IX - 2. Kinematics

Exercise Solutions

Level-1

1. Slope of displacement time graph gives you velocity.

2. Total length = 850m + 150 m = 1000m
Speed of train= 45km/h $\Rightarrow$ 12.5 m/s
Time taken = 1000/12.5 = 80 sec.

3. The formula is
Sn= u+a/2(2n-1)
For t=n=3
S3= 0+10/2(5)
S3= 50/2 m
Similarly,
S4= 0+10/2(7)
S4= 70/2m
S4/S3= 70/2×2/50
S4:S3= 7:5

4. Uniform accelerated motion.

5. $s = ut+1/2at^2$
$s= 0 + ½\ 4 \times (10)^2$
s= 200m

6. Initial velocity, u = 50 km/h = 50 × (5/18) = 250/18 m/s
Final velocity, v = 0
Distance travelled before coming to rest, s = 6 m
Using, v2 = u2 + 2as
$\Rightarrow$ a = -u2/(2s)
$\Rightarrow$ a = -16.075 m/s^2
u = 100 km/h = 500/18 m/s
v = 0
a = -16.075 m/s^2
Now, v2 = u2 + 2as
$\Rightarrow$ s = -u2/(2a) = 24 m

8. When a particle travels at a constant speed it means it covers an equal distance in equal time interval.

9. In V- T graph of a particle is not a straight line so acceleration is variable.

10. In V- T graph of a particle is in a straight line so acceleration is constant.

11. Assuming g = 10 m/s^2
$5\times t^2 = 24$
so t = sqrt(4.8) = 2.2 s

12. Displacement <= Distance.

13. In uniform circular motion accelerated motion with constant magnitude of acceleration.

15. When rope suddenly breaks stoneflies tangentially.

16. Displacement = least distance from a point
total height = nh
total distance from bottom=bn
by Pythagoras theorem
displacement^2 = nb^2 + nh^2
$=n\sqrt{(b^2 + h^2}$

17. 10m/s, 5.38m/s

18. 90 km/h = 25 m/s
$25 \times 0.5 = 12.5$m

19. Time is a scalar quantity.

20. Let "t" = time after which both stones meet
"S" = distance travelled by the stone dropped from the top of tower
(100-S) = distance travelled by the projected stone.
◆ i) For stone dropped from the top of tower
$-S = 0 + 1/2\ (-10)\ t^2$
or, $S = 5t^2$
◆ ii) For stone projected upward
$(100 - S) = 25t + 1/2\ (-10)\ t^2$
$= 25t - 5t^2$
Adding i) and ii), we get
$100 = 25t$
or $t = 4$ s
Therefore, two stones will meet after 4 s.
◆ iii) Put value of t = 4 s in Equation i) , we get
$S = 5 \times 16$
$= 80$ m.
Thus, both the stones will meet at a distance of 80 m from the top of the tower.
Distance of 20 m from the ground

Level-2

1.
1) Consider distance formula, s = ut + at 2 /2. This gives the total distance travelled in t seconds. But, the given data is of t th second and not total t seconds.
2) So, consider for 5 th second first. S 5 = distance travelled in 5 seconds - distance travelled in 4 seconds. S 5 = [(5u + 25a/2) - (4u + 16a/2)]. You will get S 5 = 14 = u + 9a/2.
3) Similarly, find S 8 = 20 = u + 15a/2.
4) So, now you have 2 equations. Solve them to get the values of 'u' and 'a'. Once you subtract them, you will get 'a' = 2 m/s^2 .
5) Then you multiply one equation by 10 and the other by 6. Then subtract the two equations and solve to get 'u'. You will get u = 5 m/s.
6) Finally use the values of u and a to get S 15 = [(15u + 225a/2) - (14u + 196a/2)] = u + 29a/2 = 34 m.

2. The relative speed between the two trains is :
30 - 10 = 20m/s
This is the initial relative speed.

When brakes are applied the train slows down.
Given the acceleration = 2 m/s^2
u = 20 m/s
With time the train comes to a sudden stop making the velocity 0.
$V^2 = U^2 - 2as$
0 = 400 - 4s
400 = 4s
S = 100m

3. Distance traveled in first 3 seconds -
$S= ut + 1/2(a*t^2)$
$S = 0.5 * 10 * 3^3$
S = 45m
Distance traveled in last second = 45m
we know that distance traveled in 'n'th second = Sn= u + **a/2** (2n-1)
45 = 0 + 10/2(2*n -1)
solve to get n = 5 seconds.
Therefore the total time taken to reach the ground is 5 seconds.

