Topic: Scalar and Vector. Date:

Points to cover.

1) Addition of Vectors
2) Subtraction of vectors.
3) Resolution of vectors
4) Conditions for Equilibrium.
5) Construction of Vector Triangle for Equilibrium.

Scalar Quantities: Quantities that are expressed in terms of their magnitude ; no direction is required. most Physical quantities are scalars

Mass , time , length, distance , Volume , density , speed , Area , Power Energy , current , Resistance , temperature , voltage, Specific H.C , Specific latent Heat.

Vector Quantities. That can be expressed both in terms of magnitude and direction.

Example :- displacment , velocity , Acceleration, gravitational field strength Weight , Electric field etc

Topic: _____ Date: _____

Case 1 : Mark Direction of Resultant in given examples.

* To obtain resultant with exact value we use the method of Head to tail rule, In this method head of first vector is joined with the tail of second vector.
The resultant is obtained by constructing a Triangle.

> The magnitude of the resultant can be obtained Either by using a scale diagram or by using Trignometric Functions.

Examples of Vector Addition:

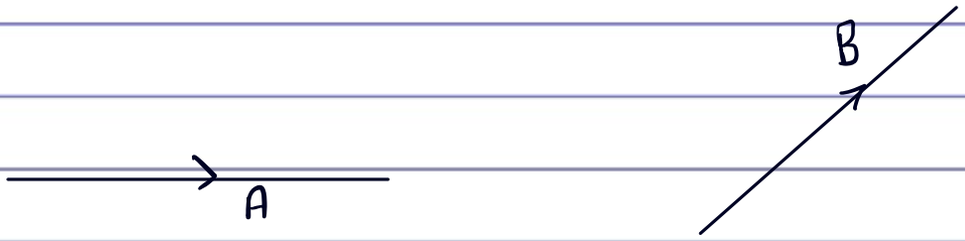
(1)

Given that C is the resultant of A+B construct a vector diagram.

Topic: _____ Date: _____

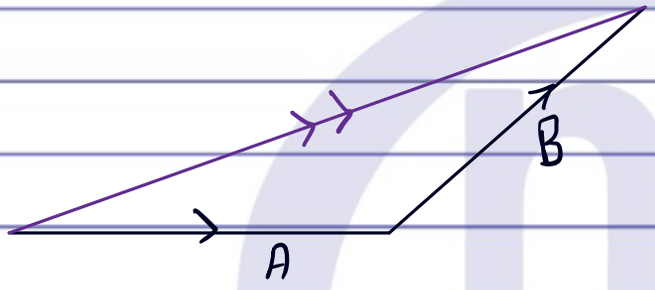
Examples of Vector Addition:

(1)



Given that C is the resultant of A+B construct a vector diagram.

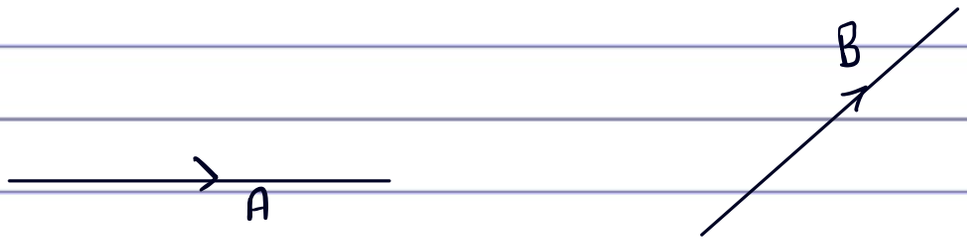
Solution. $A + B = C$



The Arrow of the Head of resultant must point towards the arrow head of the vectors.

Topic: _____ Date: _____

Examples of Vector Subtraction.

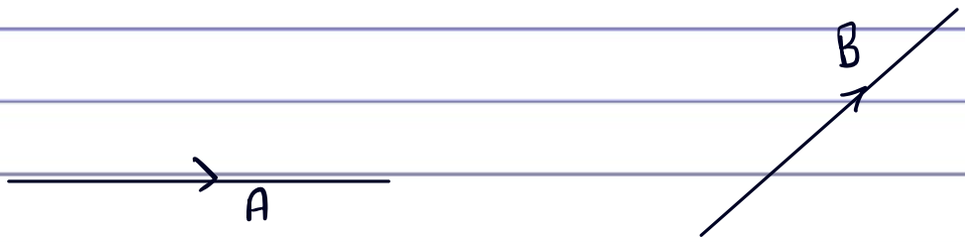
① 

Given that C is the resultant of A - B construct a vector diagram.

Topic: _____ Date: _____

Examples of Vector Subtraction.

①



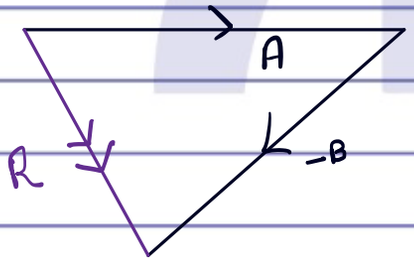
Given that C is the resultant of A-B construct a vector diagram.

Solution:

$$A - B = C$$

$$A + (-B) = C$$

→ Direction of B must be reversed.



