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Class: 9
Subject: Physics
Topic: Motion in a straight line
No. of Questions: 20

Q1. In a circular track (distance 400 m) an athlete runs 1/4 the of the ground. So what would be the displacement?

Ans. Given, length of the circular track = 400m. Since the athlete runs ¼ of the circular track the distance covered by the athlete is 100m. The displacement is the shortest distance between the initial and final position, therefore, displacement in above question is length of the straight line AB as given in the diagram below. To calculate length of the line AB we need to first calculate the radius of the circular track.

Now, Length of track = 2 πR

400 = 2 πR

R = 200/π

Now, In right triangle OAB; $AB^2 = OA^2 + OB^2$

$AB^2 = R^2 + R^2 = \sqrt{(\frac{200}{\pi})^2 + (\frac{200}{\pi})^2}$ = 90.06 m approx.

Q2. A train travels 40 km at a uniform speed of 30 km/hr. its average speed after travelling another 40 km is 45 km/hr for the whole journey. It's speed in the second half of the journey is ?

Ans. Suppose speed of the train in second half be v km/hr; total distance travelled by the train = 80 km

Total time taken t = $\frac{distance}{average\ speed} = \frac{80}{45} = \frac{16}{9} hrs$

Time taken to cover first half, $t_1 = \frac{40}{30}\ hrs = \frac{4}{3} hrs$

Time taken to cover second half, $t_2 = \frac{40}{v} hrs$

Now, $T_1 + T_2 = T \Rightarrow \frac{4}{3} + \frac{40}{v} = \frac{16}{9} \Rightarrow v = 90 km/h$

Thus the speed to travel second - half = 90km/hr

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Q3. A motorcyclist drives from a to b with the uniform speed of 30 km/h^{-1} and returns back with the speed of 20 km/h^{-1}.find the average speed?

Ans. Given: speed to travel from point a to b = 30km/hr; speed of return journey = 20 km/hr let distance between a and b is x km so, total distance covered = 2x km total time = $t_1 + t_2 = \frac{x}{30} + \frac{x}{20} = \frac{50x}{600}$

Average speed = total distance/ total time = $\frac{2x}{\frac{50x}{600}}$ = 25 km/h

Q4. A Cheetah is the fastest land animal and it can achieve a peak velocity of 100 km per hour up to distance less than 500 metres. If the cheetah spots his prey at a distance of 100 metres what is the minimum time it will take to get its prey?

Ans. if the cheetah spots the prey at its speed, the cheetah will hunt down the prey with the speed of 100 km/h. = 27.7 m/s now, speed = d/t ⇒ time = d/s =100/27.7 = 3.6 sec. so, the minimum time the cheetah will take to get the prey is 3.6 s.

Q5. A police jeep is chasing with velocity of 45 km/h. A thief in another jeep moving with a velocity of 153 km/h. police fires a bullet with muzzle velocity of 180 m/s. the velocity it will strike the car of the thief is ___?

Ans: Given: Velocity of police jeep =45km/hr = 12.5 m/s Velocity of thief's jeep = 153 km/hr = 42.5 m/s Velocity of bullet = 180 m/s Now, since bullet is fired from police jeep which is going at 42.5 m/s, Therefore, velocity of bullet is (180+12.5) = 192.5m/s. To calculate velocity with which bullet will hit the thief we use concept of relative velocity.

Therefore, we have $V_{BT} = V_B - V_T$ Here V_B is velocity of bullet and V_T is velocity of thief V_{BT} = 192.5m/s - 42.5 m/s = 150m/s

Q6. A car moves with a speed of 30km/h for half an hour; 25km/h for 1 hr and 40km/hr for 2 hrs. Find average speed.

Ans. Distance travelled with a speed of 30km/h for half an hour = 30km/h x1/2hr = 15km

Distance travelled with a speed of 25km/h for an hour = 25km/h x1hr =25 km

Distance travelled with a speed of 40km/h for an hour = 25km/h x1hr =25km

Average speed = $\frac{total\ distance}{total\ time} = \frac{(15+25+80)km}{\left(\frac{1}{2}+1+2\right)hrs} = \frac{120km}{\frac{3}{2}hrs}$ = 80km/h

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Q7. If a car travels first 40km at speed of 20km/h and next 80km at a speed of 40km/h. what is the average speed of cat during journey?

Ans. Average speed = $\frac{total\ distance}{total\ time} = \frac{(40+80)km}{\left(\frac{40}{20}+\frac{80}{40}\right)hrs} = \frac{120km}{4hrs} = 30km/h$

Q8. On a 120 km long track, a train travels the first 30 km at a speed of 30 km/h. how fast train travel the next 90 km so that average speed would be 60 km/h?

Ans. Let train travel the next 90 km at speed of x km/h, average speed given = 60km/h

Average speed = $\frac{total\ distance}{total\ time} = \frac{(30+90)km}{\left(\frac{30}{30}+\frac{90}{x}\right)hrs} = \frac{120km}{1+\frac{90}{x}} \Rightarrow$ 60km/h = $\frac{120x}{x+90} \Rightarrow$ 6000x+540=120x $\Rightarrow$ 540/60 $\Rightarrow$ x = 90km/hr

Q9. An object covers half the distance with the speed of 20m/s and other half with a speed of 30m/find average speed?

Ans. Let S be the total distance traveled by the object. It covers (S/2) with speed 20 m/s. Time taken to cover this (S/2) is = (S/2)/20 = S/40 It covers the other (S/2) with speed 30 m/s. Time taken to cover this (S/2) is = (S/2)/30 = S/60 Average speed = Total distance/Total time = (S/2 + S/2)/(S/40 + S/60) = 24 m/s

Q10. A 150 metres long train crosses a man walking at the speed of 6km/h in the opposite direction in 6 seconds. The speed of the train in km/h is how much?

