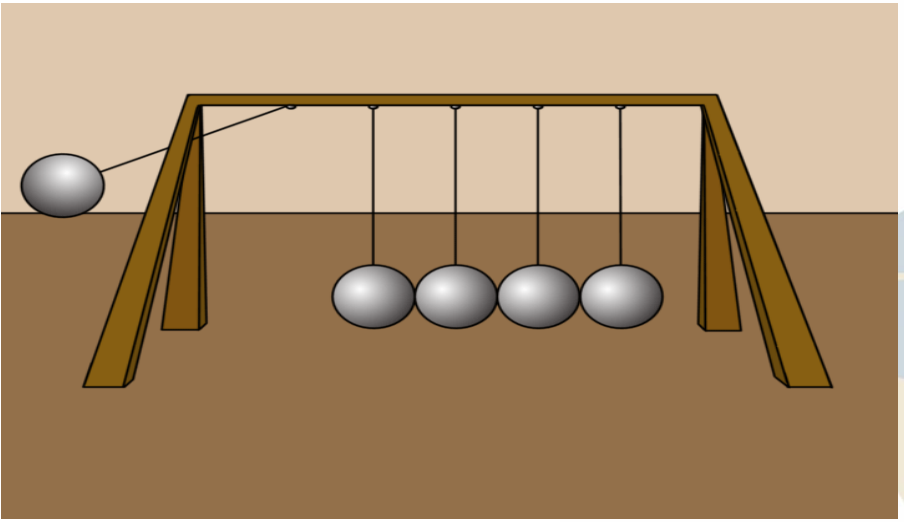

Physics - Grade 11 S

Unit Two: Mechanics

Chapter 8 – Newton's Second Law

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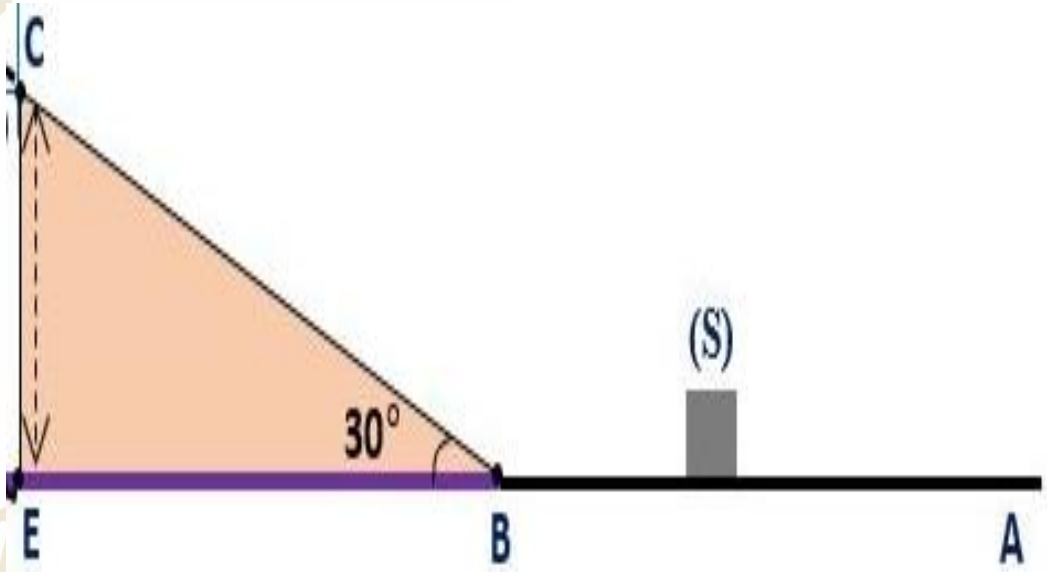
Quiz Time

Rectilinear motion **Quiz** **Time: 20min**

We intend to study the motion of a block S of mass m = 200g along the path ABC that is composed of two parts AB, and BC.

<u>Along the track AB:</u>

S starts its motion from a point A with a speed V_A = 8m/s along the track AB whose length is AB=6m.



Suppose that the friction force along the track has a constant magnitude *f*.

The position vector of S along AB is $\vec{r} = (-2t^2 + 8t)\vec{i}$ SI Units.

1. Determine the expression of the velocity vector, and the acceleration vector at any instant t. Deduce the nature of motion along AB.