Topic: _____ Date: _____

Example Question.

A Car is initially moving with a velocity of 60m/s due East
After some time it changes its direction and starts moving at 8 m/s in the direction North-East.

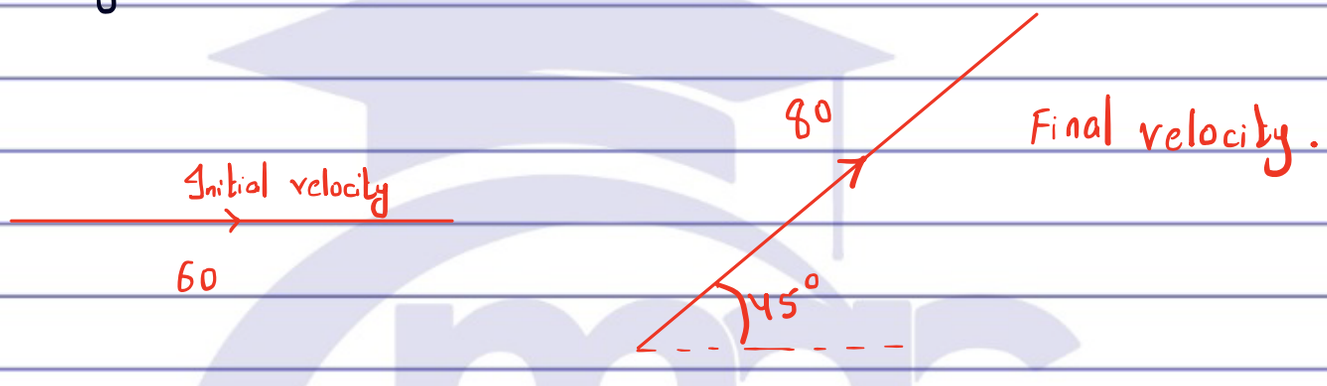
→ Construct a vector diagram to calculate magnitude of change in velocity.

Topic: _____ Date: _____

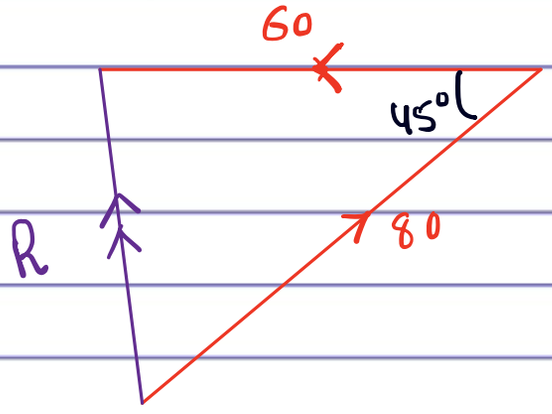
Example Question.

A Car is initially moving with a velocity of 60m/s due East
After some time it changes its direction and starts moving at 8 m/s in the direction North-East.

→ Construct a vector diagram to calculate magnitude of change in velocity.



$\Delta V = F.V - I.V \Rightarrow FV + (-IV)$



Cosine Rule

$R^2 = 60^2 + 80^2 - 2(60)(80)\cos 45$

$\Delta V = 56.7$ m/s.

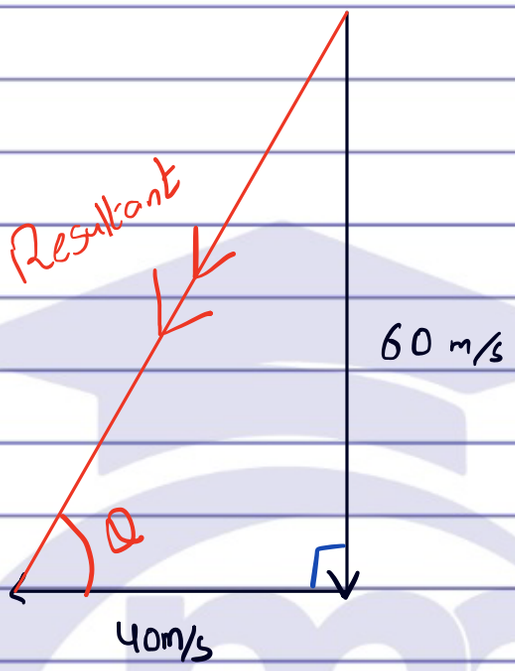
Topic: _____ Date: _____

Q) A car is travelling at 60m/s due south. Some time later it travels at 40m/s due west use a suitble scale to construct a vector diagram so that we can obtain the magnitude of Resultant & its direction (angle) with the horizontal.

Topic: _____ Date: _____

Q) A car is travelling at 60m/s due south. Some time later it travels at 40m/s due west use a suitble scale to construct a vector diagram so that we can obtain the magnitude of Resultant & its direction (angle) with the horizontal.

