CBSE

MOTION IN A PLANE WS 14

Class 11 - Physics

Section A

1. In hydrogen atom, the electron is moving around the nucleus with the velocity 2.18×10^6 m/s in an orbit of radius 0.528$\mathring{A}$. The acceleration of the electron is **[1]**

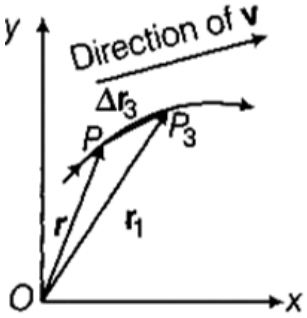
   a) $9 \times 10^{-22} m/s^2$

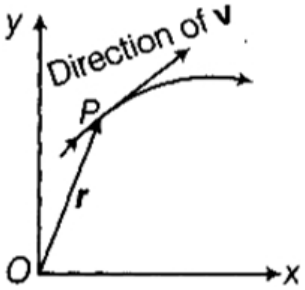
   b) $9 \times 10^{12} m/s^2$

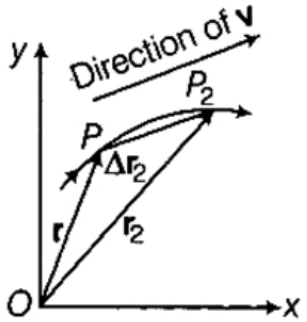
   c) $9 \times 10^{18} m/s^2$

   d) $9 \times 10^{22} m/s^2$

2. The direction of instantaneous velocity is shown by **[1]**

   a) 

   b) 

   c) 

   d) None of these

3. A sports car has a "lateral acceleration" of 0.96g = 9.4 ms^{-2}. This is the maximum centripetal acceleration the car can sustain without skidding out of a curved path. If the car is travelling at a constant 40 m/s on level ground, what is the radius R of the tightest unbanked curve it can negotiate? **[1]**

   a) minimum radius = 170 m

   b) minimum radius = 160 m

   c) minimum radius = 175 m

   d) minimum radius = 180 m

4. In uniform circular motion, **[1]**

   a) velocity is constant and acceleration changes

   b) both velocity and acceleration are constant

   c) velocity changes but acceleration is constant

   d) both velocity and acceleration change

5. A body revolving in a circle with uniform speed possesses: **[1]**

   a) tangential acceleration

   b) Non tangential acceleration

   c) normal acceleration

   d) uniform acceleration

6. A stone tied to the end of string 80 cm long is whirled in horizontal circle with a constant speed. If the stone makes 14 revolutions in 25 sec, what is the magnitude of acceleration of the stone? **[1]**

a) 680 cm/s^2 b) 990 cm/s^2

c) 860 cm/s^2 d) 720 cm/s^2

7. A particle moves in a circle of radius 5 cm with constant speed and time period 0.2π s. The acceleration of the particle is **[1]**

a) $36m/s^2$ b) 5 m/s^2

c) 25 m/s^2 d) 15 m/s^2

8. A particle moves with constant speed v along a circular path of radius r and completes the circle in time T. The acceleration of the particle is **[1]**

a) $\frac{2\pi r^2}{T}$ b) $\frac{2\pi r}{T}$

c) $\frac{2\pi v}{T}$ d) $\frac{2\pi v^2}{T}$

9. A particle moves along a circle of radius $\left(\frac{20}{\pi}\right)$m with constant tangential acceleration. If the velocity of the particle is 80 m/s at the end of the second revolution after motion has begun, the tangential acceleration is **[1]**

a) 40π m/s^2 b) 160π m/s^2

c) 640π m/s^2 d) 40 m/s^2

10. Two racing cars of masses m_1 and m_2 are moving in circles of radii r_1 and r_2 respectively. Their speeds are such that each makes a complete circle in the same time t. The ratio of the angular speeds of the first to the second car is **[1]**

a) $m_1 : m_2$ b) $m_1m_2 : r_1r_2$

c) $r_1 : r_2$ d) 1 : 1

11. **Assertion (A):** In circular motion, work done by centripetal force is zero. **[1]**
Reason (R): In circular motion, centripetal force is perpendicular to the displacement.

a) Both A and R are true and R is the correct explanation of A. b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false. d) A is false but R is true.

