



PHYSICS

BOOKS - MODERN PUBLICATION

Dynamics of Circular Motion

Exercise

1. A bend in a level road has radius of 100 m. Find the maximum speed with which a car turning this bend may have without skidding

,if the coefficient of friction between the tyres and road is 0.8.



[Watch Video Solution](#)

2. The radius of curvature of a railway track at a place where the train is moving at a speed of 72kmh^{-1} is 625 m. The distance between the rails is 1.5 m. Find the angle and the elevation of the outer rail so that there may be no side pressure on the rails. ($g = 9.8\text{ms}^{-2}$).



[Watch Video Solution](#)

3. A cyclist riding at a speed of $14\sqrt{3}ms^{-1}$ takes a turn around a circular road of radius $20\sqrt{3}m$. What is the inclination to the vertical ?



[Watch Video Solution](#)

4. One end of a string of length 1.5 m is tied to a stone of mass 0.4 kg and the other end to a small pivot on a smooth vertical board. What is the minimum speed of the stone required at

its lower most point so that the string does not slack at any point in its motion along the vertical circle ?



[Watch Video Solution](#)

5. The centripetal force of 45 N required to revolve a stone of mass 100 g along a circular path of radius 50 cm. Find the constant speed of the stone.



[Watch Video Solution](#)

6. A gramophone record is rotating at 90 r.p.m. and a coin of mass 20 g is placed at a distance of 10 cm from its centre. What is the centrifugal force acting on the coin ?



[Watch Video Solution](#)

7. A stone of mass 0.25 kg tied to the end of a string is whirled round in a circle of radius 1.5 m with a speed of 40 rev. / min in a horizontal plane. What is the tension in the string ? What is the maximum speed with

which the stone can be whirled around if the string can withstand a maximum tension of 200 N ?



[Watch Video Solution](#)

8. A body of heavy mass is suspended by a string of length 50 cm. the body revolves along a horizontal circle of radius 25 cm, keeping the string always taut. Find the angular speed of the body.



[Watch Video Solution](#)

9. Two skaters of equal mass on a circular rink go around the rink in the same time. One skater is twice as far from the centre of the rink as the other. Compare the speed of the skaters.



Watch Video Solution

10. Two particles of equal masses are revolving in circular paths of radii r_1 and r_2 respectively

with the same time period .The ratio fo the centripetal force is :



[Watch Video Solution](#)

11. Two particles of equal masses are revolving in circular paths of radii r_1 and r_2 respectively with the same time period .The ratio fo the centripetal force is :



[Watch Video Solution](#)

12. The driver of a three-wheeler moving with a speed of 36 km/h sees a child standing in the middle of the road and brings his vehicle to rest in 4.0 s just in time to save the child. What is the average retarding force on the vehicle? The mass of the three-wheeler is 400 kg and the mass of the driver is 65 kg .



Watch Video Solution

13. A car of mass 1200 kg can take a turn on a circular level road of radius of 150 m with a maximum speed of 15 m s^{-1} without skidding. Find the force of friction and the coefficient of friction between the tyres of the car and road.



Watch Video Solution

14. A cyclist speeding at 18 km h^{-1} on a level road makes a sharp circular turn of radius 3 m without reducing the speed. The coefficient of

static friction between the tyres and the road is 0.1 will the cyclist slip while taking the turn?



[Watch Video Solution](#)

15. Calculate the maximum speed with which a car can be driven safely along a curved road of radius 30 m and banked at 30° with the horizontal. Given, $g = 9.8ms^{-2}$.



[Watch Video Solution](#)

16. The radius of curvature of a railway line at a place is 40000m. the train is running at 20ms^{-1} . the distance between the two rails is 1.5 m. Find the elevation of the outer rail over the inner one so that the train may be able to run safely.



Watch Video Solution

17. The vertical section of a road over a bridge in the direction of its length in the form of an

arc of a circle of radius 4.4 m. Find the greatest velocity at which a vehicle can cross the bridge without losing with the road at the highest point, if the centre of gravity of the vehicle is 0.5 m from the ground. Given, $g = 9.8ms^{-2}$.



