

## EXAM: WORK & ENERGY

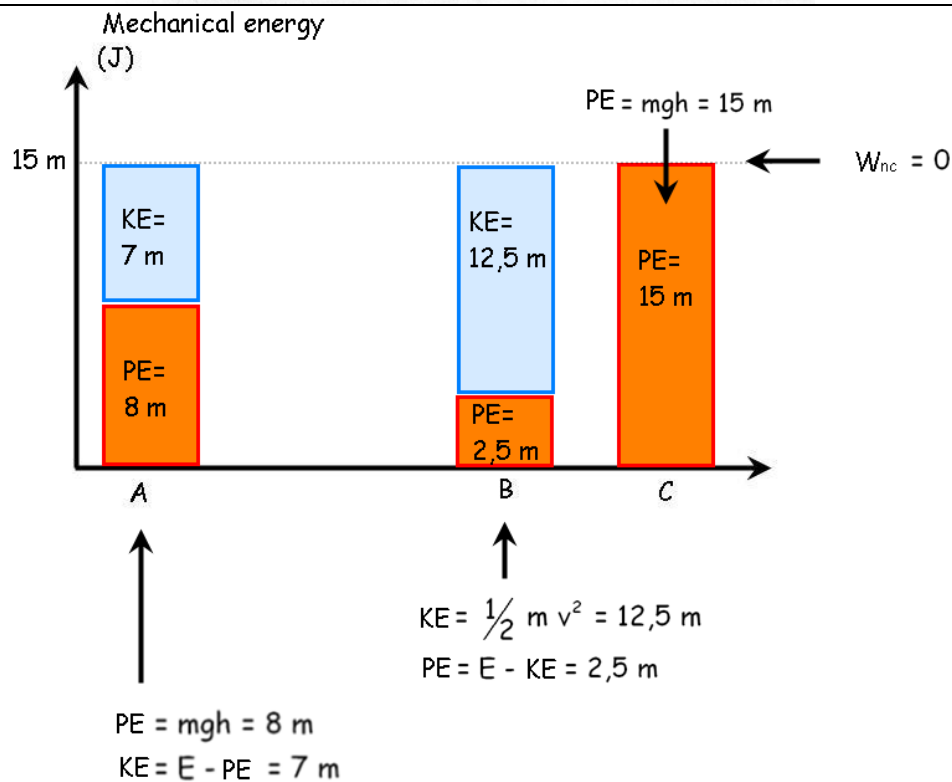
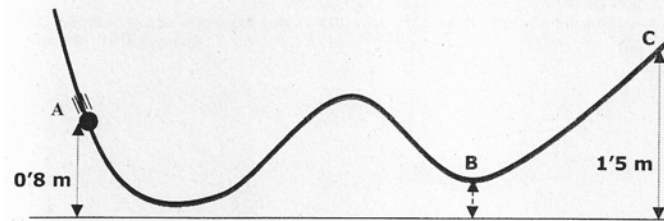
Name: \_\_\_\_\_

Course: \_\_\_\_\_

### Exercise #1

In the frictionless path below, a body moves to C and back. C is the highest point reached by the body. The speed at point B is 5 m/s. Determine:

- fill the graphic below
- the speed at point A
- the altitude at point B



The speed at A:

$$KE = \frac{1}{2} m v^2 \rightarrow 7 \text{ m} = \frac{1}{2} m v^2 \rightarrow v = \sqrt{14} = 3,7 \text{ (m/s)}$$

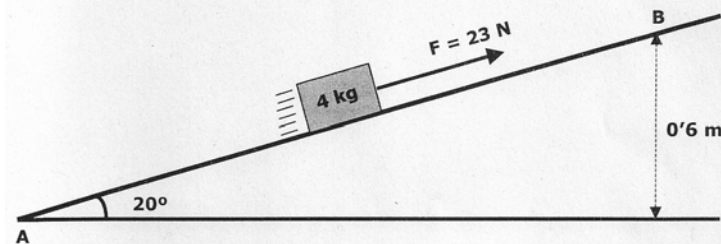
The position at B:

$$PE = mgh \rightarrow 2,5 \text{ m} = m gh \rightarrow h = \frac{2,5}{g} = 0,25 \text{ (m)}$$