1cm = 10m/s



$R^2 = 60^2 + 40^2$

$= 72.1 \text{ m/s}$

$\tan\theta = \frac{60}{40}$

$\theta = 56.3^\circ$

Topic: _____ Date: _____

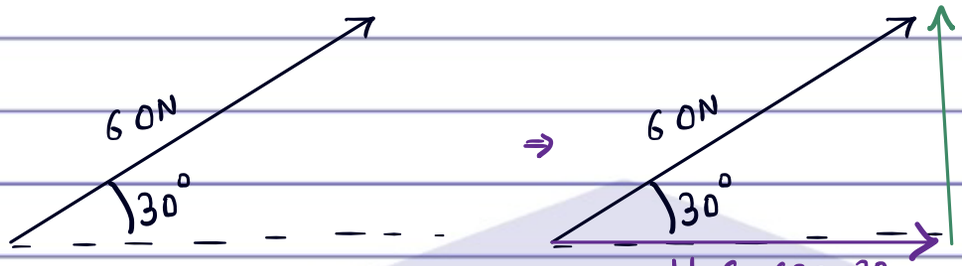
⇒ Resolution of Vectors.

The term resolution or Resolve means breaking down any vector into two perpendicular fragments or components

These components Are reffered as

* Horizontal component (HC)
* Vertical component. (VC)

Ex 1



$\text{Cos}\,\theta = \frac{\text{Adj}}{\text{Hyp}}$

$\text{Cos}\,30 = \frac{HC}{60}$

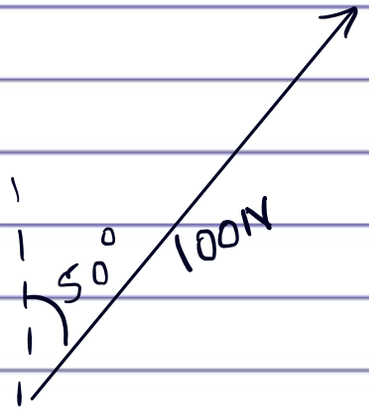
$60\,\text{Cos}\,30 = HC.$

$\text{Sin}\,\theta = \frac{\text{Opp}}{\text{Hyp}}$

$\text{Sin}\,30 = \frac{VC}{60}$

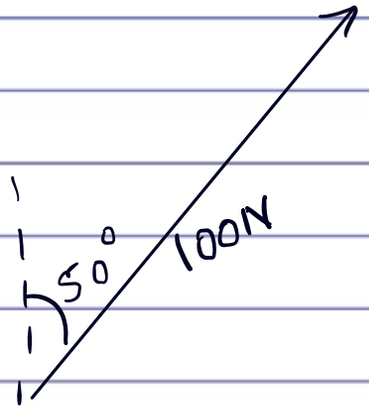
$60\,\text{Sin}\,30 = VC$

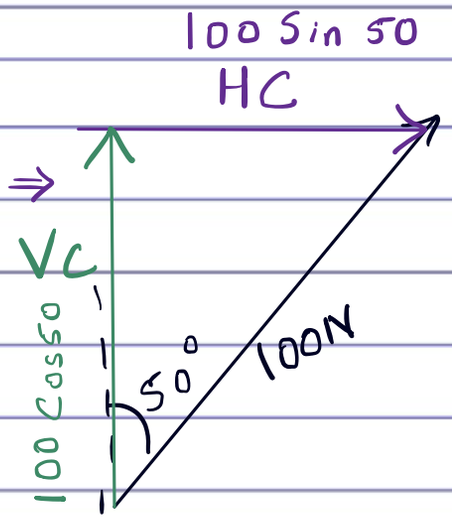
Ex 2



Topic: _____ Date: _____

Ex2





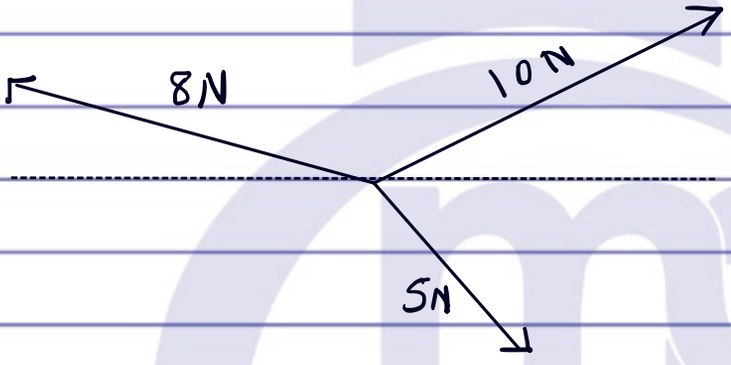
$\Rightarrow \quad \sin 50 = \frac{HC}{100}$

$100 \sin 50 = HC$

$\Rightarrow \quad \cos 50 = \frac{VC}{100}$

$100 \cos 50 = VC$

Q3)



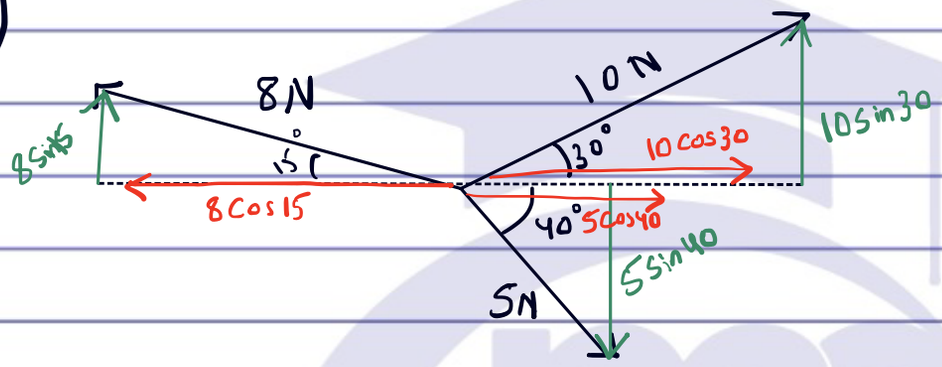
i) By resolving find the resultant of these vectors in the Horizontal plane.

ii) By Resolving find the verticle of these vectors in the horizontal plane.