[Watch Video Solution](#)

18. A body weighing 0.4 kf is whirled in a vertical circle making 2 revlutions per second. If the radius of the circle is 1.2 m, find the

tension in the string, when body is at the bottom of the circle.



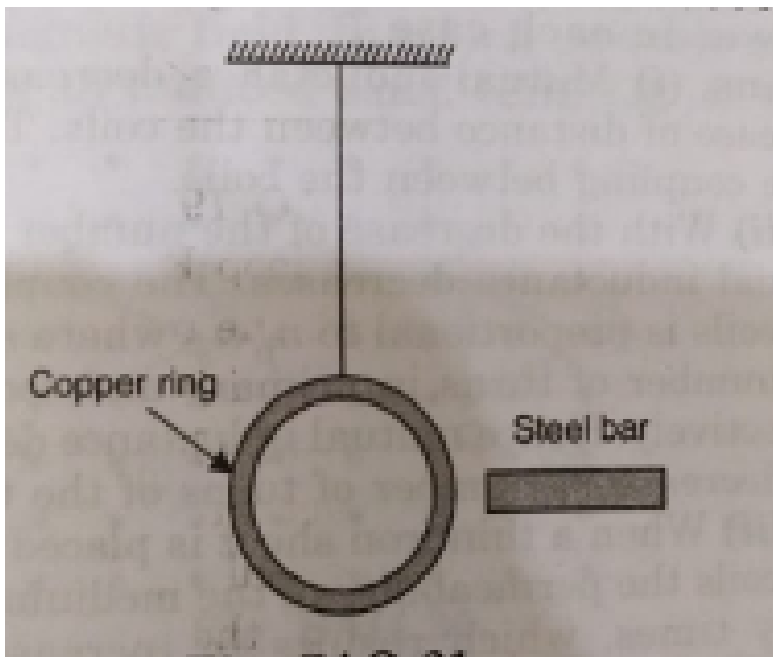
[Watch Video Solution](#)

19. A body weighing 0.4 kf is whirled in a vertical circle making 2 revolutions per second. If the radius of the circle is 1.2 m , find the tension in the string, when body is at the top of the circle.



[Watch Video Solution](#)

20. A copper ring is suspended in a vertical plane by a thread. A steel bar is passed through the ring in a horizontal direction and then a magnet is similarly passed through. Will the motion of the bar and the magnet affect the position of the ring?





[Watch Video Solution](#)

21. A car of mass M moves with a constant speed v over a horizontal flat surface. What force is exerted by the car on the bridge in the case, as it passes the middle point of the bridge ?



[Watch Video Solution](#)

22. A car of mass M moves with a constant speed v over a convex bridge. What force is

exerted by the car on the bridge in the case, as it passes the middle point of the bridge ? Take radius of curvature of the bridge in this case as r .



[Watch Video Solution](#)

23. A car of mass M moves with a constant speed v over a concave bridge. What force is exerted by the car on the bridge in the case, as it passes the middle point of the bridge ? Take

radius of curvature of the bridge in this case as r .



Watch Video Solution

24. Two blocks of mass $m_1 = 10 \text{ kg}$ and $m_2 = 5 \text{ kg}$ connected to each other by a massless inextensible string of length 0.3m are placed along a diameter of a turn table. The coefficient of friction between the table and m_1 is 0.5 while there is no friction between m_2 and the table. The table is rotating with an

angular velocity of 10rad s^{-1} about a vertical axis passing through its centre O. The masses are placed along the diameter of the table on either side of the centre O, such that m_1 is at a distance of 0.124m from O. The masses are observed to be at rest with respect to an observer on the turn table. Calculate the frictional force on m_1 .



[Watch Video Solution](#)

25. What provides the centripetal force to a satellite revolving around the earth?



Watch Video Solution

26. What provides the centripetal force to a satellite revolving around the earth?



Watch Video Solution

27. Why are electrons revolving around the nucleus?



Watch Video Solution

28. For uniform circular motion, does the direction of the centripetal force depend on the sense of rotation (clockwise or anti-clockwise)?