## Exercise #2

The body in motion starts from A (at rest) and moves to B in a frictionless path under the action of an external constant force of 23 N. Determine:

- the value of the work done by each individual force from A to B
- the speed of the body at point B (apply the work-energy theorem)
- has the mechanical energy of the body changed or remains constant? Explain briefly your answer
- Fill in the graphic



- a) Work done by each force

The path is:

$$\sin 20^\circ = \frac{0,6 \text{ m}}{d} \rightarrow d = 1.75 \text{ m}$$

Individual work:

$$W_F = (23 \text{ N}) (1.75 \text{ m}) (\cos 0^\circ) = 40.25 \text{ J}$$

$$W_N = (N) (1.75 \text{ m}) (\cos 90^\circ) = 0$$

$$W_W = (40 \text{ N}) (1.75 \text{ m}) (\cos 110^\circ) = -23.94 \text{ J}$$

- b) Speed at B (work-energy theorem)

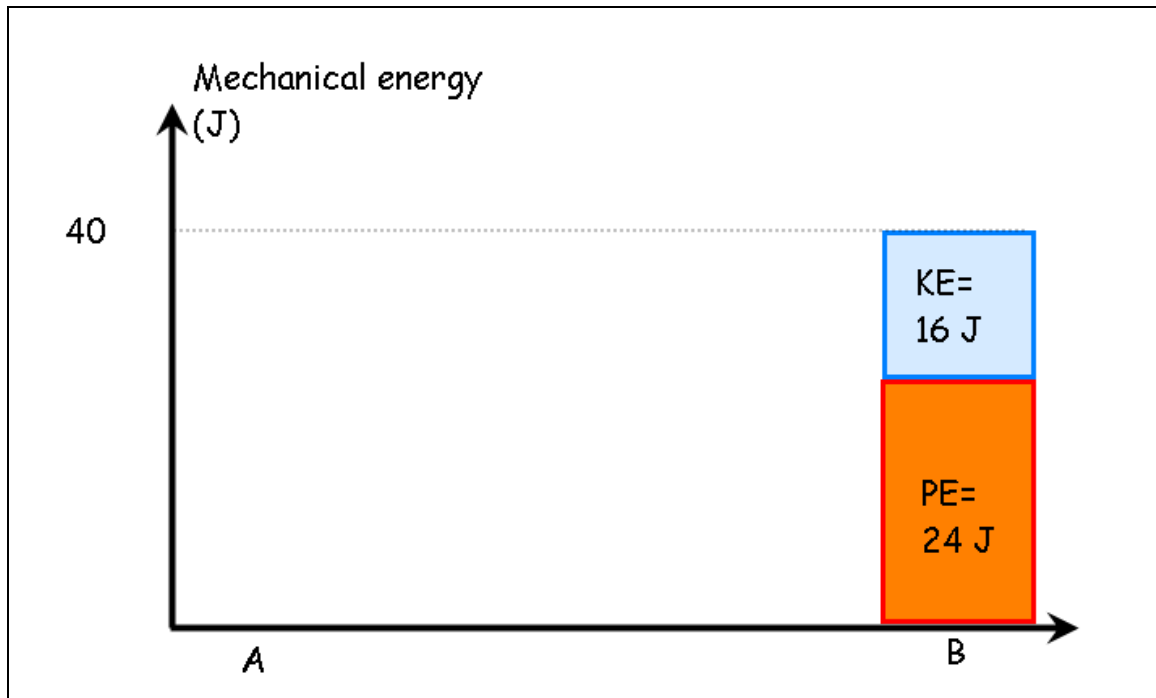
$$W_{\text{net}} = W_F + W_N + W_W = 40.25 \text{ J} - 23.94 \text{ J} = 16.31 \text{ J}$$