Topic: _____ Date: _____

iii) Hence find the (overall) resultant of all these forces.

Q3)



i) By resolving find the resultant of these vectors in the Horizontal plane.

$10\cos 30 + 5\cos 40 - 8\cos 15$ (+ →)

$= 4.8\,N$

ii) By Resolving find the vertical of these vectors in the horizontal plane.

$10\sin 30 + 8\sin 15 - 5\sin 40$ (+ ↑)

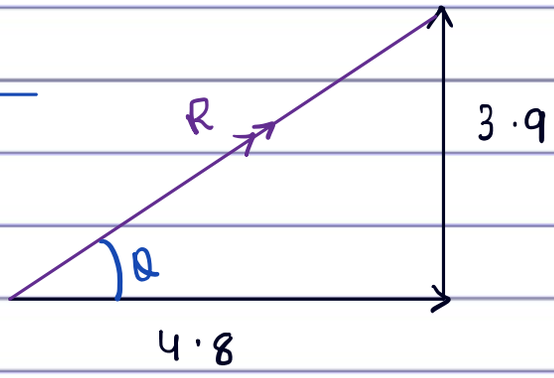
$= 3.9\,N$

Topic: _____ Date: _____

iii) Hence find the (overall) resultant of all these forces.

$R = \sqrt{(4.8)^2 + (3.9)^2}$

$= 6.2N$

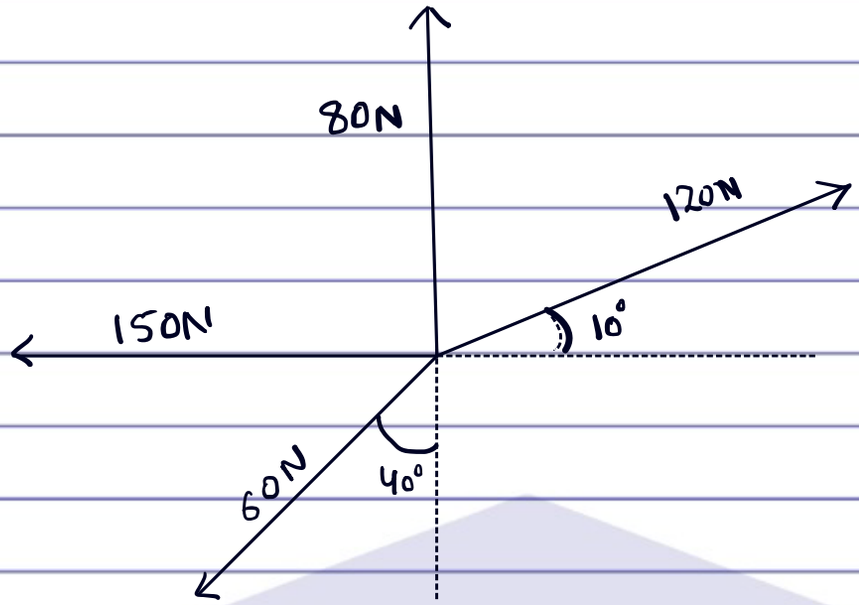


Direction of Horizontal

$\tan\theta = \frac{3.9}{4.8}$ $\theta = 39^\circ$.

Topic: _____ Date: _____

Find the magnitude of the resultant in the given diagrams?