12. **Assertion (A):** In non-uniform circular motion, linear speed of the body is variable. **[1]**
Reason (R): In non-uniform circular motion, acceleration of the body is towards the centre.

a) Both A and R are true and R is the correct explanation of A. b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false. d) A is false but R is true.

13. **Assertion (A):** Whenever a particle moves in a circular path with uniform speed, an acceleration exists which is directed towards the centre. **[1]**
Reason (R): The net acceleration of a particle in circular motion is always radially inward.

a) Both A and R are true and R is the correct b) Both A and R are true but R is not the

explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

14. **Assertion (A):** As the frictional force increases, the safe velocity limit for taking a turn on an unbanked road also increases. **[1]**

Reason (R): Banking of roads will increase the value of limiting velocity.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

15. **Assertion (A):** In a uniform circular motion, the speed is uniform not velocity. **[1]**

Reason (R): Velocity is continuously changing its direction in a uniform circular motion.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

16. **Assertion (A):** In uniform circular motion, speed is constant. **[1]**

Reason (R): In uniform circular motion, tangential acceleration is zero.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

17. **Assertion (A):** In uniform circular motion of a body, its linear speed remains constant. **[1]**

Reason (R): Total acceleration of the body has no radial component.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

18. **Assertion (A):** Two similar trains are moving along the equatorial line with the same speed but in opposite direction. They will exert equal pressure on the rails. **[1]**

Reason (R): In uniform circular motion, the magnitude of acceleration remains constant but the direction continuously changes.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

19. **Assertion (A):** An object can possess acceleration even at a time when it has uniform speed. **[1]**

Reason (R): It is possible when the direction of motion keeps changing.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

20. **Assertion (A):** Speed is constant in uniform circular motion. **[1]**

Reason (R): Acceleration is constant in uniform circular motion.

a) Both A and R are true and R is the correct

b) Both A and R are true but R is not the

explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

21. **Assertion (A):** v = u + at formula is applied for projectile but cannot be applied for uniform circular motion. **[1]**
Reason (R): v = u + at is applicable when an acceleration (a) is uniform.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

22. **Assertion (A):** In uniform circular motion, magnitude of acceleration is v^2/R and direction is always towards the centre. **[1]**
Reason (R): In uniform circular motion, acceleration is constant.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

23. **Assertion (A):** If both the speed of a body and radius of its circular path are doubled, then centripetal force also gets doubled. **[1]**
Reason (R): Centripetal force is directly proportional to both speed of a body and radius of circular path.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

24. **Assertion (A):** During a turn, the value of centripetal force should be less than the limiting frictional force. **[1]**
Reason (R): The centripetal force is provided by the frictional force between the tyres and the road.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

25. **Assertion (A):** A cyclist always bends inwards while negotiating a curve. **[1]**
Reason (R): By bending he lowers his centre of gravity.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

26. **Assertion (A):** Two similar trains are moving along the equatorial line with the same speed but in opposite direction. They will exert equal pressure on the rails. **[1]**
Reason (R): In uniform circular motion, the magnitude of acceleration remains constant but the direction continuously changes.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

27. **Assertion (A):** For a body in uniform circular motion, the centripetal force is required. **[1]**
Reason (R): The body in circular motion changes its direction everywhere.

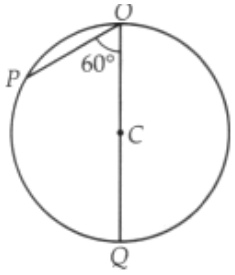
a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

28. Two particles 1 and 2 are allowed to descend on two frictionless chords OP and OQ. The ratio of the speeds of the particles 1 and 2 respectively when they reach on the circumference is **[1]**



a) 1

b) $\frac{1}{2\sqrt{2}}$

c) $\frac{1}{2}$

d) $\frac{1}{4}$

29. Which of the following statements not true? **[1]**

A. The net acceleration of a particle in a circular motion is always along the radius of the circle towards the centre

B. The acceleration vector of a particle in uniform circular motion averaged over one cycle is a null vector

C. The net acceleration of a particle in uniform circular motion is always along the radius of the circle towards the centre

