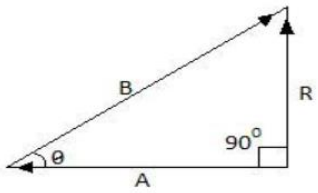
	INDIAN SCHOOL AL WADI AL KABIR	
Class: XI	**Department: SCIENCE 2024 – 25** **SUBJECT: PHYSICS**	**Date of submission:** **30-05-2024**
Worksheet No: 02 **WITH ANSWERS**	**CHAPTER / UNIT: MOTION IN A PLANE**	**Note:** **A4 FILE FORMAT**
NAME OF THE STUDENT:	**CLASS & SEC:**	**ROLL NO.:**

OBJECTIVE TYPE OF QUESTIONS (1 MARK):

1) What is the result of adding vectors A = $2\hat{\imath} + 3\hat{\jmath}$ and B = $-4\hat{\imath} + 5\hat{\jmath}$?
   a) $-2\hat{\imath} - 2\hat{\jmath}$
   b) $-2\hat{\imath} + 8\hat{\jmath}$
   c) $2\hat{\imath} + 8\hat{\jmath}$
   d) None of these

2) In the given diagram. R is the resultant of A and B. Then R = B/√2, value of angle θ is
   a) 0°
   b) 30°
   c) 60°
   d) 45°



3) The sum of the magnitudes of two forces acting at point is 18 and the magnitude of their resultant is 12. If the resultant is at 90° with the force of smaller magnitude, what are the, magnitudes of forces
   a) 12, 5
   b) 14, 4
   c) 5, 13
   d) 10, 8

4) If the magnitude of sum of two vectors is equal to magnitude of difference of two vectors, the angle between these two vectors is
   a) 0°
   b) 30°
   c) 60°
   d) 90°

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) How does acceleration affect an object's motion in a plane?
   a) Acceleration always causes an object to slow down
   b) Acceleration has no impact on an object's motion
   c) Acceleration always causes an object to speed up
   d) Acceleration can change the speed or direction of an object

7) A particle is acted upon by a force of constant magnitude which is always perpendicular to the velocity of the particle. The motion of the particle takes place in a plane. This implies that its ____
   a) Acceleration is constant
   b) Velocity is constant
   c) Kinetic energy is variable
   d) path of movement is circular

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 dot product of two vectors A and B is 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 boat moves from a point A $(4\hat{i}+5\hat{j})$ to another point across the river. The new position of the boat is given by B $(-7\hat{i}-9\hat{j})$. The displacement vector is given by
   a) $11\hat{i}+14\hat{j}$
   b) $-11\hat{i}-14\hat{j}$
   c) $-11\hat{i}+14\hat{j}$

d) $11\hat{i} - 14\hat{j}$

13) 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

14) Time of flight of a projectile is 10 s and its range is 500 m. The maximum height reached by it is
   a) 50 m
   b) 80 m
   c) 100 m
   d) 125 m

15) A body is projected horizontally from a point above the ground. The motion of the body is given by the equations $x = 2t$ and $y = 5t^2$ where x and y are horizontal and vertical displacements in metre at time t. The trajectory of the body is ____
   a) a straight line
   b) a circle
   c) an ellipse
   d) a parabola

16) 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

17) A particle moves with a constant speed v along a circular path of radius r and completes the circle in time T. The acceleration of the particle is ____
   a) $2\pi r/T$
   b) $2\pi v/T$
   c) $2\pi r^2/T$
   d) $2\pi\ v^2/\ T$

18) Zero vector or null vector is a necessity because,
   a) Zero as a number should be used
   b) There are no such zero vectors, it is only a scalar.
   c) When two vectors are equal, the resultant should be a vanishing vector with arbitrary direction.
   d) It helps in the dot product of two scalars.

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

19) **Assertion:** Adding two vectors of equal magnitude always results in a vector with a magnitude equal to the sum of the magnitudes of the individual vectors.
Reason: Vector addition follows the parallelogram law, where the resultant vector is represented by the diagonal of the parallelogram formed by the two vectors.