Topic: _____ Date: _____

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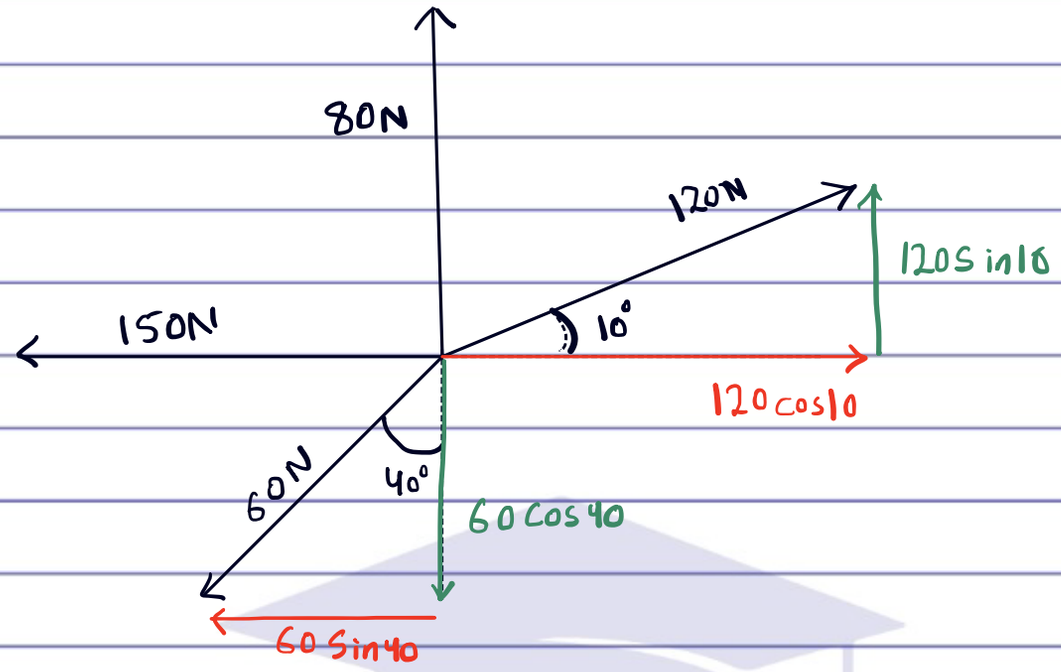
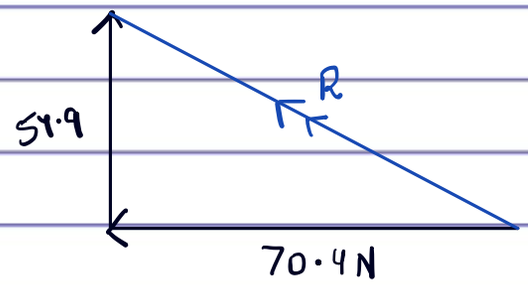


$120\cos 10 - 150 - 60\sin 40$

$= -70.4\,N$

$120\sin 10^\circ + 80 - 60\cos 40$

$= 54.9\,N$

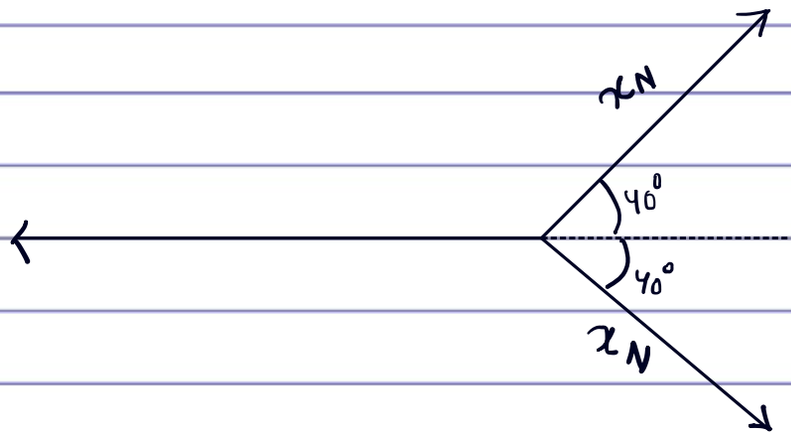


$R^2 = (70.4)^2 + (54.9)^2$

$R = 89.3N$

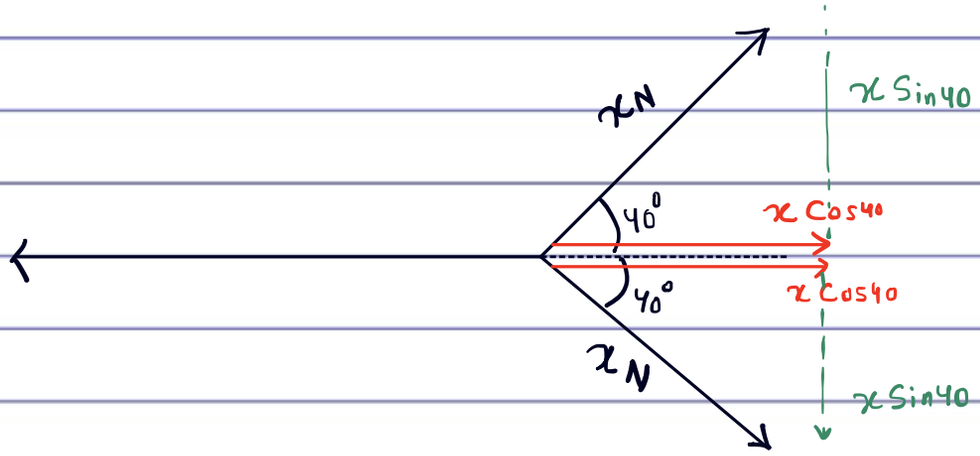
Topic: _____ Date: _____

Q6



Two identical forces of x newtons each are shown. Given that the object is in Equilibrium / Rest Cal x ?

Topic: _____ Date: _____



Two identical forces of x newtons each are shown. Given that the object is in Equlibrium / Rest Cal x ?

Equlibrium / Rest
Resultant = 0
and
Forces ⇒ Balanced.

* You may ignore forces in the vertical plane as they cancel out

* horizontal plane

RHS = LHS

$X\cos 40 + X\cos 40 = 12$

$x = 7.83N$

* This can also be solved using a vector Triangle for Equllibrium.

