	INDIAN SCHOOL AL WADI AL KABIR	
Class: XI	**Department: SCIENCE 2023 – 24** **SUBJECT: PHYSICS**	**Date of submission:** **05.06.2023**
Worksheet No: 02 **WITH ANSWERS**	**CHAPTER / UNIT: MOTION IN A PLANE**	**Note:** **A4 FILE FORMAT**
NAME OF THE STUDENT:	**CLASS & SEC:**	**ROLL NO.:**

OBJECTIVE TYPE OF QUESTIONS (1 MARK):

1) Position of a particle in a rectangular-co-ordinate system is (3, 2, 5). Then its position vector will be
   a) $3\hat{\imath} + 5\hat{\jmath} + 2\hat{k}$
   b) $3\hat{\imath} + 2\hat{\jmath} + 5\hat{k}$
   c) $5\hat{\imath} + 3\hat{\jmath} + 2\hat{k}$
   d) None of these

2) If a particle moves from point P (2,3,5) to point Q (3,4,5). Its displacement vector be
   a) $\hat{\imath} + \hat{\jmath} + 10\hat{k}$
   b) $\hat{\imath} + \hat{\jmath} + 5\hat{k}$
   c) $\hat{\imath} + \hat{\jmath}$
   d) $2\hat{\imath} + 4\hat{\jmath} + 6\hat{k}$

3) The expression $\frac{1}{\sqrt{2}}\hat{\imath} + \frac{1}{\sqrt{2}}\hat{\jmath}$ is a
   a) Unit vector
   b) Null vector
   c) A vector of magnitude √2
   d) Scalar

4) If for two vectors $\vec{A}$ and $\vec{B}$, $\vec{A} \times \vec{B} = 0$, the vectors
   a) Are perpendicular to each other
   b) Are parallel to each other
   c) Act at an angle of 60°
   d) Act at an angle of 30°

5) A river is flowing from east to west at a speed of 5 m/min. A man on south bank of river, capable of swimming 10m/min in still water, wants to swim across the river in shortest time. He should swim
   a) Due north
   b) Due north east
   c) Due north east with double the speed of river
   d) None of these

6) A body is moving in a circular path with a constant speed. It has
   a) A constant velocity
   b) A constant acceleration
   c) An acceleration of constant magnitude
   d) An acceleration which varies with time

7) A particle moves with constant speed but in constantly varying direction. The path of particle will be
   a) Elliptical
   b) Linear
   c) Circular
   d) parabolic

8) A body travels along the circumference of a circle of radius 2 m with a linear velocity of 6 m/s. Then its angular velocity is
   a) 6 rad/s
   b) 3 rad/s
   c) 2 rad/s
   d) 4 rad/s

9) A stone tied to a string is rotated in a circle. If the string is cut, the stone flies away from the circle because
   a) A centrifugal force acts on the stone
   b) A centripetal force acts on the stone
   c) Of its inertia
   d) Reaction of the centripetal force

10) If A . B = AB, then …… is the angle between A and B.
   a) 0°
   b) 30°
   c) 60°
   d) 90°

11) Three particles A, B and C are projected from the same point with the same initial speeds making angles 30°, 45° and 60° respectively with the horizontal. Which of the following statements is correct?
   a) A, B and C have unequal ranges
   b) Ranges of A and C are equal and less than that of B
   c) Ranges of A and C are equal and greater than that of B
   d) A, B and C have equal ranges

12) A force of 4N makes an angle 30 degree with x-axis. The y component of force is
   a) $2\sqrt{3}$ N
   b) 4 N
   c) $2/\sqrt{3}$ N
   d) 2 N

13) Time of flight of a projectile is 10 sec and its range is 500m.The maximum height reached by it is
   a) 50 m

b) 80 m
c) 100 m
d) 125 m

14) The angular speed of a fly-wheel making 120 r.p.m is
a) Π rad/s
b) 2π rad/s
c) 4π rad/s
d) $4\pi^2$ rad/s

15) A body is whirled in a horizontal circle of radius 20cm. It has an angular velocity of 10 rad/s. What is the linear velocity at any point on the circular path?
a) 10 m/s
b) 2 m/s
c) 20 m/s
d) $\sqrt{2}$ m/s

ASSERTION AND REASONING TYPE OF QUESTIONS (1 MARK):

DIRECTION: In the following questions, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as:
a) Both A and R are true, and R is the correct explanation of A.
b) Both A and R are true, and 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:** If the initial and final positions coincide, the displacement is a null vector.
Reason: A physical quantity cannot be called a vector, if its magnitude is zero.

