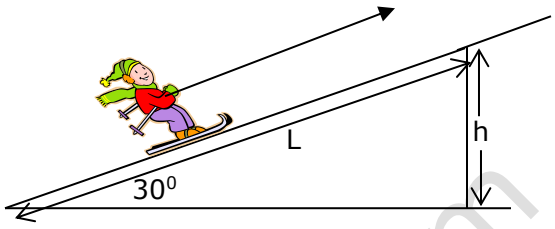
Q- Q- A skier of mass 70 kg is pulled up a slope by a motor driven cable.
(a) How much work i s required to pull him 60 m up a 30^0 slope (assumed frictionless) at a constant speed of 2.0 m/s?



Mass of the skier m = 70 kg

Length of the slop L = 60 m

Speed v = 2.0 m/s

Acceleration due to gravity g = 9.8 m/s^2

There is no non-conservative force is acting on the system and hence we can apply work energy theorem.

Work done = increase in energy

As the speed of the skier remains constant hence there will be no change in its kinetic energy. (the normal force is perpendicular to the direction of motion results no work)

As the skier is pulled up against gravity there will be an increase in its potential energy. As the gravitational force is vertical, the displacement in vertical direction (height h) is to be considered only. For this, considering the right-angled triangle we have

$$\frac{perpendicular}{hypotenuse} = \frac{h}{L} = \sin 30^0 = \frac{1}{2}$$

Gives h = L/2 = 60.0/2 = 30.0 m.

Hence

Work done = increase in potential energy

Or W = mg h = 70*9.8*30.0 = 20580 J

(b) What power must the motor have to perform this task?

Power is the rate of doing work or the work done per unit time.

As the speed of the skier is 2.0 m/s (constant), time taken to move length L = 60 m is given by

t = distance/ speed = 60.0/ 2.0 = 30 second

and hence the power of the motor must be

P = W/t = 20580/30 = 686 Watt.