D. The velocity vector of a particle at a point is always along the tangent to the path of the particle at that point.

a) (C)

b) (A)

c) (D)

d) (B)

30. A particle cannot accelerate if its velocity is constant, why? **[1]**

31. Give an example of a body moving with uniform speed but having a variable velocity and an acceleration which remains constant in magnitude but changes in direction. **[1]**

32. What is the average value of acceleration vector in uniform circular motion over one cycle? **[1]**

33. Assuming that the moon completes one revolution in a circular orbit around the earth in 27.3 days, calculate the acceleration of the moon towards the earth. The radius of the circular orbit can be taken as 3.85×10^5 km. **[1]**

34. Find the magnitude of the centripetal acceleration of a particle on the tip of a fan blade, 0.30 metre in diameter, rotating at 1200 rev/minute. **[1]**

35. If both the speed and radius of the circular path of a body are doubled, how will the centripetal acceleration change? **[1]**

36. For uniform circular motion, does the direction of centripetal acceleration depend upon the sense of rotation? **[1]**

37. When a knife is sharpened with the help of a rotating grinding stone, the spark always travels tangentially to it. Why? **[1]**

38. A stone tied to the end of a string is whirled in a circle. If the string breaks, the stone flies away tangentially. Why? **[1]**

39. Calculate the angular speed of flywheel making 420 revolutions per minute. **[1]**

Section B

40. Establish the relation $v = r\omega$ for uniform circular motion. **[2]**

41. A cyclist moves along a circular path of radius 70 m. If he completes one round in 11 s, calculate **[2]**

i. total length of path,

ii. magnitude of the displacement,

iii. average speed, and

iv. magnitude of average velocity

42. Establish a relation between linear velocity and angular velocity in a uniform circular motion and explain the direction of linear velocity. **[2]**

43. A body of mass 10 kg revolves in a circle of diameter 0.4 m making 1000 revolutions per minute. Calculate its linear velocity and centripetal acceleration. **[2]**

44. Which is greater the angular velocity of the hour hand of a watch or angular velocity of earth around its own axis? Give their ratio. **[2]**

45. A stone tied at the end of string is whirled in a circle. If the string breaks, the stone flies away tangentially. Why? **[2]**

46. An insect trapped in a circular groove of radius 12 cm moves along the groove steadily and completes 7 revolutions in 100 s. **[2]**

i. What is the angular speed and the linear speed of insect's motion?

ii. Is the acceleration vector a constant vector? What is its magnitude?

47. An aircraft executes a horizontal loop of radius 1 km with a steady speed of 900 kmh^{-1}. Compare its centripetal acceleration with the acceleration due to gravity. **[2]**

48. For a uniform circular motion show that: **[2]**

(i) $v = r\omega$ (ii) $a = r\omega^2$

49. A stone tied to the end of a string 80 cm long is whirled in a horizontal circle with a constant speed. If the stone makes 14 revolutions in 25 s, what is the magnitude and direction of acceleration of the stone? **[2]**

50. A cyclist is riding with a speed of 27 kmh^{-1}. As he approaches a circular turn on the road of radius 80 m, he applies brakes and reduces his speed at the constant rate of 0.5 ms^{-2}. What is the magnitude and direction of the net acceleration of the cyclist on the circular turn? **[2]**

51. Derive expressions for velocity and acceleration for uniform circular motion. **[2]**

52. Justify the statement that a uniform circular motion is an accelerated motion. **[2]**

Section C

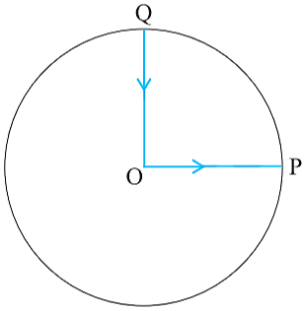
53. Define Angular velocity and Angular acceleration. Derive an expression for centripetal acceleration of a uniform circular motion of an object. **[3]**

54. A cyclist starts from the centre O of a circular park of radius 1 km, reaches the edge P of the park, then cycles along the circumference, and returns to the centre along QO as shown in figure. If the round trip takes 10 min, what is the **[3]**

i. net displacement,

ii. average velocity, and

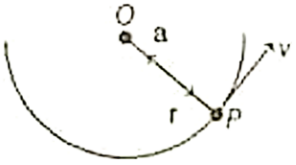
iii. average speed of the cyclist?



