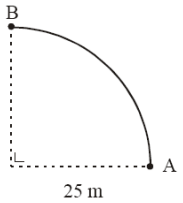
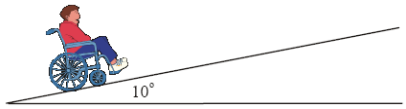
State Examinations Commission – Physics Higher Level, 2003.

Question 6.

Give the difference between vector quantities and scalar quantities and give one example of each.
Describe an experiment to find the resultant of two vectors. (18)
A cyclist travels from A to B along the arc of a circle of radius 25 m as shown.
Calculate (i) the distance traveled, (ii) the displacement undergone, by the cyclist.



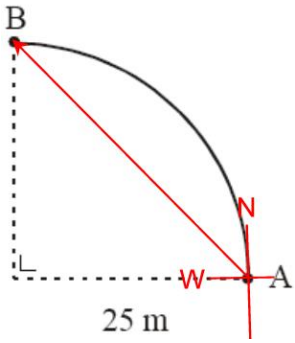
A person in a wheelchair is moving up a ramp at a constant speed. Their total weight is 900 N. The ramp makes an angle of 10^o with the horizontal.
Calculate the force required to keep the wheelchair moving at a constant speed up the ramp.
(You may ignore the effects of friction.)
The ramp is 5 m long. Calculate the power exerted by the person in the wheelchair if it takes her 10 s to travel up the ramp.



Give the difference between vector quantities and scalar quantities and give one example of each.

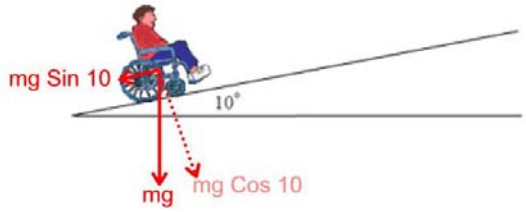
Scalar quantities have magnitude only, vector quantities have magnitude *and* direction.
Mass is a scalar quantity and weight is a vector quantity.

A cyclist travels from A to B along the arc of a circle of radius 25 m as shown.
Calculate (i) the distance traveled, (ii) the displacement undergone, by the cyclist.



Distance = ¼ x 2πr = 39.3 m
Displacement = $\sqrt{(25^2 + 25^2)}$ = 35.4 m $N45^0W$ … (Pythagoras)

A person in a wheelchair is moving up a ramp at a constant speed. Their total weight is 900 N. The ramp makes an angle of 10^o with the horizontal. Calculate the force required to keep the wheelchair moving at a constant speed up the ramp. (9)
(You may ignore the effects of friction.)



Resolving the weight of the person and wheelchair into components perpendicular and parallel to the ramp, we see that the force the person need apply to move at constant speed up the ramp is $mgSin10^0$.
i.e. $900Sin10^0$ = 156 N. (This is the force required to overcome the component of gravity acting down the ramp and get the chair moving with constant velocity)

The ramp is 5 m long. Calculate the power exerted by the person in the wheelchair if it takes her 10 s to travel up the ramp.

The work done, W, in getting the person up the ramp is W = Fd = 156 x 5 = 780 J
This work takes 10 seconds, so the power (rate at which work is done) is 780/10 = 78 W.