17) **Assertion:** A vector quantity is a quantity that has both magnitude and a direction and obeys the triangle law of addition or equivalently the parallelogram law of addition.
Reason: The magnitude of the resultant vector of two given vectors can never be less than the magnitude of any of the given vector

18) **Assertion**: The minimum number of vectors of unequal magnitude required to produce zero resultant is three
Reason: Three vectors of unequal magnitude which can be represented by the three sides of a triangle taken in order, produce zero resultant.

19) **Assertion**: Distance is a scalar quantity.
Reason: Distance is the length of path traversed.

20) **Assertion:** In projectile motion, the angle between the instantaneous velocity and acceleration at the highest point is 180°
Reason: At the highest point, velocity of projectile will be in horizontal direction only.

21) **Assertion:** Two particles of different mass, projected with same velocity at same angles. The

maximum height attained by both the particle will be same
Reason: The maximum height of projectile is independent of particle mass.

22) **Assertion:** Centripetal acceleration is always directed towards the centre.
Reason: In non-uniform circular motion acceleration is always directed towards the centre.

VERY SHORT ANSWER TYPE OF QUESTIONS: (2 MARK)

23) Is uniform circular motion a case of uniform motion? Why?

24) What is the angular velocity of the hour hand of a clock?

25) Show that when the horizontal range is maximum, height attained by the body is one fourth the maximum range in the projectile motion.

26) A gunman always keeps his gun slightly tilted above the line of sight while shooting. Why?

27) State the conditions for a projectile to achieve maximum range

28) Define centripetal force. Give an example.

SHORT ANSWER TYPE OF QUESTIONS (3 MARK):

29) Derive an expression for the time of flight and horizontal range of a projectile when launched at an angle θ with the horizontal.

30) Two forces 5 kgwt and 10 kgwt are acting with an inclination of 120° between them. What is the angle which the resultant makes with 10 kgwt?

31) Two bodies are projected at an angle Θ and $(\pi/2 - \Theta)$ to the horizontal with the same speed. Find the ratio of their time of flight.

32) Derive an expression for the centripetal acceleration in terms of angular velocity and radius of curvature.

33) A car travels 60 km north and then 40 km east. Determine the magnitude and direction of the resultant displacement.

LONG ANSWER TYPE OF QUESTIONS (5 MARK):

34) A ball is thrown with an initial velocity of 20 m/s at an angle of 30 degrees above the horizontal. Calculate:
a) The time taken for the ball to reach its maximum height.
b) The maximum height reached by the ball.
c) The horizontal range of the ball.

35) A cannonball is fired from a cannon at ground level. The cannonball follows a parabolic trajectory and hits a target located 500 meters away horizontally. The initial speed of the cannonball is 100 m/s. Determine:
   a) The angle at which the cannonball was launched.
   b) The maximum height reached by the cannonball.
   c) The time taken for the cannonball to reach the target.
   d) The velocity of the cannonball just before hitting the target.