Topic: _____ Date: _____

The velocity vector diagram for an aircraft heading due north is shown to scale in Fig. 1.1. There is a wind blowing from the north-west.

Fig. 1.1

The speed of the wind is $36\,m\,s^{-1}$ and the speed of the aircraft is $250\,m\,s^{-1}$.

(i) Draw an arrow on Fig. 1.1 to show the direction of the resultant velocity of the aircraft. **[1]**

Topic: _____ Date: _____

The velocity vector diagram for an aircraft heading due north is shown to scale in Fig. 1.1. There is a wind blowing from the north-west.

Cosine Rule

$R^2 = 36^2 + 250^2 - 2(36)(250)\cos 45$

$R = 226\ m/s$

Fig. 1.1

The speed of the wind is $36\,m\,s^{-1}$ and the speed of the aircraft is $250\,m\,s^{-1}$.

(i) Draw an arrow on Fig. 1.1 to show the direction of the resultant velocity of the aircraft. **[1]**

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Topic: _____ Date: _____

A boat travels across a river in which the water is moving at a speed of $1.8\,m\,s^{-1}$. The velocity vectors for the boat and the river water are shown to scale in Fig. 1.1.

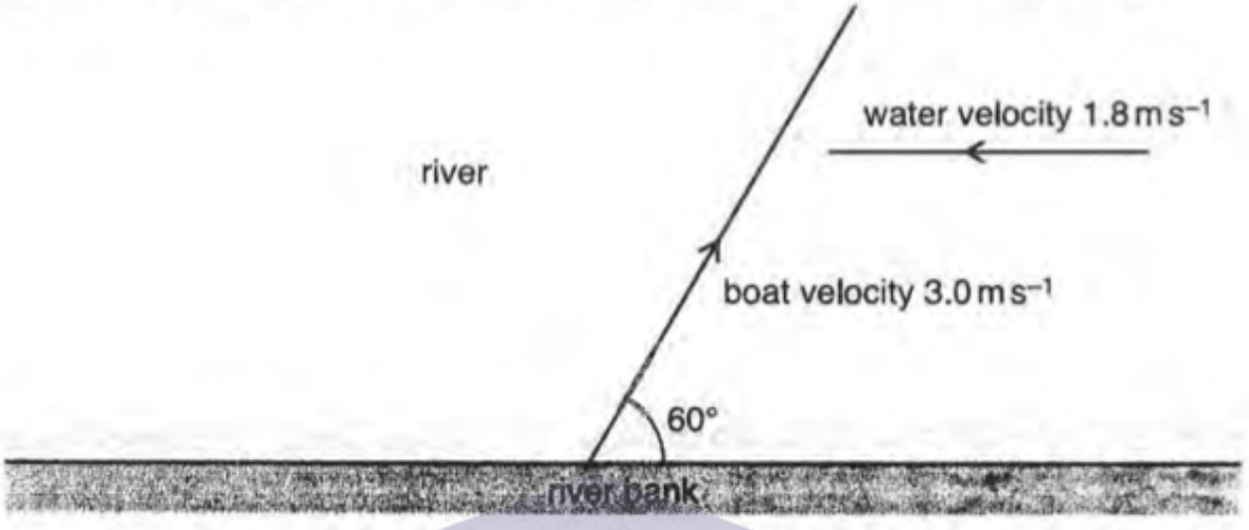


Fig. 1.1 (shown to scale)

In still water the speed of the boat is $3.0\,m\,s^{-1}$. The boat is directed at an angle of 60° to the river bank.

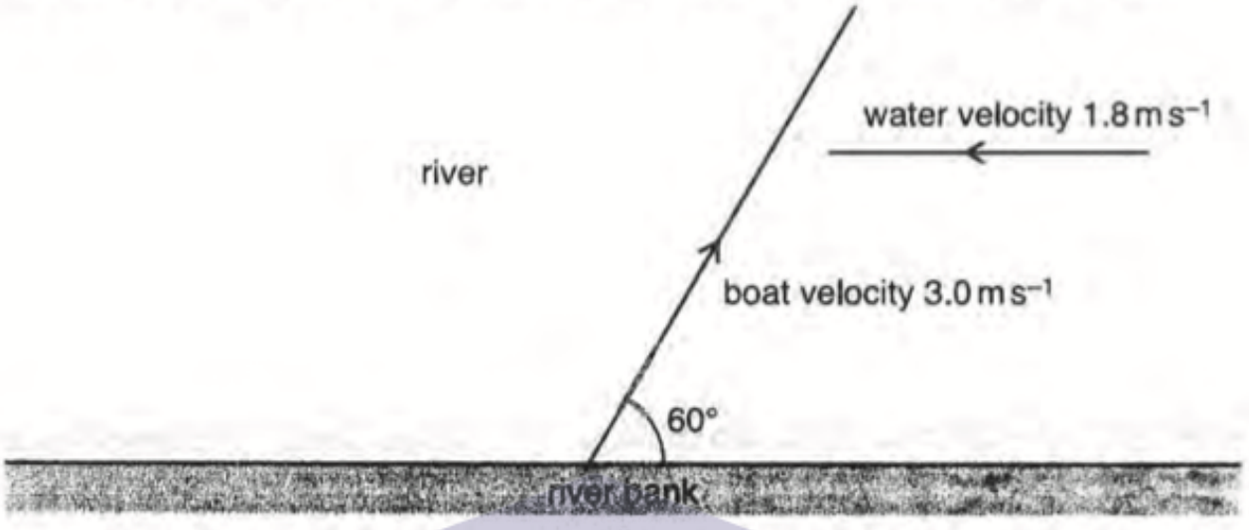
(i) On Fig. 1.1, draw a vector triangle or a scale diagram to show the resultant velocity of the boat. **[2]**