Ans. Let 'v' be the speed of the train with respect to the ground. The velocity of the man with respect to ground is (-6) km/h (negative sign is included because the man and the train are moving in opposite directions).

So, the velocity of the man to cross the 0.15 km train is = 6 s = (6/3600)h

Time taken by the man to cross the 0.15 km train is = 6 s = (6/3600)h

Using, distance = speed x time $\Rightarrow$ 0.15 = (v+6) x (6/3600) $\Rightarrow$ v = 84 km/h

So, the speed of the train is 84 km/h

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Q11. The velocity of a car in 10 sec. changes from 10 m/s to 50 m/s. what will be its acceleration?

Ans. a = $\frac{v-u}{t} \Rightarrow$ a = $\frac{50-10}{10} = 4m/s^2$

Q12. A train acquires velocity of 80km/h in just half an hour after start. Find its acceleration?

Ans. u = 0m/s; v = 80 x $\frac{1000}{3600}\ m/s = \frac{800}{36} m/s$ a = $\frac{v-u}{t} \Rightarrow$ a = $\frac{\frac{800}{36} m/s}{\frac{1}{2} x 3600} = 0.12\ m/s^2$

Q13. A car is travelling at 20 m/s along a road. A child runs out into the road 50 m ahead and the car driver steps on the brake pedal. What must the car's deceleration be if the car is to stop just before it reaches the child?

Ans. u = 20m/s; s =50 m v= 0 m/s using, 2as = v^2-$u^2 \Rightarrow$ a = $\frac{v2-u2}{2s} = \frac{(0-20^2)}{2x50}$ = 4 m/s^2 acceleration = -4 m/s^2 or, retardation = 4 m/s^2

Q14. A car is travelling along the road with 8m/s. it accelerates at 1m/s^2 for a distance of 18 m. How fast is it travelling?

Ans. Applying; $v^2 = u^2 + 2as \Rightarrow v^2 = 64 + 2x8 \Rightarrow v^2 = 100$ so, v = 10m/s

Q15. Stone dropped in a well hits water surface after 2 sec. What is the depth of well and with what speed will the stone hit water surface?

Ans. a = -g = -9.8 m/s^2; t = 2 sec; u = 0 m/s: using s = u t + $\frac{1}{2}at^2$ you get s = - 19 m or simply = 19 m using, $v^2 = u^2 + 2as$ you get v = 19.6m/s

Q16. Q. A ball hits a wall horizontally at 6m/s. it rebounds horizontally at 4.4m/s. The ball is in contact with the wall for 0.04 s. What is the acceleration of the ball?

Ans. u = 6m/s v=4.4m/s = 0.04sec. Using a = $\frac{v-u}{t}$ = $\frac{4.4-6}{0.04}$= - 40m/s^2

Q17. A train starting from rest move with uniform acceleration of 0.2m/s^2 for 5 min. Calculate the speed acquired and the distance travelled in this time?

Ans. u=0m/s a=0.2m/s^2 t=5 min, =300s using, s = s = u t + $\frac{1}{2}$ $at^2 \Rightarrow$ s=0 + 1/2x 0.2x $(300)^2$ = 0+900=900m

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Using, $v^2 = u^2 + 2as$ you get v = 60m/s

Q18. A car acquires a velocity of 180 km/h in 20 sec starting from rest find, a) acceleration, b) average velocity, c) the distance travelled in this time

Ans. At first we have to change speed in m/s, s = 180 km/hr =50 m/hr ;

Given, u = 0m/s, v=50 m/s, t = 20 s using $a = \frac{v-u}{t}$ we get, a = 50 /20 = 2.5 m/s^2

(b) Average velocity = $\frac{v+u}{2}$ = 50/2 ⇒ 25 m/s^2

(c) Distance (s) = $ut + \frac{1}{2}at^2 = 0 + 1/2\ at^2 = ½ \times 2.5(20)^2$ we get, S = 500 m

Q19. Stones are thrown vertically upwards simultaneously with their initial velocities $u_1$and u_2 respectively. Prove the heights reached by them would be in ratio $(U_1)^2 : (U_2)^2$

Ans. Using $V^2 = u^2 + 2ah$. At the top final velocity will be zero.

Using $V^2 - u^2 = 2gh$ or, $h = \frac{v^2-u^2}{2a}$ but v= Om /s and a = g we get, $h = \frac{u^2}{2g}$

Therefore : $h_1 = \frac{u1^2}{2g}$and $h_2 = \frac{u_2^2}{2g}$ $\Rightarrow \frac{h_1}{h_2} = \frac{\frac{u_1^2}{2g}}{\frac{u_2^2}{2g}} = \frac{u_1^2}{u_2^2}$

Q.20 A cyclist travels ¾ of a circular track from A to B as shown in figure. The radius of the circle track is 400 m.

(i) What is the distance travelled by the cyclist? (ii) What is the displacement?

Ans. (i) The circumference of circular path = 2πr where r is the radius of the circular path ⇒ ¾ of circular track = ¾ ×2 πr = ¾ ×2π×400 = 600 π m = 600 ×3.14 m = 1884 m

(ii) The displacement of shortest path between A and B

AB = $\sqrt{(AO)^2 + (OB)^2}$ = $\sqrt{(400)^2 + (400)^2}$ – 40,

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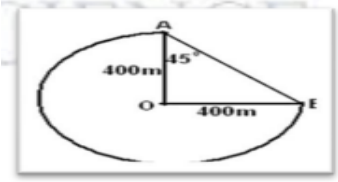

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