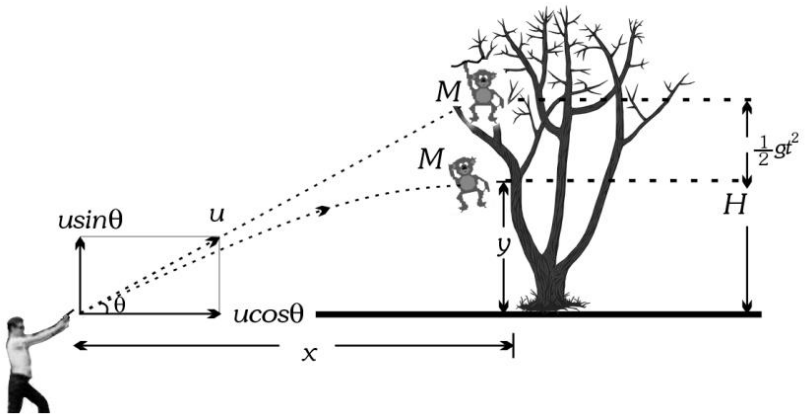
36) A body is thrown horizontally from the top of a tower and strikes the ground after three seconds at an angles of 45° with the horizontal. Find the height of the tower and the speed with which the body was projected. Take $g=9.8m/s^2$.

37) A car is moving in a circular path of radius 50 meters with a constant speed of 15 m/s. Determine:
   a) The magnitude of the centripetal acceleration.
   b) The period of the car's motion.
   c) The frequency of the car's motion.

38) A cyclist rides along a circular track of radius 100 meters with a speed of 10 m/s. Determine:
   a) The magnitude of the centripetal force acting on the cyclist if the mass of the cyclist is 60 kg.
   b) The time taken for the cyclist to complete half a revolution.
   c) The angular velocity of the cyclist's motion.

CASE STUDY TYPE OF QUESTIONS (4 MARK):

39) A hunter aims his gun and fires a bullet directly towards a monkey sitting on a distant tree. If the monkey remains in his position, he will be safe but at the instant the bullet leaves the barrel of gun, if the monkey drops from the tree, the bullet will hit the monkey because the bullet will not follow the linear path. The path of motion of a bullet will be parabolic and this motion of bullet is defined as projectile motion. If the force acting on a particle is oblique with initial velocity, then the motion of particle is called projectile motion. Find the followings:



   i. If a person can throw a projectile to a maximum distance Rmax, The maximum height during the flight to which it will rise is

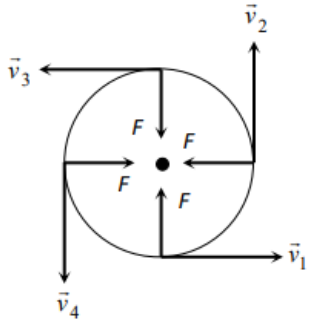
a) R_{max} / 4
b) R_{max} / 5
c) R_{max} / 2
d) R_{max} / 11

ii. If angle of projection is changed from θ to θ ′ = (90 – θ) then range
a) Remains unchanged
b) Remains changed
c) Becomes two times
d) None of these

iii. If the hunter wants to hit the monkey, which of the following adjustments should be made?
a) Increase the initial velocity of the bullet
b) Decrease the initial velocity of the bullet
c) Increase the launch angle of the bullet
d) Decrease the launch angle of the bullet

iv. In the absence of external factors, such as air resistance, the horizontal component of the bullet's velocity:
a) Remains constant throughout the motion.
b) Increases as it moves upward and decreases as it moves downward.
c) Decreases as it moves upward and increases as it moves downward.
d) Varies randomly during the motion.

40) Circular motion is an example of motion in two dimensions. To create circular motion in a body it must be given some initial velocity and a force must then act on the body which is always directed at right angles to instantaneous velocity. Since this force is always at right angles to the displacement therefore no work is done by the force on the particle. Hence, its kinetic energy and thus speed is unaffected. But due to simultaneous action of the force and the velocity the particle follows resultant path, which in this case is a circle. Give the answer of followings:



i. Acceleration acting on the object undergoing uniform circular motion always be
a) Along the tangent
b) Along the radius outwards the centre of the circular path
c) Along the radius towards the centre of the circular path.
d) None of these.