(ii) Determine the magnitude of the resultant velocity of the boat.

resultant velocity = ... $m\,s^{-1}$ **[2]**

Topic: _____ Date: _____

A boat travels across a river in which the water is moving at a speed of $1.8\,m\,s^{-1}$. The velocity vectors for the boat and the river water are shown to scale in Fig. 1.1.



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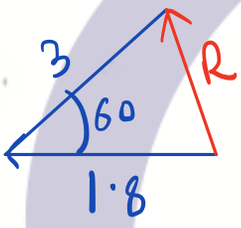
Cosine Rule

=



resultant velocity = ... $m\,s^{-1}$ **[2]**

A boat is travelling in a flowing river. Fig. 1.1 shows the velocity vectors for the boat and the river water.

Fig. 1.1

The velocity of the boat in still water is 14.0 m s^{-1} to the east. The velocity of the water is 8.0 m s^{-1} from 60° north of east.

(i) On Fig. 1.1, draw an arrow to show the direction of the resultant velocity of the boat. [1]

(ii) Determine the magnitude of the resultant velocity of the boat.

magnitude of velocity = ... m s^{-1} [2]

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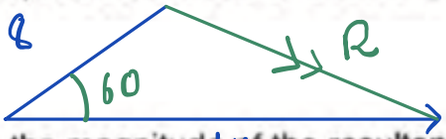


(ii) Determine the magnitude of the resultant velocity of the boat.

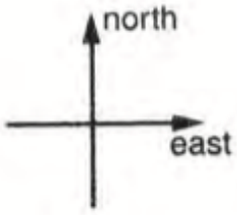
Use Cosine Rule?

magnitude of velocity = ... m s^{-1} [2]

Topic: _____ Date: _____

) A girl runs 120 m due north in 15 s. She then runs 80 m due east in 12 s.

(i) Sketch a vector diagram to show the path taken by the girl. Draw and label her resultant displacement R.



[1]

(ii) Calculate, for the girl,

1. the average speed,

average speed = ... $m\,s^{-1}$ [1]

2. the magnitude of the average velocity v and its angle with respect to the direction of the initial path.

magnitude of v = ... $m\,s^{-1}$

angle = ... °

[3]

Topic: _____ Date: _____

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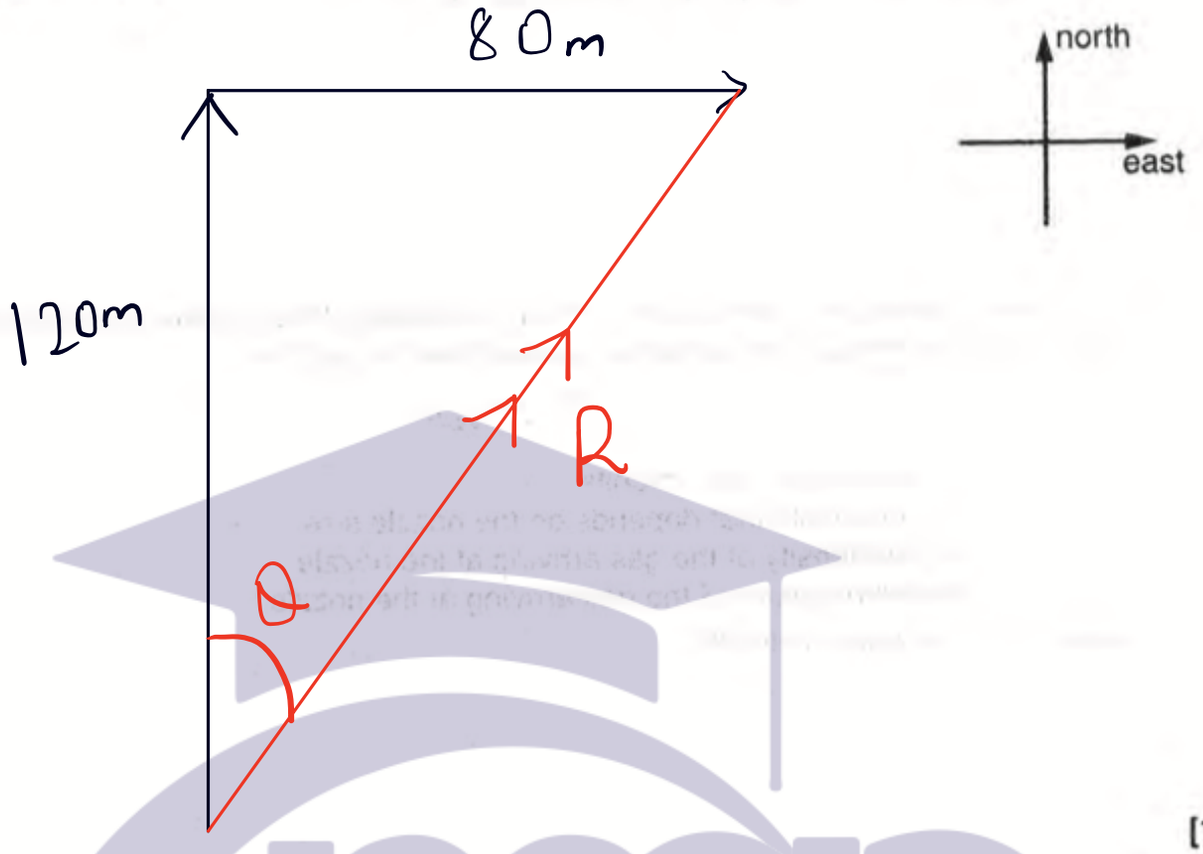