2. Determine the sum of the external forces acting on S along AB and deduce the magnitude of the friction force f along AB.

3. Verify that S attains at B a speed $V_B = 4$ m/s.

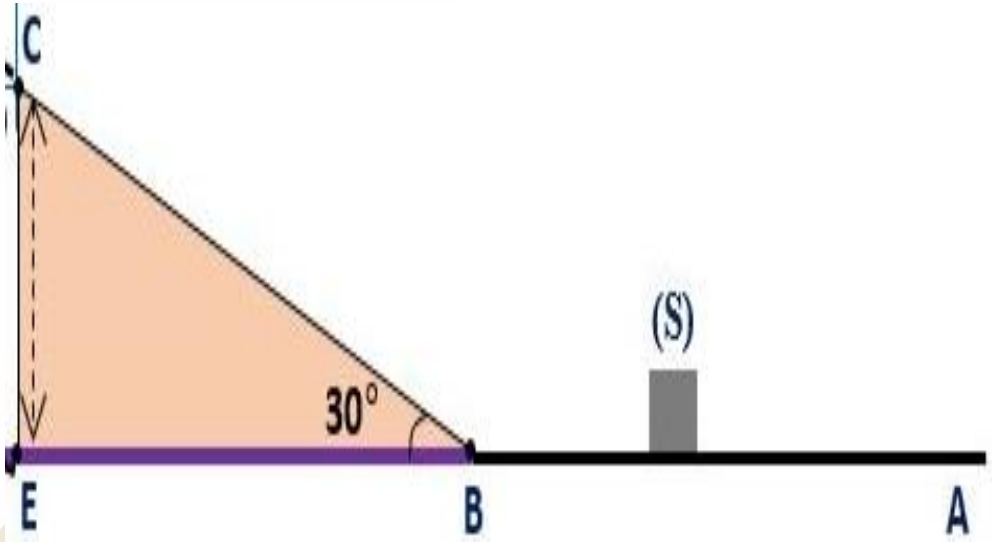
Along the track BC:

S continues along the frictionless track BC, that makes 30° with the horizontal, and arrives at C with a speed $V_C = 3$m/s.

1. Determine the acceleration of S along BC.
2. Deduce the length of the track BC and then the height of the incline CE.

m = 200g; V_A = 8m/s; AB=6m; $\vec{r} = (-2t^2 + 8t)\vec{i}$ and f.

1.Determine the expression of the velocity vector, and the acceleration vector at any instant t. Deduce the nature of motion along AB.



Velocity vector: $\vec{V} = \overrightarrow{(r)}' = -4t + 8$

Accel. vector: $\vec{a} = \overrightarrow{(V)}' = -4$

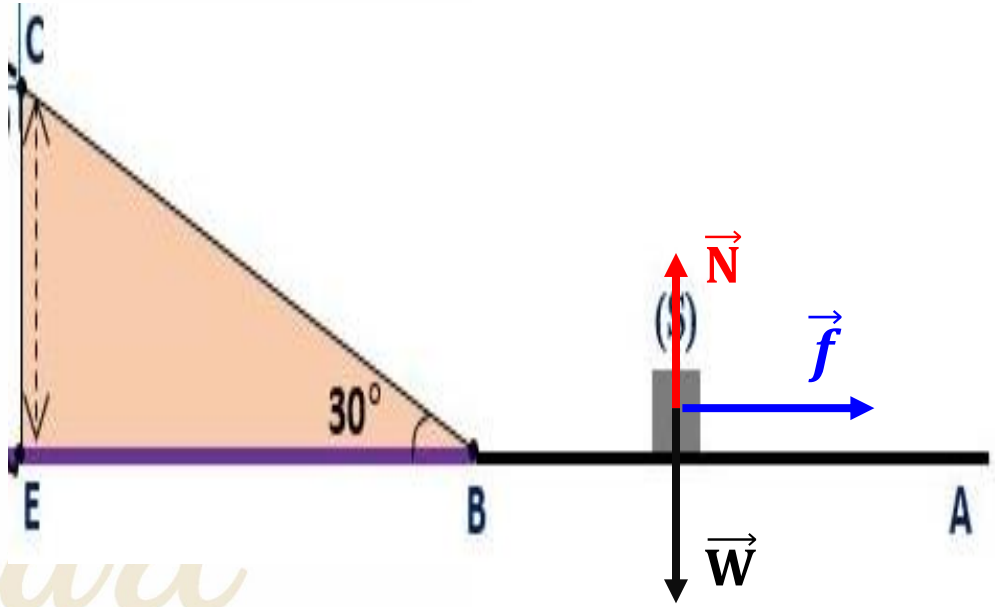
Since $a = -4m/s^2 < 0$; then the motion is UDRM

$m = 200g$; $V_A = 8m/s$; $AB=6m$; $\vec{r} = (-2t^2 + 8t)\vec{i}$ and f.