Watch Video Solution

29. Can centripetal force produce rotation?



Watch Video Solution

30. What provides the centripetal force to a car taking turn on a level road?



Watch Video Solution

31. If, in Exercise 5.21, the speed of the stone is increased beyond the maximum permissible

value, and the string breaks suddenly, which of the following correctly describes the trajectory of the stone after the string breaks :- the stone flies off tangentially from the instant the string breaks.



[Watch Video Solution](#)

32. What will be the maximum velocity with which a vehicle can negotiate a turn of radius r safely, when the coefficient of friction between the tyres and the road is μ .



[Watch Video Solution](#)

33. Moon is continuously revolving round the earth without falling towards it. Justify, why it does so ?



[Watch Video Solution](#)

34. What happens to a stone tied to the end of a string and whirled in a circle if the string suddenly breaks?



[Watch Video Solution](#)

35. One often comes across the following kind of statement concerning circular motion : 'A particle moving uniformly along a circle experience a force directed towards the centre (centripetal force) and an equal and opposite force directed away from the centre (centrifugal force). The two forces together keep the partical in equilibrium'. Explain, what is wrong with this statement.



Watch Video Solution

36. Why a person sitting inside a vehicle is thrown outwards, when vehicle rounds a curve suddenly?



Watch Video Solution

37. Why a person sitting inside a vehicle is thrown outwards, when vehicle rounds a curve suddenly?



Watch Video Solution

38. Why does a child in a merry - go - round press the side of his seat radially outward?



Watch Video Solution

39. A car is taking a sudden turn to the left. A passenger in the front seat finds himself sliding towards the door. Explain, indicating the forces acting on the passenger and on the car at this instant.



Watch Video Solution

40. The outer rail of a curved railway track is generally raised over the inner. Why ?



Watch Video Solution

41. Why does a cyclist lean to one side while going along a curve? In which direction does he lean?



Watch Video Solution

42. Why does a cyclist lean to one side while going along a curve? In which direction does he lean?



Watch Video Solution

43. A bucket containing water is rotated in a vertical circle. Explain why does not water fall down.



Watch Video Solution

44. Explain, why the pilot of the aeroplane does not fall down, while looping the loop ?



Watch Video Solution

45. Write an expression for the centripetal force.



Watch Video Solution

46. Explain centripetal force and centrifugal force. Why centrifugal force is called a pseudo force ?



Watch Video Solution

47. Define centrifugal force.



Watch Video Solution

48. Explain the need for banking of tracks.



[Watch Video Solution](#)

49. Calculate the maximum speed with which a vehicle can travel on a level circular road without skidding.



[Watch Video Solution](#)

50. Derive an expression for the angle of bending of a cyclist on a curved track.



[Watch Video Solution](#)

51. What is banking of a road ,why is it done?

Find an expression for angle of banking.



Watch Video Solution

52. Derive an expression for the angle of bending of a cyclist on a curved track.



Watch Video Solution

53. What do you mean by banking of road?



Watch Video Solution

54. Define centripetal and centrifugal forces.

Explain with the help of neat diagram, how banking provides the centripetal force necessary for a car to go in circular track. (ignore friction between tyres and road).



Watch Video Solution

55. Define angle of banking. Draw a neat labelled diagram showing different forces and their components acting on a vehicle moving on a banked road.



Watch Video Solution

56. Write an expression for maximum velocity of a vehicle on an unbanked circular road.



Watch Video Solution

57. What will be the maximum velocity with which a vehicle can negotiate a turn of radius r safely, when the coefficient of friction between the tyres and the road is μ .



[Watch Video Solution](#)

58. Why does a cyclist lean to one side while going along a curve? In which direction does he lean?



[Watch Video Solution](#)

59. Derive an expression for the angle of bending of a cyclist on a curved track.



Watch Video Solution

60. Explain why a centrifugal force is not a reaction of centripetal force.



Watch Video Solution

61. What provides the centripetal force to a satellite revolving around the earth?



Watch Video Solution

62. Derive an expression for the angle of bending of a cyclist on a curved track.



Watch Video Solution

63. Define centripetal and centrifugal forces. Explain with the help of neat diagram, how banking provides the centripetal force necessary for a car to go in circular track. (ignore friction between tyres and road).