4. Area under the V-T graph gives us displacement.
$\frac{1}{2} \times 5 \times 3 + 5 \times 3 + 2 \times 5 + \frac{1}{2} \times 5 \times 1$
= 7.5 + 15 + 10 + 2.5 = 35m

5. Velocity of particle for 2sec is 15m/s towards east
Displacement = velocity × time
Displacement =30m
Velocity of particle for next 8sec is 5m/s towards north
Displacement = velocity × time
Displacement =40m
Total Displacement = 50m
av Velocity= total Displacement/total time
av speed =50/8+2
=50/10
=5m/s

6. Height = $ut+1/2gt^2$
=1/2×10×25
=125
Height travelled in 3sec= $ut+1/2gt^2$
= 0+1/2×10×9
= 45
Height left to travel=125-45
=80
as body is stopped and then again released so again u=0
$h = ut+1/2gt^2$
$80 = 0+1/2\times10\times t^2$
$t^2 =16$
t = 4sec

7. $\Rightarrow t1 = (v-u)/a = (v-0)/3 = v/3$
$\Rightarrow t2 = (v-u)/a = (0-v)/(-2) = v/2$
Now it is given that,
$\Rightarrow t1 + t2 = 15$

$\Rightarrow v/3 + v/2 = 15$
$\Rightarrow v = 18\ m/s$

9. Total displacement covered to completely pass the platform is 300 m + 50 m = 350 m
Use equation of motion
$a = (v^2 - u^2)/(2S)$
$= [(50^2 - 0^2)/(2 \times 350)]\ m/s^2$
$= 3.57\ m/s^2$

Subjective Questions

1. 3m towards north and 4m toward west then total displacement = sqr root of (9 + 16) = 5m

2. No the displacement for the trip is not the same as the Distance travelled as the displacement will be zero as the honeybee returns to its hive I.e. to its initial point whereas distance covered cannot be zero.

3. The maximum displacement = 2 r
The minimum displacement = 04. Displacement= least distance from a point
total height=nh
total distance from bottom=bn
by Pythagoras theorem
$\text{displacement}^2 = nb^2 + nh^2$
$= n\sqrt{(b^2 + h^2)}$

5. No

6. No

7. Using properties of triangle
Sin120 / AB = Sin 30/ r
$AB = (\sqrt{3}/2 \times r)/2 = \sqrt{3}r$.

8. Yes

9. Velocity

10. No

11. Yes

12. Avg speed of Carl Lewis = 100/10 = 10 m/s
Avg speed of Bill = $(42 \times 1000) / 2 \times 60 \times 60 + 10 \times 60 = 5.38$m/s

13. $1500 \times 100/ 3 = 50000$ years

14. Relative velocity = 0.076 - 0.037 = 0.039 m/s
Distance between after 12min = $0.039 \times 12 \times 60$ m = 28.08m

15. Avg velocity = x / [(60x/100) v1 + (40x/100)/v2]
= 10 v1 v2 / 6v2 + 4v1

16. The relative speed between the two cars is zero as both are moving with same speed i.e. 30 km/h.
The third car meets the two cars in the time gap of 4 minutes.
This problem can be solved using relative motion concept.
Considering the two cars at rest.
Let the relative speed of the third car be x with respect to the two cars.
The relative displacement by the third car during the time interval of 4 minutes = 5 km.
Therefore x =
Hence velocity of third car with respect to two cars is 75 km/h
but the two cars are travelling in opposite direction to that of the third car at a speed of 30 km/h
Therefore actual speed of the third car = 75 - 30 = 45 km/h

18. $v = u + at$
$a = 3.2/2 = 1.6$ m/ses^2
$V = 1.6 \times 5 = 8$ m/s

19. $v = u + at$
$v = 200 + 10 \times 60/4$
$v = 200 + 150 = 350$ m/s

21. $3v = v + at$
$a = 2v/t$
$4v = v + at1$
$3v = 2v/t \times t1$
$t1 = 3/2\ t$
Remaining time = $t1 - t = t/2$ sec

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