[1]

(ii) Calculate, for the girl,

1. the average speed, $= \frac{\text{total dis}}{\text{total time}}$

$\frac{120+80}{15+12}$

$= 7.41$

average speed = 7.41 ms^{-1} [1]

2. the magnitude of the average velocity v and its angle with respect to the direction of the initial path.

$R^2 = 120^2 + 80^2$

$= 144.2$

avg velocity $= \frac{\text{Total disp}}{\text{Total time}}$

$= \frac{144.2}{15+12} = 5.34$

magnitude of v = 5.34 ms^{-1}

$\tan\theta = \frac{80}{120}$ ← angle = 33.7 °

[3]

Topic: _____ Date: _____

An aircraft is travelling in wind. Fig. 1.2 shows the velocities for the aircraft in still air and for the wind.

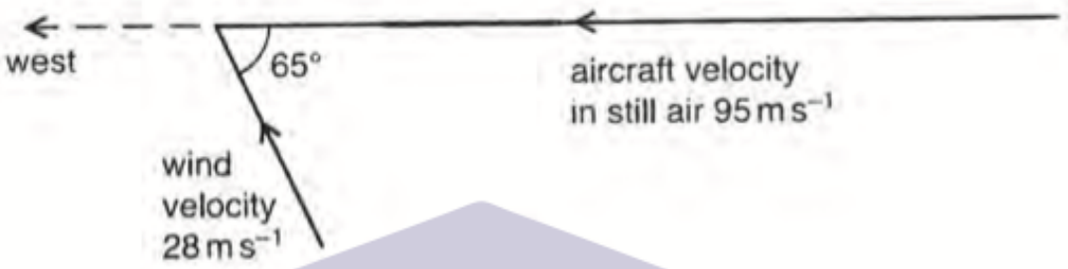

Fig. 1.2

The velocity of the aircraft in still air is 95 m s^{-1} to the west.
The velocity of the wind is 28 m s^{-1} from 65° south of east.

(i) On Fig. 1.2, draw an arrow, labelled R, in the direction of the resultant velocity of the aircraft. **[1]**

(ii) Determine the magnitude of the resultant velocity of the aircraft.

magnitude of velocity = ... m s^{-1} **[2]**

Topic: _____ Date: _____

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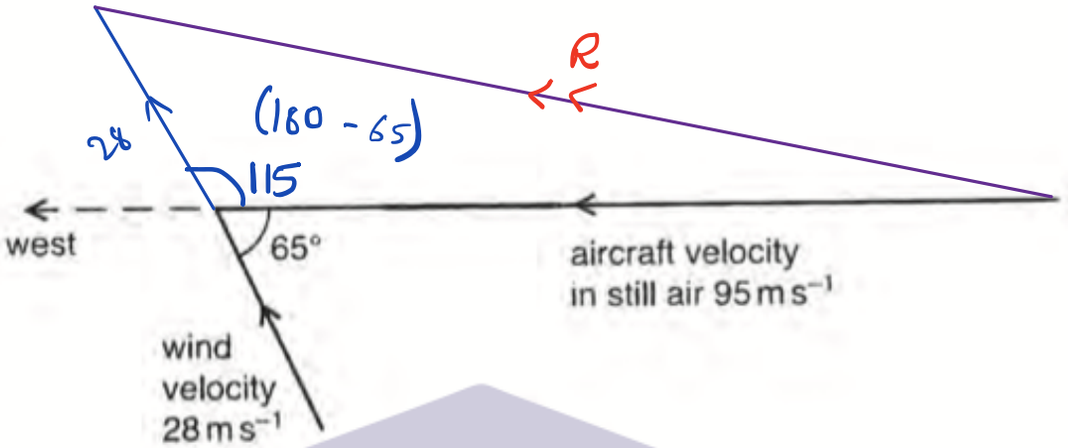

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(i) On Fig. 1.2, draw an arrow, labelled R, in the direction of the resultant velocity of the aircraft. [1]

(ii) Determine the magnitude of the resultant velocity of the aircraft.

Use Cosine Rule

$\Rightarrow$ 109.8

↳ Max 3 SF is allowed.

magnitude of velocity = 110 m/s ..... m s^{-1} [2]

Topic: _____ Date: _____

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