20) **Assertion**: A car moving along a circular track with a constant speed has a non-zero acceleration.
Reason: Acceleration is the change in velocity, and since velocity includes both speed and direction, the car's direction is continuously changing in circular motion.

21) **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.

22) **Assertion:** In projectile motion, the time taken for the projectile to reach its maximum height is equal to the time taken for it to return to the same horizontal level.
Reason: At maximum height, the vertical component of velocity becomes zero, and the projectile starts to descend with a constant acceleration due to gravity.

23) **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)

24) A body is moving on a curved path with a constant speed. What is the nature of its acceleration?

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

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

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

28) A projectile is fired at an angle of 30° with the horizontal with velocity 10m/s. What is its range? At what angle with the vertical should it be fired to get maximum range?

29) What will be the 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?

30) Two equal forces have their resultant equal to either. What is the inclination between them?

SHORT ANSWER TYPE OF QUESTIONS (3 MARK):

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

32) Derive expressions for velocity and acceleration for uniform circular motion.
OR

Derive expression for linear acceleration in uniform circular motion.

33) Two bodies are projected at an angle Θ and (π/2 - Θ) to the horizontal with the same speed. Find the ratio of their time of flight.

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

35) 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):

36) 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.

37) 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.

38) 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.

39) An aircraft is flying at a height of 3400 m above the ground. If the angle subtended at a ground observation point by the aircraft positions 10.0 s apart is 30°, what is the speed of the aircraft?

CASE STUDY TYPE OF QUESTIONS (4 MARK):

40) A unit vector is a vector of unit magnitude and points in a particular direction. Unit vectors along the x, y and z axis of a rectangular co-ordinate system are denoted by $\hat{i}$, $\hat{j}$, $\hat{k}$ respectively. If a vector $\vec{A}$ subtends an angle α, β and γ with x, y and z axis respectively, then magnitude of its components along the three axes are A_x =A cosα, A_y =A cosβ and A_z =A cos γ and the given vector $\vec{A}$ may be expressed as $\vec{A} = A_x \hat{i} + A_y \hat{j} + A_z \hat{k}$. Process of vector addition and subtraction becomes very simple because now we can add or subtract the respective components of given vectors. You are now given two vectors $\vec{A} = 2\hat{i} + 3\hat{j} + 4\hat{k}$ and $\vec{B} = 3\hat{i} - 2\hat{j} + \hat{k}$

   i. The value of $\vec{A} - \vec{B}$ is
      a) $-\hat{i} + 5\hat{j} + 3\hat{k}$
      b) $5\hat{i} + \hat{j} + 5\hat{k}$
      c) $\hat{i} - 5\hat{j} - 3\hat{k}$
      d) $-5\hat{i} - \hat{j} - 5\hat{k}$

   ii. The magnitude of $|\vec{A} + \vec{B}|$ is
      a) √50

b) √51
c) √49
d) √1

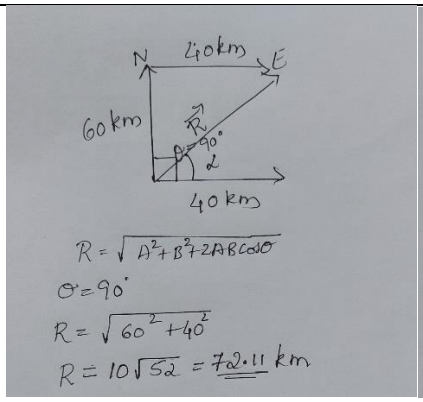
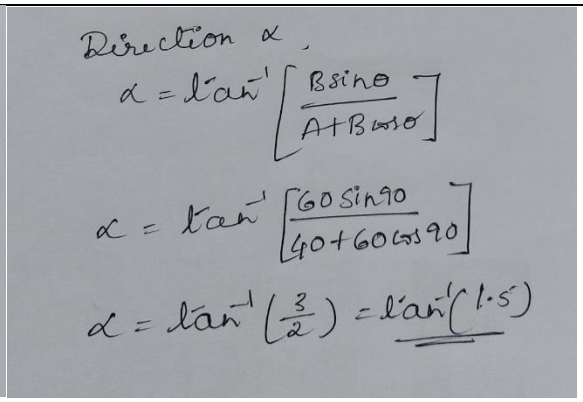
iii. Vector addition
a) Obeys commutative law
b) Does not obey commutative law
c) Sometimes obeys and sometime doesn't obey the commutative law
d) None of these

