) Calculated the time in which the electron would acquire a velocity double of its initial velocity.

(ii) How much distance the electron would cover in this time?

Ans. Given, $u = 5 \times 10^4$ m/s, $a = 10^4$ m/s^2

(i) Final velocity,

$$v = 2u = 2 \times 5 \times 10^4 = 10^5 \text{ m/s}$$

$$v = u + at$$

$$t = \frac{v-u}{a} = \frac{10^5 - 5 \times 10^4}{10^4}$$

$$= \frac{10^4(10-5)}{10^4} = 5\text{s}$$

(ii) Distance $s = ut + \frac{1}{2}at^2$

$$= 5 \times 10^4 \times 5 + \frac{1}{2} \times 10^4 \times (5)^2$$

$$= 25 \times 10^4 + \frac{25}{2} \times 10^4 \text{ m}$$

$$= 37.5 \times 10^4 \text{ m}$$

Q.54. A particle having initial velocity u is moving with a constant acceleration a for a time t.

(i) Find the displacement of the particle in the last 1 s.

(ii) Evaluate for u = 2 m/s , a = 1 m/s^2 and t = 5 s.

Ans. (i) Displacement of a particle at time t,

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

At time (t-1), displacement of a particle

$s' = u \pm (-1) + \frac{1}{2}a(t-1)^2$

therefore Displacement in the last 1 s is $s_t = s - s'$

$= ut + \frac{1}{2}at^2 - \left[u(t-1) + \frac{1}{2}a(t-1)^2\right]$

$= ut + \frac{1}{2}at^2 - ut + u - \frac{1}{2}a(t-1)^2$

$= \frac{1}{2}at^2 + u - \frac{1}{2}at^2 \frac{-a}{2} + at$

$= u + \frac{a}{2}(2t-1)$

(iii) At u = 2 m/s, a = 1 m/s^2 , t = 5 s

$s = 2 + \frac{1}{2}(10-1) = 2 + 4.5 = 6.5$ m

Q.55. Position of a particle moving along x- axis is given by $x = 3t - 4t^2 + t^3$, where x is in metres and t in seconds.

(i) Find the position of the particle at t = 2 s.

(ii) Find the displacement of the particle in the time interval from t = 0 to t = 4 s.

(iii) Find the average velocity of the particle in the time interval from t = 2s to t = 4 s.

Ans. (i) Position of a particle at t = 2, then

$x(2) = 3 \times 2 - 4 \times (2)^2 + (2)^3$

$= 6 - 4 \times 4 + 8 = -2$ m

(ii) At, t = 0, x(0) = 0

$x(4) = 3 \times 4 - 4 \times (4)^2 + (4)^3 = 12$m

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displacement = x(4) – x(0) = 12 m

(iii) $V_{av} = \frac{x(4)-x(2)}{4-2} = \frac{12-(-2)}{2} = 7$ m/s

Q.56. Manish was travelling from delhi to jaipur by his car for a meeting. He had to reach the destination in the given time. So he kept a track of the odometer and his watch all through the journey to decide upon his speed. This helps him to reach on time for the meeting.

(i) What measuring devices were used by Manish?

(ii) What qualities of Manish are worth appreciating?

(iii) Why did Manish measure the distance and time?

Ans.(i) Odometer (to measure distance) and his wrist watch (to measure time).

(ii) Manish is punctual, sincere, logical and self composed.

(iii) Manish measure distance and time because this would help him to maintain appropriate average speed throughout his journey.

Q.57. Ravi is very fond of fast driving. His sister Veena keeps telling him the hazards of speed on road. Ravi, however does not want to pay need to her device and never listens to her. Veena convinces him by narrating incidents of hazards caused by over speeding vehicles and tells him time and again, not to drive fast. Ravi is still reluctant to understand.

(i) Which values of Veena should be applauded?

(ii) Elaborate upon Ravi's values?

(iii) As a concerned neighbor, what suggestion would you give to Ravi's father to alert any unpleasant consequence?

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Ans. (i) Veena is a sensible, considerable, convicting and responsible girl.

(ii) Ravi is stubborn, immature and hard headed.

(iii) I would ask his father not to give car to Ravi till he is sensible enough to drive safely.

Q.58. Raman and his sister Saniya go to school together in their car. Raman drives much faster than Saniya. Saniya tells Raman not to take the risk of over speeding. She tells him that time taken to reach the school would depend upon average speed. By overspeeding for a little while, the risk involved is much greater compared to the little time saved.

(i) Which values are displayed by Saniya?

(ii) Is Saniya right in her statement?

(iii) How do you define average speed?

Ans. (i) Saniya is displaying safety concerns for her brother Raman in particular and all drivers in general.

(ii) Yes, Saniya statement is perfectly right.

(iii) It is defined as the ratio of the total distance travelled by an object to the total time taken.

Q.59. Mehak was removing through the city roads towards her school by a car. She recorded the odometer reading of the car after every five minutes and plotted a graph for distance versus time.

She then inferred about the type of motion and found average speed from the graph.

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(i) Which qualities of Mehak are worth mentioning?

(ii) What type of motion would she have inferred?

(iii) How is average speed calculated from the graph?

Ans. (i) Mehak is practicle, alert and skillful.

(ii) She inferred non-uniform motion.

(iii) Average speed = Slope of graph from initial time to final time interval.

Q.60. Shikhaj and sharman went to Mathura through Yamuna-Expressway. Shikhaj started the car was running at 108 km/h within 10 seconds. Sharman stopped him from doing so and told him that overspeeding on road was a straight invitation to life staking situation. Though shikhaj wanted the adventure of speeding, but he was convinced by Sharman.

(i) Why do you think it is dangerous to drive on road?

(ii) Which values of Sharman are worth appreciating?

(iii) What is the acceleration of the car?

Ans. (i) Accidents occurring with fast moving vehicles are dangerous and might be fatal.

(ii) Sharman is caring, concerned, responsible and convincing.

(iii) a = $\frac{v-u}{t}$ = $\frac{30-0}{10}$ = 3 m/s

[therefore v = 108 km/h = 108 × $\frac{5}{18}$ = 6 m/s]

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