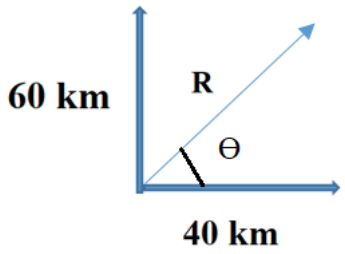
ii. The period of an object in uniform circular motion is inversely proportional to:
   a) The object's speed.
   b) The object's mass.
   c) The square of the object's speed.
   d) The square of the object's radius.

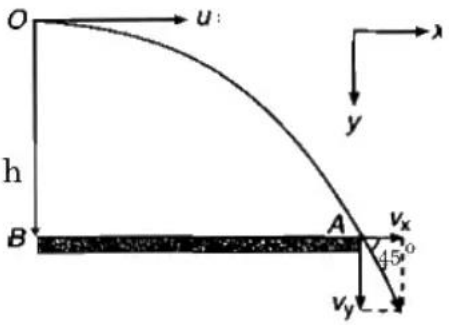
iii. What is the relationship between the force and velocity in circular motion?
   a) The force is directly proportional to the velocity.
   b) The force is inversely proportional to the velocity.
   c) The force is always equal to the velocity.
   d) The force is perpendicular to the velocity.

iv. If the radius of the circle is doubled while keeping the speed constant, what happens to the centripetal force required?
   a) It doubles.
   b) It becomes four times greater.
   c) It is halved.
   d) It remains the same.

ANSWER KEY	
1	b) $3\hat{\imath} + 2\hat{\jmath} + 5\hat{k}$
2	c) $\hat{\imath} + \hat{\jmath}$
3	a)Unit vector
4	b) Are parallel to each other
5	a)Due north
6	c)An acceleration of constant magnitude
7	c)Circular
8	b)3 rad/s
9	c)Of its inertia
10	a)0°
11	b)Ranges of A and C are equal and less than that of B
12	d) 2 N
13	d)125 m
14	c)4π rad/s
15	b)2 m/s
16	c)A is true but R is false.
17	c)A is true but R is false.
18	b)Both A and R are true, and R is not the correct explanation of A.
19	a)Both A and R are true, and R is the correct explanation of A.
20	d)A is false but R is true
21	a)Both A and R are true, and R is the correct explanation of A.
22	c)A is true but R is false.
23	Since this acceleration is perpendicular to the velocity of a particle at every instant, it is only changing the direction of velocity and not magnitude and that's why the

	motion is uniform circular motion.
24	$\omega = 2\pi/12 = \pi/6$ rad h^{-1}
25	Horizontal range $R=\frac{u^2 \sin 2\theta}{g}$; for maximum range $\theta=45°$ $R_{max} = \frac{u^2}{g}$ and Height $H = \frac{u^2 \sin^2 \theta}{2g}$; For $\theta=45°$ $H = \frac{u^2}{4g} = \frac{1}{4}$ of the R_{max}.
26	When a bullet is fired from a gun with its barrel directed towards the target, it starts falling downwards because of acceleration due to gravity. Due to which the bullet hits below the target. Just to avoid it, the barrel of gun is lined up little above the target, so that the bullet, after travelling in parabolic path hits the distant target.
27	The projectile should be launched at an angle of 45 degrees with respect to the horizontal. The projectile should be launched with a constant velocity throughout its flight
28	Centripetal force is a force that acts towards the center of a circular path, allowing an object to move in a curved trajectory. It is required to keep an object moving in a circular path instead of moving in a straight line. An example of centripetal force is the tension force in a string or rope that is holding a ball and being swung in a circular motion. Other examples of centripetal force include the gravitational force acting on a satellite orbiting the Earth, the frictional force between the tires of a car and the road as it goes around a curved path, or the gravitational force that keeps the Moon in its orbit around the Earth.
29	Refer your class work
30	Let P be the force of 5 kg weight and Q be the force of 10 kg weight. By parallelogram law of vector addition, the resultant is, $R^2 = P^2 + Q^2 + 2PQ\cos\theta$ $R^2 = 25 + 100 + 100\cos 120°$ $R = 5\sqrt{3}$ weight Let α be the angle made by R with 10 kg weight. $\tan\alpha = \frac{P\sin\theta}{P+Q\cos\theta}$ $\tan\alpha = \frac{5\sin 120}{5+10\cos 120}$ $\tan\alpha = \frac{1}{\sqrt{3}}$ $\alpha = 30°$