Watch Video Solution

64. What do you mean by banking of road?



Watch Video Solution

65. A stone of mass 50 g tied to one end of the string is rotated in a horizontal circle of radius 1 m with a speed of 5ms^{-1} . Calculate the centripetal force.



Watch Video Solution

66. An object of mass 0.4 kg is whirled in a horizontal circle of radius 2m. If it performs 60 revolutions min^{-1} , calculate the centripetal force acting on it.



Watch Video Solution

67. Find the force required to revolve a body of mass 0.2 kg along a circular path of radius 2.5 m , so as to make 100 revolutions in one minute.



Watch Video Solution

68. A stone of mass 50 g tied to one end of the string is rotated in a horizontal circle of radius

1 m with a speed of 5ms^{-1} . Calculate the centripetal force.



[Watch Video Solution](#)

69. A ball of mass 0.1 kg is revolved in a horizontal circular groove of radius 25 cm having vertical side walls. Find the contact force on the ball due to the wall of the groove, if it completes one round of the groove in 0.2s.



[Watch Video Solution](#)

70. A car of mass 800 kg is moving with a maximum speed of 10ms^{-1} along a circular level track of 50 m radius without skidding. Find the force of friction and the coefficient of friction between the tyres and the road. Take, $g = 10\text{ms}^{-2}$.



Watch Video Solution

71. Find the maximum speed at which a car can turn round a curve of 30 m radius on a level

road, if the coefficient of friction between the tyres and the road is 0.4.



[Watch Video Solution](#)

72. The radius of curvature of a railway line at a place is 40000m.the train is running at 20m.s^{-1} .the distance between the two rails is 1.5 m.Find the elevation of the outer rail over the inner one so that the train may be able to run safely.



[Watch Video Solution](#)

73. Find the angle of banking of a curved railway track of radius 600 m, if the maximum safely speed limit of 54kmh^{-1} . If the distance between the rails is 1.6 m, find the elevation of the outer track above the inner track. Given that $g = 9.8\text{ms}^{-2}$.



Watch Video Solution

74. A massless spring has a length 0.5 m and force constant 100Nm^{-1} . Its one end of is

fixed and the other end is connected to a block of mass 0.5 kg. The system lies on a horizontal table and the block is made to rotate with an angular speed of 2rads^{-1} . Find the elongation of the spring.



[Watch Video Solution](#)

75. A load is weighed on a spring balance in the carriage of a train,, which is moving along a curve of radius 400 m at a speed of

72kmh^{-1} . If the weight of the load is 5 kgf, what will the reading of spring balance be ?



[Watch Video Solution](#)

76. A sphere of mass 0.1 kg is attached to an inextensible string of length 1.3 m, whose upper end is fixed to the ceiling. The sphere is made to describe a horizontal circle of radius 0.5 m. Calculate the time period of one revolution..



[Watch Video Solution](#)

77. A sphere of mass 0.1 kg is attached to an inextensible string of length 1.3 m, whose upper end is fixed to the ceiling. The sphere is made to describe a horizontal circle of radius 0.5 m. Calculate the tension in the string.



Watch Video Solution

78. A circular race track of radius 300 m is banked at an angle of 15° . If the coefficient of friction between the wheels of a race car and

the road is 0.2, what is the optimum speed of the race car to avoid wear and tear on its tyres.



[Watch Video Solution](#)

79. A circular race track of radius 300 m is banked at an angle of 15° . If the coefficient of friction between the wheels of a race car and the road is 0.2, what is the maximum permissible speed to avoid slipping ?



[Watch Video Solution](#)

80. The centre of gravity of a loaded taxi is 1.5 m above the ground and the distance between its wheels is 2m. What is the maximum speed with which it can go round an unbanked curve of radius 100 m without being turned upside down. What minimum value would the coefficient of friction be needed at this speed ?



Watch Video Solution

81. A ball rolls down an inclined plane from a height and then goes round a vertical circle of radius 1m. What should be the height of the inclined plane, so that the ball is able to go round the circle without leaving the track ?



Watch Video Solution