QB365

Important Questions - Motion in a Plane

11th Standard CBSE

Physics

Reg.No. : | | | | | | |

Time : 01:00:00 Hrs

Total Marks : 50

Section-A

1) Three vectors not lying in a plane can never end up to give a null vector. Is it true? **1**

2) If $|A \times B| = A.B$, What is the angle between A and B? **1**

3) If A.B = $|A \times B|$, Find the value of angle between A and B. **1**

4) When the sum of the two vectors maximum and minimum? **1**

5) If A.B = $|A \times B|$, Find the value of angle between A and B. **1**

6) When the sum of the two vectors maximum and minimum? **1**

7) A body is projected with speed u at an angle θ to the horizontal to have maximum range. What is the velocity at the highest point? **1**

8) A particle cannot accelerate if its velocity is constant, why? **1**

9) Give a few wxamples of motion in two dimensions. **1**

10) Why does a tennis ball bounce higher on hills than in plains? **1**

Section-B

11) Explain the property of two vectors A and B if **2**

12) A passenger arriving in a new town wishes to go from the station to a hotel located 10 Km away on a straight road from the station. A dishonest cabman takes him along a circutious path 23 km long and reaches the hotel in 28 min.
What is the average speed of the taxi **2**

13) Find the angle of projection at which horizontal range and maximum height are equal. **2**

14) A women rides a carnival ferris wheel at radius 15m, completing five turns about its horizontal axis every minute. What are the magnitude. **2**

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

17) Can a flight of a bird, an example of composition of vectors. Why? **2**

18) 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 s apart is 30°, what is the speed of the aircraft? **2**

19) A man can swim with a speed of 4 km/h in still water. How long does he take to cross a river 1 km wide, if the river flows steadily 3 km/h and he makes his strokes normal to the river current. How far down the river does he go when he reaches the other bank? **2**

20) Abiker stands on the edge of a cliff 490 m above the ground and throws a stone horizontally with an initial speed of 15 m/s. Neglecting air resistance, find the time taken by the stone to reach the ground and the speed with which it hits the ground. Consider g = 9.8 m/s^2. **2**

Section-C

21) A particle is projected in air at an angle β to a surface which itself is inclined at an angle α to the horizontal as shown in figure **5**

Find (i) time of flight (ii) expression for the range on the plane surface i.e. L and (iii) the value of β at which range will be maximum.

22) State the reason , whether the following algebraic operations with scalar and vector physical quantities are meaningful **5**

Multiplying any two scalars

23) State the reason , whether the following algebraic operations with scalar and vector physical quantities are meaningful **5**

24) If A and B are two vectors such that $|A \times B| = \sqrt{3}A.A$ Then, **5**

Find the angle between A and B

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Section-A

1) Yes, because they cannot be represented by the three sides of a triangle taken in the same order **1**

2) **1**

As we know, AXB=ABsinθ A.B=ABcosθ According to the question ABsinθ = ABcosθ

$\Rightarrow \frac{sin\theta}{cos\theta} = 1 \Rightarrow tan\vartheta \Rightarrow \theta = 45^0$

3) As A.B = $|A \times B|$ AB cos θ = AB sinθ or tanθ = 1 or $\theta = \pi/4$ **1**

4) **1**

The sum of two vectors is maximum, when both the Vectors are in the same direction and is minimum when they act in opposite direction. As, R = $\sqrt{A^2 + B^2 + 2ABcos\theta}$ (i) For R to be maximum, cosθ = +1

$R_{max}\sqrt{A^2 + B^2 + 2AB} = A + B$ (ii) For R to be minimum cosθ = -1 or θ=180^0

$R_{min}\sqrt{A^2 + B^2 + 2AB(-1)} = A - B$

5) As A.B = $|A \times B|$ AB cos θ = AB sinθ or tanθ = 1 or $\theta = \pi/4$ **1**

6) **1**

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7) $\frac{u}{\sqrt{2}}$ **1**

8) 1

When the particle is moving with a constant velocity, there is no change in velocity with time and hence, its acceleration is zero.

9) 1

A ball dropped from an aircraft flying horizontally, a gun short fired at some angle with the horizontally, etc.

10) 1

Maximum height attained by a projectile $\alpha 1/g$.As the value of g is less on hills than on plains, so a tennis ball bounces higher on hills than on plains.

Section-B

11) As we know that 2

$$|A+B| = \sqrt{A^2+B^2+2AB\ \ cos\ \ \theta}$$

And $|A-B| = \sqrt{A^2+B^2-2AB\ \ cos\ \ \theta}$

But as per question, we have

$$\sqrt{A^2+B^2+AB\ \ cos\ \ \theta} = \sqrt{A^2+B^2-2AB\ \ cos\theta}$$

Squaring both sides, we have (4 AB cos)=0

$$\sqrt{A^2+B^2+AB\ \ cos\ \ \theta} = \sqrt{A^2+B^2-2AB\ \ cos\theta}$$

Hence, the two vectors A and B are perpendicular to each other

12) Given, shortest distance between the station and the hotel = 10 km 2

Displacement of the taxi = 10 km

Distance travelled by the taxi = 23 km

Time taken by the taxi = 28 min = $\frac{28}{60} = \frac{7}{15}h$

Average speed of the taxi = $= \frac{Total\ \ distance\ \ travelled}{Total\ \ time\ \ taken}$

$$= \frac{23}{(7/15)} = \frac{345}{7}km/h = 49.3km/h$$

13) Horizontal range = Maximum height (given) 2

$$\frac{u^2}{g}sin2\theta = \frac{u^2sin^2\theta}{2g} \Rightarrow 2sin\theta cos\theta = \frac{sin^2\theta}{2} \quad [sin2\theta = 2cos\theta sin\theta]tan\theta = 4 \Rightarrow \theta = 75^o58'$$