31	**For first body:** Angle of projection is θ. So, Time of flight $T_1 = \frac{2u\sin\theta}{g}$ ....(1) **For second body:** Angle of projection is $90° - \theta$. where u is the speed of projection. Time of flight $T_2 = \frac{2u\sin(90° - \theta)}{g} = \frac{2u\cos\theta}{g}$ ....(2) **Step 2 : Calculate ratio of $\frac{T_1}{T_2}$** Using equations (1) and (2), The ratio of time of flight $\frac{T_1}{T_2} = \frac{\sin\theta}{\cos\theta}$
32	Refer your class work
33	 Magnitude of the resultant = $\sqrt{60^2 + 40^2} = 72.11\ km$ Direction, $\theta = \tan^{-1}\frac{60}{40} = \tan^{-1}(\frac{3}{2})$
34	$T = \frac{usin\theta}{g} = \frac{20\ sin30}{10} = \frac{20(\frac{1}{2})}{10} = 1\ s$ Maximum height reached $H = \frac{u^2\sin^2\theta}{2g} = \frac{20 \times 20 \times \left(\frac{1}{2}\right)^2}{20} = 5m$ $R = \frac{u^2 sin2\theta}{g} = \frac{20^2 sin60}{10} = \frac{400\sqrt{3}}{20} = 34.64\ m$
35	$R = \frac{u^2 sin2\theta}{g}$ $sin2\theta = 500 \times \frac{10}{100^2}$ $sin2\theta = \frac{1}{2}$ $\theta = 60°$ $H = \frac{u^2 \sin^2\theta}{2g} = \frac{100^2(\frac{3}{4})}{20} = 2400\ km$

	$T = \frac{2usin\theta}{g} = \frac{200\ sin60}{10} = \frac{200\left(\frac{\sqrt{3}}{2}\right)}{10} = 17.3\ s$ the horizontal velocity just before hitting the target will be the same as the initial horizontal velocity: $v = ucos\theta = 100\left(\frac{1}{2}\right) = 50\ m/s$
36	Given : $u_y = 0$ $a_y = g = 9.8 m/s^2$ Let the projectile's initial velocity be u. Time of flight $T = 3$ s (given) Using $T = \sqrt{\frac{2h}{g}}$ $\Rightarrow h = \frac{gT^2}{2}$ $\therefore h = \frac{9.8 \times 3^2}{2} = 44.1$ m x direction : $a_x = 0$ $\Rightarrow V_x = u$ y direction : $V_y = u_y + a_y T$ $\therefore V_y = 0 + 9.8 \times 3 = 29.4 m/s$ Also $\frac{V_y}{V_x} = \tan 45^o = 1$ $\Rightarrow V_x = V_y = 29.4$ m/s Thus initial speed of the projectile $u = V_x = 29.4 m/s$ 
37	$a = \frac{v^2}{r} = \frac{15^2}{50} = 4.5\ m/s^2$ $T = \frac{2\pi r}{v} = \frac{2(3.14)50}{15} = 20.93\ s$

	$f = \frac{1}{T} = \frac{1}{20.93} = 0.048\ Hz$
38	$F = ma = \frac{mv^2}{r} = 60\ N$ $T = \frac{\pi r}{v} = \frac{(3.14)100}{10} = 31.4\ s$ $\omega = \frac{v}{r} = \frac{10}{100} = 0.1\ rad/s$
39	i. a) R_{max} / 4 ii. a)Remains unchanged iii. c)Increase the launch angle of the bullet iv. a)Remains constant throughout the motion.
40	i. c)Along the radius towards the centre of the circular path. ii. a)The object's speed iii. d)The force is perpendicular to the velocity. iv. c)It is halved.

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