iv. The value of $\vec{A} \times \vec{B}$ is

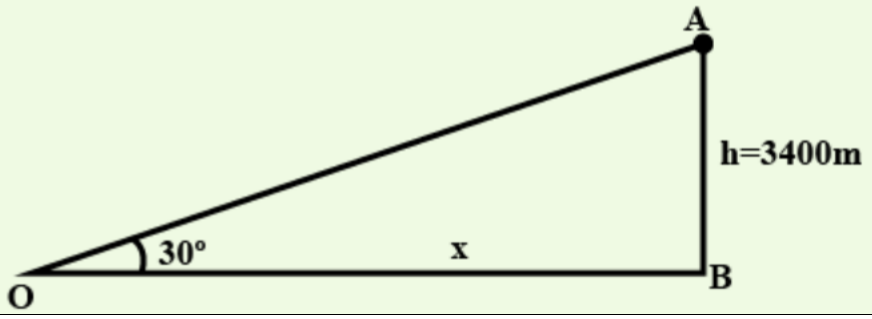
a) $6\hat{\imath} - 6\hat{\jmath} + 4\hat{k}$
b) $6\hat{\imath} - 6\hat{\jmath} - 4\hat{k}$
c) $-11\hat{\imath} - 10\hat{\jmath} - 13\hat{k}$
d) $11\hat{\imath} - 10\hat{\jmath} - 13\hat{k}$

ANSWER KEY	
1	b) $-2\hat{\imath} + 8\hat{\jmath}$
2	d)45°
3	c)5, 13
4	d) 90°
5	a)Due north
6	d)Acceleration can change the speed or direction of an object
7	d)path of movement is 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	b)$-11\hat{\imath} - 14\hat{\jmath}$
13	d)2 N
14	d)125 m
15	d)a parabola
16	c)4π rad/s
17	c)$2\pi r^2/T$
18	c)When two vectors are equal, the resultant should be a vanishing vector with arbitrary direction.
19	d)A is false but R is true
20	a)Both A and R are true, and R is the correct explanation of A.
21	a)Both A and R are true, and R is the correct explanation of A.
22	a)Both A and R are true, and R is the correct explanation of A.
23	c) A is true but R is false.
24	Acceleration must be perpendicular to the direction of motion and is called centripetal acceleration.
25	$\omega = 2\pi/12 = \pi/6$ rad h^{-1}

26	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}.
27	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.
28	$R=\frac{v^2 \sin 2\theta}{g}$ Where $\theta=30^0$ *and* $v=10m/s$ $R=\frac{10^2 \sin 60^0}{10}=5\sqrt{3}m$ *For maximum horizontal range,* $2\theta=90^0$ *or* $\theta=45^0$ *Angle with vertical* $=90^0-\theta=90^0-45^0=45^0$
29	$H=\frac{v_0^2 \sin^2(\theta)}{2g}$ $H_1=\frac{v_0^2 \sin^2(30^\circ)}{2g}$ $H_2=\frac{v_0^2 \sin^2(60^\circ)}{2g}$ $H_1=\frac{v_0^2 \sin^2(30^\circ)}{2g}=\frac{v_0^2\left(\frac{1}{2}\right)^2}{2g}=\frac{v_0^2}{8g}$ $H_2=\frac{v_0^2 \sin^2(60^\circ)}{2g}=\frac{v_0^2\left(\frac{\sqrt{3}}{2}\right)^2}{2g}=\frac{3v_0^2}{8g}$ So, the ratio of maximum heights H_2 to H_1 is: $\frac{H_2}{H_1}=\frac{\frac{3v_0^2}{8g}}{\frac{v_0^2}{8g}}=\frac{3}{1}$