14) 4.1 m/s^2. 2

15) up 2

16) Here, r = 1 km = 1000 m, 2

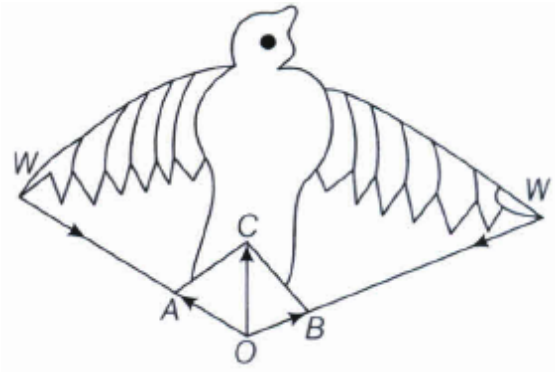
v = 900 kmh^{-1} = 900 X (1000m(/(60X60s) = 250 ms^{-1}

Centripetal acceleration, a = $\frac{v^2}{r} = \frac{(250)^2}{1000}$

Now, $\frac{a}{g} = \frac{(250)^2}{1000}X\frac{1}{9.8} = 6.38$

17) **2**

Yes, the flight of a bird is an example of composition of vectors. As the bird flies, it strikes the air with its wings W, W along WO. According to Newton's third law of
motion, air strikes the wings in opposite directions with the same force in reaction. The reactions are OA and OB. From law of parallelogram vectors, OC is the
resultant of OA and OB. This resultant upwards force OC is responsible for the flight of the bird.



18) **2**

In figure, 0 is the observation point at the ground, A and B are the positions of aircraft for which $\angle AOB = 30°$. Draw a perpendicular OC on AB.Here OC=3400 m and $\angle AOC = \angle COB = 15°$.Time taken by aircraft from A to B is 10 s.

In ΔAOC, AC=OC tan15°

=3400 $\times$ 0.2679

=910.86 m

AB=AC+CB=AC+AC=2AC

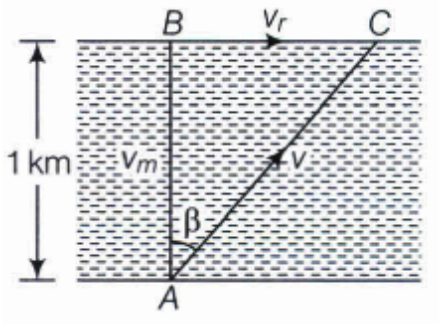
=2 $\times$ 910.86 m

Speed of the aircraft

$v=\frac{distance \quad AB}{time} = \frac{2\times 910.86}{10}$

=182.17 ms^{-1} = 182.2 ms^{-1}

19) Given, speed of man (v_m) = 4 km/h **2**



Speed of river (v_r) = 3 km/h

Width of the river (d) = 1 km

Time taken by the man to cross the river

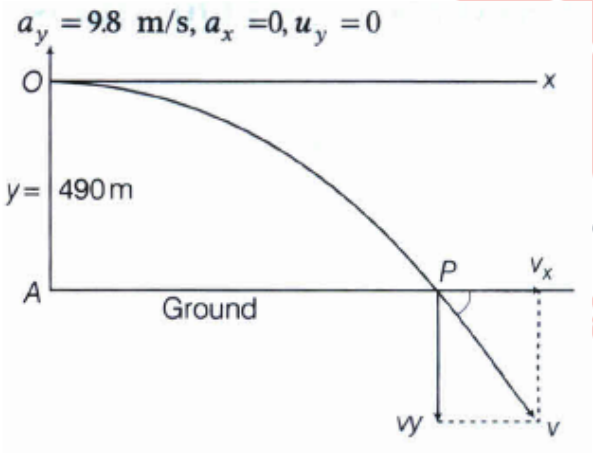
$$t = \frac{Width\ \ of\ \ the\ \ river}{Speed\ \ of\ \ the\ \ man} = \frac{1\ \ km}{4\ \ km/h} = \frac{1}{4}\ h$$

$$= \frac{1}{4} \times 60 = 15\ min$$

Distance travelled along the river = $v_r \times t = 3 \times \frac{1}{4}$

$$= \frac{3}{4} km = \frac{3000}{4} = 750\ m$$

20) Given, h=490 m, u_x= 15 m/s, a_y=9.8 m/s, a_x=0, u_y=0 **2**



Time taken by the stone is t= $\sqrt{\frac{2h}{g}} = \sqrt{\frac{2 \times 490}{9.8}} = 10\ s$

$v_x = u_x + a_x t = 15 + 0 \times 10 = 15\ m/s$

$v_y = u_y + a_y t = 0 + 9.8 \times 10 = 98\ m/s$

$v = \sqrt{v_x^2 + v_y^2} = \sqrt{15^2 + 98^2} = 99.14\ m/s$

Section-C

21) **Ans.** (i) $T = \frac{2u_0 \sin \beta}{g \cos \alpha}$ **5**

(ii) $R = \frac{2u_0 \sin \beta \cos(\alpha + \beta)}{g \cos^2 \alpha}$

(iii) $\beta = \frac{\pi}{4} - \frac{\alpha}{2}$

22) **5**

Yes, Multiplying any two scalars is meaningful.Density p and volume V both the scalar quantities.When density is multiplied by volume,then we get $p \times VB = m$, mass of the body,which is scalar quantity

23) **5**

Yes,adding a component of a vector of the same vector is meaningful because both vectors are of same dimensions

24) 60^o **5**