Section D

Question No. 55 to 58 are based on the given text. Read the text carefully and answer the questions: **[4]**

When an object follows a circular path at a constant speed, the motion of the object is called uniform circular motion. The word uniform refers to the speed which is uniform (constant) throughout the motion. Although the speed does not vary, the particle is accelerating because the velocity changes its direction at every point on the circular track. The figure shows a particle P which moves along a circular track of radius r with a uniform speed v.

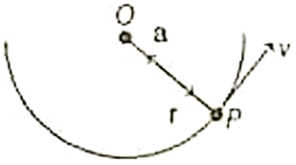


55. What type of motion is a circular motion.
56. The displacement of a particle moving on a circular path makes 60° at the centre of circle of radius r, find the displacement of body.
57. Two cars A and B move along a concentric circular path of radius r_A and r_B with velocities v_A and v_B maintaining constant distance, then find the ratio of $\frac{v_A}{v_B}$.
58. A particle is moving with a constant speed v in a circle. What is the magnitude of average velocity after half rotation?

Section E

Question No. 59 to 63 are based on the given text. Read the text carefully and answer the questions: **[5]**

When an object follows a circular path at a constant speed, the motion of the object is called uniform circular motion. The word uniform refers to the speed which is uniform (constant) throughout the motion. Although the speed does not vary, the particle is accelerating because the velocity changes its direction at every point on the circular track. The figure shows a particle P which moves along a circular track of radius r with a uniform speed v.



59. A circular motion

    a) is one-dimensional motion
    b) it is represented by combination of two variable vectors
    c) is two-dimensional motion
    d) Both is two-dimensional motion and it is represented by combination of two variable vectors

60. The displacement of a particle moving on a circular path when it makes 60° at the centre is

    a) r
    b) $\sqrt{2}r$
    c) 2r
    d) $\frac{\sqrt{2}}{r}$

61. Two cars A and B move along a concentric circular path of radius r_A and r_B with velocities v_A and v_B maintaining constant distance, then $\frac{v_A}{v_B}$ is equal to

    a) $\frac{r_A}{r_B}$
    b) $\frac{r_B}{r_A}$
    c) $\frac{r_B^2}{r_A^2}$
    d) $\frac{r_A^2}{r_B^2}$

62. A particle is moving with a constant speed v in a circle. What is the magnitude of average velocity after half rotation?

a) $\frac{2v}{\pi}$ b) $\frac{v}{2\pi}$

c) $\frac{v}{2}$ d) 2V

63. What is the centripetal acceleration of a point mass which is moving on a circular path of radius 5 m with speed 23 ms^{-1}?

a) 60 ms^{-2} b) 90 ms^{-2}

c) 106 ms^{-2} d) 30 ms^{-2}

64. **State True or False:** **[5]**

(a) The net acceleration of a particle in circular motion is always along the radius of the circle towards the centre. **[1]**

(b) A body can move on a curved path without acceleration. **[1]**

(c) Direction of velocity vector is always along the tangent to the path, therefore its magnitude must be given by its slope. **[1]**

(d) The net acceleration of a particle in a circular motion is always along the radius of the circle towards the centre. **[1]**

(e) There can be a motion in two dimensions with an acceleration only in one dimension. **[1]**

Section F

65. **Fill in the blanks:** **[7]**

(a) The net effect on maximum height of a projectile when its angle of projection is changed from 30° to 60°, keeping the same initial velocity of projection is _____. **[1]**

(b) When a stone tied to a string is whirled in a circular path, the acceleration acting on it is always at _____ angles. **[1]**

(c) The motion of planets around the sun is a _____ dimensional motion. **[1]**

(d) When an object follows a circular path at a constant speed, the motion of the object is called _____ motion. **[1]**

(e) A body is moving on a circular path with a constant speed. The nature of its acceleration is _____. **[1]**

(f) Moon revolving around the earth comes under _____ dimensional motion. **[1]**

(g) _____ is defined as the time taken by a particle to complete one revolution along its circular path. **[1]**