$$W_{\text{net}} = \Delta KE \rightarrow KE_{\text{final}} = KE_{\text{initial}} + W_{\text{net}} \xrightarrow{KE_{\text{initial}} = 0} KE_{\text{final}} = 16.31 \text{ J}$$

$$\frac{1}{2} (4 \text{ kg}) (v^2) = 16.31 \text{ J} \rightarrow v = \sqrt{\frac{2 * 16.31 \text{ J}}{4 \text{ kg}}} = 2.86 \text{ m/s}$$

- c) Change in mechanical energy

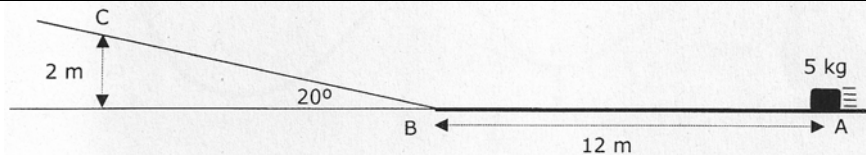
The mechanical energy increases because the non-conservative work is positive (40.25 J)



### Exercise #3

A body moves from A to B and C. Its initial speed is 8 m/s. There is a friction force between A and B, but from B to C the path is frictionless. C is the highest point reached and at that point the body starts moving backwards. Determine:

- the friction coefficient in the path AB
- will the body reach again the initial point A?
- Fill in the graphic

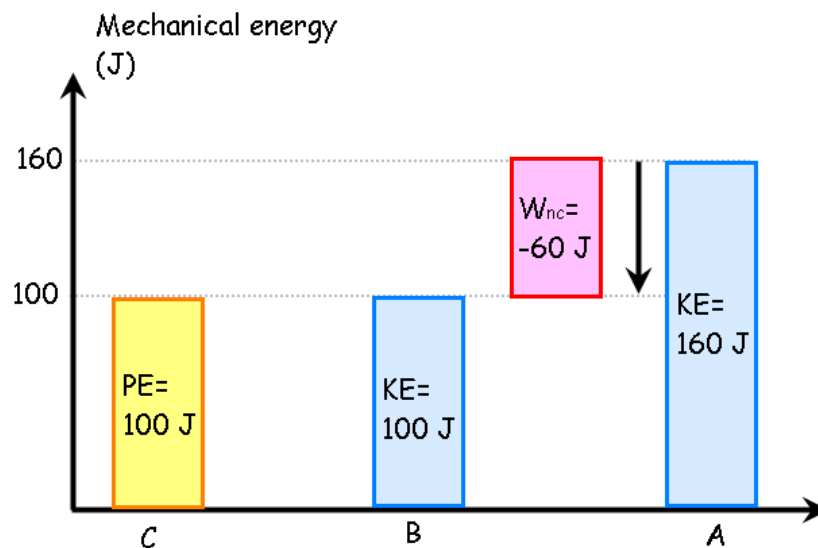


Mechanical energies:

$$E_A = \frac{1}{2} mv^2 = 0,5 (5 \text{ kg}) (8 \text{ m/s})^2 = 160 \text{ J}$$

$$E_C = mgh = (5 \text{ kg}) (10 \text{ m/s}^2) (2 \text{ m}) = 100 \text{ J}$$

$$\text{B-C path } W_{nc} = 0 \rightarrow E_B = E_C = 100 \text{ J}$$



a) The friction coefficient

$$W_{nc} = W_{Ff} = E_B - E_A \rightarrow W_{Ff} = -60 \text{ J}$$

$$W_{Ff} = -60 \text{ J} = (Ff) (12 \text{ m}) (\cos 180^\circ) \rightarrow Ff = 5 \text{ N}$$

$$N = W = 50 \text{ N} \rightarrow \mu = \frac{Ff}{N} = 0.1$$

b) The body does not reach A point in its ways back because it is losing energy.