2.Determine the sum of the external forces acting on S along AB and deduce the magnitude of the friction force f along AB.

Apply newton's second law:

$$\sum \vec{F}_{ex} = m\vec{a}: \quad \vec{W} + \vec{N} + \vec{f} = m\vec{a}:$$



Projection along x-axis:

$$-f = m \times a \Rightarrow f = -0.2 \times -4$$

$$f = 0.8N$$

m = 200g; V_A = 8m/s; AB=6m; $\vec{r} = (-2t^2 + 8t)\vec{i}$ and f.

3.Verify that S attains at B with a speed V_B = 4 m/s.

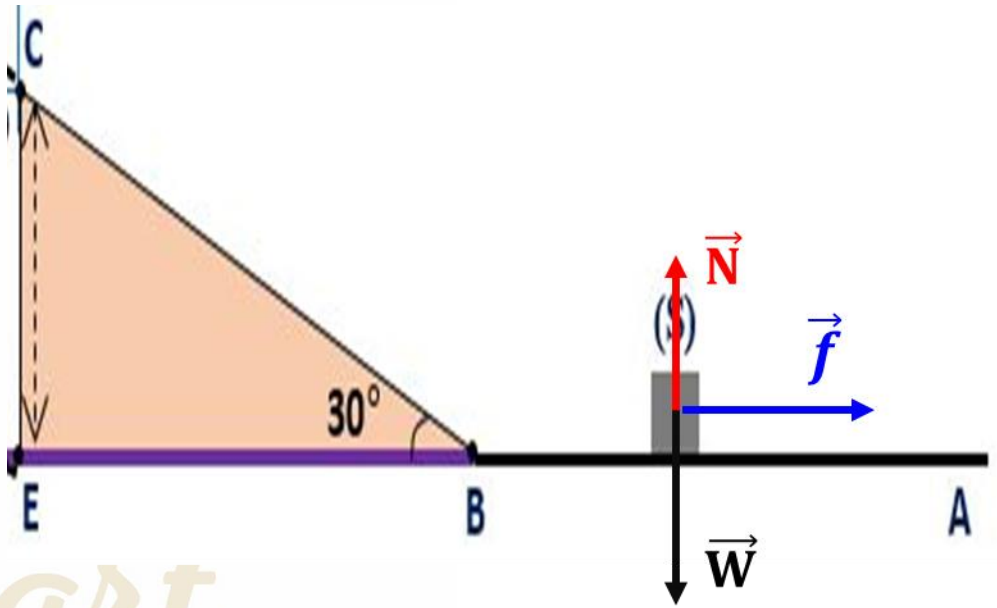
Using the time equation:

