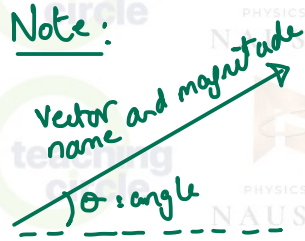
Collisions in 2D

1D VECTORS

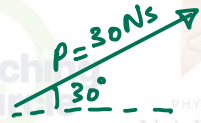
Horizontal

Vertical

Note:

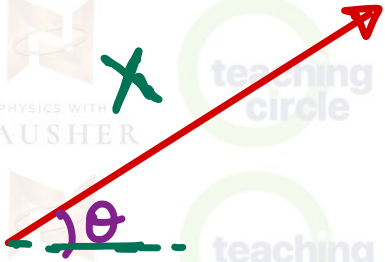


e.g

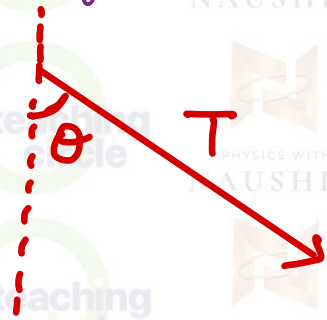


2D VECTORS

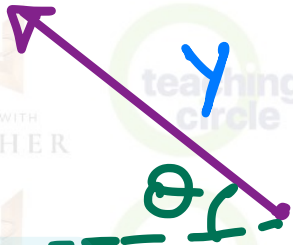
① right and up or up and right



② down and right or right and down

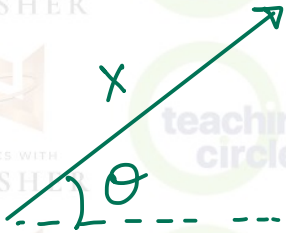


③ _____



④ _____

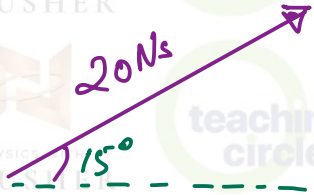
Vector Resolution



Horizontal component of X = _____

Vertical component of X = _____

Q.



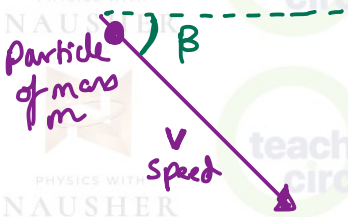
Horizontal component of momentum = $20\cos 15°$

= _____ Ns

Vertical component of momentum = $20\sin 15$

= _____ Ns

Q A particle of mass m and speed v flies off in a direction as shown below:



momentum of particle = mv

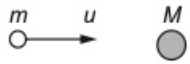
In terms of m, v, θ

horizontal component of momentum = $mv\cos\beta$

vertical component of momentum = $mv\sin\beta$

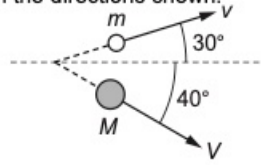
Note: Do vectors and their components always have the same units. Yes / No.

22 A ball of mass m travelling at velocity u collides with a stationary ball of mass M. After collision the two balls travel at velocities v and V respectively, in the directions shown.



before collision

not to scale



after collision

A student writes three equations relating to the collision.

a) State the total initial momentum.

$m_1u_1 + m_2u_2 =$

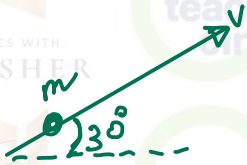
b) What is the direction of total initial momentum.

c) What should be the direction of total final momentum

Since the total initial momentum is to the right, by Law of Conservation of momentum, the total momentum after the collision should be towards right.

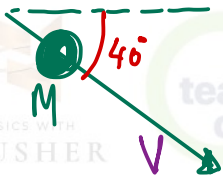
d) What is the initial vertical momentum

e) After collision



Horizontal component = _____

Vertical component = _____



Horizontal component = _____

Vertical component = _____

Total Horizontal momentum after collision = $mv\cos 30 + MV\cos 40$

Total vertical momentum after collision = $mv\sin 30 - MV\sin 40$

f) Apply LOCOM in

i) X-direction

Total momentum before = Total momentum after

$$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$$

ii) Y-direction

Total momentum before = Total momentum after

$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$

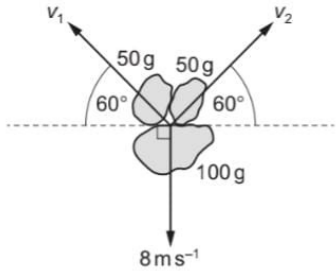
g) Why do the particles fly off in opposite directions vertically?

since _____ momentum is zero,

hence _____ momentum must also be zero. since momentum is a vector quantity, the vertical momentums of the two objects are in opposite directions so their vector sum will be zero.

Note: Recall

10 A stationary firework explodes into three pieces. The masses and the velocities of the three pieces immediately after the explosion are shown.



What are speed v_1 and speed v_2?

	v_1 / m s^{-1}	v_2 / m s^{-1}
A	4.0	4.0
B	9.2	9.2
C	14	14
D	16	16

(a) State the principle of conservation of momentum.

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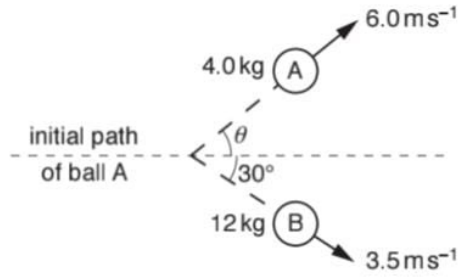
.....[2]

(b) Ball A moves with speed v along a horizontal frictionless surface towards a stationary ball B, as shown in Fig. 3.1.

before collision

Fig. 3.1



after collision

Fig. 3.2 (not to scale)

Ball A has mass 4.0 kg and ball B has mass 12 kg.
The balls collide and then move apart as shown in Fig. 3.2.
Ball A has velocity 6.0 m s^{-1} at an angle of θ to the direction of its initial path.
Ball B has velocity 3.5 m s^{-1} at an angle of 30° to the direction of the initial path of ball A.

(i) By considering the components of momentum at right-angles to the direction of the initial path of ball A, calculate θ.

θ = ... ° [3]

(ii) Use your answer in **(i)** to show that the initial speed v of ball A is $12\,m\,s^{-1}$. Explain your working.

[2]

(iii) By calculation of kinetic energies, state and explain whether the collision is elastic or inelastic.

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.....[3]

[Total: 10]