30	Here A = F; B = F; R = F; θ =? Now $R = \sqrt{A^2 + B^2 + 2AB\cos\theta}$ $F = \sqrt{F^2 + F^2 + 2F.F.\cos\theta}$ $= F\sqrt{2(1+\cos\theta)}$ $\Rightarrow 1 = 2(1+\cos\theta)$ $\cos\theta = -\frac{1}{2} = \cos 120^\circ$ $\Rightarrow \theta = 120^\circ$
31	Refer the class work
32	we know, v = rω so, $\omega = \frac{v}{r}$ angular acceleration is the rate of change of angular velocity. e.g., $\alpha = \frac{\triangle\omega}{\triangle t}$ or $\alpha = \frac{d\omega}{dt}$ $\alpha = \frac{d(\frac{v}{r})}{dt}$ $\alpha = \frac{dv}{dt}\frac{1}{r}$ $\alpha = \frac{a}{r}$ or a = rα.....(i)
33	$T \propto \sin\theta$ (As both the projectile is projected with the same initial speed u, an the value of g is constant.) $\frac{T_1}{T_2} = \frac{\sin\theta_1}{\sin\theta_2}$ $= \frac{\sin\theta}{\sin(90^\circ-\theta)}$ $= \frac{\sin\theta}{\cos\theta}$
34	Refer the class work
35	 
36	$T = \frac{usin\theta}{g} = \frac{20\,sin30}{10} = \frac{20\left(\frac{1}{2}\right)}{10} = 1\,s$

	Maximum height reached $H = \frac{u^2\sin^2\theta}{2g} = \frac{20 \times 20 \times \left(\frac{1}{2}\right)^2}{20} = 5\text{m}$ $R = \frac{u^2 sin2\theta}{g} = \frac{20^2 sin60}{10} = \frac{400\sqrt{3}}{20} = 34.64\ m$
37	$u_y = 0$ and $a_y = g = 9.8\text{m/s}^2$ Using the first equation of motion we get $s_y = u_y t + \frac{1}{2}a_y t^2$ $s_y = 0 \times 3 + \frac{1}{2} \times 9.8 \times 3^2$ $s_y = 44.1$ m Therefore, the height of the tower is 44.1 m. From the first equation of motion $v_y = u_y + a_y t = 0 + 9.8(3)$ $v_y = 29.4$ m/s As the resultant velocity v makes an angle of 45° with the horizontal, so $\tan 45° = \frac{v_y}{v_x}$ or $1 = \frac{29.4}{v_x}$ $v_x = 29.4\text{m/s}$ Therefore, the speed with which the body was projected (horizontally) is 29.4 m/s.
38	$a_c = \frac{v^2}{r}$ $a_c = \frac{(15\,\text{m/s})^2}{50\,\text{m}}$ $a_c = \frac{225}{50}\,\text{m/s}^2$ $a_c = 4.5\,\text{m/s}^2$ $T = \frac{2\pi r}{v}$ $T = \frac{2\pi \times 50}{15}$ $T = \frac{100\pi}{15}$ $T \approx 20.94\,\text{s}$ $f = \frac{1}{T}$ $f = \frac{1}{20.94}$ $f \approx 0.0477\,\text{Hz}$

39	In right angled triangle OAB, $\tan 30^\circ = \frac{h}{x}$ We get $x = \frac{h}{\tan 30^\circ}$ $\therefore x = 3400\sqrt{3} = 5889$ m Time taken t = 10.0 s Thus speed of the aircraft $v = \frac{x}{t}$ $\therefore v = \frac{5889}{10.0} = 588.9$ m/s 
40	i. a) $-\hat{i} + 5\hat{j} + 3\hat{k}$ ii. b) $\sqrt{51}$ iii. a) Obeys commutative law iv. d) $11\hat{i} - 10\hat{j} - 13\hat{k}$

PREPAED BY: *Ms VIVETTE SHIRLY LASRADO*	*CHECKED BY:* *HoD SCIENCE*