$$V^2 - V_0^2 = 2a(x - x_0)$$

$$V_B^2 - V_A^2 = 2a(AB - 0)$$

$$V_B^2 - (8)^2 = 2 \times -4(6)$$

$$V_B^2 - 64 = -48$$

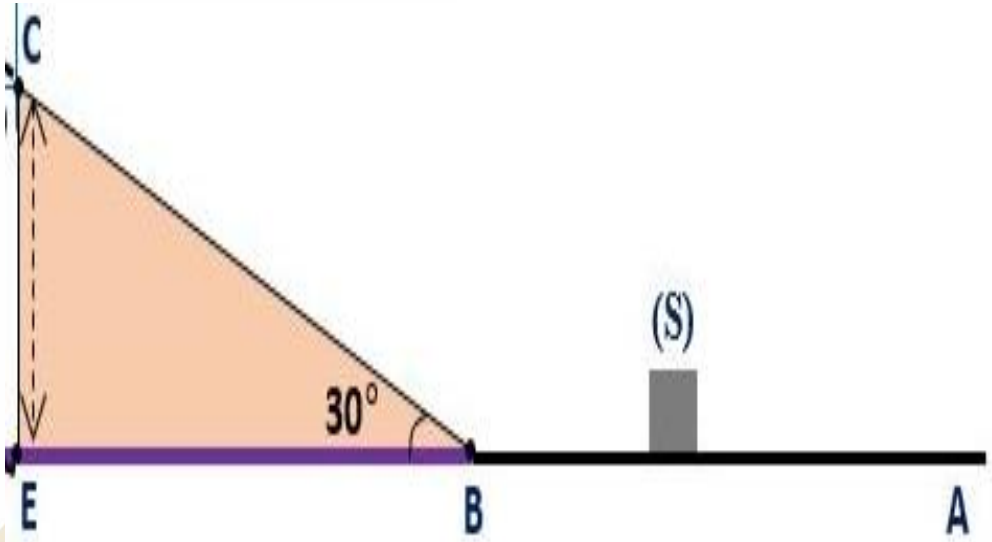


$$V_B^2 = 16 \Rightarrow V_B = \sqrt{16} \Rightarrow V_B = 4m/s$$

Along the track BC:

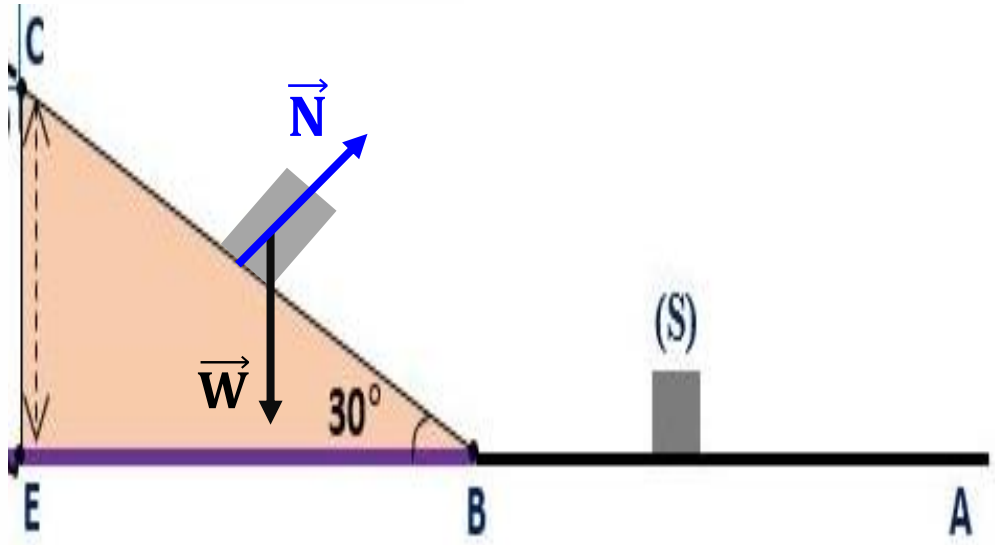
S continues along the frictionless track BC, that makes 30° with the horizontal, and arrives at C with a speed V_C = 3m/s.

1. **Determine the acceleration of S along BC.**
2. **Deduce the length of the track BC.**



$m = 200g$; $V_C = 3m/s$; BC=?; $f = 0$; $\alpha = 30$

1.Determine the acceleration of S along BC.



Apply newton's second law:

$$\sum \vec{F}_{ex} = m\vec{a}.$$

$$\vec{W}_x + \vec{W}_y + \vec{N} = m\vec{a}$$

Projection along x-axis:

$$-mgsin\alpha = ma \Rightarrow -gsin\alpha = a$$

$$a = -10 \times sin(30) \Rightarrow a = -5\,m/s^2$$

m = 200g; V_C = 3m/s; BC=?; $f = 0$; $\alpha = 30$

2.Deduce the length of the track BC.

Using the time equation:

$$V^2 - V_0^2 = 2a(x - x_0)$$

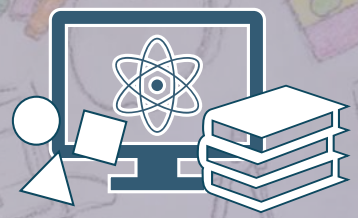
$$V_C^2 - V_B^2 = 2a(BC - 0)$$

$$(3)^2 - (4)^2 = 2 \times -5(BC)$$

$$9 - 16 = -10BC$$

$$-7 = -10BC \quad \Rightarrow \quad BC = 0.7m$$

The End



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